Southwest Power Pool

Optional Interconnection Study For Generation Interconnection Request GEN-2002-009

SPP Tariff Studies

(#GEN-2002-009)

November 2005

Executive Summary

<OMITTED TEXT> (Customer) has requested an Optional Interconnection Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of up to an 80 MW wind powered generation facility in Hansford County, Texas to the transmission system of Southwestern Public Service Company (SPS/Xcel Energy). The wind powered generation facility was originally studied with 44 individual Vestes 1.8 MW wind turbines. It is now proposed to consist of thirty-eight (38) individual 2.1MW Suzlon S88 wind turbines. The requested in-service date for the 80MW facility is September 1, 2006. This Optional Interconnection study addresses the request of the customer to study the plant with 38 individual 2.1MW Suzlon S88 wind turbines as a replacement to the originally requested Vestes turbines. This study only addresses the stability of the Suzlon turbines and the reactive compensation required by the wind farm because of the use of the Suzlon turbines.

The generation facility will interconnect to the Texas County-Spearman 115kV line circuit via a new 115kV substation. Any additional information about the interconnection configuration can be found in the Facility Study for GEN-2002-009.

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, 2007 fall case, and the 2009 summer peak case. Each case was modified to include prior queued projects that are discussed in the body of the report. The Suzlon S88 wind turbines were modeled using information provided by the manufacturer. Twenty-one contingencies were simulated.

Due to the reactive power consumption of the Suzlon turbines and losses on the collector system, a minimum of 12MVAR of capacitor banks are necessary for reactive compensation for the wind farm and for exporting power from the interconnection point. The Interconnection Agreement should require this capacitor bank.

Stability Study results show that the transmission system remains stable for all simulated contingencies studied. The wind farm stays on-line for all contingencies studied.

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 Optional Interconnection Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnecting up to an 80 MW wind powered generation facility in Hansford County, Texas to the transmission system of Southwestern Public Service Company (SPS/Xcel Energy). The wind powered generation facility studied was comprised of thirty-eight (38) individual 2.1MW Suzlon S88 wind turbines. The original study plant consisted of forty-four (44) individual 1.8 MW Vestes wind turbines. The requested in-service date for the 80MW facility is September 1, 2006. The wind powered generation facility will interconnect to the existing SPS Texas County-Spearman 115kV line. This optional study will only address the stability and reactive compensation issues associated with switching from Vestes turbines to Suzlon 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 several previously queued projects ahead of this request in the SPP Generation Interconnection queue. It was assumed for purposes of this study that not all of 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 modeled in the case (GEN-2002-006, 2002-008), 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 generating facility was studied with the assumption that it would be using the Suzlon S88 2.1MW wind turbines. The nameplate rating of each turbine is 2100kW with a machine base of 2283kVA. The turbine output voltage is 690V. The turbine runs at 0.92 leading power factor (absorbing vars) without power factor correction. Each turbine contains (14) 68kVar capacitor banks in parallel to the generator for each turbine to operate approximately at unity power factor at the generator terminals.

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 Hansford County, Texas on the existing Texas County – Spearman 115kV circuit. The new substation would be configured to accept a terminal from an adjacent 115/34.5kV transformer substation that serves the wind powered generation facility.

A minimum of (1) 12 MVAR capacitor bank is required at the Customer substation as necessary for reactive compensation for the wind farm (turbine and collector system losses) and for exporting power from the interconnection point. Stability analysis reveals that the reactive compensation does not need to be dynamic (SVC).

The total cost for adding a new 115kV switching station, the required interconnection facility is estimated at $1,849,214. This cost does not include building the 115kV line from the Customer substation to the new substation on the Texas County-Spearman 115kV line. For a full detail of the costs, the Facility Study completed by Xcel in August, 2004 can be consulted. The one-line from the Facility Study is shown below.

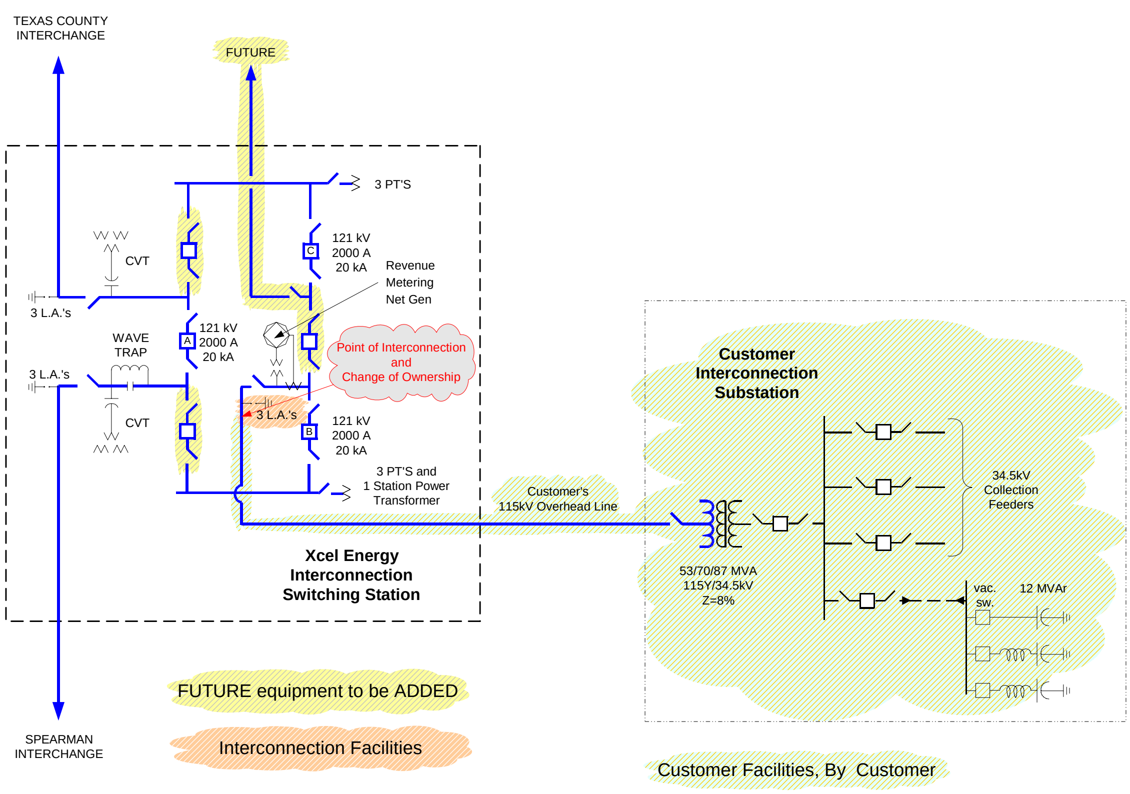


Figure 1. One-Line of the Interconnection and Generating Facilities

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-2002-009 wind farm to SPP's 115 kV transmission system.

4.2 Equivalent Modeling of the Wind Generating Facility

The rated output of the generation facility is 80MW, comprised of (38) Suzlon S88 wind turbines. The base voltage of the Suzlon turbine is 600 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 2.1 MW while the actual power output depends on the wind.

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

The generating facility 115/34.5 substation will consist of (1) 115/34.5kV transformer assumed to be 8% on a 53 MVA OA Base with a top rating of 87MVA. From the one-lines received from the customer, on the 34.5kV side of the transformer, 3 feeder circuits will extend from the Customer's 115/34.5kV substation. The feeders will consist of 13, 13, and 12 wind turbines respectively on each circuit.

