Southwest Power Pool

Impact Study For Generation Interconnection Request GEN-2005-015

SPP Tariff Studies

(#GEN-2005-015)

April 2006

Executive Summary

<OMITTED TEXT> (Customer) has requested an Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of a 150 MW wind powered generation facility in Motley County, Texas to the transmission system of Xcel Energy (Xcel). The wind farm as studied consisted of seventy-five (75) individual Gamesa G87 2.0 MW wind turbines. The Customer also requested studying the wind farm with a second wind turbine design; however, the manufacturer was not able to produce a working dynamic model. Studies for a second wind turbine design were therefore not completed. The requested in-service date for the 150MW facility is December 31, 2006. This Impact study addresses the dynamic stability effects of interconnecting the plant to the rest of the Xcel 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 generation facility will interconnect into the Tuco-Oklaunion 345kV line via a new 345kV switching station. This interconnection facility is estimated to cost $5,659,000. This cost will be refined in a Facility Study, if the Customer chooses to continue into the Facility Study stage of the Large Generator Interconnection Procedures (LGIP). From this station, the Customer will build a 345kV line to its 345/34.5kV collector substation. This substation will have feeder connections to the wind turbine collection circuits.

Transmission Line Reactors will most likely be needed at the Transmission Owner Interconnection Substation. For this Study, a 20 MVAR line reactor was modeled on the Oklaunion terminal. The need and size for these reactors will be more accurately determined in an EMTP study to be conducted during the Facility Study. Depending on the EMTP study results, this Impact Study may have to be selectively revisited for stability concerns.

Three seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. The cases studied were the 2006 winter peak, 2006 fall case, and the 2010 summer peak case. There were different variations of the 2010 summer loading case used. Each case was modified to include prior queued projects that are discussed in the body of the report. The Gamesa G87 wind turbines were modeled using information provided by the manufacturer. Nineteen contingencies were simulated.

The Gamesa G87 turbines have the ability to produce vars at a power factor up to 0.95. This study has determined that if the turbines are set to produce vars at a 0.99 lagging power factor, reactive power losses in the collector system including the substation 345/34.5kV transformer will be offset at the point of interconnection. This setting allows a zero reactive power exchange at the point of interconnection and allows for an acceptable voltage profile from the point of interconnection to the wind turbine bus. If this setting is used, an additional capacitor bank will not be needed at the substation. Depending on system conditions, the Customer should monitor the reactive power intake of the wind farm and adjust the turbine settings accordingly.

Stability Study results show that the transmission system remains stable for all simulated contingencies studied.

Further Stability study results show that the wind farm using the Gamesa wind turbines will meet the ‘Transitional’ provisions of FERC Order #661A’s Low Voltage Ride Through (LVRT) provisions. However, the wind farm may not meet the full requirement of Order #661A. The Customer should sign an Interconnection Agreement before December 31, 2006.

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 interconnecting a 150 MW wind powered generation facility in Motley County, Texas to the transmission system of Xcel Energy (Xcel). The wind farm configuration used Gamesa 2.0 MW wind turbines and was comprised of seventy-five (75) individual 2.0 MW Gamesa G87 wind turbines. The Customer also requested the wind farm to be studied with a second configuration using one-hundred-seventy-six (176) individual Gamesa G5X 850kW wind turbines. However, these studies were not completed as the manufacturer did not produce a working PTI dynamic model for the second wind turbine design.

The requested in-service date for the 150 MW facility is December 31, 2006. The wind powered generation facility will interconnect into the existing Tuco-Oklaunion 345kV transmission line. This study will address the stability and reactive compensation issues associated with 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 (iii) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the Interconnection System Impact Study is commenced: (i) are directly interconnected to the Transmission System; (ii) are interconnected to Affected Systems and may have an impact on the Interconnection Request; (iii) have a pending higher queued Interconnection Request to interconnect to the Transmission System; and (iv) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

There are two previously queued projects in the immediate area ahead of this request in the SPP Generation Interconnection queue. It was assumed for purposes of this study that those projects would be in-service if this project is built. Any changes to this assumption, i.e. one or more of the previously queued projects not included in the study signing an interconnection agreement, may require a re-study of this request at the expense of the customer. Other wind farms which have higher queue priority than this request, were modeled in this case.

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 facility was studied using the Gamesa G87 2.0 MW wind turbines. The nameplate rating of each turbine is 2000kW with a machine base of 2030kVA. The turbine output voltage is 690V. The Gamesa turbines utilize a doubly fed induction-generator. The generator synchronous speed is 1800 rpm, and a variable frequency power converter tied to the generator rotor allows the generator to operate at speeds ranging from 1020 rpm to 2340 rpm. Nominal speed at 2.0MW power output is 2015 rpm. The power converter allows the generator to produce power at a power factor of 0.95 lagging (producing vars) to 0.9 leading (absorbing vars). The power factor is settable at each WTG or by the Plant SCADA system.

3.2 Interconnection Facility

The Customer has proposed an interconnection facility, which would connect to the SPS/Xcel Energy transmission system via a new substation located in Motley County on the Tuco-Oklaunion 345kV line. The new substation would be configured to accept a terminal from an adjacent 345/34.5kV transformation substation containing one transformer that serves the wind powered generation facility.

Analysis of the reactive compensation requirements of the wind farm determined that if the Gamesa turbines power factor settings are set to produce vars at a power factor of at least 0.99 lagging, there will be no need for additional capacitor banks to account for collector system and transformer reactive power losses. Therefore, the turbine power factor settings must be set at 0.99 lagging power factor during the summer peak to allow for zero reactive power exchange.

Currently, the Tuco-Oklaunion 345kV line has reactors at both ends for switching surge purposes and for holding down the voltage due to charging on the 345kV line. At this time it is concluded a new line reactor will be required at the new substation on the terminal looking toward Oklaunion. It is estimated this line reactor will be sized at approximately 20 MVAR. If the Customer continues on into the Facility Study stage of the Interconnection Procedures, a switching surge study (EMTP study) will be conducted at this time to more accurately determine the need and size of line reactors at the switching station.

The total cost for adding a new 345kV switching station, the right of way for the station, and the cost of the line reactor, the required interconnection facility is estimated at $5,659,783. This cost does not include building the 345kV line from the Customer substation to the new substation on the Tuco-Oklaunion 345 kV line. These Facility Descriptions and Costs are shown in Table 1. and Table 2.

A preliminary one-line diagram of the generating facility and interconnection facility using the Gamesa G87 2.0MW wind turbines is shown in Figure 1.

