SPP Southwest Power Pool

Impact Re-study For Generation Interconnection Request GEN-2006-035

SPP Tariff Studies

(#GEN-2006-035)

May 2008

Executive Summary

<OMITTED TEXT> (Customer) has requested an Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of 224 MW of wind generation within the control area of American Electric Power West (AEPW) in Roger Mills County, Oklahoma. The wind powered generation facility was studied with one hundred twelve (112) individual Gamesa G8X 2.0 MW wind turbines. The requested in-service date for the 224 MW facility is December 1, 2008. This Impact study addresses the dynamic stability effects of interconnecting the plant to the rest of the AEPW transmission system as well as addressing the need for reactive compensation required by the wind farm because of the use of the Gamesa turbines.

The requirements to interconnect the 224 MW of generation at the new switching station on the Elk City – Grapevine 230 kV line will consist of building a new 230 kV ring bus substation that would be used to interconnect both GEN-2006-002 and this request. The method to interconnect one of the requests would consist of a three breaker ring bus substation with terminals to Elk City, Grapevine, and the generating facility. If both this request and GEN- 2006-002 interconnect into the station, a fourth ring bus terminal will be required. The most up to date cost estimates for the required interconnection facilities are found in the Facilities Study for Gen-2006-035. At the time of the writing of this report, GEN-2006-002 has an executed Interconnection Agreement that has been placed in suspension. At the time of the writing of this report, the possibility also exists that GEN-2006-043, which does not yet have an Interconnection Agreement, may also interconnect at this substation.

From the new switching station, the Customer will build a 230 kV line to its 230/34.5 kV collector substation. The customer substation will provide terminations for the wind turbine collection circuits.

Two seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. The cases studied were the 2008 winter peak and 2012 summer peak. Each case was modified to include prior queued projects that are listed in the body of the report. Seventeen contingencies were simulated in each case. The Gamesa G8X 2.0 MW wind turbines were modeled using information provided by the manufacturer.

To maintain an acceptable voltage level for the outage of the 230kV line from the wind farm to Elk City, the Customer will be required to maintain a power factor of +/-95% at the Point of Interconnection (POI). Powerflow analysis has shown that this power factor requirement cannot be met by the Gamesa's adjustable power factor capabilities alone. Additional reactive compensation sources are required. Dynamic stability analysis has shown that at least part of this reactive compensation should be dynamic.

Stability Study results show that with the Customer requested Gamesa wind turbines the transmission system remains stable for all simulated contingencies studied. Further Stability study results show that in order for the wind farm to meet FERC Order #661A's Low Voltage Ride Through (LVRT) requirements, the Customer shall purchase additional reactive compensation devices, some of which must be dynamic (STATCOM). This study used two (2) +/- 4MVA STATCOM devices to show acceptable results. If the Customer changes from the Gamesa turbine, this need will be re-evaluated in an Impact re-study. Sensitivity analysis has determined that the STATCOM devices are only required at such time that GEN-2006-002 brings its Interconnection Agreement out of suspension.

If any previous queued projects withdraw from the queue or suspend their construction, a restudy will be necessary to determine the impacts on this generation interconnection request.

Nothing in this study should be construed as a guarantee of transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service shall be requested on Southwest Power Pool's OASIS by the Customer.

1.0 Introduction

<OMITTED TEXT> (Customer) has requested an Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of 224 MW of wind generation within the control area of American Electric Power West (AEPW) in Roger Mills County, Oklahoma. The wind powered generation facility was studied with one hundred twelve (112) individual Gamesa G8X 2.0 MW wind turbines. The requested in-service date for the 224 MW facility is December 1, 2008. This Impact Study addresses the dynamic stability effects of interconnecting the plant to the rest of the AEPW transmission system as well as addressing the need for reactive compensation required by the wind farm because of the use of the Gamesa turbines.

2.0 Purpose

The purpose of the Interconnection System Impact Study is to evaluate the impact of the proposed interconnection on the reliability of the Transmission System. The Impact Study considers the Base Case as well as all Generating Facilities (and with respect to (b) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the Interconnection System Impact Study is commenced:

a) are directly interconnected to the Transmission System;
b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;
c) have a pending higher queued Interconnection Request to interconnect to the Transmission System; or
d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Any changes to these assumptions, for example, one or more of the previously queued projects not included in this study signing an interconnection agreement, may require a re-study of this request at the expense of the customer

Nothing in this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service.

3.0 Facilities

3.1 Generating Facility

The generating facility was studied with the assumption that it would be using 112 Gamesa G8X 2.0 MW wind turbines. The nameplate rating of each turbine is 2.0 MW with a machine base of 2105 kVA. The turbine output voltage is 690V. The Gamesa turbines utilize a doubly fed induction-generator with a wound rotor and slip rings. A variable frequency power converter tied to the generator rotor allows the generator to operate at speeds ranging from 1080 rpm to 2280 rpm. Nominal speed at 2.0 MW power output is 2016 rpm. The power converter allows the generator to produce power at a power factor of 0.95 lagging to 0.95 leading. The power factor is settable at each WTG or by the Plant SCADA system.

This study was performed using the latest Gamesa Standard Voltage and Frequency Settings with Fault Ride Through modeling stability package available from the manufacturer. These settings are shown in Table 4, Table 5, and Table 6.

Each wind turbine will feed into a 0.690/34.5 kV GSU rated at 2350 kVA. Impedance for the GSU is 11.6%.

The 112 wind turbines are divided between two collector subsystems, each of which feeds into a 34.5/230 kV transformer in the Customer substation. The distribution of wind generators are shown in Table 1. The impedance for each of the 34.5/230 kV transformers is 7.5% on a 74 MVA OA Base with a top rating of 129 MVA.

First Collector Subsystem		Second Collector Subsystem	
Collector Circuit	Number of Turbines	Collector Circuit	Number of Turbines
1	11	1	12
2	11	2	11
3	11	3	12
4	10	4	12
5	12	5	10

Table 1: Distribution of Wind Turbine Generators

Figure 1 shows the one-line modeling of the generation facility.

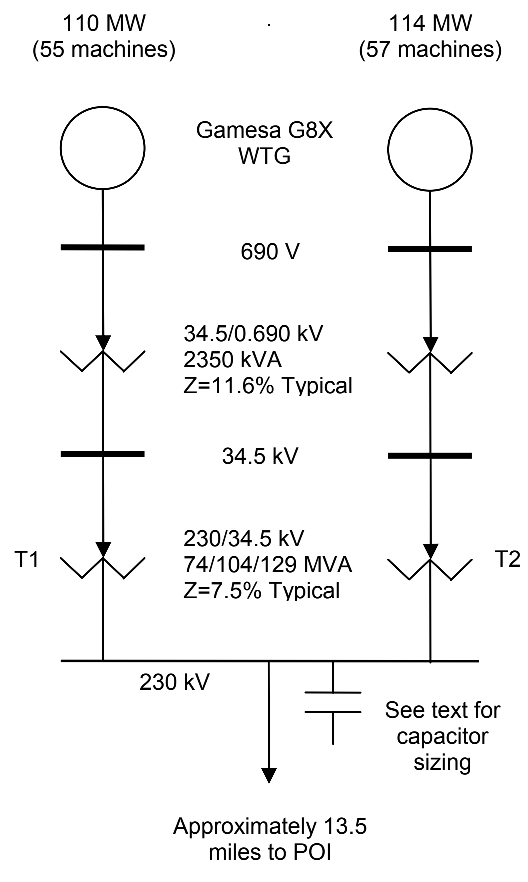


Figure 1: One-Line Drawing of the Gen-2006-035 Facility

3.2 <u>Interconnection Facility</u>

The Customer has proposed the Point of interconnection (POI) to be the AEPW transmission system via a new substation located in northwest Beckham County, Oklahoma on the existing Elk City – Grapevine 230 kV line. See Figure 2 for one-line diagram of the interconnection facility.

The requirements to interconnect the 224 MW of generation at the new switching station on the Elk City – Grapevine 230 kV line will consist of building a new 230 kV ring bus substation that would be used to interconnect both GEN-2006-002 and this request. The method to interconnect one of the requests would consist of a three breaker ring bus substation with terminals to Elk City, Grapevine, and the generating facility. If both this request and GEN- 2006-002 interconnect into the station, a fourth ring bus terminal will be required. The most up to date cost estimates for the required interconnection facilities are found in the Facilities Study for Gen-2006-035.

From the new switching station, the Customer will build a 230 kV line to its 230/34.5 kV collector substation. The Customer's substation will provide terminations for the wind turbine collection circuits.

Analysis of the reactive compensation requirements of the wind farm indicated the need for +/-95% power factor at the POI. The Customer shall purchase additional reactive compensation devices including dynamic reactive compensation devices (STATCOM).

Table 2 shows the Direct Assignment Facilities costs to be determined by the Customer.