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 shown in Figure 1. The number of individual wind turbines that are aggregated at each bus is shown.

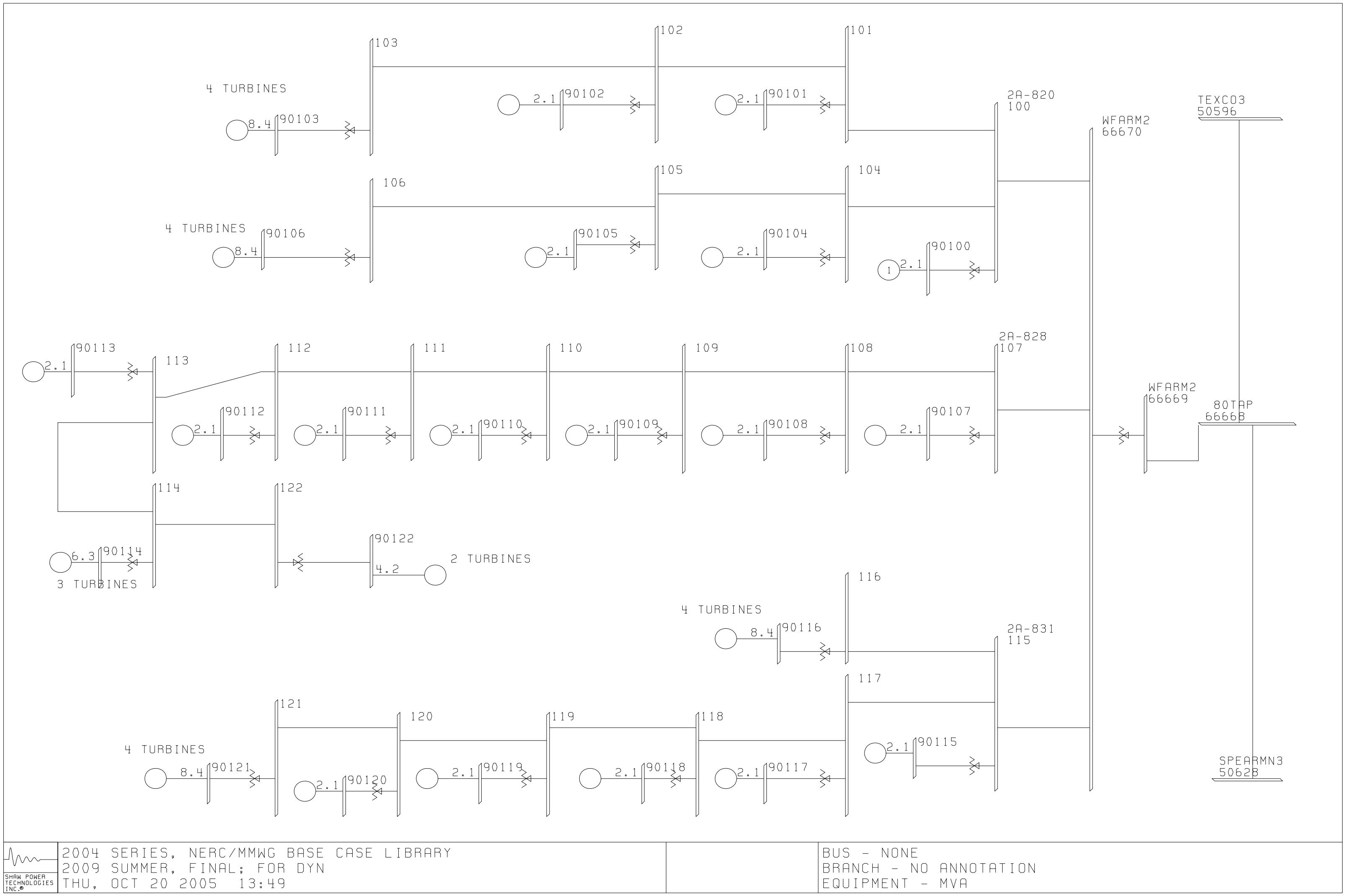


Figure 2. _One-Line Drawing of the GEN-2002-009 Facility

4.4 Modeling of the Wind Turbines for the Stability Simulation

4.4.1 Machine Dynamics Data

The Suzlon S88 generators have a nameplate rating of 2100kW with a machine base of 2283kVA. The turbine output voltage is 600V. The turbines produce power at 0.92 leading power without power factor correction. Each turbine contains (14) 68kVar capacitor banks in parallel with the generator for an approximate unity power factor at the generator terminals.

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 2.0 received from Suzlon on November 23, 2005.

The Suzlon model package consists of an Excel spreadsheet that creates a dynamic record that can be pasted into a PTI PSS/E dyre file. Also included is an object code file that was linked into the dynamic libraries already being used for the network.

The generator values provided by the Customer and manufacturer are listed below in Table 1.

Parameter	Value
BASE KV	0.600
WTG MBASE	2.283
TRANSFORMER MBASE	2.5
TRANSFORMER R ON TRANSFORMER BASE	0.001
TRANSFORMER X ON TRANSFORMER BASE	0.06
GTAP	1.0
PMAX	2.1
PMIN	0.0
RA	0.0053
LA	0.2116
R_ROT_MACH (ohms)	0.0036
INERTIA	0.50

Table 1. Suzlon Turbine Generator Parameters

The wind farm was dispatched directly by the user to the level specified (100% rated power). For this study, it was assumed the turbines would operate at 1.0 unity power factor. Default protection schemes were used for the turbines.

4.4.2 Turbine Protection Schemes

The Suzlon 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.

The voltage protection scheme provided by Suzlon is outlined in Table 2 below:

Voltage	Time Limit
1.2pu +	4.8 cycles (0.08s)
1.15pu-1.2pu	60 seconds
0.90pu-1.15pu	Continuous Operation
0.80pu – 0.90pu	60 seconds
0.60pu – 0.80pu	2.8 seconds
0.40pu – 0.60pu	1.6 seconds
0.15pu – 0.40 pu	0.7 seconds
< 0.15pu	0.08 seconds

Table 2: Suzlon Turbine Voltage Protection

The frequency protection scheme provided by Suzlon is outlined in Table 3 below:

Frequency	Time Limit
57-63 HZ	Continuous Operation
Below 57Hz	12 cycles (0.2 s)
Above 63 Hz	12 cycles (0.2 s)

Table 3: Suzlon Turbine Frequency Protection

4.5 Contingencies Simulated

Twenty-one (21) 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 exception to this practice was simulation of the SLG on the Potter-Finney 345kV line in which the apparent impedence was taken from the study commissioned by SPS which defined the impedence using single pole tripping.

