System Impact Study Report
PID 222
570MW Plant

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0	12/23/08	Posted	HDE	JDH
1	8/29/11	Revised to include Addendum A for Material Modification Evaluation	EC	BR

Contents

Executive Summary:

This System Impact Study is the second step of the interconnection process and is based on the PID-222 request for interconnection on Entergy's transmission system at the Ninemile substation. This report is organized in two sections, namely, Section – A, Energy Resource Interconnection Service (ERIS) and Section – B, Network Resource Interconnection Service (NRIS – Section B).

The Scope for the ERIS section (Section – A) includes load flow (steady state) analysis, transient stability analysis and short circuit analysis as defined in FERC orders 2003, 2003A and 2003B. The NRIS section (Section – B) contains details of load flow (steady state) analysis only, however, transient stability analysis and short circuit analysis of Section – A are also applicable to Section – B. Additional information on scope for NRIS study can be found in Section – B.

Requestor for PID-222 did request NRIS, but did not request ERIS, therefore, under Section - A (ERIS) a load flow analysis was not performed. PID 222 is a modification to an existing facility. PID 222 intends to install (1) steam turbine at the 230 kV Ninemile substation and replace (2) combustion turbines at the 115 kV Ninemile substation. The study evaluates connection of 570 MW to the Entergy Transmission System. The load flow study was performed on the latest available 2015 Summer Peak case, using PSS/E and MUST software by Siemens Power Technologies International (Siemens-PTI). The short circuit study was performed on the Entergy system short circuit model using ASPEN software. The proposed in-service date for NRIS is October 1, 2012.

Results of the System Impact Study contend that under NRIS, the estimated upgrade cost with priors is $231,735,900+TBD and without priors is $355,244,865.

Estimated Project Planning Upgrades for PID 222

Study	Estimated cost With Priors ($)	Estimated cost Without Priors ($)
NRIS	$231,735,900+TBD	$355,244,865

The costs of the upgrades are planning estimates only. Detailed cost estimates, accelerated costs and solutions for the limiting elements will be provided in the facilities study.

Section – A: Energy Resource Interconnection Service

I. Introduction

This Energy Resource Interconnection Service (ERIS) is based on the PID 222 request for interconnection on Entergy's transmission system at the Ninemile substation. The objective of this study is to assess the reliability impact of the new facility on the Entergy transmission system with respect to the steady state and transient stability performance of the system as well as its effects on the system's existing short circuit current capability. It is also intended to determine whether the transmission system meets standards established by NERC Reliability Standards and Entergy's planning guidelines when the plant is connected to Entergy's transmission system. If not, transmission improvements will be identified.

The System Impact Study process required a load flow analysis to determine if the existing transmission lines are adequate to handle the full output from the plant for simulated transfers to adjacent control areas. A short circuit analysis was performed to determine if the generation would cause the available fault current to surpass the fault duty of existing equipment within the Entergy transmission system. A transient stability analysis was conducted to determine if the new units would cause a stability problem on the Entergy system.

II. Short Circuit Analysis / Breaker Rating Analysis

Model Information

The short circuit analysis was performed on the Entergy system short circuit model using ASPEN software. This model includes all generators interconnected to the Entergy system or interconnected to an adjacent system and having an impact on this interconnection request, IPP's with signed IOAs, and approved future transmission projects on the Entergy transmission system including the proposed PID 222 unit.

Short Circuit Analysis

The method used to determine if any short circuit problems would be caused by the addition of the PID 222 generation is as follows:

1. Three phase and single phase to ground faults were simulated on the Entergy base case short circuit model and the worst case short circuit level was determined at each station. The PID 222 generator as well as the necessary NRIS upgrades shown in Section B, IV were then modeled in the base case to generate a revised short circuit model. The base case short circuit results were then compared with the results from the revised model to identify any breakers that were under-rated as a result of additional short circuit contribution from PID 222 generation. The breakers identified to be upgraded through this comparison are *mandatory* upgrades.

Analysis Results

The results of the short circuit analysis indicates that the additional generation due to PID-216 generator causes an increase in short circuit current such that they exceed the fault interrupting capability of the high voltage circuit breakers within the vicinity of the PID-216 plant with priors and without priors. The priors included 213, 211, 215, 217, & 220.

Table I: Underrated Breakers Without Priors Included

Substation	Breaker	Duty % w/o PID 222	Max Fault w/o PID-222 (amps)	Duty % w/ PID 222	Max Fault with PID-222 (amps)	Interrupting Rating (amps)
Michoud 115 kV	9803	97.9	49164	102.9	51656	50205

Table II: Underrated Breakers With Priors Included

Substation	Breaker	Duty % w/o PID 222	Max Fault w/o PID-222 (amps)	Duty % w/ PID 222	Max Fault with PID-222 (amps)	Interrupting Rating (amps)
Waterford 230 kV	6975	98.6	78896	100.7	80598	80000
Michoud 115 kV	9803	97.9	49163	102.9	51656	50205

Problem Resolution

Table III illustrates the station name, and the cost associated with upgrading the breakers at each station both for mandatory and optional breaker upgrades.

Substation	Number of Breakers	New Breaker Rating (amps)	Estimated cost of Breaker Upgrades ($)
Michoud	1	63000	$285,900*
Waterford	1	TBD	TBD

* Price based on 145 kV Breaker

III. Load Flow Analysis

No load flow analysis performed due to generator not requesting ERIS.

IV. Stability Analysis

1. Model Information

When the Transient Stability Analysis for PID-222 was performed the most realistic model available for the Entergy system was 2015 summer peak load conditions. Beyond the year 2015, the models will involve a number of uncertain projects and upgrades. Hence, the dynamic database representing 2015 summer peak load conditions was used in this analysis. The analysis was carried out on the power flow case without the upgrades identified for PID-222 in either the Power Flow or Short-Circuit analysis. The reason for not including the upgrades identified in the Power Flow and Short Circuit analysis was, if the system was stable without the required upgrades the system performance would only improve with the upgrades. Figures 1V-1, 1V-1A and 1V-2 show the current configuration of the Nine Mile 230 and 115 kV Switching Stations (SS). Figure 1V-3 shows the configuration of the Nine Mile 230 kV Switching Station (SS) after the addition of 1 – 230/18 kV transformer and a 211 MW Steam generator. Figure 1V-4 shows the configuration of the Nine Mile 115 kV Switching Station (SS) after the addition of 2 - 115/18 kV transformers and 2 - 179 MW – Combustion Turbine generators. Existing Units 1 and 2 on the 115 kV bus will be replaced by the PID222 units studied here.

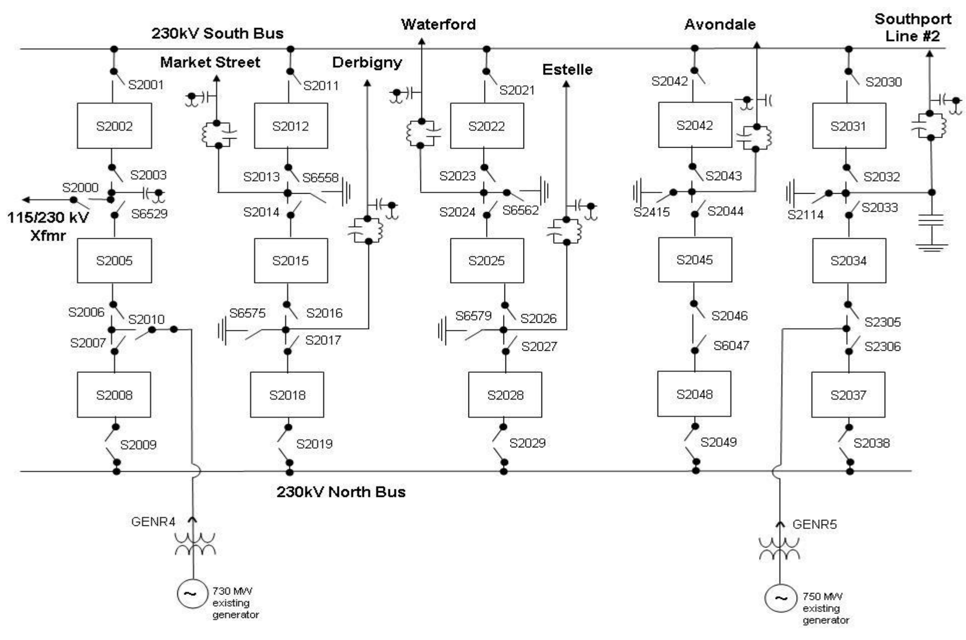

Figure 1V-1: Transmission configuration at Nine Mile 230 kV without PID-222.

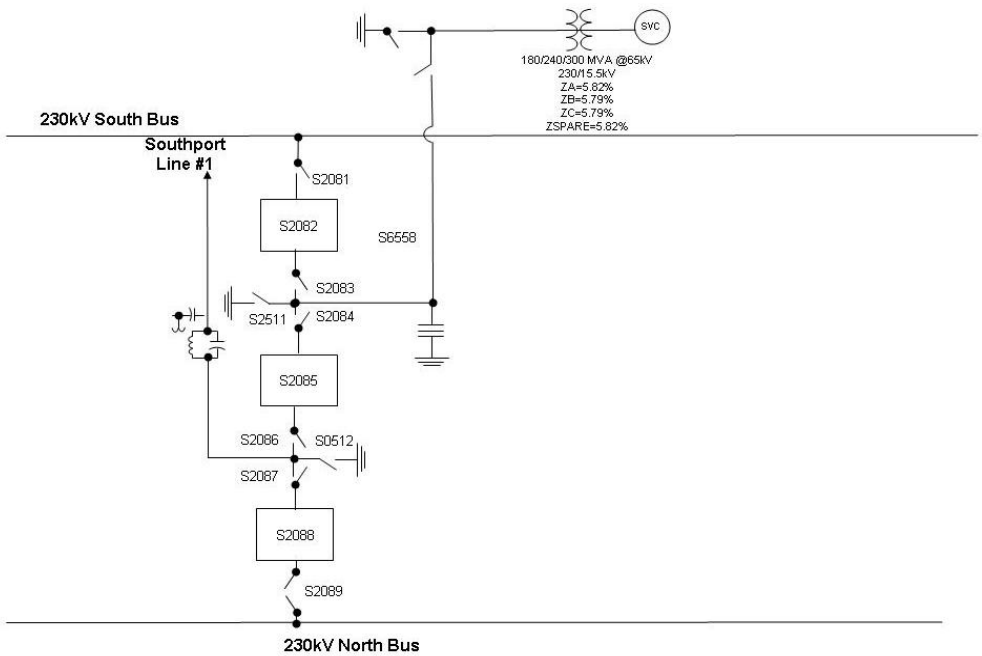

Figure 1V-1A: Transmission configuration at Nine Mile 230 kV without PID-222 cont.

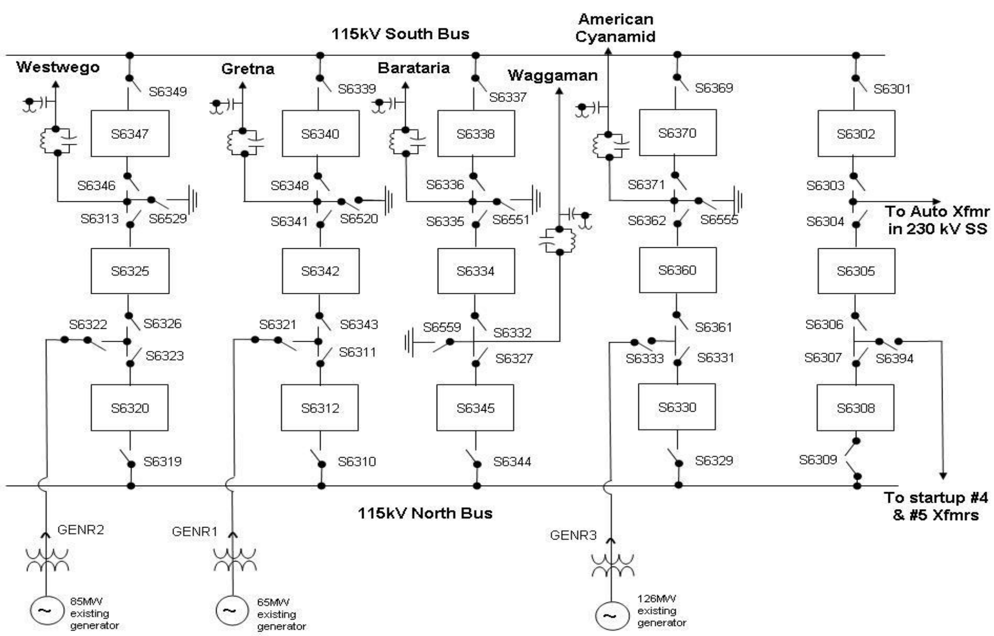

Figure 1V-2: Transmission configuration at Nine Mile 115 kV without PID-222.

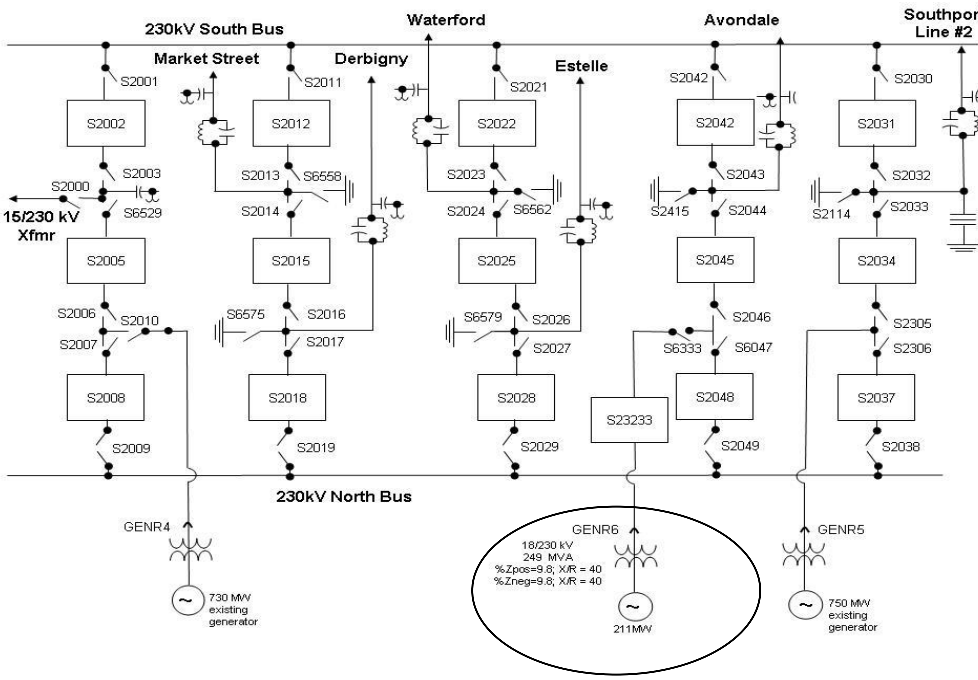

Figure 1V-3: Transmission configuration at Nine Mile 230 kV with PID-222.

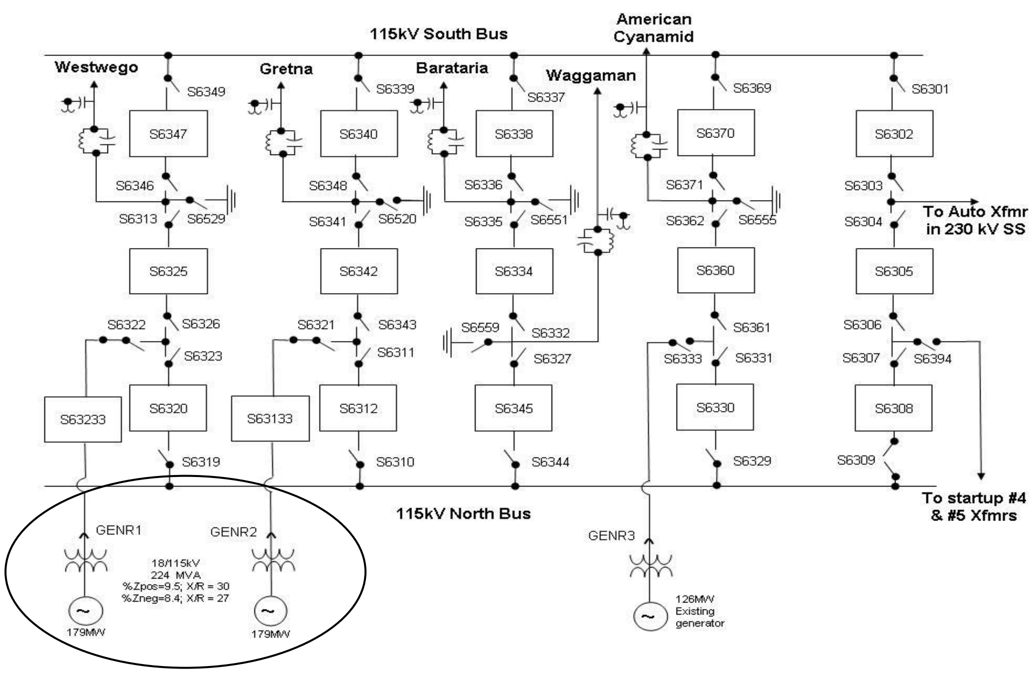

Figure 1V-4: Transmission configuration at Nine Mile 115 kV with PID-222.

The new PID-222 generators were added to the model via a new 230/18 kV transformer and a new 115/18 kV transformer connecting to the existing Nine Mile S.E.S. 230 and 115 kV buses. The new generators at the 115 kV replace the existing generation, which is being retired. Refer to Figure 1V-5 for the System Area Study diagram. The stability studies were conducted to assess the impact of PID-222 injecting 569 MW of power into Entergy's system. The loads in the Entergy system were represented as follows: for the active part, 100% was modeled with a constant current model; for the reactive part 100% was modeled with a constant impedance model.

PID-222 provided dynamic models of their generation equipment for use in this study. The generators were modeled using the standard PSS/E **GENROU** model.

PID-222 also provided data for the excitation system. The data for the PID-222 Steam turbine and Combustion turbine excitation systems were modeled using the PSS/E **ESST4B** model. The Power System Stabilizer (PSS) data was provided with the interconnection request. The PSS was modeled using the PSS/E **PSS2A** model. PID-222 provided the data for the turbine-governor controls. The Steam and Combustion turbine generators governor model were modeled using the PSS/E IEEEG1 model. The data used for the proposed PID-222 generators, exciters, power system stabilizers and governor models are shown in **Appendix A.A.**

SYSTEM STUDY AREA

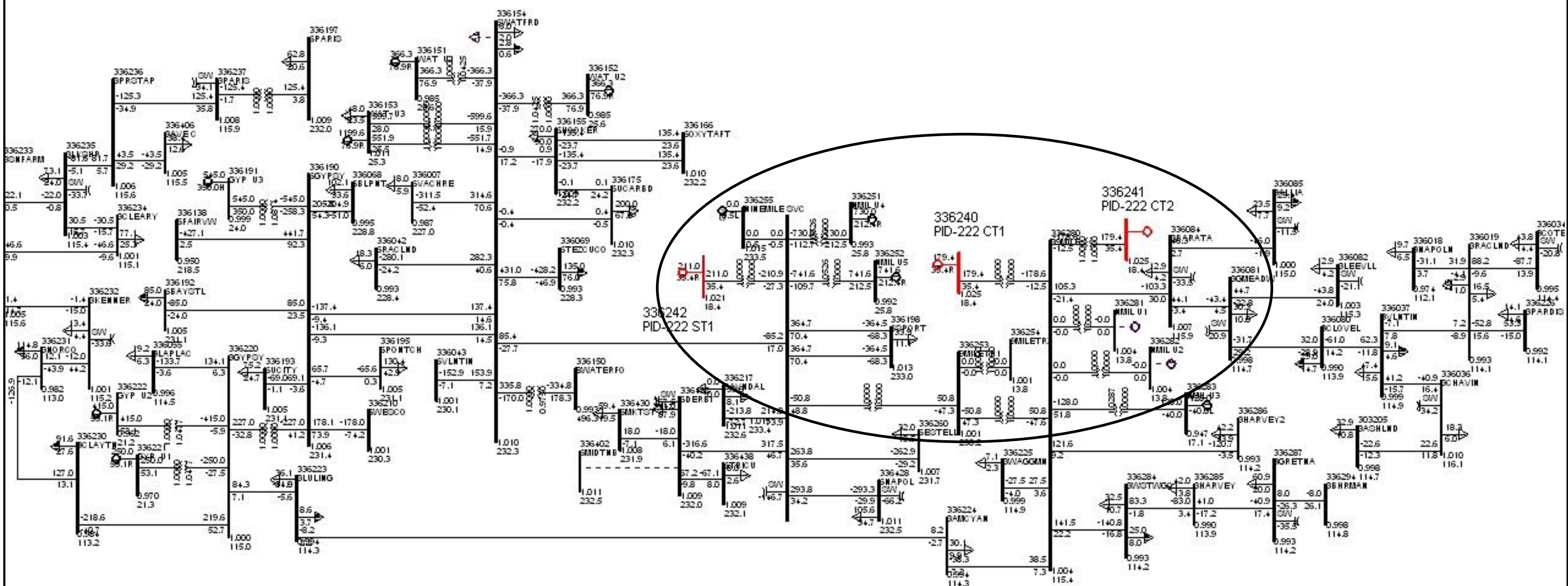

Figure IV-5: System Study Area

Transient Stability Analysis

Stability simulations were run to examine the transient behavior of the PID-222 generators and their effect on the Entergy system. The stability analysis was performed using the following procedure. Three-phase faults with normal clearing time and three-phase faults with delayed clearing times were simulated on the transmission lines connected to the Nine Mile 230 and 115 kV switching station. In addition three-phase faults with single pole circuit breaker failure were simulated on select cases involving IPO (Independent Pole Operated) circuit breakers. The stability analysis was performed using the PSS/E dynamics program. The fault clearing times used for the simulations are given in Table IV-1.

