New York ISO
Independent System Operator

TOTAL EAST STABILITY LIMITS ANALYSIS FOR ALL LINES I/S AND OUTAGE CONDITIONS (TE-22)

A Report by the
New York Independent System Operator

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Executive Summary

This study was conducted as a periodic review of stability limits for the Total East interface as well as to determine the impact of the Segment A construction including: the 30 & 31 Porter – Rotterdam 230 kV lines that are being decommissioned and the new Gordon Rd. substation. The Total East Interface is a closed interface linking central NY to eastern NY. For more details refer to Table 2 and Fig 1. The study provides updates to the all-lines-in-service limit as well as the two equipment outage limits associated with Total East. The transfer limits developed in this analysis decrease by 800 to 1700 MW as shown on Table 1.

The limits recommended in this report are all based on stable system response at the highest transfer level tested. There were no instances of any system or unit instability observed in this analysis.

On an informational basis, this study examined the system responses for contingencies involving three-phase faults, line-to-line-to-ground faults as well as the normal criteria single-phase line-to-ground faults. The new all-lines-in-service stability limits for Total East is valid for either form of contingency at the levels tested.

It is recommended that the Total East stability transfer limits be updated as reported on Table 1. Implementing these decreased limits could have impact on NYISO operations, especially with the 5018 Ramapo- Hotpatcong 500kV line out of service.

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Introduction

The purpose of this study was to conduct a periodic re-evaluation of the Total East Stability Transfer Limits as well as to determine the impact of the Segment A construction including: the 30 & 31 Porter – Rotterdam 230 kV lines that are being decommissioned and the new Gordon Rd. substation.

The study evaluated the all lines in-service condition, outage on the 5018 line and outage of an SVC/STATCOM. These system scenarios also assume the Marcy South Series Capacitors (MSSC) are bypassed. The dynamic response of the system was gauged by examining the voltage response at Edic and Pleasant Valley, and the generator angles at Athens, Arthur Kill, Gilboa, Niagara and Moses.

Summary of Proposed Limits

Table 1 shows the new proposed limits and the existing limits for Total East. The existing limits had a single stability limit for all outage conditions across the board. The new proposed limits would have an All Lines In value of 6000 MW with an 800 MW reduction for outages on the 5018 Ramapo- Hotpatcong 500kV Line and a further 100MW reduction for the outage of any SVC/STATCOM.

Table 1

Proposed and Existing Total East Stability Limits

	Scenario	Proposed Limit (MW)		Existing Limit (MW)		Diff (MW)
1	All Lines In	6000		6800		-800
2	5018 Ramapo-Hotpatcong 500kV O/S	5200		6800		-1600
3	5018 Ramapo-Hopatcong 500kV & (SVC or Statcom O/S)	5100		6800		-1700

System Operating Limit Methodology

"NYSRC Reliability Rules for Planning and Operating the New York State Power System" (NYSRC Rules) provides the methodology for developing System Operating Limits (SOLs) within the NYISO Reliability Coordinator Area. Rule C of the NYSRC Rules sets forth the contingencies to be evaluated and the performance requirements to be applied in developing SOLs. Rule C also incorporates NYISO Transmission Planning Guideline #3-1, "Guideline for Stability Analysis and Determination of Stability-Based Transfer Limits" set forth in Attachment H to the NYISO "Transmission Expansion and Interconnection Manual."

Interface Summary

The Total East interface definition is given in Table 2 and illustrated in Figure 1.

Table 2

Total East Interface Definition

Name	Line ID	(kV)		Name	Line ID	(kV)
Edic-Gordon Rd*	14	345		Hudson-Farragut*	C3403	345
Marcy-New Scotland*	18	345		Hudson-Farragut*	B3402	345
*Fraser-Gilboa	GF5-35	345		Linden-Goethals*	A2253	230
East Springfield - Inghams*	7	115		*Cresskill – Sparkill	751	69
Inghams PAR	PAR	115		*Harings Corners – W. Nyack	701	69
Inghams Bus Tie	R81	115		*Harings Corners – Corporate Drive	703	138
Middletown-Rock Tavern*	CCRT34	345		*Montvale – Bluehill	44	69
Coopers Corners- Dolson Ave*	CCDA42	345		*Montvale – Bluehill	43	69
Middletown 345*/138	BK114	345/138		*Montvale – Pearl River	491	69
West Woodbourne 115/69*	BK1	115/69		*Harings Corners – Pearl River	45	34
*Plattsburgh-Sand Bar	PV20	115		*S. Mahwah – Ramapo	51	138
Hopatcong-Ramapo*	5018	500		*S. Mahwah - Hilburn	65	69
*Waldwick- S. Mahwah	J3410	345		S. Mahwah 138/345*	BK258	138/345
*Waldwick-S. Mahwah	K3411	345				