Table 1: Direct Assignment Facilities

Facility	ESTIMATED COST (2005 DOLLARS)
Customer – 345-34.5 kV Substation facilities.	*
Customer - 345kV line between Customer substation and new SPS 345kV switching station.	*
Customer - Right-of-Way for Customer Substation & Line.	*

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

Table 2: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2005 DOLLARS)
Xcel - New 345kV switching station in existing Tuco – Oklaunion 345kV line.	$3,837,900
Xcel - Right-of-way for new SPS 345kV switching station.	47,000
Xcel – 345kV, 20MVAR line reactor in new 345kV switching station on the Oklaunion terminal	1,774,883
Total	**$5,659,783**

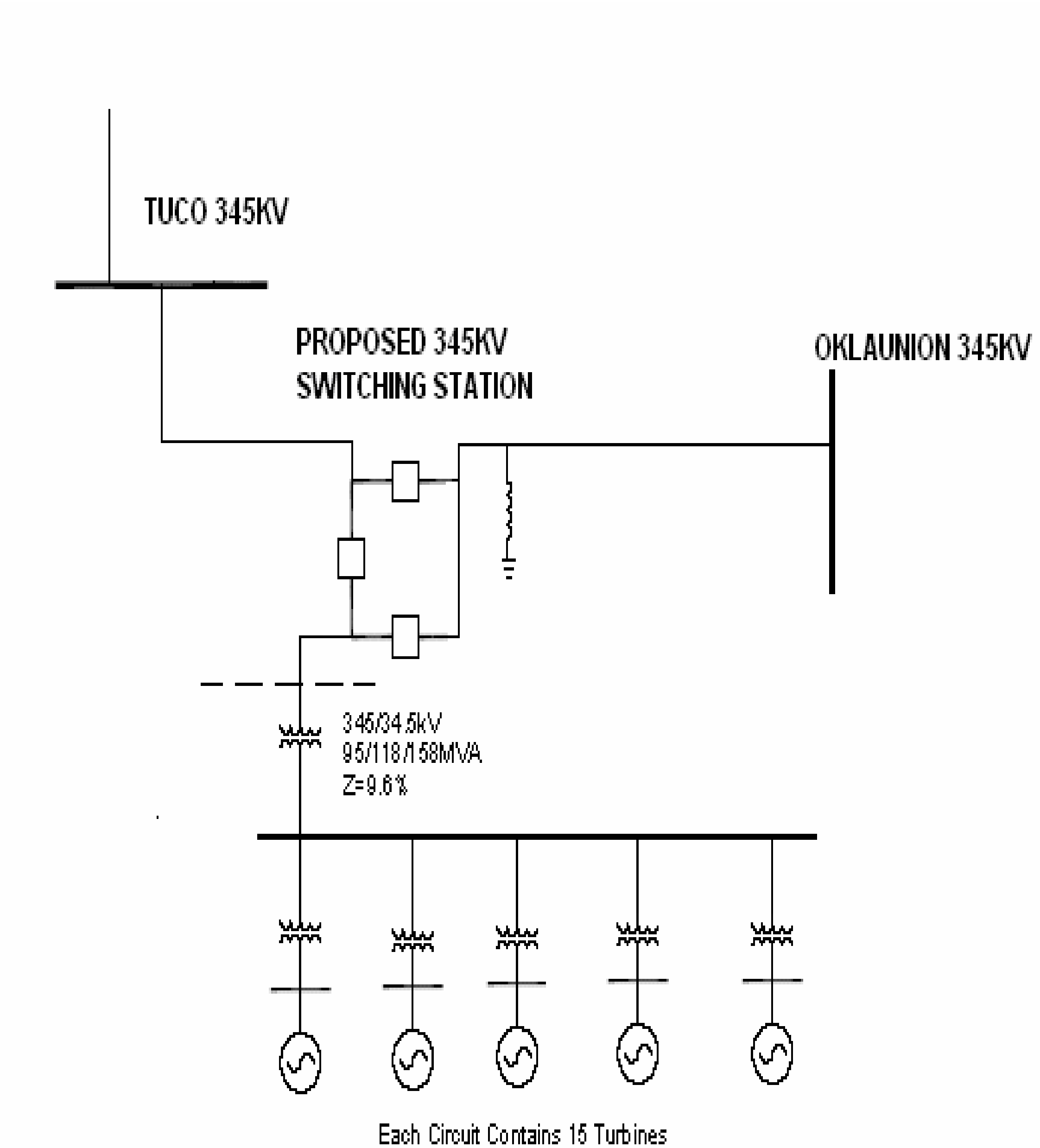


Figure 1: Proposed Interconnection Configuration With Gamesa G87 wind turbines (Final substation design to be determined)

4.0 Stability Analysis

4.1 Objective

The objective of the stability study is to determine the impact on system stability of connecting the proposed GEN-2005-015 wind farm to SPP's 345 kV transmission system.

4.2 Equivalent Modeling of the Wind Generating Facility

The rated output of the generation facility is 150MW, comprised of 75 Gamesa 2.0MW wind turbines. The base voltage of the Gamesa turbine is 690 V, and a generator step up transformer (GSU) of 2500kVA connects each unit to the high side of 34.5kV. The rated power output of each turbine is 2.0 MW while the actual power output depends on the wind.

In conducting the system impact study, the wind farm generation from the study customer and previously queued customers is dispatched into the SPP footprint.

The generating facility 345/34.5 substation will consist of (1) 345/34.5kV transformer with an impedence of 9.6% on a 95 MVA OA Base with a top rating of 158MVA. From the one-lines received from the customer, on the 34.5kV side of the transformer, 5 feeder circuits each will extend from the Customer's 345/34.5kV substation. The feeders will consist of 15 turbines on each circuit as shown in Figure 1.

4.3 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 connected to the same 34.5kV feeder end points were aggregated into one equivalent unit. An equivalent impedance of that feeder is represented in the load flow database by taking the equivalent series impedances of the different feeders connecting the wind turbines. Using this approach, the wind farm was modeled with equivalent units as indicated in Table 3. For the 2.0 MW turbines, each circuit contained 15 turbines connected in series and has identical cabling characteristics.

Wind Turbine	Circuit	Collector buses	Number of Turbines Aggregated
2.0 MW	1-5	10	1,1,1,1,1,1,1,1,1,6

Table 3. Equivalent Generators

4.4 Modeling of the Wind Turbines for the Stability Simulation

4.4.1 Machine Dynamics Data for Gamesa G87 turbines

The Gamesa G87 generators have a nameplate rating of 2.0 MW with a machine base of 2030kVA. The turbine output voltage is 690V. The Gamesa turbines utilize a doubly fed induction-generator. The generator synchronous speed is 1800 rpm, and a variable frequency power converter tied to the generator rotor allows the generator to operate at speeds ranging from 1020 rpm to 2340 rpm. Nominal speed at 2.0MW power output is 2015 rpm. The power converter allows the generator to produce power at a power factor of 0.95 lagging (producing vars) to 0.9 leading (absorbing vars). The power factor is settable at each WTG or by the Plant SCADA system.

The wind turbine manufacturer provided a wind turbine model package for use on PTI's PSS/E simulation software. This package was used exclusively in modeling this wind farm. The model package used is version 5.3 received from the Customer.

The Gamesa model package consists of an IPLAN that creates modeling data in the PSSE loadflow as well as creating a dynamic record that can be read into the program. Also included are several object code files that were linked into the dynamic libraries already being used for the transmission network.

The wind farm was dispatched directly by the user to the level specified (100% rated power for most runs). For most of the simulations in this study, it was assumed the turbines would operate at 1.0 unity power factor. However, in determining whether additional reactive compensation was necessary for the wind farm, varying power factors were also studied for the summer case. Default protection schemes were used for the turbines.

4.4.2 Turbine Protection Schemes

The Gamesa turbines have an under-voltage/over-voltage protection scheme and an under-frequency/over-frequency 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.

FERC Order #661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed before December 31, 2006, wind farms shall stay on line for faults at the point of interconnection (POI) that draw the voltage down to 0.15 pu at the POI (Customer's 345kV bus). For Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI that draws the voltage down at the POI to 0.0 pu.

The voltage protection scheme provided by Gamesa is outlined in Table 4.

Voltage	Time Limit
1.1pu +	3.6 cycles (0.06s)
0.90pu-1.1pu	Continuous Operation
0.75pu – 0.90pu	2.55 seconds
0.60pu – 0.75pu	2.05 seconds
0.45pu – 0.60pu	1.575 seconds
0.30pu – 0.45 pu	1.1 seconds
0.15pu - 0.30pu	0.625 seconds
< 0.15pu	2.4 cycles (0.04s)

Table 4: Gamesa Turbine Voltage Protection

The frequency protection scheme provided by Gamesa is outlined in Table 5 below:

Frequency	Time Limit
57-62 HZ	Continuous Operation
Below 57Hz	3 cycles (0.05 s)
Above 62 Hz	3 cycles (0.05 s)

Table 5: Gamesa Turbine Frequency Protection

4.5 Contingencies Simulated

Nineteen (19) contingencies were considered for the transient stability simulations which included three phase faults, as well as single phase line faults, at the 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.