The faults that were defined and simulated are as follows:

1. **FLT_1_3_PH –** 3 phase fault on the Wind Farm-Texas County 115kV line
    a. Apply fault at the Texas County end of the line
    a. Clear fault after 5 cycles by removing the line from service.
    b. Wait 20 cycles, and then re-close the line into the fault.
    c. Leave fault on for 5 cycles, then trip and lock out the line.
2. **FLT_2_1_PH –** SLG fault same as FLT_1_3_PH
3. **FLT_3_3_PH –** 3 phase fault on the Wind Farm-Spearman 115kV line
    a. Apply fault at the Spearman end of the line
    d. Clear fault after 5 cycles by removing the line from service.
    e. Wait 20 cycles, and then re-close the line into the fault.
    f. Leave fault on for 5 cycles, then trip and lock out the line.
4. **FLT_4_1_PH –** SLG fault same as FLT_3_3_PH
5. **FLT_5_3_PH –** 3 phase fault on the Elk City-Grapevine 230kV line
    a. Apply fault at the Elk City 230kV bus
    b. Clear fault after 5 cycles by tripping the Elk City-Grapevine 230kV line
    c. Wait 20 cycles, then reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line
6. **FLT_6_1_PH -** SLG fault same as FLT_5_3_PH
7. **FLT_7_3_PH –** 3 phase fault on the Nichols-Grapevine 230kV line
    a. Apply fault at the midpoint of the Nichols-Grapevine 230kV line
    b. Clear fault after 5 cycles by removing the line from service.
    c. Wait 20 cycles, and then re-close the line into the fault.
    d. Leave fault on for 5 cycles, then trip and lock out the line
8. **FLT_8_1_PH -** SLG fault same as FLT_7_3_PH
9. **FLT_9_3_PH** – 3 phase fault on the Potter-Finney 345kV line
    a. Apply fault at the midpoint of the line between GEN-2002-008 and GEN-2003-013
    b. Clear fault after 3 cycles by tripping the GEN-2002-008-GEN-2003-013 345kV line and associated line reactors
    c. Wait 20 cycles then reclose the line sections and reactors into the fault
    d. Leave fault on for 3 cycles, then trip the line sections and line reactors out.
10. **FLT_10_1_PH**- SLG Fault on the Potter-Finney 345kV line (utilizing single pole tripping)
    a. Apply single phase at the midpoint of the line between GEN-2002-008 and GEN-2003-013
    b. After 3 cycles, trip one phase of the line
    c. Wait 20 cycles and reclose the single phase back into the line
    d. After 3 cycles, disconnect the line and lock out
11. **FLT_11_3_PH –** 3 phase fault on the Plant X-Potter 230kV line
    a. Apply fault at the Plant X 230kV bus
    b. Clear fault after 5 cycles by tripping the Plant X- Potter 230kV line
    c. Wait 20 cycles, then reclose the line into the fault

    d. Leave fault on for 5 cycles, then trip and lock out the line
12. **FLT_10_1_PH -** SLG fault same as FLT_11_3_PH
13. **FLT_13_3_PH –** 3 phase fault on the Pringle-Blackhawk 115kV line
    a. Apply fault at the Blackhawk 115kV bus
    b. Clear fault after 5 cycles by tripping the Pringle-Blackhawk 115kV line
    c. Wait 20 cycles, then reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line
14. **FLT_14_1_PH -** SLG fault same as FLT_13_3_PH
15. **FLT_15_3_PH –** 3 phase fault on the Terry County-Woolforth 115kV line
    a. Apply fault at the Terry County 115kV bus
    b. Clear fault after 5 cycles by tripping the Terry County-Woolforth 115kV line
    c. Wait 20 cycles, then reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line
16. **FLT_16_1_PH -** SLG fault same as FLT_15_3_PH
17. **FLT_17_3_PH –** 3 phase fault on the Pringle-Harrington 230kV line
    a. Apply fault at the Pringle 230kV bus
    b. Clear fault after 5 cycles by tripping the Pringle-Harrington 230kV line
    c. Wait 20 cycles, then reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line
18. **FLT_18_1_PH -** SLG fault same as FLT_17_3_PH
19. **FLT_19_3_PH –** 3 phase fault on the Perryton-Coleman 115kV line
    a. Apply fault at the Perryton 115kV bus
    b. Clear fault after 5 cycles by tripping the Perryton-Coleman 115kV line
    c. Wait 20 cycles, then reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line
20. **FLT_20_1_PH -** SLG fault same as FLT_19_3_PH

An additional fault was run to see if the Suzlon turbines could withstand a 3 phase fault at the Point-of-Interconnection.

21. **FLT_21_3_PH** – 3 phase fault on the Wind Farm – Texas County 115kV line near the Wind Farm Bus.
    a. Apply fault at the Wind Farm 115kV Bus (#66668)
    b. Clear fault after 5 cycles by tripping the Wind Farm-Texas County 115kV lline
    c. Wait 20 cycles and reclose the line into the fault
    d. Leave fault on for 5 cycles, then trip and lock out the line.

4.6 Further Model Preparation

The above cases were run for the following conditions

- 2009 Summer Peak Loading (All Previous Queued Projects included)
- 2006 Winter Peak Loading (All Previous Queued Projects included)
- 2007 Fall Loading (All Previous Queued Projects included)

The previously queued projects which were added to the stability base case are summarized in Table 4.

Study Plant	Total MW
GEN-2002-006	150
GEN-2002-008	240
GEN-2002-009	80

Table 4 – Summary of Prior Queued Projects

4.7 Stability Results

Results for all the disturbances simulated are summarized in Table 5. The results indicate that for all of the simulated contingencies, the transmission system remains stable and oscillations are well damped.

The wind farm remains on line for all faults simulated including the 3 phase fault at the point-of-interconnection. The wind farm stays on line due to the ability of the Suzlon turbines to withstand faults down to 0.15 pu voltage for 42 cycles and 0.0 pu voltage for 4.8 cycles per the information provided by the turbine manufacturer.

FAULT	FAULT DEFINITION	2006 WP	2007 Fall	2009 SP
FLT_1_3_PH	3 PHASE FAULT ON THE WIND FARM-TEXAS COUNTY 115kV LINE NEAR TEXAS COUNTY	STABLE	STABLE	STABLE
FLT_2_1_PH	SLG same as FLT_1_3_PH	STABLE	STABLE	STABLE
FLT_3_3_PH	3 PHASE FAULT AT ON THE WIND FARM-SPEARMAN 115KV LINE NEAR SPEARMAN	STABLE	STABLE	STABLE
FLT_4_1_PH	SLG same as FLT_3_3_PH	STABLE	STABLE	STABLE
FLT_5_3_PH	3 PHASE FAULT AT ON THE GRAPEVINE-ELK CITY 230KV LINE NEAR GRAPEVINE	STABLE	STABLE	STABLE
FLT_6_1_PH	SLG same as FLT_5_3_PH	STABLE	STABLE	STABLE
FLT_7_3_PH	3 PHASE FAULT AT ON NICHOLS-GRAPEVINE 230KV LINE NEAR THE MIDPOINT OF THE LINE	STABLE	STABLE	STABLE
FLT_8_1_PH	SLG same as FLT_7_3_PH	STABLE	STABLE	STABLE
FLT_9_3_PH	3 PHASE FAULT AT ON THE POTTER-FINNEY LINE NEAR THE MIDPOINT	STABLE	STABLE	STABLE
FLT_10_1_PH	SLG same as FLT_9_3_PH	STABLE	STABLE	STABLE
FLT_11_3_PH	3 PHASE FAULT AT ON THE PLANT X-POTTER 230KV LINE NEAR PLANT X	STABLE	STABLE	STABLE
FLT_12_1_PH	SLG same as FLT_11_3_PH	STABLE	STABLE	STABLE
FLT_13_3_PH	3 PHASE FAULT AT ON THE PRINGLE-BLACKHAWK 115KV LINE NEAR BLACKHAWK	STABLE	STABLE	STABLE
FLT_14_1_PH	SLG same as FLT_13_3_PH	STABLE	STABLE	STABLE
FLT_15_3_PH	3 PHASE FAULT AT ON THE TERRYCOUNTY-WOOLFORTH 115KV LINE NEAR TERRY COUNTY	STABLE	STABLE	STABLE
FLT_16_1_PH	SLG same as FLT_15_3_PH	STABLE	STABLE	STABLE
FLT_17_3_PH	3 PHASE FAULT AT ON THE PRINGLE-HARRINGTON 230KV LINE NEAR PRINGLE	STABLE	STABLE	STABLE
FLT_18_1_PH	SLG same as FLT_17_3_PH	STABLE	STABLE	STABLE
FLT_19_3_PH	3 PHASE FAULT AT ON THE PERRYTON-COLEMAN 115KV LINE NEAR PERRYTON	STABLE	STABLE	STABLE
FLT_20_1_PH	SLG same as FLT_19_3_PH	STABLE	STABLE	STABLE
FLT_21_3_PH	3 PHASE FAULT ON THE WIND FARM-TEXAS COUNTY 115KV LINE NEAR THE WIND FARM	STABLE	STABLE	STABLE