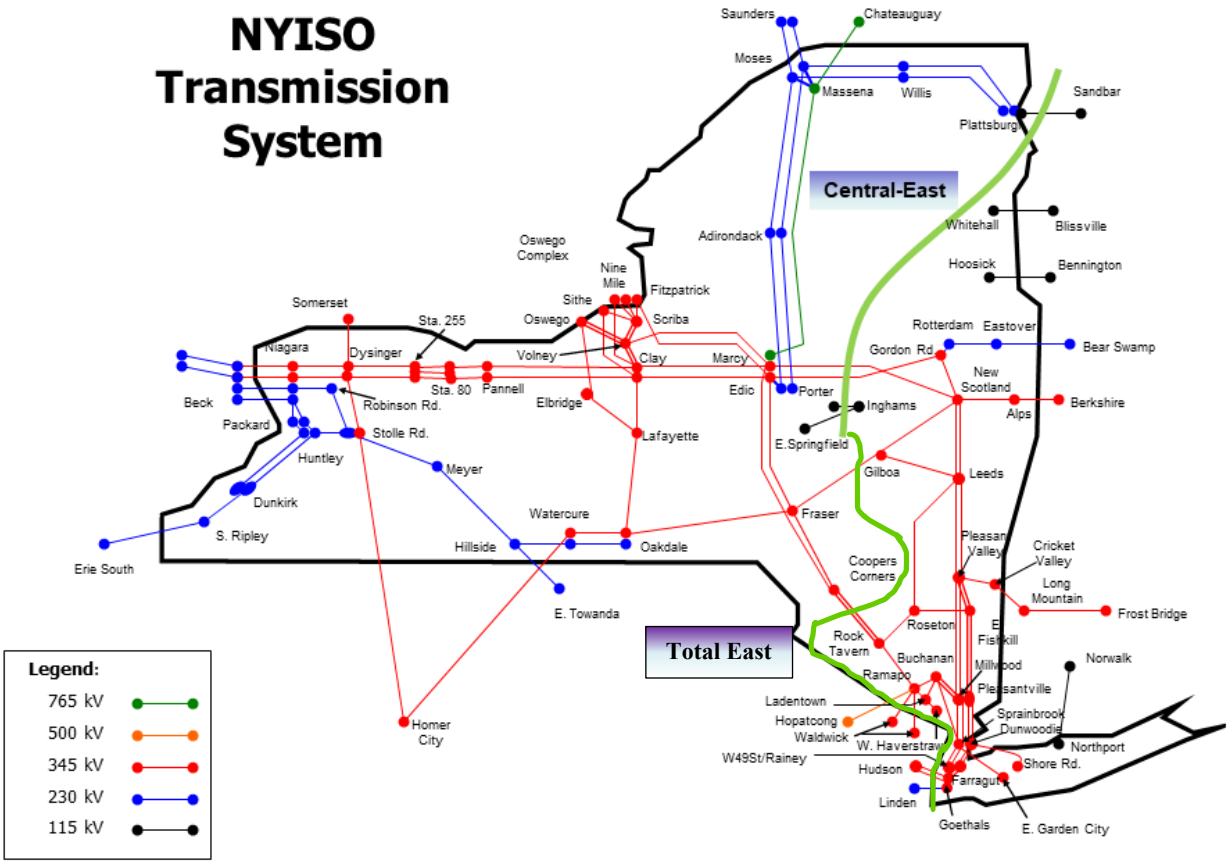

Figure 1. NYCA Transmission System Interface (Total East inset)

System Representation and Transfer Case Development

The analysis was based on the 2021 NYISO Dynamics Base Case that was developed from the 2020 MMWG Dynamics Base Case with the NYISO representation updated to reflect the results of the NYISO 2021 Summer Operating Study.

The base case model includes the following:

- the NYISO Transmission Operator area;
- all Transmission Operator areas contiguous with NYISO;
- all system elements modeled as in-service;
- all generation represented;
- phase shifters in the regulating mode;
- the NYISO Load Forecast;
- transmission facility additions and retirements;
- generation facility additions and retirements;
- Remedial Action Scheme (RAS) models currently existing or projected for implementation within the studied time horizon;
- series compensation for each line at the expected operating level; and
- facility Ratings as provided by the Transmission Owner and Generator Owner.

Three transfer cases were developed as shown on Table 3. The capacitor banks at Oakdale and Edic were producing maximum VAR output of 135MVAR and 200MVAR respectively. The 7040 tie line between Hydro-Quebec and the NYCA was importing 1312 MW (all AC) with the DC lines put out of service.

