# System Impact Study Report
# PID 231
# 31 MW Plant

**Prepared by:**
**Southwest Power Pool, Independent Coordinator of Transmission (SPP ICT)**
**415 North McKinley, Suite 140**
**Little Rock, AR 72205**

**Revision: 0**

| Rev | Issue Date | Description of Revision | Revised By | Project Manager |
|---|---|---|---|---|
| 0 | 11/20/09 | Posted | HDE | JDH |

# Executive Summary:

This System Impact Study is the second step of the interconnection process and is based on the PID-231 request for interconnection on Entergy's transmission system at the Good Hope 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.

PID 231 intends to install a 31 MW generator in the Entergy transmission system. PID 231 is an ERIS only project. The proposed project will be connected at the Good Hope 230 kV substation using a 13.8/230 kV step up transformer. The load flow study was not required because the generator would not be exporting power. The short circuit study was performed on the Entergy system short circuit model using ASPEN software. The requested in-service date for this facility is June 1, 2010.

Results of the System Impact Study contend that under ERIS, the estimated upgrade cost with priors is $0 and without priors is $0.

**Estimated Project Planning Upgrades for PID 231**

| Study | Estimated cost With Priors ($) | Estimated cost Without Priors ($) |
|---|---|---|
| ERIS | $0 | $0 |

The costs of the upgrades are planning estimates only.

TABLE OF CONTENTS FOR SECTION –A (ERIS)

# Section – A

Energy Resource Interconnection Service

# I. Introduction

This Energy Resource Interconnection Service (ERIS) is based on the PID 231 request for interconnection on Entergy's transmission system at the Good Hope 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

## A. 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 231 unit.

## B. Short Circuit Analysis

The method used to determine if any short circuit problems would be caused by the addition of the PID 231 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 231 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 231 generation. The breakers identified to be upgraded through this comparison are *mandatory* upgrades.

## C. Analysis Results

The results of the short circuit analysis indicates that the additional generation due to PID 231 generator does not cause an increase in short circuit current such that they exceed the fault interrupting capability of the high voltage circuit breakers within the Entergy Transmission system.

### D. Problem Resolution

There were no problems identified for this part of the study that were a result of the additional PID 231 generation.

# III. Load Flow Analysis

No load flow analysis performed due to generator not exporting power and interconnection request of ERIS. If the generator would like to export power at some point in the future then the generator would need to re enter the generation interconnection queue to have a load flow analysis performed.

# IV. Stability Analysis

### A. Executive Summary

Southwest Power Pool (SPP) has commissioned ABB Inc. to perform a stability analysis for system impact study of PID-231, which is an interconnection request for 31 MW of generation at the Good Hope 230 kV substation in the Entergy transmission system. The feasibility (power flow) study was not performed as a part of this study.

The objective of this study was to evaluate the impact of proposed PID-231 (31 MW) on system stability and the nearby transmission system and generating stations. The study was performed on 2012 Summer Peak case, provided by SPP/Entergy.

The system was stable following all simulated three-phase normally cleared and stuck-breaker faults ***except for Fault_7_3PH***.

Following **Fault_7_3PH**, 6+9 cycle three-phase stuck breaker fault involving loss of Prospect – WESCO 230 kV line, the proposed PID-231 project was found to be UNSTABLE. All other units in Entergy system were found to be STABLE. The developer should consider an over speed protection or an out-of-step protection system to trip PID-231 Project in order to prevent damage to the PID-231 generator unit following such conditions. The 6 + 9 cycle stuck-breaker single-line-to-ground (SLG) fault involving loss of Prospect – WESCO 230kV line was simulated. All the generators in Entergy system including the PID-231 were found to be STABLE following the delayed clearing single-line-to-ground fault.

The Fault_7_3PH is a NERC category D fault (Extreme Contingency). Hence per the NERC transmission planning criteria the instability of PID-231 project following Fault_7_3PH was not deemed to be a stability criteria violation. No voltage criteria violation was observed following simulated faults.

Based on the results of stability analysis it can be concluded that interconnection of the proposed PID-231 (31 MW) generation at the Good Hope 230 kV bus does not adversely impact the stability of the Entergy System in the local area.

*The results of this analysis are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study model change, the results provided in this report may not apply.*

## B. INTRODUCTION

SPP has commissioned ABB Inc. to perform a stability analysis for System Impact study of PID-231, which is an interconnection request for 31 MW of generation at the Good Hope 230 kV bus in the Entergy transmission system. The feasibility (power flow) study was not performed as a part of this study.

The objective of the impact study is to evaluate the impact on system stability after connecting the additional 31 MW generation and its impact on the nearby transmission system and generating stations. The study was performed on 2012 Summer Peak case, provided by Entergy. Figure 0-1 shows the location of the proposed 31 MW generation interconnecting station.

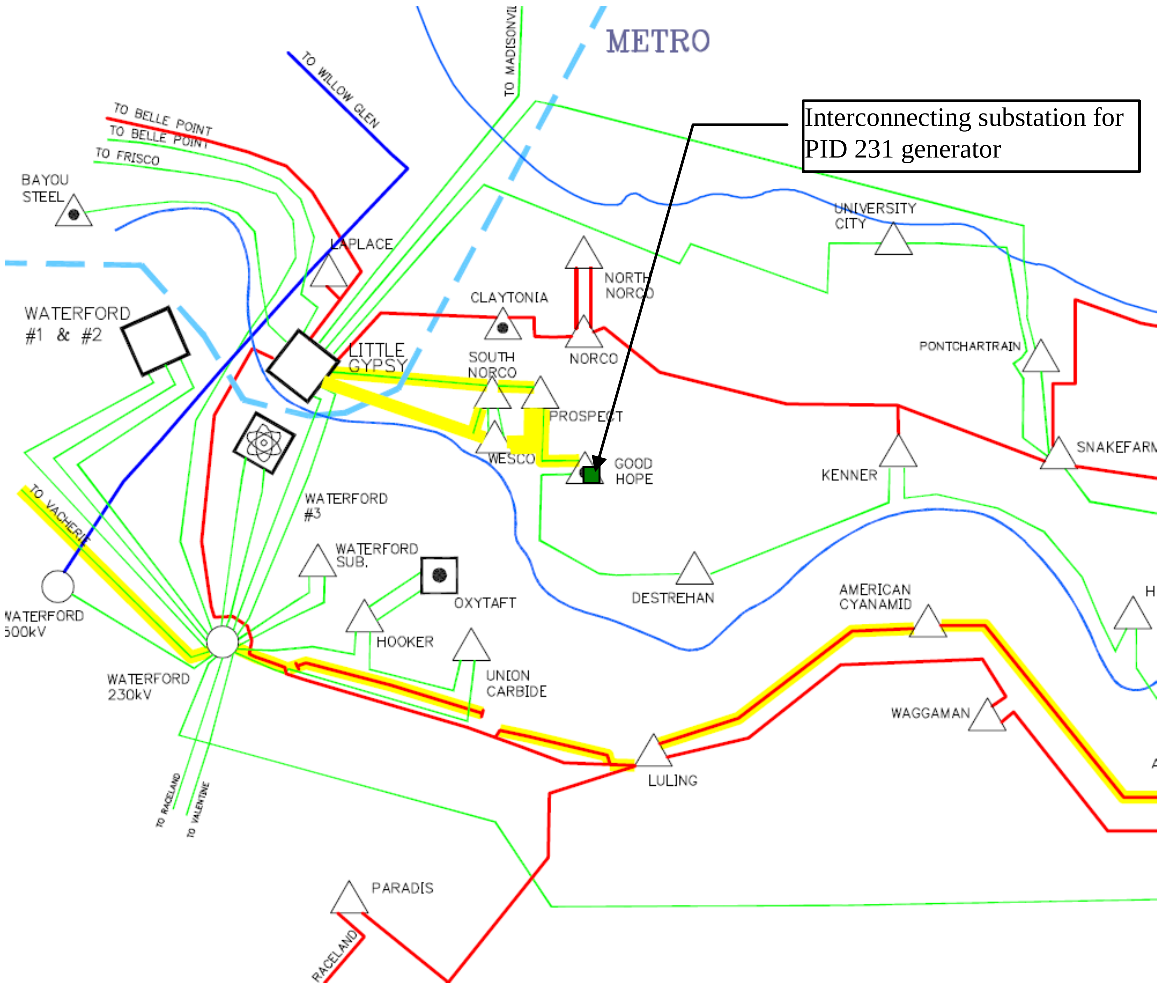



Figure 0-1: PID-231 interconnecting substation

## C. STABILITY ANALYSIS

### *i. STABILITY ANALYSIS METHODOLOGY*

Using Planning Standards approved by NERC, the following stability definition was applied in the Transient Stability Analysis:

"Power system stability is defined as that condition in which the differences of the angular positions of synchronous machine rotors become constant following an aperiodic system disturbance."

Stability analysis was performed using Siemens-PTI's PSS/E$^{TM}$ dynamics program V30.3.2. Three-phase and single-phase line faults were simulated for the specified durations and the synchronous machine rotor angles were monitored to make sure they maintained synchronism following the fault removal.

All the breakers at Good Hope 230 kV substation are assumed to be common trip breakers. Based on the Entergy study criteria, three-phase faults with normal clearing and delayed clearing were simulated.

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.

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

## *ii.* *STUDY MODEL DEVELOPMENT*

The study model consists of power flow cases and dynamics databases, developed as follows.

***Power Flow Case***

A Powerflow case "EN12S08_Final_U2_r3+2009CPupg+GI_Priors_unconv.sav" representing the 2012 Summer Peak conditions was provided by SPP/ Entergy.

Three prior-queued projects, PID-223 (125 MW),PID-224 (100 MW), and PID-228 (114.8 MW) were added to the basecase. The 35 MW load connected at Good Hope 230 kV substation in the provided basecase was moved to Good Hope 69 kV substation. The derived powerflow case was saved as 'PRE-PID-231.sav'. This was considered as the Pre-PID-231 case.

The proposed PID-231 project will be connected to the 230 kV Good Hope (#336213) with one 230/13.8 kV transformer. The proposed project was added to the pre-project "PRE-PID-231.sav" case and the generation was dispatched against the White Bluff Unit 1. Table 2-1 summarizes the dispatch. Thus a post-project power flow case with PID-231 was established and named as 'POST-PID-231.sav'.

**Table 0-1: PID-231 project details**

| System condition | MW | Point of Interconnection | Sink |
|---|---|---|---|
| 2012 Summer Peak | 31 | Good Hope 230 kV Substation (#336213) | White Bluff Unit 1 (#337652) |

Figure 2-1 and Figure 2-2 show the PSS/E one-line diagrams for the local area WITHOUT and WITH the PID-231 project, respectively, for 2012 Summer Peak system conditions.

***Stability Database***

A basecase stability database was provided by SPP/Entergy in a PSSE *.dyr file format ('red11S_newnum.dyr').