Table 5. SUMMARY OF FAULT SIMULATION RESULTS

5.0 Conclusion

No stability concerns presently exist for the GEN-2002-009 wind farm as proposed and studied using thirty-eight (38) Suzlon S88 2.1 MW wind turbines. The wind farm and the transmission system remain stable for all contingencies studied

The Network Upgrade cost of interconnecting the Customer project approximately $1,849,000. It is not anticipated that the Facility Study will need to be updated. This figure does not address the cost of the Customer substation, the 12 MVAR capacitor bank to be installed in the Customer substation, or the transmission line between the Customer substation and the SPS/Excel switching substation located on the Texas County-Spearman 115kV line.

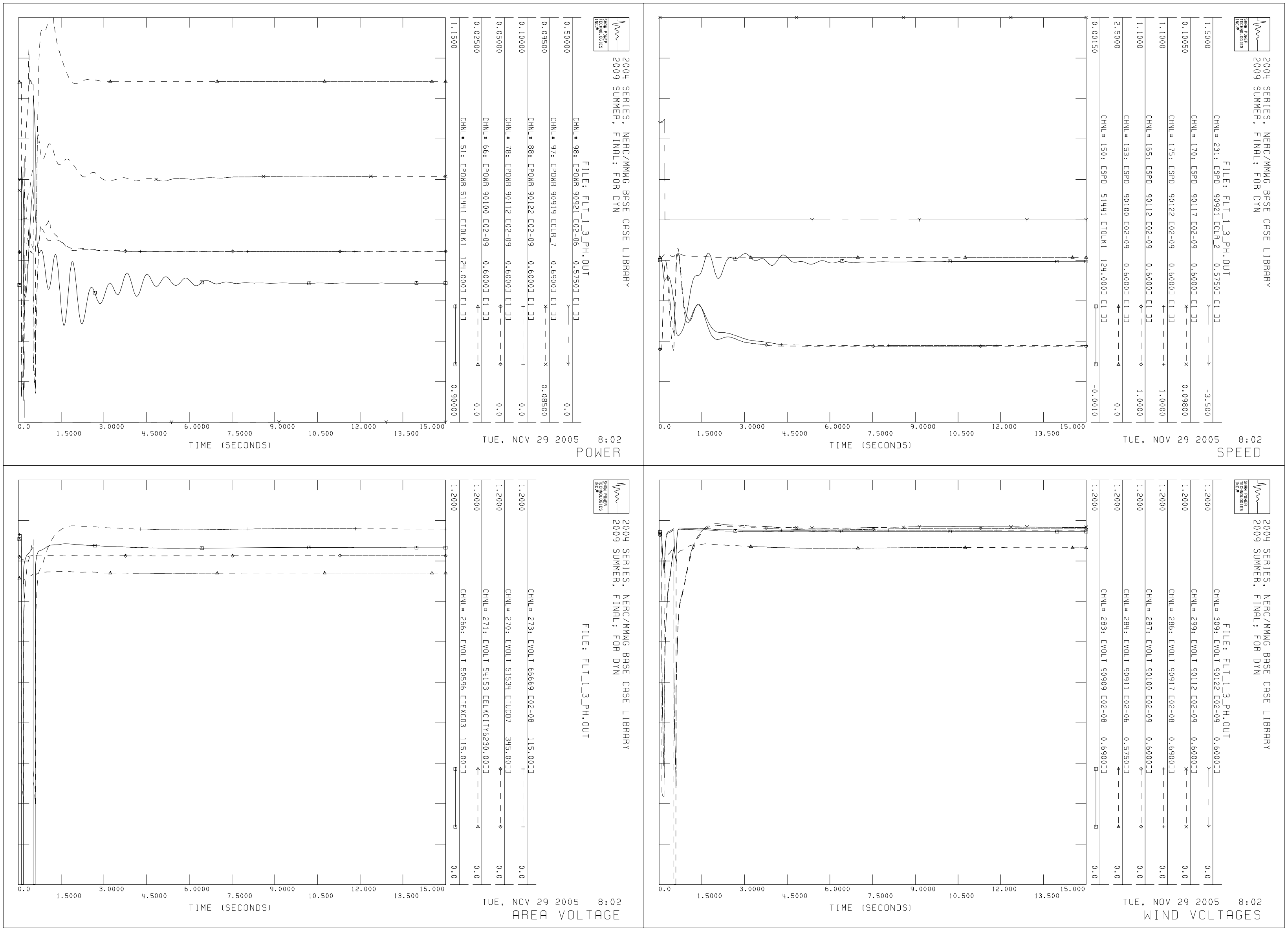
The Customer will be responsible for installing a 34.5kV, 12 MVAR capacitor bank in its substation on the 34.5kV bus to bring the power factor at the point of interconnection to unity.