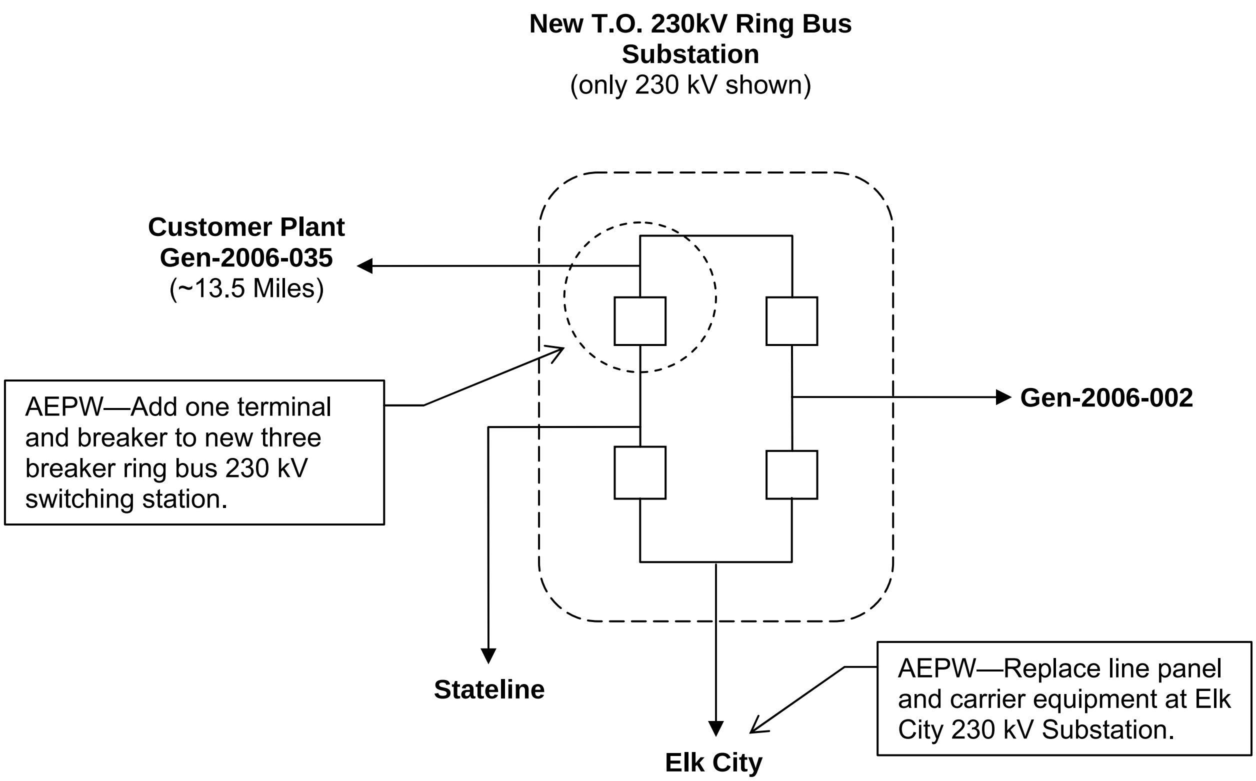


Figure 2: Proposed Interconnection Configuration

FACILITY	ESTIMATED COST
Customer – 230/34.5 kV Substation facilities.	*
Customer – 230 kV transmission line facilities between Customer facilities and AEPW 230 kV switching station.	*
Customer - Right-of-Way for Customer facilities.	*
Customer – Reactive compensation in Customer substation to maintain a power factor of +/- 95% at the POI.	*
Total	*

Note: * Estimates of cost to be determined by Customer.

Table 2: Direct Assignment Facilities

4.0 Power Factor Requirements

FERC Order #661A requires wind farms to maintain an acceptable voltage schedule. It was found that for the wind farm to maintain system intact voltage in the power flow case for the outage of the Wind Farm – Elk City 230 kV transmission line, a power factor of 95% leading (supplying vars) was necessary. It was also found that the power factor capabilities of the Gamesa turbines could not supply this power factor requirement at the POI.

Therefore, additional reactive compensation devices will be required for this wind farm to meet FERC Order #661A requirements. In the stability analysis, the Gamesa wind turbines were set to 95% leading power factor to determine further reactive requirements. Table 3 shows the results of the analysis.

Season	System Intact Voltage	Contingency	MW at POI	Vars needed to maintain Voltage at POI	Power Factor Required
Summer	0.992 pu	Wind Farm – Stateline	217 MW	32 Mvar	98.9%
Summer	0.992 pu	Wind Farm – Elk City	217 MW	56 Mvar	96.8%
Winter	1.00 pu	Wind Farm – Stateline	216 MW	43 Mvar	98.0%
Winter	1.00 pu	Wind Farm – Elk City	216 MW	50 Mvar	97.0%

Table 3: Reactive Compensation Requirements

5.0 Stability Analysis

5.1 Modeling of the Wind Turbines in the Power Flow

In order to simplify the model of the wind farm while capturing the effect of the different impedances of cables (due to change of the conductor size and length), the wind turbines and associated impedances connected to the each 230/34.5 kV transformer were aggregated into one equivalent unit (see Figure 1).

5.2 Modeling of the Wind Turbines in Dynamics

The generating facility was studied with the assumption that it would be using 112 Gamesa G8X 2.0 MW wind turbines. The nameplate rating of each turbine is 2.0 MW with a machine base of 2105 kVA. The turbine output voltage is 690V. The Gamesa turbines utilize a doubly fed induction-generator with a wound rotor and slip rings. A variable frequency power converter tied to the generator rotor allows the generator to operate at speeds ranging from 1080 rpm to 2280 rpm. Nominal speed at 2.0 MW power output is 2016 rpm. The power converter allows the generator to produce power at a power factor of 0.95 lagging to 0.95 leading. The power factor is settable at each WTG or by the Plant SCADA system.

For this analysis, the Gamesa turbines were set at 95% leading (supplying vars) power factor. To maintain this power factor in system intact conditions, the 230/34.5 kV transformer taps were set to 2.5% buck and the wind turbine GSU transformer taps were set to 2.5% buck.

The generator data used by the stability model is shown in Table 4.

For the simulations, the wind farm was dispatched directly by the user to the level specified (100% rated power). It was assumed the turbines would operate at +/-0.95 power factor.

Parameter	Value
Base kV	0.69
WTG MBASE	2.00
Transformer MBASE	2.35
Transformer R on Transformer Base	0.00601
Transformer X on Transformer Base	0.116
GTAP	1.00
Pmax (MW)	2.00
Pmin (MW)	0.00
Ra	0.01022
La	0.14238
Lm Delta	7.21137
Lm D Y	6.94532
L1	0.17503
Rmach	0.01008

Table 4: Gamesa G8X 2.0 MW Wind Turbine Generator Parameters

5.2.1 Turbine Protection Schemes

The Gamesa turbines utilize an undervoltage/overvoltage protection scheme and an underfrequency/overfrequency protection scheme. The various protection schemes are designed to protect the wind turbines in the case of system disturbances that can cause damage to the mechanical systems or power electronics on board the turbine. Generally, the protection schemes will disconnect the generator from the electric grid if the sampled frequency or voltage is outside of a specified band for a specified amount of time. Table 5 shows the voltage protection scheme, and Table 6 shows the frequency protection scheme.

FERC Order #661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI (in this case, the 230 kV bus at the AEP switching station) that draw the voltage down at the POI to 0.0 pu. In order for the wind farm to meet the LVRT provisions of FERC Order #661A, the Customer will be required to purchase the Gamesa turbines with the low voltage ride through package offered by the manufacturer. Also required will be additional reactive compensation devices, of which part shall be dynamic (STATCOM).

Voltage Settings in Per Unit	Time Delay in Seconds	Breaker Time in Seconds
V ≤ 0.15	0.04	0.05
0.15 < V ≤ 0.30	0.625	0.05
0.30 < V ≤ 0.45	1.10	0.05
0.45 < V ≤ 0.60	1.575	0.05
0.60 < V ≤ 0.75	2.050	0.05
0.75 < V ≤ 0.90	2.55	0.05
V ≥ 1.10	0.06	0.05

Table 5: Gamesa G8X 2.0 MW Wind Turbine Voltage Protection

Frequency Settings in Hertz	Time Delay in Seconds	Breaker Time in Seconds
F ≤ 57.0	0.05	0.05
F ≥ 62.0	0.05	0.05

Table 6: Gamesa G8X 2.0 MW Wind Turbine Frequency Protection

5.3 <u>Contingencies Simulated</u>

Sixteen (16) contingencies were considered for the transient stability simulations (see Table 7). These contingencies included three phase faults, single phase line faults, and a breaker failure fault at locations defined by SPP. Single-phase line faults were simulated by applying a fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

Cont. No.	Cont. Name	Description
1	FLT13PH	3 phase fault on the Wind Farm (560012) to Stateline (50054) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Stateline.
2	FLT21PH	*Single phase fault and sequence like Cont. No. 1*
3	FLT33PH	3 phase fault on the Wind Farm (560012) to Elk City (511490) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Elk City.
4	FLT41PH	*Single phase fault and sequence like Cont. No. 3*
5	FLT53PH	3 phase fault on the Clinton Jct (511485) – Elk City (511458) 138 kV line, near Clinton Jct. a. Apply fault at the Clinton Jct 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton Jct. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT61PH	*Single phase fault and sequence like Cont. No. 5*
7	FLT73PH	3 phase fault on the G02-05 (560000) – Morewood (521001) 138 kV line, near Morewood. a. Apply fault at the Morewood 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – G02-05 c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT81PH	*Single phase fault and sequence like Cont. No.7*
9	FLT93PH	3 phase fault on the Hobart Jct (511446) – Elk City (511458) 138 kV line, near Elk City. a. Apply fault at the Elk City 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton AFB (511446) - Hobart Jct c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT101PH	*Single phase fault and sequence like Cont. No.9*
11	FLT113PH	3 phase fault on the Grapevine (523771) – Nichols (524044) 230 kV line near Grapevine. a. Apply fault at the Grapevine bus. b. Clear fault after 5 cycles by tripping the line Grapevine-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT121PH	*Single phase fault and sequence like Cont. No.11*
13	FLT133PH	3 phase fault on the Grapevine 230/115 kV autotransformer on the 230 kV bus a. Apply fault at the Grapevine 230 kV bus. b. Clear fault after 5 cycles by tripping the autotransformer c. No reclose
14	FLT141PH	*Single phase fault and sequence like Cont. No.13*
15	FLT153PH	3 phase fault on the Conway (524079)-Yarnell (524072) –Nichols (524072) 115 kV line near Nichols a. Apply fault at the Nichols bus. b. Clear fault after 5 cycles by tripping the line Conway-Yarnell-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
16	FLT161PH	*Single phase fault and sequence like Cont. No.15*

Table 7: Contingencies Evaluated

5.4 <u>Further Model Preparation</u>

The two base cases contain prior queued projects as shown in Table 8. The wind farm generation from the study customer and previously queued customers is dispatched into the SPP footprint. Initial simulations were carried out on both base cases and cases with the added generation for a no-disturbance run of 20 seconds to verify the numerical stability of the model. All cases were confirmed to be stable.

Project	MW
GEN-2001-026	74
GEN-2002-005	114
GEN-2003-004 GEN-2004-023 GEN-2005-003	151
GEN-2003-020	160
GEN-2003-022 GEN-2004-020	147.5
GEN-2004-003	240
GEN-2005-021	85.5
GEN-2006-002	150

Table 8: Prior Queued Projects

6.0 Results

Initial simulation studies indicated that the worst case scenarios are for those faults at the POI. Therefore, considerable study was done on faults FLT13PH and FLT33PH for both summer peak and winter peak cases.