To create a dynamic database (a snapshot file) for Pre-PID-231 powerflow case, stability data for PID-223, PID-224 and PID-228 was appended to the basecase stability database. The dynamic data for the PID-226 project was updated to eliminate the simulation errors. 0gives the modified dynamic data for PID-226 project. Thus a *.dyr file for the pre project case 'PRE-PID-231.dyr' is developed.

Then, the stability data for PID-231 was appended to the pre-project stability database to create dynamic database for Post-PID-231 powerflow case.

The data provided at the Interconnection Request for PID-231 is included in 0. The PSS/E power flow and stability data for PID-231, used for this study, are included in 0.

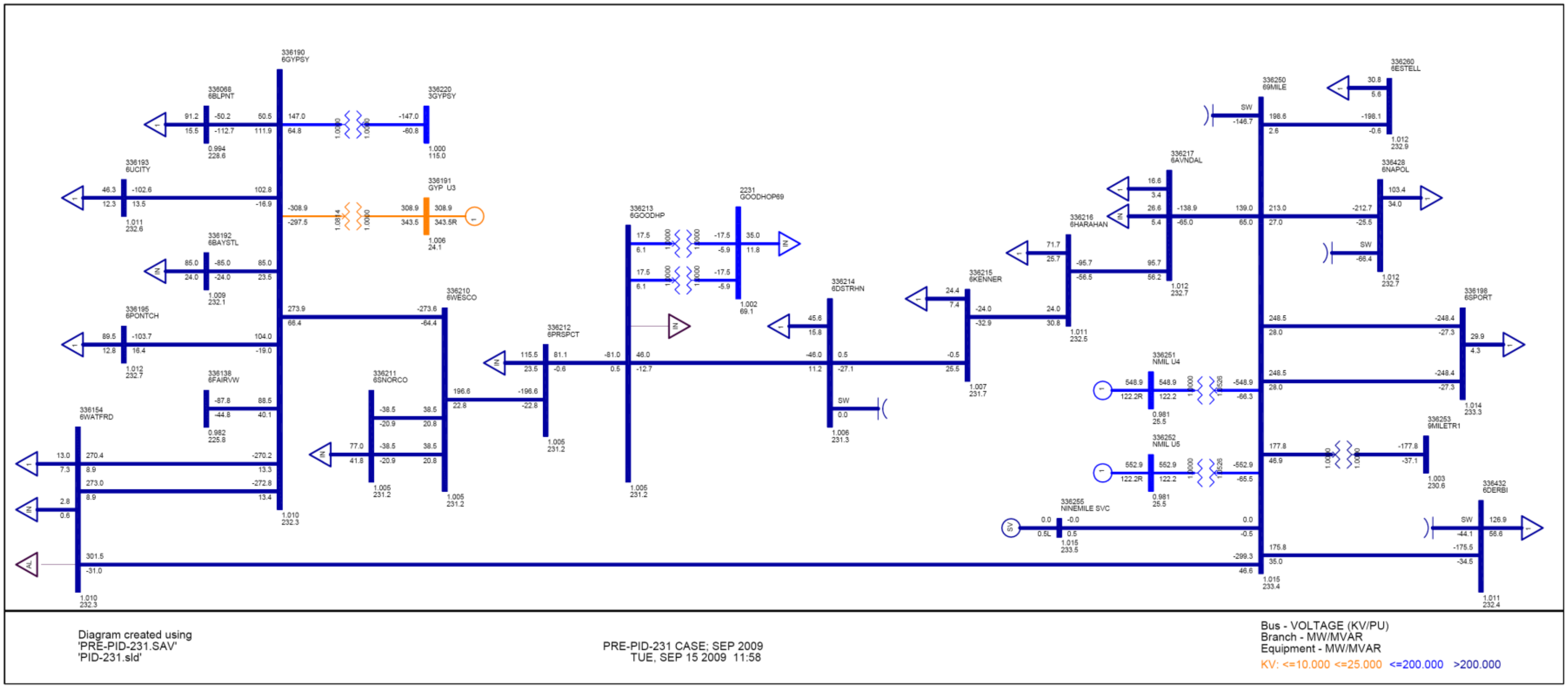



**Figure 0-2: 2012 Summer Peak Flows and Voltages <u>without</u> PID-231**

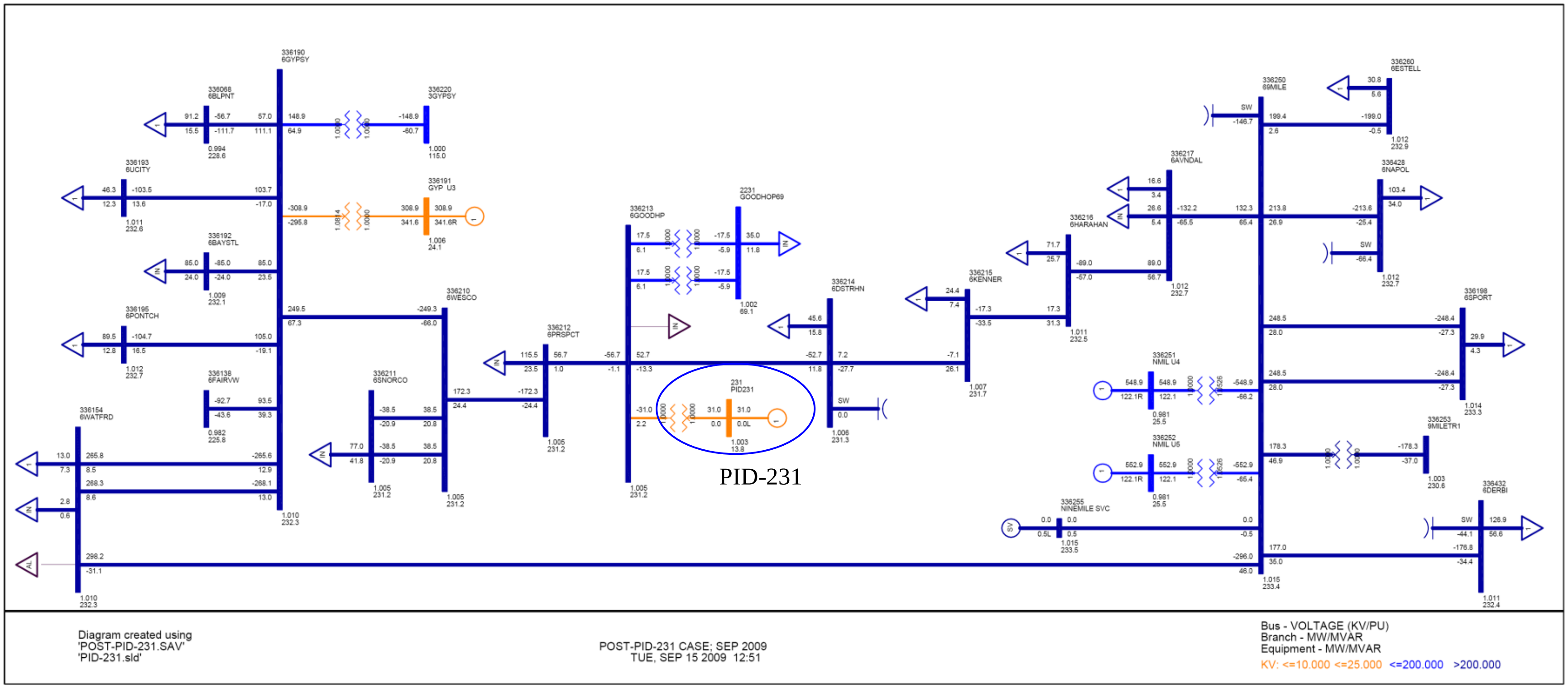



**Figure 0-3: 2012 Summer Peak Flows and Voltages with PID-231**

## *iii.* *TRANSIENT STABILITY ANALYSIS*

Stability simulations were run to examine the transient behavior of the PID-231 generator and its impact on the Entergy system. Stability analysis was performed using the following procedure. First, three-phase faults with normal clearing were simulated. Next, the stuck breaker three phase fault conditions were simulated. If a stuck breaker fault was found to be unstable, then a single-line-to-ground (SLG) fault followed by breaker failure was studied. This procedure is being followed since if the units are stable for a more severe fault (such as three phase fault with breaker failure) then the need to study stability for a less severe fault (such as SLG fault with breaker failure) does not arise. The fault clearing times used for the simulations are given inTable 0-2.

**Table 0-2: Fault Clearing Times**

| Contingency at kV level | Normal Clearing | Delayed Clearing |
|---|---|---|
| 230 | 6 cycles | 6+9 cycles |

The breaker failure scenario was 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.

3) The fault is then cleared by back-up clearing. If the system was found to be unstable, then the fault was repeated without the proposed PID-231 plant.

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

Table 0-3 lists all the fault cases that were simulated in this study..

FLT_1_3PH to FLT_6_3PH represent the normally cleared 3-phase faults. FLT_7_3PH and FLT_8_3PH Faults represent the 3-phase stuck breaker faults.

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 0-3: Fault Cases Simulated for Post-project Case: 3-phase faults with normal clearing**

| CASE | LOCATION | TYPE | CLEARING TIME (cycles) | | BREKAER # | | | TRIPPED FACILITIES | STABLE? | Acceptable Voltages? |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | PRIMARY | BACKUP | STUCK BRK | PRIMARY | SECONDARY | | | |
| FAULT_1_3PH | Good Hope 230 kV | 3 PH | 6 | -- | | S6455, GCB#S8272, GCB#S4799 | -- | Good Hope - Prospect 230 kV | YES | YES |
| FAULT_2_3PH | Good Hope 230 kV | 3 PH | 6 | -- | | S6430, GCB#S8801 | -- | Good Hope - Destrehan - Harahan 230 kV | YES | YES |
| FAULT_3_3PH | Prospect 230 kV | 3 PH | 6 | -- | | S7726, S3930, GCB#S3095, GCB#S3098 | -- | Prospect - WESCO 230 kV | YES | YES |
| FAULT_4_3PH | Harahan 230 kV | 3 PH | 6 | -- | | S6601, GCB#S2042, GCB#S2045 | -- | Harahan - Avondale - Nine Mile 230 kV | YES | YES |
| FAULT_5_3PH | Gypsy U3 | 3 PH | 6 | -- | | | -- | Gypsy Unit #3 (545 MW) | YES | YES |
| FAULT_6_3PH | Nine Mile U4 | 3 PH | 6 | -- | | | -- | Nine Mile Unit #4 (730 MW) | YES | YES |
| FAULT_7_3PH | Prospect 230 kV | 3 PH Stuck BRK | 6 | 9 | S3930 | S7726, GCB#S3095, GCB#S3098 | S4824, M4 | Prospect - WESCO 230 kV | YES | YES |
| FAULT_8_3PH * | Harahan 230 kV | 3 PH Stuck BRK | 6 | 9 | S6601 | GCB#S2042, GCB#S2045 | S5962 | Harahan - Avondale - Nine Mile 230 kV and Good Hope - Destrehan - Harahan 230 kV | YES | YES |

**Note:-**
* The loads at Harahan 230 kV and Prospect Substation have been modeled as lumped load without the detailed step-down transformers. Hence, the loss of partial load was not simulated following the stuck breaker event.