Table 3
Transfer Cases

A	TE 6675, Marcy Statcom I/S, Leeds I/S, Fraser I/S, 5018 I/S
B	TE 5780, Marcy Statcom I/S, Leeds I/S, Fraser I/S, 5018 O/S
C	TE 5670, Any SVC/Statcom O/S, 5018 O/S

Tested Contingencies

Thirty five (35) contingencies were tested for each developed Total East transfer case scenario. Table 4 provides the identification and description of these contingencies.

Table 4.

Contingencies applied for evaluating Total East stability transfer limits.

#	ID	Description
1	TE02(LLG)	LLG@FISHKILL-L/O TOWER(2-1938)FISHKILL*PLEASANTVILLE
2	TE03(LLG)	LLG@SPRAIN BK-L/O TOWER(2-1956)MILLWOOD*SPRAIN BROOK
3	TE10	SLG-STK@RAMAPO (BKR T77-94-2) – L/O RAMAPO-ROCK TAVERN (77) / BKUP CLR Y94
4	TE12	SLG-STK@RAMAPO500 (BRK T1500-W72-2) – L/O RAMAPO-HOPATCONG (5018) / BKUP CLR#W72
5	TE14	SLG/STK@LEEDS*GILBOA / STK R391 / CLR#91 PL.VALLEY
6	TE15	SLG/STK@LEEDS*PLEASANT VALLEY/STK R9293/CLR#93 NS
7	TE16	SLG/STK @ ROSETON/ROSETON*ROCK TAVERN#311/STK 31151
8	TE18(LLG)	LLG@LADENTOWN-L/O TOWER Y88/Y94 DOUBLE CIRCUIT
9	TE20(LLG)	LLG@DUNWOODIE-L/O TOWER(2-1938)PLEASANTVILLE*DUNWO.
10	TE21	3PH@PLEAS.VAL-L/O TOWER(2-1961)PV*MILLWOOD DBL CKT
11	TE27	SLG/STK@ROCK TAVERN*COOPERS/CLR ROCK TAVN*RAMAPO
12	TE29	3PH@N.SCOT / N.SCOT-LEEDS#93 W/HS RCL
13	TE30	3PH@LEEDS / GILBOA * LEEDS GL-3
14	TE31	3PH@GILBOA – L/O GILBOA - NEW SCOTLAND (GNS-1)
15	TE32	3PH@NEW SCOTLAND - 77 BUS
16	TE33	3PH@NEW SCOTLAND - 99 BUS
17	TE34	SLG-STK@GILBOA/GILBOA*NSCOT / STUCK 3208
18	TE35	3PH-NC@LEEDS – L/O LEEDS-ATHENS#95 W/HS RCL
19	TE36	3PH @ LEEDS / LEEDS - HURLEY AVENUE
20	TE38	3PH/NC @ ROCK TAVERN / ROSETON * ROCK TAVERN #311
21	TE39	STORM-L/O 69/J3410 W/OUT FAULT & 1.1SEC LATER LLG@LADENTOWN – L/O Y88/Y94 DCT W/RCL
22	TE40 (LLG)	LLG@RAMAPO - L/O 69/J3410+70/K3411 DCT
23	TE41	SLG-STK@GILBOA (BKR 3208) – L/O GILBOA - LEEDS (GL-3) / BKUP CLR GILBOA#1, 2

24	TE42	3PH-NC@RAMAPO500 – L/O RAMAPO-HOPATCONG
25	TE43	3PH-NC@LEEDS – L/O LEEDS-PLTVLLEY#92 W/HS RCL
26	TE44(LLG)	LLG@RAMAPO - L/O RAMAPO - ROCK-TAVERN 77 & 76 / DCT
27	CE03	SLG-STK@EDIC345 (BKR R935) – L/O EDIC-N.SCOT #14 / BKUP CLR FE1
28	CE06	3PH-NC@MARCY345 – L/O EDIC-MARCY (UE1-7)
29	CE07(LLG)	LLG@MARCY/EDIC - L/O MARCY-COOPERS (UCC2-41) & EDIC-FRASER (EF24-40) DCT
30	CE07AR(LLG)	LLG@MARCY/EDIC - L/O MARCY-COOPERS (UCC2-41) & EDIC-FRASER (EF24-40) DCT W/RCL
31	CE09	SLG-STK@EDIC345KV – L/O FITZ-EDIC #FE-1/BKUP CLR#14
32	CE15	SLG-STK@MARCY345(BKR 3108) – L/O VOLNEY-MARCY (VU-19) / BKUP CLR#UE1-7
33	CE36	SLG--STK@SCRIBA345 (BKR R100)/SCRIBA-FITZ #10/ BKUP CLR SCRIBA 345-SCRIBA 115 XFMR
34	CE99	SLG-STK@SCRIBA345 (BKR R935) – L/O SCRIBA-VOLNEY 21 / BKUP CLR FITZ-SCRIBA #10
35	SA01_Q556	SLG-STK@EDIC345 (BKR R915) – L/O EDIC-FRASER EF24-40 / BKUP CLR 2-15

