SPP Southwest Power Pool

Impact Study For Generation Interconnection Request GEN-2006-037

SPP Tariff Studies

(#GEN-2006-037)

April, 2007

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Black & Veatch performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting Customer and SPP for SPP Generation Interconnection request #GEN-2006-037.

Interconnection Facilities

No new facilities were determined to be necessary by this Impact Study. The estimated Interconnection Facility and Network Upgrade Costs were given in the Feasibility Study. These costs are re-stated below in Table 1 and Table 2. These costs do not include the results of short circuit analysis. Detailed facility costs and a short circuit analysis will be conducted by the Transmission Owner during a Facility Study, if the Customer wishes to execute a Facility Study Agreement for this generation interconnection request.

Table 1: Direct Assignment Facilities

Facility	ESTIMATED COST (2006 DOLLARS)
Customer – 345kV-GSU voltage Substation facilities.	*
Customer – 345kV facilities between Customer facilities and OKGE Sooners Energy Center 345kV switching station	*
Customer - Right-of-Way for Customer facilities.	*
Total	*****

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

Table 2: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2006 DOLLARS)
OKGE – Add a 345kV generator/line terminal to the existing Sooner 345kV Substation bus including two 345kV circuit breakers, associated switches, buswork, relaying and all miscellaneous equipment.	$2,000,000
Total	**$2,000,000**