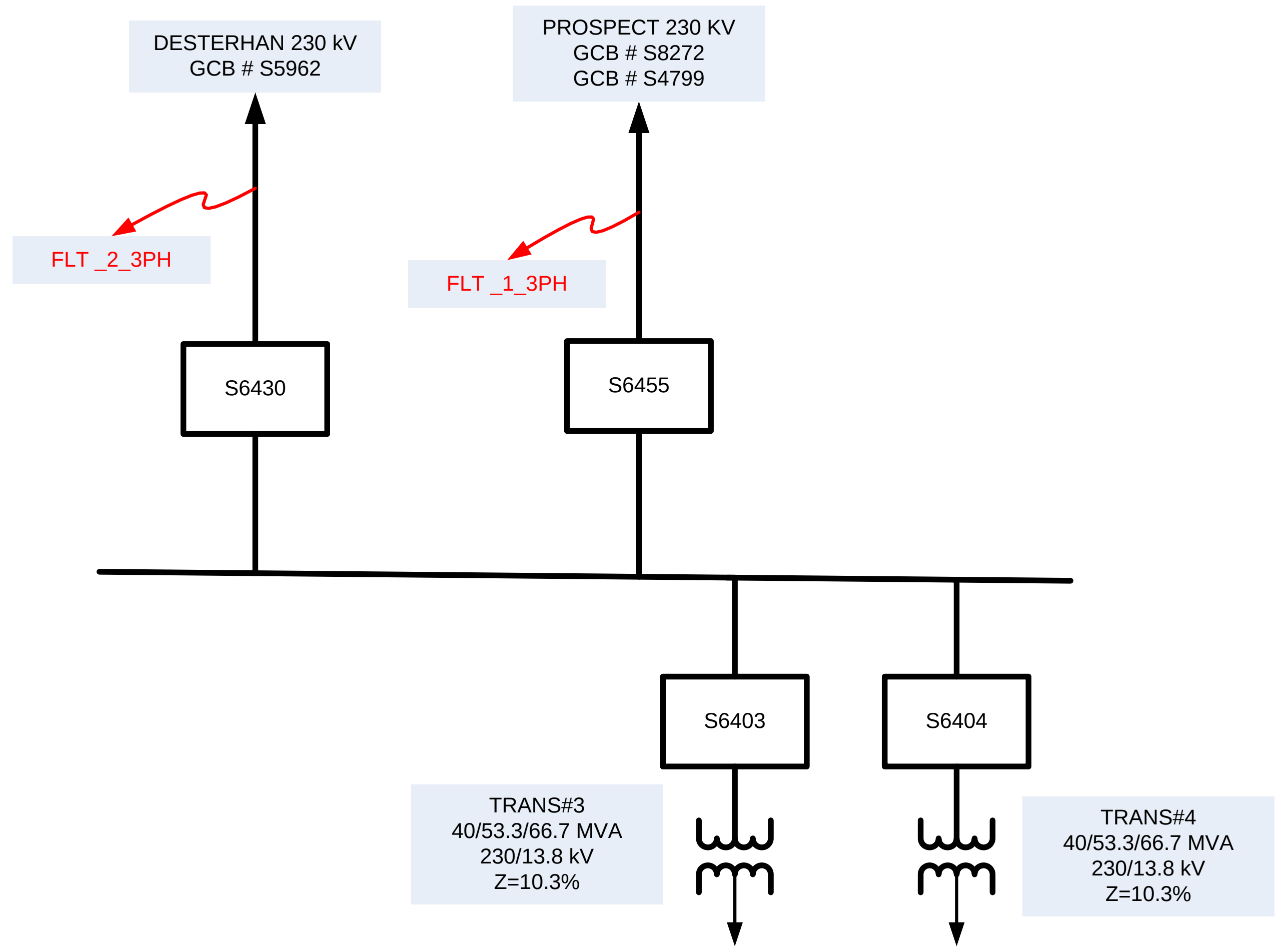



**Figure 0-4 Layout diagram for Good Hope Substation**

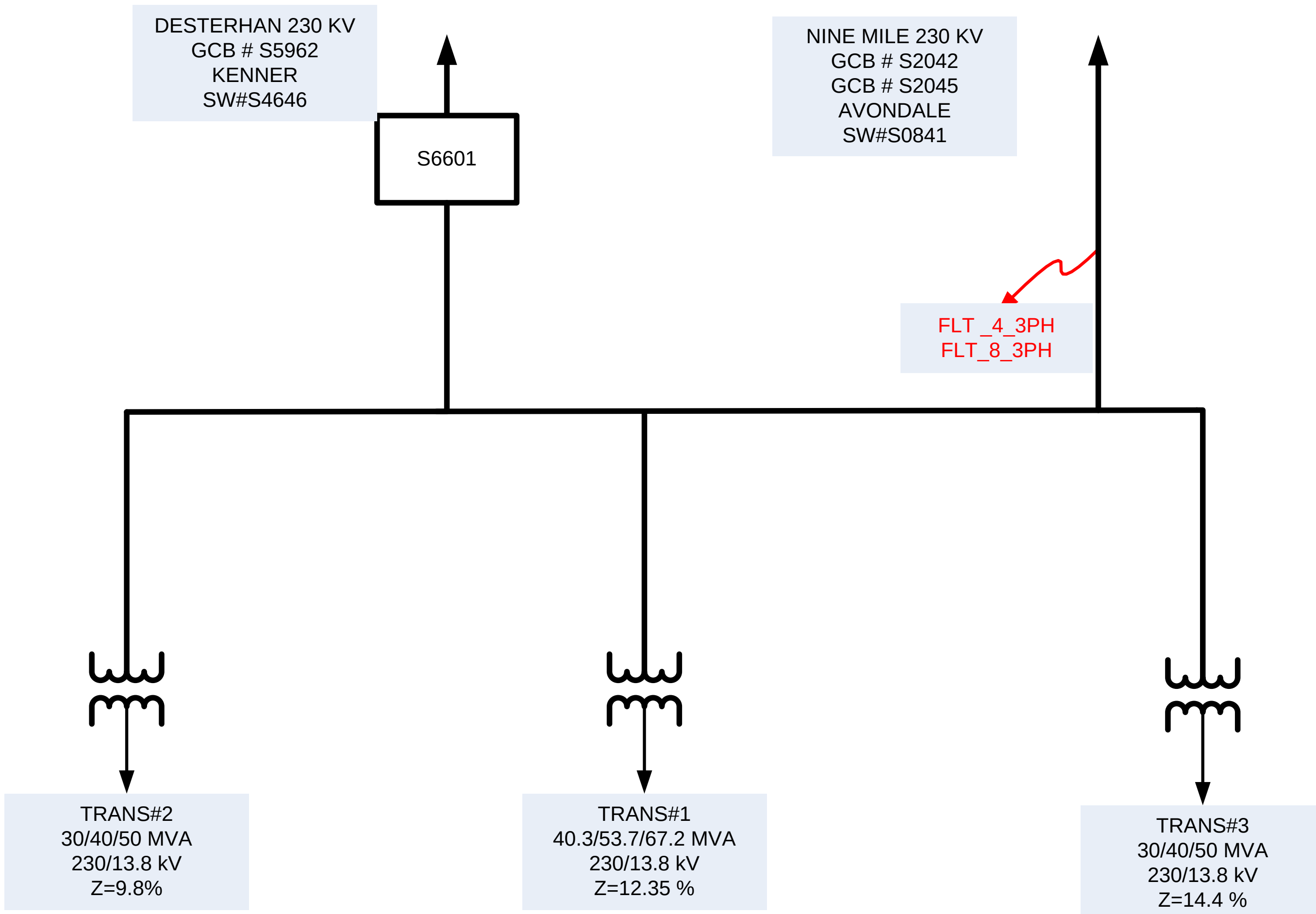



**Figure 0-5 Layout diagram for Harhan Substation**

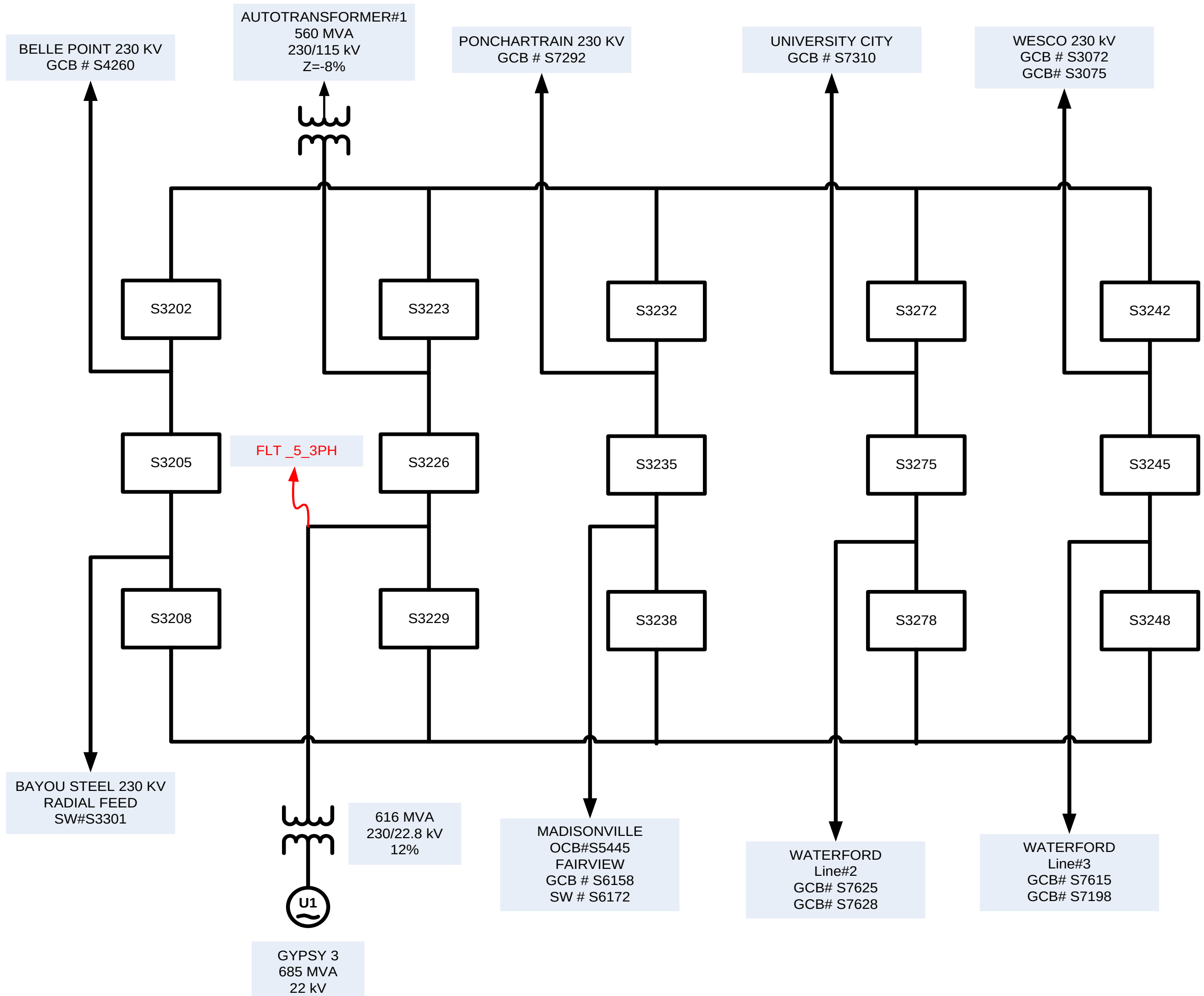



**Figure 0-6 Layout diagram for Little Gypsy Substation**

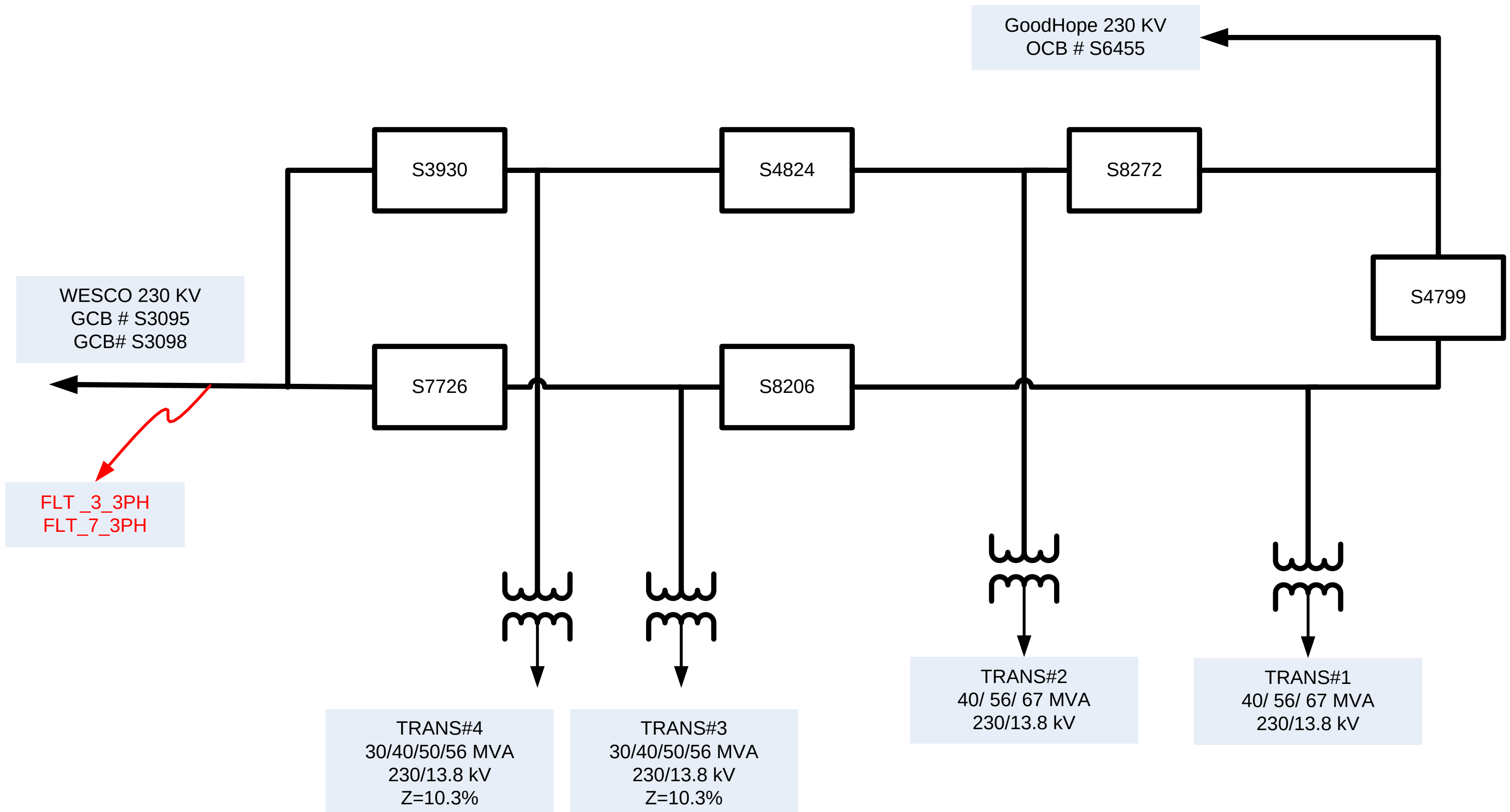



**Figure 0-7 Layout diagram for Prospect Substation**

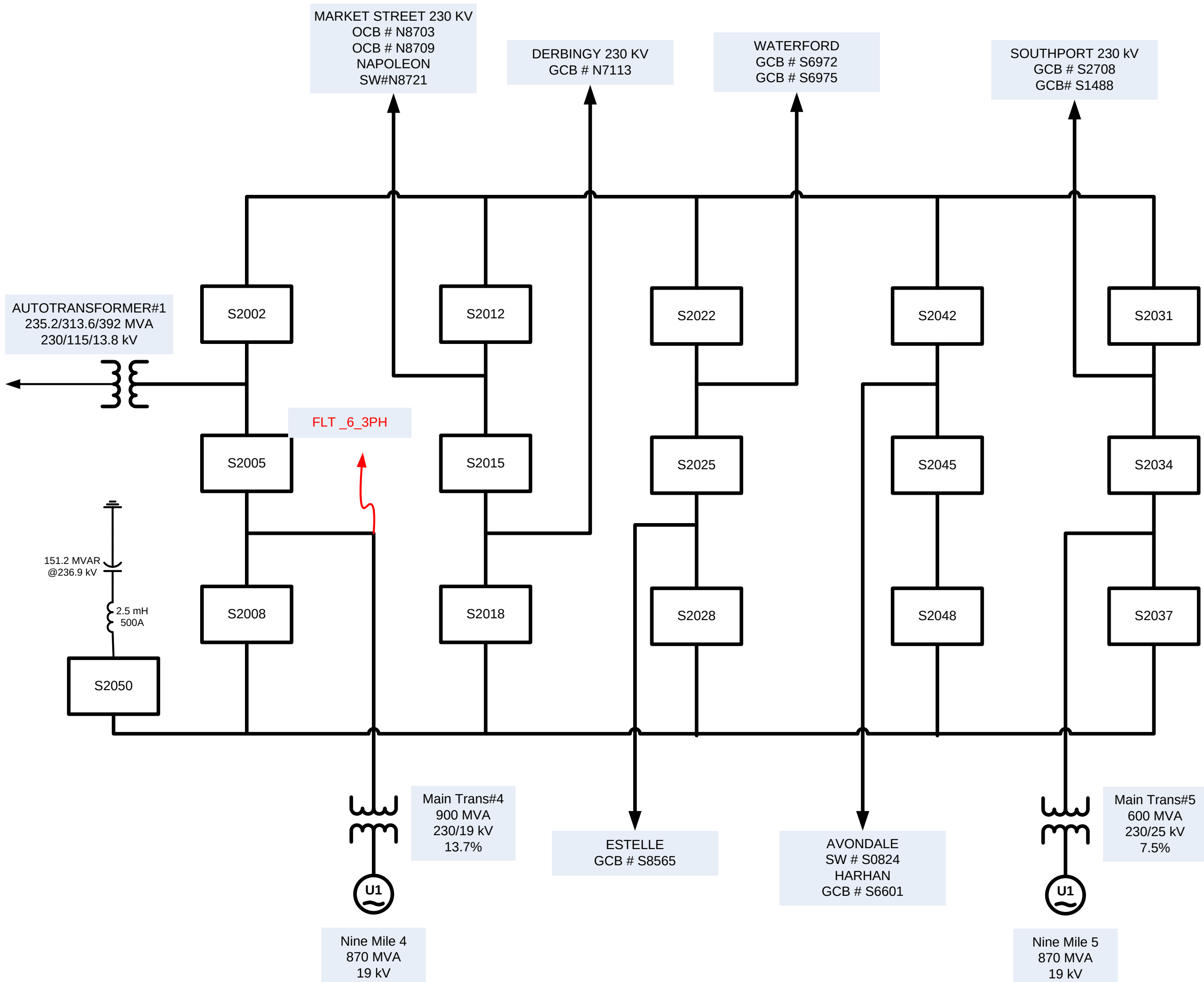



**Figure 0-8 Layout diagram for NineMile Substation**

The system was found to be STABLE following all the normally cleared three-phase faults and all stuck breaker three-phase faults ***except*** FLT_7_3PH. Figure 0-9 shows plot for PID-231 following FLT_1_3PH.

The Fault_7_3PH was a NERC category D fault (Extreme Contingency). Hence per the NERC transmission planning criteria the instability of PID-231 project following Fault_7_3PH was not deemed to be a stability criteria violation. No voltage criteria violation was observed following simulated faults.

Following the 6+9 cycle three-phase stuck breaker fault the proposed PID-231 project was found to be UNSTABLE (see Figure 0-10). All other units in Entergy system were found to be STABLE. The developer should consider an over speed protection or an out-of-step protection system to trip PID-231 Project in order to prevent damage to the PID-231 generator unit following such conditions. The 6 + 9 cycle stuck-breaker single-line-to-ground (SLG) fault involving loss of Prospect – WESCO 230kV line was simulated. (see Figure 0-11). All the generators in Entergy system including the PID-231 were found to be STABLE following the delayed clearing single-line-to-ground fault.

The stability plots showed undamped oscillations in the speed of 18 MW machine at 3HODGE 115 kV (#337347) for all the faults. On further investigation it was found that the subject generator is represented by using a classical generator model ('*GENCLS*') in the dynamic database. The undamped oscillations were observed in both, WITH and WITHOUT PID-231 project (see Figure 0-12). Hence, the undamped oscillations are not attributable to the proposed PID-231 project.

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 three-phase faults followed by stuck breaker conditions unless the determined impact is extremely widespread.

The voltages at all buses in the Entergy system (115 kV and above) were monitored during each of the fault cases as appropriate. No Voltage criteria violation was observed following a normally cleared three-phase fault.

As there is no specific voltage dip criteria for three-phase stuck breaker faults, the results of these faults were compared with the most stringent voltage dip criteria of - not to exceed 20 % for more than 20 cycles. After comparison against the voltage-criteria, no faults were found to be in violation WITH PID-231 case.

