St. Lucie Unit 2
Extended Power Uprate
Licensing Report

Attachment 5
Appendix C

Grid Stability Analysis and System Impact Study
for
St. Lucie Plant with Proposed EPU

This Coversheet Plus 41 Pages

Grid Stability Analysis for St. Lucie Plant with Proposed EPU

In accordance with section 2.3.2 of NRC document RS-001, a grid stability study was performed for the St. Lucie Nuclear Power Plant (St. Lucie) with the proposed extended power uprate (EPU). The St. Lucie study focused on whether the loss of the nuclear unit, the largest operating generating facility on the grid, or the most critical transmission line will result in the loss-of-offsite power (LOOP) to the plant following implementation of the proposed EPU. The NRC's acceptance criteria for offsite power systems are based on GDC-17. Specific review criteria are contained in SRP sections 8.1 and 8.2, and Appendix A to SRP section 8.2, and Branch Technical Positions (BTPs) PSB-1 and ICSB-11. The information in this report is intended to update section 8.2.2 analysis section of the St. Lucie FSAR.

Analysis

Procedure

Contingencies were selected to conform to USNRC Standard Review Plan 8.2-III. 1.f. Several cases were analyzed for each of the single event outage types specified in the SRP. The most up-to-date transmission model representing projected 2012 summer peak load conditions was used. Additional non-firm transfers were modeled in the 2012 summer peak load case to bring the total Florida import level up to the transfer limit of 3600 MW. This represents the most conservative scenario.

The PTI dynamic simulation software (PSS/E rev.30) was used to simulate the outage events. The simulation results were analyzed for any sign of instability, protective relay action or load shedding. The figures accompanying the simulation results show the St. Lucie plant and transmission system response to the contingency events modeled. Each figure is divided into four parts which show voltage magnitude, machine angle, bus frequency, and line flows.

Power flow analysis of the post transient condition for each case was done using the PTI load flow program (PSS/E rev.30) This analysis was used to assess whether the event causes any voltage or line loading violations. The power flow results are summarized in Table 1.

Conclusions

The results of this study indicate that the thermal, voltage, and stability performance is not degraded by implementation of the EPU. The transmission system and St. Lucie response is stable for all of the contingency events simulated. None of the outage events modeled cause transmission voltages or line loadings to exceed ratings.

Dynamic Stability Results

Loss of the largest source

Case 1 - The largest power source within the Florida interconnected power system is the St. Lucie #2 generator, which is modeled with a gross output of 1072 MW. The sudden trip of St. Lucie #2 is modeled in case 1. A St. Lucie #2 auxiliary load of 49 MW and 33 MVAR is left connected to the St. Lucie 230 kV bus.

System response is stable. The frequency briefly dips to 59.91 Hz and settles at 59.99 hertz. This response is consistent with observed response of the grid. The decline in machine angles is due to the slight decline in overall grid frequency. Machine angles are calculated relative to a fixed 60 hertz source with this simulation software. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Case 2 - St. Lucie #1 is assumed to be off line with its capacity replaced by increased generation at the Martin, Manatee and Sanford power plants. The sudden trip of St. Lucie #2 is modeled in case 2. A total St. Lucie auxiliary load of 98 MW and 65 MVAR is left connected to the St. Lucie 230 kV bus.

System response is stable. The St. Lucie 230 kV bus voltage drops from 104.2% (of 230 kV) to 102.9%. The frequency briefly dips to 59.94 Hz and settles at 59.99 hertz. This response is consistent with observed response of the grid. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Loss of the most critical transmission circuit

Case 3 - The St. Lucie-Midway 230 kV #3 is faulted and tripped in case 3. A three phase fault at the St. Lucie end of this circuit is disconnected after a total fault duration of 0.067 seconds (normal fault clearing time). The same system response would occur for an outage of either the #1 or #2 circuits as the three St. Lucie-Midway 230 kV circuits have nearly identical impedances.

System response is stable. The #1 circuit loading increases to 968 MVA and the #2 circuit loading increases to 959 MVA. These loadings are well within their 1111 MVA ratings. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Case 4 - The Midway 500/230 kV autotransformer is faulted and tripped in case 4. A three phase fault on the 230 kV side is disconnected after a total fault duration of 0.067 seconds (normal fault clearing time). The Midway 500/230 transformer could be regarded as the most critical transmission circuit affecting the St. Lucie plant.

System response is stable. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Case 5 - The Duval - Thalmann 500 kV circuit is faulted and tripped in case 5. A three phase fault is modeled on the Duval side. The fault is disconnected after a total fault duration of 0.05 seconds (normal fault clearing time). The Duval-Thalmann 500 kV circuit could be regarded as the most critical transmission circuit affecting the Florida transmission system as this contingency frequently sets the Georgia to Florida transfer limit.

System response is stable. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Loss of the largest load

Case 6 - The Andytown-Nobhill 230 kV circuit is faulted and tripped in case 6. This disconnects five distribution stations with a total load of 231 MW. This is the largest amount of load served from one transmission circuit during 2012 summer peak load conditions.

System response is stable. The rise in machine angles is due to the slight increase in overall grid frequency. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Case 7 - The Nobhill station is isolated by tripping the Andytown-Nobhill and Conservation-Nobhill 230 kV circuits. This disconnects six distribution stations with a total load of 372 MW. This is the largest amount of load that can be interrupted by the outage of a single transmission system element.

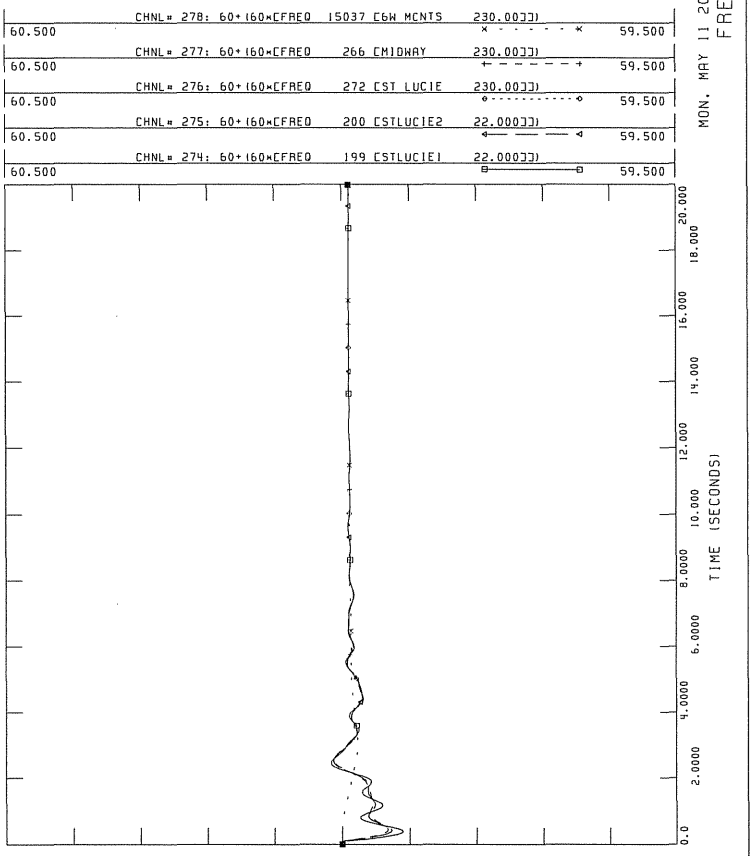
System response is stable. No transmission overloads, generator reactive overloads or voltage problems are caused by this outage.

Table 1 – Power Flow Analysis

Case	Event	St. Lucie 230 voltage	Grid voltage or loading problems
base	PSL @ 2124 MW gross	239.6	none
1	PSL2 tripped	238.8	none
2	PSL1 off, PSL2 tripped	237.6	none
3	SL-Midway #3 line tripped	239.1	none
4	Midway 500/230 Tx tripped	237.8	none
5	Duval-Thalmann 500 tripped	239.5	none
6	Andytwn-Nobhill line tripped	239.9	none
7	(2) Nobhill lines tripped	240.0	none

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 1 - ST. LUCIE #2 TRIPPED

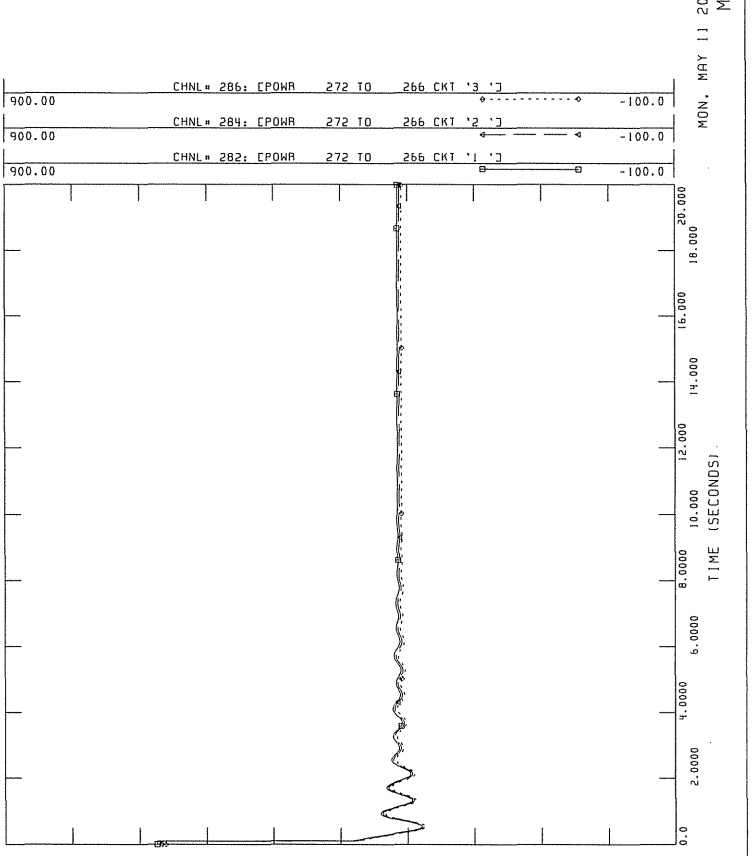
FILE: 2012smpk-1.out



MON. MAY 11 2009 10:59
FREQUENCY

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 1 - ST. LUCIE #2 TRIPPED

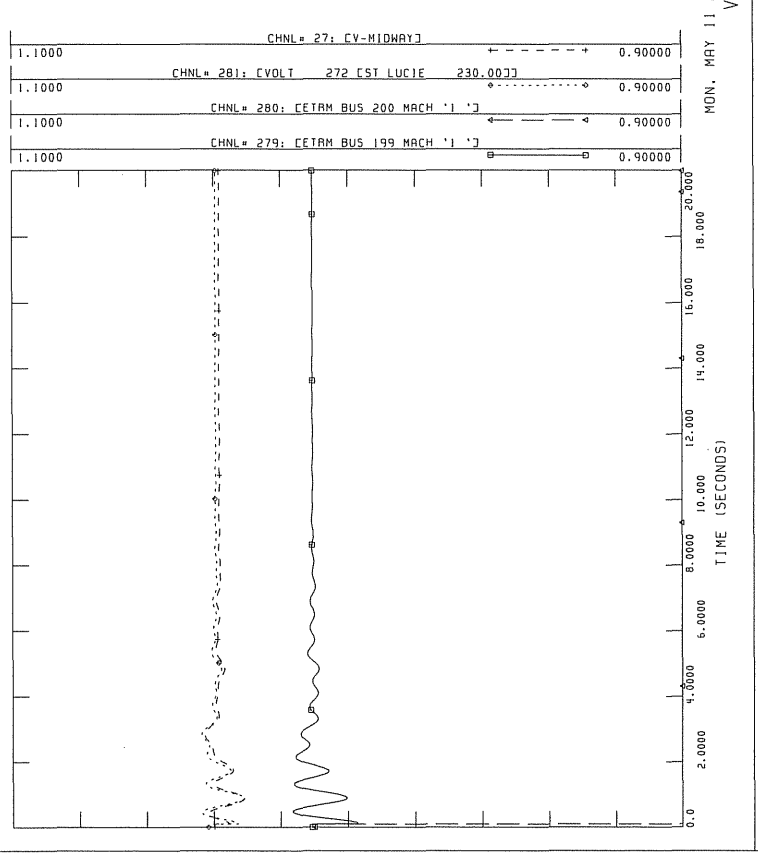
FILE: 2012smpk-1.out



MON. MAY 11 2009 10:59
MW FLOW

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 1 - ST. LUCIE #2 TRIPPED

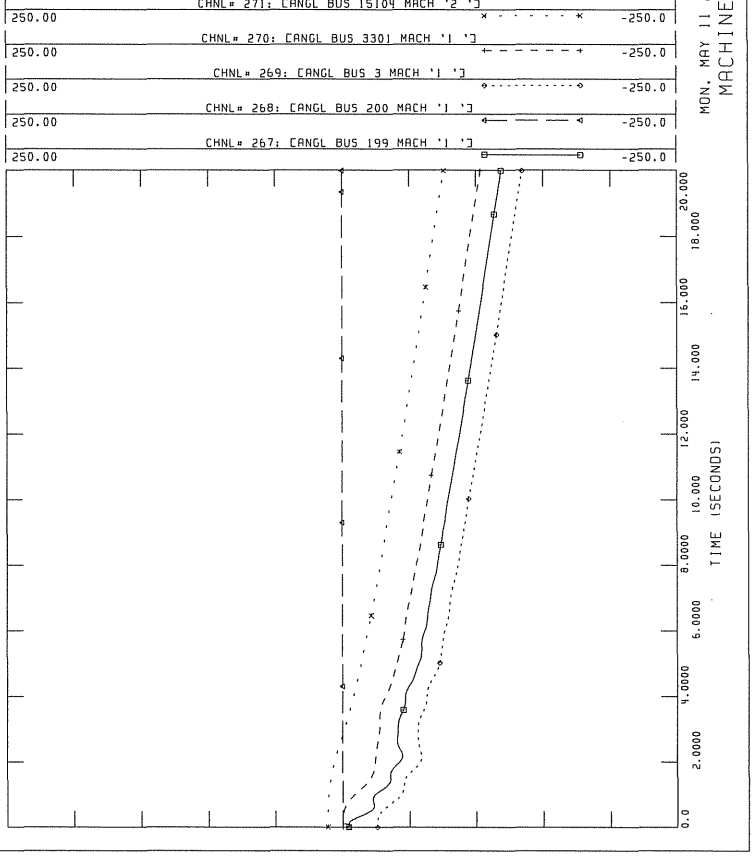
FILE: 2012smpk-1.out



MON. MAY 11 2009 10:59
VOLTAGES

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 1 - ST. LUCIE #2 TRIPPED

FILE: 2012smpk-1.out



MON. MAY 11 2009 10:59
MACHINE ANGLES

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE #2 @1072MW GROSS. AUX LD= 49+J33 EA.
CASE 2 - ST. LUCIE#1 OFF. ST. LUCIE #2 TRIPPED