Table IV-1 Fault Clearing Times

Contingency at kV level	Normal Clearing	Delayed Clearing
230	6 cycles	6+9 cycles
115	6 cycles	6+9 cycles
230 3-1 Phase	6 cycles	6+9 cycles

The breaker failure scenarios were simulated with the following sequence of events:

1) At the normal clearing time for the primary breakers, the faulted line is tripped at the far end from the fault by normal breaker opening.

2) The fault remains in place for three-phase stuck-breakers. For single-phase stuck breakers (IPO) conditions the fault impedance is appropriately adjusted to account for the line trip of step 1.

3) The fault is then cleared by back-up clearing. If the system is shown to be unstable for this condition, then stability of the system without the PID-222 plant needs to be verified.

All line trips are assumed to be permanent (i.e. no high speed re-closure).

The stability analysis was performed using the PSS/E dynamics program, which only simulates the positive sequence network. Unbalanced faults involve the positive, negative, and zero sequence networks. For unbalanced faults, the equivalent fault admittance must be inserted in the

PSS/E positive sequence model between the faulted bus and ground to simulate the effect of the negative and zero sequence networks. For a single-line-to-ground (SLG) fault, the fault admittance equals the inverse of the sum of the positive, negative and zero sequence Thevenin impedances at the faulted bus. Since PSS/E inherently models the positive sequence fault impedance, the sum of the negative and zero sequence Thevenin impedances needs to be added and entered as the fault impedance at the faulted bus. Note: Three phase faults with single pole circuit breaker failure were simulated for selected cases, and reported on in Table IV-2C.

For three-phase faults, a fault admittance of –j2E9 is used (essentially infinite admittance or zero impedance).

Table IV-2A, Table IV-2B and Table IV-2C list all the fault cases that were simulated one the 230 kV system in this study. Table IV-3A and Table IV-3B list all the fault cases that were simulated on the 115 kV system in this study. Fault scenarios were formulated by examining the system configuration shown in Figures IV-1A, IV-3 and IV-4.

For the 230 kV bus, faults 1 through 12 of Table IV-2A represent the normal clearing 3-phase faults. Faults 1A through 12B of Table IV-2B represent 3 phase faults with stuck breakers conditions with the appropriate delayed back-up clearing times and Table IV-2C, 1AP through 3BP represent 3 phase faults with single pole circuit beaker failure.

For the 115 kV bus, faults 1 through 9 of Table IV-3A represent the normal clearing 3-phase faults. Faults 1A through 9B of Table IV-3B represent 3 phase faults with stuck breakers with the appropriate delayed back-up clearing times

For all cases analyzed, the initial disturbance was applied at t = 0.1 seconds. The breaker clearing was applied at the appropriate time following this fault inception.

Table IV-2A Fault Cases Simulated in this Study: 3 phase Faults with Normal Clearing 230 kV BUS

FAULT REF. NO.	CASE	Prior Outage Element	LOCATION	TYPE	Clearing Time (cy)	PRIMARY BRK TRIP #	TRIPPED FACILITIES	Stable	Acceptable Voltages
1	FAULT-115/230 kV XFMR	--	NINE MILE 230 kV	3PH	6	S2002/S2005	NINE MILE – 115/230 kV XFM4	YES	YES
2	FAULT-MARKET STREET	--	NINE MILE 230 kV	3PH	6	S2012/S2015	NINE MILE –MARKET STREET	YES	YES
3	FAULT-DERBIGNY	--	NINE MILE 230 kV	3PH	6	S2015/S2018	NINE MILE - DERBIGNY	YES	YES
4	FAULT-WATERFORD	--	NINE MILE 230 kV	3PH	6	S2022/S2025	NINE MILE - WATERFORD	YES	YES
5	FAULT-ESTELLE	--	NINE MILE 230 kV	3PH	6	S2025/S2028	NINE MILE – ESTELLE	YES	YES
6	FAULT-AVONDALE	--	NINE MILE 230 kV	3PH	6	S2042/S2044	NINE MILE - AVONDALE	YES	YES
7	FAULT-SOUTHPORT LINE #1	--	NINE MILE 230 kV	3PH	6	S2082/S2085	NINE MILE – SOUTHPORT LINE #1	YES	YES
8	FAULT-SOUTHPORT LINE #2	--	NINE MILE 230 kV	3PH	6	S2031/S2034	NINE MILE – SOUTHPORT LINE #2	YES	YES
9	FAULT-GENR4	--	NINE MILE 230 kV –GENR4	3PH	6	S2008/S2005	NINE MILE GENR4	YES	YES
10	FAULT-GENR5	--	NINE MILE 230 kV –GENR5	3PH	6	S2037/S2034	NINE MILE GENR5	YES	YES
11	FAULT-GENR6	--	NINE MILE 230 kV –GENR6	3PH	6	S23223/S2045 S2048	NINE MILE GENR6	YES	YES
12	FAULT-SVC	--	NINE MILE 230 kV	3PH	6	S2082/S2085	NINE MILE SVC	YES	YES

Table IV-2B Fault Cases Simulated in this Study: Faults with Stuck Breaker Conditions 230 kV BUS

REF. NO.	CASE	LOCATION	TYPE	CLEARING TIME (cycles)		STUCK BRK #	PRIMARY (Normal) BRK TRIP #	SECONDARY BRK (Backup) TRIP	TRIPPED FACILITIES	Stable	Acceptable Voltage
				PRIMARY	Back-up						
1A	FAULT-230/115 kV XFMR_SB	NINE MILE 230 kV	3PH*	6	9	S2002	S2005	S2012 S2022/S2042 S2031/S2082	NINE MILE -230/115 kV XFMR	YES	YES
1B	FAULT-230/115 kV XFMR_SB	NINE MILE 230 kV	3*PH	6	9	S2005	S2002	S2008	NINE MILE – 230/115 kV XFMR NINE MILE – GENR4	YES	YES
2A	FAULT-MARKET STREET_SB	NINE MILE 230 kV	3PH	6	9	S2012	S2015	S2002/ S2022S2042 S2031/S2082	NINE MILE – MARKET STREET	YES	YES
2B	FAULT-MARKET STREET_SB	NINE MILE 230 kV	3PH	6	9	S2015	S2012	S2018	NINE MILE – MARKET STREET NINE MILE - DERBIGNY	YES	YES
3A	FAULT-DERBIGNY_SB	NINE MILE 230 kV	3PH	6	9	S2018	S2015	S2008 S2028/S2048 S2037/S2088	NINE MILE – DERBIGNY	YES	YES
3B	FAULT-DERBIGNY_SB	NINE MILE 230 kV	3PH	6	9	S2015	S2018	S2012	NINE MILE - DERBIGNY NINE MILE – MARKET STREET	YES	YES
4A	FAULT-WATERFORD_SB	NINE MILE 230 kV	3PH	6	9	S2022	S2025	S2002 S2012/S2042 S2031/S2082	NINE MILE - WATERFORD	YES	YES
4B	FAULT-WATERFORD_SB	NINE MILE 230 kV	3PH	6	9	S2025	S2022	S2028	NINE MILE – WATERFORD NINE MILE – ESTELLE	YES	YES
5A	FAULT-ESTELLE_SB	NINE MILE 230 kV	3PH	6	9	S2028	S2025	S2008 S2018/S2048 S2037/S2088	NINE MILE - ESTELLE	YES	YES
5B	FAULT-ESTELLE_SB	NINE MILE 230 kV	3PH	6	9	S2025	S2028	S2022	NINE MILE – ESTELLE NINE MILE – WATERFORD	YES	YES
6A	FAULT-AVONDALE_SB	NINE MILE 230 kV	3PH	6	9	S2042	S2045	S2002 S2012/S2022 S2031/S2082-	NINE MILE – AVONDALE	YES	YES
6B	FAULT-AVONDALE_SB	NINE MILE 230 kV	3PH	6	9	S2045	S2042	S2048	NINE MILE – AVONDALE NINE MILE – GENR6	YES	YES

* Three phase fault with single pole circuit breaker failure also simulated and reported on in Table 1V-2C.

Table IV-2B Cont. Fault Cases Simulated in this Study: Faults with Stuck Breaker Conditions 230 kV BUS

REF. NO.	CASE	LOCATION	TYPE	CLEARING TIME (cycles)		STUCK BRK #	PRIMARY (Normal) BRK TRIP #	SECONDARY BRK (Backup) TRIP	TRIPPED FACILITIES	Stable	Acceptable Voltages
				PRIMARY	Back-up						
7A	FAULT-SOUTHPORT LINE #1_SB	NINE MILE 230 kV	3PH*	6	9	S2088	S2034	S2002 S2012/S2022 S2042/S2031	NINE MILE – SOUTHPORT LINE #1	YES	YES
7B	FAULT-SOUTHPORT LINE #1_SB	NINE MILE 230 kV	3PH*	6	9	S2085	S2082	S2088	NINE MILE – SOUTHPORT LINE #1 NINE MILE – SVC	YES	YES
8A	FAULT-SOUTHPORT LINE #2_SB	NINE MILE 230 kV	3PH	6	9	S2031	S2034	S2002 S2012/S2022 S2042/S2082	NINE MILE – SOUTHPORT LINE #2	YES	YES
8B	FAULT-SOUTHPORT LINE #2_SB	NINE MILE 230 kV	3PH	6	9	S2034	S2031	S2037	NINE MILE – SOUTHPORT LINE #2 NINE MILE – GENR5	YES	YES
9A	FAULT-GENR4_SB	NINE MILE 230 KV	3PH*	6	9	S2008	S2005	S2018 S2028/S2048 S2037/S2088	NINE MILE – GENR4	YES	YES
9B	FAULT-GENR4_SB	NINE MILE 230 KV	3PH*	6	9	S2005	S2008	S2002	NINE MILE – GENR4 NINE MILE – 115/230 kV XFMR	YES	YES
10A	FAULT-GENR5_SB	NINE MILE 230 Kv	3PH	6	9	S2037	S2034	S2008/S2018 S2028/S2048 S2088	NINE MILE – GENR5	YES	YES
10B	FAULT-GENR5_SB	NINE MILE 230 KV	3PH	6	9	S2034	S2037	S2031	NINE MILE – GENR5 NINE MILE – SOUTHPORT LINE #2	YES	YES
11A	FAULT-GENR6_SB	NINE MILE 230 kV	3PH	6	9	S2048	S2045	S2008 S2018/S2028 S2037/S2088	NINE MILE – GENR6	YES	YES
11B	FAULT-GENR6_SB	NINE MILE 230 kV	3PH	6	9	S2045	S2048	S2042	NINE MILE – GENR6 NINE MILE – AVONDALE	YES	YES
12A	FAULT-SVC GENR	NINE MILE 230 kV	3PH*	6	9	S2082	S2085	S2031 S2042/S2022 S2012/S2002	NINE MILE – SVC GENR	YES	YES
12B	FAULT-SVC GENR	NINE MILE 230 kV	3PH*	6	9	S2085	S2082	S2088	NINE MILE – SVC GENR NINE MILE – SOUTHPORT LINE #1	YES	YES

***** Three phase fault with single pole circuit breaker failure also simulated and reported on in Table 1V-2C.

Table IV-2C Fault Cases Simulated in this Study: Faults with Stuck Breaker Conditions 230 kV BUS (Single Pole Circuit Breaker Failure)

REF. NO.	CASE	LOCATION	TYPE	CLEARING TIME (cycles)		STUCK BRK #	PRIMARY (Normal) BRK TRIP #	SECONDARY BRK (Backup) TRIP	TRIPPED FACILITIES	Stable	Acceptable Voltages
				PRIMARY	Back-up						
1AP	FAULT-115/230 kV XFMR_SB	NINE MILE 230 kV	3PH-1PH	6	9	S2002	S2005	S2012 S2022/S2042 S2031/S2082	NINE MILE - 115/230 kV XFMR	YES	YES
1BP	FAULT-115/230 kV XFMR_SB	NINE MILE 230 kV	3PH-1PH	6	9	S2005	S2002	S2008	NINE MILE – 115/230 kV XFMR NINE MILE – GENR4	YES	YES
2AP	FAULT-SVC	NINE MILE 230 kV	3PH-1PH	6	9	S2082	S2085	S2031 S2042/S2022 S2012/S2002	NINE MILE – SVC	YES	YES
2BP	FAULT-SVC	NINE MILE 230 kV	3PH-1PH	6	9	S2085	S2082	S2088	NINE MILE – SVC NINE MILE – SOUTHPORT LINE #1	YES	YES
3AP	FAULT-GENR4_SB	NINE MILE 230 Kv	3PH-1PH	6	9	S2088	S2005	S2018 S2028/S2048 S2037/S2088	NINE MILE – GENR4	YES	YES
3BP	FAULT-GENR4_SB	NINE MILE 230 Kv	3PH-1PH	6	9	S2005	S2008	S2002	NINE MILE – GENR4 NINE MILE – 115/230 kV XFMR	YES	YES

NOTE: Bay 1 and Bay 6 of Nine Mile 230 kV SS are Independent Pole Operated Breakers.

Table IV-3A Fault Cases Simulated in this Study: 3 phase Faults with Normal Clearing 115 kV BUS

FAULT REF. NO.	CASE	Prior Outage Element	LOCATION	TYPE	Clearing Time (cy)	PRIMARY BRK TRIP #	TRIPPED FACILITIES	Stable	Acceptable Voltages
1	FAULT-WESTWEGO	--	NINE MILE 115 kV	3PH	6	S6347/S6325	NINE MILE - WESTWEGO	YES	YES
2	FAULT-GRETNA	--	NINE MILE 115 kV	3PH	6	S6340/S6342	NINE MILE -GRETNA	YES	YES
3	FAULT-BARATARIA	--	NINE MILE 115 kV	3PH	6	S6338/S6334	NINE MILE - BARATARIA	YES	YES
4	FAULT-WAGGAMAN	--	NINE MILE 115 kV	3PH	6	S6334/S6345	NINE MILE - WAGGAMAN	YES	YES
5	FAULT-AMERICAN CYANAMID	--	NINE MILE 115 kV	3PH	6	S6370/S6360	NINE MILE – AMERICAN CYANAMID	YES	YES
6	FAULT-GENR1	--	NINE MILE 115 kV -GENR1	3PH	6	S63233/S6325 S6320	NINE MILE GENR1	YES	YES
7	FAULT-GENR2	--	NINE MILE 115 kV -GENR2	3PH	6	S63133/S6312 S6342	NINE MILE GENR2	YES	YES
8	FAULT-GENR3	--	NINE MILE 115 kV –GENR3	3PH	6	S6330/S6360	NINE MILE GENR3	YES	YES
9	FAULT-115/230 kV XFMR	--	NINE MILE 115 kV –115/230 kV	3PH	6	S6302/S6305	NINE MILE 115/230 kV XFMR	YES	YES

Table IV-3B Fault Cases Simulated in this Study: Faults with Stuck Breaker Conditions 115 kV BUS

REF. NO.	CASE	LOCATION	TYPE	CLEARING TIME (cycles)		STUCK BRK #	PRIMARY (Normal) BRK TRIP #	SECONDARY BRK (Backup) TRIP	TRIPPED FACILITIES	Stable	Acceptable Voltages
				PRIMARY	Back-up						
1A	FAULT-WESTWEGO_SB	NINE MILE 115 kV	3PH	6	9	S6347	S6325	S6340/S6338 S6370/S6302	NINE MILE - WESTWEGO	YES	YES
1B	FAULT-WESTWEGO_SB	NINE MILE 115 kV	3PH	6	9	S6325	S6347	S6320	NINE MILE – WESTWEGO NINE MILE – GENR1	YES	YES
2A	FAULT-GRETNA_SB	NINE MILE 115 kV	3PH	6	9	S6340	S6342	S6347/S6338 S6370/S6302	NINE MILE – GRETNA	YES	YES
2B	FAULT-GRETNA_SB	NINE MILE 115 kV	3PH	6	9	S6342	S6340	S6312	NINE MILE – GRETNA NINE MILE – GENR2	YES	YES
3A	FAULT-BARATARIA_SB	NINE MILE 115 kV	3PH	6	9	S6338	S6334	S6347/S6340 S6370/S6302	NINE MILE – BARATARIA	YES	YES

Table IV-3B Cont. Fault Cases Simulated in this Study: Faults with Stuck Breaker Conditions 115 kV BUS

REF. NO.	CASE	LOCATION	TYPE	CLEARING TIME (cycles)		STUCK BRK #	PRIMARY (Normal) BRK TRIP #	SECONDARY BRK (Backup) TRIP	TRIPPED FACILITIES	Stable	Acceptable Voltages
				PRIMARY	Back-up						
3B	FAULT-BARATARIA_SB	NINE MILE 115 kV	3PH	6	9	S6334	S6338	S6345	NINE MILE – BARATARIA NINE MILE – WAGGAMAN	YES	YES
4A	FAULT-WAGGAMAN_SB	NINE MILE 115 kV	3PH	6	9	S6345	S6334	S6320/S6312 S6330/S6308-	NINE MILE - WAGGAMAN	YES	YES
4B	FAULT-WAGGAMAN_SB	NINE MILE 115 kV	3PH	6	9	S6334	S6345	S6338	NINE MILE – WAGGAMAN NINE MILE – BARATARIA	YES	YES
5A	FAULT-AMERICAN CYANAMID_SB	NINE MILE 115 kV	3PH	6	9	S6370	S6360	S6347/S6340 S6338/S6302	NINE MILE – AMERICAN CYANAMID	YES	YES
5B	FAULT-AMERICAN CYANAMID_SB	NINE MILE 115 kV	3PH	6	9	S6360	S6370	S6330	NINE MILE – AMERICAN CYANAMID NINE MILE – GENR3	YES	YES
6A	FAULT GENR1_SB	NINE MILE 115 kV	3PH	6	9	S6320	S6325	S6312/S6345 S6330/S6308	NINE MILE – GENR1	YES	YES
6B	FAULT GENR1_SB	NINE MILE 115 kV	3PH	6	9	S6325	S6320	S6347	NINE MILE – WESTWEGO NINE MILE – GENR1	YES	YES
7A	FAULT GENR2_SB	NINE MILE 115 kV	3PH	6	9	S6312	S6342	S6320/S6345 S6330/S6308	NINE MILE – GENR2	YES	YES
7B	FAULT GENR2_SB	NINE MILE 115 kV	3PH	6	9	S6342	S6312	S6340	NINE MILE – GENR2 NINE MILE – GRETNA	YES	YES
8A	FAULT GENR3	NINE MILE 115 kV	3PH	6	9	S6330	S6360	S6320/S6312 S6345/S6308	NINE MILE – GENR3	YES	YES
8B	FAULT GENR3	NINE MILE 115 kV	3PH	6	9	S6360	S6330	S6370	NINE MILE – GENR3 NINE MILE – AMERICAN CYANAMID	YES	YES
9A	FAULT 115/230 kV	FAULT-115/230 kV XFMR	3PH	6	9	S6302	S6305	S6347/S6340 S6338/S6370	NINE MILE – 115/230 kV XFMR	YES	YES
9B	FAULT 115/230 kV	FAULT-115/230 kV XFMR	3PH	6	8	S6305	S6302	S6308	NINE MILE – 115/230 kV XFMR NINE MILE - #4 & #5 STARTUP XFMRS	YES	YES

Analysis Results

All of the three-phase faults with stuck breaker conditions were stable. Even though none of these were unstable, three-phase faults with normal clearing were simulated as well, for completeness. All of the three-phase faults with normal clearing were stable as well. This study also includes three-phase faults with single pole circuit breaker failure for the breakers that are IPO (Independent Pole Operated). The plots are provided in Appendix A.C.