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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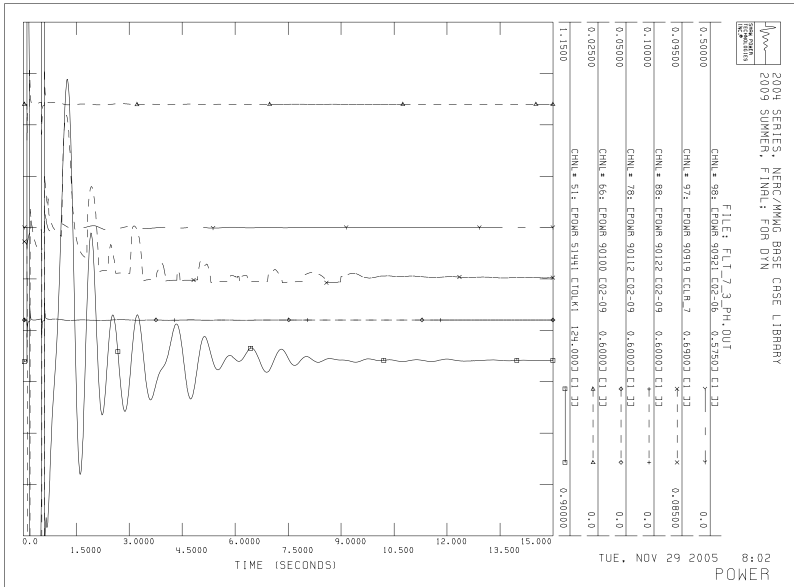
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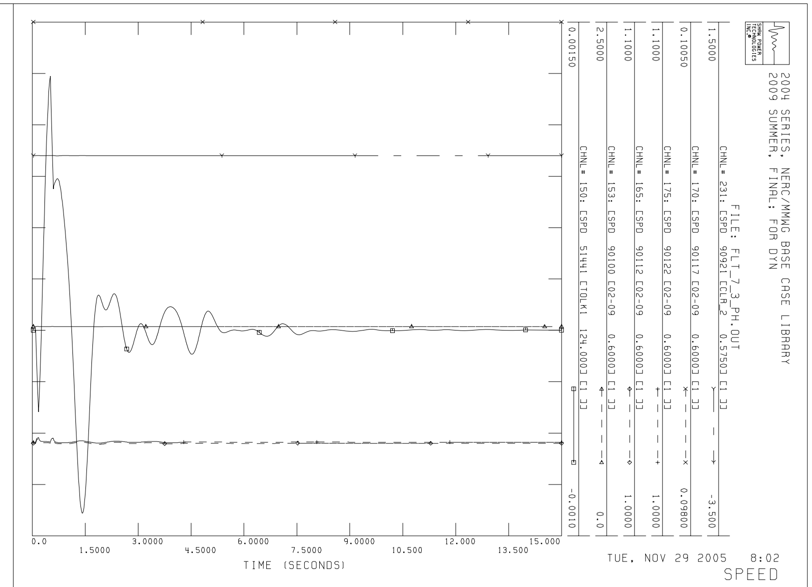
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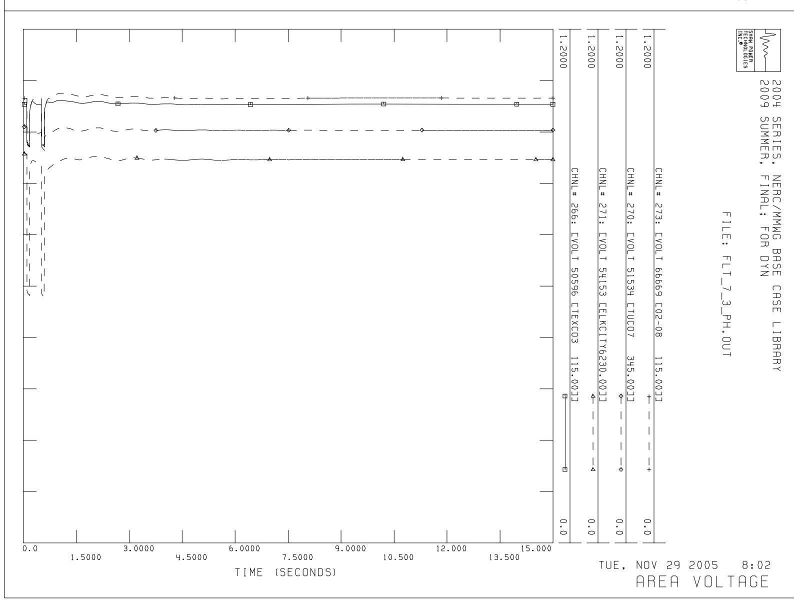
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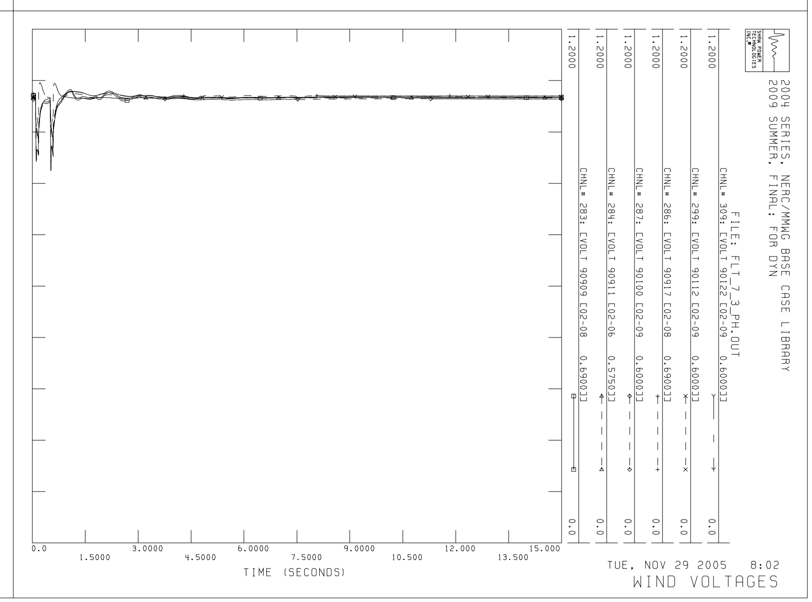
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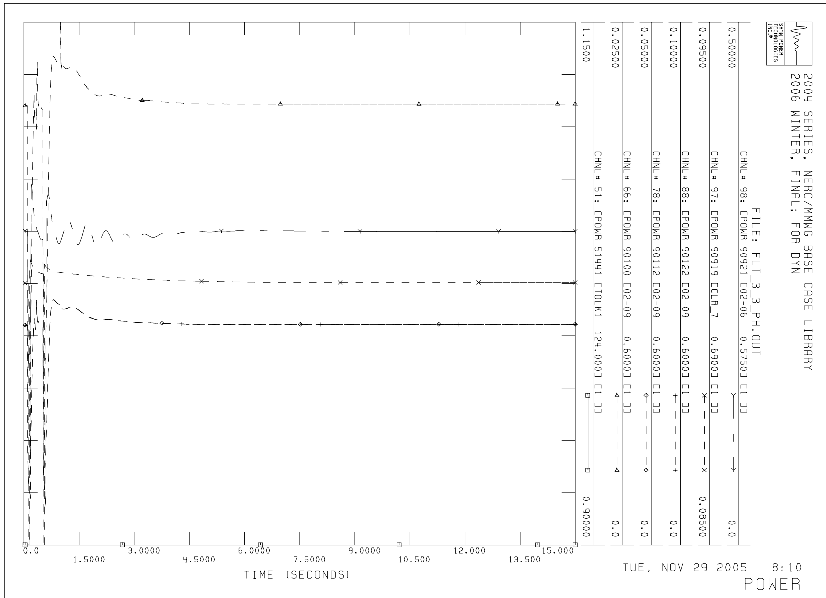
WIND VOLTAGES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2006 WINTER, FINAL; FOR DYN
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CHNL# 98: [POWR 90921 [C02-06 0.575]] [1 1] 0.50000 0.0
CHNL# 97: [POWR 90919 [CLR_7 0.690]] [1 1] 0.09500 0.08500
CHNL# 88: [POWR 90122 [02-09 0.600]] [1 1] 0.10000 0.0
CHNL# 78: [POWR 90112 [02-09 0.600]] [1 1] 0.05000 0.0
CHNL# 66: [POWR 90100 [02-09 0.600]] [1 1] 0.02500 0.0
CHNL# 51: [POWR 51441 [TOLK1 124.000]] [1 1] 1.1500 0.90000
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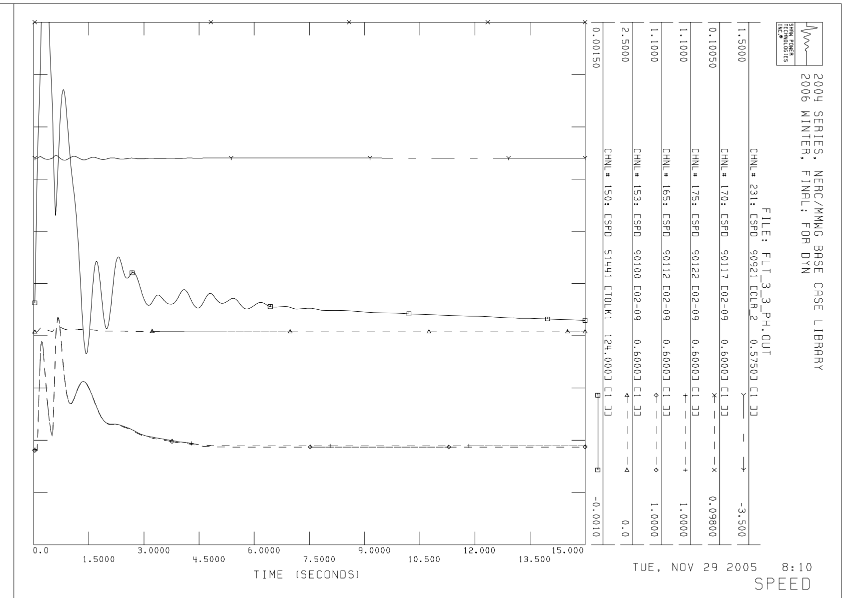
TIME (SECONDS)
TUE, NOV 29 2005 8:10
POWER


