Southwest Power Pool

Impact Study for Generation Interconnection Request GEN–2007–018

SPP Tariff Studies
(#GEN-2007-018)

April 15, 2008

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), ABB Grid Systems Consulting (ABB) performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customer and SPP for SPP Generation Interconnection request GEN-2007-018. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Introduction

GEN-2007-018 Customer has requested an Impact Study for the purpose of interconnecting 315 MW of gas fired generation within the control area of Missouri Public Service (MIPU) located in Pettis County, Missouri. The proposed method of interconnection is a new 161 kV ring-bus switching station to be located on the existing Sedalia – Sedalia East 161kV line owned by MIPU. The proposed in-service date is May 31, 2010.

Facilities

The requirements for interconnection of the 315 MW of generation consist of constructing a new 161 kV three-breaker ring-bus switching station near the generation site on the existing Sedalia – Sedalia East 161 kV transmission line, owned by MIPU. This substation will be constructed and maintained by MIPU. A preliminary one-line drawing of the interconnection facilities are shown in Figure 1.

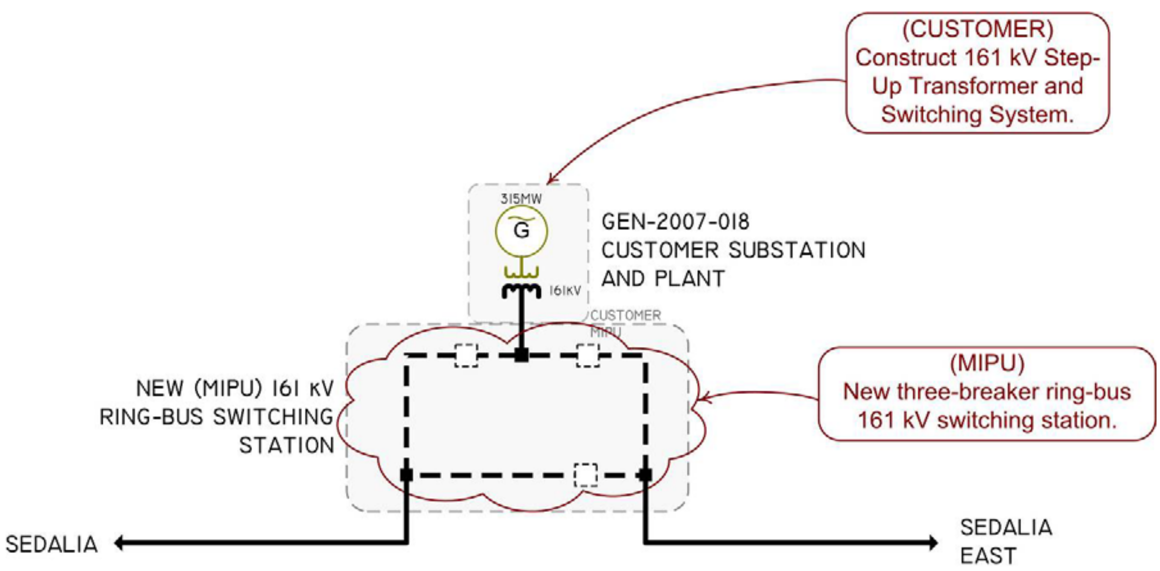

Figure 1: Proposed Method of Interconnection
(Final design to be determined)

Table 1: Direct Assignment Facilities

FACILITY	ESTIMATED COST (2008 DOLLARS)
CUSTOMER – GSU substation facilities.	*
CUSTOMER – 161 kV generator leads for GSU substation to the MIPU switching station.	*
CUSTOMER – Right-of-Way for all Customer facilities.	*
TOTAL	*

* *Estimates of cost to be determined.*

Table 2: Required Interconnection Network Upgrade Facilities

FACILITY	ESTIMATED COST (2008 DOLLARS)
MIPU – (1) 161kV three-breaker ring-bus switching station for GEN-2007-018 located in Pettis County on the Sedalia – Sedalia East 161kV transmission line. Station to include breakers, switches, control relaying, high speed communications, metering and related equipment and all related structures.	$3,200,000
TOTAL	**$3,200,000**

* *Estimates of cost to be determined.*

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2009 summer and winter peak, the 2012 summer and winter peak models, and the 2017 summer peak model. The output of the Customer's facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection request. The proposed in-service date of the generation is October 15, 2010. The available seasonal models used were through the 2017 Summer Peak of which is the end of the current SPP planning horizon.

Powerflow analysis of the Customer's project indicates that, given the requested generation level of 315 MW and location, additional criteria violations will occur on the MIPU, Associated Electric Cooperative (AECI), and Ameren (AMRN) transmission systems under steady state and contingency conditions in the peak seasons. Table 3 lists these overloaded facilities.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

A TSR study is also in progress for this generation interconnection request. Network Upgrades which are under study for the deliverability for this generating facility include, but are not limited to the following.

- Build a new 161kV transmission line from GEN-2007-018 facility to the AECI Georgetown substation (approx. 3 miles). Add 161kV terminal at GEN-2007-018 and AECI Georgetown. Cost is approximately $2,400,000 additional cost to the cost in Table 2.
- Reconductor the 161kV transmission line from Sedalia to Georgetown. Cost is approximately $4,000,000 additional cost to the cost in Table 2.
- Reconductor the 161kV transmission line from GEN-2007-018 to Sedalia. Cost is approximately $3,500,000 in addition to cost in Table 2.

These costs will be finalized in the TSR study for this request.

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) criteria states that: “The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable NERC Planning Standards for System Adequacy and Security – Transmission System Table I hereafter referred to as NERC Table I) and its applicable standards and measurements”.

Using the created models and the ACCC function of PSS\E, single contingencies in portions or all of the modeled control areas of Sunflower Electric Power Corporation (SUNC), Missouri Public Service (MIPU), Westar Energy (WERE), Kansas City Power & Light (KCPL), West Plains (WEPL), Midwest Energy (MIDW), Oklahoma Gas and Electric OKGE, American Electric Power West (AEPW), Grand River Dam Authority (GRDA), Southwestern Public Service Company (SPS), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the ‘more probable’ contingency testing criteria mandated by NERC and the SPP criteria.

Table 3. Contingency Analysis

	ELEMENT	RATE	LOADING	ATC	CONTINGENCY
	2009 Summer Peak				
09SP	'ANZIO - FORT JUNCTION SWITCHING STATION 115KV CKT 1'	92	125.0	0	'WEST JUNCTION CITY - WEST JUNCTION CITY JUNCTION (EAST) 115KV CKT 1'
09SP	'GEORGETOWN (GEORGETO) 161/69/13.2KV TRANSFORMER CKT 1'	56	113.8	137	'NORTON (NORTON) 161/69/13.2KV TRANSFORMER CKT 1'
09SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	123.7	237	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
09SP	'OVERTON 161.00 - SEDALIA EAST 161KV CKT 1'	223	125.2	245	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
09SP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	124.3	253	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
09SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	227	108.5	287	'BASE CASE'
	2009 Winter Peak				
09WP	'GEORGETOWN (GEORGETO) 161/69/13.2KV TRANSFORMER CKT 1'	56	121.4	54	'NORTON (NORTON) 161/69/13.2KV TRANSFORMER CKT 1'
09WP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	124.2	229	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
09WP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	124.9	252	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
09WP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	227	116.6	260	'BASE CASE'
	2012 Summer Peak				
12SP	'GEORGETOWN (GEORGETO) 161/69/13.2KV TRANSFORMER CKT 1'	56	142.8	0	'NORTON (NORTON) 161/69/13.2KV TRANSFORMER CKT 1'
12SP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	557	119.7	0	'AI21'
12SP	'MOBERLY TAP - THOMAS HILL 161KV CKT 1'	372	108.5	0	'AI21'
12SP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	625	106.7	12	'AI21'
12SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	124.7	230	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
12SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	124.0	242	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
12SP	'OVERTON 161.00 - SEDALIA EAST 161KV CKT 1'	223	124.3	246	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
12SP	'OVERTON 161.00 - SEDALIA EAST 161KV CKT 1'	223	124.3	246	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'

Table 3. Contingency Analysis

	ELEMENT	RATE	LOADING	ATC	CONTINGENCY
12SP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	124.3	253	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
12SP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	124.3	253	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
12SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	227	112.5	274	'BASE CASE'
	2012 Winter Peak				
12WP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	557	119.6	0	'AI21'
12WP	'GEORGETOWN (GEORGETO) 161/69/13.2KV TRANSFORMER CKT 1'	56	149.4	0	'NORTON (NORTON) 161/69/13.2KV TRANSFORMER CKT 1'
12WP	'MOBERLY TAP - THOMAS HILL 161KV CKT 1'	386	104.3	0	'AI21'
12WP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	625	106.6	14	'AI21'
12WP	'WARRENSBURG EAST - WARRENSBURG PLANT 69KV CKT 1'	32	132.0	55	'ODESSA - WARRENSBURG EAST 161KV CKT 1'
12WP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	127.4	214	'NORTON - SALISBURY 161KV CKT 1'
12WP	'WARRENSBURG EAST - WARRENSBURG PLANT 69KV CKT 1'	30	109.0	229	'BASE CASE'
12WP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	124.9	234	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
12WP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	227	122.2	243	'BASE CASE'
12WP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	125.6	251	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
12WP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	125.5	251	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
	2017 Summer Peak				
17SP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	557	123.5	0	'AI21'
17SP	'THOMAS HILL (THOMAS H) 345/161/13.8KV TRANSFORMER CKT 1'	625	110.1	0	'AI21'
17SP	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'	245	124.4	242	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'
17SP	'OVERTON 161.00 - SEDALIA EAST 161KV CKT 1'	223	123.2	248	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'
17SP	'SEDALIA EAST - SEDALIA SUB 161.00 161KV CKT 1'	245	124.6	253	'SEDALIA - SEDALIA SUB 161.00 161KV CKT 1'