Contingencies 1, 2, 8, 9 and 10 are tower three-phase faults, which are beyond NYSRC criteria for the determination of NYISO System Operating Limits. Those contingencies were only examined on an informational basis.

Monitored Parameters

In order to assess system stability response for the Total East power transfer scenarios considering contingencies, the following parameters were monitored and analyzed:

- Generators' angles, power outputs, terminal voltages in the following areas/zones (West, North, Mohawk, Capital, representative generators from West, Central, Hudson and Capital);

- Bus voltages around Total East, Western NY and Central East especially at Edic and Pleasant Valley.

Discussion

Angle, Voltage, and Frequency Monitoring

Machine angle, voltage and frequency were employed in this analysis as the key indicators of system stability. Machine angles at Niagara and Athens, voltages at Edic and Pleasant Valley stations and frequency at New Scotland station were plotted for the CE-09 contingency on the all equipment in-service scenario, as shown in Figure 2. The CE09 contingency consists of a SLG-STK@EDIC345KV – L/O FITZ-EDIC #FE-1/BKUP CLR#14.

Edic voltage was selected as the representative indicator of system performance for the CE-09 contingency in the discussions that follow. Similar plots for all the Total East contingencies simulated are included in the appendices.

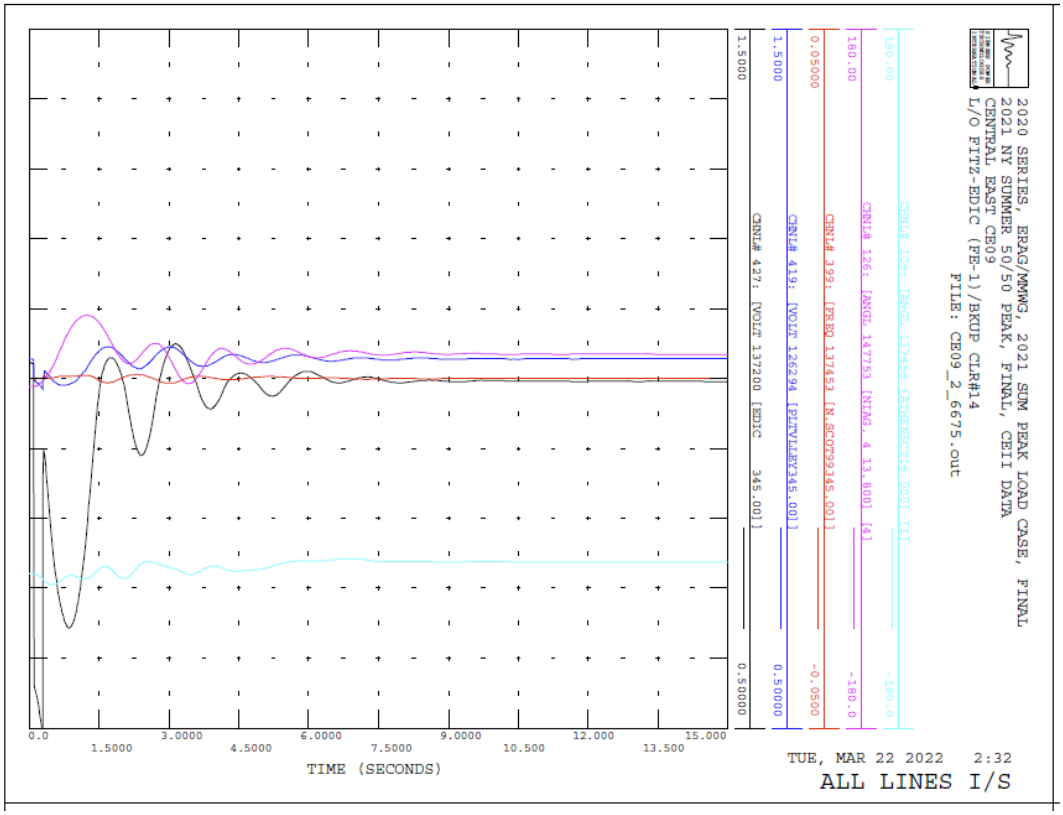

Figure 2. Voltage Angle and Frequency for scenario with all equipment in-service

Most Severe Contingency

Edic voltages were plotted for all the Total East contingencies as shown in Figure 3. It can be seen from Figure 3 that the voltage response at Edic 345KV is most severe for CE-09 contingency compared to all other Total East contingencies. The magnitude of the post contingency voltage swings was found to be the largest when the CE-09 contingency was applied. The CE-09 contingency was selected as the most severe contingency in the discussions that follow. Similar plots for all the Total East contingencies simulated are included in the appendices.