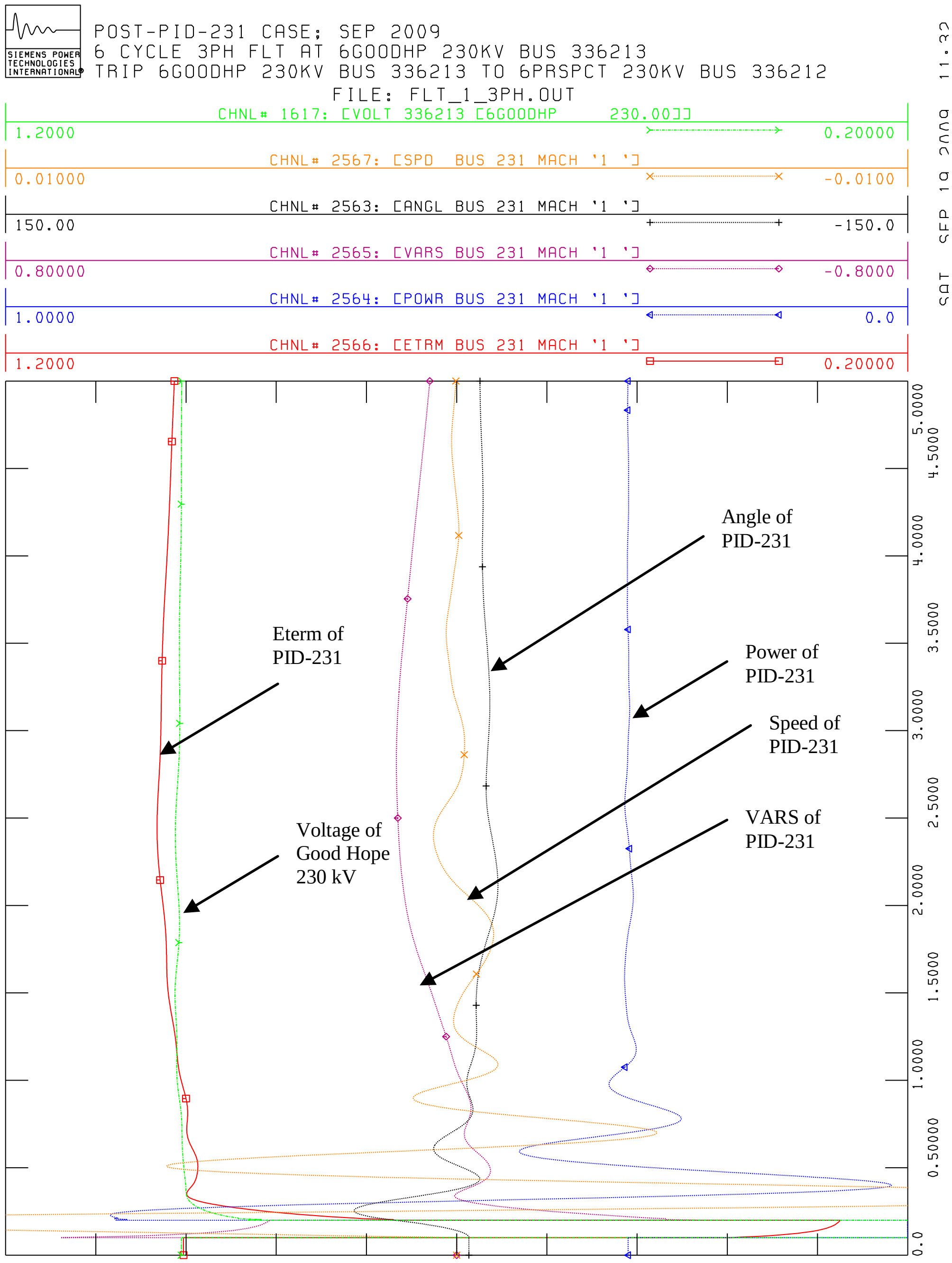



**Figure 0-9: Fault_1_3PH with PID-231**

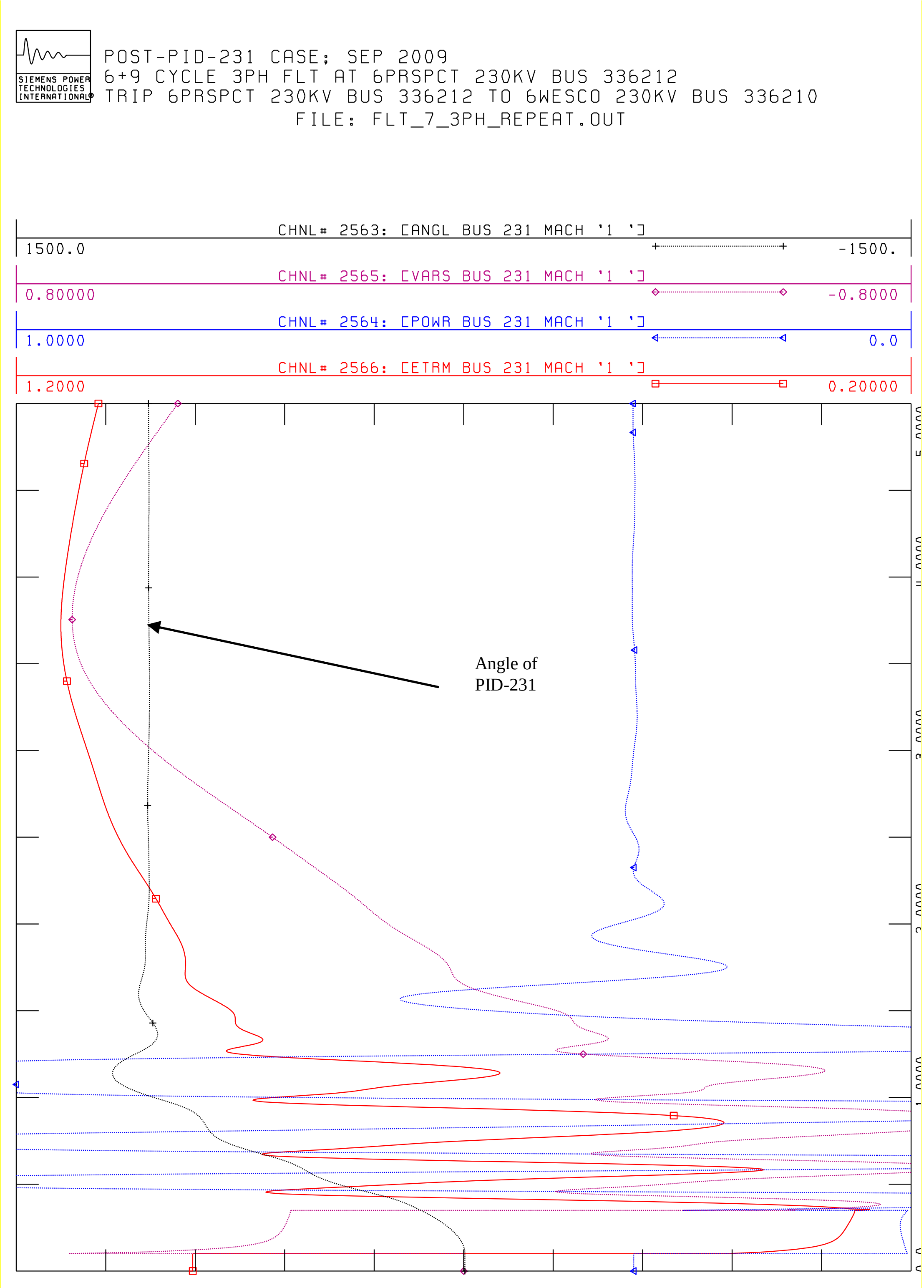



**Figure 0-10: Fault_7_3PH with PID-231**

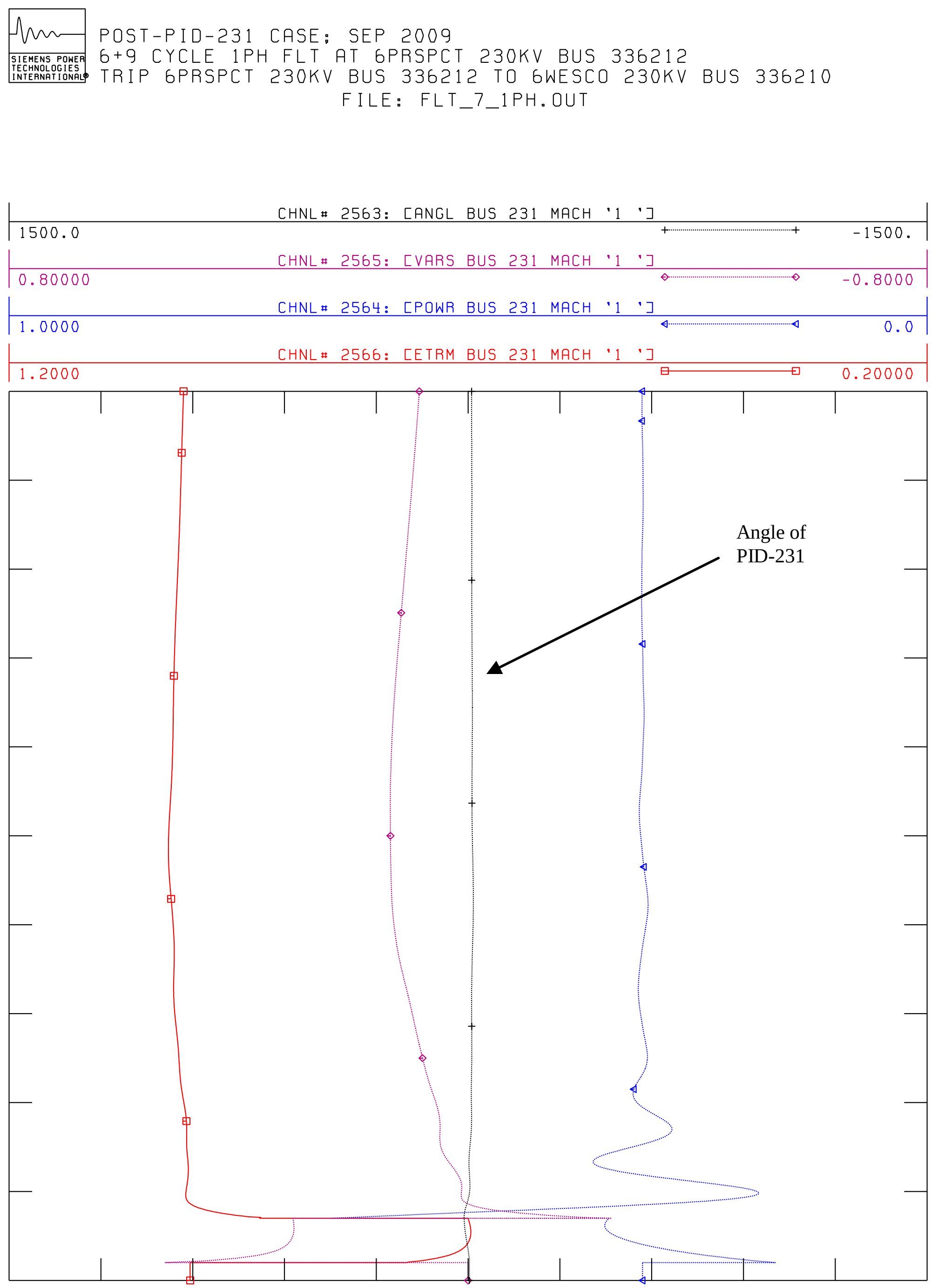



**Figure 0-11: Fault_7_1PH with PID-231**

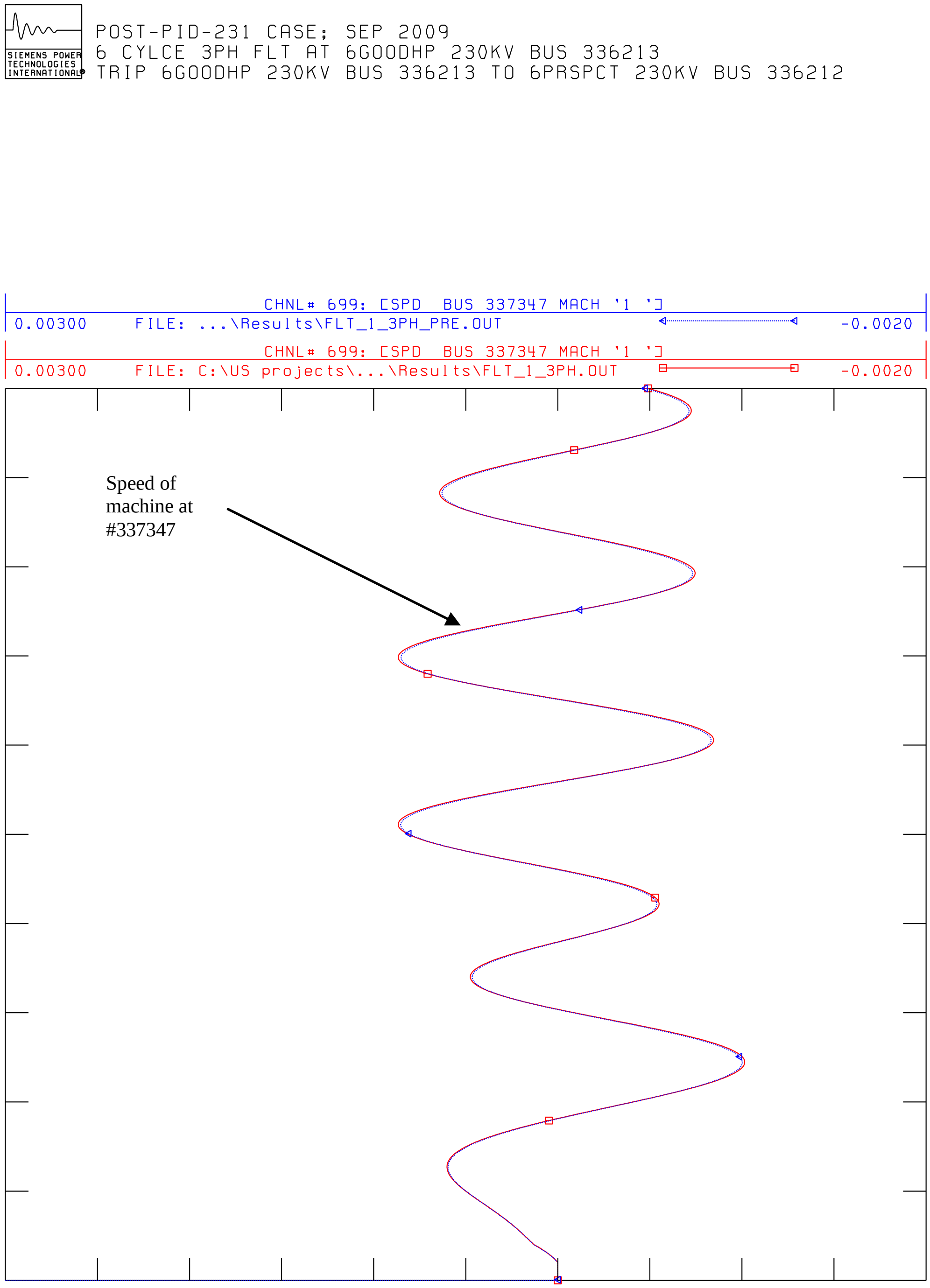



**Figure 0-12: Fault_1_3PH <u>without and with</u> PID-231**

# V. CONCLUSIONS

The objective of this study was to evaluate the impact of proposed PID-231 (31 MW) on system stability and the nearby transmission system and generating stations. The study was performed on 2012 Summer Peak case, provided by SPP/Entergy.

The system was stable following all simulated three-phase normally cleared and stuck-breaker faults ***except for Fault_7_3PH***.

Following **Fault_7_3PH**, 6+9 cycle three-phase stuck breaker fault involving loss of Prospect – WESCO 230 kV line, the proposed PID-231 project was found to be UNSTABLE. All other units in Entergy system were found to be STABLE. The developer should consider an over speed protection or an out-of-step protection system to trip PID-231 Project in order to prevent damage to the PID-231 generator unit following such conditions. The 6 + 9 cycle stuck-breaker single-line-to-ground (SLG) fault involving loss of Prospect – WESCO 230kV line was simulated. All the generators in Entergy system including the PID-231 were found to be STABLE following the delayed clearing single-line-to-ground fault.

The Fault_7_3PH is a NERC category D fault (Extreme Contingency). Hence per the NERC transmission planning criteria the instability of PID-231 project following Fault_7_3PH was not deemed to be a stability criteria violation. No voltage criteria violation was observed following simulated faults.

Based on the results of stability analysis it can be concluded that interconnection of the proposed PID-231 (31 MW) generation at the Good Hope 230 kV bus does not adversely impact the stability of the Entergy System in the local area.

# VI. APPENDIX A DATA PROVIDED BY CUSTOMER

**Attachment A to Appendix 1**
**Interconnection Request**

**LARGE GENERATING FACILITY DATA**

**UNIT RATINGS**

kVA 46,555 °F 95 Voltage 13,800
Power Factor 0.8 lagging; 1.0 leading
Speed (RPM) 1800 Connection Y
Short Circuit Ratio 54% Frequency, Hertz 60
Stator Amperes at Rated kVA 1948 Field Volts 159 main rotor; 106 exciter
Max Turbine MW 36,173 °F 102 max

**COMBINED TURBINE-GENERATOR-EXCITER INERTIA DATA**

Inertia Constant, H = 1.45 kW sec/kVA