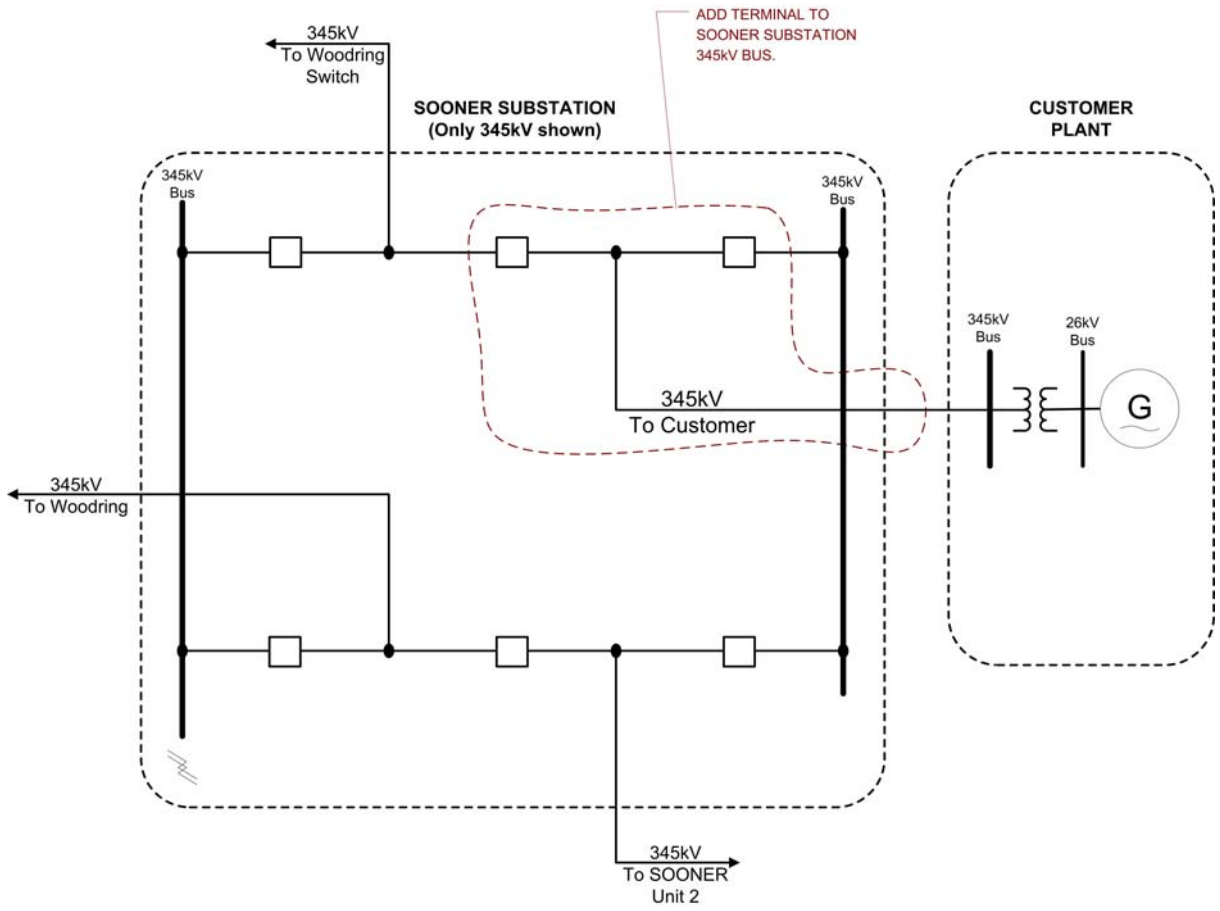

Figure 1: Proposed Interconnection
(Final substation design to be determined)