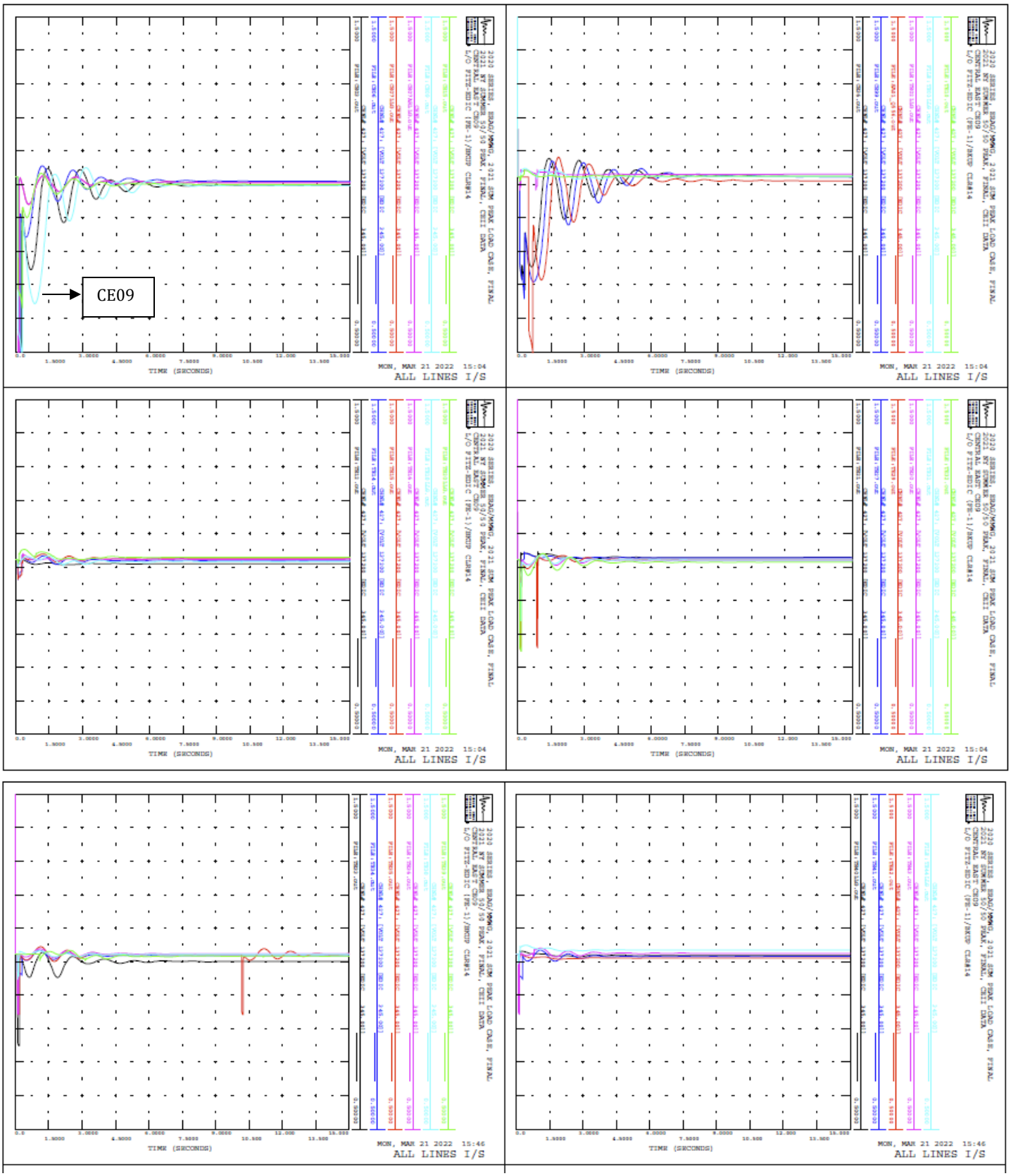

Figure 3. Edic Voltage response for all contingencies for all equipment in-service

5018 Out of Service

Machine angle, voltage and frequency were employed in this analysis as the key indicators of system stability and the dynamic response of the system under this outage condition is shown in Fig 4. All dynamic responses were clearly stable for this configuration at a test level of 5780 MW. The Edic voltage response for all 35 contingencies with 5018 Line out of service is found in Appendix B.