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2006 WINTER, FINAL; FOR DYN
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CHNL# 231: [SPD 90921 [CLR_2 0.575]] [1 1] 1.5000 -3.500
CHNL# 170: [SPD 90117 [02-09 0.600]] [1 1] 0.10050 0.09800
CHNL# 175: [SPD 90122 [02-09 0.600]] [1 1] 1.1000 1.0000
CHNL# 165: [SPD 90112 [02-09 0.600]] [1 1] 1.1000 1.0000
CHNL# 153: [SPD 90100 [02-09 0.600]] [1 1] 2.5000 0.0
CHNL# 150: [SPD 51441 [TOLK1 124.000]] [1 1] 0.00150 -0.0010
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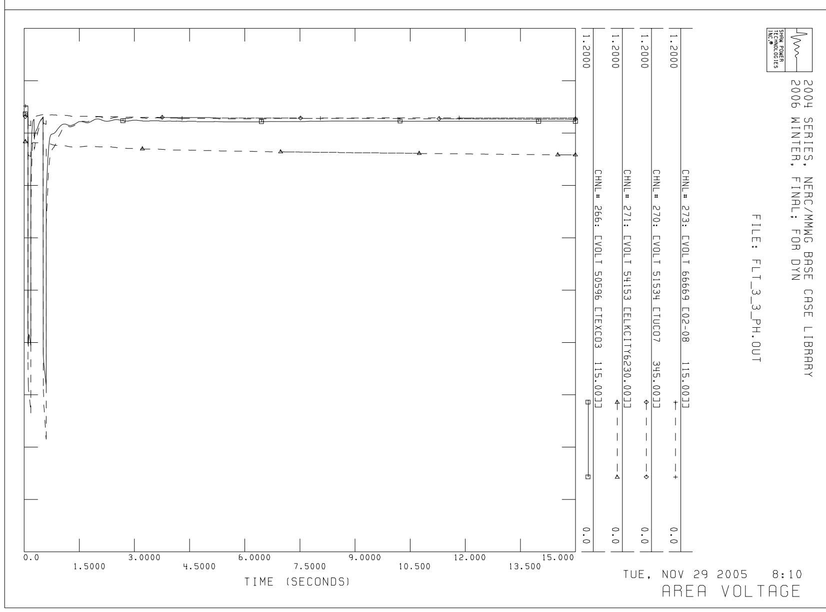
TUE, NOV 29 2005 8:10
SPEED


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2006 WINTER, FINAL; FOR DYN
FILE: FLT_3_3_PH.OUT
CHNL# 273: [VOLT 66669 [02-08 115.00]] 1.2000 0.0
CHNL# 270: [VOLT 51534 [TUCO7 345.00]] 1.2000 0.0
CHNL# 271: [VOLT 54153 [ELKCITY6230.00]] 1.2000 0.0
CHNL# 266: [VOLT 50596 [TEXCO3 115.00]] 1.2000 0.0
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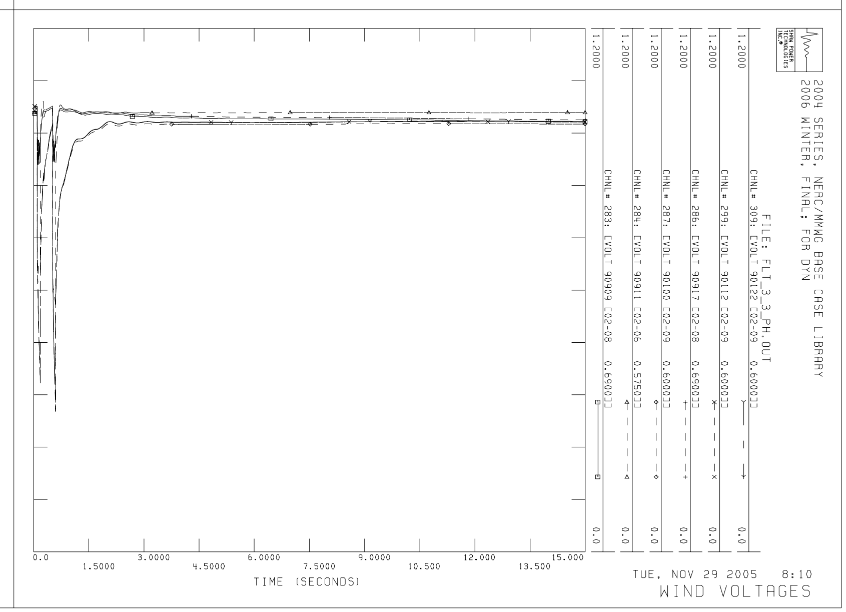
TIME (SECONDS)
TUE, NOV 29 2005 8:10
AREA VOLTAGE