Table 3. Contingency Analysis

	ELEMENT	RATE	LOADING	ATC	CONTINGENCY
17SP	'MOBERLY TAP - THOMAS HILL 161KV CKT 1'	372	100.3	287	'AI21'

POWER SYSTEMS DIVISION
GRID SYSTEMS CONSULTING

IMPACT STUDY FOR GENERATION INTERCONNECTION REQUEST GEN-2007-018

DRAFT REPORT

REPORT NO.:
Issued: April 15, 2008

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ABB Inc – Grid Systems Consulting

Technical Report

Southwest Power Pool	**No.**	
Impact Study for Generation Interconnection Request GEN-2007-018	4/15/2008	# Pages 23

Author(s):	**Reviewed by:**	**Approved by:**
Gang Shen S. Pillutla	William Quaintance	

Executive Summary

Southwest Power Pool (SPP) has commissioned ABB Inc. to perform the stability portion of a generator interconnection study for a combustion turbine power plant in Pettis County, Missouri. The proposed plant will be interconnected at a new 161kV substation to be located half-way on the Sedalia – Sedalia East 161kV transmission line. This line is owned by Missouri Public Service (MIPU).

Based on the available information, the generation developer is considering one of the following two alternatives for the turbine-generator installation at the plant:

- Three (3) Siemens units: each unit is rated 130 MVA with output 105 MW
- Four (4) GE units: each unit is rated 114 MVA with output 77 MW

The plant has the total output of 315 MW with Siemens alternatives and 308 MW with GE alternatives. SPP has requested that stability studies be conducted for both alternatives. This report discusses the impact of the interconnected power plant with Siemens units and GE units respectively.

The study was conducted for two system conditions: 2008 Winter Peak and 2012 Summer Peak. Several faults were simulated on the SPP system for these loading conditions.

Based on the results of stability analysis it can be concluded that the proposed GEN-2007-018 project with either Siemens units or GE units does not adversely impact the stability of the SPP system.

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

Rev No.	Revision Description	Date	Authored by	Reviewed by	Approved by
DISTRIBUTION: Charles Hendrix – Southwest Power Pool					

TABLE OF CONTENTS

1 INTRODUCTION

Southwest Power Pool (SPP) has commissioned ABB Inc. to perform a generator interconnection study for a 161 kV interconnection of a combustion turbine power plant in Pettis County, Missouri. The plant will have a total output of 315 MW with Siemens turbines or 308 MW with GE turbines. This generation will be interconnected at a new 161kV substation that is located half-way on the Sedalia – Sedalia East 161kV transmission line. This line is owned by Missouri Public Service (MIPU). The feasibility (power flow) study was not performed as a part of this study.

Based on the available information, the generation developer is considering one of the following two alternatives for the turbine-generator installation at the plant:

- Three (3) Siemens units: each is rated 130 MVA with output 105 MW
- Four (4) GE units: each is rated 114 MVA with output 77 MW

The plant will have a total output of 315 MW with Siemens units or 308 MW with GE units. SPP has requested that stability studies be conducted for both alternatives.

The objective of this study is to evaluate the impact of interconnecting the proposed plant on transmission system stability performance. See Appendix A for the detailed scope. The study is performed on two system scenarios, 2008 Winter Peak and 2012 Summer Peak, provided by SPP. SPP included all nearby prior-queued projects in these base cases.

Figure 1-1 shows the location of the proposed interconnection. Figure 1-2 and Figure 1-3 show the one-line diagrams of the proposed interconnection using Siemens units and GE units respectively with the existing network.