The faults that were defined and simulated are listed in Table 6.

Table 6. Contingencies Evaluated

Cont. No.	*Cont. Name*	*Description*
1	*FLT13PH*	Three phase fault on the Oklaunion to the Wind Farm Switching Station 345kV line, near the Wind Farm. a. Apply fault at the Wind Farm Switching Station 345kV bus. b. Clear Fault after 4 cycles by removing the 345kV line from the Wind Farm to Oklaunion and removing the line reactor from service. c. Wait 30 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 4 cycles, then trip the line in (b) and remove fault.
2	FLT21PH	*Single phase fault and sequence like Cont. No. 1*
3	FLT33PH	Three phase fault on the Wind Farm Switching Station to Tuco 345 kV line, near Tuco. a. Apply fault at the Tuco 345kV bus. b. Clear fault after 5 cycles by removing the 345kV line from Tuco to the Wind Farm Switching Station and the Tuco 345/230kV autotransformer. c. Wait 30 cycles, and then re-close the line and autotransformer in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line and autotransformer in (b) and remove fault.
4	FLT41PH	*Single phase fault and sequence like Cont. No. 3*
5	FLT53PH	Three phase fault on the Oklaunion to Lawton Eastside 345V line, near Lawton East Side. a. Apply Fault at the Lawton East Side bus. b. Trip the line after 2.5 cycles by removing the line from Oklaunion to Lawton ES and the Oklaunion HVDC tie, and remove the fault. c. Wait 30 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 2.5 cycles, then trip the line in (b) and remove fault.
6	FLT61PH	*Single phase fault and sequence like Cont. No. 5*
7	FLT73PH	Three phase fault on the Tuco to Tolk 230kV line near Tolk. a. Apply fault at the Tolk 230 kV bus. b. Clear fault after 5 cycles by tripping the 230kV line from Tolk to Tuco. (No reclose on power plant bus).
8	FLT81PH	*Single phase fault and sequence like Cont. No. 7*
9	FLT93PH	Three phase fault on the Tuco to Swisher 230kV line, near Swisher. a. Apply fault at the Swisher 230kV bus. b. Clear fault after 5 cycles by tripping the 230kV line from Swisher to Tuco. 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	Three phase fault on the Tuco to Jones 230kV line near Tuco. a. Apply fault at the Tuco 230kV bus. b. Clear fault after 5 cycles by tripping the 230kV line from Tuco to Jones (no relose on power plant bus)
12	FLT121PH	*Single phase fault and sequence like Cont. No. 11*
13	FLT133PH	Three phase fault on the Grapevine to Elk City 230kV line near Grapevine. a. Apply fault at the Grapevine 230kV bus. b. Clear fault after 5 cycles by tripping the 230kV line from Grapevine to Elk City.

Cont. No.	*Cont. Name*	*Description*
		c. Wait 20 cycles, and then re-close line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT141PH	*Single phase fault and sequence like Cont. No. 13*
15	FLT153PH	With the Tuco SVC out of service, repeat Contingency #1
16	FLT161PH	*Single phase fault and sequence like Cont. No. 15*
17	FLT173PH	With the Tuco SVC out of service, repeat Contingency #3
18	FLT181PH	*Single phase fault and sequence like Cont. No. 17*
19	FLT193PH	Three phase fault on the Finney to GEN-2003-013 Wind Farm 345kV line near Finney a. Apply fault at the Finney 345kV bus. b. Clear fault after 3.5 cycles by removing the line from GEN-2003-013 Wind Farm to Finney (no reclose).

4.6 Further Model Preparation

The contingencies were simulated for the following scenarios

- 2010 Summer Peak Loading (SPP MDWG Case)(Turbines running at 100% except where noted)
    - Case #1 (All contingencies)
        - Turbines running at 1.0 PF
    - Case #2 (All contingencies)
        - Turbines running at 20% production
        - Turbines operating at 1.0 PF
    - Case #3 (Power Flow Only)
        - Turbines running at 0.99 leading (drawing vars)
        - Wind farm runs at .0.95 lagging power factor (drawing vars)
        - Potential for low voltages for loss of line to Tuco (0.89 pu)
    - Case #4 (Power Flow Only)
        - Turbines running at 0.99 lagging (producing vars)
        - Wind farm runs at 1.0 power factor
        - No system problems
- 2006 Winter Peak Loading (All contingencies)
    - Case #1 – same as 2010 summer
- 2007 Fall Loading (All contingencies)
    - Case #1 – same as 2010 summer

The previously queued projects which were added to the stability base case are summarized in Table 7.

Study Plant	Total MW
GEN-2001-033	175
GEN-2001-036	80
GEN-2005-010	160

Table 7. – Summary of Prior Queued Projects

4.7 Results

Results are summarized in Table 8. The results indicate that for all contingencies, the transmission system remains stable.

When the wind farm is modeled with the wind turbines operating at the default 1.0 pf, the wind farm collector circuit and substation transformer losses result in the wind farm drawing approximately 20MVAR at the point of interconnection. As indicated above, with this configuration, the transmission system remains stable.

When the turbines are modeled as drawing vars, less than desirable conditions occur. If the wind turbines are running at anything below unity, system voltages begin show the potential to deteriorate. A loss of the 345kV line to Tuco may cause voltages below SPP criteria for this configuration.

Therefore, the wind turbines should not be in a power factor mode setting in which case they are drawing vars. In lower load seasons, the Customer may have to adjust the power factor settings of the turbines such that the voltage does not get too high.

An additional run was made with the turbines running at 20% production. This reduced output from the turbines was chosen to closer simulate actual conditions during the summer peak. Results did not change from the 100% production runs with the exception of the faults taken at the Point of Interconnection. If a full three phase fault is simulated for the 20% production case, the turbines will trip off. This will be discussed further in the Order #661 section.

<u>FERC Order #661A Compliance</u> – Contingency FLT13PH AND FLT33PH were simulated for determining compliance with FERC Order #661A. This request will fall under the 'Transitional' clause of the Order's Low Voltage Ride Through (LVRT) provisions if an Interconnection Agreement is signed before December 31, 2006. The 'Transitional' clause states that the turbines should stay on line for a 5-9 cycle fault that produces 0.15 pu voltage at the point of interconnection. For

this study, the fault duration was treated the same as the other faults simulated (5 cycles). The turbines stayed on line for the referenced contingency (which in initial runs produced a 0.0 pu voltage at the POI).

However, for the reduced production cases (20% production), the full 3 phase fault that produced a 0.0 pu voltage causes the turbines to trip off-line. The fault was re-simulated using the 'Transitional' clause in Order#661A, in which a weaker fault that produced a voltage of 0.15 pu voltage. For the weaker fault, the turbines stayed on-line.

The result is that this wind farm request will meet the 'Transitional' clause requirements of Order #661A, but not the full requirements of the Order. Therefore, an Interconnection Agreement should be signed for this request before December 31, 2006.