FILE: 2012smpk-2.out

MON. MAY 11 2009 10:59

FREQUENCY

CHNL# 278: 60+(60*CFREQ 15037 E6W MCNTS 230.00JJ) 60.500 59.500
CHNL# 277: 60+(60*CFREQ 266 EMIDWAY 230.00JJ) 60.500 59.500
CHNL# 276: 60+(60*CFREQ 272 EST LUCIE 230.00JJ) 60.500 59.500
CHNL# 275: 60+(60*CFREQ 200 ESTLUCIE2 22.000JJ) 60.500 59.500
CHNL# 274: 60+(60*CFREQ 199 ESTLUCIE1 22.000JJ) 60.500 59.500

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE #2 @1072MW GROSS. AUX LD= 49+J33 EA.
CASE 2 - ST. LUCIE#1 OFF. ST. LUCIE #2 TRIPPED

FILE: 2012smpk-2.out

MON. MAY 11 2009 10:59

MW FLOW

CHNL# 286: CPOWR 272 TO 266 CKT '3 'J 900.00 -100.0
CHNL# 284: CPOWR 272 TO 266 CKT '2 'J 900.00 -100.0
CHNL# 282: CPOWR 272 TO 266 CKT '1 'J 900.00 -100.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE #2 @1072MW GROSS. AUX LD= 49+J33 EA.
CASE 2 - ST. LUCIE#1 OFF. ST. LUCIE #2 TRIPPED

FILE: 2012smpk-2.out

MON. MAY 11 2009 10:59

VOLTAGES

CHNL# 27: CV-MIDWAYJ 1.1000 0.90000
CHNL# 281: CVOLT 272 EST LUCIE 230.00JJ 1.1000 0.90000
CHNL# 280: CETAM BUS 200 MACH '1 'J 1.1000 0.90000
CHNL# 279: CETAM BUS 199 MACH '1 'J 1.1000 0.90000

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE #2 @1072MW GROSS. AUX LD= 49+J33 EA.
CASE 2 - ST. LUCIE#1 OFF. ST. LUCIE #2 TRIPPED

FILE: 2012smpk-2.out

MON. MAY 11 2009 10:59

MACHINE ANGLES

CHNL# 271: CANGL BUS 15104 MACH '2 'J 250.00 -250.0
CHNL# 270: CANGL BUS 3301 MACH '1 'J 250.00 -250.0
CHNL# 269: CANGL BUS 3 MACH '1 'J 250.00 -250.0
CHNL# 268: CANGL BUS 200 MACH '1 'J 250.00 -250.0
CHNL# 267: CANGL BUS 199 MACH '1 'J 250.00 -250.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 3 - ST. LUCIE-MIDWAY #3 LINE FAULTED & TRIPPED

FILE: 2012smpk-3.out

MON, MAY 11 2009 10:59

FREQUENCY

CHNL# 278: 60+(60*CFREQ 15037 C6W MCNTS 230.00JJ)
60.500 59.500

CHNL# 277: 60+(60*CFREQ 266 CMIDWAY 230.00JJ)
60.500 59.500

CHNL# 276: 60+(60*CFREQ 272 CST LUCIE 230.00JJ)
60.500 59.500

CHNL# 275: 60+(60*CFREQ 200 CSTLUCIE2 22.000JJ)
60.500 59.500

CHNL# 274: 60+(60*CFREQ 199 CSTLUCIE1 22.000JJ)
60.500 59.500

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 3 - ST. LUCIE-MIDWAY #3 LINE FAULTED & TRIPPED

FILE: 2012smpk-3.out

MON, MAY 11 2009 10:59

MW FLOW

CHNL# 286: CPOWR 272 TO 266 CKT '3 'J
1400.0 -100.0

CHNL# 284: CPOWR 272 TO 266 CKT '2 'J
1400.0 -100.0

CHNL# 282: CPOWR 272 TO 266 CKT '1 'J
1400.0 -100.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 3 - ST. LUCIE-MIDWAY #3 LINE FAULTED & TRIPPED

FILE: 2012smpk-3.out

MON, MAY 11 2009 10:59

VOLTAGES

CHNL# 27: CV-MIDWAYJ
1.1000 0.90000

CHNL# 281: CVOLT 272 CST LUCIE 230.00JJ
1.1000 0.90000

CHNL# 280: CETRM BUS 200 MACH '1 'J
1.1000 0.90000

CHNL# 279: CETRM BUS 199 MACH '1 'J
1.1000 0.90000

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 3 - ST. LUCIE-MIDWAY #3 LINE FAULTED & TRIPPED

FILE: 2012smpk-3.out

MON, MAY 11 2009 10:59

MACHINE ANGLES

CHNL# 271: CANGL BUS 15104 MACH '2 'J
250.00 -250.0

CHNL# 270: CANGL BUS 3301 MACH '1 'J
250.00 -250.0

CHNL# 269: CANGL BUS 3 MACH '1 'J
250.00 -250.0

CHNL# 268: CANGL BUS 200 MACH '1 'J
250.00 -250.0

CHNL# 267: CANGL BUS 199 MACH '1 'J
250.00 -250.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

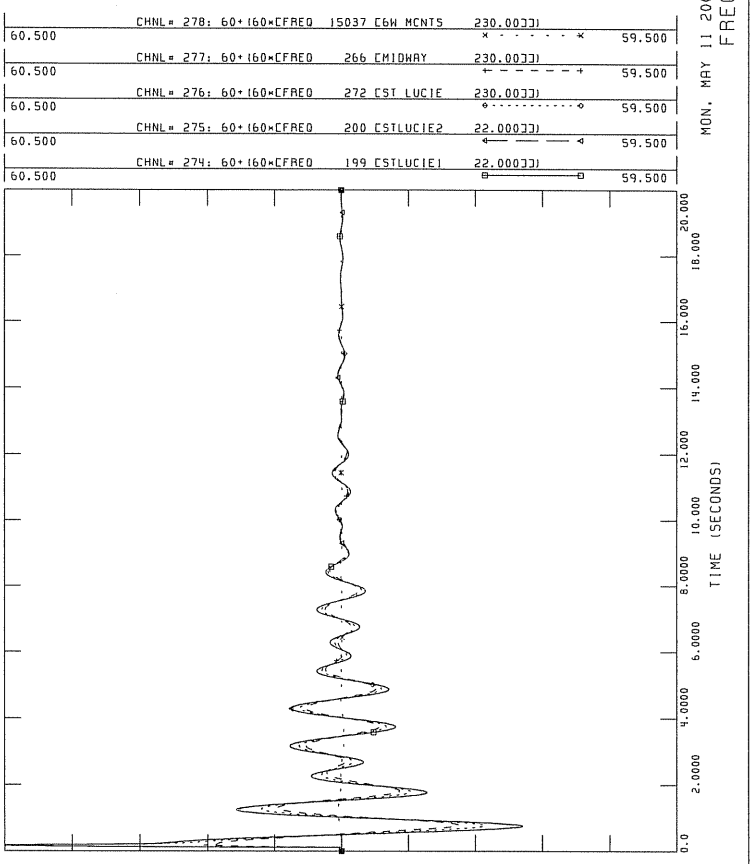
TIME (SECONDS)

2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 4 - MIDWAY 500/230 AUTO FAULTED & TRIPPED

FILE: 2012smpk-4.out

MON, MAY 11 2009 10:59

FREQUENCY

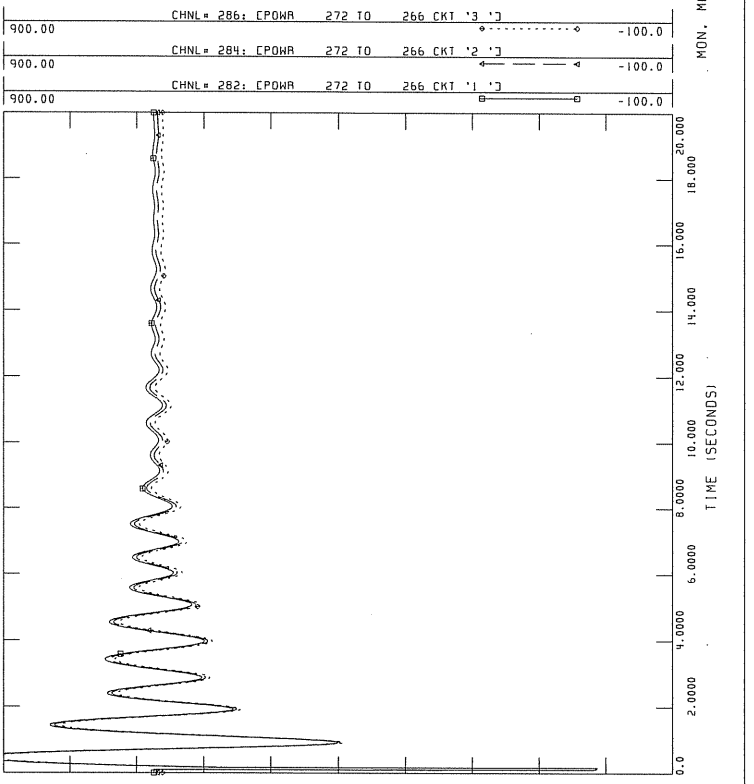


2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 4 - MIDWAY 500/230 AUTO FAULTED & TRIPPED

FILE: 2012smpk-4.out

MON, MAY 11 2009 10:59

MW FLOW

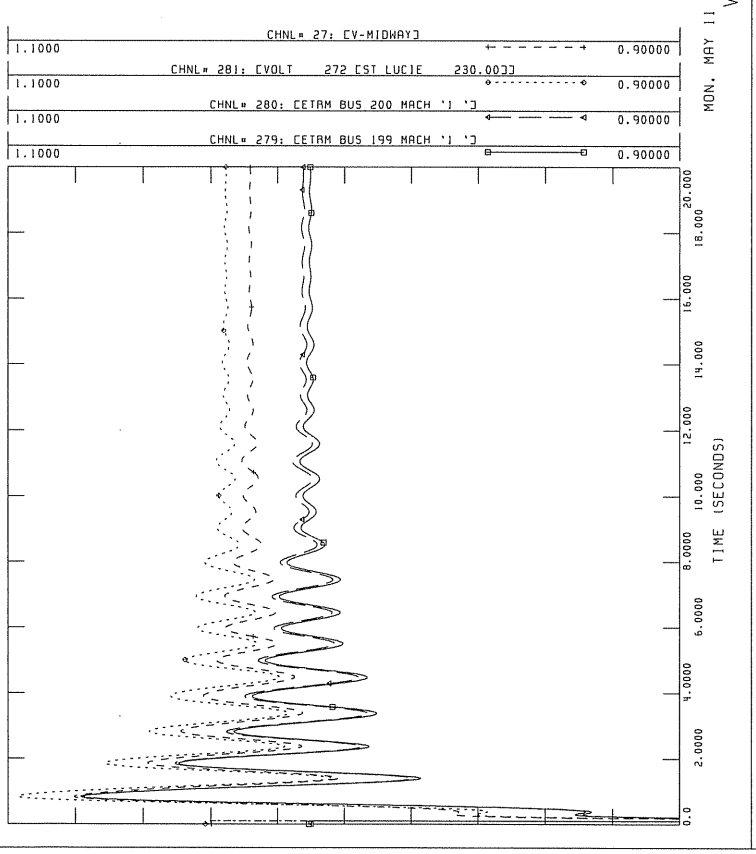


2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 4 - MIDWAY 500/230 AUTO FAULTED & TRIPPED