In addition to criteria for the stability of the machines, Entergy has evaluation criteria for the transient voltage dip as follows:

- 3-phase fault or single-line-ground fault with normal clearing resulting in the loss of a single component (generator, transmission, circuit, or transformer) or a loss of a single component without fault:

  Not to exceed 20% for more than 20 cycles at any bus

  Not to exceed 25% at any load bus

  Not to exceed 30% at any non-load bus

- 3-phase faults with normal clearing resulting in the loss of two or more components (generator, transmission circuit or transformer), and SLG fault with delayed clearing resulting in the loss of one or more components:

  Not to exceed 20% for more than 40 cycles at any bus

  Not to exceed 30% at any bus

The duration of the transient voltage dip excludes the duration of the fault. The transient voltage dip criteria will not be applied to single-phase faults followed by stuck breaker conditions unless the determined impact is extremely widespread.

The voltages at all buses in the Entergy system (138 kV and above) were monitored during each of the fault cases as appropriate. No voltage violations were observed for normally cleared three-phase faults.

Hence, it can be concluded that the proposed PID-222 units do not degrade the Entergy system performance.

The plots for voltages, frequency and machine angles in the local area following Fault 2A of Table V1-2B are shown in Figure IV-5 through Figure IV-10. Plots of relevant parameters (machine angles, frequencies, and bus voltages) are shown in Appendix A.C.