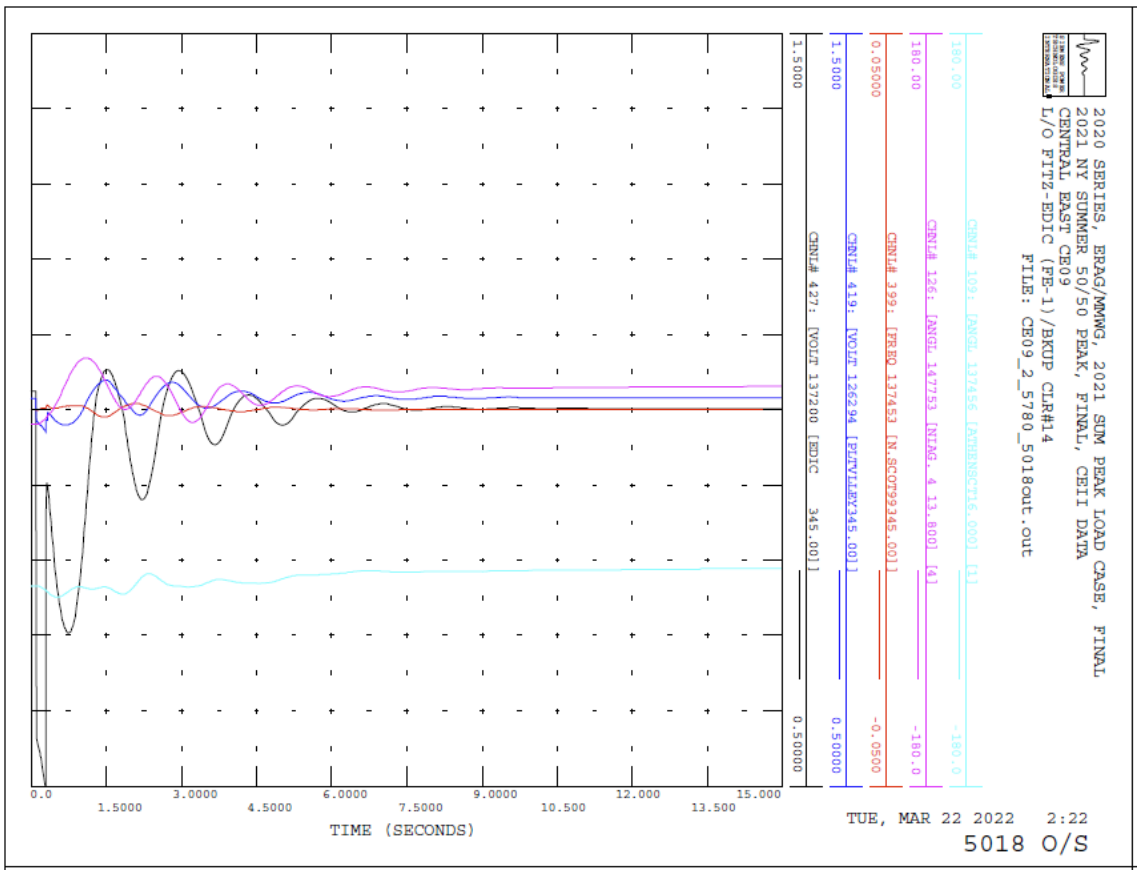

Figure 4. Voltage Angle and Frequency for scenario with 5018 O/S

5018 Out of Service and SVCs and STATCOM's Out of Service

Machine angle, voltage and frequency were employed in this analysis as the key indicators of system stability and the dynamic response of the system under this outage condition is shown in Fig 5, 6, 7. All responses were clearly stable for this configuration at a test level of 5680 MW.