FILE: 2012smpk-4.out

MON, MAY 11 2009 10:59

VOLTAGES

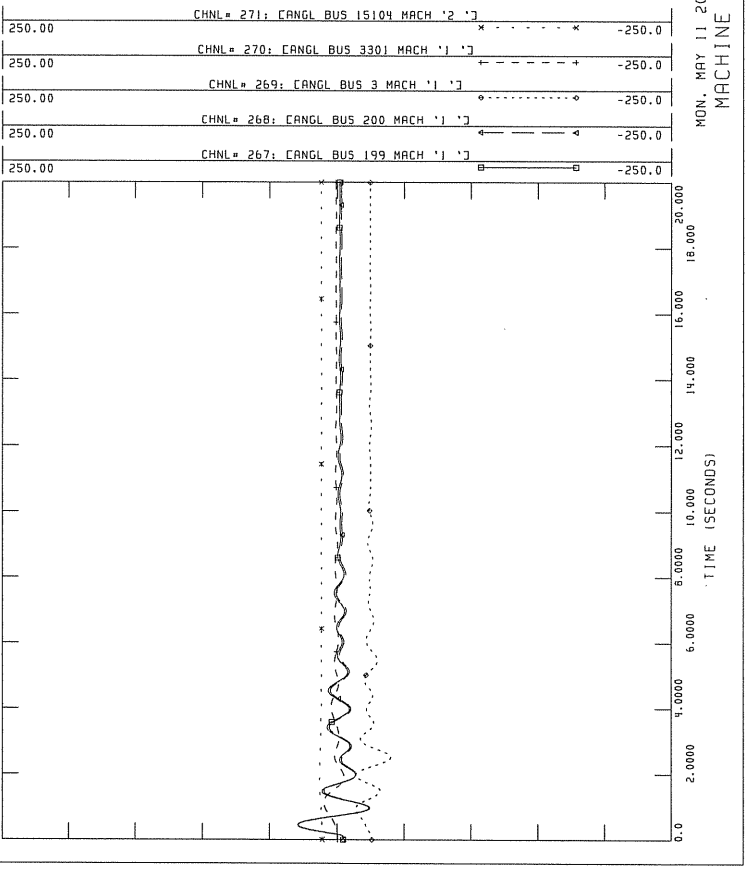


2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 4 - MIDWAY 500/230 AUTO FAULTED & TRIPPED

FILE: 2012smpk-4.out

MON, MAY 11 2009 10:59

MACHINE ANGLES



2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 5 - DUVAL-THALMANN 500 FAULTED & TRIPPED

FILE: 2012smpk-5.out

MON. MAY 11 2009 10:59

FREQUENCY

CHNL# 278: 60+(60*CFREQ 15037 C6W MCNTS 230.00[J]
60.500 59.500

CHNL# 277: 60+(60*CFREQ 266 CMIDWAY 230.00[J]
60.500 59.500

CHNL# 276: 60+(60*CFREQ 272 CST LUCIE 230.00[J]
60.500 59.500

CHNL# 275: 60+(60*CFREQ 200 CSTLUCIE2 22.000[J]
60.500 59.500

CHNL# 274: 60+(60*CFREQ 199 CSTLUCIE1 22.000[J]
60.500 59.500

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 5 - DUVAL-THALMANN 500 FAULTED & TRIPPED

FILE: 2012smpk-5.out

MON. MAY 11 2009 10:59

MW FLOW

CHNL# 286: CPOWR 272 TO 266 CKT '3 'J
900.00 -100.0

CHNL# 284: CPOWR 272 TO 266 CKT '2 'J
900.00 -100.0

CHNL# 282: CPOWR 272 TO 266 CKT '1 'J
900.00 -100.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 5 - DUVAL-THALMANN 500 FAULTED & TRIPPED

FILE: 2012smpk-5.out

MON. MAY 11 2009 10:59

VOLTAGES

CHNL# 27: CV-MIDWAY]
1.1000 0.90000

CHNL# 281: CVOLT 272 CST LUCIE 230.00[J]
1.1000 0.90000

CHNL# 280: CETAM BUS 200 MACH '1 'J
1.1000 0.90000

CHNL# 279: CETAM BUS 199 MACH '1 'J
1.1000 0.90000

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 5 - DUVAL-THALMANN 500 FAULTED & TRIPPED

FILE: 2012smpk-5.out

MON. MAY 11 2009 10:59

MACHINE ANGLES

CHNL# 271: CANGL BUS 15104 MACH '2 'J
250.00 -250.0

CHNL# 270: CANGL BUS 330] MACH '1 'J
250.00 -250.0

CHNL# 269: CANGL BUS 3 MACH '1 'J
250.00 -250.0

CHNL# 268: CANGL BUS 200 MACH '1 'J
250.00 -250.0

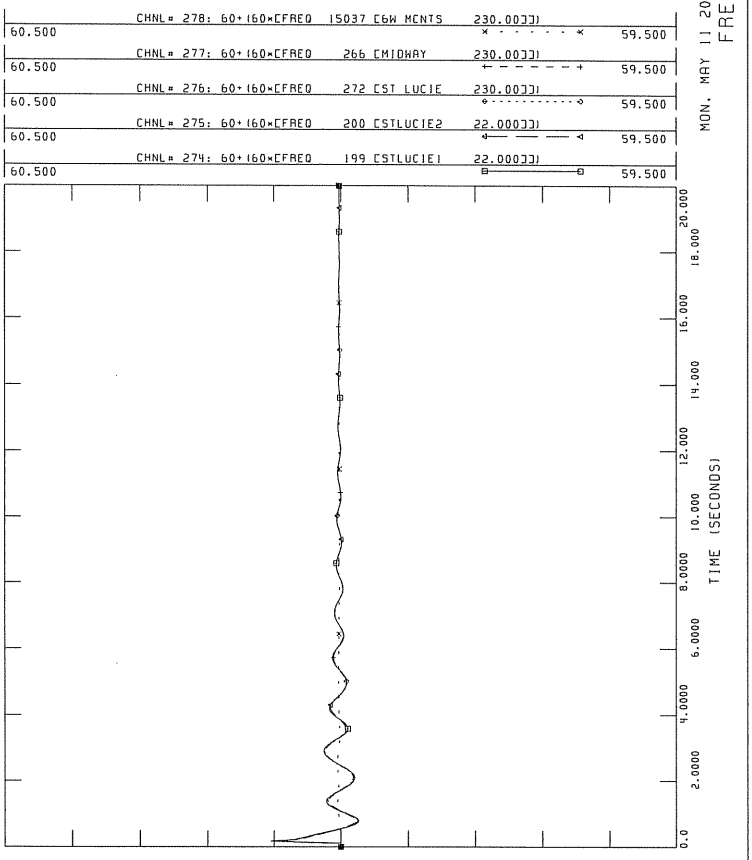
CHNL# 267: CANGL BUS 199 MACH '1 'J
250.00 -250.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000

TIME (SECONDS)

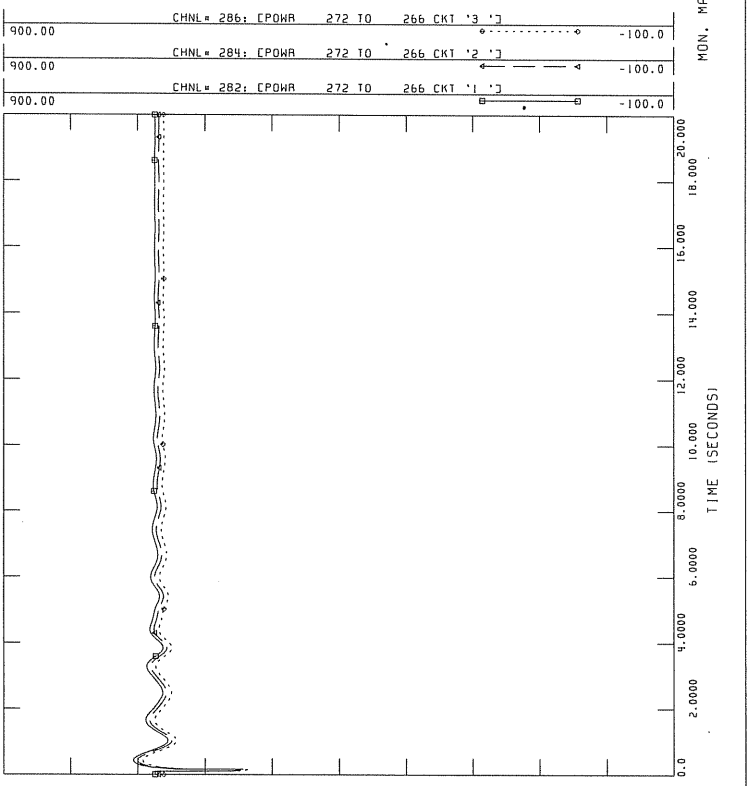
2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 6 - ANDYTOWN-NOBHILL 230 CKT FAULTED & TRIPPED
231 MW OF LOAD DISCONNECTED
FILE: 2012smpk-6.out

MON, MAY 11 2009 10:59
FREQUENCY



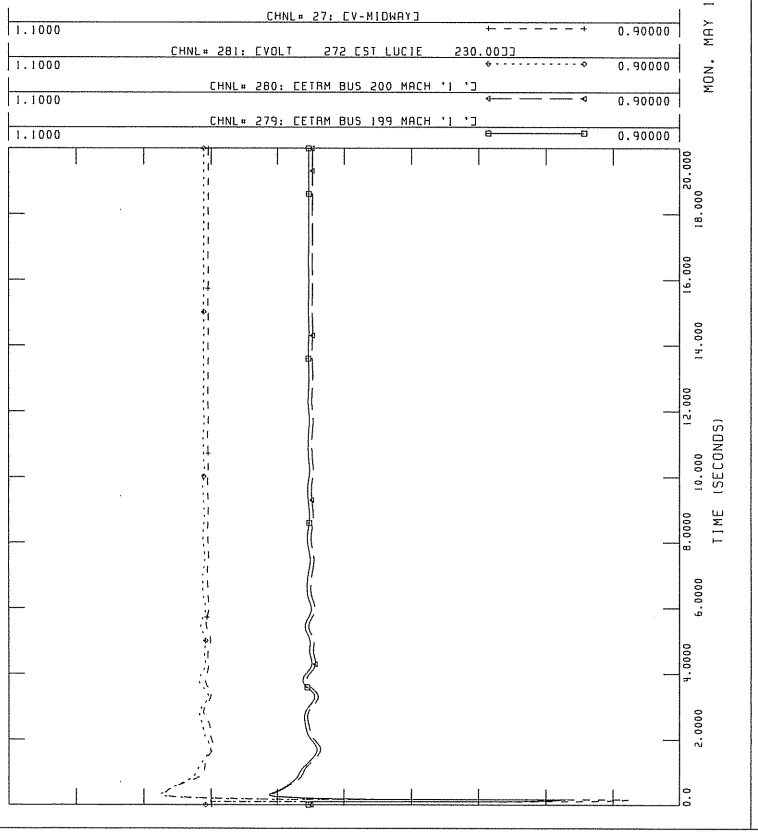
2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 6 - ANDYTOWN-NOBHILL 230 CKT FAULTED & TRIPPED
231 MW OF LOAD DISCONNECTED
FILE: 2012smpk-6.out

MON, MAY 11 2009 10:59
MW FLOW



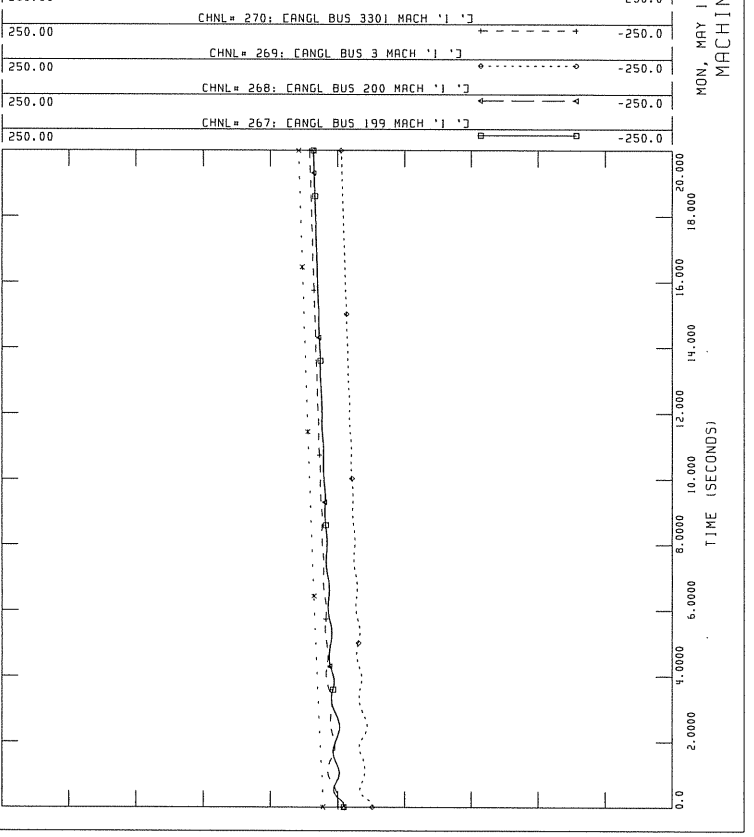
2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 6 - ANDYTOWN-NOBHILL 230 CKT FAULTED & TRIPPED
231 MW OF LOAD DISCONNECTED
FILE: 2012smpk-6.out