The FLT 13PH and FLT33PH simulations were run with several variations to determine reactive compensation requirements for the wind farm. In the simulations, the capacitors were switched in two seconds after the fault was cleared. The results are shown in Tables 9 -12. The capacitors for each project shown in the tables are located on the 230 kV bus of their respective generation facility.

Table 9: FLT33PH (Summer Peak)

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	0	0	Yes (UV)
97 Lag	95 Lag	30	0	Yes (UV)
97 Lag	95 Lag	30	10	Yes (UV)
97 Lag	95 Lag	30	20	Yes (UV)
97 Lag	95 Lag	30	25	Yes (OV)
97 Lag	95 Lag	30	30	Yes (OV)

Table 10: FLT13PH (Summer Peak)

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	0	0	Yes (UV)
97 Lag	95 Lag	30	0	Yes (UV)
97 Lag	95 Lag	30	10	Yes (UV)
97 Lag	95 Lag	30	15	Yes (UV)
97 Lag	95 Lag	30	20	Yes (OV)
97 Lag	95 Lag	30	25	Yes (OV)

Table 11: FLT33PH (Winter Peak)

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	30	0	Yes (UV)
97 Lag	95 Lag	30	10	Yes (UV)
97 Lag	95 Lag	30	15	Yes (UV)
97 Lag	95 Lag	30	20	Yes (UV)
97 Lag	95 Lag	30	25	Yes (UV)
97 Lag	95 Lag	30	30	Yes (UV)
97 Lag	95 Lag	30	35	Yes (OV)
97 Lag	95 Lag	30	40	Yes (OV)

Table 12: FLT13PH (Winter Peak)

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	0	0	Yes (UV)
97 Lag	95 Lag	30	0	Yes (UV)
97 Lag	95 Lag	30	10	Yes (OV)
97 Lag	95 Lag	30	15	Yes (UV)
97 Lag	95 Lag	30	20	Yes (UV)
97 Lag	95 Lag	30	25	Yes (UV)
97 Lag	95 Lag	30	30	Yes (OV)

The results indicate that there is a narrow bandwidth (if any) of capacitance value in which the Customer wind farm will remain in service for fault FLT33PH. Therefore, it does not appear that static capacitor banks alone will be adequate to keep the wind farm on line for faults at the POI. The response of the Gamesa wind turbines power factor mode causes the wind turbines to trip on high voltage for most instances when a capacitor bank is switched on.

Next, the simulations were run with two 34.5 kV +/-4MVA STATCOM devices at the Customer 34.5 kV buses. The wind farm will meet FERC Order #661A requirements with the STATCOM. Please see Tables 13 -16 below. Final sizing of capacitor banks and STATCOM devices will be determined by the manufacturer of the devices. The manufacturer and Customer may also determine if a high speed capacitor switching solution may be workable. This solution scheme will need to be given to SPP and the Transmission Owner for review and approval.

Table 13: FLT33PH (Summer Peak) STATCOM

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	0	0	Yes
97 Lag	95 Lag	30	0	Yes
97 Lag	95 Lag	30	10	Yes
97 Lag	95 Lag	30	15	No
97 Lag	95 Lag	30	20	No
97 Lag	95 Lag	30	25	No
97 Lag	95 Lag	30	30	No
97 Lag	95 Lag	30	35	No
97 Lag	95 Lag	30	40	Yes

Table 14: FLT13PH (Summer Peak) STATCOM

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	30	0	No
97 Lag	95 Lag	30	10	No
97 Lag	95 Lag	30	15	No
97 Lag	95 Lag	30	20	Yes
97 Lag	95 Lag	30	25	Yes

Table 15: FLT33PH (Winter Peak) STATCOM

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	30	0	Yes
97 Lag	95 Lag	30	10	Yes
97 Lag	95 Lag	30	15	Yes
97 Lag	95 Lag	30	20	No
97 Lag	95 Lag	30	25	No
97 Lag	95 Lag	30	30	No
97 Lag	95 Lag	30	35	No

Table 16: FLT13PH (Winter Peak) STATCOM

GEN-2006-002 Turbines	GEN-2006-035 Turbines	GEN-2006-002 Capacitors (Mvar)	GEN-2006-035 Capacitors (Mvar)	Wind Farm Trip?
97 Lag	95 Lag	30	0	Yes
97 Lag	95 Lag	30	10	Yes
97 Lag	95 Lag	30	15	Yes
97 Lag	95 Lag	30	20	No
97 Lag	95 Lag	30	30	No
97 Lag	95 Lag	30	40	Yes

With the addition of the two 34.5 kV +/-4MVA STATCOM devices at the Customer 34.5 kV buses and the appropriately sized capacitor(s) switched in on the Customer 230kV bus, the Customer generation facility will remain on line for all contingencies simulated. The results of the stability analysis with the addition of the STATCOM and capacitors are summarized in Table 17.

Selected stability plots for the two seasons are in Appendix A and Appendix B. All plots are available on request.

The wind farm was modeled using the manufacturer supplied low voltage ride through package for the Gamesa wind turbines. This package is required for the wind farm to meet FERC Order #661A Low Voltage Ride Through Requirements. If the Customer changes the wind turbines to be used for this request at any time, an Impact re-study will be required.

Table 17: Summary of Fault Simulation Results

Cont. No.	Cont. Name	Description	2008 Winter Peak	2012 Summer Peak
1	FLT13PH With Capacitors and STATCOM	3 phase fault on the Wind Farm (560012) to Stateline (50054) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Stateline.	**STABLE**	**STABLE**
2	FLT21PH With Capacitors and STATCOM	*Single phase fault and sequence like Cont. No. 1*	**STABLE**	**STABLE**
3	FLT33PH With Capacitors and STATCOM	3 phase fault on the Wind Farm (560012) to Elk City (511490) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Elk City.	**STABLE**	**STABLE**
4	FLT41PH With Capacitors and STATCOM	*Single phase fault and sequence like Cont. No. 3*	**STABLE**	**STABLE**
5	FLT53PH	3 phase fault on the Clinton Jct (511485) – Elk City (511458) 138 kV line, near Clinton Jct. a. Apply fault at the Clinton Jct 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton Jct. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	**STABLE**	**STABLE**
6	FLT61PH	*Single phase fault and sequence like Cont. No. 5*	**STABLE**	**STABLE**
7	FLT73PH	3 phase fault on the G02-05 (560000) – Morewood (521001) 138 kV line, near Morewood. a. Apply fault at the Morewood 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – G02-05 c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	**STABLE**	**STABLE**
8	FLT81PH	*Single phase fault and sequence like Cont. No.7*	**STABLE**	**STABLE**
9	FLT93PH	3 phase fault on the Hobart Jct (511446) – Elk City (511458) 138 kV line, near Elk City. a. Apply fault at the Elk City 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton AFB (511446) - Hobart Jct. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	**STABLE**	**STABLE**
10	FLT101PH	*Single phase fault and sequence like Cont. No.9*	**STABLE**	**STABLE**

Cont. No.	Cont. Name	Description	2008 Winter Peak	2012 Summer Peak
11	FLT113PH	3 phase fault on the Grapevine (523771) – Nichols (524044) 230 kV line near Grapevine. a. Apply fault at the Grapevine bus. b. Clear fault after 5 cycles by tripping the line Grapevine-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	**STABLE**	**STABLE**
12	FLT121PH	*Single phase fault and sequence like Cont. No.11*	**STABLE**	**STABLE**
13	FLT133PH	3 phase fault on the Grapevine 230/115 kV autotransformer on the 230 kV bus a. Apply fault at the Grapevine 230 kV bus. b. Clear fault after 5 cycles by tripping the autotransformer c. No reclose	**STABLE**	**STABLE**
14	FLT141PH	*Single phase fault and sequence like Cont. No.13*	**STABLE**	**STABLE**
15	FLT153PH	3 phase fault on the Conway (524079)-Yarnell (524072) –Nichols (524072) 115 kV line near Nichols a. Apply fault at the Nichols bus. b. Clear fault after 5 cycles by tripping the line Conway-Yarnell-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault	**STABLE**	**STABLE**
16	FLT161PH	*Single phase fault and sequence like Cont. No.15*	**STABLE**	**STABLE**

Table 17: Summary of Fault Simulation Results (continued)

7.0 Results without GEN-2006-002

Generation Interconnection Request GEN-2006-002, which has requested interconnection at the same point as this interconnection request has an executed Interconnection Agreement that is currently in suspension.

GEN-2006-002 Customer will have three years in which to bring the Interconnection Agreement out of suspension, or the Agreement will be terminated by SPP. SPP simulated the contingencies with the GEN-2006-002 project removed so as to determine the requirements without the previous queued project.

The results of the simulations show that GEN-2006-035 will remain on-line and the transmission system will remain stable without the addition of the STATCOM devices.

The results are shown in Table 18.

Table 18: Summary of Fault Simulation Results (if GEN-2006-002 does not come out of suspension)

Cont. No.	Cont. Name	Description	2008 Winter Peak	2012 Summer Peak
1	FLT13PH	3 phase fault on the Wind Farm (560012) to Stateline (50054) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Stateline.	STABLE	STABLE
2	FLT21PH	*Single phase fault and sequence like Cont. No. 1*	STABLE	STABLE
3	FLT33PH	3 phase fault on the Wind Farm (560012) to Elk City (511490) 230 kV line, near the Wind Farm. a. Apply fault at the Wind Farm 230 kV bus. b. Clear fault after 5 cycles by tripping the line from the Wind Farm-Elk City.	STABLE	STABLE
4	FLT41PH	*Single phase fault and sequence like Cont. No. 3*	STABLE	STABLE
5	FLT53PH	3 phase fault on the Clinton Jct (511485) – Elk City (511458) 138 kV line, near Clinton Jct. a. Apply fault at the Clinton Jct 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton Jct. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	STABLE	STABLE
6	FLT61PH	*Single phase fault and sequence like Cont. No. 5*	STABLE	STABLE
7	FLT73PH	3 phase fault on the G02-05 (560000) – Morewood (521001) 138 kV line, near Morewood. a. Apply fault at the Morewood 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – G02-05 c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	STABLE	STABLE
8	FLT81PH	*Single phase fault and sequence like Cont. No.7*	STABLE	STABLE
9	FLT93PH	3 phase fault on the Hobart Jct (511446) – Elk City (511458) 138 kV line, near Elk City. a. Apply fault at the Elk City 138 kV bus. b. Clear fault after 5 cycles by tripping the line from the Elk City – Clinton AFB (511446) - Hobart Jct. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	STABLE	STABLE
10	FLT101PH	*Single phase fault and sequence like Cont. No.9*	STABLE	STABLE
11	FLT113PH	3 phase fault on the Grapevine (523771) – Nichols (524044) 230 kV line near Grapevine. a. Apply fault at the Grapevine bus. b. Clear fault after 5 cycles by tripping the line Grapevine-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	STABLE	STABLE
12	FLT121PH	*Single phase fault and sequence like Cont. No.11*	STABLE	STABLE
13	FLT133PH	3 phase fault on the Grapevine 230/115 kV autotransformer on the 230 kV bus a. Apply fault at the Grapevine 230 kV bus. b. Clear fault after 5 cycles by tripping the autotransformer c. No reclose	STABLE	STABLE