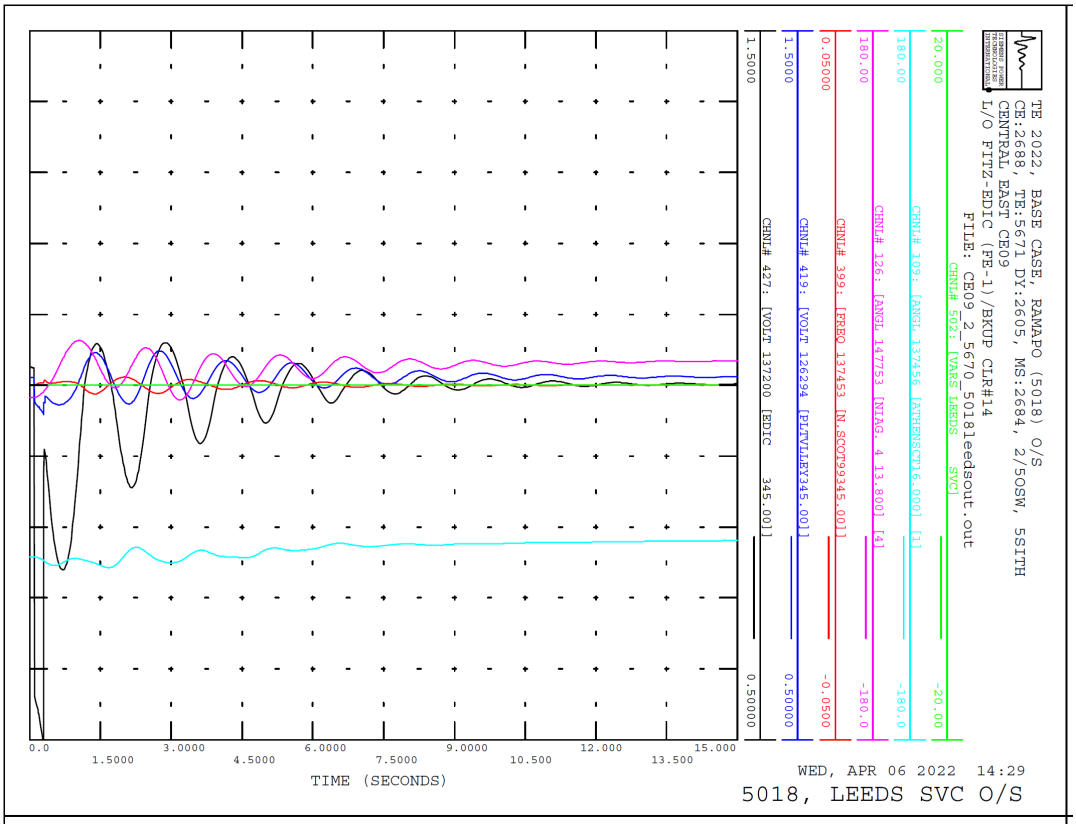

Figure 5. Voltage Angle and Frequency for scenario with 5018 O/S and Leeds SVC O/S

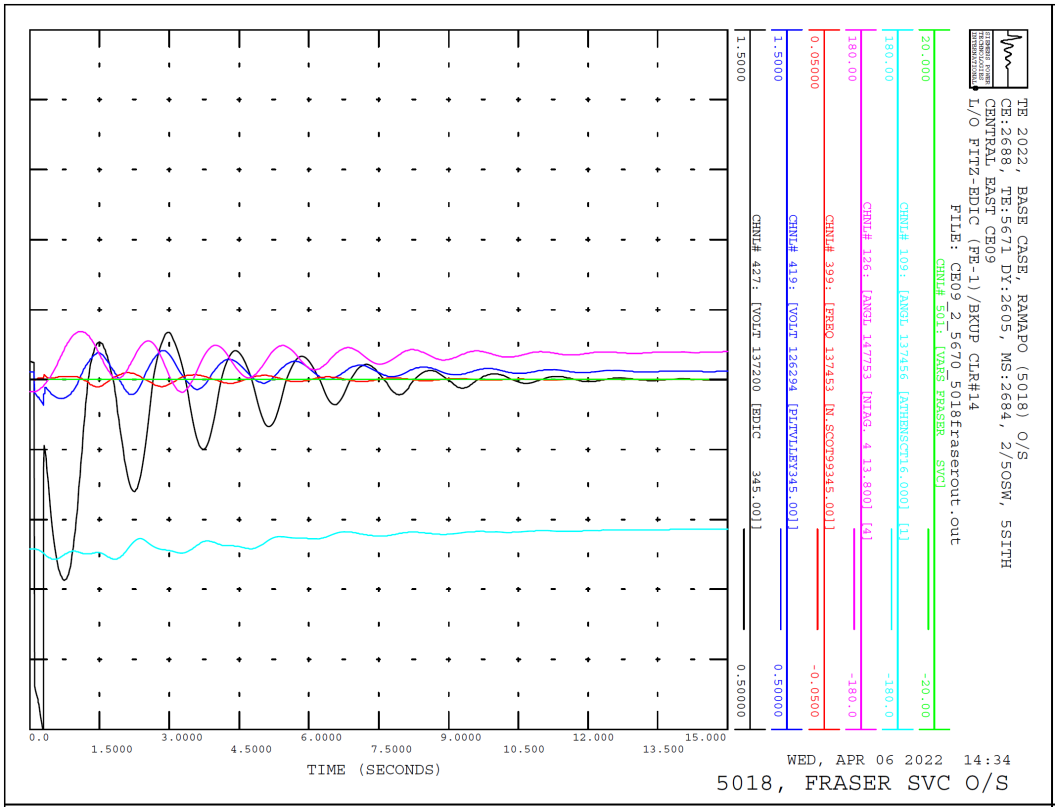

Figure 6. Voltage Angle and Frequency for scenario with 5018 O/S and Fraser SVC O/S