MON, MAY 11 2009 10:59
VOLTAGES



2012 SUMMER PEAK LOAD, SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS,AUX LD= 49+J33 EA.
CASE 6 - ANDYTOWN-NOBHILL 230 CKT FAULTED & TRIPPED
231 MW OF LOAD DISCONNECTED
FILE: 2012smpk-6.out

MON, MAY 11 2009 10:59
MACHINE ANGLES



2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS.AUX LD= 49+J33 EA.
CASE 7 - ANDYTOWN-NOBHILL-CONSERVATION 230 CKTS
FAULTED & TRIPPED. 372 MW OF LOAD DISCONNECTED
FILE: 2012smpk-7.out

MON. MAY 11 2009 11:00
FREQUENCY

CHNL= 278: 60+(60*CFREQ 15037 [6W MONTS 230.00]]
60.500 59.500
CHNL= 277: 60+(60*CFREQ 266 [MIDWAY 230.00]]
60.500 59.500
CHNL= 276: 60+(60*CFREQ 272 [ST LUCIE 230.00]]
60.500 59.500
CHNL= 275: 60+(60*CFREQ 200 [STLUCIE2 22.000]]
60.500 59.500
CHNL= 274: 60+(60*CFREQ 199 [STLUCIE1 22.000]]
60.500 59.500

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS.AUX LD= 49+J33 EA.
CASE 7 - ANDYTOWN-NOBHILL-CONSERVATION 230 CKTS
FAULTED & TRIPPED. 372 MW OF LOAD DISCONNECTED
FILE: 2012smpk-7.out

MON. MAY 11 2009 11:00
MW FLOW

CHNL= 286: [POWR 272 TO 266 CKT '3 ']
900.00 -100.0
CHNL= 284: [POWR 272 TO 266 CKT '2 ']
900.00 -100.0
CHNL= 282: [POWR 272 TO 266 CKT '1 ']
900.00 -100.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS.AUX LD= 49+J33 EA.
CASE 7 - ANDYTOWN-NOBHILL-CONSERVATION 230 CKTS
FAULTED & TRIPPED. 372 MW OF LOAD DISCONNECTED
FILE: 2012smpk-7.out

MON. MAY 11 2009 11:00
VOLTAGES

CHNL= 27: [V-MIDWAY]
1.1000 0.90000
CHNL= 281: [VOLT 272 [ST LUCIE 230.00]]
1.1000 0.90000
CHNL= 280: [ETRM BUS 200 MACH '1 ']
1.1000 0.90000
CHNL= 279: [ETRM BUS 199 MACH '1 ']
1.1000 0.90000

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)

2012 SUMMER PEAK LOAD. SOU-FLA = 3600 MW
ST. LUCIE 1 & 2 @1052MW & 1072MW GROSS.AUX LD= 49+J33 EA.
CASE 7 - ANDYTOWN-NOBHILL-CONSERVATION 230 CKTS
FAULTED & TRIPPED. 372 MW OF LOAD DISCONNECTED
FILE: 2012smpk-7.out

MON. MAY 11 2009 11:00
MACHINE ANGLES

CHNL= 271: [ANGL BUS 15104 MACH '2 ']
250.00 -250.0
CHNL= 270: [ANGL BUS 330] MACH '1 ']
250.00 -250.0
CHNL= 269: [ANGL BUS 3 MACH '1 ']
250.00 -250.0
CHNL= 268: [ANGL BUS 200 MACH '1 ']
250.00 -250.0
CHNL= 267: [ANGL BUS 199 MACH '1 ']
250.00 -250.0

0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)

GENERATION INTERCONNECTION SERVICE
And
NETWORK RESOURCE INTERCONNECTION SERVICE

SYSTEM IMPACT STUDY

FPL EXTENDED POWER UPRATE PROJECTS
ST. LUCIE 1 & 2

Q114 & Q115

REVISED 9/17/2010

Revision	Date
Original study document	November 24, 2008
Incorporated results of St. Lucie switchyard string bus study	September 17, 2010

Summary:
In accordance with the Standard Large Generator Interconnection Procedures Florida Power & Light Company ("FPL") has completed a Generation Interconnection Service ("GIS") System Impact Study ("SIS") regarding the increased power output of the St. Lucie 1 extended power uprate project ("SL1EPUP") & St. Lucie 2 extended power uprate project ("SL2EPUP") associated with FPL's GIS queue requests No.114 & No.115 respectively, to the FPL Transmission System and an attendant request for Network Resource Interconnection Service ("NRIS"). GIS queue request 114 is for an increase in the capacity of the existing St. Lucie unit 1 from 905 MW gross to a maximum potential cold winter output of 1052 MW gross. GIS queue request 115 is for an increase in the capacity of the existing St. Lucie unit 2 from 905 MW gross to a maximum potential cold winter output of 1072 MW gross.

As delineated in the SIS Agreement, the purpose of the SIS was to provide:

- Identification of any circuit breaker short circuit capability limits exceeded as a result of SL1EPUP and SL2EPUP;
- Identification of any thermal overload or voltage limit violations resulting from SL1EPUP and SL2EPUP; and
- Identification of any instability or inadequately damped response to system disturbances resulting from the interconnection; and
- A description and non-binding estimated cost of facilities required to integrate SL1EPUP and SL2EPUP to the FPL Transmission System and to address the identified short circuit, instability and power flow issues that the request to increase the power output of the proposed SL1EPUP and SL2EPUP may create on the FPL Transmission System.

The performance of the SIS consisted of a:

- Reactive Power Capability Analysis;
- Short Circuit Analysis;
- Analysis of NRIS request for SL1EPUP and SL2EPUP;
- Dynamic Stability Analysis;
- Southern/Florida Transmission Interface Assessment; and
- Transmission Project's Facilities Cost Estimate consisting of:
- Substation Facilities Cost Estimate;
- Protection and Control Facilities Cost Estimate; and
- Transmission Facilities Cost Estimate.

In summary the results of the SIS are as follows:

<u>Reactive Power Capability Analysis</u>

The reactive capability of the units was analyzed. The analysis recognized that the units' current reactive capability is grandfathered as acceptable, and that the SL1EPUP and SL2EPUP projects' incremental increase in MW output to the FPL transmission system must meet the requirements of the Standard Large Generator Interconnection Procedures in FPL's OATT. In order to determine whether the incremental increase in MW output of each unit meets the requirements, a

comparison was made between the existing units' reactive capabilities, and the uprated units' reactive capabilities. Each unit is recognized as meeting the requirements provided that the uprated unit does not increase a current MVar deficiency in reactive capability. Any improvement in a current MVar deficiency as a result of the uprates is credited to the existing deficiency and not considered to be the uprated portion exceeding the requirement. The reactive capability following the uprates must be maintained at the new design capability specified in the data submittal. Based upon these criteria the analysis results were that:

- The SL1EPUP uprate meets the reactive capability requirements.
- The SL2EPUP uprate meets the reactive capability requirements.

Short Circuit Analysis

- Fault current levels did not exceed the rating of any circuit breakers as a result of the SL1EPUP and SL2EPUP GIS request.

These results are predicated on upgrades to the FPL system attributed to preceding GIS requests being in place prior to the increase in power output of the SL1EPUP and SL2EPUP. Withdrawal of one or more of these preceding GIS requests may result in SL1EPUP and/or SL2EPUP being responsible for such breaker upgrades and/or substation reconfigurations. FPL will advise SL1EPUP and SL2EPUP of any changes associated with preceding GIS requests that may require a re-study of the GIS request for the SL1EPUP and SL2EPUP.

Please refer to Appendix I for detailed results.

Provision of NRIS for SL1EPUP

Based on the current status of FPL's GIS queue and transmission service requests the following are the results of this part of the evaluation:

- The integration of SL1EPUP as an FPL network resource does not require upgrading of the existing facilities or construction of new facilities.

Provision of NRIS for SL2EPUP

Based on the current status of FPL's GIS queue and transmission service requests the following are the results of this part of the evaluation:

- The integration of SL2EPUP as an FPL network resource requires an increase in the thermal rating of the existing St. Lucie-Midway #1, St. Lucie-Midway #2, and St. Lucie-Midway #3 230 kV lines. Transmission line conductor ampacity of 3050A (185F/85C) for the 2X1691AAAC and 3395A (239F/115C) for the 3400ACSR is limited to 2790 A due to clearances. Therefore, the three St. Lucie-Midway line ratings will be increased from 2380A to 2790A.

Please refer to Appendix II for detailed results.

Dynamic Stability Analysis

- The existing BFBU total clearing time at Midway 230kV substation of 9.9 cycles is adequate.
- The existing BFBU total clearing time at St. Lucie 230kV substation of 8.8 cycles is adequate.
- Stabilizers are required for St. Lucie #1 and #2 units to improve oscillations damping.
- Results of the dynamic simulations indicate acceptable performance for the most extreme NERC Category D event at Midway substation. The most severe fault at Midway substation is on the Midway 500/230kV auto with delayed clearing for breaker failure. Similar to the existing performance without the upgrades, the St. Lucie #1 and #2 units lose synchronism and trip after the fault is cleared however the transmission system remains stable, which is acceptable performance for the NERC Category D extreme event. It is recommended that all future breaker replacements at Midway 230kV substation use Independent Pole Operated breakers to improve system performance for extreme events.

Please refer to Appendix III for detailed results.

Southern/Florida Transmission Interface Assessment

The principal finding of this analysis is that the SL1EPUP and SL2EPUP projects will not adversely affect the current Southern to Florida import capability of 3600 MW in the 2012 timeframe. In addition, the 4100 MW transfer case also indicates acceptable performance for the outage of the St. Lucie #2 unit. Based on this analysis it appears that the Southern/Florida transmission interface in the 2012 time frame will be more robust and thus able to accommodate a larger generator outage within the FRCC Region. Based on past studies for previously queued Transmission Service Requests (TSRs), the most severe contingency affecting the SO/FL interface at the increased transfer level of 4100 MW is the outage of the Duval-Thalmann 500 kV tie line as opposed the near term studies at a 3600 MW SO/FL transfer level that shows the most severe outage being the loss of an 800 - 900 MW class generating unit outage in Florida**.**

Please refer to Appendix IV for detailed results.

Transmission Project's Facilities Cost Estimate

The total non-binding, good faith estimate to upgrade the existing FPL Transmission System to accommodate the uprates excluding the GSU improvements, is **$11.5 Million**. The estimates for Unit #1 are escalated to 2011 dollars and the estimates for Unit #2 are escalated to 2012 dollars.

Please refer to Appendix V for detailed scope of work.

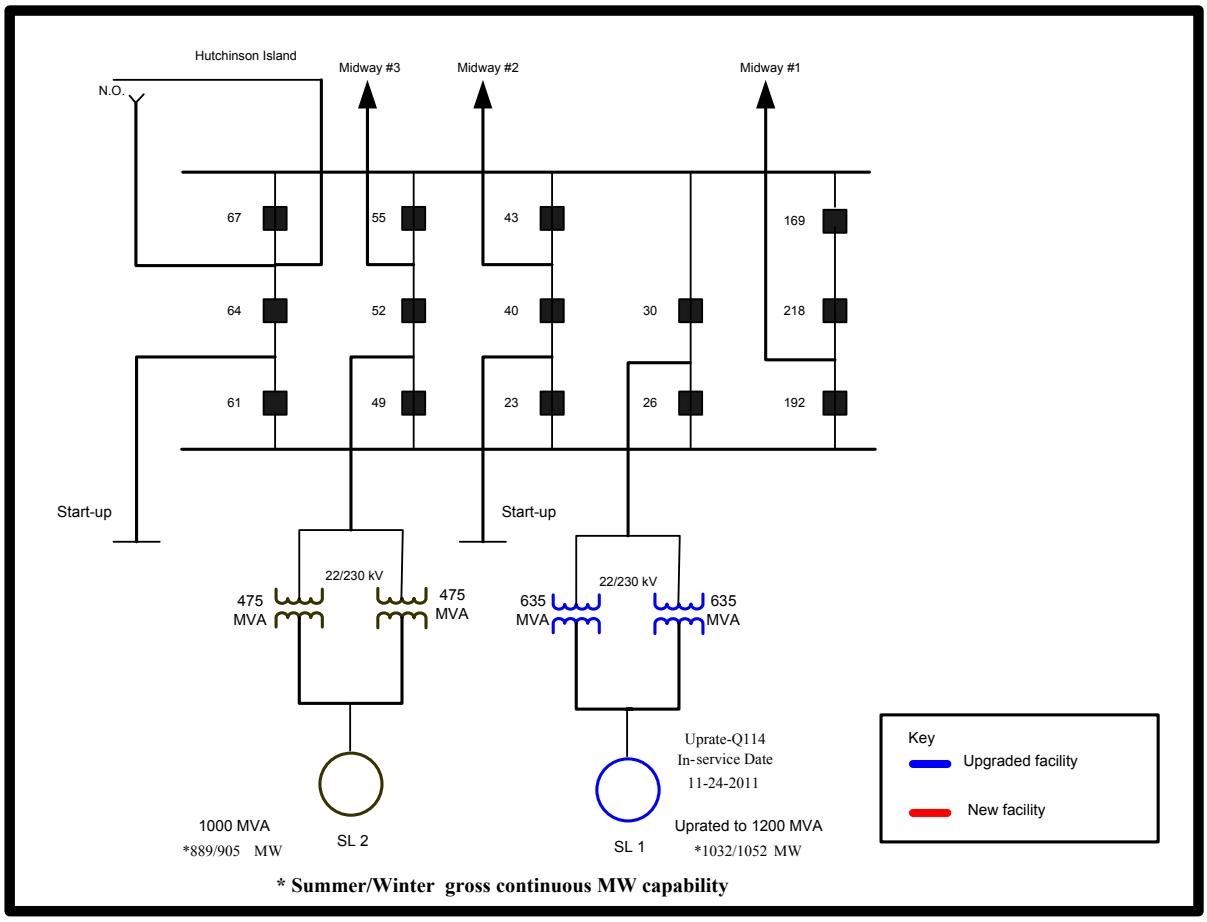
APPENDIX I

SHORT CIRCUIT ANALYSIS

I. SHORT CIRCUIT ANALYSIS FOR SL1EPUP-Q114

PURPOSE:
Determine the impact on breaker interrupting capability at FPL's substations due to the SL1EPUP-Q114 as specified in the following configuration (See Figure A).