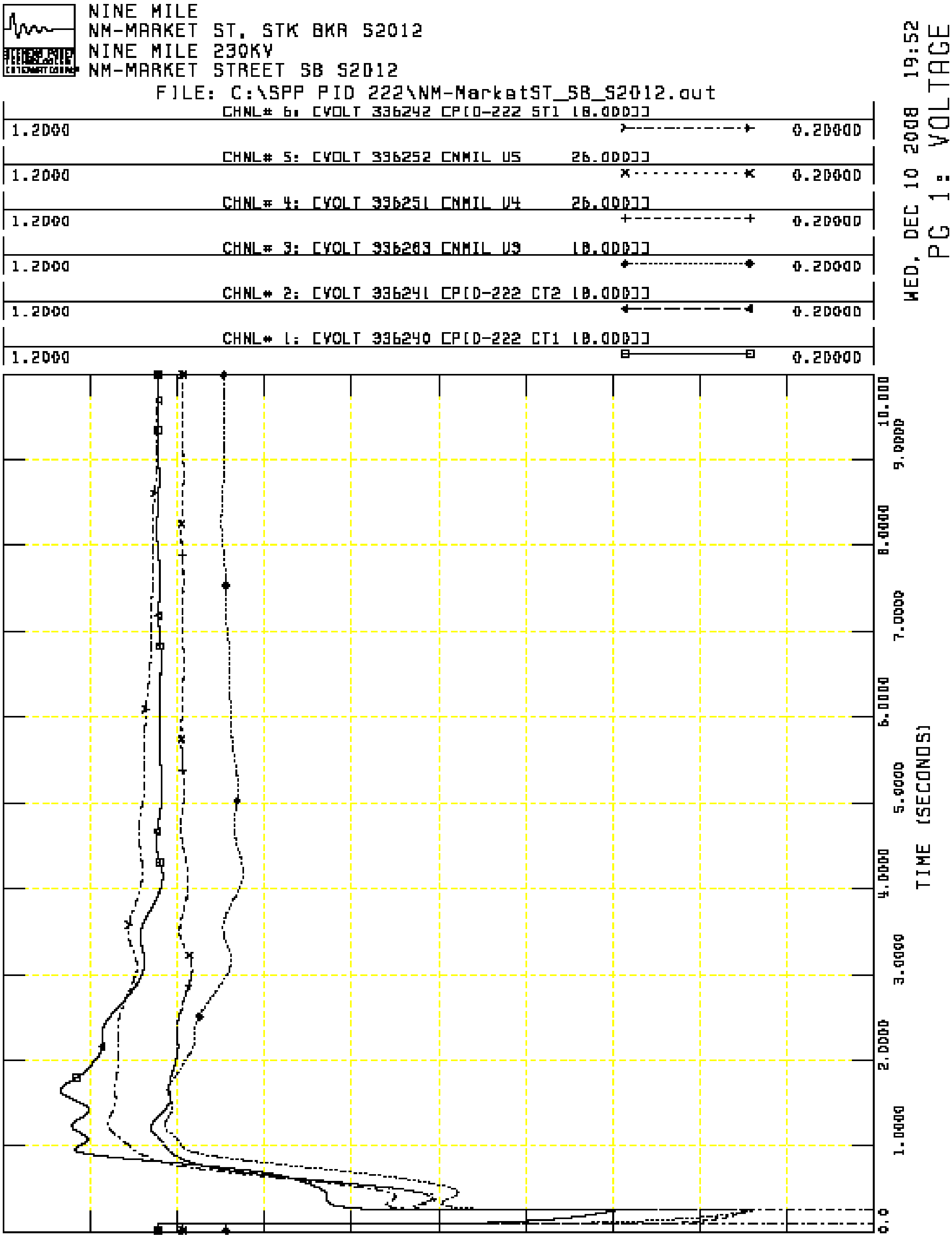

Figure IV-5: Local area voltages following Fault-1A Table IV-2B with PID-222

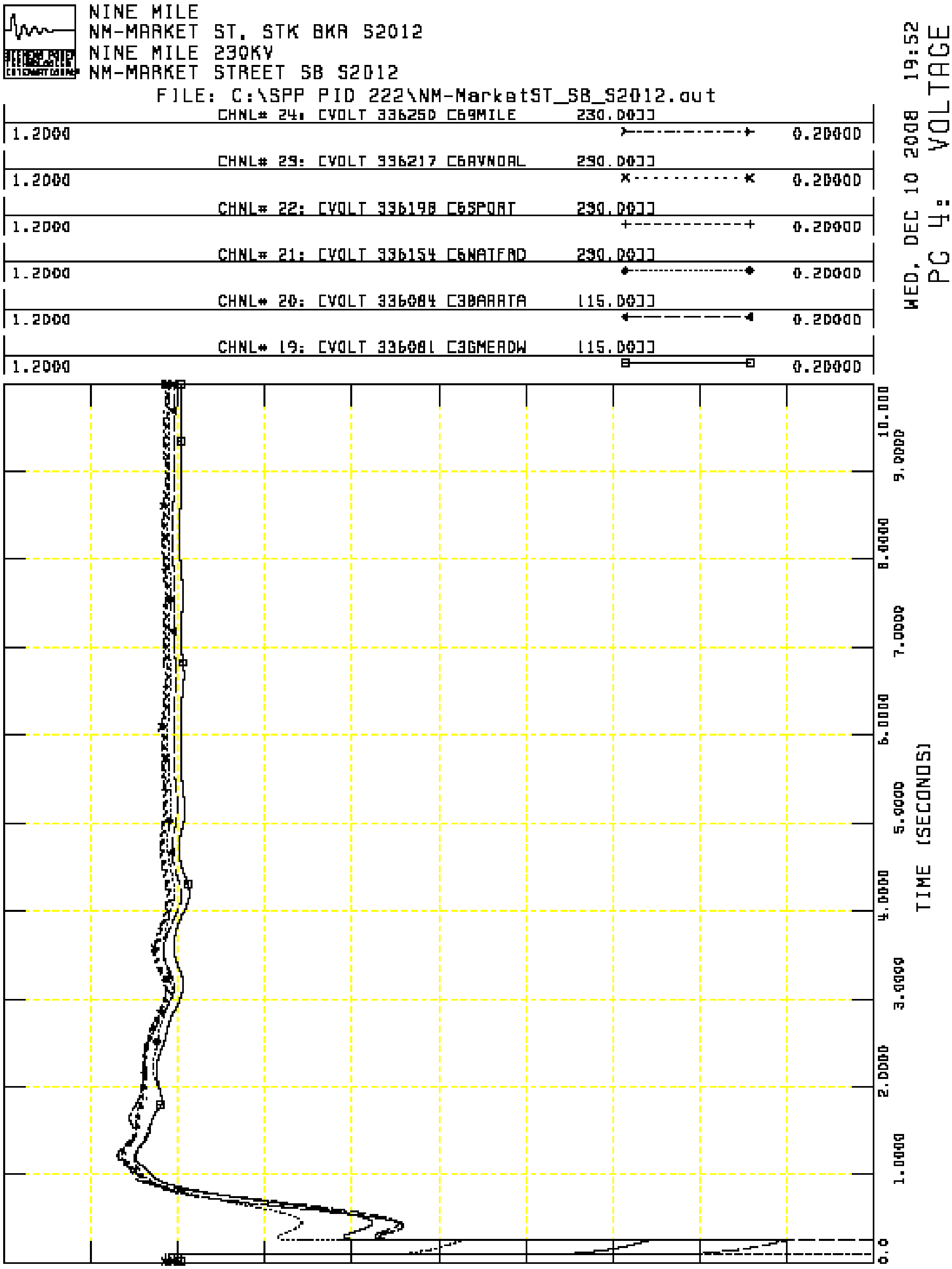

Figure IV-6: Local area voltages following Fault-2A Table IV-2B with PID-222

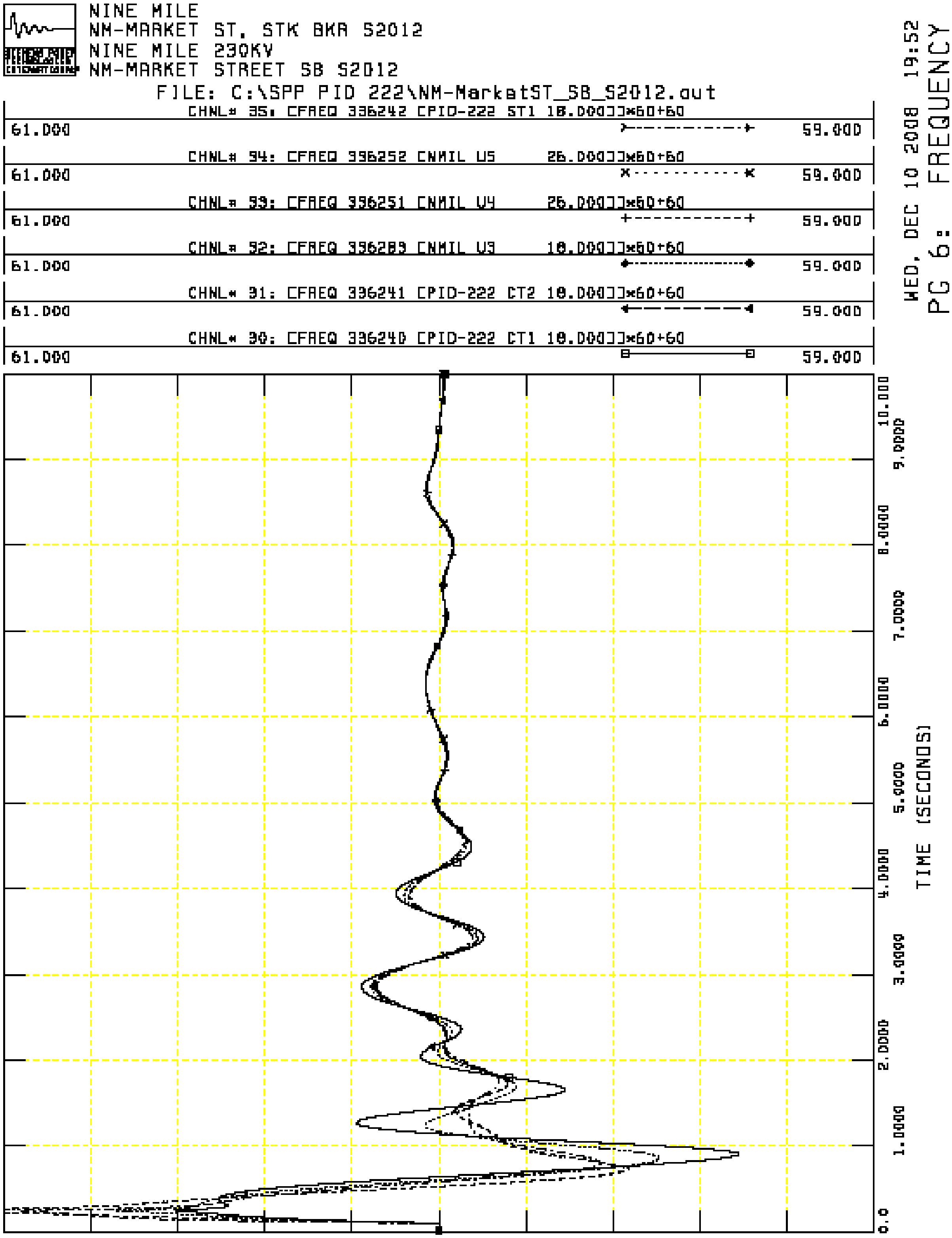

Figure IV-7: Local area frequency following Fault-2A Table IV-2B with PID-222

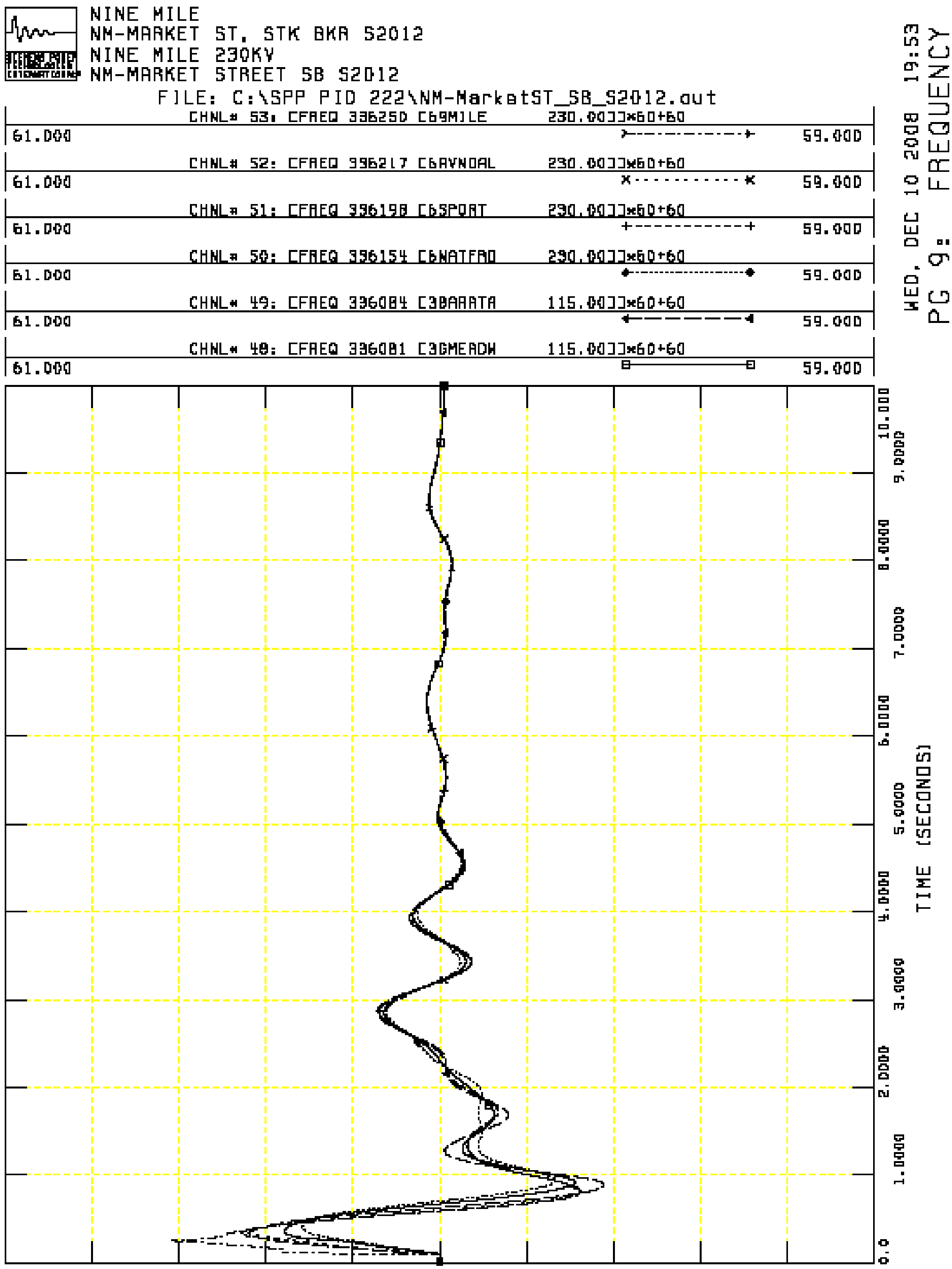

Figure IV-8: Local area frequency following Fault-2A Table IV-2B with PID-222

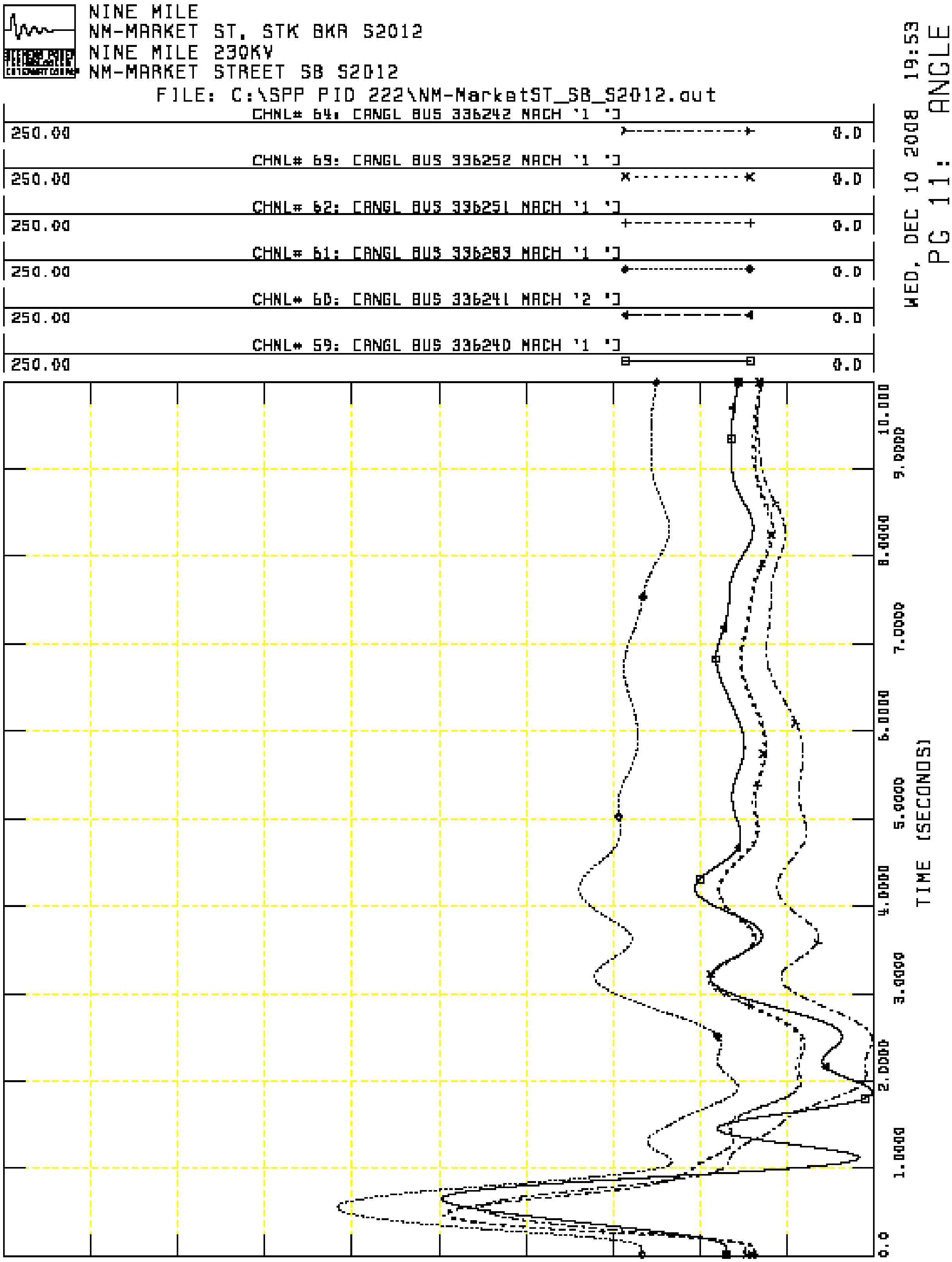

Figure IV-9: Local area angles following Fault-2A Table IV-2B with PID-222

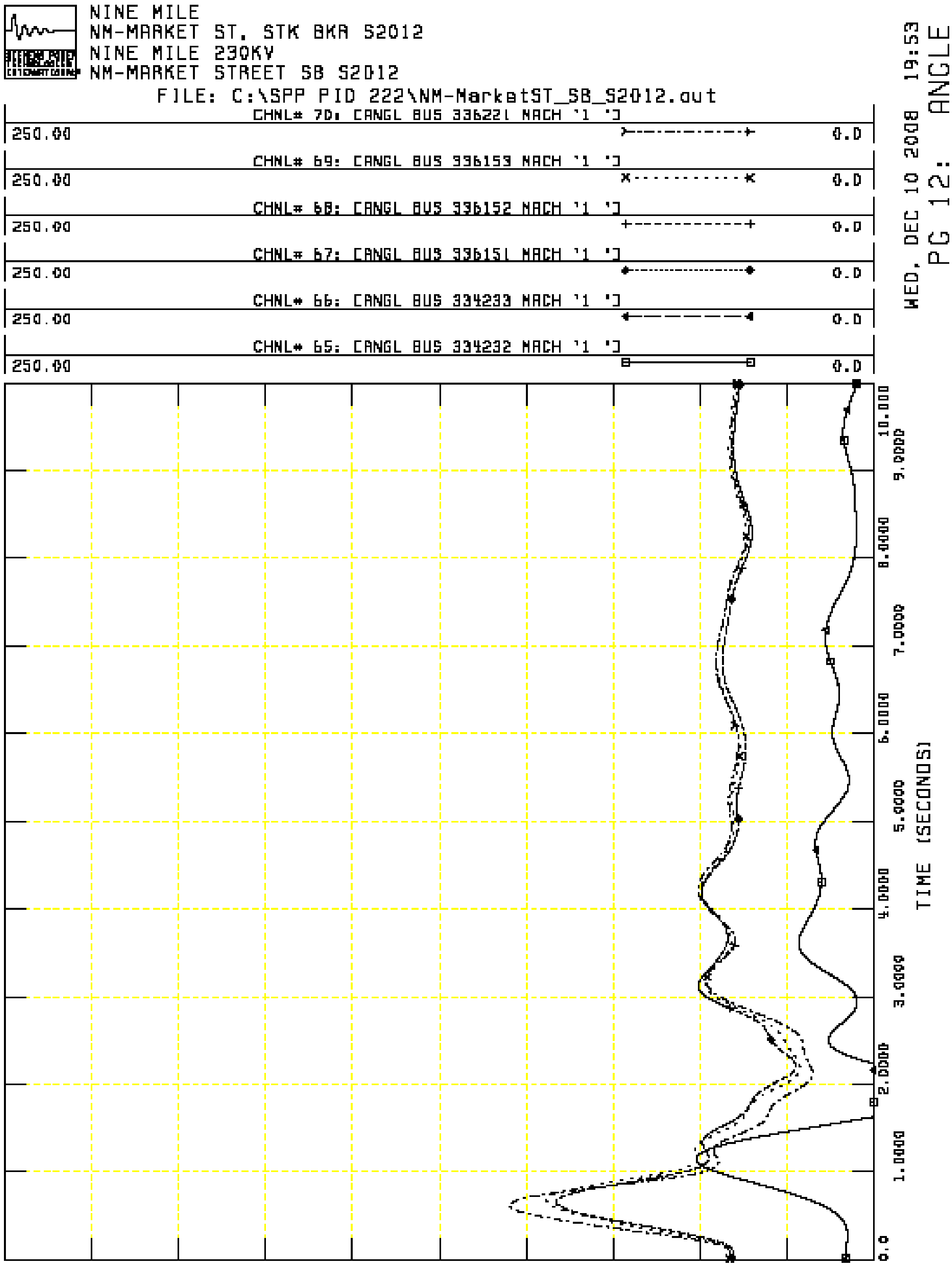

Figure IV-10: Local area frequency following Fault-2A Table IV-2B with PID-222

In summary, when considering the new PID-222 (570 MW) generation at the Nine Mile. 230 and 115 kV buses, all simulated faults are stable. No violations of the voltage dip criteria were observed. This meets Entergy's performance criteria when the PID-222 plant is in-service.

Due to restructuring of the utility industry, there has been a large increase of merchant generation activity on the Entergy system. These generators are equipped with modern exciters that have a high gain and a fast response to enhance transient stability. However, these fast response exciters, if used without stabilizers, can lead to oscillatory instability affecting local or regional reliability. This problem is exacerbated particularly in areas where there is a large amount of generation with limited transmission available for exporting power. Stability studies carried out at Entergy have validated this concern. Furthermore, based on the understanding of operational problems experienced in the WECC area over the last several years and the opinion of leading experts in the stability area, Power System Stabilizers (PSS) are an effective and a low cost means of mitigating dynamic stability problems. In particular, PSS cost can be low if it is included in power plant procurement specifications.

Therefore, as a pre-emptive measure, Entergy requires all generation intending to interconnect to its transmission system to install PSS on their respective units. Please refer to Appendix A.B for Entergy's Policy Statement on PSS Requirements.

Section – B: Network Resource Interconnection Service

Introduction:

A Network Resource Interconnection Services (NRIS) study was requested by the customer to serve 570MW of Entergy network load. The expected in service date for this NRIS generator is 10/1/2012. The tests were performed with only confirmed transmission reservations and existing network generators and with transmission service requests in study mode.

Two tests were performed, a deliverability to generation test and a deliverability to load test. The deliverability to generation (DFAX) test ensures that the addition of this generator will not impair the deliverability of existing network resources and units already designated as NRIS while serving network load. The deliverability to load test determines if the tested generator will reduce the import capability level to certain load pockets (Amite South, WOTAB and Western Region) on the Entergy system. A more detailed description for these two tests is described in Appendix B-A and Appendix B-B.

Also, it is understood that the NRIS status provides the Interconnection Customer with the capability to deliver the output of the Generating Facility into the Transmission System. NRIS in and of itself does not convey any right to deliver electricity to any specific customer or Point of Delivery

Analysis:

Models

The models used for this analysis is the 2015 summer peak case developed in 2007.

The following modifications were made to the base cases to reflect the latest information available:

- Non-Firm IPPs within the local region of the study generator were turned off and other non-firm IPPs outside the local area were increased to make up the difference.
- Confirmed firm transmission reservations were modeled for the year 2015.
- Approved transmission reliability upgrades for 2008 - 2010 were included in the base case. These upgrades can be found at Entergy's OASIS web page, http://www.entergy.com/etroasis/, under approved future projects.

Year	**Approved Future Projects**
2008 – 2010	2007CP_2009_Approved_ELL-S_Amite_South_Area_Improvements_PhaseII.idv
	2007CP_2009_Approved_ELL-S_EGSI-LA_Amite_South_Area_Improvements_PhaseIII.idv
	2008CP_EAI 2008 Maumelle Approved.idv
	2008CP_EAI 2010 SMEPA Approved.idv
	2011_Approved_ETI_Western_Region_Reliability_Improvement_Phase3_Interim

Year	**Proposed Projects for prior generator interconnection requests**
2015	Webre – Richard 500kV transmission line (56 miles triple bundled 954)
	Fancy Point – Hartburg/Mount Olive line tap 500kV transmission line
	Cypress – Jacinto 230kV transmission line
	Hartburg – Sabine 230kV transmission line
	Lewis Creek – Conroe 230kV transmission line
	BP08-038 - Loblolly-Hammond Build 230kv Line_R2Corrected.idv Upgraded to 954 DB

Prior Generation Interconnection NRIS requests that were included in this study:

PID	Substation	MW	In Service Date
PID 208	Fancy Point	1594	1/1/2015
PID 211	Lewis Creek	570	6/1/2011
PID 216	Wilton 230kV	251	1/1/2010
PID 221	Wolfcreek	875	In Service

Prior transmission service requests that were included in this study:

OASIS #	PSE	MW	Begin	End
1460900	Louisiana Energy & Power Authority	116	1/1/2009	1/1/2030
1478781	Entergy Services, Inc. (EMO)	804	1/1/2008	1/1/2058
1481059	Constellation Energy Group	60	2/1/2011	2/1/2030

OASIS #	PSE	MW	Begin	End
1481111	City of Conway	50	2/1/2011	2/1/2046
1481119	Constellation Energy Group	30	2/1/2011	2/1/2030
1481235	Louisiana Energy & Power Authority	50	2/1/2011	2/1/2016
1481438	NRG Power Marketing	20	2/1/2011	2/1/2021
1483241	NRG Power Marketing	103	1/1/2010	1/1/2020
1483243	NRG Power Marketing	206	1/1/2010	1/1/2020
1483244	NRG Power Marketing	309	1/1/2010	1/1/2020
1520043	Municipal Energy Agency of Miss	20	1/1/2011	1/1/2026
1551562	CLECO Power LLC	11	6/1/2009	6/1/2018
1552146	Entergy Services (EMO)	1	1/1/2009	1/1/2014
1552148	Entergy Services (EMO)	1	1/1/2009	1/1/2014
1555717	East Texas Electric Coop	1	1/1/2010	1/1/2015
1555718	Entergy Services (EMO)	158	1/1/2010	1/1/2015
1557602	East Texas Electric Coop	1	1/1/2009	1/1/2017
1558905	NRG Power Marketing	250	7/1/2009	7/1/2014
1558911	NRG Power Marketing	100	1/1/2009	1/1/2014
1559579	NRG Power Marketing	500	5/1/2010	5/1/2015
1559580	NRG Power Marketing	500	5/1/2010	5/1/2015
1559581	NRG Power Marketing	150	5/1/2010	5/1/2015
1562340	Entergy Services (EMO)	1	7/1/2008	7/1/2009
1562529	Constellation Energy Group	123	1/1/2009	1/1/2010
1563290 1563291	Muni Energy Agency of Miss	40	6/1/2013	6/1/2043
1563814	NRG Power Marketing	125	1/1/2011	1/1/2021

Contingencies and Monitored Elements

Single contingency analyses on Entergy’s transmission facilities (including tie lines) 115kV and above were considered. All transmission facilities on Entergy transmission system above 100 kV were monitored.

Generation used for the transfer

The Ninemile 570MW generators were used as the source for the deliverability to generation test.

Results

<u>Deliverability to Generation (DFAX) Test:</u>

The deliverability to generation (DFAX) test ensures that the addition of this generator will not impair the deliverability of existing network resources and units already designated as NRIS while serving network load. A more detailed description for these two tests is described in Appendix B-A and Appendix B-B.

Constraints:

Study Case	Study Case with Priors
Belle Point - Gypsy 230kV	Belle Point - Gypsy 230kV
Champagne - Krotz Spring 138kV	Bevil - Cypress 230kV
China Bulk - Sabine 230kV	Cypress 500/138kV transformer 1
Fairview - Gypsy 230kV	Cypress 500/230kV transformer
Fairview - Madisonville 230kV	Fairview - Gypsy 230kV
French Settlement - Sorrento 230kV	Front Street - Michoud 230kV
Front Street - Michoud 230kV	Front Street - Slidell 230kV
Front Street - Slidell 230kV	Hartburg - Inland Orange 230kV
Gibson - Humphrey 115kV	Hartburg 500/230kV transformer 1
Gibson - Ramos 138kV	Helbig - McLewis 230kV
Greenwood - Humphrey 115kV	Inland - McLewis 230kV
Greenwood - Terrebone 115kV	LaBarre - South Port 230kV
Krotz Spring - Line 642 Tap 138kV	SouthPort - NineMile 230kV Ckt 1
LaBarre - South Port 230kV	SouthPort - NineMile 230kV Ckt 2
Livonia - Line 642 Tap 138kV	Sterlington 500/115kV transformer 2
Livonia - Wilbert 138kV	
SouthPort - NineMile 230kV Ckt 1	
SouthPort - NineMile 230kV Ckt 2	

DFAX Study Case Results:

Limiting Element	**Contingency Element**	**ATC(MW)**
Greenwood - Terrebone 115kV	Webre - Wells 500kV	0
Livonia - Wilbert 138kV	Webre - Wells 500kV	0
Greenwood - Humphrey 115kV	Webre - Wells 500kV	0
Gibson - Humphrey 115kV	Webre - Wells 500kV	0
Fairview - Gypsy 230kV	French Settlement - Sorrento 230kV	0
Livonia - Line 642 Tap 138kV	Webre - Wells 500kV	0
French Settlement - Sorrento 230kV	Franklin - McKnight 500kV	0
Fairview - Gypsy 230kV	Front Street - Slidell 230kV	0
Krotz Spring - Line 642 Tap 138kV	Webre - Wells 500kV	0
Belle Point - Gypsy 230kV	Tezcuco - Waterford 230kV	0
Front Street - Michoud 230kV	Fairview - Gypsy 230kV	45
Front Street - Michoud 230kV	Franklin - McKnight 500kV	54
Front Street - Michoud 230kV	Bogalusa - Adams Creek 500/230kV transformer	125
Front Street - Michoud 230kV	Bogalusa - Franklin 500kV	125
China Bulk - Sabine 230kV	Amelia Bulk - China Bulk 230kV	173
Front Street - Michoud 230kV	French Settlement - Sorrento 230kV	213
Gibson - Ramos 138kV	Webre - Wells 500kV	218
Front Street - Michoud 230kV	French Settlement - Springfield 230kV	352
SouthPort - NineMile 230kV Ckt 2	SouthPort - NineMile 230kV Ckt 1	363
SouthPort - NineMile 230kV Ckt 1	SouthPort - NineMile 230kV Ckt 2	363
Fairview - Gypsy 230kV	Base Case	387
Front Street - Slidell 230kV	Fairview - Gypsy 230kV	431
Front Street - Slidell 230kV	Franklin - McKnight 500kV	447
LaBarre - South Port 230kV	Front Street - Slidell 230kV	516
Champagne - Krotz Spring 138kV	Webre - Wells 500kV	525
Fairview - Madisonville 230kV	Base Case	534

DFAX Study Case with Priors Results:

Limiting Element	Contingency Element	ATC(MW)
Hartburg - Inland Orange 230kV	Cypress - Hartburg 500kV	0
Inland - McLewis 230kV	Cypress - Hartburg 500kV	0
Helbig - McLewis 230kV	Cypress - Hartburg 500kV	0
Sterlington 500/115kV transformer 2	Eldorado EHV - Sterlington 500kV	0
Cypress 500/138kV transformer 1	Cypress 500/230kV transformer	0
Hartburg 500/230kV transformer 1	Cypress - Hartburg 500kV	0
Cypress 500/230kV transformer	Cypress 500/138kV transformer 1	0
Front Street - Michoud 230kV	Franklin - McKnight 500kV	0
Fairview - Gypsy 230kV	Front Street - Slidell 230kV	0
Front Street - Michoud 230kV	Fairview - Gypsy 230kV	0
Front Street - Michoud 230kV	Bogalusa - Adams Creek 500/230kV transformer	74
Front Street - Michoud 230kV	Bogalusa - Franklin 500kV	74
Front Street - Michoud 230kV	Madisonville - Mandeville 230kV (CLECO)	112
Front Street - Slidell 230kV	Franklin - McKnight 500kV	154
Front Street - Michoud 230kV	French Settlement - Sorrento 230kV	298
Front Street - Slidell 230kV	Fairview - Gypsy 230kV	377
SouthPort - NineMile 230kV Ckt 2	SouthPort - NineMile 230kV Ckt 1	381
SouthPort - NineMile 230kV Ckt 1	SouthPort - NineMile 230kV Ckt 2	381
Bevil - Cypress 230kV	Hartburg 500/230kV transformer 1	459
Bevil - Cypress 230kV	Hartburg - Inland Orange 230kV	465
Belle Point - Gypsy 230kV	Tezcuco - Waterford 230kV	498
LaBarre - South Port 230kV	Front Street - Slidell 230kV	531

Deliverability to Load Test:

The deliverability to load test determines if the tested generator will reduce the import capability level to certain load pockets (Amite South, WOTAB and Western Region) on the Entergy system. A more detailed description for these two tests is described in Appendix B-A and Appendix B-B.

Amite South: Passed

WOTAB: Passed

Western Region: Passed

Required Upgrades for NRIS

Preliminary Estimates of Direct Assignment of Facilities and Network Upgrades

Confirmed Case: W/O Priors

Limiting Element	Planning Estimate for Upgrade
Belle Point - Gypsy 230kV	Build Waterford – Frisco 230kV 13.5 miles $23,625,000
Fairview - Gypsy 230kV	Build Coly – Hammond 230kV (BP08-038 - Loblolly-Hammond Build 230kv Line_R2Corrected.idv) $ Base Plan
Fairview - Madisonville 230kV	
French Settlement - Sorrento 230kV	
Front Street - Michoud 230kV	Build Slidell – Michoud 230kV to 600MVA 30 miles $52,500,000
Front Street - Slidell 230kV	
Champagne - Krotz Spring 138kV Livonia - Line 642 Tap 138kV Livonia - Wilbert 138kV Gibson - Humphrey 115kV Gibson - Ramos 138kV Greenwood - Humphrey 115kV Greenwood - Terrebone 115kV Krotz Spring - Line 642 Tap 138kV	Build Webre – Richard 500kV line 56 miles $229,401,465
LaBarre - South Port 230kV	Upgrade LaBarre – South Port 230kV to 700MVA 2.1 miles $3,675,000 Add 3rd South Port – Nine Mile river crossing $7,257,500 Build Nine Mile – Michoud 230kV line 22 miles $38,500,000
SouthPort - NineMile 230kV Ckt 1	
SouthPort - NineMile 230kV Ckt 2	

With priors:
In addition to the approved upgrades for the construction plan and proposed upgrades for prior generation interconnection request, the following upgrades have been identified for this study:

<table>
<tr><th>Limiting Element</th><th>Planning Estimate for Upgrade</th></tr>
<tr><td>Belle Point - Gypsy 230kV</td><td rowspan="2">Upgrade Fairview – Gypsy 230kV to 700MVA
34.33 miles $60,077,500
Upgrade Madisonville – Mandeville 230kV (CLECO)
10 miles $17,500,000</td></tr>
<tr><td>Fairview - Gypsy 230kV</td></tr>
<tr><td>Front Street - Michoud 230kV</td><td rowspan="2">Upgrade Front Street – Michoud to 800MVA
$40,950,000
Upgrade Front Street – Slidell to 800MVA
$10,990,000
Build Slidell – Michoud 230kV to 600MVA
30 miles $52,500,000
Build Nine Mile – Michoud 230kV to 600MVA
22 miles $38,500,000</td></tr>
<tr><td>Front Street - Slidell 230kV</td></tr>
<tr><td>LaBarre - South Port 230kV</td><td>Upgrade LaBarre – South Port 230kV to 700MVA
2.1 miles $3,675,000</td></tr>
<tr><td>SouthPort - NineMile 230kV Ckt 1</td><td rowspan="2">Add 3rd South Port – Nine Mile river crossing
$7,257,500</td></tr>
<tr><td>SouthPort - NineMile 230kV Ckt 2</td></tr>
<tr><td>Sterlington 500/115kV transformer 2</td><td>Supplemental upgrade cost to be determined</td></tr>
</table>

The costs of the upgrades are planning estimates only. Detailed cost estimates, accelerated costs and solutions for the limiting elements will be provided in the facilities study.

APPENDIX B-A: Deliverability Test for Network Resource Interconnection Service Resources

1. Overview

Entergy will develop a two-part deliverability test for customers (Interconnection Customers or Network Customers) seeking to qualify a Generator as an NRIS resource: (1) a test of deliverability "from generation", that is out of the Generator to the aggregate load connected to the Entergy Transmission system; and (2) a test of deliverability "to load" associated with sub-zones. This test will identify upgrades that are required to make the resource deliverable and to maintain that deliverability for a five year period.

1.1 The "From Generation" Test for Deliverability

In order for a Generator to be considered deliverable, it must be able to run at its maximum rated output without impairing the capability of the aggregate of previously qualified generating resources (whether qualified at the NRIS or NITS level) in the local area to support load on the system, taking into account potentially constrained transmission elements common to the Generator under test and other adjacent qualified resources. For purposes of this test, the resources displaced in order to determine if the Generator under test can run at maximum rated output should be resources located outside of the local area and having insignificant impact on the results. Existing Long-term Firm PTP Service commitments will also be maintained in this study procedure.