FAULT	FAULT DEFINITION	2010 SP Case 1	2010 SP Case 2	2006 WP	2006 Fall
FLT13PH	Three phase fault on the Wind Farm to Oklaunion 345kV line near the Wind Farm.	STABLE	STABLE*	STABLE	STABLE
FLT21PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT33PH	Three phase fault on the Wind Farm to Tuco 345kV line near Tuco.	STABLE	STABLE*	STABLE	STABLE
FLT41PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT53PH	Three phase fault on the Oklaunion to Lawton Eastside 345kV line near Lawton Eastside	STABLE	STABLE	STABLE	STABLE
FLT61PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT73PH	Three phase fault on the Tuco-Tolk 230kV line near Tolk	STABLE	STABLE	STABLE	STABLE
FLT81PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT93PH	Three phase fault on the Tuco-Swisher 230kV line near Swisher	STABLE	STABLE	STABLE	STABLE
FLT101PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT113PH	Three phase fault on the Tuco-Jones 230kV line near Tuco	STABLE	STABLE	STABLE	STABLE
FLT121PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT133PH	Three phase fault on the Grapevine to Elk City 230kV line near Grapevine.	STABLE	STABLE	STABLE	STABLE
FLT141PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT153PH	With Tuco SVC out of service, Three phase fault o the Wind Farm to Oklaunion 345kV line near the Wind Farm	STABLE	STABLE	STABLE	STABLE
FLT161PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT173PH	Wind the Tuco SVC out of service, Three Phase fault on the Wind Farm-Tuco 345kV line near Tuco.	STABLE	STABLE	STABLE	STABLE
FLT181PH	Single phase fault same as above	STABLE	STABLE	STABLE	STABLE
FLT193PH	Three phase fault on the Finney-GEN-2003-013 Wind Farm 345kV line near Finney	STABLE	STABLE	STABLE	STABLE

* If a full 3 phase fault that draws the voltage to 0.0 pu, the turbines will trip off line

Table 8. SUMMARY OF FAULT SIMULATION RESULTS (Using Gamesa 2.0 MW Turbines)

5.0 Conclusion

No stability concerns presently exist for the GEN-2005-015 wind farm as proposed and studied using seventy-five (75) Gamesa G87 2.0 MW. The wind farm and the transmission system remain stable for all contingencies studied.

The Network Upgrade cost of interconnecting the Customer project is approximately $5,659,783. This figure does not address the cost of the Customer substation, or the transmission line between the Customer substation and the Xcel Energy switching substation located on the Tuco-Oklaunion 345kV line.

Transmission Line Reactors will most likely be needed at the Transmission Owner Interconnection Substation. The need and size for these reactors will be determined in an EMTP study to be conducted during the Facility Study. Depending on the results of the EMTP study, this Impact Study may have to be selectively revisited for stability concerns.

The wind farm does not need additional capacitor banks as long as the Gamesa wind turbines are programmed to produce vars into the power system.

The studied plant configuration and turbines will meet the 'Transitional' clause for the LVRT provisions of FERC Order #661A, but may not meet the full requirements necessary for later requests. The Customer should sign an Interconnection Agreement before December 31, 2006 in order to qualify for the 'Transitional' requirements.