Figure A – SL1EPUP – Q114



METHODOLOGY:
The analysis was performed using PSS/E application for automatic sequence fault calculation for three phase and phase to ground faults. Fault calculations were performed with a line outage condition (each line outaged individually), where applicable, on all buses in FPL's area. The breaker duty fault current was determined by taking the larger of the two, three phase or single phase fault currents.

The breaker duty fault current was then compared to the breaker interrupting capability in order to determine if any breaker(s) needed to be upgraded. In circumstances where the study case fault current levels exceeded the mid-breaker rating an additional analysis was performed in order to determine the breaker duty for such mid-breakers.

ASSUMPTIONS:

Base Case

- Given the SL1EPUP in-service date of June 2011, the 2011-year Summer Case (based on the most recent available FRCC Transmission Working Group case) was used as the Base Case. This Base Case represents late summer 2011 and reflects changes in load, generation capacity, and transmission capacity that have been planned through such period in time. In addition, the Base Case was modified to reflect preceding GIS requests, and the attendant incremental facilities necessary for such preceding GIS requests that may potentially have a material impact on the results of this analysis.

Study Case

- The Study Case was derived from the aforementioned Base Case while also modeling SL1EPUP. SL1EPUP is modeled as one generating unit with a gross summer capacity of 1032MW, 1200 MVA connected to St. Lucie 230 kV switchyard. See Figure A.

FINDINGS

- In the Study Case the breaker duty did not exceeded the rating of any existing circuit breakers as a result of the SL1EPUP GIS request. The following table below shows the impact of SL1EPUP on fault current levels at Midway and St. Lucie 230 kV substations:

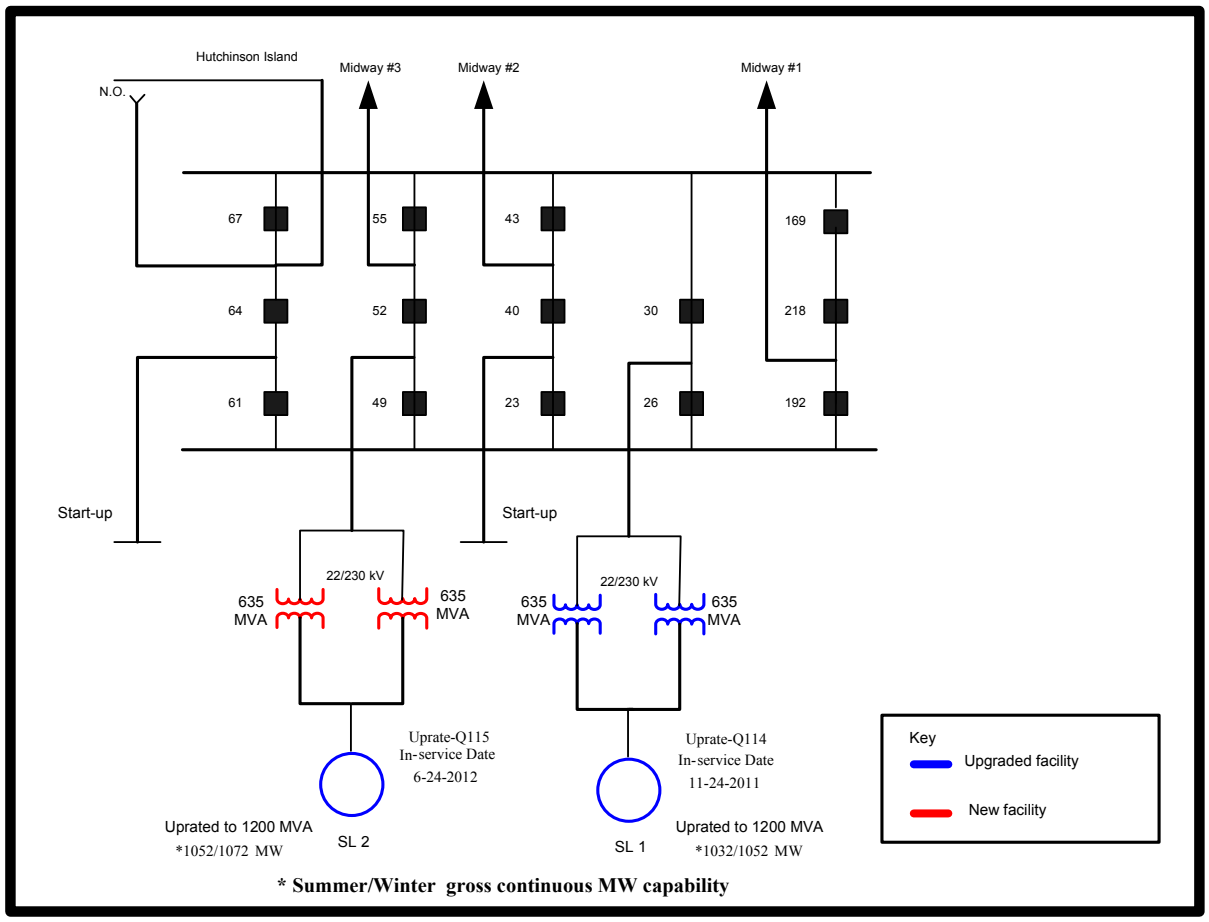
STATION	kV	Rating kA	STUDY kA	kA prior to SL1EPUP
Midway	230	63	57.3	57.1
St. Lucie	230	63	45.0	44.6

II. SHORT CIRCUIT ANALYSIS FOR SL2EPUP-Q115

PURPOSE:

Determine the impact on breaker interrupting capability at FPL's substations due to the SL2EPUP-Q115 as specified in the following configuration (See Figure B).

Figure B – SL2EPUP – Q115



METHODOLOGY:

The analysis was made using PSS/E application for automatic sequence fault calculation for three phase and phase to ground faults. Fault calculations were performed with a line outage condition (each line outaged individually), where applicable, on all buses in FPL's area. The breaker duty fault current was determined by taking the larger of the two, three phase or single phase fault currents.

The breaker duty fault current was then compared to the breaker interrupting capability in order to determine if any breaker(s) needed to be upgraded. In circumstances where the study case fault current levels exceeded the mid-breaker rating an additional analysis was performed in order to determine the breaker duty for such mid-breakers.

ASSUMPTIONS:

Base Case

- Given the SL2EPUP in-service date of Dec. 2012, the 2013-year Summer Case (based on the most recent available FRCC Transmission Working Group case) was used as the Base Case. This Base Case represents late summer 2013 and reflects changes in load, generation capacity,

and transmission capacity that have been planned through such period in time. In addition, the Base Case was modified to reflect preceding GIS requests, including SL1EPUP, and the attendant incremental facilities necessary for such preceding GIS requests that may potentially have a material impact on the results of this analysis.

Study Case

- The Study Case was derived from the aforementioned Base Case while also modeling SL2EPUP. SL2EPUP is modeled as one generating unit with a gross summer capacity of 1052MW, 1200 MVA connected to St. Lucie 230 kV switchyard. See Figure B.

FINDINGS

- In the Study Case the breaker duty did not exceeded the rating of any existing circuit breakers as a result of the SL2EPUP GIS request. . The following table below shows the impact of SL2EPUP on fault current levels at Midway and St. Lucie 230 kV substations:

STATION	kV	Rating kA	Study kA	kA prior to SL2EPUP
Midway	230	63	58.6	58.4
St. Lucie	230	63	46.8	46.2

APPENDIX II

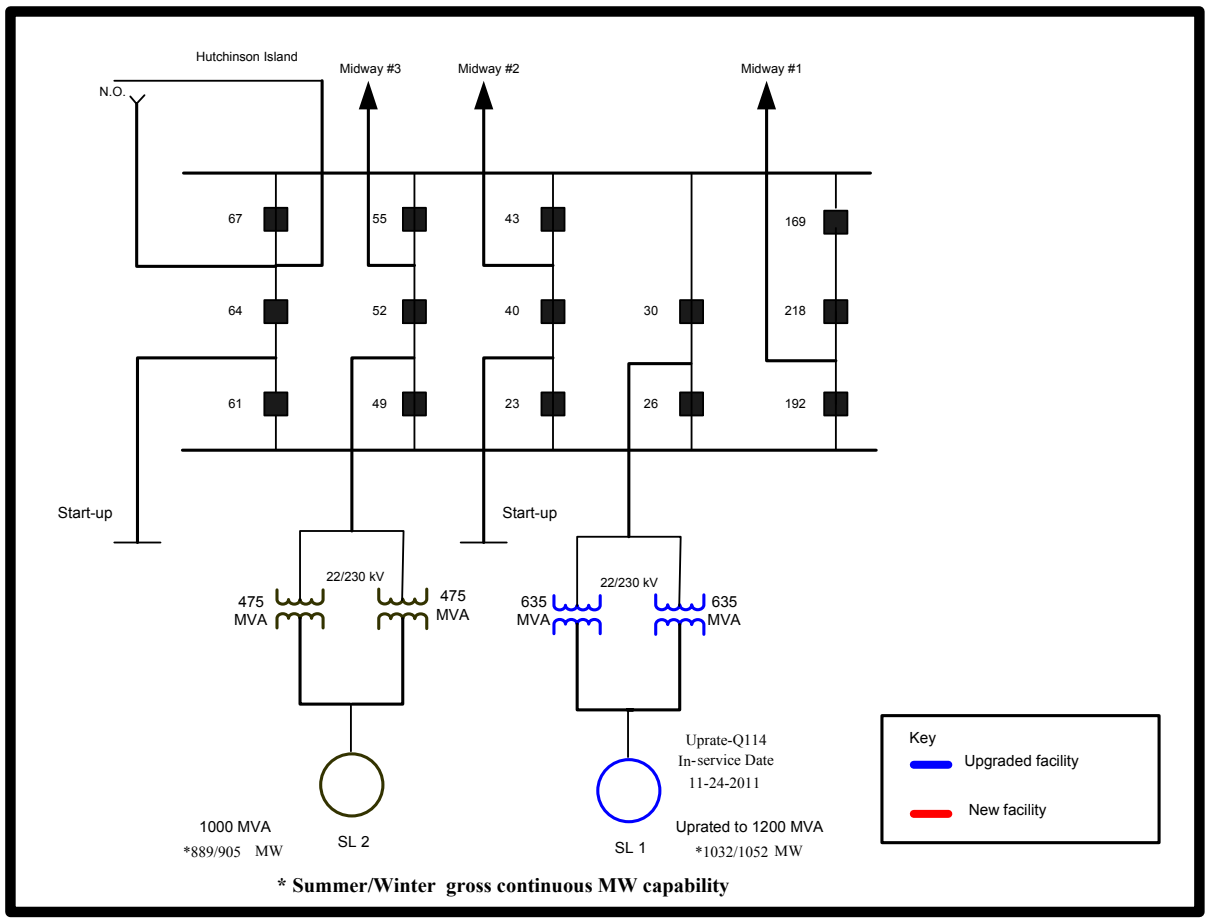
NRIS ASSESSMENT

SL1EPUP NRIS Assessment:

PURPOSE
Determine the transmission system additions/modifications for the proposed SL1EPUP to be integrated as an FPL's Network Resource.

SUMMARY
- This project consists of one generating unit with a maximum potential cold winter continuous capability of 1052 MW and a November 2011 in-service date. See Figure C below.

Figure C – SL1EPUP – Q114



The integration of SL1EPUP as a Network Resource does not require upgrading of the existing facilities or construction of new facilities.

METHODOLOGY:
The study was performed by conducting a single contingency power flow analysis. All systems elements 69kV or higher in the FRCC region were simulated for NERC Category A and B contingency scenarios. Overloads greater than 100% of a facility rating that is materially aggravated (more than 3%) when compared to the reference case or overloads that were not existing in the reference case, for the same contingency, are attributed to SL1EPUP. Similarly,

low voltages, less than 0.95 p.u., that were materially lower (more than 2%) when compared to the reference case, for the same contingency, are attributed to SL1EPUP.