Moment-of-Inertia, $WR^2$ = 90154 lb. $ft.^2$

**REACTANCE DATA (PER UNIT-RATED KVA)**

| | **DIRECT AXIS** | | **QUADRATURE AXIS** | |
|---|---|---|---|---|
| Synchronous – saturated | $X_{dv}$ | 1.85 | $X_{qv}$ | 0.842 |
| Synchronous – unsaturated | $X_{di}$ | 1.98 | $X_{qi}$ | 0.904 |
| Transient – saturated | $X'_{dv}$ | 0.222 | $X'_{qv}$ | N/A |
| Transient – unsaturated | $X'_{di}$ | 0.258 | $X'_{qi}$ | N/A |
| Subtransient – saturated | $X''_{dv}$ | 0.137 | $X''_{qv}$ | 0.2061 |
| Subtransient – unsaturated | $X''_{di}$ | 0.161 | $X''_{qi}$ | 0.242 |
| Negative Sequence – saturated | $X2_v$ | 0.137 | | |
| Negative Sequence – unsaturated | $X2_i$ | 0.161 | | |
| Zero Sequence – saturated | $X0_v$ | 0.055 | | |
| Zero Sequence – unsaturated | $X0_i$ | 0.065 | | |
| Leakage Reactance | $Xl_m$ | 0.118 | | |

### FIELD TIME CONSTANT DATA (SEC)

| | | | | |
|---|---|---|---|---|
| Open Circuit | $T'_{do}$ | 10.72 | $T'_{qo}$ | N/A |
| Three-Phase Short Circuit Transient | $T'_{d3}$ | 1.02 | $T'_{q}$ | N/A |
| Line to Line Short Circuit Transient | $T'_{d2}$ | 0.72 | | |
| Line to Neutral Short Circuit Transient | $T'_{d1}$ | 0.35 | $T'_{d}$ | 1.02 |
| Short Circuit Subtransient | $T''_{d}$ | 0.025 | $T''_{q}$ | 0.037 |
| Open Circuit Subtransient | $T''_{do}$ | 0.039 | $T''_{qo}$ | 0.14 |

### ARMATURE TIME CONSTANT DATA (SEC)

| | | | | |
|---|---|---|---|---|
| Three Phase Short Circuit | $T_{a3}$ | 0.14 | $T_{a}$ | 0.14 |
| Line to Line Short Circuit | $T_{a2}$ | 0.098 | | |
| Line to Neutral Short Circuit | $T_{a1}$ | 0.048 | | |

NOTE: If requested information is not applicable, indicate by marking "N/A."

### MW CAPABILITY AND PLANT CONFIGURATION LARGE GENERATING FACILITY DATA

### ARMATURE WINDING RESISTANCE DATA (PER UNIT)

| | | | | |
|---|---|---|---|---|
| Positive | $R_1$ | 0.0033 | $R_1$ | 0.01369 Ω/ph |
| Negative | $R_2$ | 0.0047 | $R_2$ | 0.01936 Ω/ph |
| Zero | $R_0$ | 0.0017 | $R_0$ | 0.00684 Ω/ph |

Rotor Short Time Thermal Capacity $I_2^2t$ = 40
Field Current at Rated kVA, Armature Voltage and PF = 437 amps (main rotor)
Field Current at Rated kVA and Armature Voltage, 0 PF = 491 amps (main rotor)
Three Phase Armature Winding Capacitance = 0.0504 microfarad
Field Winding Resistance = 0.280 ohms 20 °C
Armature Winding Resistance (Per Phase) = 0.0092 ohms 20 °C

## CURVES

Provide Saturation, Vee, Reactive Capability, Capacity Temperature Correction curves. Designate normal and emergency Hydrogen Pressure operating range for multiple curves.