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

All Plots available upon request

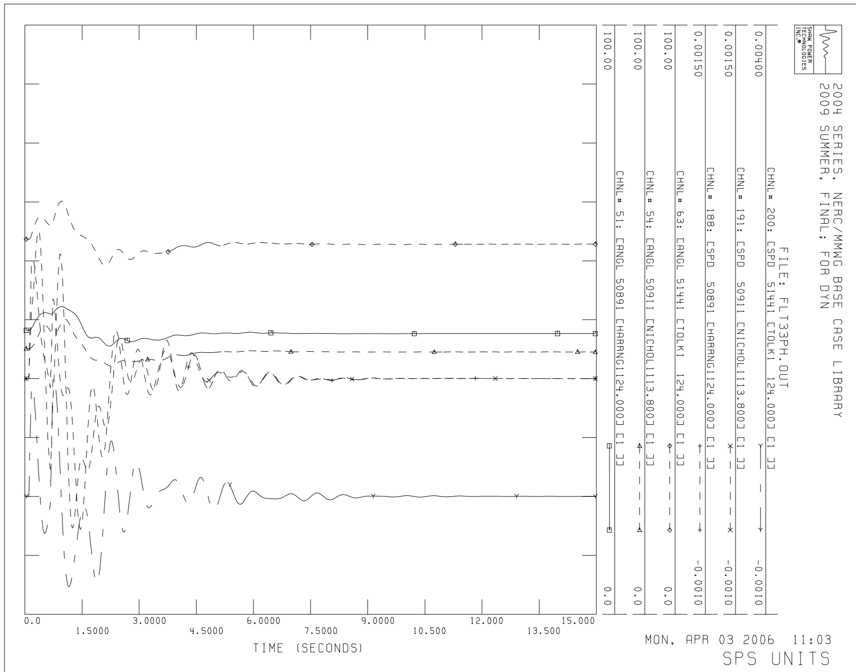
Page A2 – 2010 SP - Contingency FLT13PH

Page A3 – 2010 SP - Contingency FLT73PH

Page A4 – 2006 WP - Contingency FLT33PH

Page A5 – 2006 WP - Contingency FLT53PH

Page A6 – 2006 FA - Contingency FLT113PH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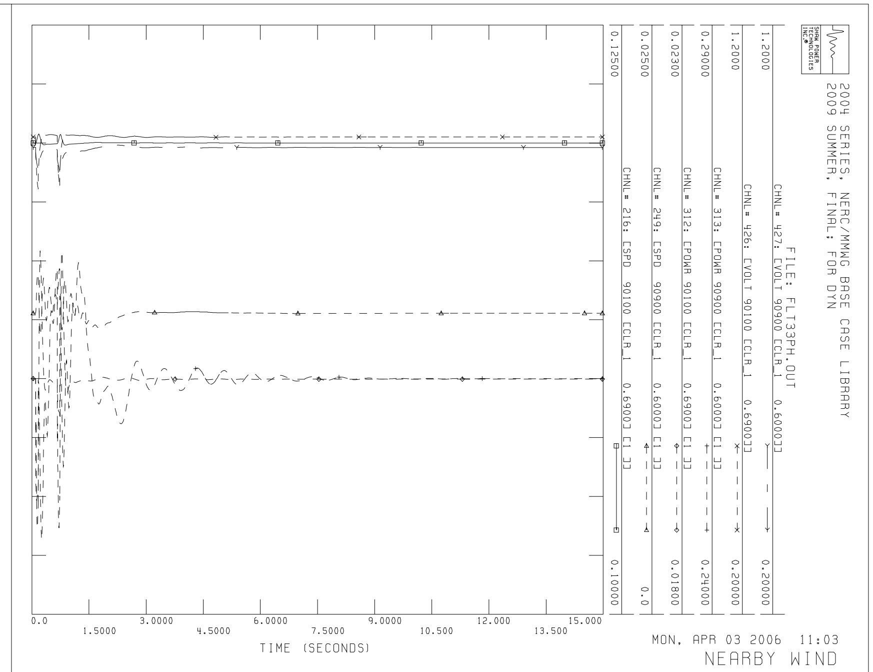
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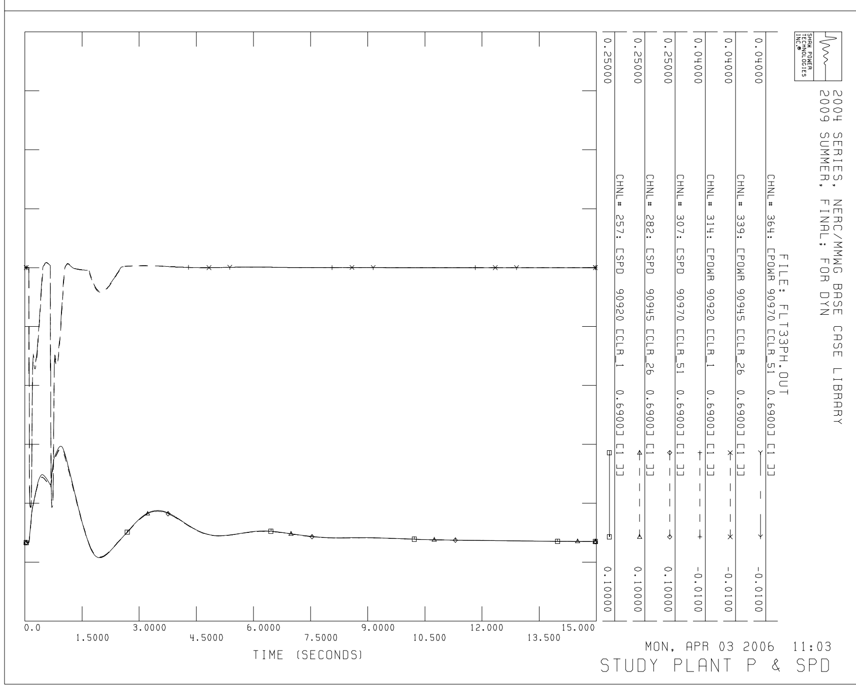