In addition, multiple contingencies were simulated for NERC Category C scenarios. The study was performed by conducting a multiple contingency power flow analysis. All systems elements 100kV or higher in the FPL East region were simulated for NERC Category C2, C3 and C5 contingency scenarios. Following the FRCC methodology of analyzing overloads greater than 130% for Category C3 and greater than 100% for Category C2 and C5 of a facility rating that is materially aggravated (more than 3%) when compared to the reference case or overloads that were not existing in the reference case, for the same contingency, are attributed to SL1EPUP or SL2EPUP. Similarly, low voltages, less than 0.90 p.u., that were materially lower (more than 2%) when compared to the reference case, for the same contingency, are attributed to SL1EPUP or SL2EPUP.

The latest available peak case for the winter of 2011 from the 2008 FRCC databank (FY08 Rev3) with firm long-term contractual obligations was used to create a base case for the power flow analysis. This case was updated to include the most up-to-date information on the FPL system (e.g., planned new transmission facilities and upgrades, committed new generation, confirmed transmission service obligations, etc.). The updated base case was then modified to incorporate relevant preceding GIS requests and transmission service requests.

The Study Case was derived from the aforementioned Base Case while also modeling SL1EPUP. SL1EPUP is modeled as one steam generating unit with a maximum potential cold winter gross capacity of 1052MW.

FINDINGS:

The results of the contingency power flow analysis show that there were no overloads of facilities that resulted from SL1EPUP. Also, no existing overloads in the cases were materially aggravated (more than 3%) due to the SL1EPUP. Similarly, there were no low voltages observed that were materially lower (lower than 2%) due to the SL1EPUP.

Note that these results are based on the current FPL GIS and transmission service queue which includes requests preceding the SL1EPUP GIS request. To the extent that one or more of these requests are modified or withdrawn, the results presented in this analysis may no longer apply to this request and may change materially. FPL will advise SL1EPUP of any changes associated with preceding GIS requests that may require a re-study of the GIS request for the SL1EPUP.

CONCLUSION

Based on the current status of FPL's GIS queue and transmission service requests the following are the results of this part of the evaluation:

- The integration of SL1EPUP as a Network Resource does not require upgrading of the existing facilities or construction of new facilities.

SL2EPUP NRIS Assessment:

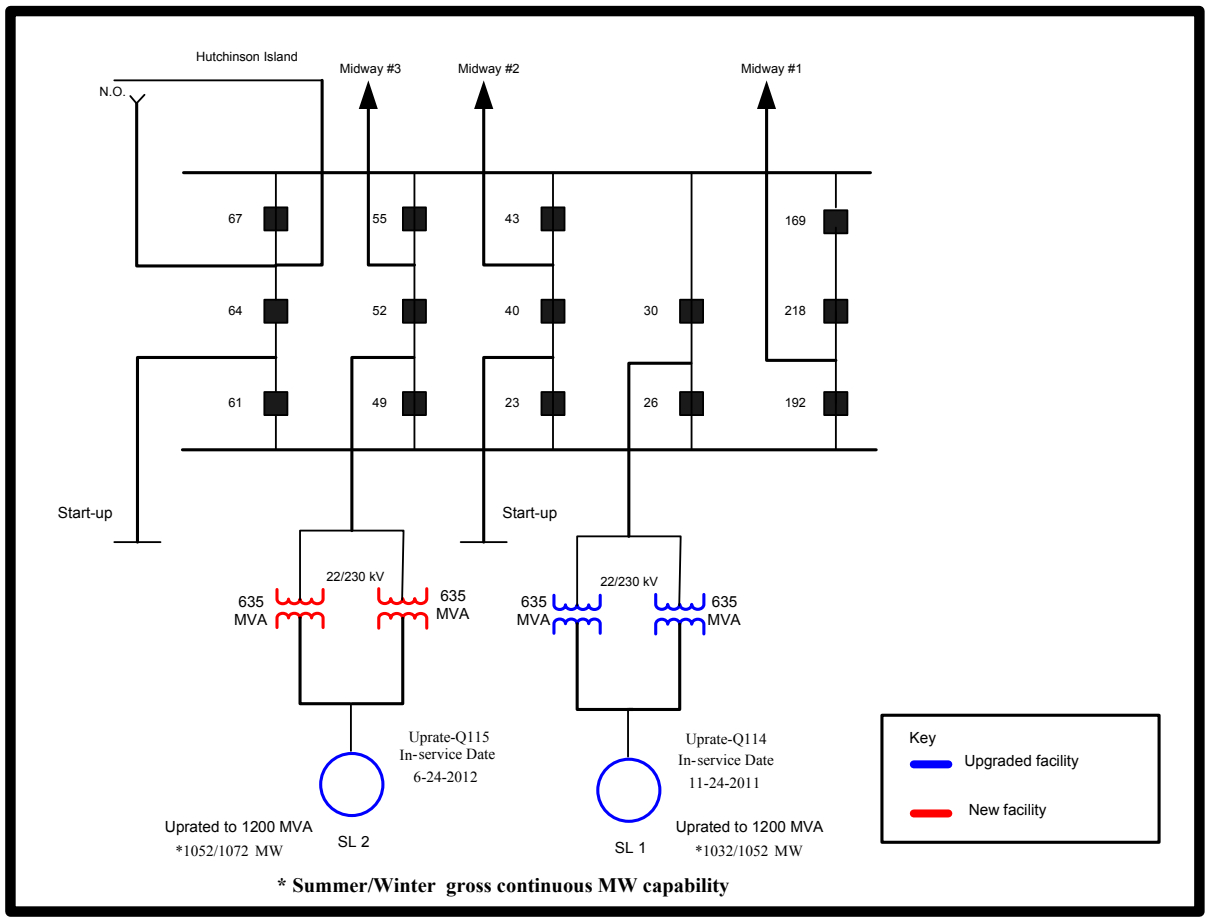
PURPOSE

Determine the transmission system additions/modifications to integrate SL2EPUP as an FPL Network Resource.

SUMMARY

- This project consists of one generating unit with a maximum potential cold winter gross continuous capability of 1072 MW and a June 2012 in-service date. See Figure C below.

Figure C – SL2EPUP – Q115



- The integration of SL2EPUP as an FPL network resource requires an increase in the thermal rating of the existing St. Lucie-Midway #1, St. Lucie-Midway #2, and St. Lucie-Midway #3 230 kV lines. Transmission line conductor ampacity of 3050A (185F/85C) for the 2X1691AAAC and 3395A (239F/115C) for the 3400ACSR is limited to 2790 A due to clearances. Therefore, the three St. Lucie-Midway line ratings will be increased from 2380A to 2790A.

METHODOLOGY:
The study was performed by conducting a single contingency power flow analysis. All systems elements 69kV or higher in the FRCC region were simulated for NERC Category A and B contingency scenarios. Overloads greater than 100% of a facility rating that is materially aggravated (more than 3%) when compared to the reference case or overloads that were not existing in the reference case, for the same contingency, are attributed to SL2EPUP. Similarly, low voltages, less than 0.95 p.u., that were materially lower (more than 2%) when compared to the reference case, for the same contingency, are attributed to SL2EPUP.

In addition, multiple contingencies were simulated for NERC Category C scenarios. The study was performed by conducting a multiple contingency power flow analysis. All systems elements 100kV or higher in the FPL East region were simulated for NERC Category C2, C3 and C5 contingency scenarios. Following the FRCC methodology of analyzing overloads greater than 130% for Category C3 and greater than 100% for Category C2 and C5 of a facility rating that is materially aggravated (more than 3%) when compared to the reference case or overloads that were not existing in the reference case, for the same contingency, are attributed to SL1EPUP or SL2EPUP. Similarly, low voltages, less than 0.90 p.u., that were materially lower (more than 2%) when compared to the reference case, for the same contingency, are attributed to SL1EPUP or SL2EPUP.

The latest available peak cases for the summer and winter of 2012 from the 2008 FRCC databank (FY08 Rev 3) with firm long-term contractual obligations were used to create base cases for the power flow analysis. These cases were updated to include the most up-to-date information on the FPL system (e.g., planned new transmission facilities and upgrades, committed new generation, confirmed transmission service obligations, etc.). The updated base cases were then modified to incorporate relevant preceding GIS requests and transmission service requests.
The Study Cases were derived from the aforementioned Base Cases while also modeling SL2EPUP. SL2EPUP is modeled as one steam generating unit with a maximum potential cold winter/summer gross capacity of 1072/1052MW.

Category B Results:
The results of the contingency power flow analysis show the following overloads as a result of SL2EPUP:

2012 Summer Case
No Overloads as a result of SL2EPUP

2012 Winter Case

Contingency	Violation	Overload (%)	Rating (MVA @ 230kV)	Comments	Loading w/ upgrade (%)
St. Lucie-Midway #2 230 kV	St. Lucie-Midway #1 230 kV	101.1	948	Need to upgrade	80.2
St. Lucie-Midway #1 230 kV	St. Lucie-Midway #2 230 kV	100.7	948	Need to upgrade	79.9

Slight differences in system impedances caused the St. Lucie-Midway #3 circuit to be loaded slightly below its thermal rating under contingency; however the line is recommended to be upgraded with the #1 and #2 circuits.

There were no low voltages observed that were materially lower (lower than 2%) due to the SL2EPUP.

Note that these results are based on the current FPL GIS and transmission service queue which includes requests preceding the SL2EPUP GIS request. To the extent that one or more of these requests are modified or withdrawn, the results presented in this analysis may no longer apply to this request and may change materially. FPL will advise SL2EPUP of any changes associated with preceding GIS requests that may require a re-study of the GIS request for the SL2EPUP.

Category C Results:

The results of the multiple contingency power flow analysis show that there were no Category C2 or C5 overloads of facilities that resulted from SL1EPUP or SL2EPUP. Also, no existing overloads in the cases were materially aggravated (more than 3%) due to the SL1EPUP or SL2EPUP. Similarly, there were no low voltages observed that were materially lower (lower than 2%) due to the SL1EPUP or SL2EPUP. Below are the results of the Category C3 contingency power flow analysis which indicate the following overloads as a result of SL1EPUP and SL2EPUP:

Category C3 Results:

Table 1 - Thermal Overloads for 2011 Winter Case

N-2 Contingency	Violation	Overload (%)	Rating (MVA @230kV)	% Loading prior to SL1EPUP	% Loading w/upgrade to 2790A	Comments
D:MIDWAY -ST LUCIE1 +MIDWAY -ST LUCIE2	MIDWAY - ST LUCIE 230 3	184.6	948	170.1	157.4	reduce generation at St. Lucie & increase generation in the Southeast
D:MIDWAY -ST LUCIE1 +MIDWAY -ST LUCIE3	MIDWAY - ST LUCIE 230 2	184.6	948	170.1	157.4	reduce generation at St. Lucie & increase generation in the Southeast
D:MIDWAY -ST LUCIE2 +MIDWAY -ST LUCIE2	MIDWAY - ST LUCIE 230 1	184.5	948	170.1	157.3	reduce generation at St. Lucie & increase generation in the Southeast

Table 2 - Thermal Overloads for 2012 Summer Case

N-2 Contingency	Violation	Overload (%)	Rating (MVA @230kV)	% Loading prior to SL2EPUP	% Loading w/upgrade to 2790A	Comments
D:MIDWAY -ST LUCIE1 +MIDWAY -ST LUCIE2	MIDWAY - ST LUCIE 230 3	198.7	948	182.1	169.5	reduce generation at St. Lucie & increase generation in the Southeast
D:MIDWAY -ST LUCIE1 +MIDWAY -ST LUCIE3	MIDWAY - ST LUCIE 230 2	198.6	948	182.1	169.5	reduce generation at St. Lucie & increase generation in the Southeast
D:MIDWAY -ST LUCIE2 +MIDWAY -ST LUCIE2	MIDWAY - ST LUCIE 230 1	198.6	948	182.0	169.5	reduce generation at St. Lucie & increase generation in the Southeast
D:EMERSON - NIGHTHAW1 +HARTMAN -F PIERCE1	HARTMAN - LAWNWOOD 69 1	136.9	92	133.1	-	Needs to be addressed by transmission owner
D:HARTMAN -F PIERCE1 +MIDWAY - NIGHTHAW1	HARTMAN - LAWNWOOD 69 1	140.9	92	137.1	-	Needs to be addressed by transmission owner
D:MIDWAY - NIGHTHAW1 +F PIERCE-INDRIO 1	HARTMAN - LAWNWOOD 69 1	133.3	92	129.6	-	Needs to be addressed by transmission owner

Category C3 contingencies allow for system adjustments to be performed after the first contingency in order to prepare for the second contingency. For the loss of one St. Lucie-Midway circuit, either an emergency rating for each circuit to be capable of carrying the two units at full output for a sufficient time that an operator could execute a mitigation plan prior to the line rating being exceeded, or a pre- contingency system adjustment (lowering out put of the generating units) after the first contingency will be required in order to maintain compliance with NERC Reliability Standards FAC-010, and TPL-003. This will necessarily require a revision to the Transmission and Substations Power Supply department's "St. Lucie-Midway Transmission Capacity and Plant Notification" procedure. The revised procedure will be reviewed by Power Supply Operations and coordinated with St.Lucie Plant management, as required under the POWER SYSTEMS AND ST LUCIE PLANT TRANSMISSION SWITCHYARD INTERFACE AGREEMENT.