## GENERATOR STEP-UP TRANSFORMER DATA RATINGS

Capacity — Self-cooled/ Maximum Nameplate

40,000 / 52,000 kVA

Voltage Ratio (Generator Side/System side/Tertiary)

13,800 / 230,000 / N/A kV

Winding Connections (Low V/High V/Tertiary V (Delta or Wye))

Delta / Grounded Y / N/A

Fixed Taps Available ____________________

Present Tap Setting

____________________

## IMPEDANCE

Positive — $Z_1$ (on self-cooled kVA rating) 9.0 % ________ X/R

Zero — $Z_0$ (on self-cooled kVA rating) ________ % ________ X/R

# GGOV1
## GE General Governor / Turbine Model

| | |
|---|---|
| This model is located at system bus | # _____ IBUS, |
| machine | # _____ I, |
| This model uses CONs starting with | # _____ J, |
| And STATEs starting with | # _____ K, |
| And VARS starting with | # _____ L, |
| And ICONs starting with | # _____M, |

| CONs | # | Values | Description |
|---|---|---|---|
| J | | .04 | R Permanent droop, pu |
| J+1 | | .2 | $T_{pelec}$ Electrical power transducer time constant, sec |
| J+2 | | 1 | Maxerr Maximum value for speed error signal |
| J+3 | | -1 | Minerr Minimum value for speed error signal |
| J+4 | | 4 | $K_{pgov}$ Governor proportional gain |
| J+5 | | $\frac{1}{15(\text{sec})}$ | $K_{igov}$ Governor integral gain |
| J+6 | | 0 | $K_{dgov}$ Governor derivative gain |
| J+7 | | 0 | $T_{dgov}$ Governor derivative controller time constant, sec |
| J+8 | | 1 | $V_{max}$ Maximum valve position limit |
| J+9 | | 0 | $V_{min}$ Minimum valve position limit |
| J+10 | | .2 | $T_{act}$ Actuator time constant, sec |
| J+11 | | | $K_{turb}$ Turbine gain |
| J+12 | | | $W_{fnl}$ No load fuel flow, pu |
| J+13 | | | $T_b$ Turbine lag time constant, sec |
| J+14 | | | $T_c$ Turbine lead time constant, sec |
| J+15 | | 0 | $T_{eng}$ Transport lag time constant for diesel engine, sec |
| J+16 | | n/a | $T_{fload}$ Load Limiter time constant, sec |
| J+17 | | n/a | $K_{pload}$ Load limiter proportional gain for PI controller |
| J+18 | | n/a | $K_{iload}$ Load limiter integral gain for PI controller |
| J+19 | | n/a | $L_{dref}$ Load limiter reference value pu |

| CONs | # | Values | Description |
|---|---|---|---|
| J+20 | | | $D_m$ Mechanical damping coefficient, pu |
| J+21 | | 3 | $R_{open}$ Maximum valve opening rate, pu/sec |
| J+22 | | 3 | $R_{close}$ Maximum valve closing rate, pu/sec |
| J+23 | | n/a | $K_{imw}$ Power controller (reset) gain |
| J+24 | | n/a | $A_{set}$ Acceleration limiter setpoint, pu/sec |
| J+25 | | 0 | $K_a$ Acceleration limiter gain |
| J+26 | | n/a | $T_a$ Acceleration limiter time constant, sec |
| J+27 | | | $T_{rate}$ Turbine rating (MW) |
| J+28 | | 0 | db Speed governor deadband |
| J+29 | | n/a | $T_{sa}$ Temperature detection lead time constant, sec |
| J+30 | | n/a | $T_{sb}$ Temperature detection lag time constant, sec |
| J+31 | | n/a | $R_{up}$ Maximum rate of load limit increase |
| J+32 | | n/a | $R_{down}$ Maximum rate of load limit decrease |

| STATEs | # | Description |
|---|---|---|
| K | | Machine Electrical Power Measurement |
| K+1 | | Governor Differential Control |
| K+2 | | Governor Integral Control |
| K+3 | | Turbine Actuator |
| K+4 | | Turbine Lead-Lag |
| K+5 | | Turbine load limiter measurement |
| K+6 | | Turbine Load Limiter Integral Control |
| K+7 | | Supervisory Load Control |

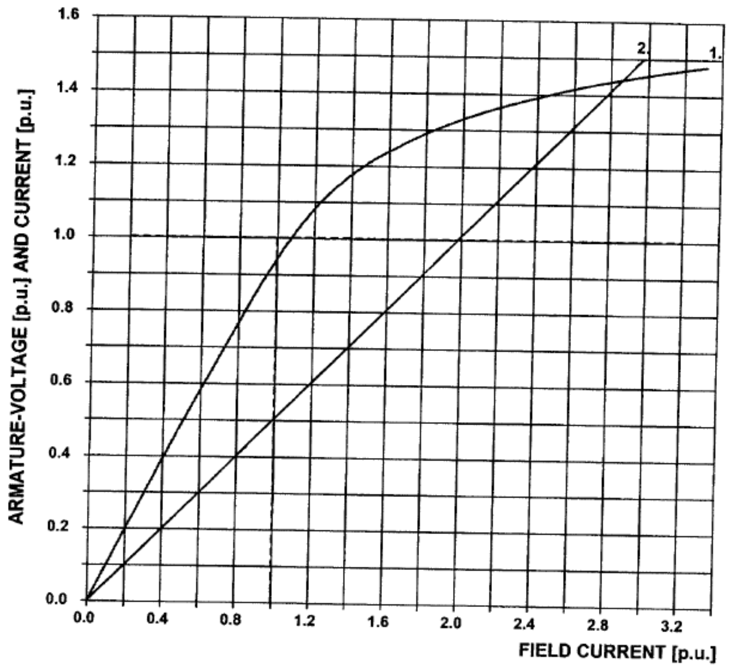
| STATEs | # | Description |
|---|---|---|
| K+8 | | Acceleration Control |
| K+9 | | Temperature Detection Lead-Lag |

| VARs | # | Description |
|---|---|---|
| L | | Load Reference |
| L+1 | | Output of Load Limiter PI Control |
| L+2 | | Output of Governor PID Control |
| L+3 | | Low Value Select Output |
| L+4 | | Output of Turbine Actuator |
| L+5 | | Output of Turbine Lead-Lag |
| L+6 | | Supervisory Load Controller Setpoint, Pmwset |
| L+7 . . . L+19 | | Delay Table |
| L+20 | | Dead Band |

| ICON | # | Value | Description |
|---|---|---|---|
| M | | -1 | $R_{select}$ Feedback signal for governor droop.<br>= 1 electrical power<br>= 0 none (isochronous governor)<br>= -1 governor output (requested stroke)<br>= -2 fuel valve stroke (true stoke) |
| M+1 | | 0 | Flag Switch for fuel source characteristic<br>=0 fuel flow independent of speed<br>=1 fuel flow proportional to speed |

**SATURATION CURVES - A**

**AMS 1250LH 46555 kVA 60 Hz 0.80 PF 13800 V 1948 A 1800 rpm**




1. OPEN -CIRCUIT SATURATION
2. SHORT-CIRCUIT SATURATION

| | | |
|---|---|---|
| ARMATURE VOLTAGE | 1 p.u. = | 13800 V |
| ARMATURE CURRENT | 1 p.u. = | 1948 A |
| FIELD CURRENT | 1 p.u. = | 153 A |

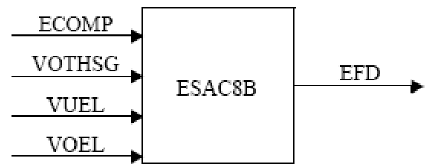
| | | Document number | Lang. | Rev. ind. | Sheet |
|---|---|---|---|---|---|
| ABB | ABB AB, Machines | XYK210094-FHP | en | | 2 |

TEMPLATE: NORMAL.DOT; PRINTDATE: 2008-04-23 1:37:00 PM; SAVEDATE: 2008-04-22 4:43:00 PM; OSKAR VERSION: 3.48 (2008-03-04)

# ESAC8B

## Basler DECS

This model is located at system bus #_______ IBUS,
machine #_______ I.
This model uses CONs starting with #_______ J,
and STATEs starting with #_______ K,
and VAR #_______ L.

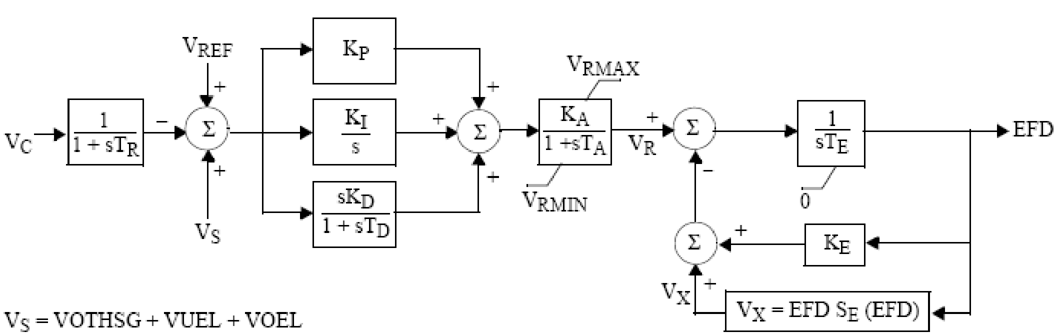



| CONs | # | Value | Description |
|---|---|---|---|
| J | | | $T_R$ (sec) |
| J+1 | | | $K_P$ |
| J+2 | | | $K_I$ |
| J+3 | | | $K_D$ |
| J+4 | | | $T_D$ (sec) |
| J+5 | | | $K_A$ |
| J+6 | | | $T_A$ |
| J+7 | | | $V_{RMAX}$ or zero |
| J+8 | | | $V_{RMIN}$ |
| J+9 | | | $T_E > 0$ (sec) |
| J+10 | | | $K_E$ or zero |
| J+11 | | | $E_1$ |
| J+12 | | | $S_E(E_1)$ |
| J+13 | | | $E_2$ |
| J+14 | | | $S_E(E_2)$ |

| STATEs | # | Description |
|---|---|---|
| K | | Sensed $V_T$ |
| K+1 | | Integral controller |
| K+2 | | Derivative controller |
| K+3 | | Voltage regulator |
| K+4 | | Exciter output, EFD |

| VAR | # | Description |
|---|---|---|
| L | | $K_E$ |

IBUS, 'ESAC8B', I, $T_R$, $K_P$, $K_I$, $K_D$, $T_D$, $K_A$, $T_A$, $V_{RMAX}$, $V_{RMIN}$, $T_E$, $K_E$, $E_1$, $S_E(E_1)$, $E_2$, $S_E(E_2)$/




$V_S$ = VOTHSG + VUEL + VOEL

# VII APPENDIX B POWERFLOW AND STABILITY DATA

Following data is presented in PSS/E VER 30.3.2 format
**Powerflow Data**

**PID-223**

```
99223,'PID223POI   ',  161.0000,1,     0.000,     0.000, 351, 163,0.97341, -61.0000    1
 99923,'PID223COL   ',  34.5000,1,     0.000,     0.000, 351, 163,0.97184, -61.0000,   1
999223,'PID223GEN   ',   0.6900,2,     0.000,     0.000,   1,   1,0.97001, -61.0000,   1
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
999223,'1 ',   125.000,     0.000,     0.000,     0.000,1.00000,     0,   125.000,
0.00000,9999.00000,   0.00000,   0.00000,1.00000,1,  100.0,   125.000,     0.000,
1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
 99223, 99923,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID223SUB   ',1,   1,1.0000
   0.001726,   0.09498,    81.00
1.00000,   0.000,   0.000,   135.00,   135.00,   135.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
 99923,999223,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID223GSU   ',1,   1,1.0000
   0.0095,   0.05711,   125.00
1.00000,   0.000,   0.000,   125.00,   125.00,   125.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
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
 99923,0,1.00000,1.00000,     0,  100.0,'            ',   30.00, 1,  30.00
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
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

**PID-224**