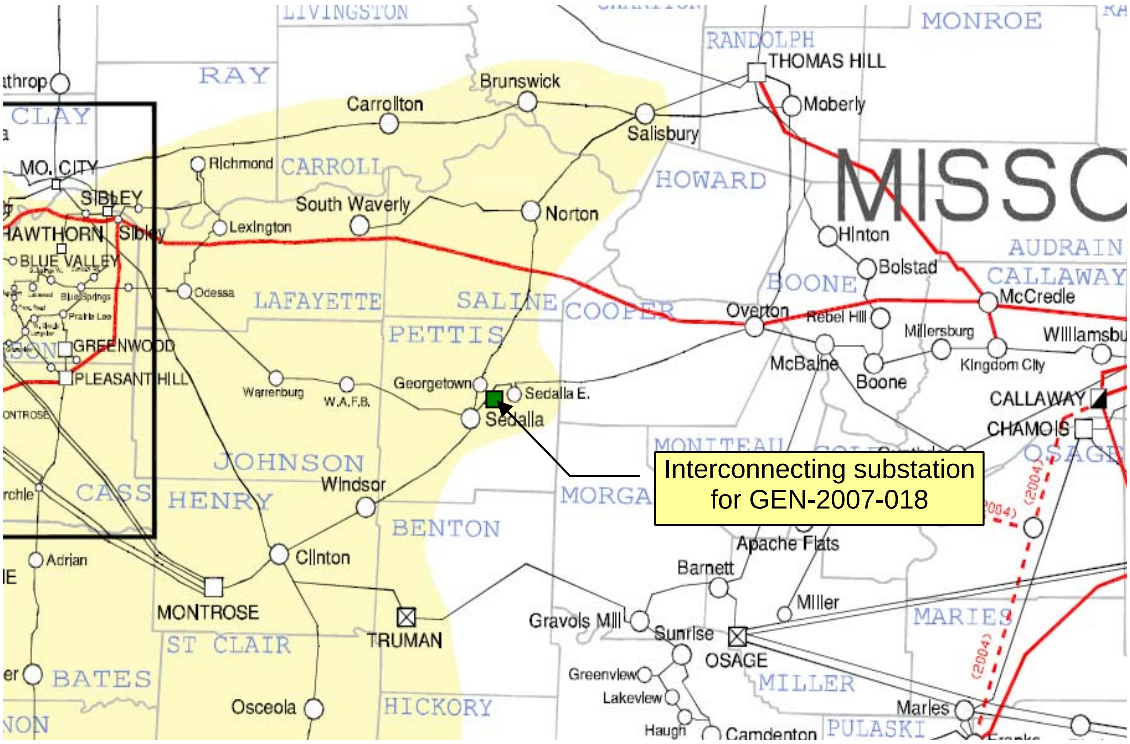

Figure 1-1: Power Plant (GEN-2007-018) interconnecting substation

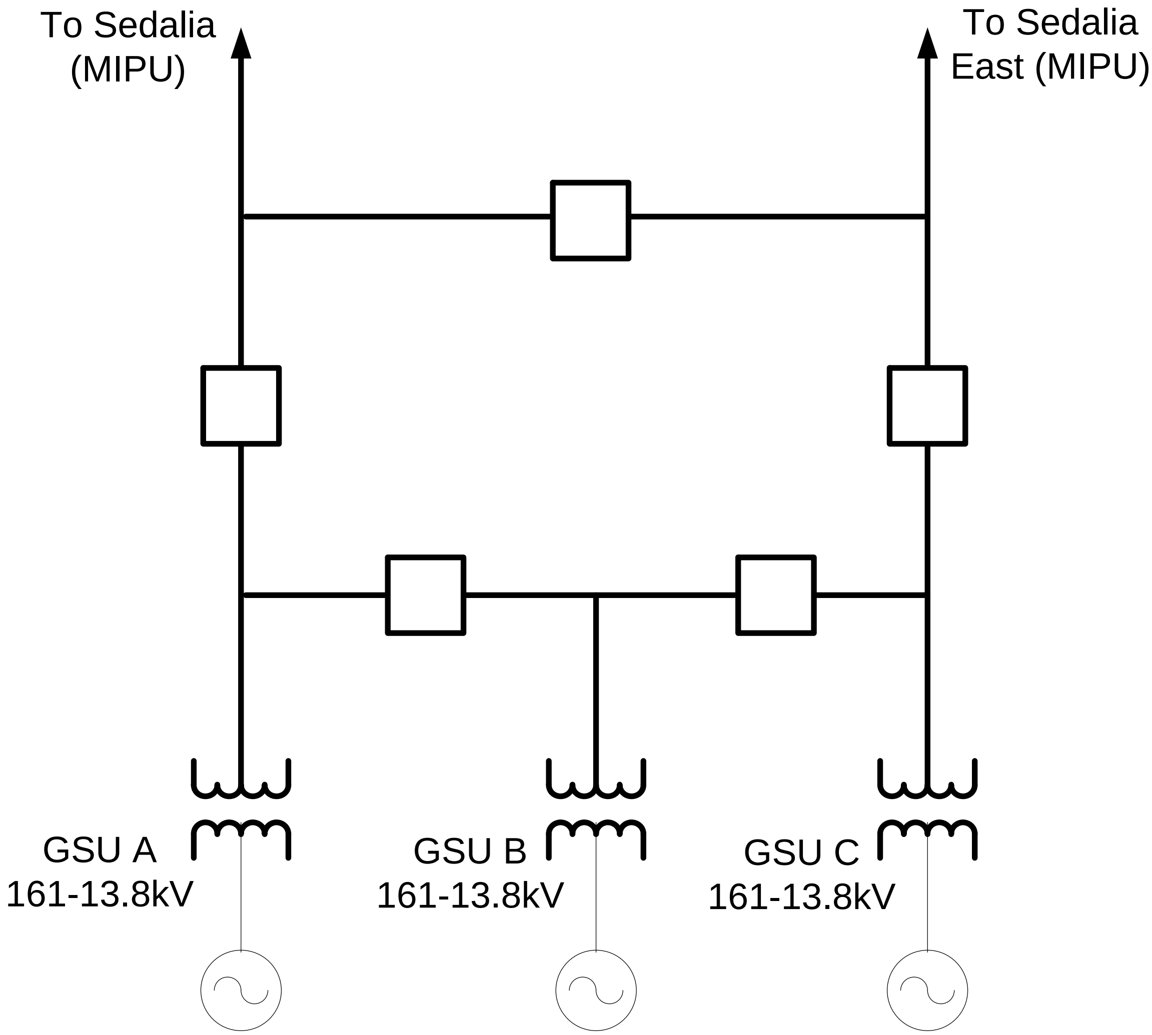

Figure 1-2: Proposed 315 MW Siemens Units interconnection

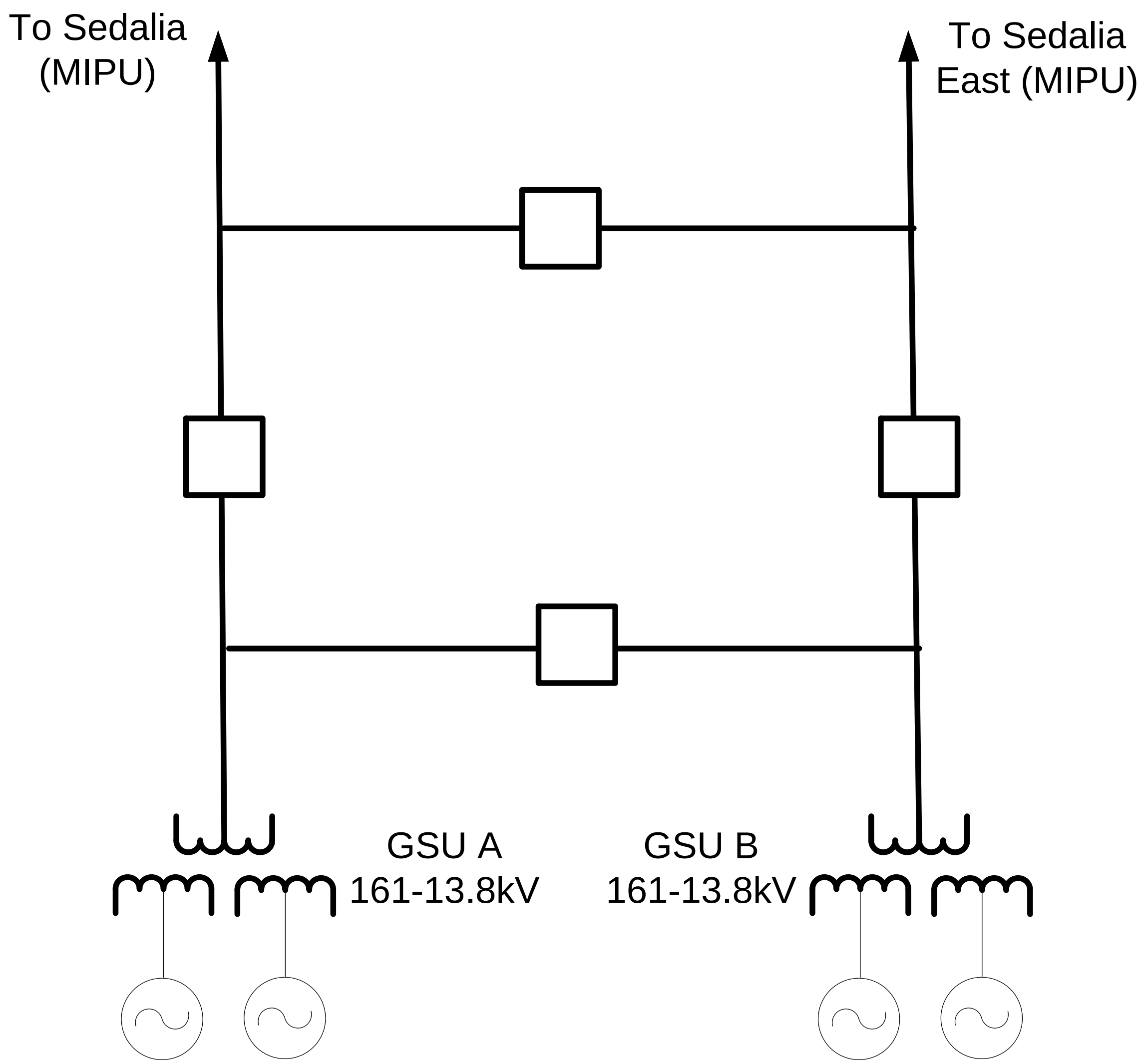

Figure 1-3: Proposed 308 MW GE Units interconnection

2 STABILITY ANALYSIS

In this stability study, ABB investigated the stability of the system for a series of faults specified by SPP that are in the vicinity of the proposed plant. Three-phase and single-line-to-ground (SLG) faults with re-closing in the vicinity of the proposed project were considered.

2.1 Stability Analysis Methodology

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

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

Stability analysis was performed using Siemens-PTI's PSS/E^{TM} dynamics program V30.2.1. Three-phase and single-phase line faults were simulated for the specified durations, including re-closing, and the synchronous machine rotor angles were monitored to make sure they maintained synchronism following the fault removal.

Single-phase line faults were simulated with the standard method of applying fault impedance to the positive sequence network 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 fault location of approximately 60% of pre-fault voltage, which is a typical value.

2.2 Study Model Development

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

2.2.1 Power Flow Cases

This study started with two (2) pre-project PSS/E power flow cases called "*gen-2007-018_08wp.sav*" representing the 2008 Winter Peak conditions and the "*gen-2007-018_12sp.sav*" representing the 2012 Summer Peak conditions. These cases were provided by SPP.

2008 Winter Peak Conditions

The proposed GEN-2007-018 project with Siemens units is comprised of 3 Siemens 105MW gas turbine generators. The proposed project was added to the pre-project 2008 winter peak cases and the generation was dispatched by scaling down the total generation at areas 520, 524, 525, 540, 536, 541, 544 by 315MW. Table 2-1 summarizes the dispatch. The post-project power flow case with Siemens units was then developed:

- G07-018_08wp_SMS.sav – a 2008 winter peak case with Siemens units

The proposed GEN-2007-018 project with GE units is comprised of 4 GE 77MW gas turbine generators. The proposed project was added to the pre-project 2008 winter peak cases and the generation was dispatched by scaling down the total generation at areas 520, 524, 525, 540, 536, 541, 544 by 308 MW. Table 2-1 summarizes the dispatch. The post-project power flow case with GE units was then developed:

- G07-018_08wp_GE.sav – a 2008 winter peak case with GE units

Table 2-1: GEN-2007-018 project details for 2008 winter peak

System condition	Units	MW	Location	Point of Interconnection	Sink
2008 Winter Peak	Siemens	315	Pettis County, Missouri	New Substation at half-way between Sedalia (#541209) and Sedalia East (#541241)	Areas 520, 524, 525, 540, 536, 541, 544
	GE	308			

Figure 2-1 and Figure 2-2 show the PSS/E one-line diagrams for the local area with the GEN-2007-018 project for 2008 Winter Peak for Siemens units and GE units respectively.

2012 Summer Peak Conditions

As in 2008 winter peak conditions, the post-project power flow cases with Siemens units and GE units was developed respectively:

- G07-018_12sp_SMS.sav – a 2012 summer peak case with Siemens units
- G07-018_12sp_GE.sav – a 2012 summer peak case with GE units

Table 2-2: GEN-2007-018 project details for 2012 summer peak

System condition	Units	MW	Location	Point of Interconnection	Sink
2012 Summer Peak	Siemens	315	Pettis County, Missouri	New Substation at half-way between Sedalia (#541209) and Sedalia East (#541241)	Areas 520, 524, 525, 540, 536, 541, 544
	GE	308			

Figure 2-3 and Figure 2-4 show the PSS/E one-line diagrams for the local area with the GEN-2007-018 project for 2012 Summer Peak for Siemens units and GE units respectively.

2.2.2 Stability Database

SPP provided PSS/E IDEV response files to develop pre-project stability databases for this study; one for 2008 and one for 2012. The pre-project stability database snapshot files are named "*gen-2007-018_08wp.snp*" for the 2008 Winter Peak configuration and "*gen-2007-018_12sp.snp*" for the 2012 Summer Peak configuration.

2008 Winter Peak Conditions

The stability data for GEN-2007-018 was appended to the pre-project 2008 winter peak data to develop the two post-project snapshots:

- G07-018_08wp_SMS.snp: snapshot file for GEN-2007-018 with Siemens units
- G07-018_08wp_GE.snp: snapshot file for GEN-2007-018 with GE units

The PSS/E power flow and stability model data for 2008 winter peak conditions for GEN-2007-018 with Siemens units and GE units are included in Appendix B.

2012 Summer Peak Conditions

Similar to the 2008 winter peak conditions, the stability data for GEN-2007-018 was appended to the pre-project 2012 summer peak data to develop the two post-project snapshots:

- G07-018_12sp_SMS.snp: snapshot file for GEN-2007-018 with Siemens units
- G07-018_12sp_GE.snp: snapshot file for GEN-2007-018 with GE units

The PSS/E power flow and stability model data for 2012 summer peak conditions for GEN-2007-018 with Siemens units and GE units are included in **Error! Reference source not found.**.