CONCLUSION

Based on the current status of FPL's GIS queue and transmission service requests the following are the results of this part of the evaluation:

- The provision of NRIS for SL2EPUP requires an increase in the thermal rating of the existing St. Lucie-Midway #1, St. Lucie-Midway #2, and St. Lucie-Midway #3 230 kV lines. Transmission line conductor ampacity of 3050A (185F/85C) for the 2X1691AAAC and 3395A (239F/115C) for the 3400ACSR is limited to 2790 A due to clearances. Therefore, the three St. Lucie-Midway line ratings will be increased from 2380A to 2790A.

- The revised rating of the lines and increased output of the St. Lucie units will require modification of Transmission and Substations Power Supply department's "St. Lucie-Midway Transmission Capacity and Plant Notification" procedure (See Attachment 1 below). The requirement to revise the procedure will be reviewed by Power Supply Operations and coordinated with St.Lucie Plant management, as required under the POWER SYSTEMS AND ST LUCIE PLANT TRANSMISSION SWITCHYARD INTERFACE AGREEMENT.

Attachment 1

FPL
Power Supply

TITLE	PROCEDURE NUMBER
St. Lucie/Midway Transmission capability and Plant Notification	Nuke-5
	FILE NAME: Sys-Tran-Nuke-Plant notification
	DATE: 1/27/2007
	PAGE 1 OF 1

TO: Memo Book Holders
LOCATION: Miami, Florida

FROM: C. M. Mennes
DATE: March 26, 1992

SUBJECT: **ST. LUCIE/MIDWAY TRANSMISSION CAPACITY AND PLANT NOTIFICATION**
COPIES TO: D. A. Sager-PSL
G. J. Boissy-PSL

The System Operator must notify St. Lucie Plant of any changes to the status of the three Midway/St. Lucie 230kV lines.

In addition to immediate notification of status change, for the conditions listed the following actions shall be taken:

UNIT ON LINE	PRE-CONDITION # LINES IN SERVICE	POST CONDITION # LINES IN SERVICE	AMBIENT AIR TEMPERATURE AT ST. LUCIE/WPB	TIME FOR ACTION	ACTION
2 UNITS	2 LINES	1 LINE	Greater than 80°F	4 MIN	Drop plant output below 1000 MW
2 UNITS	2 LINES	1 LINE	Less than or equal to 80°F	9 MIN	Drop plant output below 1000MW
2 UNITS	3 LINES	1 LINE	Greater than 80°F	6.5 MIN	Drop plant output below 1000 MW
2 UNITS	3 LINES	1 LINE	Less than or equal to 80°F	11 MIN	Drop plant output below 1000 MW

Any time there are 2 units with 2 lines or 1 unit with 1 line the plant should be placed in alert and may require load reduction or trip of a unit.

St. Lucie plant must be notified on any changes to the line status out of the plant to and including Midway Substation. This would include line outages in the same bay as a PSL line at Midway, as a bus lockout would open the terminal. Also, any testing either at St. Lucie or Midway which may involve the power supply to the plant must be reported.

C. M. Mennes
Director
Power Supply

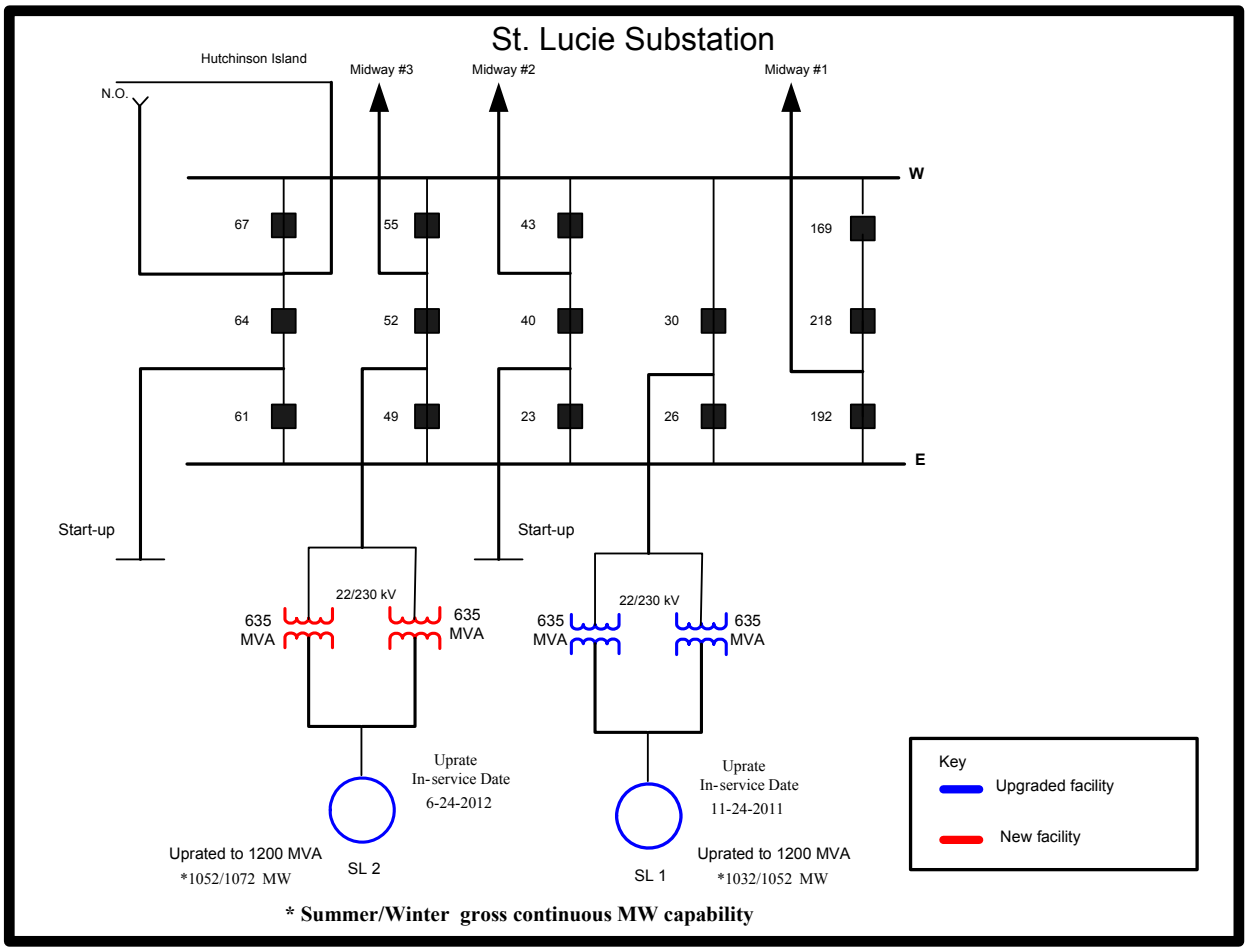
CMM/SJM/bk

APPENDIX III

DYNAMIC STABILITY ANALYSIS

SUMMARY:
A dynamic stability analysis was performed for the SL1EPUP and SL2EPUP (GIS # 114 & 115) as seen in figure A below. The study was performed for the maximum potential cold winter capability of 1052 MW gross for SL1EPUP and 1072 MW gross for SL2EPUP.

Figure A



ASSUMPTIONS:
Dynamic simulations were performed using the latest available 2012 summer peak base case at a peak load and off peak (50% of peak) load levels with existing commitments of all the companies in Florida. The study cases assumed the connection of the relevant GIS requests preceding the SL1EPUP AND SL2EPUP (and attendant incremental facilities for each such GIS request) in the base case that may have an impact on the SL1EPUP AND SL2EPUP stability.

In the study cases SL1EPUP AND SL2EPUP units (GIS #114 & 115), with the maximum potential cold winter capability of 1052 MW gross and 1072 MW gross respectively were

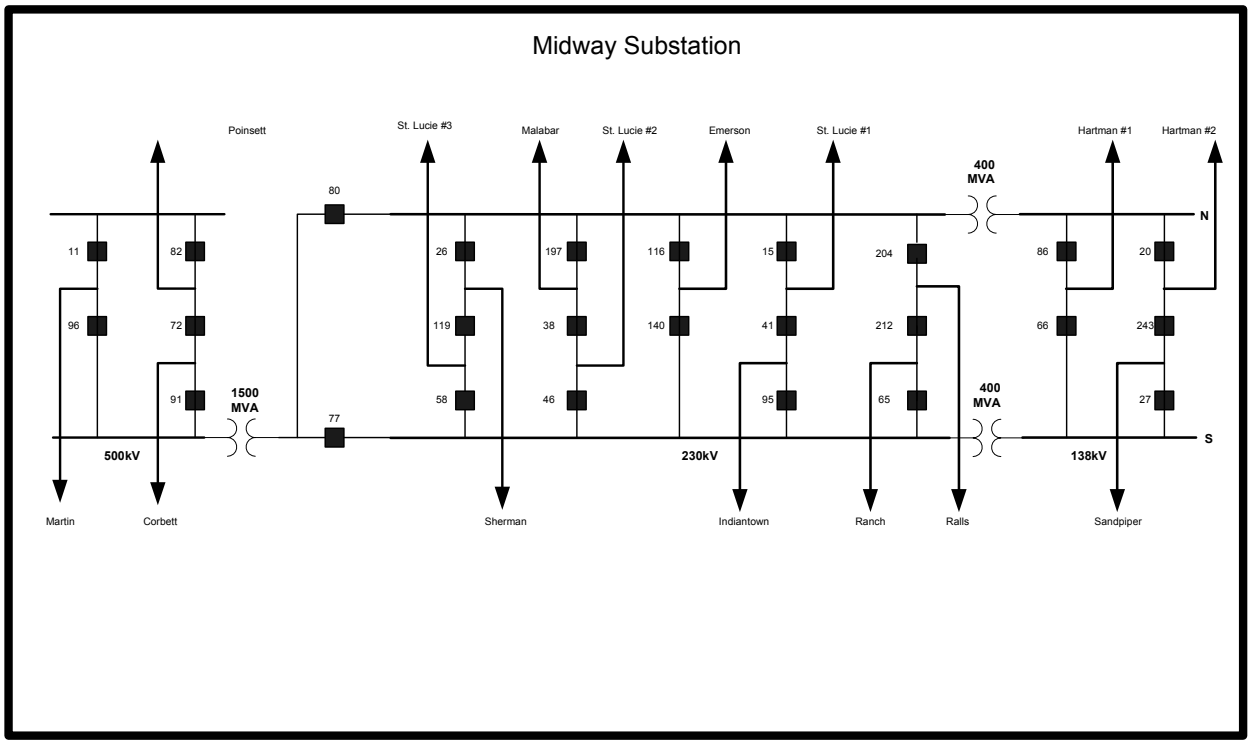
modeled at the St. Lucie site. Auxiliary loads of 49.14 MW, 33.7 MVAR and 49.48 MW, 32.8 MVAR were modeled at the SL1EPUP AND SL2EPUP units respectively.

Study case assumptions were selected to identify system performance under stressed but likely scenarios. Conditions more likely to occur at summer peak load and off peak load (approximately 50% of summer peak) were considered.

Normally cleared faults and delayed clearing faults due to breaker failure were simulated at the following locations:

1. St. Lucie 230kV substation (See figure A above)
2. Midway 230kV substation (See figure B below)

Figure B



Simulations of the faults in (1) and (2) above were intended to determine the acceptable clearing time at each substation based on breaker failure. Simulations of these faults were sufficient for the determination of the impact of the SL1EPUP AND SL2EPUP on the system stability. Disturbances electrically remote from the SL1EPUP AND SL2EPUP plant were not considered relevant as they may relate to this request. Midway and St. Lucie 230kV substations have redundant line, transformer and bus protection therefore simulation of relay failure is not required.

RESULTS:

Midway 230kV Substation

- The existing BFBU total clearing time at Midway 230kV substation of 9.9 cycles is adequate.
- Results of the dynamic simulations indicate acceptable performance for the most extreme NERC Category D event at Midway substation. The most severe fault at Midway substation is on the Midway 500/230kV auto with delayed clearing for breaker failure (See Ref. Table 1 case C11). Similar to the existing performance without the upgrades, the St. Lucie #1 and #2 units lose synchronism and trip after the fault is cleared however the transmission system remains stable, which is acceptable performance for the NERC Category D extreme event. It is recommended that all future breaker replacements at Midway 230kV substation use Independent Pole Operated breakers to improve system performance for extreme events. See Ref. Table 1 cases C11 & C11_ipo.

St. Lucie 230kV Substation

- The existing BFBU total clearing time at St. Lucie 230kV substation of 8.8 cycles is adequate.

- **Stabilizers are required for SL1EPUP AND SL2EPUP units to improve oscillations damping.** See Ref. Table 1 cases C11_ncl and C1_ncl_pss.