Cont. No.	Cont. Name	Description	2008 Winter Peak	2012 Summer Peak
14	FLT141PH	*Single phase fault and sequence like Cont. No.13*	STABLE	STABLE
15	FLT153PH	3 phase fault on the Conway (524079)-Yarnell (524072) –Nichols (524072) 115 kV line near Nichols a. Apply fault at the Nichols bus. b. Clear fault after 5 cycles by tripping the line Conway-Yarnell-Nichols c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault	STABLE	STABLE
16	FLT161PH	*Single phase fault and sequence like Cont. No.15*	STABLE	STABLE

Table 18: Summary of Fault Simulation Results (if GEN-2006-002 does not come out of suspension) (Continued)

8.0 Conclusion

The Customer has requested interconnection of a 224 MW wind farm in Roger Mills County, Oklahoma using one hundred twelve (112) Gamesa G8X 2.0 MW wind turbines. The transmission system will remain stable for all contingencies studied.

However, the Customer facility will trip off line for contingencies at the POI. In order for the wind farm to meet the LVRT provisions of FERC Order #661A, the Customer will be required to meet a power factor of +/- 95% at the point of interconnection. The customer shall purchase the Gamesa turbines with the low voltage ride through package offered by the manufacturer. Also required will be additional reactive compensation devices, of which part needs to be dynamic (STATCOM).

If Generation Interconnection Request #GEN-2006-002 does not come out of suspension and is subsequently withdrawn from the generation interconnection queue, the STATCOM devices will not be required.

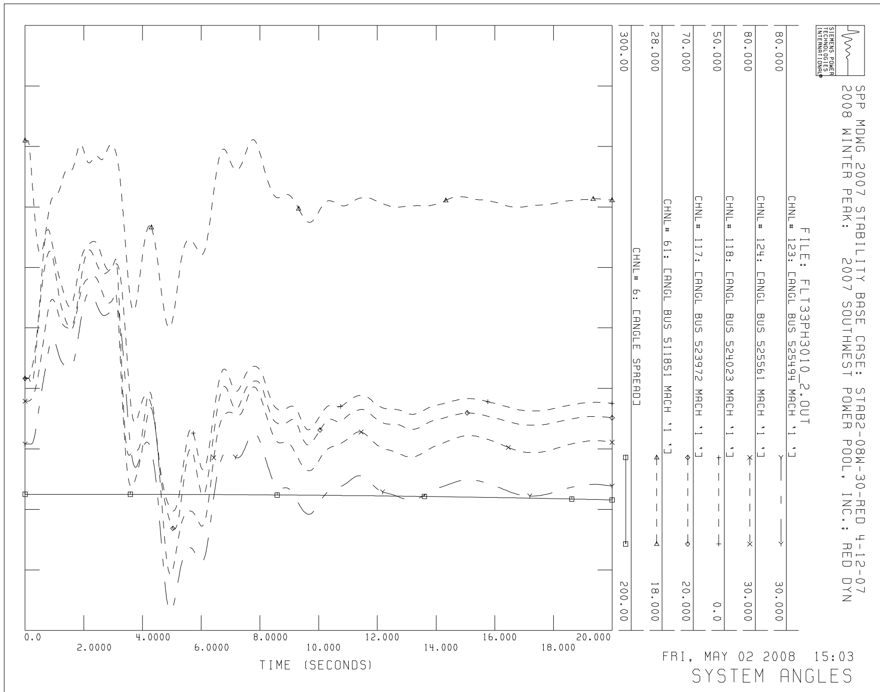
The Facilities Study for Gen-2006-035 provides the most up to date cost estimates for the required interconnection facilities. The Facilities Study does not address the cost of the Customer substation, the Customer's reactive compensation requirements, or the transmission line between the Customer substation and the proposed AEPW switching substation located on the Grapevine – Elk City 230 kV line.

The costs do not include any costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer requests transmission service through Southwest Power Pool's OASIS. It should be noted that the models used for simulation do not contain all SPP transmission service.

APPENDIX A.