Table 2-3 lists the faults simulated for stability analysis.

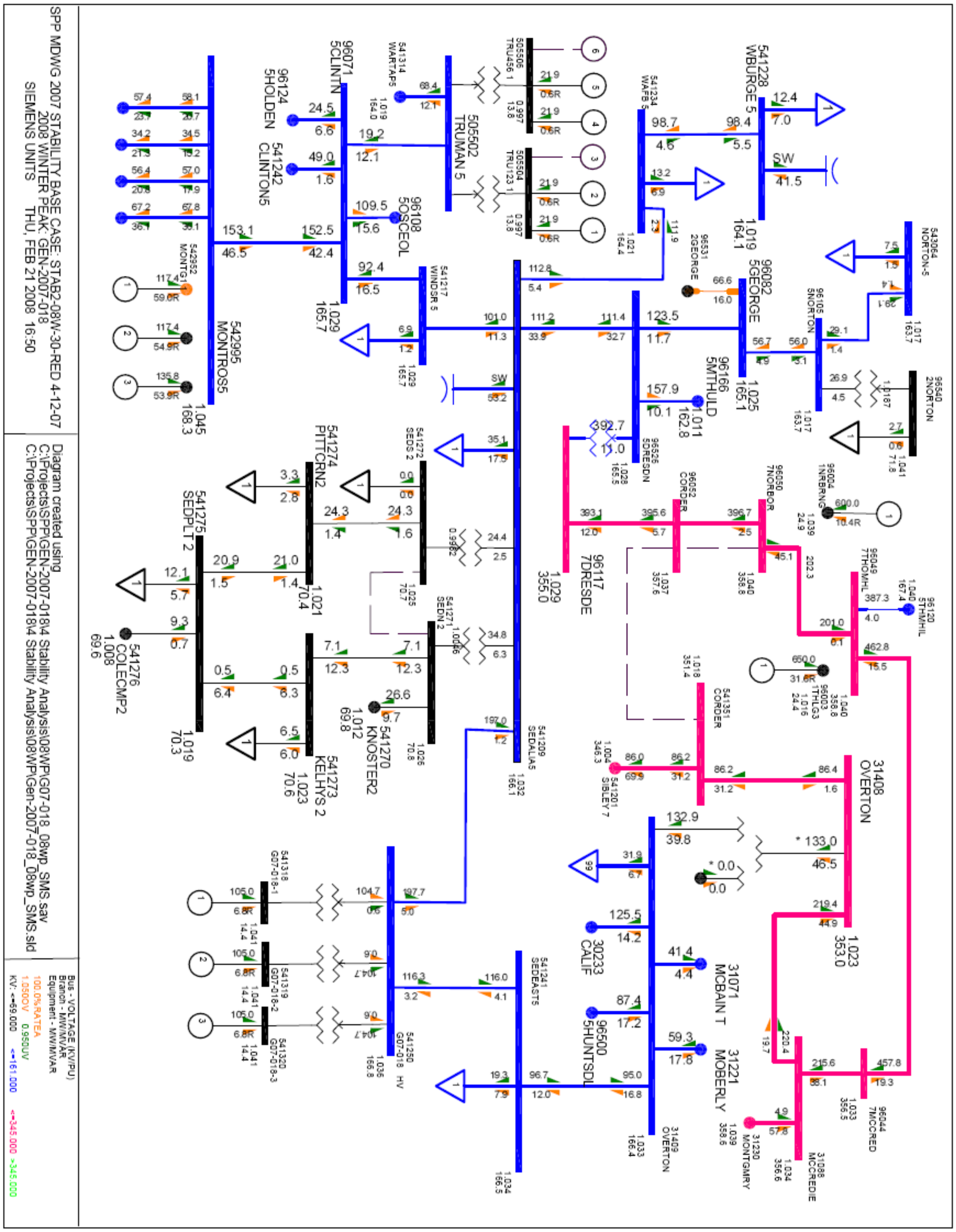

Figure 2-1: 2008 Winter Peak Flows and Voltages with GEN-2007-018 (Siemens)

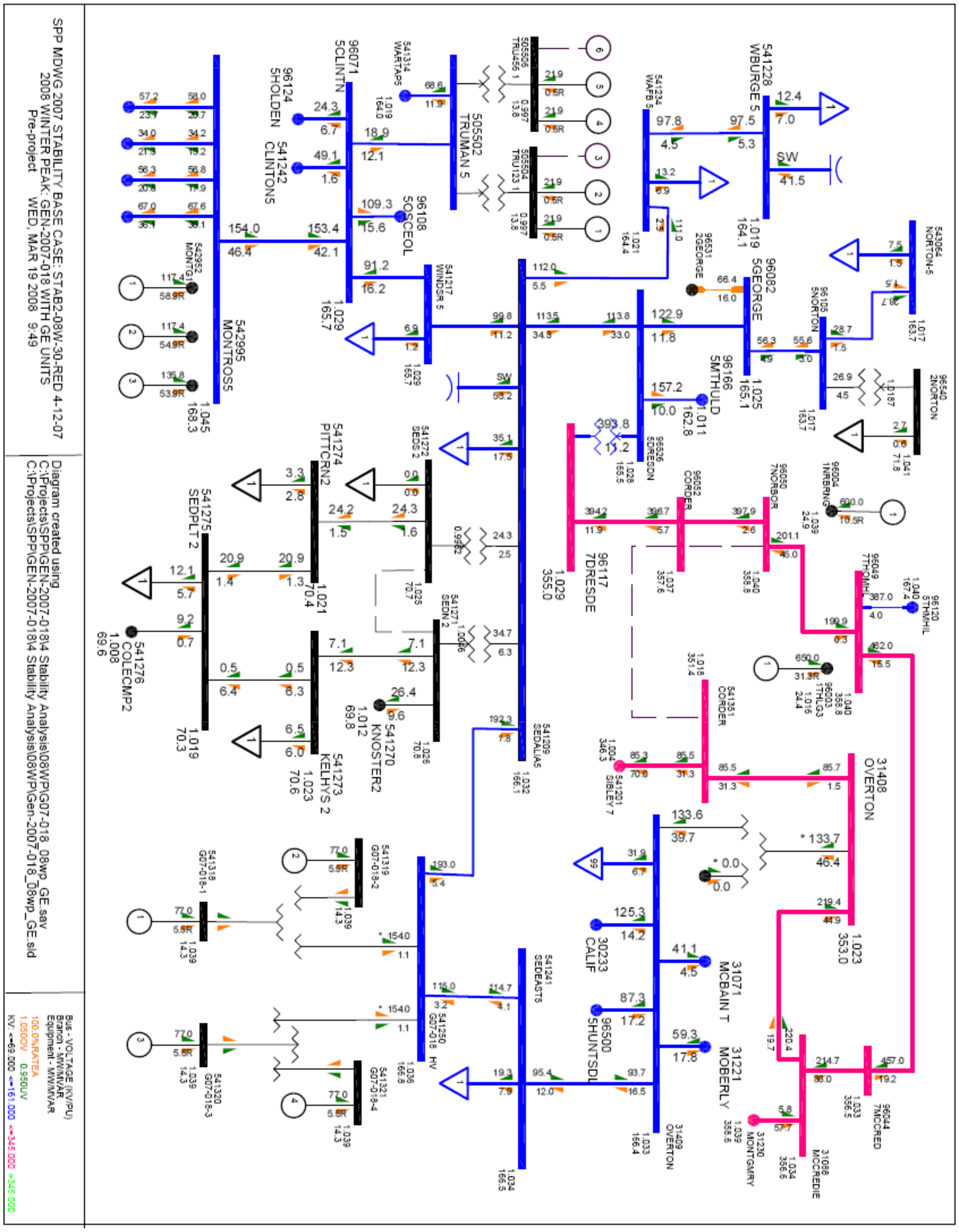

Figure 2-2: 2008 Winter Peak Flows and Voltages with GEN-2007-018 (GE)