1.2 The "To Load" Test for Deliverability

The Generator under test running at its rated output cannot introduce flows on the system that would adversely affect the ability of the transmission system to serve load reliably in import-constrained sub-zones. Existing Long-term Firm PTP Service commitments will also be maintained in this study procedure.

1.3 Required Upgrades.

Entergy will determine what upgrades, if any, will be required for an NRIS applicant to meet deliverability requirements pursuant to Appendix B-B.

Appendix B-B – NRIS Deliverability Test

Description of Deliverability Test

Each NRIS resource will be tested for deliverability at peak load conditions, and in such a manner that the resources it displaces in the test are ones that could continue to contribute to the resource adequacy of the control area in addition to the studied resources. The study will also determine if a unit applying for NRIS service impairs the reliability of load on the system by reducing the capability of the transmission system to deliver energy to load located in import-constrained sub-zones on the grid. Through the study, any transmission upgrades necessary for the unit to meet these tests will be identified.

Deliverability Test Procedure:

The deliverability test for qualifying a generating unit as a NRIS resource is intended to ensure that 1) the generating resource being studied contributes to the reliability of the system as a whole by being able to, in conjunction with all other Network Resources on the system, deliver energy to the aggregate load on the transmission system, and 2) collectively all load on the system can still be reliably served with the inclusion of the generating resource being studied.

The tests are conducted for "peak" conditions (both a summer peak and a winter peak) for each year of the 5-year planning horizon commencing in the first year the new unit is scheduled to commence operations.

1) Deliverability of Generation

The intent of this test is to determine the deliverability of a NRIS resource to the aggregate load on the system. It is assumed in this test that all units previously qualified as NRIS and NITS resources are deliverable. In evaluating the incremental deliverability of a new resource, a test case is established. In the test case, all existing NRIS and NITS resources are dispatched at an expected level of generation (as modified by the DFAX list units as discussed below). Peak load withdrawals are also modeled as well as net imports and exports. The output from generating resources is then adjusted so as to "balance" overall load and generation. This sets the baseline for the test case in terms of total system injections and withdrawals.

Incremental to this test case, injections from the proposed new generation facility are then included, with reductions in other generation located outside of the local area made to maintain system balance.

Generator deliverability is then tested for each transmission facility. There are two steps to identify the transmission facilities to be studied and the pattern of generation on the system:

1) Identify the transmission facilities for which the generator being studied has a 3% or greater distribution factor.

2) For each such transmission facility, list all existing qualified NRIS and NITS resources having a 3% or greater distribution factor on that facility. This list of units is called the Distribution Factor or DFAX list.

For each transmission facility, the units on the DFAX list with the greatest impact are modeled as operating at 100% of their rated output in the DC load flow until, working down the DFAX list, a 20% probability of all units being available at full output is reached (e.g. for 15 generators with a Forced Outage Rate of 10%, the probability of all 15 being available at 100% of their rated output is 20.6%). Other NRIS and NITS resources on the system are modeled at a level sufficient to serve load and net interchange.

From this new baseline, if the addition of the generator being considered (coupled with the matching generation reduction on the system) results in overloads on a particular transmission facility being examined, then it is not "deliverable" under the test.

2) Deliverability to Load

The Entergy transmission system is divided into a number of import constrained sub-zones for which the import capability and reliability criteria will be examined for the purposes of testing a new NRIS resource. These sub-zones can be characterized as being areas on the Entergy transmission system for which transmission limitations restrict the import of energy necessary to supply load located in the sub-zone.

The transmission limitations will be defined by contingencies and transmission constraints on the system that are known to limit operations in each area, and the sub-zones will be defined by the generation and load busses that are impacted by the contingent transmission lines. These sub-zones may change over time as the topology of the transmission system changes or load grows in particular areas.

An acceptable level of import capability for each sub-zone will have been determined by Entergy Transmission based on their experience and modeling of joint transmission and generating unit contingencies. Typically the acceptable level of transmission import capacity into the sub-zones will be that which is limited by first-contingency conditions on the transmission system when generating units within the sub-region are experiencing an abnormal level of outages and peak loads.

The “deliverability to load” test compares the available import capability to each sub-zone that is required for the maintaining of reliable service to load within the sub-zone both with and without the new NRIS resource operating at 100% of its rated output. If the new NRIS resource does not reduce the sub-zone import capability so as to reduce the reliability of load within the sub-zone to an unacceptable level, then the deliverability to load test for the unit is satisfied. This test is conducted for a 5-year planning cycle. When the new NRIS resource fails the test, then transmission upgrades will be identified that would allow the NRIS unit to operate without degrading the sub-zone reliability to below an acceptable level.

<u>Other Modeling Assumptions:</u>

1) Modeling of Other Resources

Generating units outside the control of Entergy (including the network resources of others, and generating units in adjacent control areas) shall be modeled assuming “worst case” operation of the units – that is, a pattern of dispatch that reduces the sub-zone import capability, or impact the common limiting flowgates on the system to the greatest extent for the “from generation” deliverability test.

2) Must-run Units

Must-run units in the control area will be modeled as committed and operating at a level consistent with the must-run operating guidelines for the unit.

3) Base-line Transmission Model

The base-line transmission system will include all transmission upgrades approved and committed to by Entergy Transmission over the 5-year planning horizon. Transmission line ratings will be net of TRM and current CBM assumptions will be maintained.

Addendum A: Stability Study and Short Circuit Analysis for Material Modification Evaluation

Stability Analysis

1. Executive Summary

The PID 222 project is a modification to an existing facility. The Project intends to install 1 steam turbine at the 230 kV Ninemile substation and replace 2 combustion turbines at the 115 kV Ninemile substation.

The purpose of this report is to present the results of the stability analysis performed to re-evaluate the impact of the proposed PID 222 project on the Entergy's system dynamic performance, considering the original system model updated with the revised plant data and also evaluate PID 222 using a different system model (2014 summer peak), updated with the revised plant data and PID 228.

A. Model Development

Stability models for the PID 222 combustion and steam units were added to the Entergy's stability database, based on the technical documentation provided by the developer. The tests performed to the Excitation system and PSS indicate properly damped performance, which indicates adequate set of parameters provided for PID 222.

However, while the combustion turbine speed governor present properly damped oscillations, consistent with the characteristics of the generator/turbine, the steam turbine governor model settings causes the governor to be practically inactive during the time range of the stability simulations.

B. Stability Analysis

The stability impact re-study was performed in two phases. The Phase 1 evaluation consisted of the original model (2015 Summer Peak) used for PID 222 previous impact study, updated with the revised plant data. The Phase 2 evaluation consisted of the 2014 summer peak model updated with the revised plant data and the addition of the PID 228 generation facility to the load flow model.

Three-phase faults with stuck breaker (Faults 12a to 32a listed in Table 3-2) were simulated for both Phases 1 and 2. The results obtained demonstrate that:

- The PID 222 proposed project, did not lose synchronism with the system trip during any of the contingencies tested.
- All other synchronous generators in the monitored areas were stable and remained in synchronism during the majority of contingencies simulated.
- Acceptable damping and voltage recovery was observed, within applicable standards, that is, no violations to the voltage dip criteria.

The exception is the Fault_32a, on which the 115/230 kV transformer at Nine Mile substation is tripped off-line following a 3 phase fault at the 115 kV bus with delayed clearing, that is, stuck breaker condition. Under this fault, the generator Nine Mile Unit 3 (bus#336283) loses synchronism with the rest of the system. When the same fault is considering either 3 phase fault with normal clearing (6 cycles) or single line to ground fault with delayed clearing, the system presented a satisfactory dynamic performance. The Nine Mile Unit 3 remained in synchronism following the disturbances with acceptable damping and voltage recovery.

C. Critical Clearing Times

Critical Clearing Time (CCT) assessment was performed on the system with and without PID 222 in both Phases of the re-study. Three phase faults with delayed clearing were applied increasing the applied fault time in steps of 1 cycle, until the first generator loses synchronism with the rest of the system. The results indicate that the PID 222 project does have a significant impact on the critical clearing times for all contingencies tested.

D. General Conclusion

The PID 222 project, with its 2 combustion turbines and 1 steam turbine does not cause any detrimental impact on the Entergy system, in terms of dynamic performance, for the conditions and contingencies tested. Therefore PID 222 project is able to deliver its full power output to the Entergy transmission system without compromising the system reliability.

2. Stability Analysis

A. Introduction

A Large Generating Facility Customer requested interconnection of 570 MW generation on Entergy's transmission system at the Ninemile substation. The Project has the queue denomination of PID 222.
The PID 222 project is a modification to an existing facility. PID 222 intends to install 1 steam turbine at the 230 kV Ninemile substation and replace 2 combustion turbines at the 115 kV Ninemile substation. A System Impact Study was performed as part of the requirements for the interconnection. A report was prepared and issued on December 2008 by Southwest Power Pool, which is the Independent Coordinator of Transmission for Entergy.
The previous impact study was performed based on the latest available 2015 Summer Peak case. The purpose of the analysis presented in this report is to re-evaluate the original system model used for PID 222 studies, updated with the revised plant data. Also evaluate PID 222 using a different system model (2014 summer peak), updated with the revised plant data and PID 228.
Transient stability analysis was performed using the package provided by SPP. It contains the latest stability database in PSS®E version 30.3.3. The stability package also includes the dynamic data for the previously queued projects.

B. Purpose

The stability analysis was performed to determine the ability of the proposed generation facility to remain in synchronism and within applicable planning standards following system disturbances. Three possible types of system faults were considered for the simulations:

a) three phase faults with stuck breaker
b) three phase normally cleared faults
c) single line to ground faults with stuck breaker

Based on the Entergy study criteria, if system is unstable following a three-phase stuck breaker fault, the simulation is then repeated assuming a single-phase stuck breaker fault.

A critical clearing time (CCT) assessment was performed on the system, with and without the PID 222 Project, in order to evaluate the Project influence on the dynamic system performance

Siemens PTI modeled the PID 222 project in the base case and tested the simulation models with the results presented in Section 2. Section 3 describes the methodology and criteria adopted in the study. Section 4 presents and discusses the simulation results and the PID 222 impact on the Entergy transmission grid. The Appendices, in turn, document the PID 222 models and data, as well as present the simulation plots, illustrating the system's dynamic performance.

C. Model Development

The study has considered 2014 and 2015 Summer Peak load flow models with the PID 222 project modeled. The base case also contains significant previous queued generation interconnection projects in the interconnection queue. In particular, as PID 228 is an important prior queued project for the PID 222 stability analysis, its model data is also present in the subsequent tables.

D. Power Flow Data

The proposed PID222 totals 570 MW, consisting of two gas turbine generators and 1 steam turbine generator. Table 2-1 presents the size of the generation project, the type of the prime mover, the reactive capability of the generator, the project's point of interconnection, as well as the PSS®E bus number in the load flow model for PID 222 and PID 228 Interconnection Requests.

Table 2-1 – Details of the PID 222 and PID 228 Interconnection Requests

Project	Max Output (MW)	Type of Turbine	Reactive Capability of Project		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
PID 222	179.3	Gas Turbine	115	-80	Nine Mile 115 kV Substation	336280
	179.3	Gas Turbine	115	-80	Nine Mile 115 kV Substation	336280
	211.6	Steam Turbine	160	-110	Nine Mile 230 kV Substation	336250
PID 228	104	Steam Turbine	56	-34	Tap Patterson – Claiborne 115 kV line	336421

The PID-222 revised plant data were added to the base cases, as well as the step-up transformer data, connecting the plants to the existing Nine Mile substation at the 230 and 115 kV buses. Table2-2 presents the step-up transformer parameters for both PID 222 and PID 228 Projects.

Table 2-2 – Step-Up Transformer Data for PID 222 and PID 228

Project	Step Up Transformer	HV (kV)	XV (kV)	Rating (MVA)	Tap Voltages		Impedance (%)	Base (MVA)
					H	X		
PID 222	GT 1	115	18	217	None	± 5% in two 2½ % steps	0.258 + j 7.74 %	130
	GT 2	115	18	217	None	± 5% in two 2½ % steps	0.258 + j 7.74 %	130
	ST	230	18	300	None	± 5% in two 2½ % steps	0.258 + j 7.74 %	180
PID 228	ST	115	13.8	125	None	± 5% in two 2½ % steps	0.222 + j 7.77 %	75

Figure 2-1 presents the surrounding area of the PID 222 point of interconnection. The single line diagram show the line flows and voltage profile for the summer peak scenario, on which the study is based.

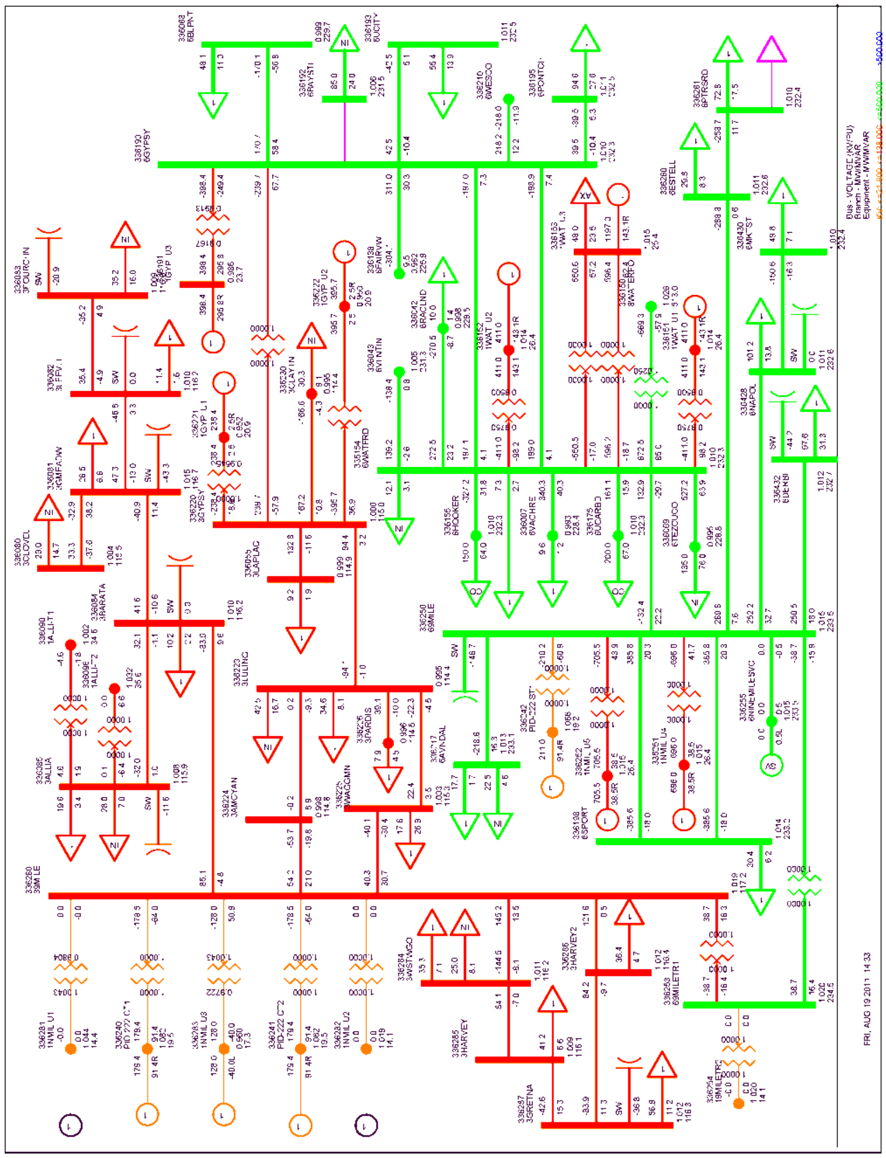

Figure 2-1 – PID 222 Interconnection Surrounding Area – 2014 Summer Peak Model

Figure A-1 and Figure A-2 in Appendix A present single line diagrams of the PID 222 plant modeling details and impedance data of the Step-Up transformers. Appendix A also presents the PSS®E raw data file, documenting the steady state modeling data for the project, added to the base cases.

E. Stability Database

The transient stability analysis was performed using the data provided by SPP. The revised Plant and the stability models for the PID 222 interconnection request were added to the dynamic database, based on the technical documentation provided by the developer.

It is important to note that the PSS®E datasheets filled out by the costumer and attached to the documentation provided, present incorrect operational impedances for the generators, as the costumer should have entered unsaturated values of all machine reactances, not the saturated values.

Siemens PTI performed different simulations using its proprietary software PSS®E to assess the performance and adequacy of the proposed PID 222 dynamic simulation models: generator, excitation system, and turbine/speed governor.

The PSS®E dynamic models output list is shown in Appendix B, documenting the dynamic models and parameters for the PID 222 project.

F. Open Circuit Voltage Setpoint Step Test

In this test, the generator is initially set to nominal speed on open circuit, similar to a typical condition prior to its synchronization to the grid. The terminal voltage is set to the generator rated voltage (1.000 pu terminal voltage) with the excitation system in automatic control. The initial generator field voltage E_{FD} is equal to 1+S(1.0), where S(1.0) is the generator saturation factor for 1.000 pu terminal voltage. This value should correspond to the no load field voltage, usually specified on the generator datasheet.

A 2% step change to the voltage reference of the automatic voltage regulator V_{ref} is applied at t = 0 seconds and the dynamic response of the excitation system is monitored. Figures 2-2 and Figure 2-3 show the results obtained for the CT 1&2 and ST units, respectively.

The excitation system model of the CT units shows a properly damped response with a small overshoot following the step change in the voltage reference. The rise time of the terminal voltage is approximately 0.43 seconds and the settling time is about 1.48 seconds.

The excitation system model of the ST unit also shows a properly damped response with a small overshoot following the step change in the voltage reference. The rise time of the terminal voltage is approximately 0.54 seconds and the settling time is about 2.0 seconds.