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2006 WINTER, FINAL; FOR DYN
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CHNL# 299: [VOLT 90112 [02-09 0.600]] 1.2000 0.0
CHNL# 286: [VOLT 90917 [02-08 0.690]] 1.2000 0.0
CHNL# 287: [VOLT 90100 [02-09 0.600]] 1.2000 0.0
CHNL# 284: [VOLT 90911 [02-06 0.575]] 1.2000 0.0
CHNL# 283: [VOLT 90909 [02-08 0.690]] 1.2000 0.0
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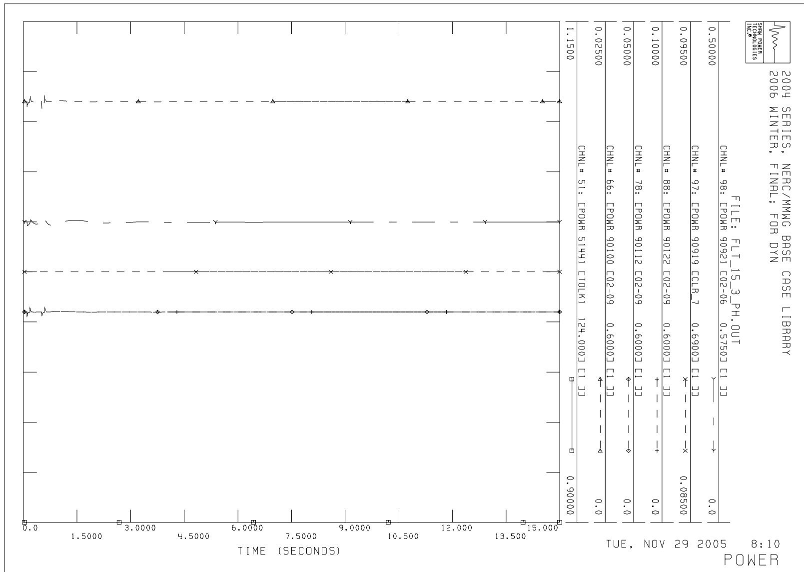
TUE, NOV 29 2005 8:10
WIND VOLTAGES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4.5000
6.0000
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9.0000
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12.000
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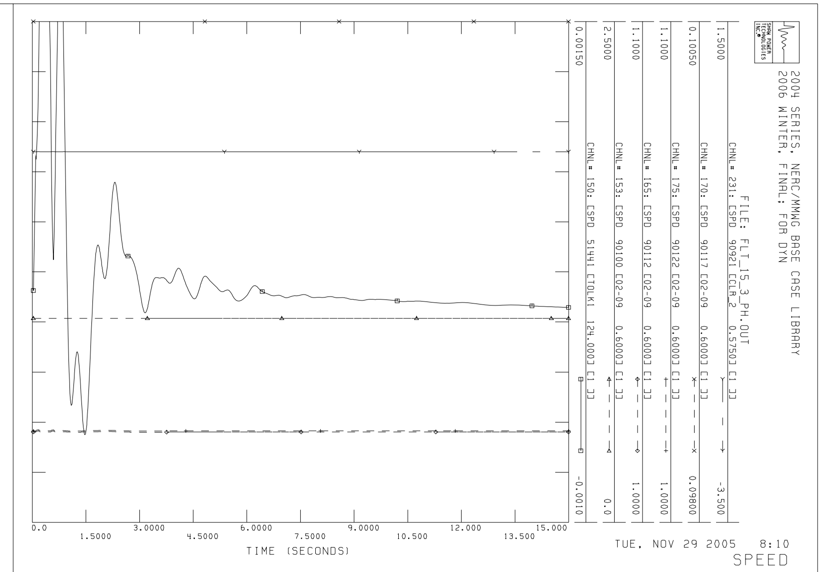
TUE. NOV 29 2005 8:10
POWER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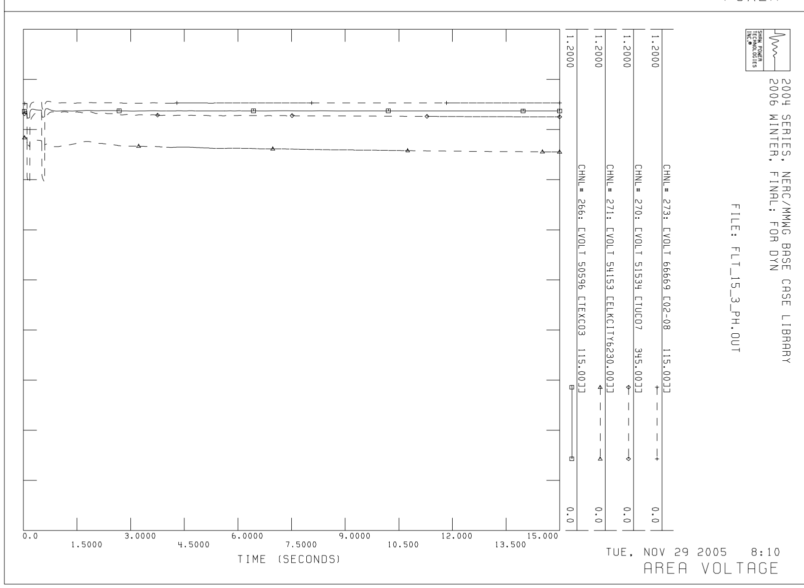
TIME (SECONDS)
TUE. NOV 29 2005 8:10
SPEED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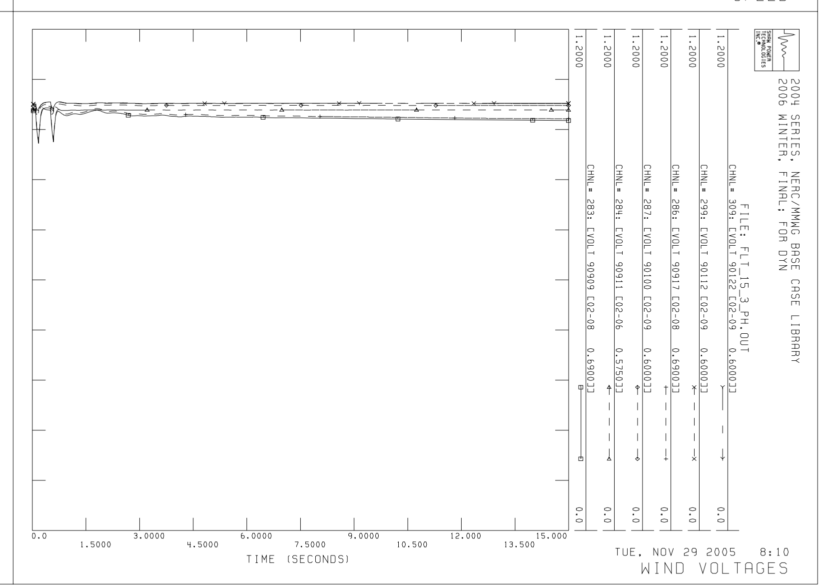
TIME (SECONDS)
TUE. NOV 29 2005 8:10
AREA VOLTAGE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1.5000
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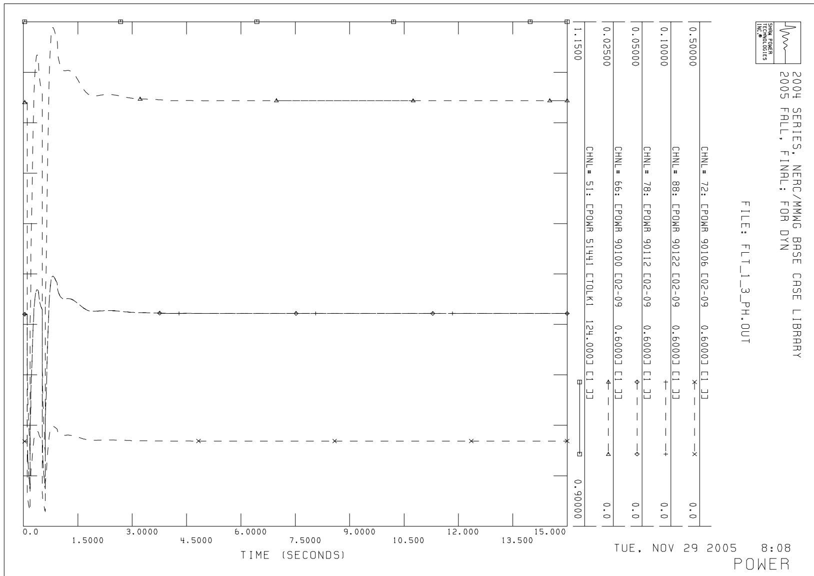
4.5000
6.0000
7.5000
9.0000
10.500
12.000
13.500
15.000
TIME (SECONDS)
TUE. NOV 29 2005 8:10
WIND VOLTAGES