Table 1
2012 Summer Loading with SL1EPUP AND SL2EPUP

Run ID	Description	Peak Load	Off Peak Load
C11_ncl	3-pha fault at Midway 500/230kV Auto TX, At 3 cy open Auto TX & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 0 MW St. Lucie units have poorly damped oscillations, need to add PSS.
C11_ncl_pss	3-pha fault at Midway 500/230kV Auto TX, At 3 cy open Auto TX & clear fault. **PSS on at SL1 & SL2**	System Stable Loadshed 0 MW	System Stable Loadshed 0 MW St. Lucie units well damped with PSS.
C11	3-pha fault at Midway 500/230kV Auto TX, BRK 77 fails, At 3 cy open Auto TX, At 9.9 cy open S 230kV & 138kV bus breakers at Midway & clear fault.	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. Loadshed 845 MW	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. Loadshed 1347 MW
C11_ipo	3-pha fault at Midway 500/230kV Auto TX, BRK 77 fails, At 3 cy open Auto TX and convert fault to SLG,	System Stable Loadshed 0 MW	System Stable Loadshed 0 MW

Run ID	Description	Peak Load	Off Peak Load
	At 9.9 cy open S 230kV & 138kV bus breakers at Midway & clear fault. **Changed breakers to Independent Pole Operated breakers at Midway.**		
C11_slg	SLG fault at Midway 500/230kV Auto TX, BRK 77 fails, At 3 cy open Auto TX, At 9.9 cy open S 230kV & 138kV bus breakers at Midway & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 0 MW
C12	3-pha fault at Midway N 230kV Bus, BRK 15 fails, At 3 cy open all N 230kv & 138kV bus breakers tripping Midway 230/138kV N Auto TX, At 9.9 cy open BRK 41 tripping St. Lucie-Midway#1 230kV line & clear fault.	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. Loadshed 1503 MW	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. . Out of Step scheme at Ft. White splits Ft. White substation. Loadshed 1894 MW
C13	3-pha fault at Midway S 230kV Bus, BRK 65 fails, At 3 cy open all S 230kv & 138kV bus breakers tripping Midway 230/138kV S Auto TX, At 9.9 cy open BRK 212 tripping St. Midway-Ranch 230kV line & clear fault.	System Stable Loadshed 0 MW	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. Out of Step scheme at Ft. White splits Ft. White substation. Loadshed 1892 MW
C14	3-pha fault at Midway on Midway-Ralls 230kV line, Mid BRK 212 fails At 3 cy open Midway-Ralls line at Ralls, At 9.9 cy open Midway-Ranch line at Midway & clear fault at Midway 230kV. At 10.9 cy open Midway-Ranch at Ranch & clear fault on line.	System Stable Loadshed 0 MW	System stable following loss of synchronism by unstable St. Lucie #1 and #2 units. . Out of Step scheme at Ft. White splits Ft. White substation. Loadshed 1896 MW
C1	3-pha fault at St. Lucie on St. Lucie-Midway #1 230kV line. BRK 192 fails, At 4 cy open St. Lucie-Midway #1 at Midway. At 8.8 cy open E 230kV bus breakers at St. Lucie & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW
C2	3-pha fault at St. Lucie E 230kV Bus, BRK 192 fails, at 8.8 cy open BRK 218 tripping St. Lucie-Midway#1 230kV line & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW
C3	3-pha fault at St. Lucie on St. Lucie-Midway #2 230kV line. BRK 43 fails,	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW

Run ID	Description	Peak Load	Off Peak Load
	At 4 cy open St. Lucie-Midway #2 at Midway. At 8.8 cy open BRK 40 & clear fault.		
C4	3-pha fault at St. Lucie on St. Lucie-Midway #3 230kV line. BRK 52 fails, At 4 cy open St. Lucie-Midway #3 at Midway. At 8.8 cy open BRK 49 tripping St. Lucie Unit #2 & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW
C4a	3-pha fault at St. Lucie on St. Lucie-Midway #3 230kV line. BRK 55 fails, At 4 cy open St. Lucie-Midway #3 at Midway. At 8.8 cy open BRK 52 & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW
C5	3-pha fault at St. Lucie W 230kV Bus, BRK 43 fails, at 8.8 cy open BRK 40 tripping St. Lucie-Midway#2 230kV line & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW
C5a	3-pha fault at St. Lucie W 230kV Bus, BRK 55 fails, at 8.8 cy open BRK 52 tripping St. Lucie-Midway#3 230kV line & clear fault.	System Stable Loadshed 0 MW	System Stable Loadshed 423 MW

NOTE: All simulations were performed with Power System stabilizers on at St. Lucie #1 and #2 units, except for C11_ncl.

APPENDIX IV

SOUTHERN/FLORIDA TRANSMISSION INTERFACE ASSESSMENT

Based on current information, the largest unit in the Florida Reliability Coordinating Council (FRCC) region in the 2011-2012 timeframe will be the Progress Energy Florida Crystal River Nuclear Unit 3 which is currently planned to be uprated in 2011 to approximately 1070 MW gross output. The St.Lucie Unit #2 uprate is currently planned to increase the unit to 1072 MW maximum potential cold winter gross output. The size of the single largest generator in Peninsular Florida is a factor because the transmission system must be capable of sustaining the loss of that generator without violating any Reliability Standards. This requirement may have a direct impact on the import capability from the Southeast Electric Reliability Council (SERC).

PURPOSE:
The purpose of this portion of the FPL SL1EPUP and SL2EPUP System Impact Study is to determine if the increase in capacity of the existing St. Lucie unit 1 and St. Lucie unit 2 could adversely impact the Southern to Florida transfer capability and the Southern/Florida Transmission Interface. The import capability into Peninsular Florida from SERC is in large part determined by the contingency of the instantaneous loss of the largest unit in the FRCC, and the attendant sudden in-rush of power from the eastern United States interconnection reacting to replace such lost power source until additional generation is dispatched in the FRCC region.
The St. Lucie #2 unit, the larger of the two units, will now be 1052 MW summer gross output. Simulation of the outage of the St. Lucie #2 unit will be tested for the current Southern to Florida TTC level of 3600 MW in the summer. In addition, due to previously queued TSRs, a Southern to Florida TTC level of 4100 MW will also be tested for the outage of the St. Lucie #2 unit.

ASSUMPTIONS:
The transmission interface between the Southeastern Subregion of SERC and FRCC Regions ("SO/FL") is a multiple owner transmission interface that is governed by Reliability Coordination agreements and the Florida – Southern Transmission Interface Allocation Agreement Among Florida Power and Light Company, Florida Power Corporation, Jacksonville Electric Authority, and City of Tallahassee, and is currently limited to a total transfer capability ("TTC") of 3600 MW into the FRCC for summer conditions due to voltage security limitations associated with generating unit outage contingencies. FPL is currently performing studies for other interconnection and transmission service customers with higher queue priorities that have direct impacts on the SO/FL interface. At this time FPL has developed a series of transmission improvements that would increase the Southern to FRCC transfer capability from 3600 MW to 4100 MW in the 2012 timeframe, in order to accommodate these higher queued requests.

The 2012 summer peak load Joint Study case that was used for this year's Southern/Florida long term screening evaluations (performed for the Southern/Florida Reliability Coordination Agreement Planning Committee) was used as a base case to create the study cases for this analysis. The 4100 MW Southern to Florida transfer case includes previously identified transmission system improvements to accommodate the increase from 3600 MW. The improvements to increase the Southern/Florida transmission interface from 3600 MW to 4100 MW includes installing a +500/-100 MVAR SVC and an additional 482 MVAR of capacitor banks at Duval 500 kV substation and a 110 MVAR capacitor bank at Tocoi 230 kV substation.

FINDINGS:
Currently, based upon assessments performed by FPL, the sudden outage of a unit size of approximately 1,200MW gross output or less should not adversely impact the FRCC's import capability from SERC in this time frame. The assessments performed by FPL indicate that the addition of approximately 4700MW of generation in Southeast Florida (Turkey Point and West County Energy Center Combined Cycle units) and planned system upgrades in Northeast Florida will make the Southern/Florida transmission interface more robust and able to accommodate the outage of a larger generating unit within the FRCC Region.

The principal finding of this analysis is that the SL1EPUP and SL2EPUP projects will not adversely affect the current Southern to Florida transfer capabilities of 3600 in the 2012 timeframe. In addition, the 4100 MW transfer case also indicates acceptable performance for the outage of the St. Lucie #2 unit. Based on past studies for previously requested queued TSRs, the most severe contingency affecting the SO/FL interface at the increased transfer levels of 4100 MW is the outage of the Duval-Thalmann 500 kV tie line as opposed the near term studies at a 3600 MW SO/FL transfer level that shows the most severe outage being the loss of an 800 - 900 MW class generating unit outage in Florida.

APPENDIX V

Transmission Projects Assessment

TRANSMISSION PROJECTS
CONCEPTUAL SCOPE OF REQUIRED WORK
FOR UPRATE OF ST. LUCIE UNIT #1 & UNIT #2

The results delineated below may be subject to change based on a more detailed investigation or should unforeseen circumstances be encountered during the performance of the Facilities Study.

1. **SCOPE OF WORK (SUBSTATION)**

   This study addresses the scope of changes required to the FPL system for the uprates of St. Lucie Units 1 and 2 respectively. The interconnection configuration is as shown in the Transmission Planning portion of this System Impact Study.

   St. Lucie Switchyard

   The eighteen (18) 2500 amp, 230kV disconnect switches in generator bays #1 (8G34, 8G32, 8G31, 8G29, 8G27, 8G25), #2 (8G37,8G24,8G39,8G41,8G42,8G44), and #3 (8G48,8G50,8G51,8G53,8G54,8G56) must be replaced with 3000A switches.

   The switchyard pulloff structures have been evaluated. The field inspection has determined that improvements will not be required.

   A field inspection has been conducted to determine if improvements or replacements are required for the GSU dead end structures in the nuclear plant. The study has determined that the structures are sufficient without improvements.

   This study has been amended to include the requirements to uprate one of the GSUs removed from Unit 2 to install coolers so that the uprated GSU can be used as the spare.

   Midway 230kV Switchyard

   One (1) 2000 amp, 230kV breaker (8W95) in tie line bay #2 and eleven (11) 2000 amp, 230kV disconnect switches in tie line bays #4 (8G18, 8G14, 8G36, 8G40, 8G44, 8G48) and #5 (8G30, 8G28, 8G32, 8G54, 8G56) must be replaced with 3000A disconnect switches and a 230kV 63kA independent pole breaker. Additionally, the associated jumpers, bus work and equipment connections must be upgraded.

   GSU Transformers (Excluded from total cost.)

   The Unit 1A and 1B coolers and low side bushings on 1A, will be replaced to uprate the GSU transformers to 635 MVA. Coolers will be installed on the St. Lucie Spare to uprate it to 635 MVA so that it can be used to replace Unit 2A.

   A new 635 MVA GSU transformer purchase will be required for replacement of Unit 2B.

2. **SCOPE OF WORK (PROTECTION AND CONTROL)**

   This study evaluates the scope of changes required to the FPL transmission protection systems for the SL1EPUP and SL2EPUP unit uprate projects.

Relay Protection:

Midway – St. Lucie 230kV Line #1, #2, #3

There is no additional Protective Equipment required. The existing breaker failure protection is to be moved to a separate set of CTs as part of the breaker replacement of 8W95 at Midway. Protection and Control personnel will need to change the line protection CT ratio to 3000/5 on the #1 line at Midway. Protection and Control personnel will review and revise the line protection relay settings as needed.

Control & Reclosing:

There will be no change to the existing control and reclosing at St. Lucie or Midway Substations.

Metering & Data Acquisition:

No Changes.

3. SCOPE OF WORK (TRANSMISSION)

St. Lucie Switchyard

Transmission/Substation Engineering performed field measurements of the string bus conductor sag and temperature during the 2009 St. Lucie Unit 2 outage. The data acquired in the field was entered into PLSCADD to model the string busses. PLSCADD is a widely accepted computer program used in transmission line design. The model indicated that the string busses can operate at the proposed unit rating without modification.

St. Lucie – Midway 230kV Tie Lines

Spacers will need to be installed between the existing bundled phase conductors on the Midway-St. Lucie #1, #2 and #3 230kV lines. The distance of these lines is approximately 11.8 miles each. Each of the three St. Lucie lines has a normal (continuous) rating of 2380A. Following the upgrade, each of the lines will have a normal (continuous) rating of 2790 amps. In addition, the overhead ground wires outside of Midway will need to be tied together and the grounding will require improvements due to fault current requirements.

4. SCOPE OF WORK (OPERATIONS)

There will be requirements for various 230kV bus clearances. Timing of these clearances will be dependent upon many factors including but not limited to the time of year, maintenance requirements, other previously granted clearances, weather, telecommunication traffic/contracts and system load conditions.

Clearances are reviewed on a daily basis and may be cancelled or delayed due to reliability considerations associated with the factors listed above. Such cancellations or delays associated with planned clearances will be considered unavoidable and may affect the scheduled completion of requirements associated with this project which in turn may delay the in-service date as well as impact the total cost of the project.

TOTAL UPRATE PROJECT COST

The total non-binding, good faith estimate to upgrade the existing FPL Transmission System to accommodate the uprate, excluding the GSU improvements, is **$11.5 Million**. This estimate includes the permitting, engineering and installation of all equipment and materials, labor and vehicle associated with the work to be performed by FPL as described within this study report.

The estimates shown for Unit #1 are escalated to 2011 dollars and the estimates for Unit #2 are escalated to 2012 dollars. In addition, labor, material and equipment costs are subject to change depending upon market conditions and delivery schedules. Labor costs are based upon contractors performing the work under FPL supervision.

The estimated duration to engineer, permit, acquire material and construct the FPL scope of work described herein is 24 months from the date of authorization to proceed.