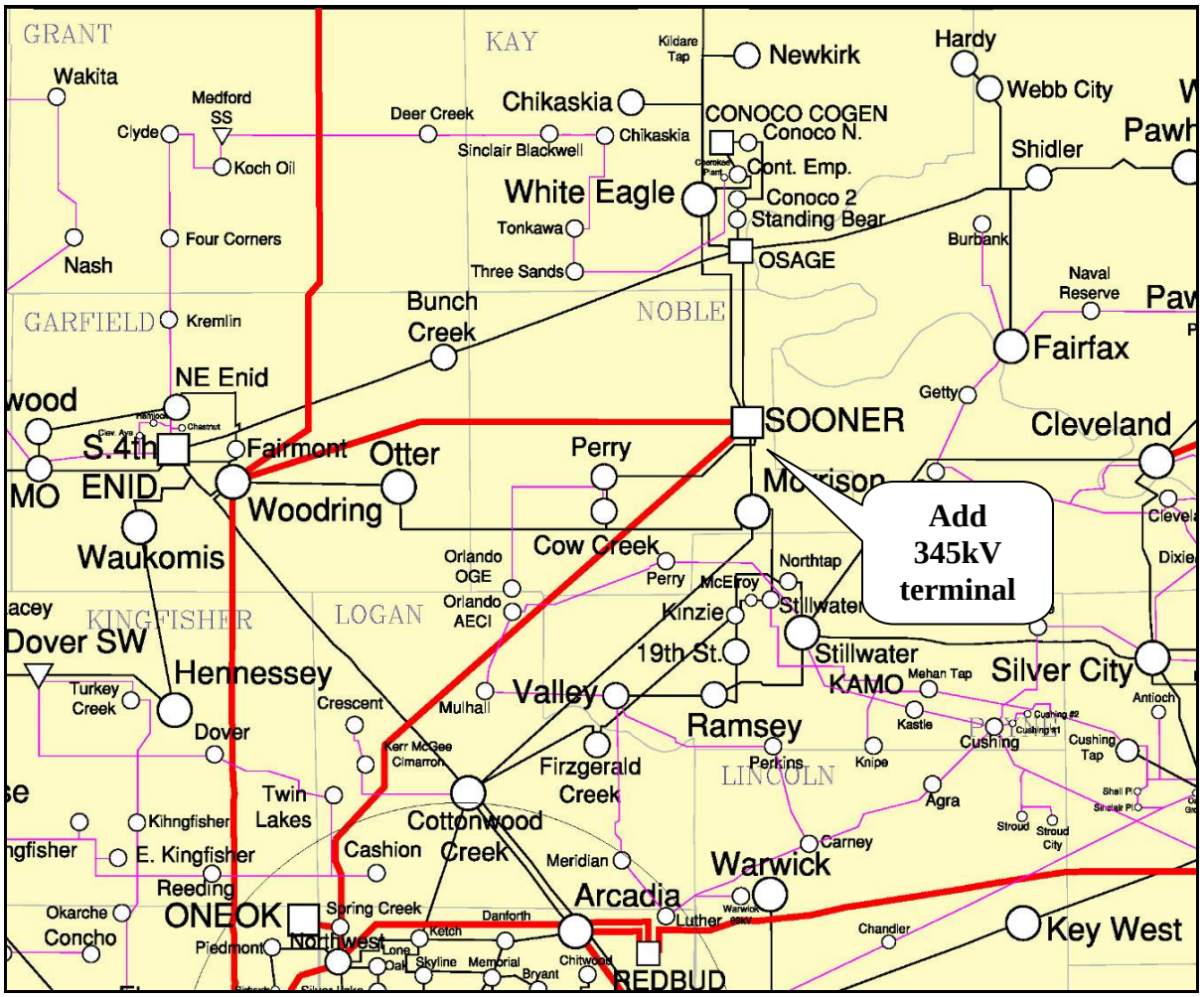

Figure 2. MAP OF THE LOCAL AREA

IMPACT STUDY FOR SPP GENERATION

QUEUE POSITION GEN-2006-037

SOUTHWEST POWER POOL (SPP)

April 25, 2007

Final Report

By

BLACK & VEATCH

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EXECUTIVE SUMMARY

A transient stability study has been performed for Southwest Power Pool (SPP) Interconnection Queue Position GEN-2006-037 as part of the System Impact Study. The Interconnection Queue Position GEN-2006-037 is a coal-fired steam turbine generator with a capacity of 893 MW (Summer) /925 MW (Winter) located in Noble County, Oklahoma. The generation facility will be interconnected to the Sooner 345kV substation on the Oklahoma Gas & Electric (OKGE) transmission system.

The SPP MDWG 2006 series models of the 2011 summer peak and 2007 winter peak load flow case together with the SPP MDWG 2006 stability model were used as the base case for the transient stability analysis. The study was performed using PTI's PSS/E program, which is an industry-wide accepted power system simulation program.

Transient Stability studies were conducted with the 100% total capacity of 893 MW in the summer and 925 MW in the winter. Twenty two (22) contingencies were considered for each of the scenarios.

The study has not indicated any angular or voltage instability problem for the contingencies analyzed after the addition of GEN-2006-037.

If any previously queued projects that were included in this study drop out then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on OGKE transmission facilities.

1. INTRODUCTION

This report discusses the results of a transient stability study performed for Southwest Power Pool (SPP) Interconnection Queue Position GEN-2006-037.

The Interconnection Queue Position GEN-2006-037 is a generating facility with a coal fired steam turbine generator of total capacity of 893 MW (Summer) / 925 MW (Winter). The generating facility will be located in Noble County, Oklahoma within the service territory of Oklahoma Gas and Electric Company and will be interconnected to Sooner 345kV substation. The system one line diagram of the area near the Queue Position Gen-2006-037 is shown below.