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2005 FALL, FINAL, FOR DYN
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CHNL# 51: [POWR 51441 [TOLK1 124.00] [1]]
CHNL# 66: [POWR 90100 [02-09 0.6000] [1]]
CHNL# 78: [POWR 90112 [02-09 0.6000] [1]]
CHNL# 88: [POWR 90122 [02-09 0.6000] [1]]
CHNL# 72: [POWR 90106 [02-09 0.6000] [1]]
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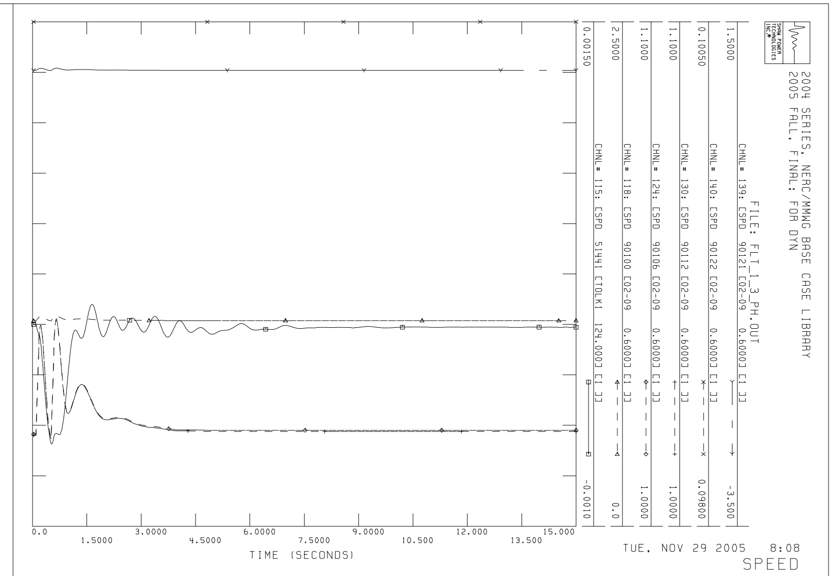
0.05000
0.10000
0.50000
0.0
TIME (SECONDS)
TUE, NOV 29 2005 8:08
POWER


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2005 FALL, FINAL, FOR DYN
FILE: FLT_1_3_PH.OUT
CHNL# 115: [SPD 51441 [TOLK1 124.00] [1]]
CHNL# 118: [SPD 90100 [02-09 0.6000] [1]]
CHNL# 124: [SPD 90106 [02-09 0.6000] [1]]
CHNL# 130: [SPD 90112 [02-09 0.6000] [1]]
CHNL# 140: [SPD 90122 [02-09 0.6000] [1]]
CHNL# 139: [SPD 90121 [02-09 0.6000] [1]]
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-0.0010
2.5000
1.1000
1.0000
0.10050
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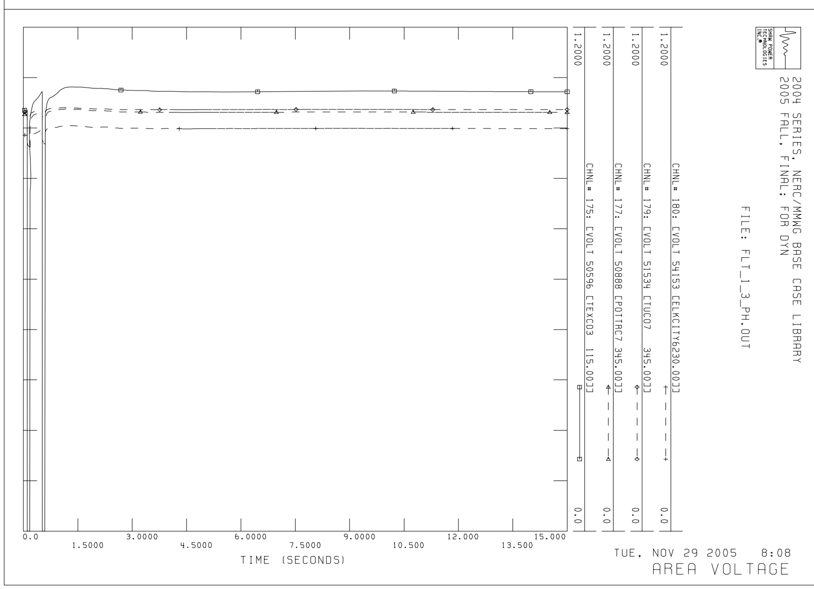
-3.500
TIME (SECONDS)
TUE, NOV 29 2005 8:08
SPEED


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2005 FALL, FINAL, FOR DYN
FILE: FLT_1_3_PH.OUT
CHNL# 175: [VOLT 50596 [TEXC03 115.00]]
CHNL# 177: [VOLT 50888 [POTTRC7 345.00]]
CHNL# 179: [VOLT 51534 [TUCO7 345.00]]
CHNL# 180: [VOLT 54153 [ELKCITY6230.00]]
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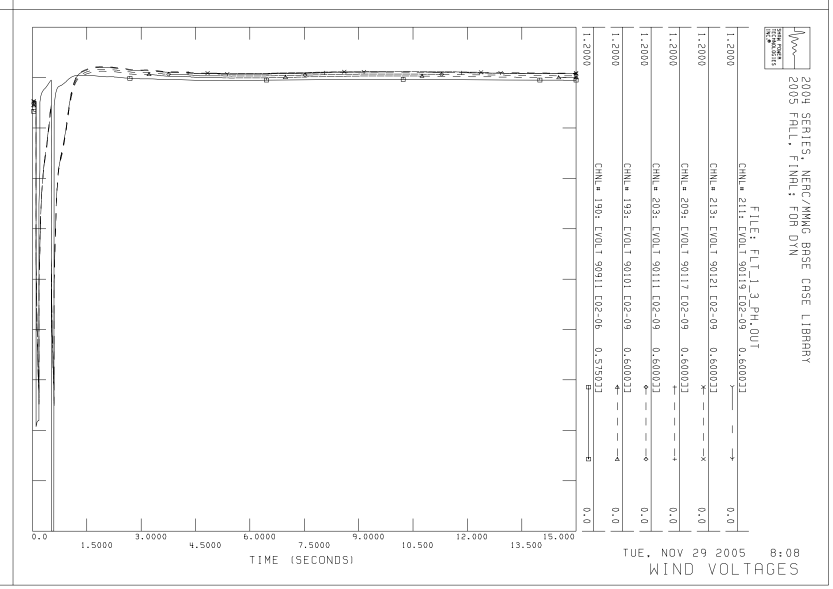
0.0
TIME (SECONDS)
TUE, NOV 29 2005 8:08
AREA VOLTAGE


2004 SERIES, NERC/MMWG BASE CASE LIBRARY
2005 FALL, FINAL, FOR DYN
FILE: FLT_1_3_PH.OUT
CHNL# 190: [VOLT 90911 [02-06 0.5750]]
CHNL# 193: [VOLT 90101 [02-09 0.6000]]
CHNL# 203: [VOLT 90111 [02-09 0.6000]]
CHNL# 209: [VOLT 90117 [02-09 0.6000]]
CHNL# 213: [VOLT 90121 [02-09 0.6000]]
CHNL# 211: [VOLT 90119 [02-09 0.6000]]
1.2000
0.0
TIME (SECONDS)
TUE, NOV 29 2005 8:08
WIND VOLTAGES