SELECTED STABILITY PLOTS – 2008 Winter Peak

All plots available on request.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2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
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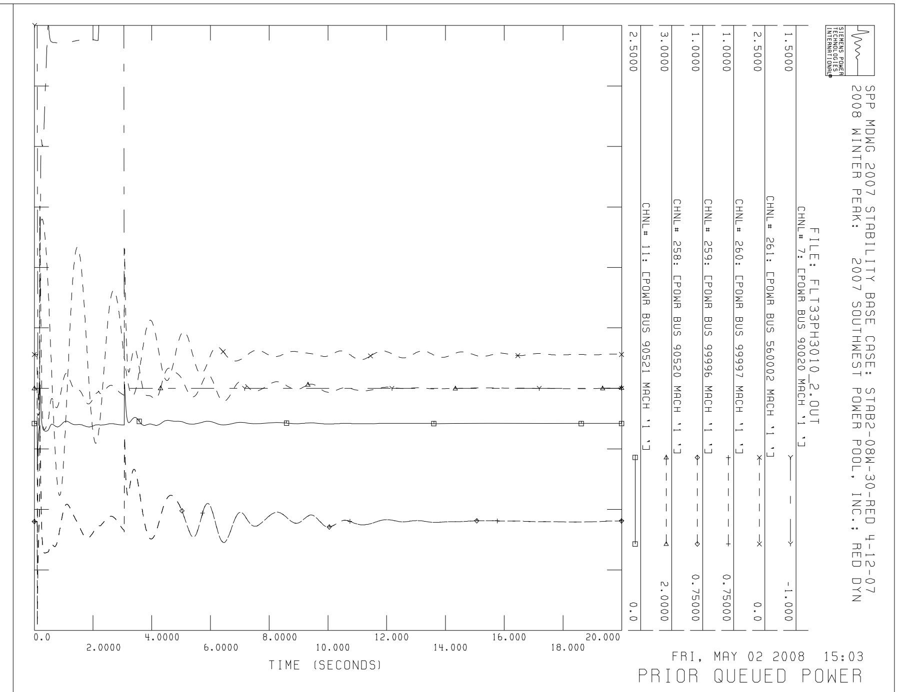
CHNL# 124: CANGL BUS 525561 MACH '1 ']
CHNL# 118: CANGL BUS 524023 MACH '1 ']
CHNL# 117: CANGL BUS 523972 MACH '1 ']
CHNL# 61: CANGL BUS 511851 MACH '1 ']
CHNL# 6: CANGLE SPREAD]
TIME (SECONDS)
FRI, MAY 02 2008 15:03
SYSTEM ANGLES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2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
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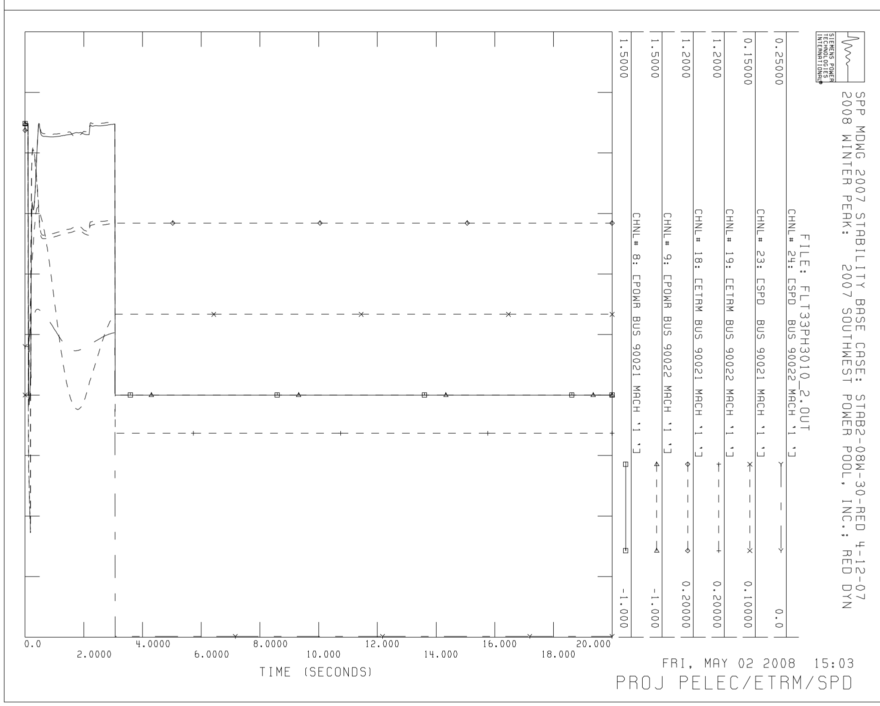
CHNL# 7: CPOWR BUS 90020 MACH '1 ']
CHNL# 261: CPOWR BUS 560002 MACH '1 ']
CHNL# 260: CPOWR BUS 99997 MACH '1 ']
CHNL# 259: CPOWR BUS 99996 MACH '1 ']
CHNL# 258: CPOWR BUS 90520 MACH '1 ']
CHNL# 11: CPOWR BUS 90521 MACH '1 ']
TIME (SECONDS)
FRI, MAY 02 2008 15:03
PRIOR QUEUED POWER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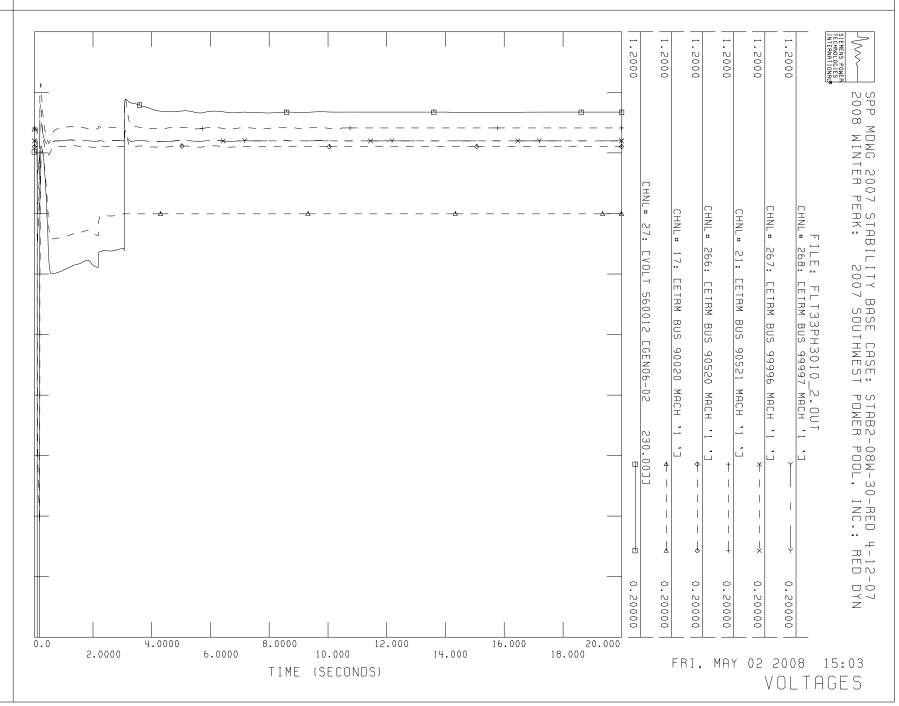
2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3010_2.OUT
CHNL# 24: CSPD BUS 90022 MACH '1 ']
CHNL# 23: CSPD BUS 90021 MACH '1 ']
CHNL# 19: CETRM BUS 90022 MACH '1 ']
CHNL# 18: CETRM BUS 90021 MACH '1 ']
CHNL# 9: CPOWR BUS 90022 MACH '1 ']
CHNL# 8: CPOWR BUS 90021 MACH '1 ']
TIME (SECONDS)
FRI, MAY 02 2008 15:03
PROJ PELEC/ETRM/SPD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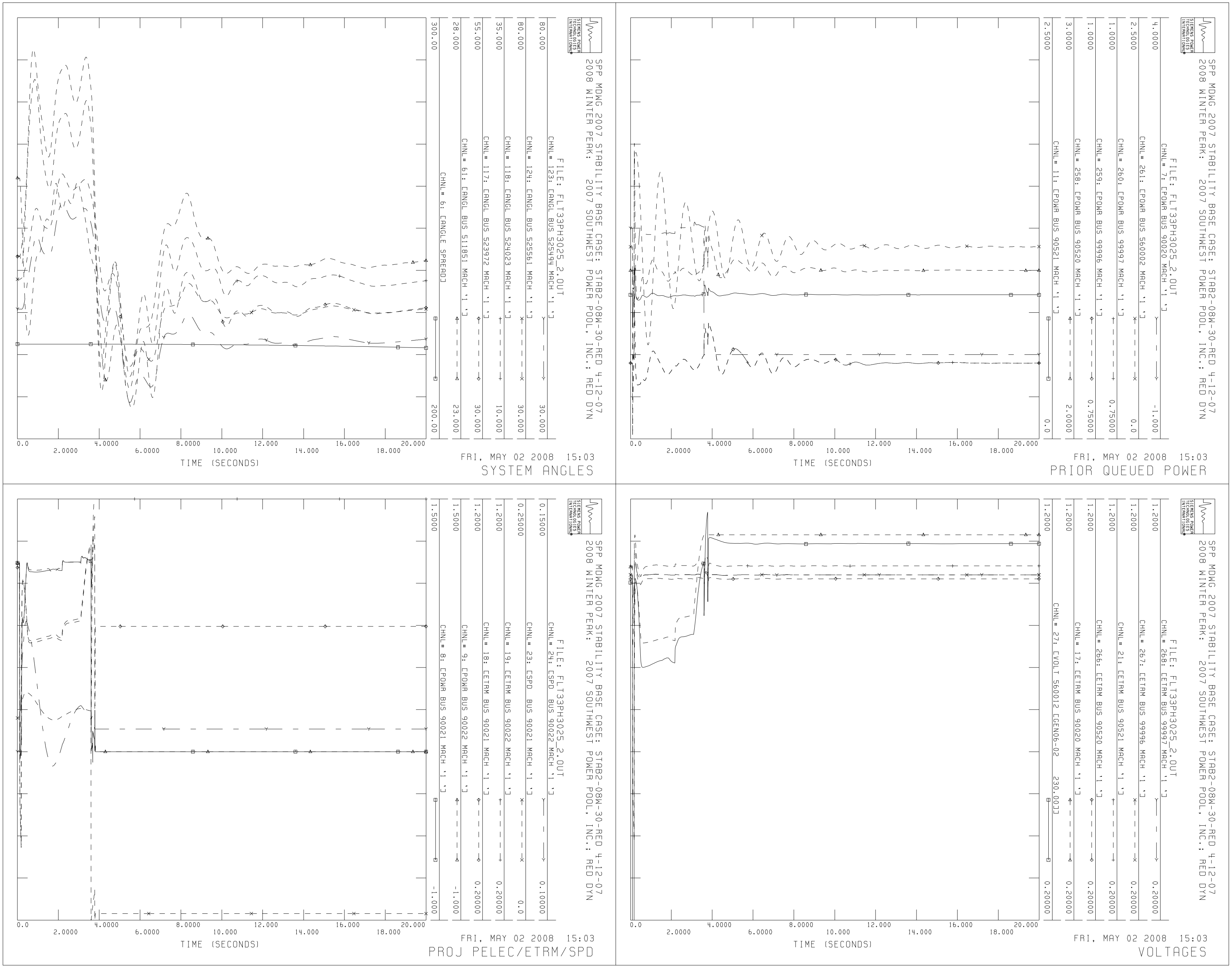
2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3010_2.OUT
CHNL# 268: CETRM BUS 99997 MACH '1 ']
CHNL# 267: CETRM BUS 99996 MACH '1 ']
CHNL# 21: CETRM BUS 90521 MACH '1 ']
CHNL# 266: CETRM BUS 90520 MACH '1 ']
CHNL# 17: CETRM BUS 90020 MACH '1 ']
CHNL# 27: CVOLT 560012 [GEN06-02 230.00]
TIME (SECONDS)
FRI, MAY 02 2008 15:03
VOLTAGES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2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
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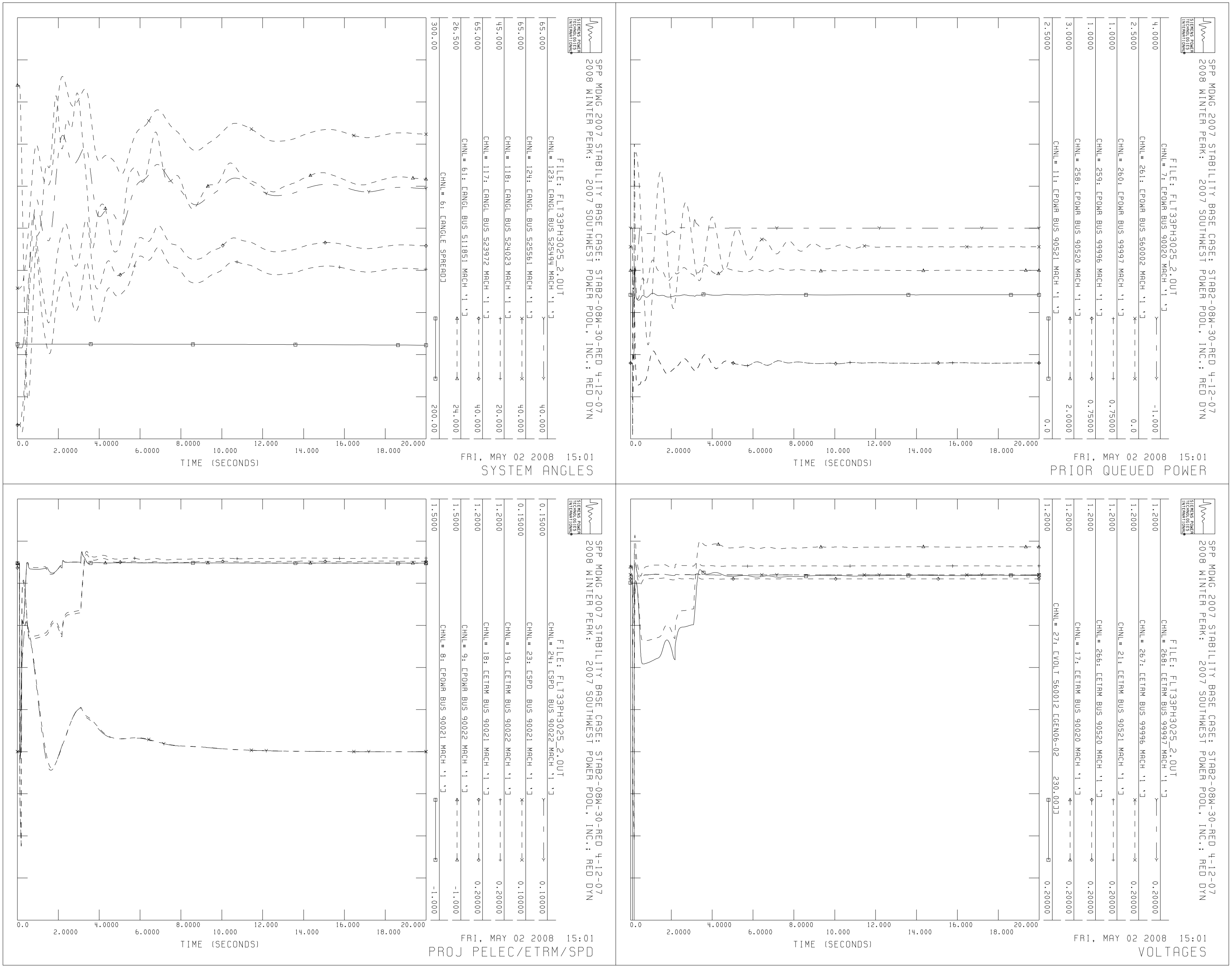
CHNL# 124: [ANGL BUS 525561 MACH '1 ']
CHNL# 118: [ANGL BUS 524023 MACH '1 ']
CHNL# 117: [ANGL BUS 523972 MACH '1 ']
CHNL# 61: [ANGL BUS 511851 MACH '1 ']
CHNL# 6: [ANGLE SPREAD]
TIME (SECONDS)
FRI, MAY 02 2008 15:03
SYSTEM ANGLES
CHNL# 7: [POWR BUS 90020 MACH '1 ']
CHNL# 261: [POWR BUS 560002 MACH '1 ']
CHNL# 260: [POWR BUS 99997 MACH '1 ']
CHNL# 259: [POWR BUS 99996 MACH '1 ']
CHNL# 258: [POWR BUS 90520 MACH '1 ']
CHNL# 11: [POWR BUS 90521 MACH '1 ']
PRIOR QUEUED POWER
CHNL# 24: [SPD BUS 90022 MACH '1 ']
CHNL# 23: [SPD BUS 90021 MACH '1 ']
CHNL# 19: [ETRM BUS 90022 MACH '1 ']
CHNL# 18: [ETRM BUS 90021 MACH '1 ']
CHNL# 9: [POWR BUS 90022 MACH '1 ']
CHNL# 8: [POWR BUS 90021 MACH '1 ']
PROJ PELEC/ETRM/SPD
CHNL# 268: [ETRM BUS 99997 MACH '1 ']
CHNL# 267: [ETRM BUS 99996 MACH '1 ']
CHNL# 21: [ETRM BUS 90521 MACH '1 ']
CHNL# 266: [ETRM BUS 90520 MACH '1 ']
CHNL# 17: [ETRM BUS 90020 MACH '1 ']
CHNL# 27: [VOLT 560012 [GEN06-02 230.00]]
VOLTAGES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2008 WINTER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
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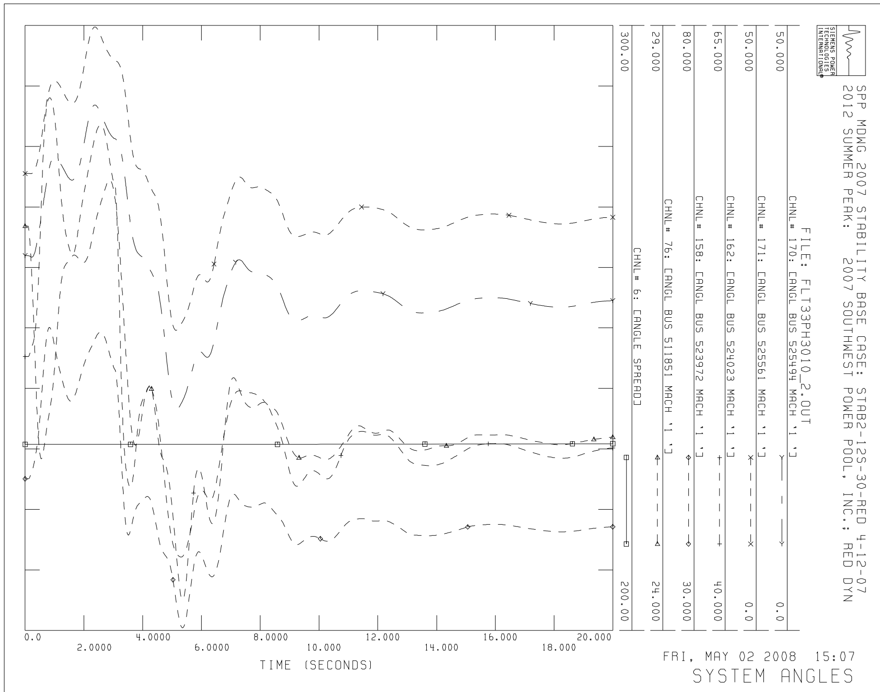
CHNL# 124: [ANGL BUS 525561 MACH '1 ']
CHNL# 118: [ANGL BUS 524023 MACH '1 ']
CHNL# 117: [ANGL BUS 523972 MACH '1 ']
CHNL# 61: [ANGL BUS 511851 MACH '1 ']
CHNL# 6: [ANGLE SPREAD]
FRI, MAY 02 2008 15:01
SYSTEM ANGLES
TIME (SECONDS)
CHNL# 7: [POWR BUS 90020 MACH '1 ']
CHNL# 261: [POWR BUS 560002 MACH '1 ']
CHNL# 260: [POWR BUS 99997 MACH '1 ']
CHNL# 259: [POWR BUS 99996 MACH '1 ']
CHNL# 258: [POWR BUS 90520 MACH '1 ']
CHNL# 11: [POWR BUS 90521 MACH '1 ']
PRIOR QUEUED POWER
CHNL# 24: [SPD BUS 90022 MACH '1 ']
CHNL# 23: [SPD BUS 90021 MACH '1 ']
CHNL# 19: [ETRM BUS 90022 MACH '1 ']
CHNL# 18: [ETRM BUS 90021 MACH '1 ']
CHNL# 9: [POWR BUS 90022 MACH '1 ']
CHNL# 8: [POWR BUS 90021 MACH '1 ']
PROJ PELEC/ETRM/SPD
CHNL# 268: [ETRM BUS 99997 MACH '1 ']
CHNL# 267: [ETRM BUS 99996 MACH '1 ']
CHNL# 21: [ETRM BUS 90521 MACH '1 ']
CHNL# 266: [ETRM BUS 90520 MACH '1 ']
CHNL# 17: [ETRM BUS 90020 MACH '1 ']
CHNL# 27: [VOLT 560012 [GEN06-02 230.00]]
VOLTAGES