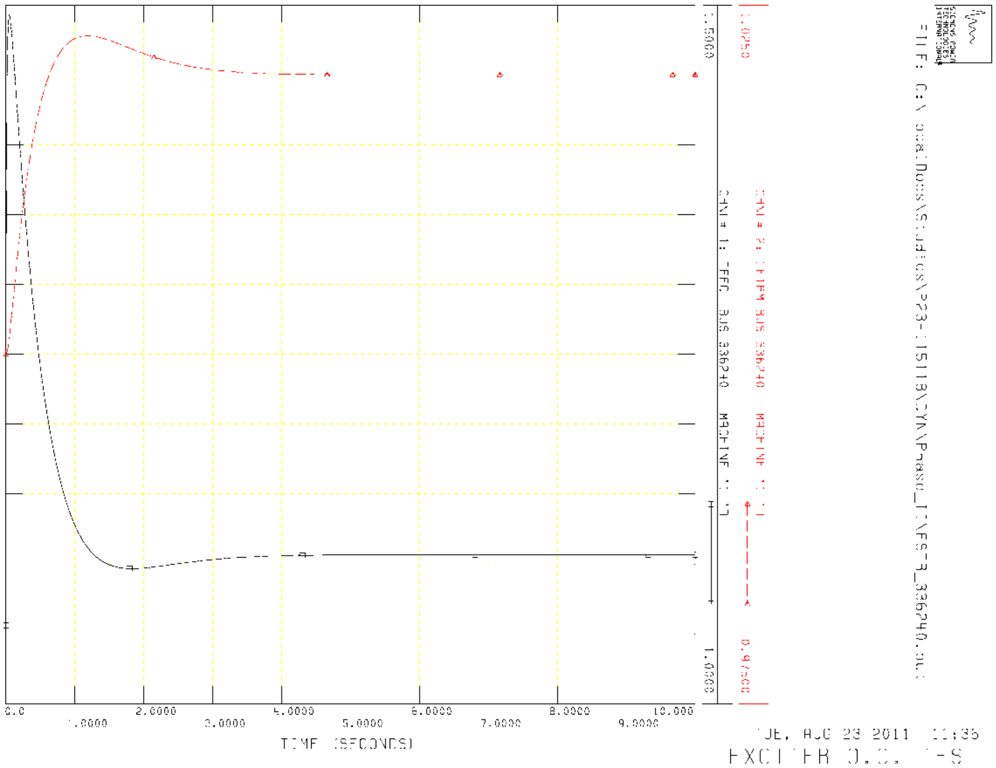

Figure 2-2 – Open Circuit 2% Step Response for the PID 222 Excitation System – CT Units 1 and 2

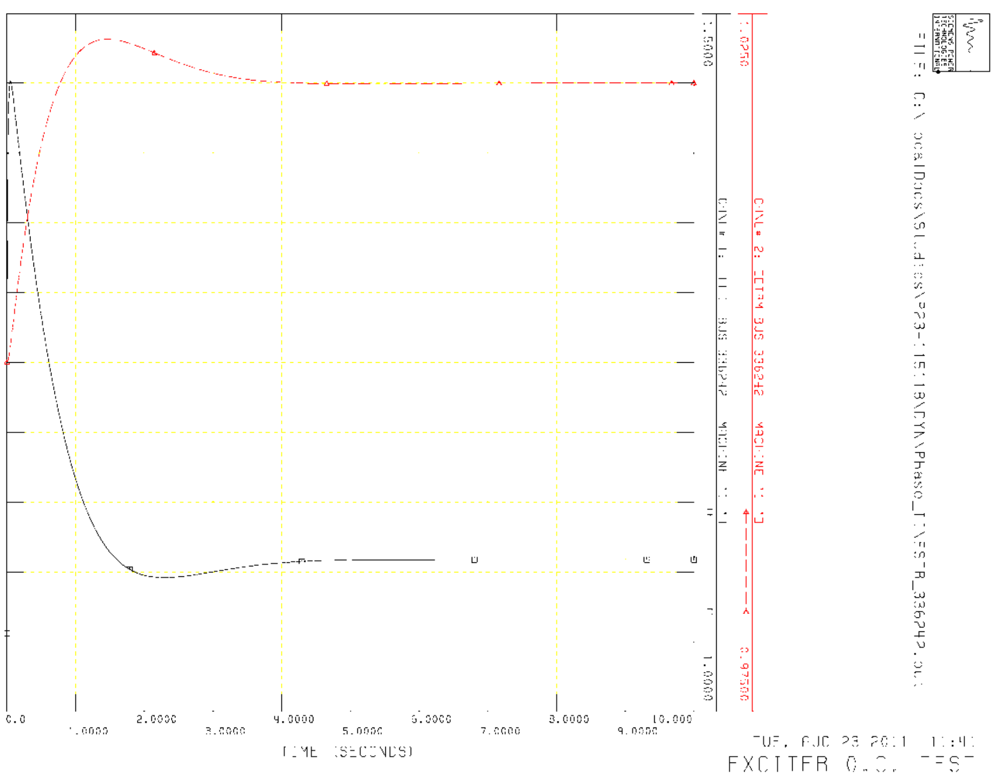

Figure 2-3 – Open Circuit 2% Step Response for the PID 222 Excitation System – ST

G. Speed Governor Response Test

The speed governor response test considered the PID 222 generators operating in an isolated mode, supplying an initial electrical load P_0 with unity power factor, as shown in Figure 2.3. A sudden increase in the load demand □P is applied, resulting in an imbalance between generation and load. This power imbalance results in a deceleration of the generation unit and thus a decrease in speed/frequency. The speed governor reacts to the deviation and increases the turbine mechanical power output to restore the balance between generation and load.

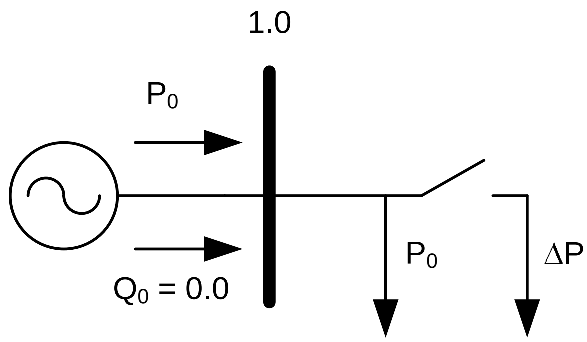

Figure 2.4 – System Configuration for the Speed Governor Response Test

For this test, the initial electrical load P_0 is set to 70% of the generator's Pmax. The electrical load is suddenly increase by 5% of the generator's Pmax. Figure 2-5 and Figure 2-6 present the simulated results of the speed governor response test following the step change in load for the CT and steam units, respectively.

The combustion turbine speed governor test present oscillations properly damped, considering the inertia and other characteristics of the generator/turbine.

The steam turbine speed governor presents an extremely slow response to the step change in load. After 15 seconds the mechanical power has increased 0.7%, instead the intended 5%. The reason is the governor time constant T1, which is set to 999 s. A typical value for T1 is 0.5 sec. Therefore, setting T1 to 999 causes the governor to be practically inactive during the time range of the stability simulations.

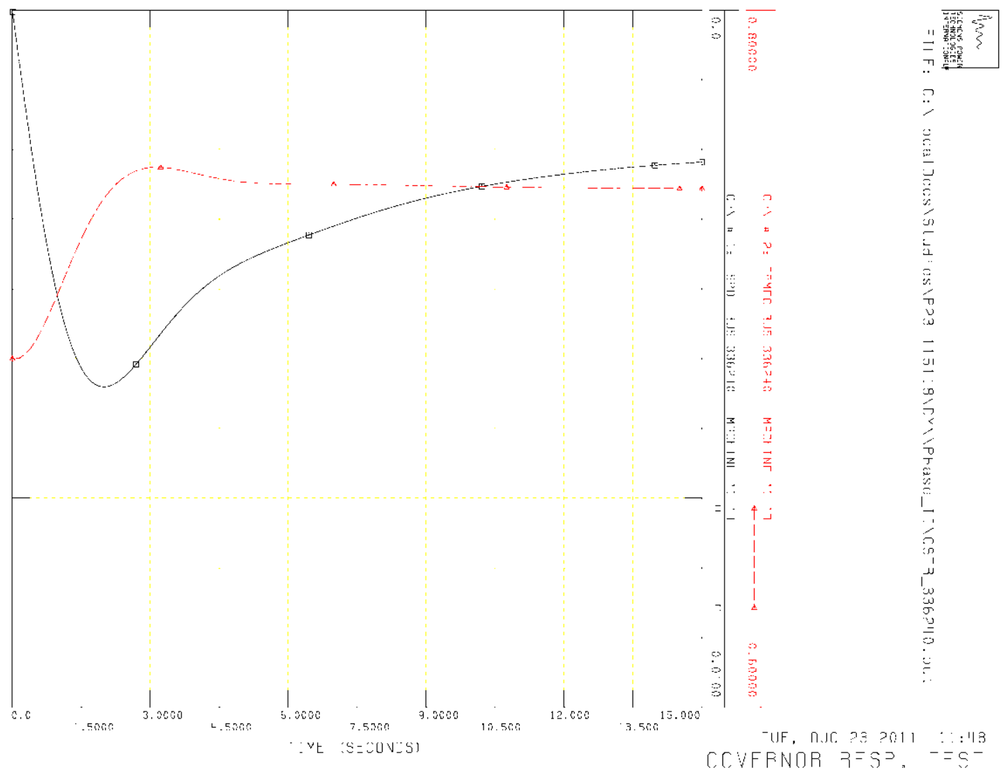

Figure 2-5– Speed Governor Response Test Results for the PID 222 Combustion Turbines

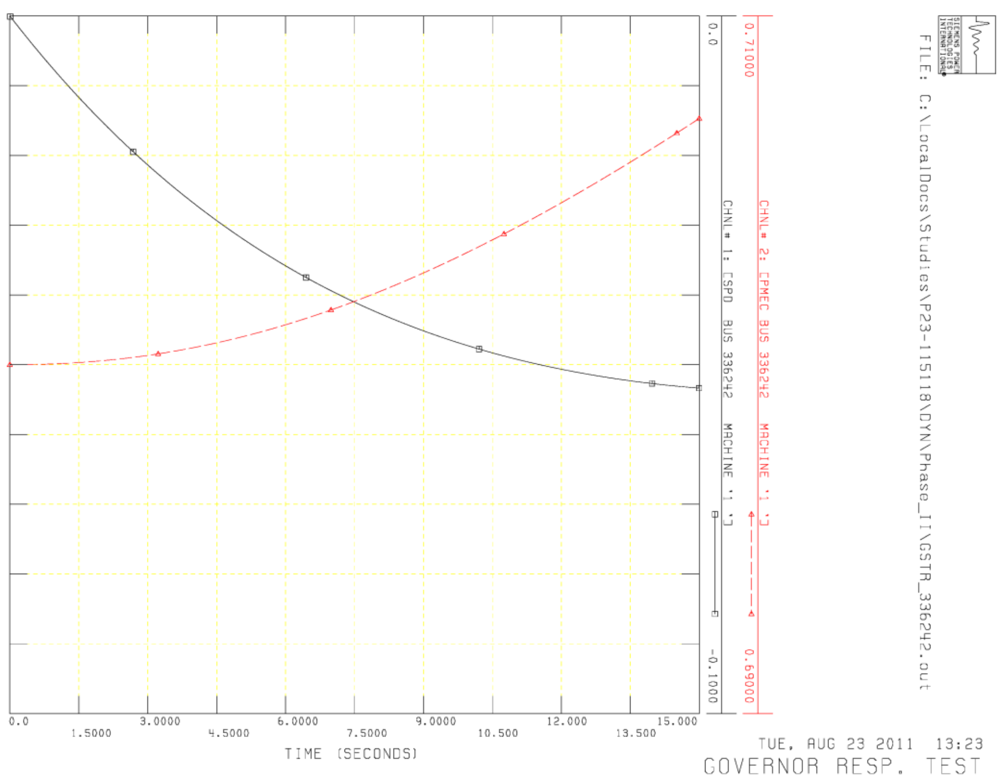

Figure 2-6– Speed Governor Response Test Results for the PID 222 Steam Turbine

H. Power System Stabilizer

In the PSS tests performed, in order to introduce a relatively small disturbance designed to highlight the linear response of the generator and excitation system, a reactor with 25% of the generator MVA rating (56.25 Mvar CT and 76.50 Mvar ST) is connected to the high-voltage side of the generator step-up transformer for 6 cycles and then it is removed without changing the network configuration, that is, no line trips. Two different simulations were carried out: with and without the PSS model implemented.

Figure 2-5 presents the simulation results. The two curves represent the electrical power output with and without the power system stabilizer model implemented. It can be seen that the models indeed contribute to increase damping of the oscillations.

These results do not intend to evaluate the PSS tuning. They simply indicate that the power system stabilizer and its tuned transfer function cause no harm to the overall system performance.

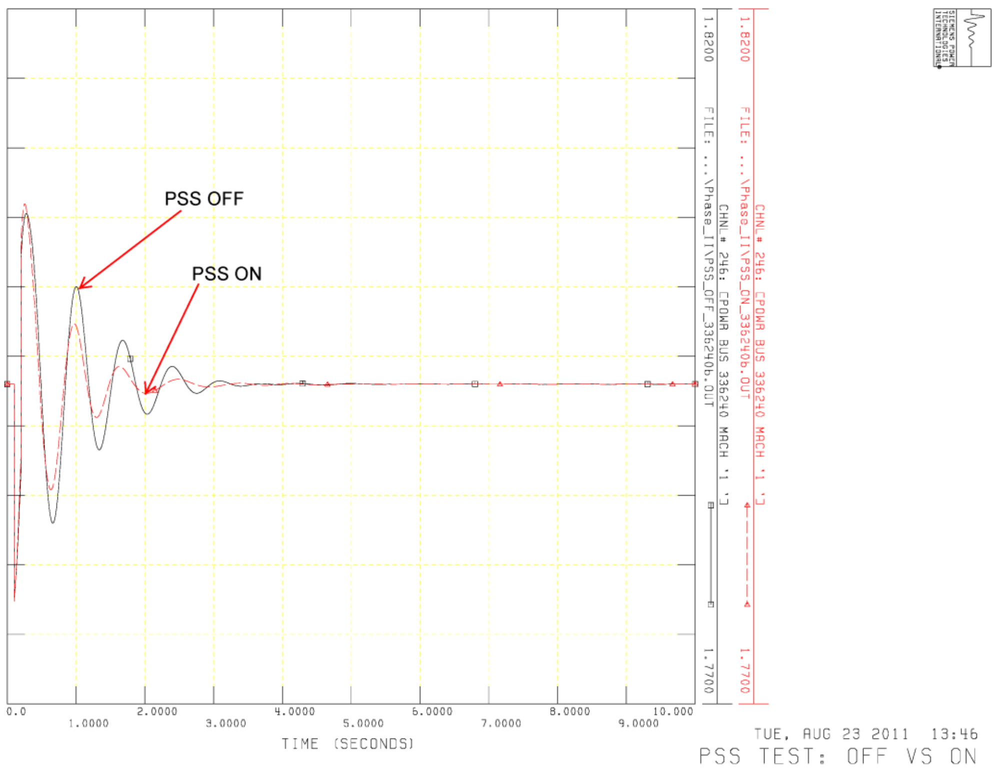

Figure 2.7 – PID 222 Power System Stabilizer Test for the PID 222 Combustion Turbines

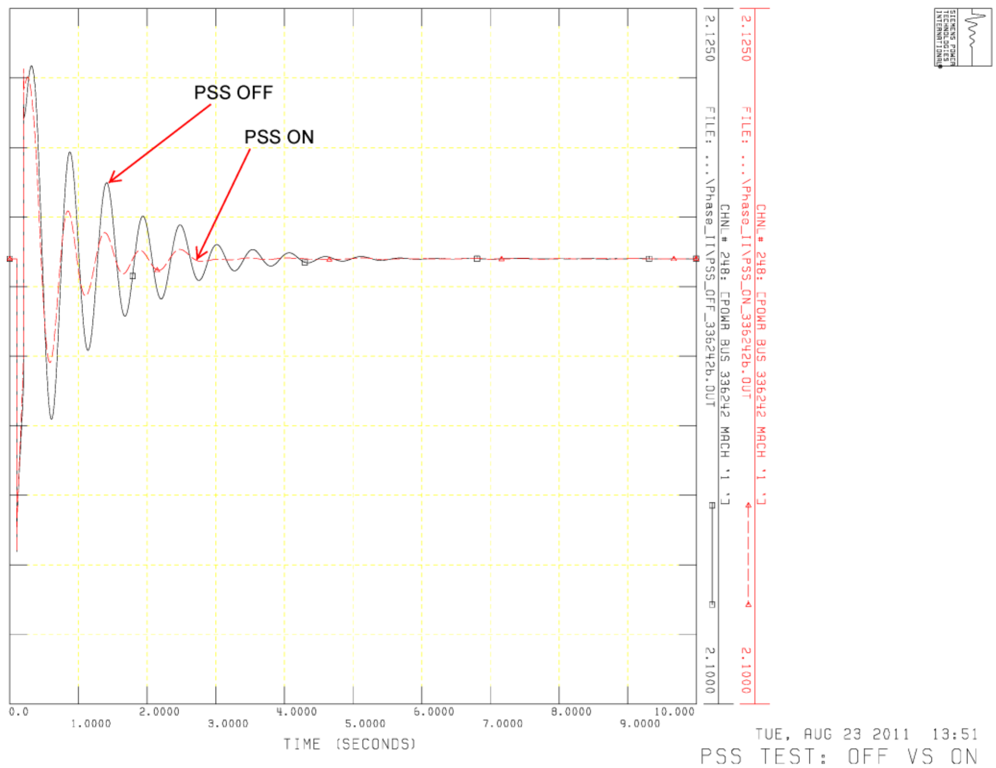

Figure 2.8 – PID 222 Power System Stabilizer Test for the PID 222 Steam Turbine

3. Methodology and Assumptions

The study considered the 2014 Summer Peak and 2015 Summer Peak power flow cases with the required interconnection generation requests modeled as described in Section 2. The base case also contains all the significant previous queued projects in the interconnection queue.
The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
351	EES
332	LAGN
502	CELE

A. Methodology

Stability Simulations

The dynamic simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single-phase faults in the neighborhood of PID 222 Point of interconnection were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The system performance was evaluated in terms of its the ability, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance.

In addition to criteria for the stability of the machines, Entergy has evaluation criteria for the transient voltage dip as follows:

1) For three phase fault or single-line-ground fault with normal clearing resulting in the loss of a single component or even single outage without fault:

    - Not to exceed 20% for more than 20 cycles at any bus
    - Not to exceed 25% at any load bus
    - Not to exceed 30% at any non-load bus

2) For three phase faults with normal clearing resulting in loss of two or more components (generator, transmission circuit or transformer), and SLG fault with delayed clearing resulting in loss of one or more components:

    - Not to exceed 20% for more than 40 cycles at any bus
    - Not to exceed 30% at any bus

    Notes:

    - The time period on which the transient voltage dip is accounted for excludes the duration of the fault.
    - The transient voltage dip criteria are not applicable for three-phase stuck-breaker faults unless the determined impact is extremely widespread.

Disturbances for Stability Analysis

The faults are defined as single line to ground, and three phase faults. The fault clearing includes delays for all contingencies.

Three possible types of system faults were considered for the simulations:

a) three phase faults with stuck breaker
b) three phase normally cleared faults
c) single line to ground faults with stuck breaker

If system presents unstable behavior or poor dynamic performance following a three-phase stuck breaker fault, the simulation is then repeated assuming both three phase fault with normal clearing and a single-phase to ground fault with stuck breaker.

The disturbances evaluated are concentrated in the Nine Mile substation, at 230 and 115 kV buses. For Critical Clearing Time (CCT) evaluation the disturbances simulated are, in turn, concentrated at the Waterford 230 kV substation. The contingencies are listed in the following Table 3-2 and Table 3-3.

Table 3-2 – Contingencies Considered for the PID 222 CCT Analysis – Waterford 230 kV Substation

Fault #	Line on which Fault occurs	Fault Location (For Simulation)	Fault Type	Fault Clearing (Cycles)		Stuck Breaker	Breaker Clearing		Tripped Facilities
				Primary	Back - up		Primary	Back-up	
FAULT_1a	Waterford - Vacherie 230 kV	Waterford 230 kV	3 Phase SB	6	9	S6985	BRK S6982,GCB #S6665	S6988 #13015,# 13345	Waterford - Vacherie 230 kV and Waterford to Willow Glen 500 kV
FAULT_2a	Waterford - Raceland 230 kV	Waterford 230 kV	3 Phase SB	6	9	S7132	BRK S7136, GCB #S6682	S7142 OCB #S7145	Waterford - Raceland 230 kV and Waterford Gen. 2
FAULT_3a	Waterford - Valentine 230 kV	Waterford 230 kV	3 Phase SB	6	9	S6975	BRK S6978, GCB S7427	S6972 S2025, S2022	Waterford - Valentine 230 kV and Waterford – Nine Mile
FAULT_4a	Waterford 230/26 kV; U1	Waterford 230 kV	3 Phase SB	6	9	S7161	BRK S7151, OCB 7154	S7166	Waterford 230/26 kV transformer ; U1 (411 MW)
FAULT_4b	Waterford 230/26 kV; U2	Waterford 230 kV	3 Phase SB	6	9	S7132	BRK S7142, S7145	S7136, OCB #S7145	Waterford 230/26 kV transformer (Unit 2) and Waterford - Raceland 230 kV line
FAULT_5a	Waterford 230/25 kV transformer #1 (Transformer for U3)	Waterford 230 kV	3 Phase SB	6	9	S7176	BRK S7172	S7682, S7198, S7186, S7112, S7166, S7136, S6988, S6978	Waterford 230/25 kV transformer #1 (Transformer for U3)
FAULT_6a	Waterford 500/230 kV transformer	Waterford 230 kV	3 Phase SB	6	9	S6985	BRK S6985, ACB #13015, GCB #13345	S6982, GCB #S6655	Waterford 500/230 kV transformer; Waterford - W. Glenn 500 kV and Waterford – Vachere 230 line
FAULT_7a	Waterford - Hooker 230 kV	Waterford 230 kV	3 Phase SB	6	9	S7615	BRK S7612,GCB S4181,S546 0	S7612 #S3245,S 3248	Waterford - Hooker 230 kV and Waterford - Gypsy 230 kV lines
FAULT_8a	Waterford - Union Carbide 230 kV	Waterford 230 kV	3 Phase SB	6	9	S7106	BRK S7112, GCB #S1882,	S7102	Waterford - Union Carbide 500 kV and Waterford - 6TEZCUCO 230 kV line

Fault #	Line on which Fault occurs	Fault Location (For Simulation)	Fault Type	Fault Clearing (Cycles)		Stuck Breaker	Breaker Clearing		Tripped Facilities
				Primary	Back - up		Primary	Back-up	
							S4555		
FAULT_9a	Waterford - Gypsy 230 kV	Waterford 230 kV	3 Phase SB	6	9	S7615	BRK S7198,GCB #S3245,S3248	S7612, S4181,S5460	Waterford - Gypsy 230 kV and Waterford – Hooker 230 kV
FAULT_10a	Waterford - 6TEZCUCO 230 kV	Waterford 230 kV	3 Phase SB	6	9	S7106	BRK S7102, GCB S4526, S4523	S7112, S1882, S4555	Waterford - 6TEZCUCO 230 kV and Waterford – Union Carbide 230 kV
FAULT_11a	Waterford - Ninemile 230 kV	Waterford 230 kV	3 Phase SB	6	9	S6975	BRK S6972, GCB #S2025, S2022	S6978, S7427	Waterford - Ninemile 230 kV and Waterford - Valentine 230 kV lines