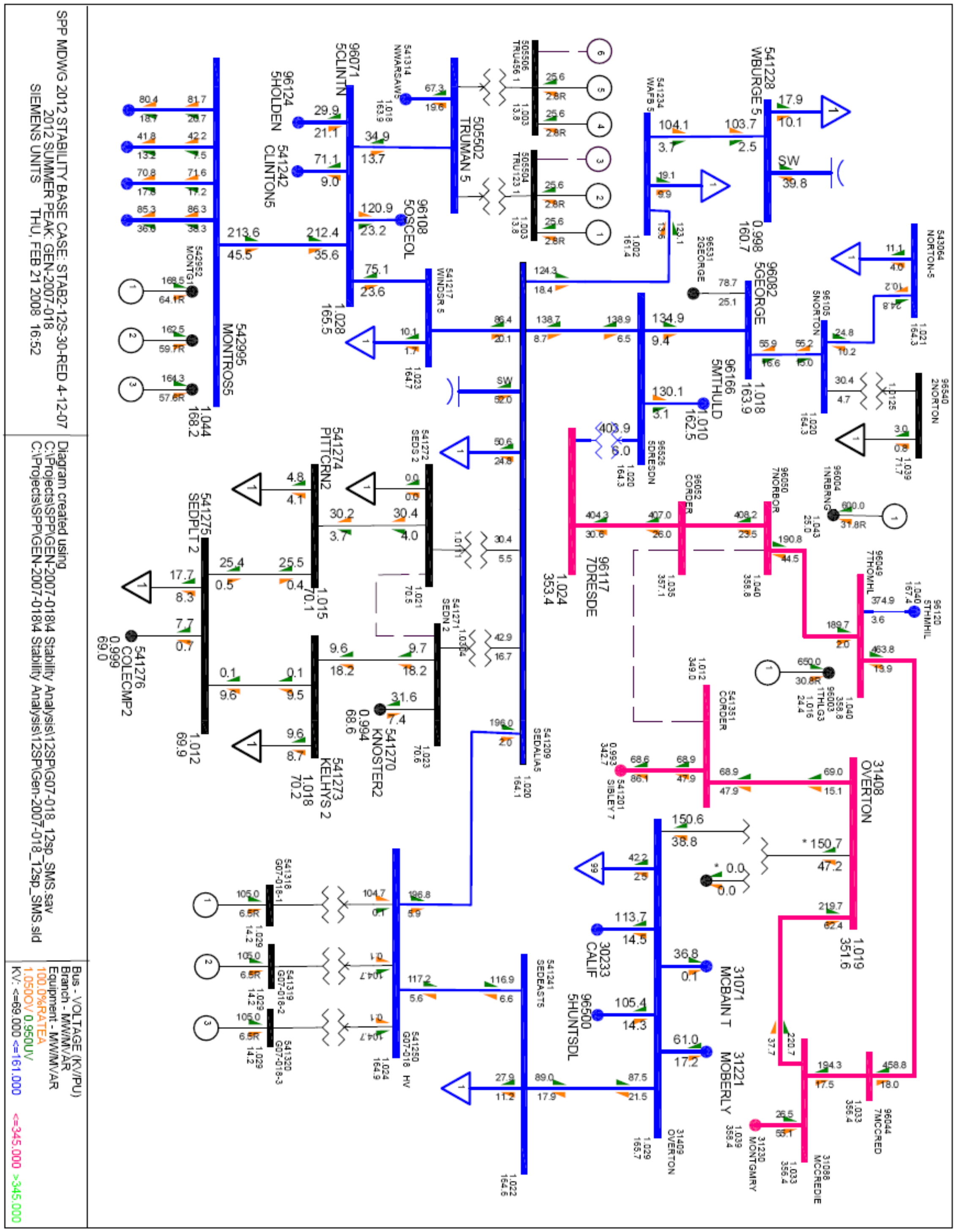

Figure 2-3: 2012 Summer Peak Flows and Voltages with GEN-2007-018(Siemens)

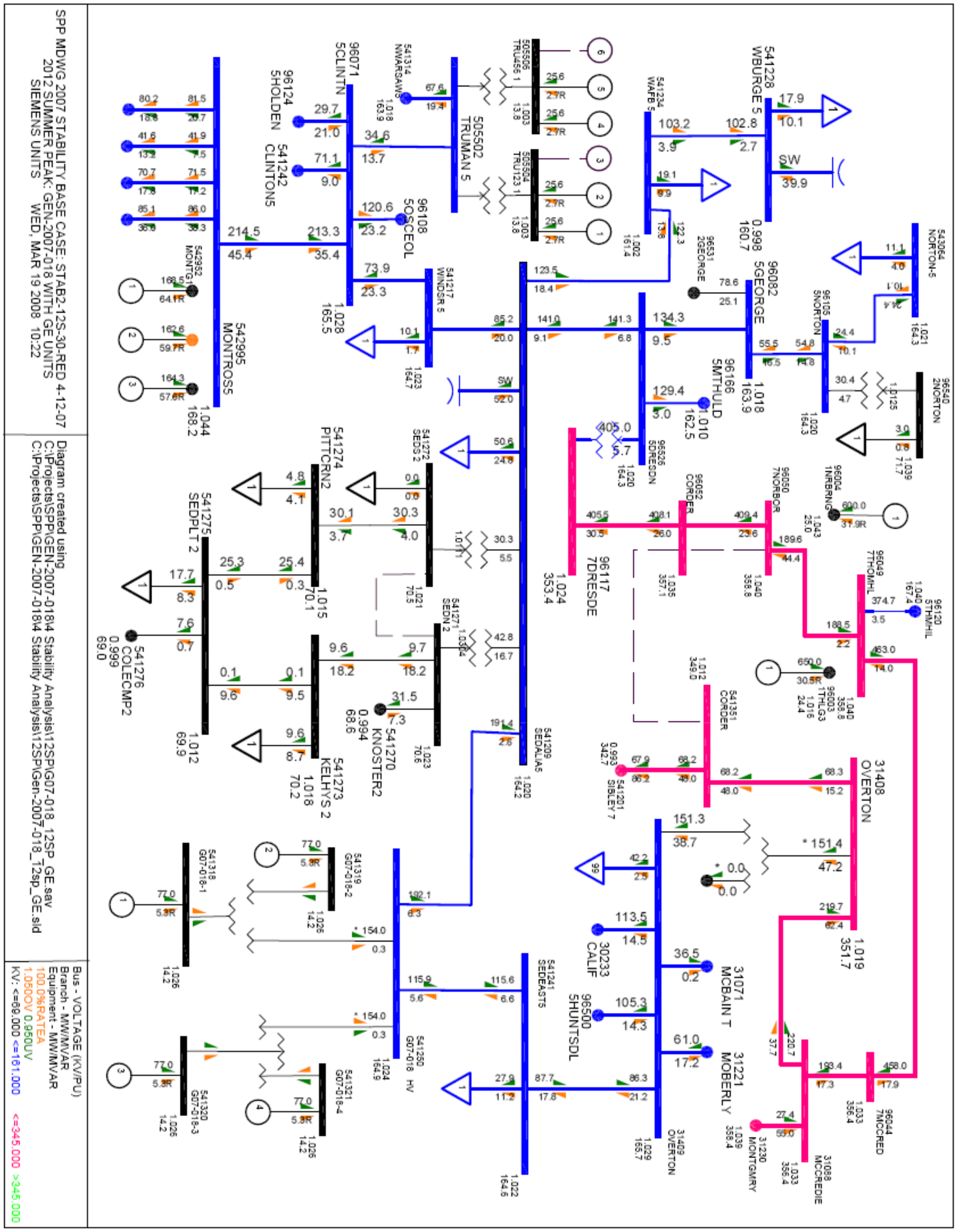

Figure 2-4: 2012 Summer Peak Flows and Voltages with GEN-2007-018(GE)

Table 2-3 List of Faults for Stability Analysis

No.	***Fault Name***	***Description***
1	FLT_1_3PH	3 phase fault at the Generation Facility (541250) to Sedalia (541209) 161kV line, near the Generation Facility. a. Apply fault at the Generation Facility b. Clear fault after 5 cycles by tripping the line from the Generation Facility to Sedalia. 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.
2	FLT_2_1PH	Single phase fault and sequence like Cont. No. 1
3	FLT_3_3PH	3 phase fault at the Generation Facility (541250) to Sedalia East (541241) 161kV line, near the Generation Facility. a. Apply fault at the Generation Facility b. Clear fault after 5 cycles by tripping the line from the Generation Facility to Sedalia East. 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.
4	FLT_4_1PH	Single phase fault and sequence like Cont. No. 3
5	FLT_5_3PH	3 phase fault on the Dresden (96526) to Georgetown (96082) 161kV line, near the Georgetown. a. Apply fault at Georgetown b. Clear fault after 5 cycles by tripping the line from Dresden to Georgetown. 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	FLT_6_1PH	Single phase fault and sequence like Cont. No. 5
7	FLT_7_3PH	3 phase fault on the Sedalia (541209) to Windsor (541217) 161kV line, near Sedalia. a. Apply fault at Sedalia b. Clear fault after 5 cycles by tripping the line from Windsor to Sedalia. 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	FLT_8_1PH	Single phase fault and sequence like Cont. No. 7
9	FLT_9_3PH	3 phase fault on the Sedalia (541209) to WAFB (541234) 161kV line, near Sedalia. a. Apply fault at Sedalia b. Clear fault after 5 cycles by tripping the line from WAFB to Sedalia. 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	FLT_10_1PH	Single phase fault and sequence like Cont. No.9
11	FLT_11_3PH	3 phase fault on the AECI PQ (96050) to Thomas Hill (96049) 345kV line, near AECI PQ. a. Apply fault at AECI PQ b. Clear fault after 5 cycles by tripping the line from AECI PQ to Thomas Hill. 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	FLT_12_1PH	Single phase fault and sequence like Cont. No.119
13	FLT_13_3PH	3 phase fault on the McCredie (96044) to Thomas Hill (96049) 345kV line, near Thomas Hill. a. Apply fault at Thomas Hill b. Clear fault after 5 cycles by tripping the line from McCredie to Thomas Hill. 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.