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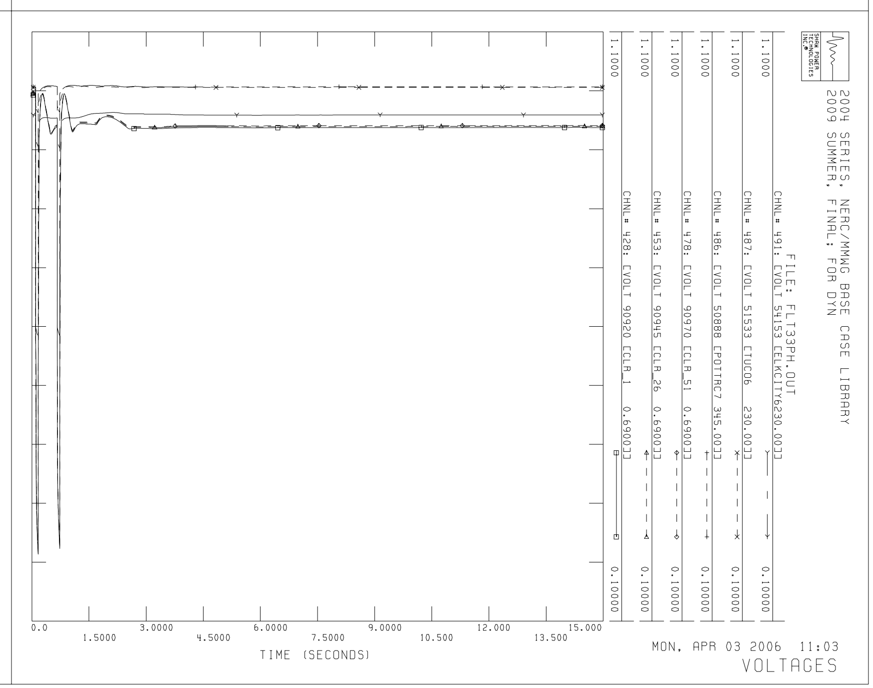
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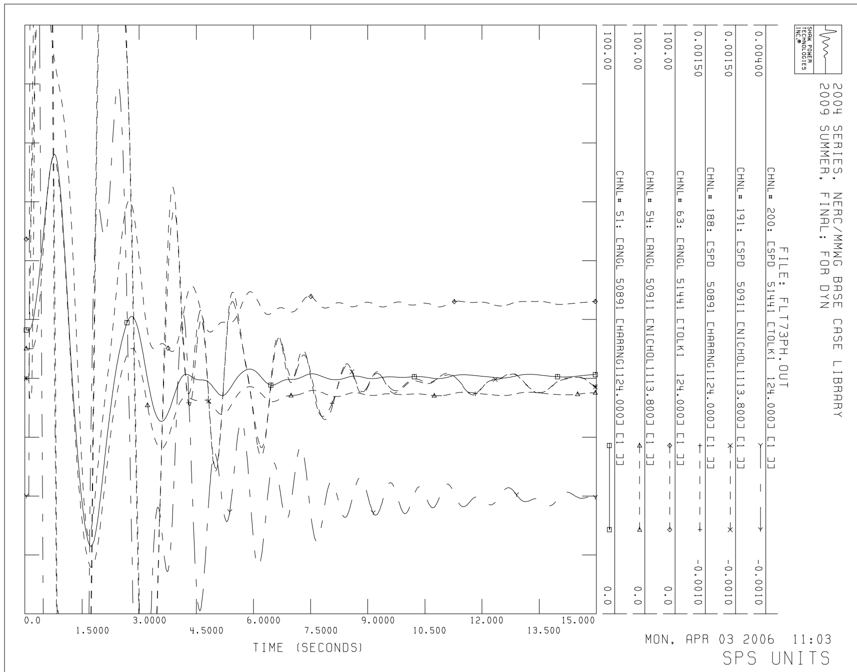
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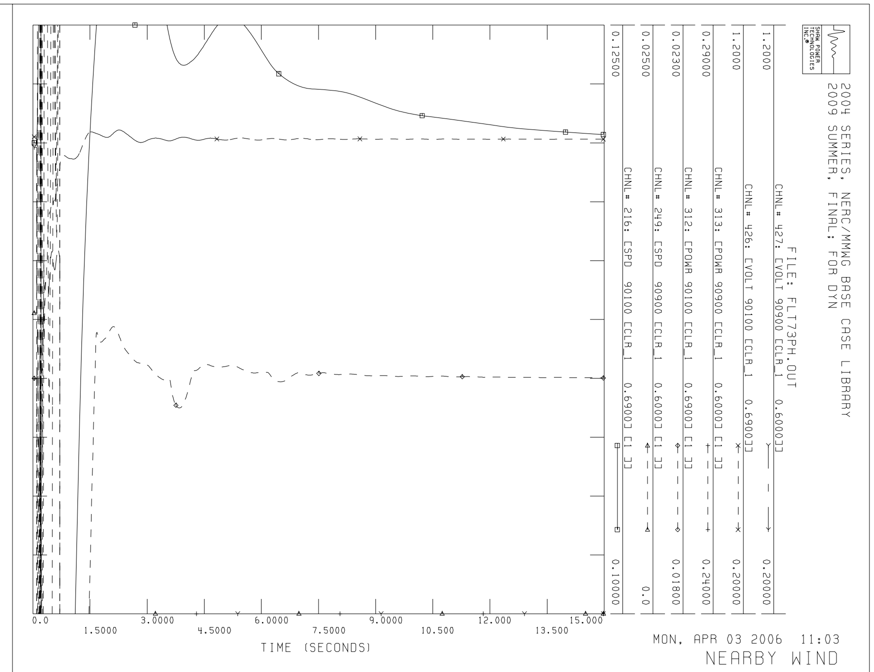
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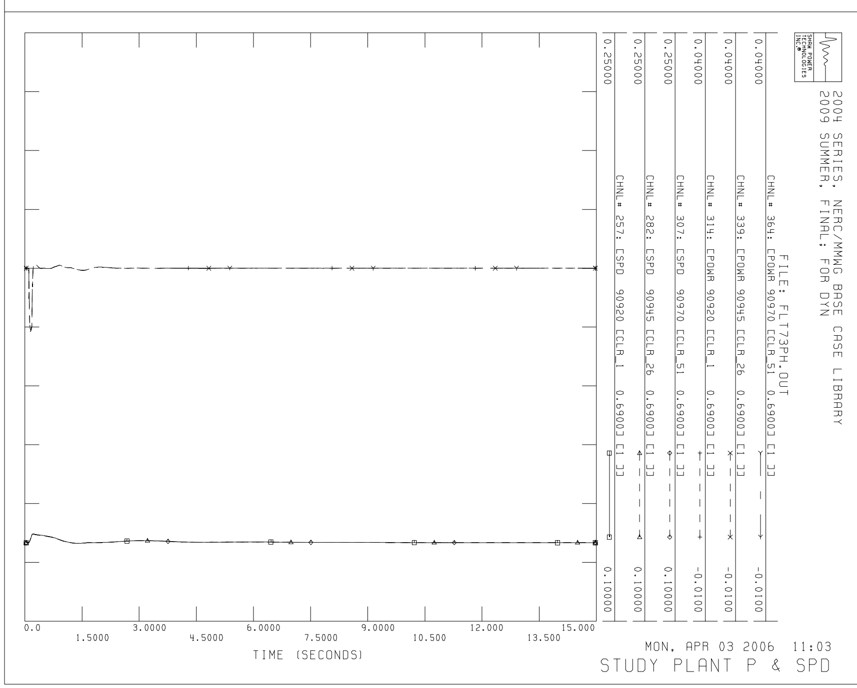
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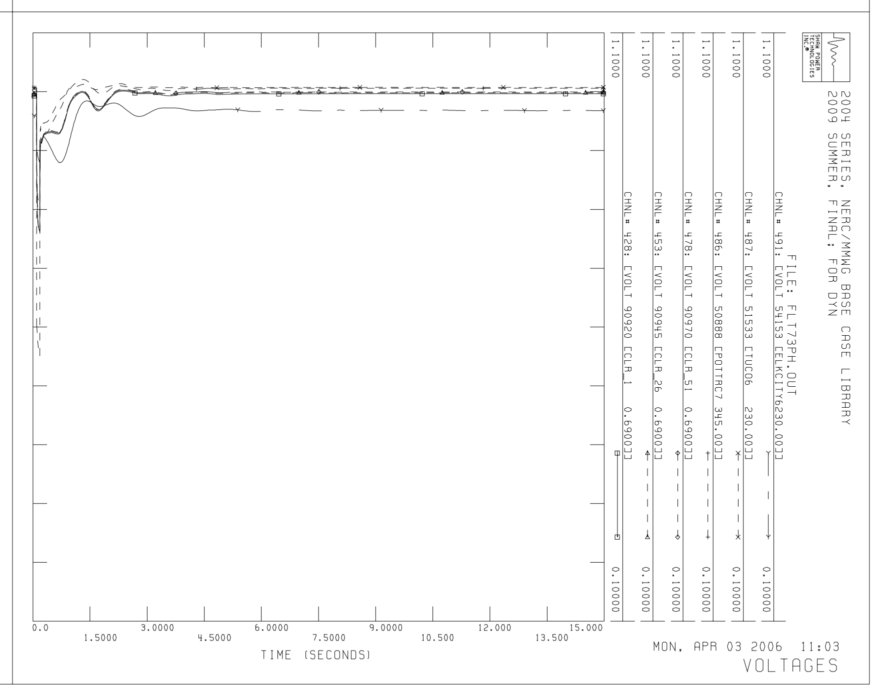
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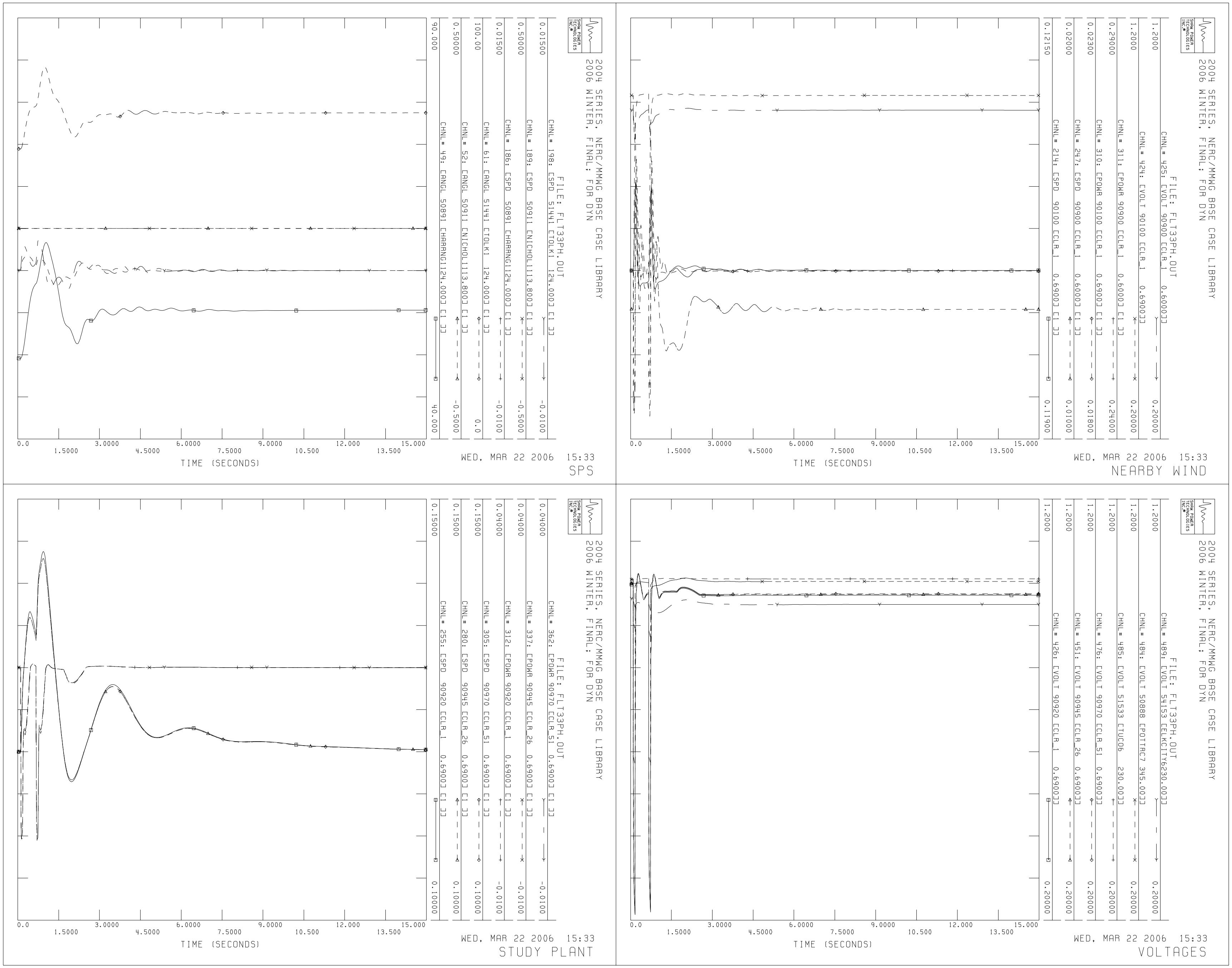