Table 3-3 – Contingencies Considered for the PID 222 Stability Analysis – Nine Mile Substation

Fault #	Line on which Fault occurs	Fault Location (For Simulation)	Fault Type	Fault Clearing (Cycles)		Stuck Breaker	Breaker Clearing		Tripped Facilities
				Primary	Back - up		Primary	Back-up	
FAULT_12a	NINE MILE – WATERFORD, NINE MILE – ESTELLE	NINE MILE 230 kV	3 Phase SB	6	9	S2025	S2022	S2028	NINE MILE – WATERFORD, NINE MILE – ESTELLE
FAULT_13a	NINE MILE – SOUTHPORT LINE #1 , NINE MILE – SVC	NINE MILE 230 kV	3 Phase SB	6	9	S2085	S2082	S2088	NINE MILE – SOUTHPORT LINE #1 , NINE MILE – SVC
FAULT_14a	NINE MILE – AVONDALE , NINE MILE – GENR6	NINE MILE 230 kV	3 Phase SB	6	9	S2045	S2042	S2048	NINE MILE – AVONDALE , NINE MILE – GENR6
FAULT_15a	NINE MILE – ESTELLE , NINE MILE – WATERFORD	NINE MILE 230 kV	3 Phase SB	6	9	S2025	S2028	S2022	NINE MILE – ESTELLE , NINE MILE – WATERFORD
FAULT_16a	NINE MILE – MARKET STREET, NINE MILE - DERBIGNY	NINE MILE 230 kV	3 Phase SB	6	9	S2015	S2012	S2018	NINE MILE – MARKET STREET, NINE MILE - DERBIGNY
FAULT_17a	NINE MILE - DERBIGNY , NINE MILE – MARKET STREET	NINE MILE 230 kV	3 Phase SB	6	9	S2015	S2018	S2012	NINE MILE - DERBIGNY , NINE MILE – MARKET STREET
FAULT_18a	NINE MILE – 230/115 kV XFMR, NINE MILE – GENR4	NINE MILE 230 kV	3 Phase SB	6	9	S2005	S2002	S2008	NINE MILE – 230/115 kV XFMR, NINE MILE – GENR4
FAULT_19a	NINE MILE – SOUTHPORT LINE #2, NINE MILE – GENR5	NINE MILE 230 kV	3 Phase SB	6	9	S2034	S2031	S2037	NINE MILE – SOUTHPORT LINE #2, NINE MILE – GENR5
FAULT_20a	NINE MILE – GENR4, NINE MILE – 115/230 kV XFMR	NINE MILE 230 kV	3 Phase SB	6	9	S2005	S2008	S2002	NINE MILE – GENR4, NINE MILE – 115/230 kV XFMR
FAULT_21a	NINE MILE – GENR5, NINE MILE – SOUTHPORT LINE #2	NINE MILE 230 kV	3 Phase SB	6	9	S2034	S2037	S2031	NINE MILE – GENR5, NINE MILE – SOUTHPORT LINE #2
FAULT_22a	NINE MILE – GENR6, NINE MILE – AVONDALE	NINE MILE 230 kV	3 Phase SB	6	9	S2045	S2048 S23233	S2042	NINE MILE – GENR6, NINE MILE – AVONDALE
FAULT_23a	NINE MILE – SVC GENR, NINE MILE –	NINE MILE 230 kV	3 Phase SB	6	9	S2085	S2088	S2082	NINE MILE – SVC GENR, NINE MILE – SOUTHPORT

Fault #	Line on which Fault occurs	Fault Location (For Simulation)	Fault Type	Fault Clearing (Cycles)		Stuck Breaker	Breaker Clearing		Tripped Facilities
				Primary	Back - up		Primary	Back-up	
	SOUTHPORT LINE #1								LINE #1
FAULT_24a	NINE MILE – WESTWEGO, NINE MILE – GENR2	NINE MILE 115 kV	3 Phase SB	6	9	S6325	S6347	S6320	NINE MILE – WESTWEGO, NINE MILE – GENR1
FAULT_25a	NINE MILE – GRETNA, NINE MILE – GENR1	NINE MILE 115 kV	3 Phase SB	6	9	S6342	S6340	S6312	NINE MILE – GRETNA, NINE MILE – GENR2
FAULT_26a	NINE MILE – BARATARIA , NINE MILE – WAGGAMAN	NINE MILE 115 kV	3 Phase SB	6	9	S6334	S6338	S6345	NINE MILE – BARATARIA , NINE MILE – WAGGAMAN
FAULT_27a	NINE MILE – WAGGAMAN, NINE MILE – BARATARIA	NINE MILE 115 kV	3 Phase SB	6	9	S6334	S6345	S6338	NINE MILE – WAGGAMAN, NINE MILE – BARATARIA
FAULT_28a	NINE MILE – AMERICAN CYANAMID, NINE MILE – GENR3	NINE MILE 115 kV	3 Phase SB	6	9	S6360	S6370	S6330	NINE MILE – AMERICAN CYANAMID, NINE MILE – GENR3
FAULT_29a	NINE MILE – WESTWEGO, NINE MILE – GENR2	NINE MILE 115 kV	3 Phase SB	6	9	S6325	S6320 S63233	S6347	NINE MILE – WESTWEGO, NINE MILE – GENR1
FAULT_30a	NINE MILE – GENR1, NINE MILE – GRETNA	NINE MILE 115 kV	3 Phase SB	6	9	S6342	S6312	S6340	NINE MILE – GENR2, NINE MILE – GRETNA
FAULT_31a	NINE MILE – GENR3, NINE MILE – AMERICAN CYANAMID	NINE MILE 115 kV	3 Phase SB	6	9	S6360	S6330	S6370	NINE MILE – GENR3, NINE MILE – AMERICAN CYANAMID
FAULT_32a	NINE MILE – 115/230 kV XFMR, NINE MILE - #4 & #5 STARTUP XFMRS	NINE MILE 115 kV	3 Phase SB	6	9	S6305	S6302	S6308	NINE MILE – 115/230 kV XFMR, NINE MILE - #4 & #5 STARTUP XFMRS

The following Figure 3-1 presents the fault locations at the Waterford substation. Figure 3-2 and Figure 3-3 present the fault locations within the Nine Mile substation.

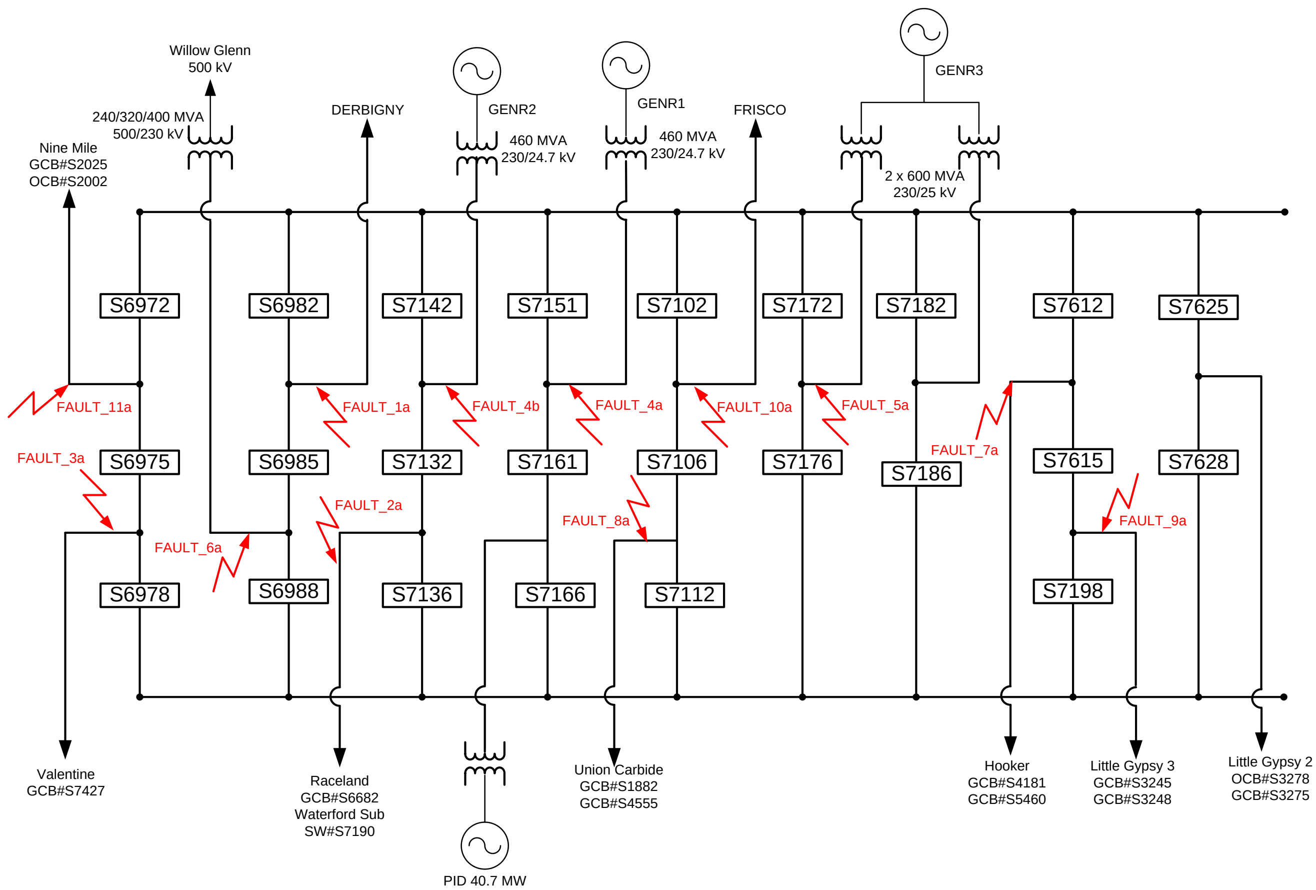

Figure 3-1 – Fault Locations in the Waterford 230 kV Substation

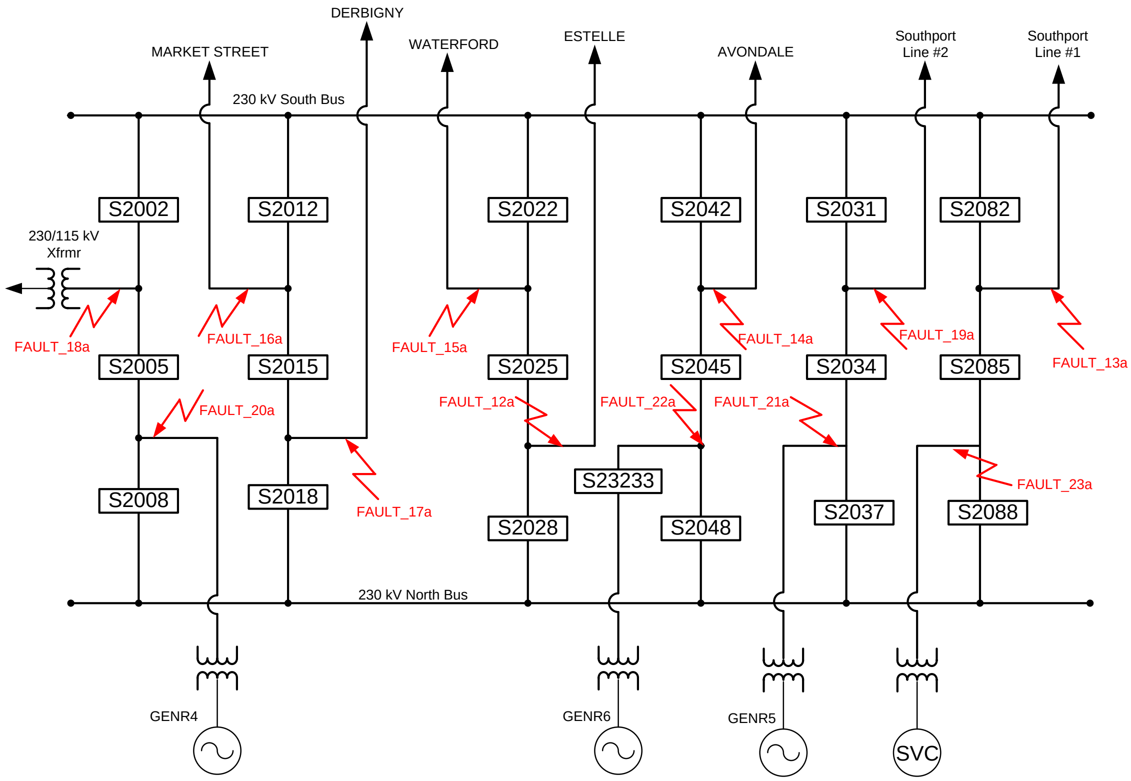

Figure 3-2 – Fault Locations in the Nine Mile 230 kV Substation

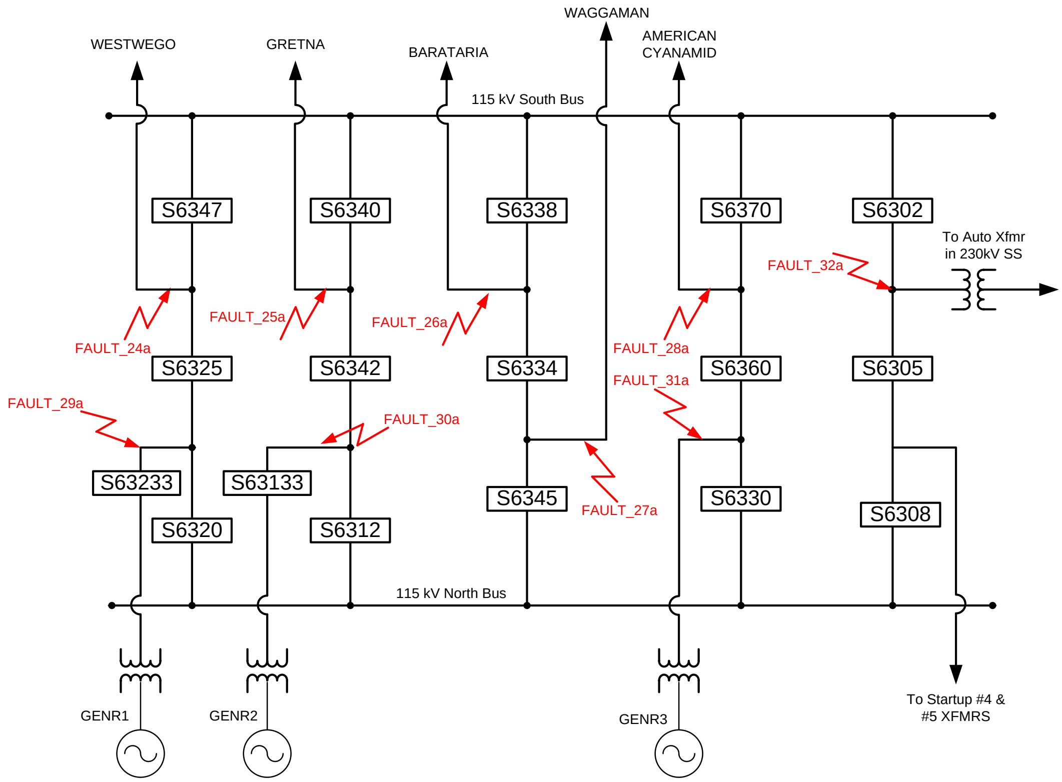

Figure 3-3 – Fault Locations in the Nine Mile 115 kV Substation

4. Stability Analysis Results

The stability analysis was performed to determine the ability of the proposed generation facility to remain in synchronism and within applicable planning standards following system disturbances.

As defined by the scope of work defined by SPP, the stability impact re-study was performed in two phases. The Phase 1 evaluation consisted of the original model (2015 Summer Peak) used for PID 222 previous impact study, updated with the revised plant data. The Phase 2 evaluation consisted of the 2014 summer peak model updated with the revised plant data and the addition of the PID 228 generation facility to the load flow model.

A. Phase 1 – Original Load Flow Model (2015 Summer Peak)

Stability Results

Three-phase faults with stuck breaker (Faults 12a to 32a) were simulated for the specified duration. System voltages, as well as synchronous machine rotor angles were monitored in order to verify if the system maintained synchronism and do not present voltage violations with regards to the voltage recovery criteria following fault clearing and line outages. Table 4-1 summarizes the results obtained from the stability simulations for Phase 1of the PID 222 impact re-study.

Stability plots of the contingencies evaluated are presented in Appendix C.

Table 4-1: Results Obtained – Phase I of PID 222 Stability Analysis

Name	**Dynamic System Performance**
FAULT_12a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_13a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_14a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_15a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_16a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_17a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_18a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_19a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_20a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_21a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_22a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_23a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_24a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_25a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_26a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_27a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_28a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_29a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_30a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_31a	*Stable. Acceptable oscillations damping and voltage recovery*

Name	Dynamic System Performance
FAULT_32a	*Nine Mile Unit 3 loses synchronism. Rest of system stable*

The Entergy system, including the PID 222 combustion and steam turbines, presented a well behaved performance under the contingencies tested, that is, all generators remained in synchronism following the disturbances. Acceptable damping and voltage recovery was observed.

The exception is the Fault_32a, on which the 115/230 kV transformer at Nine Mile substation is tripped off-line following a 3 phase fault at the 115 kV bus with delayed clearing, that is, stuck breaker condition. Under this fault, the generator Nine Mile Unit 3 (bus#336283) loses synchronism with the rest of the system.

Thus, Fault _32a was repeated considering:

- 3 phase fault with normal clearing (6 cycles)
- Single line to ground fault with delayed clearing (breaker S6305 stuck)

The results show that, under less severe faults, the system presented a satisfactory dynamic performance. Nine Mile Unit 3 remained in synchronism following the disturbances. Acceptable damping and voltage recovery was observed.

Table 4-2 summarizes the results obtained from re-evaluation of Fault_32a considering 3 phase fault with normal clearing and single line to ground with stuck breaker.

Table 4-2: Contingencies Re-evaluated – Phase 1 of PID 222 Stability Analysis

Name	Dynamic System Performance
FAULT_32a **3ph normal clearing**	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_13a **SLG stuck breaker**	*Stable. Acceptable oscillations damping and voltage recovery*

Critical Clearing Times

A critical clearing time (CCT) assessment was performed on the system, with and without the Project to determine the impact of the PID 222. Three phase faults with delayed clearing were applied to the Waterford 230 kV substation (as described in Table 3-1) increasing the applied fault time in steps of 1 cycle, until the first generator loses synchronism with the rest of the system.

In all CCT simulations, nearby generators including those at Nine Mile, Waterford and Gypsy substations were monitored in the pre and post-Project conditions. The simulation plots for Phase 1 are included in Appendix D.

Table 4-3 summarizes the results of the critical clearing time analysis for the 2015 Summer Peak model. The results indicate that the PID 222 project does not affect the critical clearing times significantly for all contingencies tested. In fact, for Fault_7A, PID 222 increased the critical clearing time by 1 cycle, from 22 to 23 cycles. For Fault_6a, PID 222 decreased the critical clearing time by 1 cycle, from 14 to 13 cycles.

Table 4-3: Critical Clearing Times for Phase 1- 2015 Summer Peak Model

CONTINGENCY	Without PID 222		With PID 222	
	CCT (cycles)	1st Unit to Lose Synchronism	CCT(cycles)	1st Unit to Lose Synchronism
Fault_1a	17	Waterford Unit 3	17	Waterford Unit 3
Fault_2a	21	Waterford Unit 1	21	Waterford Unit 1
Fault_3a	20	Union Carbide Units	20	Union Carbide Units
Fault_4a	24	Waterford Unit 2	24	Waterford Unit 2
Fault_4b	24	Waterford Unit 1	24	Waterford Unit 1
Fault_5a	18	Waterford Unit 3	18	Waterford Unit 3
Fault_6a	14	Waterford Unit 2	13	Waterford Unit 2
Fault_7a	22	Waterford Unit 2	23	Waterford Unit 2
Fault_8a	21	Waterford Unit 2	21	Waterford Unit 2
Fault_9a	20	Union Carbide Units	20	Union Carbide Units
Fault_10a	20	Union Carbide Units	20	Union Carbide Units
Fault_11a	19	Union Carbide Units	19	Union Carbide Units

B. Phase 2 – 2014 Summer Peak Load Flow Model with PID 228

Stability Results

Three-phase faults with stuck breaker (Faults 12a to 32a) were also simulated for Phase 2, that is, 2014 Summer Peak load flow model, according to the Table 3-2. System voltages, as well as synchronous machine rotor angles were monitored in order to verify if the system maintained synchronism and do not present voltage violations with regards to the voltage recovery criteria following fault clearing and line outages. Table 4-4 summarizes the results obtained.