APPENDIX B.

SELECTED STABILITY PLOTS – 2012 Summer Peak

All plots available on request.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2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
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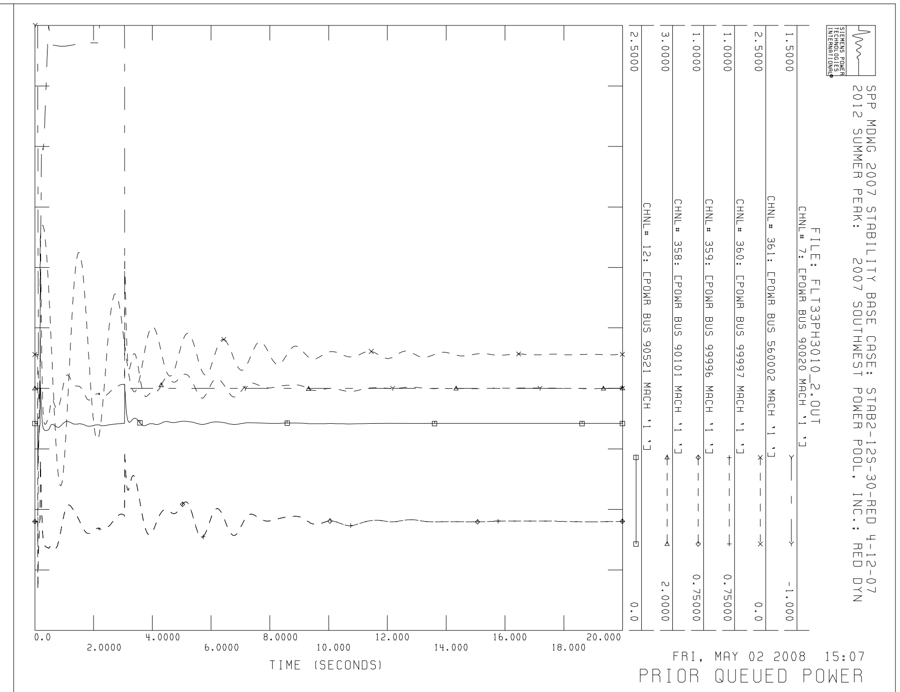
50.000 0.0
CHNL# 171: [ANGL BUS 525561 MACH '1 ']
50.000 0.0
CHNL# 162: [ANGL BUS 524023 MACH '1 ']
65.000 40.000
CHNL# 158: [ANGL BUS 523972 MACH '1 ']
80.000 30.000
CHNL# 76: [ANGL BUS 511851 MACH '1 ']
29.000 24.000
CHNL# 6: [ANGLE SPREAD]
300.00 200.00
TIME (SECONDS)
FRI, MAY 02 2008 15:07
SYSTEM ANGLES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2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3010_2.OUT
CHNL# 7: [POWR BUS 90020 MACH '1 ']
1.5000 -1.000
CHNL# 361: [POWR BUS 560002 MACH '1 ']
2.5000 0.0
CHNL# 360: [POWR BUS 99997 MACH '1 ']
1.0000 0.75000
CHNL# 359: [POWR BUS 99996 MACH '1 ']
1.0000 0.75000
CHNL# 358: [POWR BUS 90101 MACH '1 ']
3.0000 2.0000
CHNL# 12: [POWR BUS 90521 MACH '1 ']
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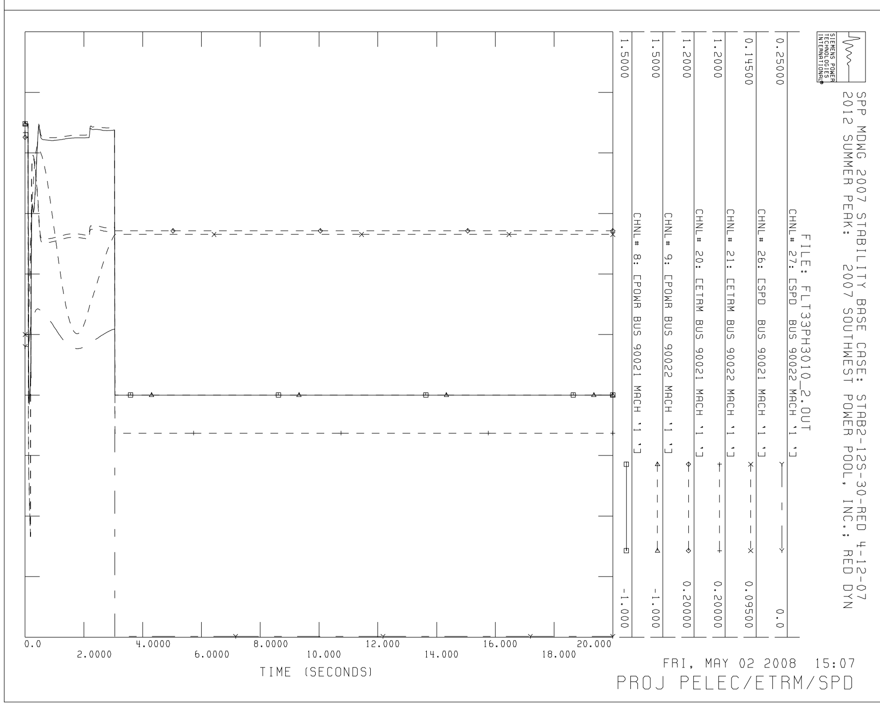
TIME (SECONDS)
FRI, MAY 02 2008 15:07
PRIOR QUEUED POWER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2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3010_2.OUT
CHNL# 27: [SPD BUS 90022 MACH '1 ']
0.25000 0.0
CHNL# 26: [SPD BUS 90021 MACH '1 ']
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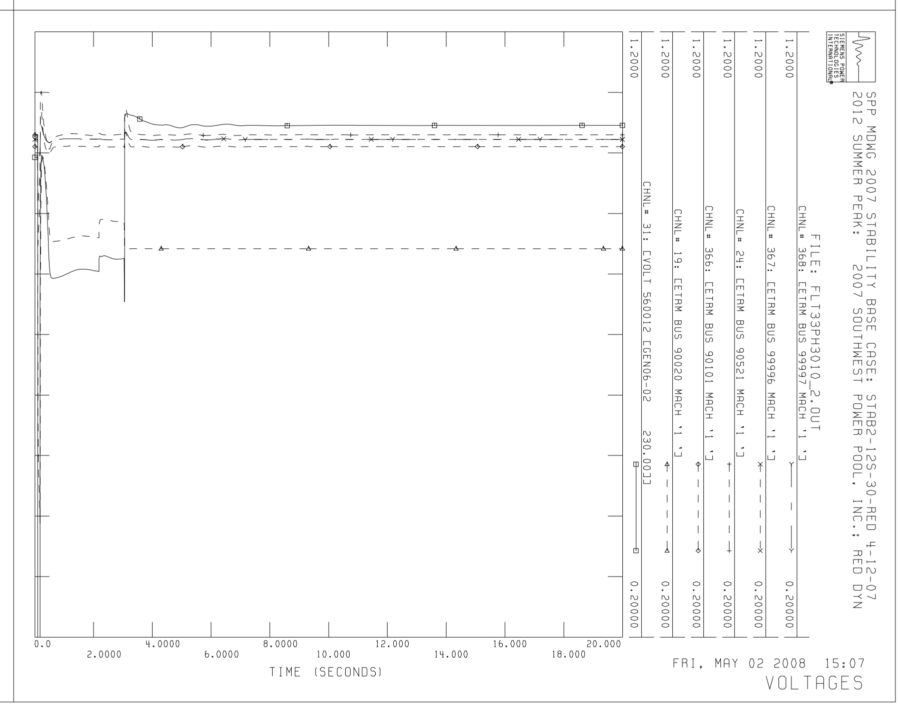
CHNL# 21: [ETRM BUS 90022 MACH '1 ']
1.2000 0.20000
CHNL# 20: [ETRM BUS 90021 MACH '1 ']
1.2000 0.20000
CHNL# 9: [POWR BUS 90022 MACH '1 ']
1.5000 -1.000
CHNL# 8: [POWR BUS 90021 MACH '1 ']
1.5000 -1.000
TIME (SECONDS)
FRI, MAY 02 2008 15:07
PROJ PELEC/ETRM/SPD