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SPS
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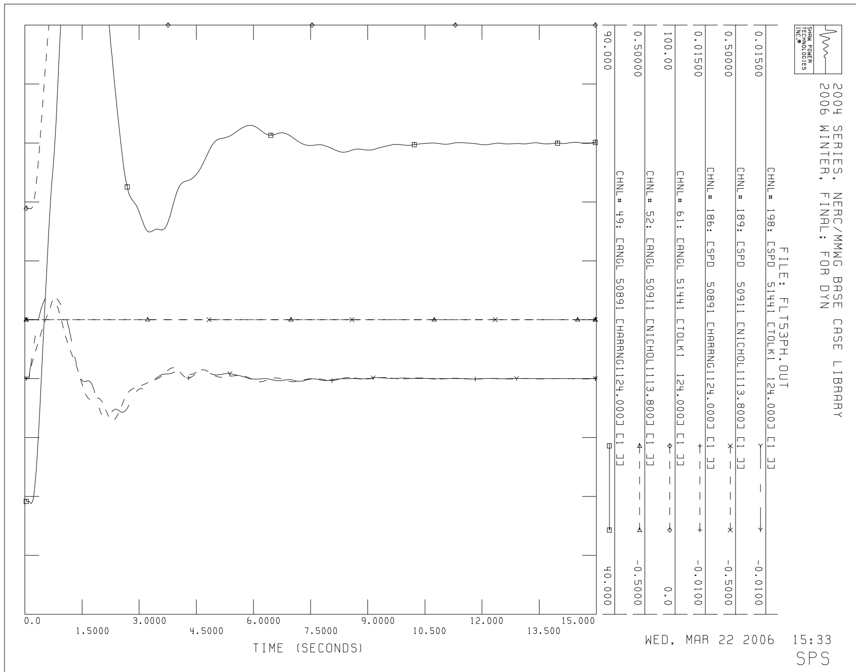
VOLTAGES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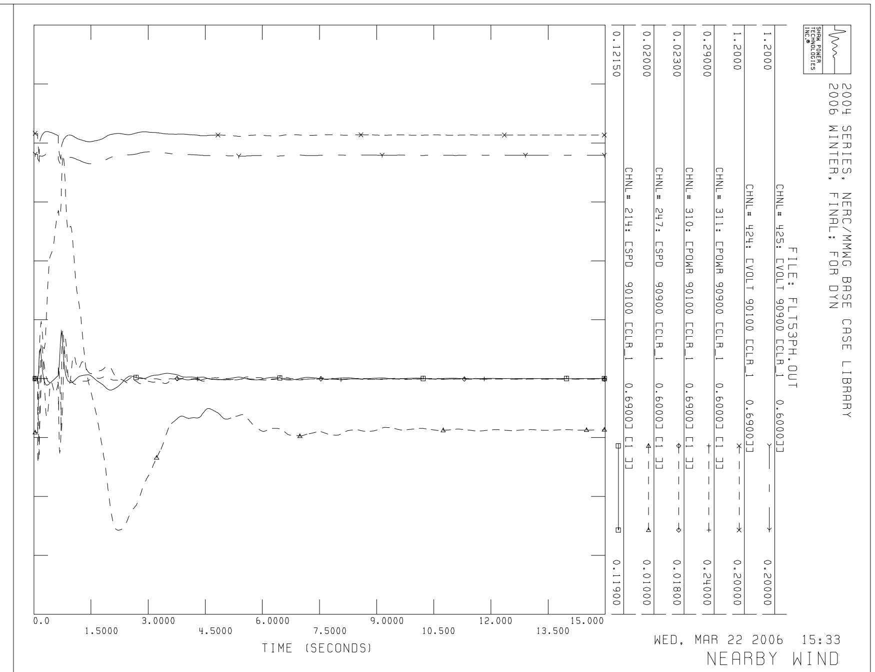
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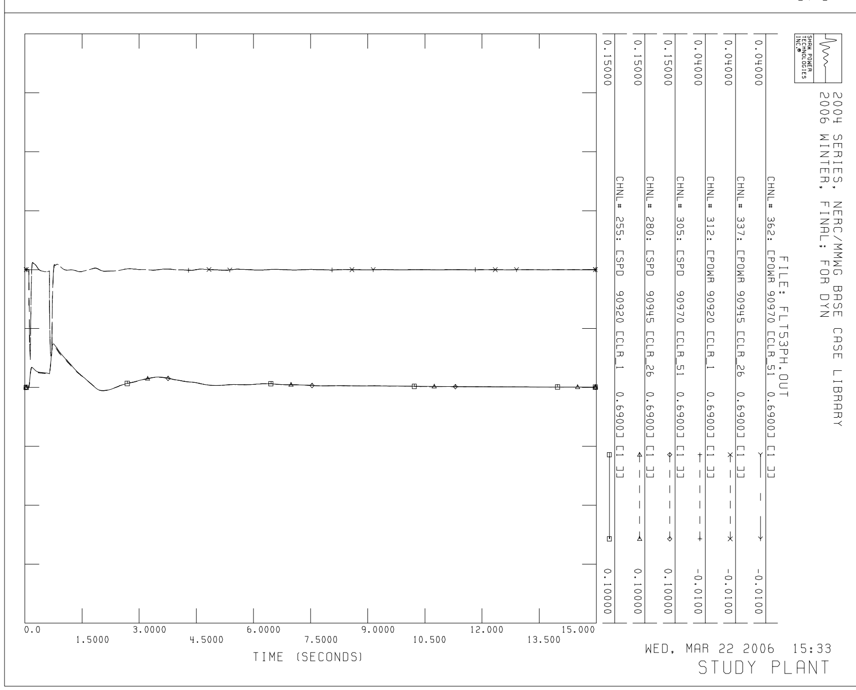
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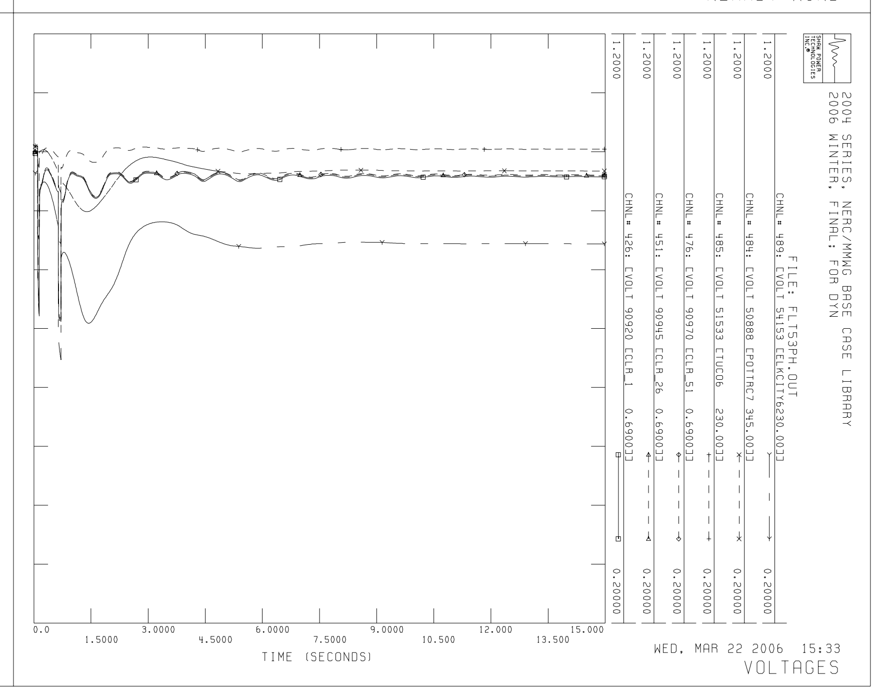
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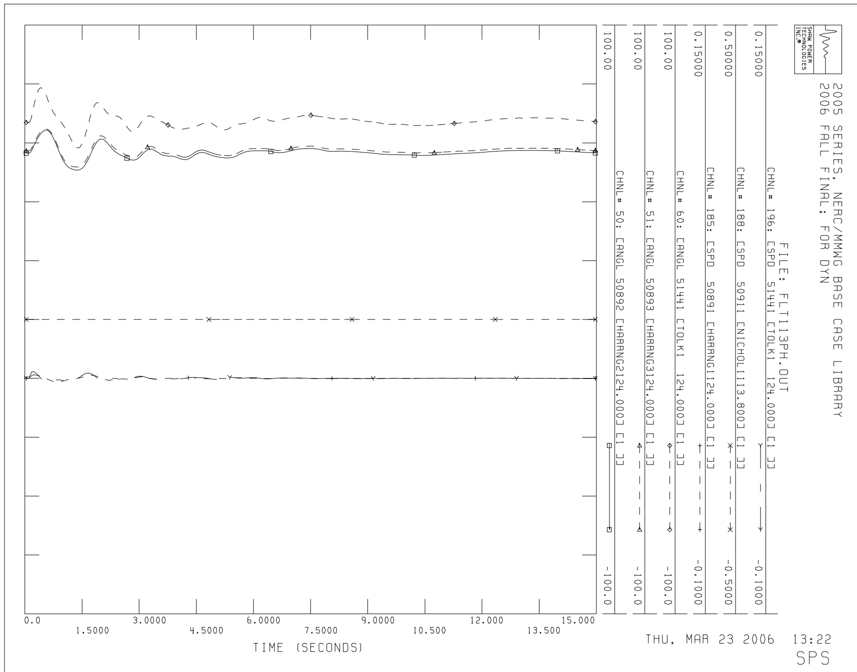