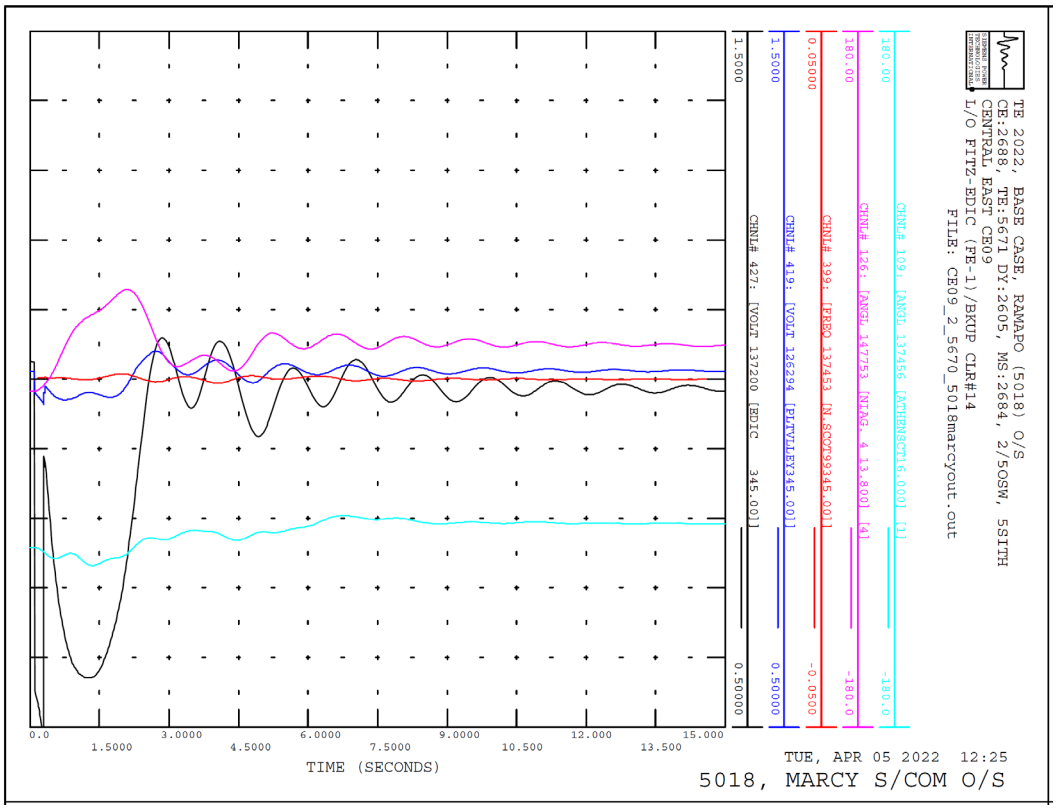

Figure 7. Voltage Angle and Frequency for scenario with 5018 O/S and Marcy STATCOM O/S

Recommendations

This report has been reviewed and recommended for NYISO Operating Committee approval by the NYISO Operating Studies Task Force (OSTF) and the System Operations Advisory Subcommittee (SOAS).

It is recommended that the stability limit of Total East be lowered. The transfer case was set up for a transfer level of 6675MW and a stability limit of 6000MW across Total East. Table 5 outlines the proposed stability limits for Total East and also the stability limit under outage conditions.

#	Scenario	2022		2017		
		Total East Stability Limit(MW)	Total East Tested Transfer Level(MW)	Total East Stability Limit (MW)	Total East Tested Transfer Level (MW)	Difference of Proposed limit from the existing Total East Stability Limit (MW)
1	All Lines In	6000	6675	6800	7758	-800
2	5018 Ramapo-Hopatcong 500kV O/S	5200	5780	6800	7758	-1600
3	5018 Ramapo-Hopatcong 500kV & Any SVC/STATCOM O/S	5100	5670	6800	7758	-1700

Table 5: Summary of proposed Total East Stability Transfer Limits