No.	***Fault Name***	***Description***
14	FLT_14_1PH	Single phase fault and sequence like Cont. No.13
15	FLT_15_3PH	3 phase fault on the Georgetown (96082) to Norton (96105) 161kV line, near Georgetown. a. Apply fault at Georgetown b. Clear fault after 5 cycles by tripping the line from Georgetown to Norton. 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	FLT_16_1PH	Single phase fault and sequence like Cont. No.15
Sensitivity case 1		For the following contingencies - Close branch between #96052 and #541351, circuit #1. Close branch between #96052 and #96050, circuit #2.
17	FLT_17_3PH	*Repeat contingency #1*
18	FLT_18_3PH	*Repeat contingency #3*
19	FLT_19_3PH	*Repeat contingency #5*
20	FLT_20_3PH	*Repeat contingency #7*
21	FLT_21_3PH	*Repeat contingency #9*
22	FLT_22_3PH	*Repeat contingency #11*
23	FLT_23_3PH	*Repeat contingency #13*
24	FLT_24_3PH	*Repeat contingency #15*
Sensitivity case 2		For the following contingencies - Disconnect bus #96050, #96052, and #96117. Disconnect branch from 96526-96166. Turn off unit #96004. Dispatch per SPP. (see notes below).
25	FLT_25_3PH	*Repeat contingency #1*
26	FLT_26_1PH	*Repeat contingency #2*
27	FLT_27_3PH	*Repeat contingency #3*
28	FLT_28_1PH	*Repeat contingency #4*
29	FLT_29_3PH	*Repeat contingency #5*
30	FLT_30_1PH	*Repeat contingency #6*
31	FLT_31_3PH	*Repeat contingency #7*
32	FLT_32_1PH	*Repeat contingency #8*
33	FLT_33_3PH	*Repeat contingency #9*
34	FLT_34_1PH	*Repeat contingency #10*
35	FLT_35_3PH	*Repeat contingency #15*
36	FLT_36_1PH	*Repeat contingency #16*
37	FLT_37_3PH	3 phase fault on the Overton (31408) – Corder (541351) 345kV line, near Overton. a. Apply fault at Overton b. Clear fault after 5 cycles by tripping the line from the Overton - Corder. 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.
38	FLT_38_1PH	*Single phase fault and sequence like contingency #FLT_37_3PH*
39	FLT_39_3PH	3 phase fault on the Overton (31408) – McCredie (31088) 345kV line, near Overton. a. Apply fault at Overton b. Clear fault after 5 cycles by tripping the line from the Overton - McCredie. 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.
40	FLT_40_1PH	*Single phase fault and sequence like contingency #FLT_39_3PH*

Notes (new dispatch for faults #25 through #40 per SPP):
(1) 2008 winter peak case: *96010(230 MW), 96011(230 MW), 18137(140 MW)*
(2) 2012 summer peak case: *96002(60 MW), 96019(40 MW), 96011(200 MW), 96012 (100 MW), 96013(100 MW), 96014(100 MW)*

2.3 Study Results

2008 Winter Peak Conditions

The results for the simulated disturbances for 2008 Winter Peak conditions are summarized in Table 2-4. The post-project plots showing the simulation results are included in Appendix 0 for Siemens units and Appendix C.2 for GE units.

In general, all generators remained on-line and were stable for the faults that were tested. Also, no wind farms tripped following these faults.

Faults #1 - #16 were simulated with a transmission configuration that included the addition of a 600 MW base load coal plant in the AECI control area. The configuration included a transmission interconnection from AECI to KCPL on the Overton-Sibley 345kV line. For simulating faults #17 through #24, this interconnection was removed. Three sensitivity cases were developed:

- Sensitivity case #08WP1A: Pre-project power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #08WP1B: Siemens units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #08WP1C: GE units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
    - 96052 CORDER 345kV – 541351 CORDER 345kV, circuit #1.
    - 96052 CORDER 345kV – 96050 7NORBOR 345kV, circuit #2.

For faults #17 through #24, all generators were stable and there were no stability problems.

For simulating faults #25 through #40, the entire 600 MW coal plant in the AECI control and all of its associated transmission was removed. Three additional sensitivity cases were developed:

- Sensitivity case #08WP2A: Pre-project power flow case discussed in section 2.2 + the following transmission and generation changes as requested by SPP.
- Sensitivity case #08WP2B: Siemens units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #08WP2C: GE units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
    - Disconnect buses #96050 7NORBOR 345kV, #96052 CORDER 345kV, and #96117 7DRESDE 345kV
    - Disconnect branch from #96526 5DRESDN 161kV to #96166 5MTHULD 161kV
    - Turn off unit #96004 (600 MW)
    - Turn on units #96010(230 MW) and #96011(230 MW)
    - Scale up the generation of swing bus #18137 by 140 MW

For faults #25 through #40, all generators were stable and there were no stability problems.

Table 2-4: Results of Stability Simulations for 2008 Winter Peak

	2008 Winter Peak	
FAULT	Siemens Units	GE Units
FLT_1_3PH	STABLE	STABLE
FLT_2_1PH	STABLE	STABLE
FLT_3_3PH	STABLE	STABLE
FLT_4_1PH	STABLE	STABLE
FLT_5_3PH	STABLE	STABLE
FLT_6_1PH	STABLE	STABLE
FLT_7_3PH	STABLE	STABLE
FLT_8_1PH	STABLE	STABLE
FLT_9_3PH	STABLE	STABLE
FLT_10_1PH	STABLE	STABLE
FLT_11_3PH	STABLE	STABLE
FLT_12_1PH	STABLE	STABLE
FLT_13_3PH	STABLE	STABLE
FLT_14_1PH	STABLE	STABLE
FLT_15_3PH	STABLE	STABLE
FLT_16_1PH	STABLE	STABLE
FLT_17_3PH	STABLE	STABLE
FLT_18_3PH	STABLE	STABLE
FLT_19_3PH	STABLE	STABLE
FLT_20_3PH	STABLE	STABLE
FLT_21_3PH	STABLE	STABLE
FLT_22_3PH	STABLE	STABLE
FLT_23_3PH	STABLE	STABLE
FLT_24_3PH	STABLE	STABLE
FLT_25_3PH	STABLE	STABLE
FLT_26_1PH	STABLE	STABLE
FLT_27_3PH	STABLE	STABLE
FLT_28_1PH	STABLE	STABLE
FLT_29_3PH	STABLE	STABLE
FLT_30_1PH	STABLE	STABLE
FLT_31_3PH	STABLE	STABLE
FLT_32_1PH	STABLE	STABLE
FLT_33_3PH	STABLE	STABLE
FLT_34_1PH	STABLE	STABLE
FLT_35_3PH	STABLE	STABLE
FLT_36_1PH	STABLE	STABLE
FLT_37_3PH	STABLE	STABLE
FLT_38_1PH	STABLE	STABLE
FLT_39_3PH	STABLE	STABLE
FLT_40_1PH	STABLE	STABLE

2012 Summer Peak Conditions

For 2012 summer peak conditions, floating point problems were encountered and PSS/E crashed for some faults. Investigation showed that it was caused by exciter model "EX2000" at Generator #30061 (this generation was offline in the 2008 winter peak conditions). SPP found that this problem exists in the NERC dynamic models that SPP uses to build the SPP dynamic models. It was decided to turn this model off. The following results were obtained with exciter model "EX2000" at bus 30061 turned off.

The results for the simulated disturbances for 2012 Summer Peak conditions are summarized in Table 2-5. The post-project plots showing the simulation results are included in Appendix D.1 for Siemens units and Appendix D.2 for GE units.

In general, all generators remained on-line and were stable for the faults that were tested. Also, no wind farms tripped following these faults.

Faults #1 - #16 were simulated with a transmission configuration that included the addition of a 600 MW base load coal plant in the AECI control area. The configuration included a transmission interconnection from AECI to KCPL on the Overton-Sibley 345kV line. For simulating faults #17 through #24, this interconnection was removed. Three sensitivity cases were developed:

- Sensitivity case #12SP1A: Pre-project power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #12SP1B: Siemens units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #12SP1C: GE units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
  - 96052 CORDER 345kV – 541351 CORDER 161kV, circuit #1.
  - 96052 CORDER 345kV – 96050 7NORBOR 345kV, circuit #2.

For faults #17 through #24, all generators were stable and there were no stability problems.

For simulating faults #25 through #40, the entire 600 MW coal plant in the AECI control and all of its associated transmission was removed. Three additional sensitivity cases were developed:

- Sensitivity case #12SP2A: Pre-project power flow case discussed in section 2.2 + the following transmission and generation changes as requested by SPP.
- Sensitivity case #12SP2B: Siemens units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
- Sensitivity case #12SP2C: GE units power flow case discussed in section 2.2 + the following transmission changes as requested by SPP.
  - Disconnect buses #96050 7NORBOR 345kV, #96052 CORDER 345kV, and #96117 7DRESDE 345kV
  - Disconnect branch from #96526 5DRESDN 161kV to #96166 5MTHULD 161kV
  - Turn off unit #96004 (600 MW)
  - Turn on units #96010(230 MW) and #96011(230 MW)

- Scale up the generation of swing bus #18137 by 140 MW

For faults #25 through #40, all generators were stable and there were no stability problems.

Table 2-5: Results of Stability Simulations for 2012 Summer Peak

	2012 Summer Peak	
FAULT	Siemens Units	GE Units
FLT_1_3PH	STABLE	STABLE
FLT_2_1PH	STABLE	STABLE
FLT_3_3PH	STABLE	STABLE
FLT_4_1PH	STABLE	STABLE
FLT_5_3PH	STABLE	STABLE
FLT_6_1PH	STABLE	STABLE
FLT_7_3PH	STABLE	STABLE
FLT_8_1PH	STABLE	STABLE
FLT_9_3PH	STABLE	STABLE
FLT_10_1PH	STABLE	STABLE
FLT_11_3PH	STABLE	STABLE
FLT_12_1PH	STABLE	STABLE
FLT_13_3PH	STABLE	STABLE
FLT_14_1PH	STABLE	STABLE
FLT_15_3PH	STABLE	STABLE
FLT_16_1PH	STABLE	STABLE
FLT_17_3PH	STABLE	STABLE
FLT_18_3PH	STABLE	STABLE
FLT_19_3PH	STABLE	STABLE
FLT_20_3PH	STABLE	STABLE
FLT_21_3PH	STABLE	STABLE
FLT_22_3PH	STABLE	STABLE
FLT_23_3PH	STABLE	STABLE
FLT_24_3PH	STABLE	STABLE
FLT_25_3PH	STABLE	STABLE
FLT_26_1PH	STABLE	STABLE
FLT_27_3PH	STABLE	STABLE
FLT_28_1PH	STABLE	STABLE
FLT_29_3PH	STABLE	STABLE
FLT_30_1PH	STABLE	STABLE
FLT_31_3PH	STABLE	STABLE
FLT_32_1PH	STABLE	STABLE
FLT_33_3PH	STABLE	STABLE
FLT_34_1PH	STABLE	STABLE
FLT_35_3PH	STABLE	STABLE
FLT_36_1PH	STABLE	STABLE
FLT_37_3PH	STABLE	STABLE
FLT_38_1PH	STABLE	STABLE
FLT_39_3PH	STABLE	STABLE
FLT_40_1PH	STABLE	STABLE

3 CONCLUSIONS

The objective of this study is to evaluate the impact of the proposed GEN-2007-018 gas fired combustion turbine power plant on the stability of SPP system.