SPP MDWG 2007 STABILITY BASE CASE: STAB2-12S-30-RED 4-12-07
2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
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1.2000 0.20000
CHNL# 367: [ETRM BUS 99996 MACH '1 ']
1.2000 0.20000
CHNL# 24: [ETRM BUS 90521 MACH '1 ']
1.2000 0.20000
CHNL# 366: [ETRM BUS 90101 MACH '1 ']
1.2000 0.20000
CHNL# 19: [ETRM BUS 90020 MACH '1 ']
1.2000 0.20000
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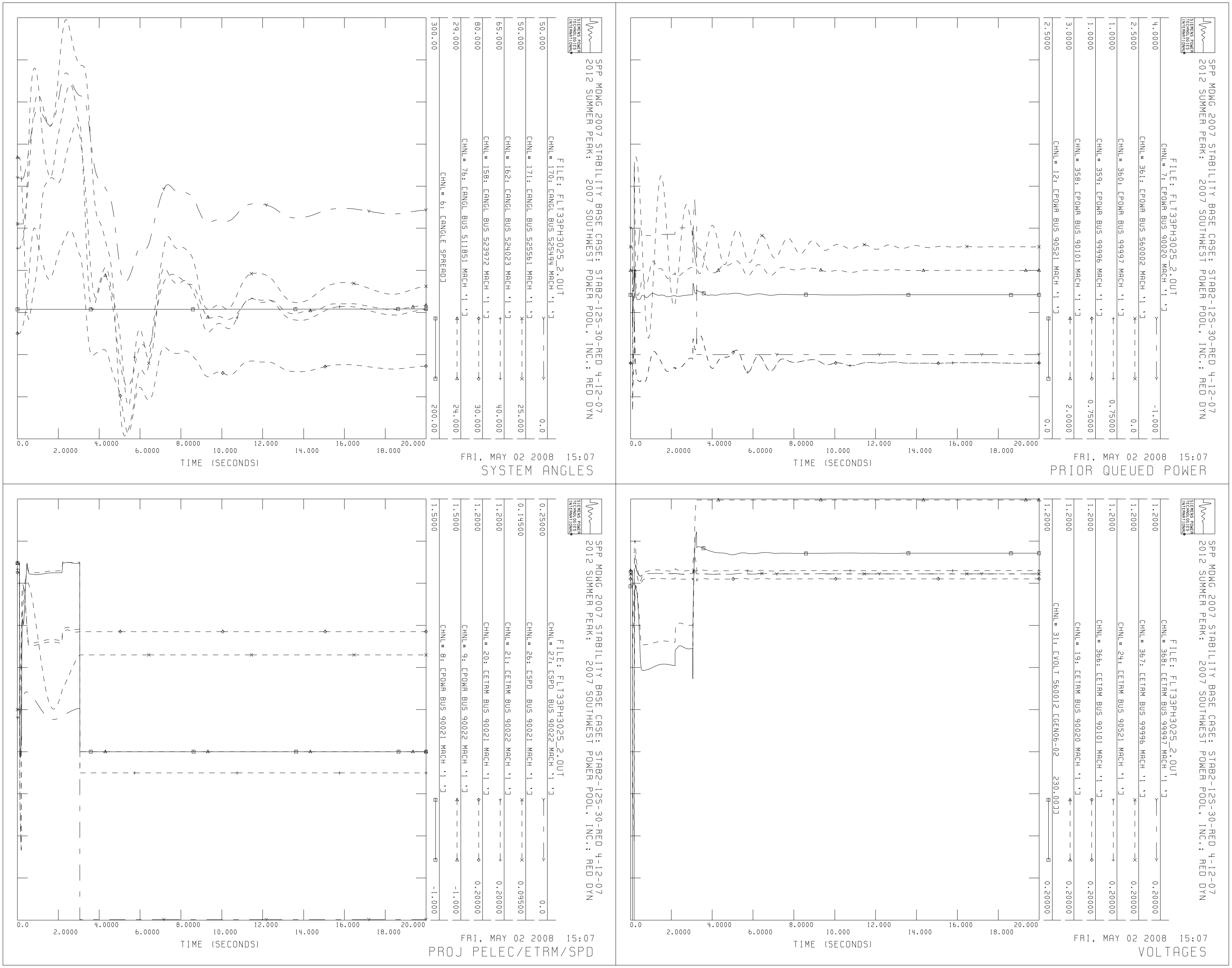
TIME (SECONDS)
FRI, MAY 02 2008 15:07
VOLTAGES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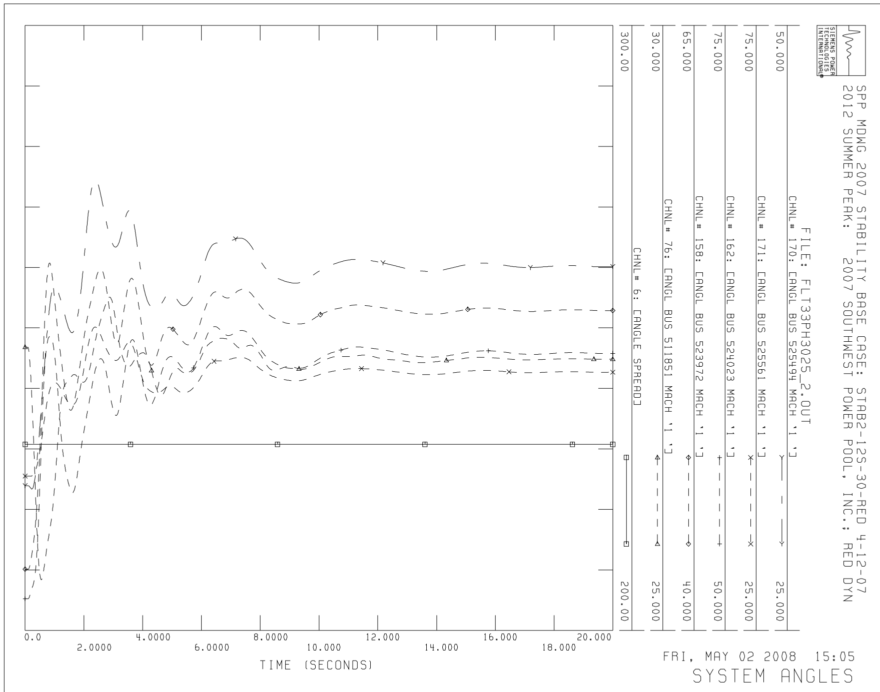
2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
CHNL# 170: CANGL BUS 525494 MACH '1 '
CHNL# 171: CANGL BUS 525561 MACH '1 '
CHNL# 162: CANGL BUS 524023 MACH '1 '
CHNL# 158: CANGL BUS 523972 MACH '1 '
CHNL# 76: CANGL BUS 511851 MACH '1 '
CHNL# 6: CANGLE SPREAD
FRI, MAY 02 2008 15:07
SYSTEM ANGLES
TIME (SECONDS)
CHNL# 7: CPOWR BUS 90020 MACH '1 '
CHNL# 361: CPOWR BUS 560002 MACH '1 '
CHNL# 360: CPOWR BUS 99997 MACH '1 '
CHNL# 359: CPOWR BUS 99996 MACH '1 '
CHNL# 358: CPOWR BUS 90101 MACH '1 '
CHNL# 12: CPOWR BUS 90521 MACH '1 '
PRIOR QUEUED POWER
CHNL# 27: CSPD BUS 90022 MACH '1 '
CHNL# 26: CSPD BUS 90021 MACH '1 '
CHNL# 21: CETRM BUS 90022 MACH '1 '
CHNL# 20: CETRM BUS 90021 MACH '1 '
CHNL# 9: CPOWR BUS 90022 MACH '1 '
CHNL# 8: CPOWR BUS 90021 MACH '1 '
PROJ PELEC/ETRM/SPD
CHNL# 368: CETRM BUS 99997 MACH '1 '
CHNL# 367: CETRM BUS 99996 MACH '1 '
CHNL# 24: CETRM BUS 90521 MACH '1 '
CHNL# 366: CETRM BUS 90101 MACH '1 '
CHNL# 19: CETRM BUS 90020 MACH '1 '
CHNL# 31: CVOLT 560012 [GEN06-02 230.00]
VOLTAGES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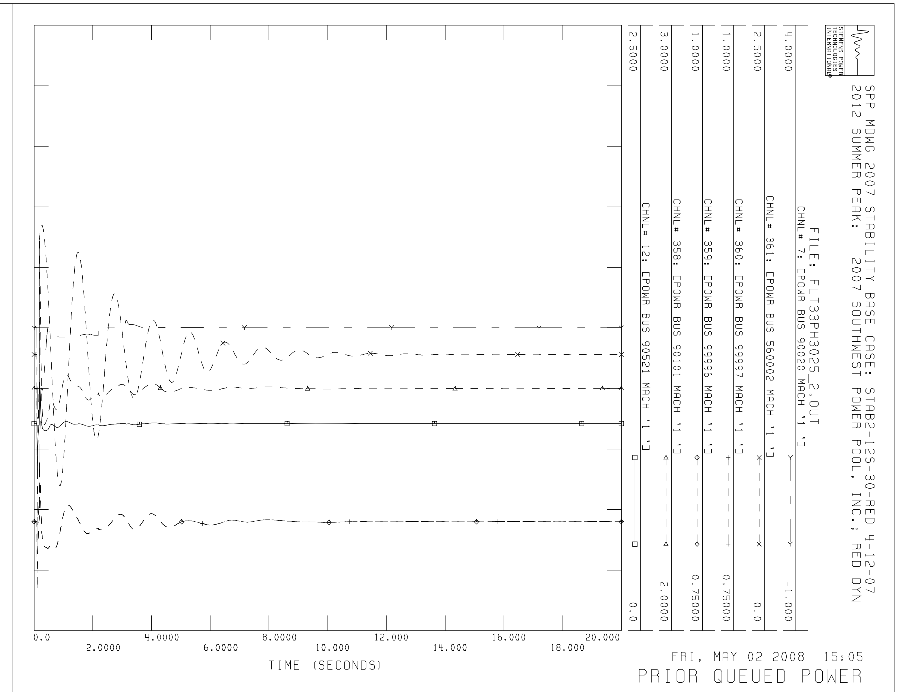
2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
CHNL# 170: [ANGL BUS 525494 MACH '1 '] 50.000 25.000
CHNL# 171: [ANGL BUS 525561 MACH '1 '] 75.000 25.000
CHNL# 162: [ANGL BUS 524023 MACH '1 '] 75.000 50.000
CHNL# 158: [ANGL BUS 523972 MACH '1 '] 65.000 40.000
CHNL# 76: [ANGL BUS 511851 MACH '1 '] 30.000 25.000
CHNL# 6: [ANGLE SPREAD] 300.00 200.00
0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)
FRI, MAY 02 2008 15:05
SYSTEM ANGLES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2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
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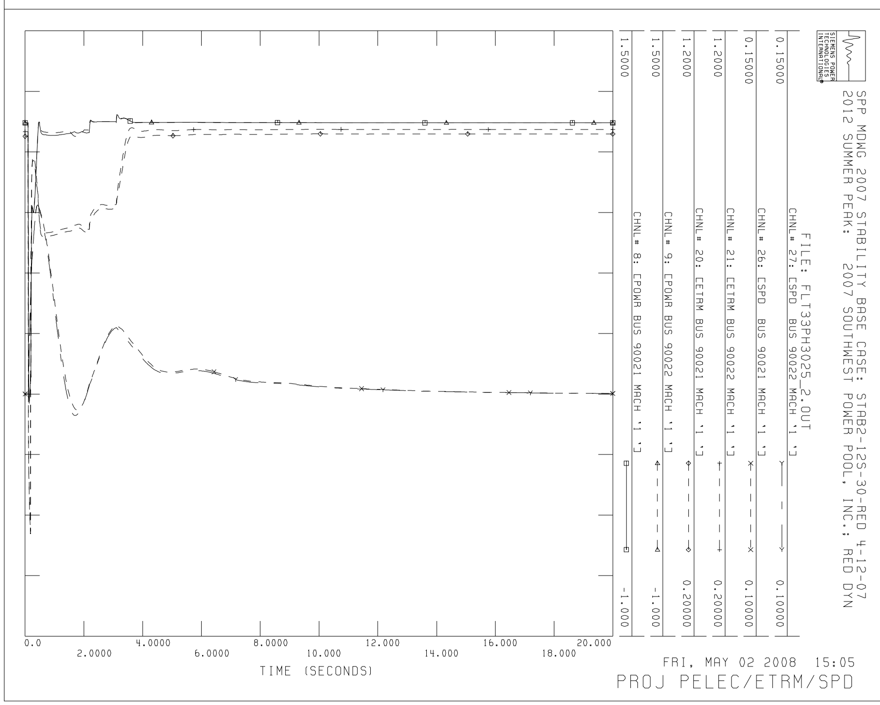
CHNL# 359: [POWR BUS 99996 MACH '1 '] 1.0000 0.75000
CHNL# 358: [POWR BUS 90101 MACH '1 '] 3.0000 2.0000
CHNL# 12: [POWR BUS 90521 MACH '1 '] 2.5000 0.0
0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)
FRI, MAY 02 2008 15:05
PRIOR QUEUED POWER