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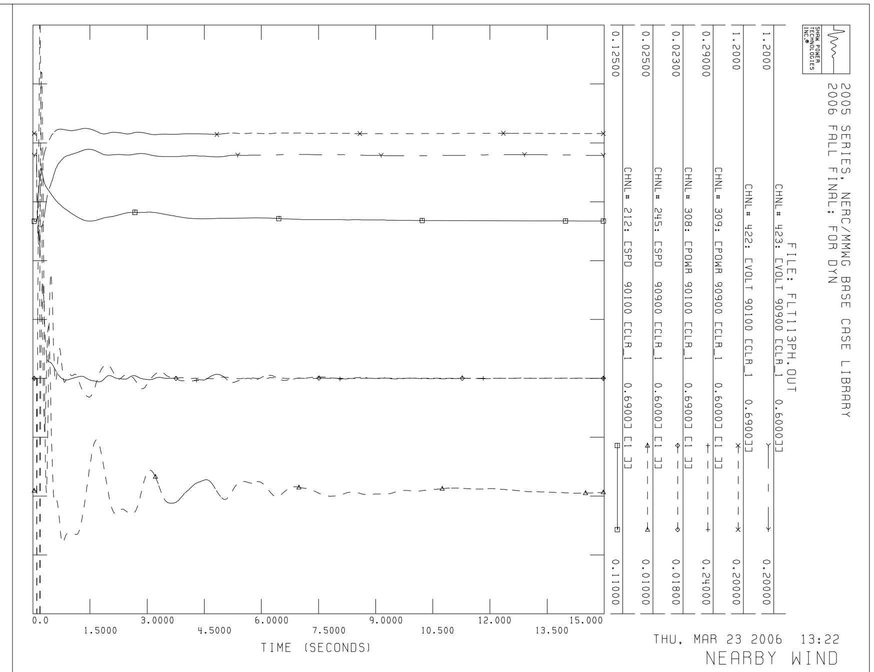
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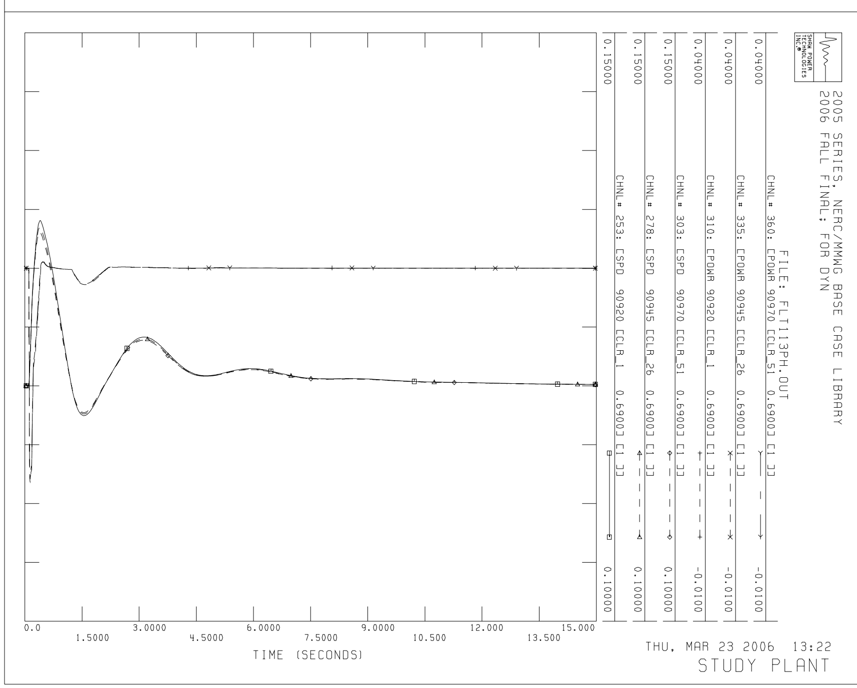
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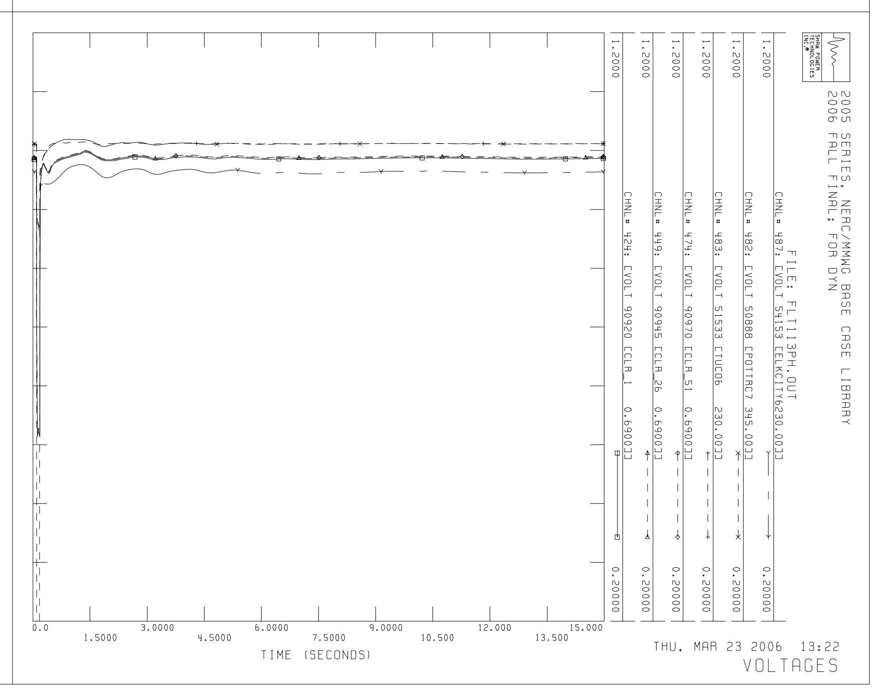
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CHNL# 483: [VOLT 51533 [TUCO6 230.00]]
CHNL# 474: [VOLT 90970 [CLR_51 0.690]]
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CHNL# 424: [VOLT 90920 [CLR_1 0.690]]
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VOLTAGES