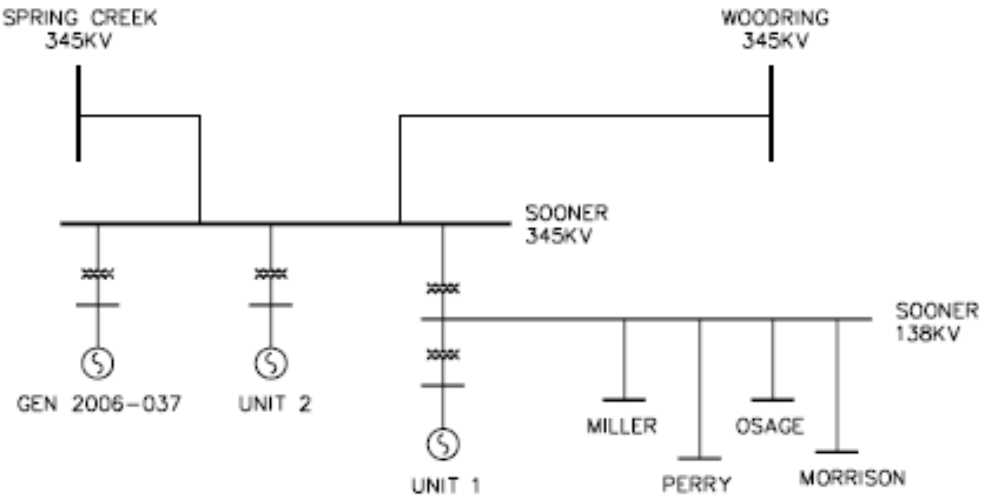

Figure 1: System One Line Diagram near GEN-2006-037

Transient Stability studies were conducted with the 100% total capacity, i.e., 893 MW in summer case and 925 MW in winter case. The data for the new turbine generator were provided by the Customer for the study.

2. STABILITY STUDY CRITERIA

The SPP MDWG 2006 series 2011 summer peak and 2007 winter peak load flow cases together with the SPP MDWG 2006 stability model database were used as the base case for the transient stability analysis. These models were provided by SPP.

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

"Power system stability is defined as that condition in which the difference of the angular positions of synchronous machine rotor becomes constant following an aperiodic system disturbance."

Disturbances such as three phase and single phase line faults were simulated for a specified duration and the synchronous machine rotor angles were monitored for their synchronism following the fault removal.

The ability of the wind generators to stay connected to the grid during the disturbances and during the fault recovery was also monitored.

3. SIMULATION CASES

Transient Stability studies were conducted with the Gen-2006-037 output at 100% for two scenarios, i.e., (i) 2011 summer peak load and (ii) 2007 winter peak load.

Table 1 indicates the contingencies which were studied.

Fault Number	Fault Definition
FLT13PH	Three phase fault on the Sooner –Woodring 345 kV line, near Sooner, with one shot reclosing after 20 cycles.
FLT21PH	Single phase fault on the Sooner –Woodring 345 kV line, near Sooner, with one shot reclosing after 20 cycles.
FLT33PH	Three phase fault on the Sooner –Spring Creek 345 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT41PH	Single phase fault on the Sooner –Spring Creek 345 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT53PH	Three phase fault on the Sooner autotransformer – 345 kV bus.
FLT61PH	Single phase fault on the Sooner autotransformer – 345 kV bus.
FLT73PH	Three phase fault on the Sooner - Miller 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT81PH	Single phase fault on the Sooner - Miller 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT93PH	Three phase fault on the Sooner- Morrison 138 kV line, near Sooner with one shot reclosing after 20 cycles.

FLT101PH	Single phase fault on the Sooner- Morrison 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT113PH	Three phase fault on the Sooner - Perry 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT121PH	Single phase fault on the Sooner - Perry 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT133PH	Three phase fault on the Sooner - SNRPMPT 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT141PH	Single phase fault on the Sooner - SNRPMPT 138 kV line, near Sooner with one shot reclosing after 20 cycles.
FLT153PH	Three phase fault on the Woodring - Wichita 345 kV line, near Woodring with one shot reclosing after 20 cycles.
FLT161PH	Single phase fault on the Woodring - Wichita 345 kV line, near Woodring with one shot reclosing after 20 cycles.
FLT173PH	Three phase fault on the Woodring - Cimarron 345 kV line, near Woodring with one shot reclosing after 20 cycles.
FLT181PH	Single phase fault on the Woodring - Cimarron 345 kV line, near Woodring with one shot reclosing after 20 cycles.
FLT193PH	Three phase fault on the Redbud - Riverside 345 kV line, near Redbud with one shot reclosing after 20 cycles.
FLT201PH	Single phase fault on the Redbud - Riverside 345 kV line, near Redbud with one shot reclosing after 20 cycles.
FLT213PH	Three phase fault on the Northwest - Arcadia 345 kV line, near Arcadia with one shot reclosing after 20 cycles.
FLT221PH	Single phase fault on the Northwest - Arcadia 345 kV line, near Arcadia with one shot reclosing after 20 cycles.

Table 1: Study Cases

4. SIMULATION MODEL

Gen-2006-037 is a coal-fired steam turbine generator. The following are the main parameters of the turbine generator unit and Table 2 shows the electrical parameters of the generators.