SPP MDWG 2007 STABILITY BASE CASE; STAB2-12S-30-RED 4-12-07
2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
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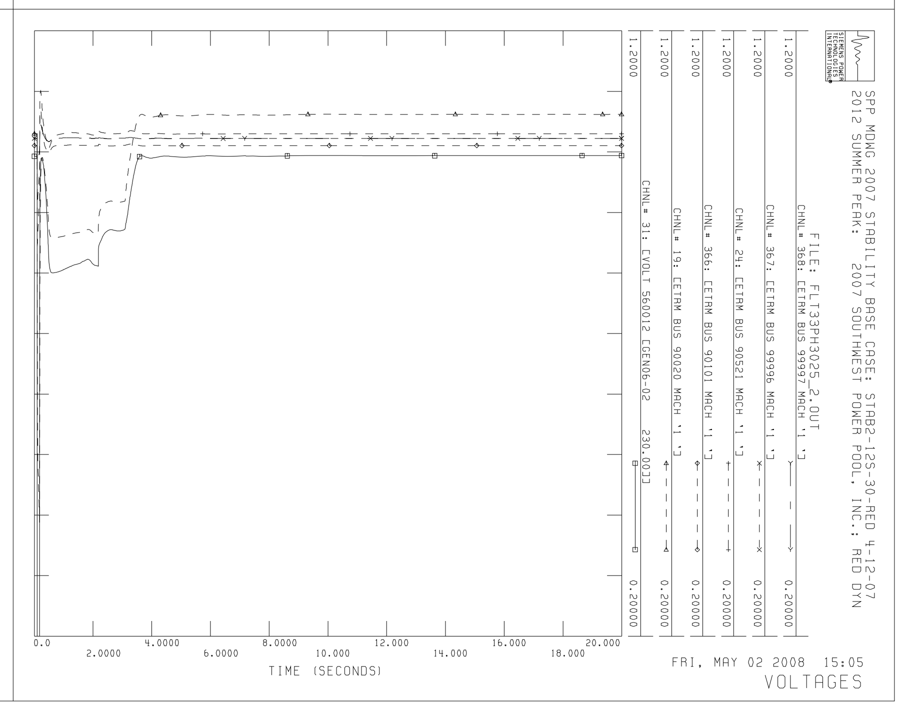
CHNL# 26: [SPD BUS 90021 MACH '1 '] 0.15000 0.10000
CHNL# 21: [ETRM BUS 90022 MACH '1 '] 1.2000 0.20000
CHNL# 20: [ETRM BUS 90021 MACH '1 '] 1.2000 0.20000
CHNL# 9: [POWR BUS 90022 MACH '1 '] 1.5000 -1.000
CHNL# 8: [POWR BUS 90021 MACH '1 '] 1.5000 -1.000
0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)
FRI, MAY 02 2008 15:05
PROJ PELEC/ETRM/SPD


SPP MDWG 2007 STABILITY BASE CASE; STAB2-12S-30-RED 4-12-07
2012 SUMMER PEAK: 2007 SOUTHWEST POWER POOL, INC.; RED DYN
FILE: FLT33PH3025_2.OUT
CHNL# 368: [ETRM BUS 99997 MACH '1 '] 1.2000 0.20000
CHNL# 367: [ETRM BUS 99996 MACH '1 '] 1.2000 0.20000
CHNL# 24: [ETRM BUS 90521 MACH '1 '] 1.2000 0.20000
CHNL# 366: [ETRM BUS 90101 MACH '1 '] 1.2000 0.20000
CHNL# 19: [ETRM BUS 90020 MACH '1 '] 1.2000 0.20000
CHNL# 31: [VOLT 560012 [GEN06-02 230.00]] 1.2000 0.20000
0.0 2.0000 4.0000 6.0000 8.0000 10.000 12.000 14.000 16.000 18.000 20.000
TIME (SECONDS)
FRI, MAY 02 2008 15:05
VOLTAGES