Based on the available information, the generation developer is considering one of the following two alternatives for the turbine-generator installation at the plant:

- Three (3) Siemens units: each is rated 130 MVA with output 105 MW
- Four (4) GE units: each is rated 114 MVA with output 77 MW

The plant has a total output of 315 MW with Siemens alternatives and 308 MW with GE alternatives. SPP has requested that stability studies be conducted for both alternatives.

The study is performed for two system scenarios: the 2008 Winter Peak and the 2012 Summer Peak.

Based on the results of stability analysis it can be concluded that the proposed GEN-2007-018 project with either Siemens units or GE units does not adversely impact the stability of the SPP system.

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

Appendix A Study Scope

SCOPE OF INTERCONNECTION IMPACT STUDY
FOR
<Omitted Text>
(GEN-2007-018)
To be performed by: ABB

Introduction

<Omitted Text> has a requested a generator interconnection study through the Southwest Power Pool Tariff for a 161 kV interconnection for a 315 MW gas fired combustion turbine power plant in Pettis County, Missouri. This generation will be interconnected near at a new 161kV substation on the Sedalia – Sedalia East 161kV transmission line. This line is owned by Missouri Public Service (MIPU). The customer has asked for a study case of 100% MW output. The Customer has submitted two different machine manufacturers to be evaluated. Runs shall also be made to determine maximum MW with no upgrades.

SPP will be the primary contact for this study.

We would appreciate a quote as soon as possible on the following work efforts:

Study Assumptions

1. Interconnection will be at a new station on the Sedalia – Sedalia East 161kV transmission line (bus # to given at time of study. The SPP footprint will be displaced.
2. Plant to consist of three (3) 105 MW combustion turbines. Customer wishes to study two different manufacturers of machines. Consultant to make two runs for each manufacturer.

Study Timeline

1. All needed data provided to consultant by January 2, 2007
2. Study report completed and draft issued to SPP by February 6, 2008

Study Contents

1. Perform a stability analysis for the proposed combustion turbines. (FOLLOWING NOT APPLICABLE to combustion turbines) The wind farm model will be based on the level of detail per the Customer data. The consultant shall add to the wind farm model capacitance to begin each turbine modeling based on a unity power factor. This amount of capacitance shall be included in the report. The preference is to locate the capacitance banks on the 34.5 kV Customer side. Based on the capacitance required will determine the number of breakers required for the capacitance banks due to switching maximums. During the study if voltage collapse is encountered a STATCOM or SVC system may need to be considered. The consultant shall size the system. Keep in mind that additional capacitor banks may be required on the 138 kV side. The addition of equipment on the 138 kV side shall be kept to a minimum since it escalates the cost implications.

2. The faults would be defined as single line to ground, and three phase faults. The fault clearing will be 3-phase tripping with re-closing. The necessary timing information is listed below.

3. SPP will provide two (2) of the latest SPP stability database cases in version 30.2.1, which has been screened and run. SPP will include the modeling data for the previously queued projects to be included by the consultant.

4. There should not be any special modeling required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

5. Monitor area 540, 541, 542, 544, 546, 130, 356.

6. The report will need to be sufficiently comprehensive to demonstrate to the Customer either the presence or absence of stability problems. The report should contain the assumptions, observations, conclusions, and data plots. The report should also contain the maximum generation levels at which no stability problems are present. At this time, it is not necessary to investigate more generation levels than the maximum requested and the maximum with no problems present.

7. For contingencies that result in a prior queued project tripping off-line; the contingency shall be re-run with the prior queued project's voltage and frequency tripping disabled.

8. The cases will contain several prior queued projects in the base case. These projects should be monitored and their generating status shall be reported for each contingency. The projects are as follows;
   a. 600 MW coal plant in AECI queue
   b. 1500 MW nuclear plant in MISO queue

ATC Studies

ATC studies will not be performed at this time. These studies will be required at the time transmission service is requested. Additional transmission facilities may be required based on this analysis.

Fault Definitions

For each powerflow case, the following contingencies should be run.

Cont. No.	*Cont. Name*	*Description*
1	*FLT13PH*	3 phase fault at the Generation Facility (xxxxxx) to Sedalia (541209) 161kV line, near the Generation Facility. a. Apply fault at the Generation Facility b. Clear fault after 5 cycles by tripping the line from the Generation Facility to Sedalia. 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.
2	FLT21PH	*Single phase fault and sequence like Cont. No. 1*
3	*FLT33PH*	3 phase fault at the Generation Facility (xxxxxx) to Sedalia East (541241) 161kV line, near the Generation Facility. a. Apply fault at the Generation Facility b. Clear fault after 5 cycles by tripping the line from the Generation Facility to Sedalia East. 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.
4	FLT41PH	*Single phase fault and sequence like Cont. No. 3*
5	*FLT53PH*	3 phase fault on the Dresden (96526) to Georgetown (96082) 161kV line, near the Georgetown. a. Apply fault at Georgetown b. Clear fault after 5 cycles by tripping the line from Dresden to Georgetown. c. Wait 20 cycles, and then re-close the line in (b) back into the fault.

Cont. No.	Cont. Name	Description
		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 Sedalia (541209) to Windsor (54121) 161kV line, near Sedalia. a. Apply fault at Sedalia b. Clear fault after 5 cycles by tripping the line from Windsor to Sedalia. 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 Sedalia (541209) to WAFB (541234) 161kV line, near Sedalia. a. Apply fault at Sedalia b. Clear fault after 5 cycles by tripping the line from WAFB to Sedalia. 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 AECI PQ (96050) to Thomas Hill (96049) 345kV line, near AECI PQ. a. Apply fault at AECI PQ b. Clear fault after 5 cycles by tripping the line from AECI PQ to Thomas Hill. 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.119*
13	FLT133PH	3 phase fault on the McCredie (96044) to Thomas Hill (96049) 345kV line, near Thomas Hill. a. Apply fault at Thomas Hill b. Clear fault after 5 cycles by tripping the line from McCredie to Thomas Hill. 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.
14	FLT141PH	*Single phase fault and sequence like Cont. No.13*
15	FLT153PH	3 phase fault on the Georgetown (96082) to Norton (96105) 161kV line, near Georgetown. a. Apply fault at Georgetown b. Clear fault after 5 cycles by tripping the line from Georgetown to Norton. 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*
		For the following contingencies - Close branch between #96052 and #541351, circuit #1. Close branch between #96052 and #96050, circuit #2.
17	FLT173PH	*Repeat contingency #1*
18	FLT183PH	*Repeat contingency #3*
19	FLT193PH	*Repeat contingency #5*
20	FLT2013H	*Repeat contingency #7*
21	FLT213PH	*Repeat contingency #9*
22	FLT223PH	*Repeat contingency #11*
23	FLT233PH	*Repeat contingency #13*
24	FLT243PH	*Repeat contingency #15*
		For the following contingencies - Disconnect bus #96050, #96052, and #96117. Disconnect branch from 96526-96166. Turn off unit #96004. dispatch per SPP.
25	FLT253PH	*Repeat contingency #1*
26	FLT261PH	*Repeat contingency #2*
27	FLT273PH	*Repeat contingency #3*
28	FLT281PH	*Repeat contingency #4*
29	FLT293PH	*Repeat contingency #5*
30	FLT301PH	*Repeat contingency #6*
31	FLT313PH	*Repeat contingency #7*
32	FLT321PH	*Repeat contingency #8*

Cont. No.	Cont. Name	Description
33	FLT333PH	*Repeat contingency #9*
34	FLT341PH	*Repeat contingency #10*
35	FLT353PH	*Repeat contingency #15*
36	FLT361PH	*Repeat contingency #16*
37	FLT373PH	3 phase fault on the Overton (31408) – Corder (541351) 345kV line, near Overton. a. Apply fault at Overton b. Clear fault after 5 cycles by tripping the line from the Overton - Corder. 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.
38	FLT381PH	*Single phase fault and sequence like contingency #FLT373PH*
39	FLT393PH	3 phase fault on the Overton (31408) – McCredie (31088) 345kV line, near Overton. a. Apply fault at Overton b. Clear fault after 5 cycles by tripping the line from the Overton - McCredie. 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.
40	FLT401PH	*Single phase fault and sequence like contingency #FLT393PH*

Before starting the listed faults run a fault on the Plant 161kV bus to verify the model is working correctly. Other faults may be needed based on observed results from these cases. If problems are discovered, an additional base case may need to be created to test solutions to the problem. For example, if a problem is found at full plant output, then that fault will need to be re-run at a lower plant output to determine the stability limit. Sometimes a dynamic capacitance system may be required to solve voltage collapse. This will have to be reviewed as we go.