Stability plots of the contingencies evaluated for Phase 2 are also included in Appendix C.

Table 4-4: Results Obtained – Phase 2 of PID 222 Stability Analysis

Name	**Dynamic System Performance**
FAULT_12a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_13a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_14a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_15a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_16a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_17a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_18a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_19a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_20a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_21a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_22a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_23a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_24a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_25a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_26a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_27a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_28a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_29a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_30a	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_31a	*Stable. Acceptable oscillations damping and voltage recovery*

Name	Dynamic System Performance
FAULT_32a	*Nine Mile Unit 3 loses synchronism. Rest of system stable*

Like in Phase 1, Fault _32a also causes the Nine Mile Unit 3 to lose synchronism in Phase 2.

Therefore this simulation was repeated considering:

- 3 phase fault with normal clearing (6 cycles)
- Single line to ground fault with delayed clearing (breaker S6305 stuck)

The results show that, under less severe faults, the system presented a satisfactory dynamic performance. Nine Mile Unit 3 remained in synchronism following the disturbances. Acceptable damping and voltage recovery was observed.

Table 4-5 summarizes the results obtained from re-evaluation of Fault_32a considering 3 phase fault with normal clearing and single line to ground with stuck breaker.

Table 4-5: Contingencies Re-evaluated – Phase 2 of PID 222 Stability Analysis

Name	Dynamic System Performance
FAULT_32a **3ph normal clearing**	*Stable. Acceptable oscillations damping and voltage recovery*
FAULT_13a **SLG stuck breaker**	*Stable. Acceptable oscillations damping and voltage recovery*

Critical Clearing Times

A critical clearing time (CCT) assessment was performed on the 2014 Summer Peak load flow model, with and without the Project to determine the impact of the PID 222 on the clearing times. Three phase faults with delayed clearing were applied to the Waterford 230 kV substation (as described in Table 3-1) increasing the applied fault time in steps of 1 cycle, until the first generator loses synchronism with the rest of the system.

In all CCT simulations, nearby generators including those at Nine Mile, Waterford and Gypsy substations were monitored in the pre and post-Project conditions. The simulation plots for Phase 2 are also included in Appendix D.

Table 4-5 summarizes the results of the critical clearing time analysis for the 2014 Summer Peak model. The results indicate that the PID 222 project does not have a significant impact in the critical clearing times for all contingencies tested. For Fault_1A, PID 222 decreased the critical clearing time by 1 cycle, from 17 to 16 cycles.

Table 4-6: Critical Clearing Times for Phase 2- 2014 Summer Peak Model

CONTINGENCY	Without PID 222		With PID 222	
	CCT (cycles)	1st Unit to Lose Synchronism	CCT(cycles)	1st Unit to Lose Synchronism
Fault_1a	17	Waterford Unit 3	16	Waterford Unit 3

CONTINGENCY	Without PID 222		With PID 222	
	CCT (cycles)	1st Unit to Lose Synchronism	CCT(cycles)	1st Unit to Lose Synchronism
Fault_2a	22	Waterford Unit 3	22	Waterford Unit 3
Fault_3a	21	Waterford Unit 3	21	Waterford Unit 3
Fault_4a	24	Waterford Unit 2	24	Waterford Unit 2
Fault_4b	24	Waterford Unit 1	24	Waterford Unit 1
Fault_5a	18	Waterford Unit 3	18	Waterford Unit 3
Fault_6a	13	Waterford Unit 3	13	Waterford Unit 3
Fault_7a	23	Waterford Unit 3	23	Waterford Unit 3
Fault_8a	22	Waterford Unit 3	22	Waterford Unit 3
Fault_9a	21	Waterford Unit 3	21	Waterford Unit 3
Fault_10a	20	Waterford Unit 3	20	Waterford Unit 3
Fault_11a	20	Waterford Unit 3	20	Waterford Unit 3

Conclusions

The purpose of this report is to present the results of the stability analysis performed to re-evaluate the impact of the proposed PID 222 project on the Entergy's system dynamic performance, considering the original system model updated with the revised plant data and also evaluate PID 222 using a different system model (2014 summer peak), updated with the revised plant data and PID 228 interconnection request.

Stability models for the PID 222 combustion and steam units were added to the Entergy's stability database, based on the technical documentation provided by the developer. The tests performed to the Excitation system and PSS indicate properly damped performance, which indicates adequate set of parameters provided for PID 222. The combustion turbine speed governor models present settings consistent with the characteristics of the generator/turbine, the steam turbine governor model settings causes the governor to be practically inactive during the time range of the stability simulations.

The stability impact re-study was performed for the two phases of the re-study. Three-phase faults with stuck breaker (Faults 12a to 32a listed in Table 3-2) were simulated for both Phases 1 and 2. The results obtained demonstrate that:
The PID 222 proposed project, did not lose synchronism with the system trip during any of the contingencies tested.

All other synchronous generators in the monitored areas were stable and remained in synchronism during the majority of contingencies simulated.

Acceptable damping and voltage recovery was observed, within applicable standards, that is, no violations to the voltage dip criteria.

The exception is the Fault_32a, on which the 115/230 kV transformer at Nine Mile substation is tripped off-line following a 3 phase fault at the 115 kV bus with delayed clearing, that is, stuck breaker condition. Under this fault, the generator Nine Mile Unit 3 (bus#336283) loses synchronism with the rest of the system.

Thus, Fault _32a was repeated considering two different fault conditions: 3 phase fault with normal clearing (6 cycles) and single line to ground fault with delayed clearing. The results show that the system presented a satisfactory dynamic performance. The Nine Mile Unit 3 remained in synchronism following the disturbances with acceptable damping and voltage recovery.

A Critical Clearing Time (CCT) assessment was performed on the system with and without PID 222 in both Phases of the re-study. The 3 phase faults specified in Table 3-1were applied increasing the applied fault time in steps of 1 cycle, until the first generator loses synchronism with the rest of the system. The results obtained led to the conclusion that the PID 222 project does have a significant impact on the critical clearing times for all contingencies tested.

General Conclusion

The PID 222 project, with its 2 combustion turbines and 1 steam turbine does not cause any detrimental impact on the Entergy system, in terms of dynamic performance, for the conditions and contingencies tested. Therefore PID 222 project is able to deliver its full power output to the Entergy transmission system without compromising the system reliability.

Short Circuit Analysis

The method used to determine if any short circuit problems would be caused by the addition of the PID 222 generation is as follows:

1. Methodology

Three-phase and single-phase to ground faults were simulated on the Entergy base case short circuit model and the worst case short circuit level was determined at each station. The PID 222 generator was then modeled in the base case with the new parameters to generate a revised short circuit model. The base case short circuit results were then compared with the results from the revised model to identify any breakers that were under-rated as a result of additional short circuit contribution from PID 222 generation. Any breakers identified to be upgraded through this comparison are mandatory upgrades.

2. Analysis Results

The results of the short circuit analysis indicated that the additional generation due to PID 222 generation causes an increase in short circuit current such that they exceed the fault interrupting capability of the high voltage circuit breakers within the vicinity of the PID 222 plant with priors and without priors. The Michoud 115kV breaker 9803 was already identified in the previous analysis, but Ninemile 115kV breaker S6342 was identified in the new analysis. Priors included are: PID 228. This project was chosen due to its close proximity to the PID 222 project.

3. Problem Resolution

Replace 1 breaker Michoud 115kV(N9803) (*Approved CP Project*)
Estimated Cost is $**351,900**

Replace 1 breaker Ninemile 115kV (S6342)
Estimated Cost is $**351,900**

Appendix A: Modeling Detail

This appendix contains the PSS®E raw data file and a single line diagram, documenting the steady state modeling for the PID 222.

PSS/E Raw Data File

```
1,   100.00         / PSS/E-30.3    TUE, AUG 23 2011  10:51

336240,'PID-222 CT1 ',  18.0000,2,     0.000,     0.000, 351, 104,1.00000,  41.5745,   1
336241,'PID-222 CT2 ',  18.0000,2,     0.000,     0.000, 351, 104,1.05662,  41.1402,   1
336242,'PID-222 ST1 ',  18.0000,2,     0.000,     0.000, 351, 104,1.00000,  40.0690,   1
336411,'            ', 115.0000,1,     0.000,     0.000, 351, 130,1.01886,  31.8399,   1
336421,'PID-228     ',  13.8000,2,     0.000,     0.000, 351, 130,1.07107,  37.4187,  36
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
336240,'1 ',   179.300,    -7.582,   115.000,   -80.000,1.00000,     0,   225.000,   0.00000,
0.19000,   0.00000,   0.00000,1.00000,1,  100.0,   179.300,     0.000,   1,1.0000
336241,'1 ',   179.300,    91.423,   115.000,   -80.000,1.00000,334072,   225.000,   0.00000,
0.19000,   0.00000,   0.00000,1.00000,1,  100.0,   179.300,     0.000,   1,1.0000
336242,'1 ',   211.600,   -32.336,   160.000,  -110.000,1.00000,     0,   306.000,   0.00000,
0.24400,   0.00000,   0.00000,1.00000,1,  100.0,   211.650,     0.000,   1,1.0000
336421,'1 ',   104.000,    56.000,    56.000,   -34.000,1.02000,336411,   126.320,   0.00000,
0.14000,   0.00000,   0.00000,1.00000,1,  100.0,   104.000,     0.000,  36,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
336411,-336412,'1 ',   0.00230,   0.01705,   0.00741,  208.00,  208.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,   3.11,   1,1.0000
336411, 336416,'1 ',   0.00230,   0.01705,   0.00741,  208.00,  208.00,    0.00,  0.00000,  0.00000,
0.00000,  0.00000,1,   3.11,   1,1.0000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
336280,336240,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
  0.00258,   0.07740,   130.00
1.00000,   0.000,   0.000,   217.00,   217.00,   217.00, 0,      0, 1.10000, 0.90000, 1.10000,
0.90000,   5, 0, 0.00000, 0.00000
1.00000,   0.000
336280,336241,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
  0.00258,   0.07740,   130.00
1.00000,   0.000,   0.000,   217.00,   217.00,   217.00, 0,      0, 1.10000, 0.90000, 1.10000,
0.90000,   5, 0, 0.00000, 0.00000
1.00000,   0.000
336250,336242,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
  0.00258,   0.07740,   180.00
1.00000,   0.000,   0.000,   300.00,   300.00,   300.00, 0,      0, 1.10000, 0.90000, 1.10000,
0.90000,   5, 0, 0.00000, 0.00000
1.00000,   0.000
336411,336421,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID_228     ',1,   1,1.0000
  0.00222,   0.07770,    75.00
1.00000,   0.000,   0.000,   125.00,   125.00,   125.00, 0,      0, 1.05000, 0.95000, 1.10000,
0.90000,   5, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
 351,337653,   125.900,    10.000,'EES         '
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VSC DC LINE DATA
0 / END OF VSC DC LINE DATA, BEGIN SWITCHED SHUNT DATA
```

0 / END OF SWITCHED SHUNT DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
 104,'GSTNCN   '
 130,'NORDSG   '
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
   1,'DEFAULT   '
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA

PID 222 Single Line Diagrams

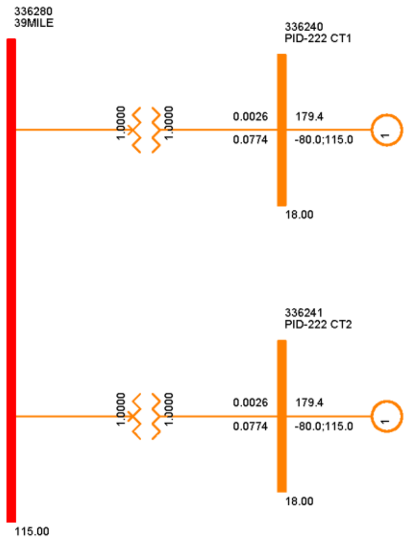

Figure A-1 – PID 222 Modeling Detail – CT1 & 2

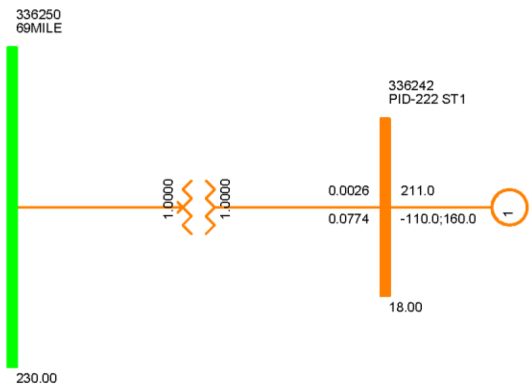

Figure A-2 – PID 222 Modeling Detail – ST

Appendix B: Stability Models

This appendix shows the PSS®E dynamic models and parameters used to represent the PID 222 project in the stability simulations.

Synchronous Generators

PID 222 – CT1

```
** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336240 PID-222 CT1  18.000 1   44592-44605   19967-19972

          MBASE     Z S O R C E        X T R A N      GENTAP
          225.0  0.00000+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
  7.04 0.040  0.57 0.080   5.04  0.00 2.0300 1.9100 0.2550 0.4500 0.1900 0.1710

                        S(1.0)  S(1.2)
                                             0.560  5500
```

PID 222 – CT2

```
** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336241 PID-222 CT2  18.000 1   44606-44619   19973-19978

          MBASE     Z S O R C E        X T R A N      GENTAP
          225.0  0.00000+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
  7.04 0.040  0.57 0.080   5.04  0.00 2.0300 1.9100 0.2550 0.4500 0.1900 0.1710

                        S(1.0)  S(1.2)
                                             0.560  5500
```

PID 222 – ST

```
** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336242 PID-222 ST1  18.000 1   44620-44633   19979-19984

          MBASE     Z S O R C E        X T R A N      GENTAP
          306.0  0.00000+J 0.24400  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
  8.70 0.024  0.83 0.040   2.94  0.00 2.2200 2.1700 0.2950 0.4680 0.2440 0.2190

                        S(1.0)  S(1.2)
                        0.0560  0.6000
```

Power System Stabilizer (PSS)

PID 222 – CT1

** UPSS2B ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S V A R S I C O N S
336240 PID-222 CT1 18.000 1 55098-55120 28597-28613 2355-2358 3210-3215

IC1 REMBUS1 IC2 REMBUS2 M N
1 0 3 0 5 1

TW1	TW2	T6	TW3	TW4	T7	KS2	KS3
2.000	2.000	0.000	2.000	0.000	2.000	0.199	1.000

T8	T9	KS1	T1	T2	T3	T4	T10	T11	
0.500	0.100	8.000	0.150	0.030	0.150	0.030	0.000	0.000	

VS1MAX	VS1MIN	VS2MAX	VS2MIN	VSTMAX	VSTMIN
0.80	-0.080	1.250	-1.250	0.100	-0.100

PID 222 – CT2

** UPSS2B ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S V A R S I C O N S
336241 PID-222 CT2 18.000 1 55121-55143 28614-28630 2359-2362 3216-3221

IC1 REMBUS1 IC2 REMBUS2 M N
1 0 3 0 5 1

TW1	TW2	T6	TW3	TW4	T7	KS2	KS3
2.000	2.000	0.000	2.000	0.000	2.000	0.199	1.000

T8	T9	KS1	T1	T2	T3	T4	T10	T11	
0.500	0.100	8.000	0.150	0.030	0.150	0.030	0.000	0.000	

VS1MAX	VS1MIN	VS2MAX	VS2MIN	VSTMAX	VSTMIN
0.80	-0.080	1.250	-1.250	0.100	-0.100

PID 222 – ST

** PSS2A ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S V A R S I C O N S
336242 PID-222 ST1 18.000 1 55144-55160 28631-28646 2363-2366 3222-3227

IC1 REMBUS1 IC2 REMBUS2 M N
1 0 3 0 5 1

TW1	TW2	T6	TW3	TW4	T7	KS2	KS3
2.000	2.000	0.000	2.000	0.000	2.000	0.340	1.000

T8	T9	KS1	T1	T2	T3	T4	VSTMAX	VSTMIN
0.500	0.100	8.000	0.150	0.030	0.150	0.030	0.100	-0.100

Excitation System

PID 222 – CT1

```
** ESST4B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336240 PID-222 CT1  18.000 1  102058-102074  41438-41441

    TR    KPR     KIR     VRMAX    VRMIN    TA     KPM     KIM    VMMAX   VMMIN
  0.000   3.570   3.570   0.960  -0.830   0.010   1.000   0.000   0.960  -0.830

          KG      KP      KI   VBMAX     KC      XL    THETAP
               0.06.190   0.000   7.750   0.080  0.0000   0.000
```

PID 222 – CT2

```
** ESST4B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336241 PID-222 CT2  18.000 1  102075-102091  41442-41445

    TR    KPR     KIR     VRMAX    VRMIN    TA     KPM     KIM    VMMAX   VMMIN
  0.000   3.570   3.570   0.960  -0.830   0.010   1.000   0.000   0.960  -0.830

          KG      KP      KI   VBMAX     KC      XL    THETAP
               0.06.190   0.000   7.750   0.080  0.0000   0.000
```

PID 222 – ST

```
** ESST4B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
         336242 PID-222 ST1  18.000 1  102092-102108  41446-41449

    TR    KPR     KIR     VRMAX    VRMIN    TA     KPM     KIM    VMMAX   VMMIN
  0.000   3.260   3.260   0.960  -0.830   0.010   1.000   0.000   0.960  -0.830
          KG      KP      KI   VBMAX     KC      XL    THETAP
        0.000   6.130   0.000   7.750   0.080  0.0000   0.000
```

Turbine Governor

PID 222 – CT1

** GGOV1 ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S V A R S ICONS
336240 PID-222 CT1 18.000 1 130248-130280 51099-51108 8104-8123 3842-3843

R	TPELEC	MAXERR	MINERR	KPGOV	KIGOV	KDGOV	TDGOV	VMAX	VMIN
0.040	1.000	0.050	-0.050	10.000	2.000	0.000	1.000	1.000	0.150

TACT	KTURB	WFNL	TB	TC	TENG	TFLOAD	KPLOAD	KILOAD	LDREF
0.500	1.500	0.200	0.100	0.000	0.000	3.000	2.000	0.670	1.062

DM	ROPEN	RCLOSE	KIMW	ASET	KA	TA	TRATE	DB
0.000	0.100	-0.100	0.000	0.010	10.000	0.100	179.300	0.000

TSA	TSB	RUP	RDOWN
4.000	5.000	99.000	-99.000

ICON(M)= 1 (Feedback signal for governor droop)
ICON(M+1)= 0 (Switch for fuel source characteristic)

PID 222 – CT2

** GGOV1 ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S V A R S ICONS
336241 PID-222 CT2 18.000 1 130281-130313 51109-51118 8125-8144 3844-3845

R	TPELEC	MAXERR	MINERR	KPGOV	KIGOV	KDGOV	TDGOV	VMAX	VMIN
0.040	1.000	0.050	-0.050	10.000	2.000	0.000	1.000	1.000	0.150

TACT	KTURB	WFNL	TB	TC	TENG	TFLOAD	KPLOAD	KILOAD	LDREF
0.500	1.500	0.200	0.100	0.000	0.000	3.000	2.000	0.670	1.062

DM	ROPEN	RCLOSE	KIMW	ASET	KA	TA	TRATE	DB
0.000	0.100	-0.100	0.000	0.010	10.000	0.100	179.300	0.000

TSA	TSB	RUP	RDOWN
4.000	5.000	99.000	-99.000

ICON(M)= 1 (Feedback signal for governor droop)
ICON(M+1)= 0 (Switch for fuel source characteristic)

PID 222 – ST

** TGOV1 ** BUS X-- NAME --X BASEKV MC C O N S S T A T E S VAR
336242 PID-222 ST1 18.000 1 130314-130320 51119-51120 8146

R	T1	VMAX	VMIN	T2	T3	DT
0.050	999.000	1.000	0.000	2.100	7.000	0.000

APPENDIX C: Plots for Stability Simulations

Plots will be posted in a separate posting titled *System Impact Study Report Stability Plots*.

The plots can be viewed at the following link:

http://www.oatioasis.com/EES/EESDocs/interconnection_studies_ICT.htm