```
99224,'PID224POI  ',  161.0000,1,     0.000,     0.000, 351, 163,0.97341, -61.0000    1
99925,'PID224     ',  161.0000,1,     0.000,     0.000, 351, 163,0.97341, -61.0000    1
99924,'PID224COL  ',  34.5000,1,     0.000,     0.000, 351, 163,0.97184,  -61.0000,   1
999224,'PID224GEN   ',   0.6900,2,     0.000,     0.000,   1,   1,0.97001, -61.0000,   1
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
999224,'1 ',   100.000,     0.000,     0.000,     0.000,1.00000,     0,   100.000,
0.00000,9999.00000,   0.00000,   0.00000,1.00000,1,  100.0,   100.000,     0.000,
1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
99224, 99925,'1 ',   0.00335,   0.01592,   0.00784,  100.00,  100.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1, 6.00,   1,1.0000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
 99925, 99924,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID224SUB   ',1,   1,1.0000
   0.000,   0.1000,    69.00
1.00000,   0.000,   0.000,   135.00,   135.00,   135.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
 99924,999224,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID224GSU   ',1,   1,1.0000
   0.0000,   0.0575,   110.00
```

```
1.00000,   0.000,   0.000,   110.00,   110.00,   110.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
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
 99924,0,1.00000,1.00000,     0,  100.0,'            ',   20.00, 1,  20.00
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
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

**PID-226**

```
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
336821,'1 ',  1544.000,   0.000,   330.000,  -330.000,1.02000,336820,  1600.000,
0.003656,   0.2880,   0.00000,   0.00000,1.00000,1,  100.0,  1544.000,   150.000,
1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
336820,336821,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
   0.0035,   0.1627,   1650.00
1.00000,   0.000,   0.000,  1650.00,  1650.00,  1650.00, 0,      0, 1.07500, 0.97500,
1.07500, 0.97500, 5, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
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
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

**PID-228**

```
336421,'PID-228     ',  13.8000, 2,     0.000,     0.000, 351, 130,1.00129, -33.9091,  36
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
336421,'1 ',   114.800,   -24.352,    46.000,   -38.000,1.02000,336411,   126.320,
0.00000,   0.17000,   0.00000,   0.00000,1.00000,1,  100.0,   104.000,     0.000,
,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
336411,336421,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
   0.00228,   0.07990,    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
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
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
```

```
0 / END OF FACTS DEVICE DATA
```

**PID-231**

```
231,'PID231',  13.8000,2,     0.000,     0.000, 351, 123,1.0000, 0.0000    1
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
231,'1 ',   31.000,     0.000,    23.000,     0.000,1.0000,0,   46.500,   0.00000,0.1610,
0.00000,   0.00000,1.00000, 1,  100.0,   31.000,     0.000,   1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
 231, 336213,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'PID231SUB   ',1,   1,1.0000
   0.000,   0.0900,    40.00
1.00000,   0.000,   0.000,   135.00,   135.00,   135.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
Q
```

## Dynamics Data

## PID-223

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, SEP 15 2009  20:14

PRE-PID-231 CASE; SEP 2009

PLANT MODELS

REPORT FOR ALL MODELS                    BUS 999223 [PID223GEN   0.6900] MODELS


    ** C93GEN **  BUS  MACH        C O N S       S T A T E S
              999223   1      44864- 44868  20087- 20090

                   H     MBASE    KPLL   TAUPLL   ISPD
                  5.69  125.00    0.10    0.03    1.00


    ** C93TUR **  BUS  MACH        C O N S       S T A T E S
              999223   1     130691-130696  51327- 51327

                 KPP      KPI    PAMIN   PAMAX    PAINIT   MBASE
                 63.50    6.95    0.00   90.00     0.00  125.00
```

## PID-224

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, SEP 15 2009  20:14

PRE-PID-231 CASE; SEP 2009

PLANT MODELS

REPORT FOR ALL MODELS                    BUS 999224 [PID224GEN   0.6900] MODELS


    ** C93GEN **  BUS  MACH        C O N S       S T A T E S
              999224   1      44869- 44873  20091- 20094

                   H     MBASE    KPLL   TAUPLL   ISPD
                  5.69  100.00    0.10    0.03    1.00


    ** C93TUR **  BUS  MACH        C O N S       S T A T E S
              999224   1     130697-130702  51328- 51328

                 KPP      KPI    PAMIN   PAMAX    PAINIT   MBASE
                 63.50    6.95    0.00   90.00     0.00  100.00
```

## PID-226

```
 PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      SAT, SEP 19 2009  10:41

 PRE-PID-231 CASE; SEP 2009

 PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 336821 [GGULF       21.000] MODELS


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            336821 GGULF        21.000 1   42650-42663   19121-19126

             MBASE     Z S O R C E         X T R A N       GENTAP
            1600.0  0.00366+J 0.28800  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
  6.29 0.047  0.38 0.123   4.51  0.00 1.5510 1.4730 0.4170 0.8320 0.2880 0.2450

                                S(1.0)  S(1.2)
                                0.2000  0.5000


 ** 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
            336821 GGULF        21.000 1   54546-54562   27992-28007    2199-2202
2946-2951

                    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    0.202    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


 ** ESAC5A **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
            336821 GGULF        21.000 1  100186-100200  41065-41069    3623

    TR      KA      TA   VRMAX   VRMIN     KE     TE     KF     TF1    TF2    TF3
  0.200  600.00  0.100  6.400  -6.400   1.000  0.220  0.020  1.000  0.130  0.000

                    E1     S(E1)    E2     S(E2)        KE VAR
                  3.7000  0.7300  2.8000  0.7300        0.0000


 ** IEEEG1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            336821 GGULF        21.000 1  129450-129469  50937-50942    7582-7583

      K      T1      T2      T3     UO      UC    PMAX   PMIN     T4      K1
    12.00   0.000   0.000   0.075  0.600  -0.600 0.9700 0.0000   0.250   0.350

    K2      T5      K3      K4      T6      K5      K6      T7      K7      K8
  0.000   2.750   0.650   0.000   0.000   0.000   0.000   0.000   0.000   0.000
```

**PID-228**

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, SEP 15 2009  20:14

PRE-PID-231 CASE; SEP 2009

PLANT MODELS

REPORT FOR ALL MODELS                    BUS 336421 [PID-228     13.800] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           336421 PID-228      13.800 1   42524-42537   19067-19072

            MBASE     Z S O R C E         X T R A N       GENTAP
            126.3  0.00000+J 0.17000  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
 8.00 0.050  1.00 0.400   2.00  0.00 2.0000 1.8000 0.2200 0.3500 0.1700 0.1200

                               S(1.0)  S(1.2)
                               0.0500  0.4000


** 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
           336421 PID-228      13.800 1   54529-54545   27976-27991    2195-2198
2940-2945
```

| 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 | 0.200 | 1.000 |

| T8 | T9 | KS1 | T1 | T2 | T3 | T4 | VSTMAX | VSTMIN |
|---|---|---|---|---|---|---|---|---|
| 0.500 | 0.100 | 10.000 | 0.300 | 0.200 | 0.200 | 0.200 | 0.100 | -0.100 |

| ** ESST1A ** | BUS | X-- NAME --X | BASEKV | MC | C O N S | S T A T E S | I C O N S |
|---|---|---|---|---|---|---|---|
| | 336421 | PID-228 | 13.800 | 1 | 99989-100006 | 41018-41022 | 3646-3647 |

| UEL | VOS | TR | VIMAX | VIMIN | TC | TB | TC1 | TB1 | KA |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0.000 | 0.100 | -0.100 | 1.000 | 10.000 | 1.000 | 1.000 | 200.0 |

| TA | VAMAX | VAMIN | VRMAX | VRMIN | KC | KF | TF | KLR | ILR |
|---|---|---|---|---|---|---|---|---|---|
| 0.020 | 5.000 | -5.000 | 5.000 | -5.000 | 0.050 | 0.000 | 1.000 | 5.000 | 2.800 |

| ** IEESGO ** | BUS | X-- NAME --X | BASEKV | MC | C O N S | S T A T E S | VAR |
|---|---|---|---|---|---|---|---|
| | 336421 | PID-228 | 13.800 | 1 | 129411-129421 | 50924-50928 | 7577 |

| T1 | T2 | T3 | T4 | T5 | T6 | K1 | K2 | K3 | PMAX | PMIN |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.500 | 0.200 | 0.50 | 10.00 | 20.0 | 0.20 | 0.60 | 1.00 | 0.00 |

## PID-231

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, SEP 15 2009  20:14

PRE-PID-231 CASE; SEP 2009

PLANT MODELS

REPORT FOR ALL MODELS                    BUS 231 [PID231      13.800] MODELS

| ** GENSAL ** | BUS | X-- NAME --X | BASEKV | MC | C O N S | S T A T E S |
|---|---|---|---|---|---|---|
| | 231 | PID231 | 13.800 | 1 | 130995-131006 | 51337-51341 |

| MBASE | Z S O R C E | X T R A N | GENTAP |
|---|---|---|---|
| 46.5 | 0.00000+J 0.16100 | 0.00000+J 0.00000 | 1.00000 |

| T'D0 | T''D0 | T''Q0 | H | DAMP | XD | XQ | X'D | X''D | XL |
|---|---|---|---|---|---|---|---|---|---|
| 10.720 | 0.039 | 0.140 | 1.45 | 0.00 | 1.9800 | 0.9040 | 0.2580 | 0.1610 | 0.1180 |

| S(1.0) | S(1.2) |
|---|---|
| 0.4762 | 0.2000 |

| ** ESAC8B ** | BUS | X-- NAME --X | BASEKV | MC | C O N S | S T A T E S | VAR |
|---|---|---|---|---|---|---|---|
| | 231 | PID231 | 13.800 | 1 | 131007-131021 | 51342-51346 | 9993 |

| TR | KP | KI | KD | TD | KA | TA | VRMAX | VRMIN | TE | KE |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.005 | 50.00 | 28.00 | 19.00 | 0.080 | 1.000 | 0.000 | 7.300 | 0.000 | 0.410 | 1.000 |

| E1 | S(E1) | E2 | S(E2) | KE VAR |
|---|---|---|---|---|
| 6.5000 | 0.3000 | 9.0000 | 3.0000 | 0.0000 |