Rated Power	: 925 MW
Voltage	: 26,000 V
Rated Power Factor	: 0.90

The Customer also provided the following Generator Step-up Transformers impedance:

Transformer Impedance: 10 % on 990 MVA

The generating unit was considered to be connected with the Sooner substation directly via GSU.

The models of the generating station equipment such as generators and transformers were added to the base case for the purpose of this study.

Prior queued project GEN-2005-024 was included in the study model, with its energy being displaced in the AEPW control area. Spring Creek was brought on line in the winter model and its energy was dispatched into the Westar control area. Spring Creek was already on line in the summer model. Also, Redbud was brought on line at 487MW in the winter and summer model with its energy being displaced in the Entergy control area.

No additional transmission lines were added to either the MDWG 2006 series winter or summer stability loadflow model.

Description	Value
Open Circuit Transient Time Constant, T'D0	5.90
Open Circuit Subtransient Time Constant, T"D0	0.034
Open Circuit Quadrature axis Time Constant, T'Q0	0.69
Open Circuit Quadrature axis Subtransient Time Constant,T"Q0	0.067
Inertia Constant, H	3.13
Synchronous reactance, XD	2.18
Quadrature axis reactance, XQ	2.07
Transient Reactance, X'D	0.28

Quadrature axis Transient Reactance, X'Q	0.465
Sub transient Reactance, X"D	0.23
Leakage reactance, XL	0.155

Table 2: Generator Parameters

5. STUDY ASSUMPTIONS

The following assumptions were made in the Study:

1. The generation in the SPP control area were scaled down to accommodate the new generation as indicated in Table 3.

Scenario	Generation within SPP	
	Summer	Winter
With the GEN-2006-037	38,742 MW	26,894 MW
Without the GEN-2006-037	37,849 MW	25,969 MW

Table 3: SPP Dispatches

6. SIMULATION RESULTS

Initial simulation was carried out for 20 seconds without any disturbance to verify the numerical stability of the model and was confirmed to be stable.

Table 4 provides the summary of the stability studies for Gen-2006-037.

Fault Number	Summer Peak	Winter Peak
FLT1_3PH	- -	- -
FLT2_1PH	- -	- -
FLT3_3PH	- -	- -
FLT4_1PH	- -	- -
FLT5_3PH	- -	- -
FLT6_1PH	- -	- -
FLT7_3PH	- -	- -
FLT8_1PH	- -	- -

FLT9_3PH	- -	- -
FLT10_1PH	- -	- -
FLT11_3PH	- -	- -
FLT12_1PH	- -	- -
FLT13_3PH	- -	- -
FLT14_1PH	- -	- -
FLT15_3PH	- -	- -
FLT16_1PH	- -	- -
FLT17_3PH	- -	- -
FLT18_1PH	- -	- -
FLT19_3PH	- -	- -
FLT20_1PH	- -	- -
FLT21_3PH	- -	--
FLT22_1PH	- -	- -

UV : Tripped due to low voltage
OV : Tripped due to high voltage
UF : Tripped due to low frequency
OF : Tripped due to high frequency
S : Stability issues encountered

Table 4 : Stability Study Results Summary

GEN-2006-037 and the rest of the system were found to be stable for all the contingencies that were studied.

Figure 2 shows the system response for FLT1_3PH in summer peak load case.

7. SUMMARY

A transient stability analysis was conducted for the SPP Interconnection Generation Queue Position GEN-2006-037 with the maximum output of 893 MW in summer and 925 MW in winter. The study was conducted for two different power flow scenarios, i.e., one for 2011 summer peak load and the other for 2007 winter peak load. The study has not indicated any instability in the system with the addition of GEN-2006-037.

Disclaimer

If any previously queued projects that were included in this study drop out, then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on OKGE transmission facilities. Since this is also a preliminary System Impact Study, not all previously queued projects were assumed to be in service in this System Impact Study. If any of those projects are constructed, then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on OKGE transmission facilities. In accordance with FERC and SPP procedures, the study cost for restudy shall be borne by the Interconnection Customer.

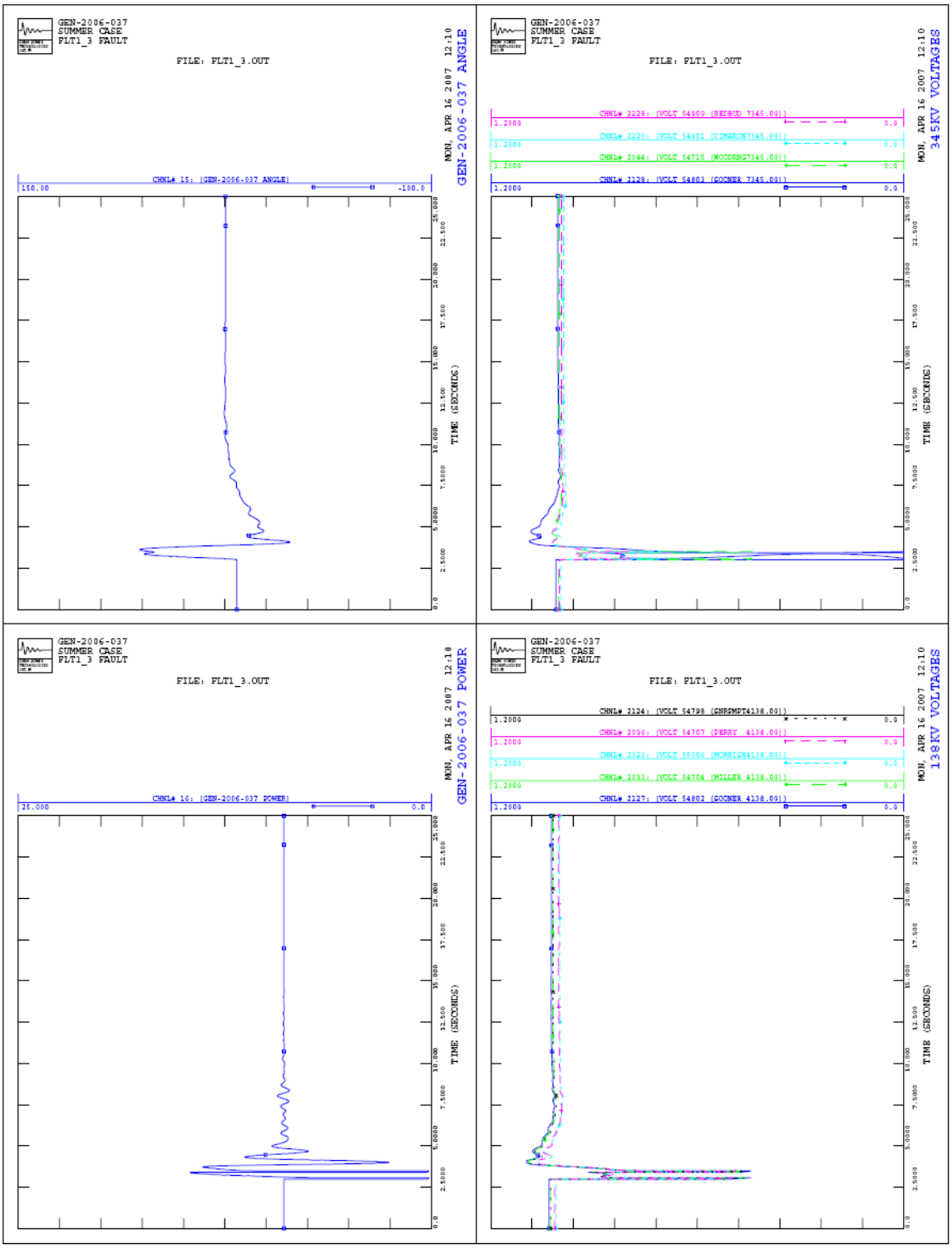

Figure 2 : System Responses with 100% output of Gen-2006-037

Figure 2 : System Responses with 100% output of Gen-2006-037 (Cont'd)