FERC Order 661A Compliance – The wind farm shall comply with the latest FERC order on low voltage ride through for wind farms. Therefore, the wind farm should not trip off line for faults FLT13PH and FLT33PH for under voltage relay actuation. If the wind farm is seen to trip off line, an appropriate sized SVC or STATCOM device shall be specified to keep the wind farm on-line for the fault. It may occur that no SVC or STATCOM device is required. If the wind farm trips off line for any of the other contingencies, SPP should be consulted to determine if the addition of an SVC or STATCOM is warranted (i.e. may not be warranted for stuck breaker condition).

Stability Data

The low bidder will receive the stability data on the combustion turbines. SPP will provide what information <Omitted Text> has provided and the consultant will have to determine if there is sufficient data to proceed to build an accurate equivalent plant stability model. If the data seems incomplete the consultant may need to contact the manufacturer directly to build the most accurate model for the particular turbine.

Appendix B Load Flow and Stability Data for GEN-2007-018

B.1 Power Flow Data for Siemens units

```
541250,'G07-018   HV', 161.0000,1,     0.000,     0.000, 540,1670,1.03600, -13.7175,   1
541318,'G07-018-1   ',  13.8000,2,     0.000,     0.000, 540,1670,1.04559,  -8.6273,   1
541319,'G07-018-2   ',  13.8000,2,     0.000,     0.000, 540,1670,1.04559,  -8.6273,   1
541320,'G07-018-3   ',  13.8000,2,     0.000,     0.000, 540,1670,1.04559,  -8.6273,   1
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
541318,'1 ',   105.000,     9.955,    56.670,   -56.670,1.03600,541250,   130.000,
0.00300,   0.15500,   0.00000,   0.00000,1.00000,1,  100.0,   105.000,     0.000,
1,1.0000
541319,'2 ',   105.000,     9.955,    56.670,   -56.670,1.03600,541250,   130.000,
0.00300,   0.15500,   0.00000,   0.00000,1.00000,1,  100.0,   105.000,     0.000,
1,1.0000
541320,'3 ',   105.000,     9.955,    56.670,   -56.670,1.03600,541250,   130.000,
0.00300,   0.15500,   0.00000,   0.00000,1.00000,1,  100.0,   105.000,     0.000,
1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
541209, 541250,'1 ',   0.00206,   0.01220,   0.00602,  312.00,  324.00,    0.00,
0.00000,  0.00000,  0.00000,  0.00000,1,   4.15,   1,0.5000,   1,0.5000
541241,-541250,'1 ',   0.00206,   0.01220,   0.00602,  312.00,  324.00,    0.00,
0.00000,  0.00000,  0.00000,  0.00000,1,   4.15,   1,0.5000,   1,0.5000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
541250,541318,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
   0.00490,   0.09200,   100.00
1.00000,   0.000,   0.000,   150.00,   150.00,   150.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
541250,541319,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
   0.00490,   0.09200,   100.00
1.00000,   0.000,   0.000,   150.00,   150.00,   150.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
541250,541320,     0,'1 ',1,2,1,   0.00000,   0.00000,2,'            ',1,   1,1.0000
   0.00490,   0.09200,   100.00
1.00000,   0.000,   0.000,   150.00,   150.00,   150.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VSC DC LINE DATA
0 / END OF VSC DC LINE DATA, BEGIN SWITCHED SHUNT DATA
0 / END OF SWITCHED SHUNT DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

B.2 **Dynamics Data for Siemens units**

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:56
SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
2008 WINTER PEAK: GEN-2007-018

PLANT MODELS
REPORT FOR ALL MODELS                    BUS 541318 [G07-018-1   13.800] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541318 G07-018-1    13.800 1  104721-104734  40977-40982

            MBASE     Z S O R C E         X T R A N       GENTAP
            130.0  0.00300+J 0.15500  0.00000+J 0.00000  1.00000

 T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 8.66 0.042  1.00 0.087   5.92  0.00 1.8300 1.7400 0.1960 0.3970 0.1550 0.0920

                                 S(1.0)  S(1.2)
                                 0.1830  0.8560


** EXAC1 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541318 G07-018-1    13.800 1  104763-104779  40995-40999

         TR       TB       TC       KA       TA    VRMAX   VRMIN     TE
       0.000    0.000    0.000    400.0    0.020  12.400 -11.200   0.420

     KF       TF       KC       KD       KE      E1     S(E1)     E2     S(E2)
   0.030    1.000    0.530    2.060    1.000  3.6000  0.0600  4.8000  0.2200


** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
           541318 G07-018-1    13.800 1  104814-104822  41010-41012    9978

      R       T1      T2       T3    LOAD LIM    KT      VMAX    VMIN     DT
    0.040   0.590   0.500   2.000    1.000   3.000   1.200   0.200   0.000

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:56
SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
2008 WINTER PEAK: GEN-2007-018

PLANT MODELS

REPORT FOR ALL MODELS                    BUS 541319 [G07-018-2   13.800] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541319 G07-018-2    13.800 2  104735-104748  40983-40988

            MBASE     Z S O R C E         X T R A N       GENTAP
            130.0  0.00300+J 0.15500  0.00000+J 0.00000  1.00000

 T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 8.66 0.042  1.00 0.087   5.92  0.00 1.8300 1.7400 0.1960 0.3970 0.1550 0.0920

                                 S(1.0)  S(1.2)
                                 0.1830  0.8560


** EXAC1 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541319 G07-018-2    13.800 2  104780-104796  41000-41004

         TR       TB       TC       KA       TA    VRMAX   VRMIN     TE
       0.000    0.000    0.000    400.0    0.020  12.400 -11.200   0.420

     KF       TF       KC       KD       KE      E1     S(E1)     E2     S(E2)
   0.030    1.000    0.530    2.060    1.000  3.6000  0.0600  4.8000  0.2200


** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
           541319 G07-018-2    13.800 2  104823-104831  41013-41015    9979

      R       T1      T2       T3    LOAD LIM    KT      VMAX    VMIN     DT
```

```
    0.040  0.590  0.500   2.000   1.000   3.000   1.200   0.200   0.000

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:56
SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
2008 WINTER PEAK: GEN-2007-018

PLANT MODELS

REPORT FOR ALL MODELS                       BUS 541320 [G07-018-3   13.800] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541320 G07-018-3    13.800 3  104749-104762  40989-40994

            MBASE     Z S O R C E         X T R A N       GENTAP
            130.0  0.00300+J 0.15500  0.00000+J 0.00000  1.00000

 T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 8.66 0.042  1.00 0.087   5.92  0.00 1.8300 1.7400 0.1960 0.3970 0.1550 0.0920

                               S(1.0)  S(1.2)
                               0.1830  0.8560


** EXAC1 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541320 G07-018-3    13.800 3  104797-104813  41005-41009

         TR       TB       TC       KA       TA    VRMAX   VRMIN     TE
       0.000    0.000    0.000    400.0    0.020  12.400 -11.200   0.420

     KF       TF       KC       KD       KE       E1      S(E1)     E2     S(E2)
   0.030    1.000    0.530    2.060    1.000   3.6000  0.0600  4.8000  0.2200


** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
           541320 G07-018-3    13.800 3  104832-104840  41016-41018    9980

      R       T1      T2       T3   LOAD LIM   KT     VMAX     VMIN     DT
    0.040  0.590  0.500   2.000   1.000   3.000   1.200   0.200   0.000
```

B.3 **Power Flow Data for GE units**

```
541250,'G07-018   HV', 161.0000,1,     0.000,     0.000, 540,1670,1.03600, -13.8096,   1
541318,'G07-018-1   ',  13.8000,2,     0.000,     0.000, 540,1670,1.03862, -10.1169,   1
541319,'G07-018-2   ',  13.8000,2,     0.000,     0.000, 540,1670,1.03862, -10.1169,   1
541320,'G07-018-3   ',  13.8000,2,     0.000,     0.000, 540,1670,1.03862, -10.1169,   1
541321,'G07-018-4   ',  13.8000,2,     0.000,     0.000, 540,1670,1.03862, -10.1169,   1
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
541318,'1 ',    77.000,     5.502,    26.090,   -36.000,1.03600,541250,   114.000,
0.00400,   0.19000,   0.00000,   0.00000,1.00000,1,  100.0,    77.000,     0.000,
1,1.0000
541319,'2 ',    77.000,     5.502,    26.090,   -36.000,1.03600,541250,   114.000,
0.00400,   0.19000,   0.00000,   0.00000,1.00000,1,  100.0,    77.000,     0.000,
1,1.0000
541320,'3 ',    77.000,     5.502,    26.090,   -36.000,1.03600,541250,   114.000,
0.00400,   0.19000,   0.00000,   0.00000,1.00000,1,  100.0,    77.000,     0.000,
1,1.0000
541321,'4 ',    77.000,     5.502,    26.090,   -36.000,1.03600,541250,   114.000,
0.00400,   0.19000,   0.00000,   0.00000,1.00000,1,  100.0,    77.000,     0.000,
1,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
541209, 541250,'1 ',   0.00206,   0.01220,   0.00602,  312.00,  324.00,    0.00,
0.00000,  0.00000,  0.00000,  0.00000,1,   4.15,   1,0.5000,   1,0.5000
541241,-541250,'1 ',   0.00206,   0.01220,   0.00602,  312.00,  324.00,    0.00,
0.00000,  0.00000,  0.00000,  0.00000,1,   4.15,   1,0.5000,   1,0.5000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
541250,541318,541319,'1 ',1,1,1,   0.00000,   0.00000,2,'G07-018-3WT1',1,   1,1.0000
   0.00000,   0.12000,   100.00,   0.00000,   0.30000,   100.00,   0.00000,   0.12000,
100.00,1.03665, -16.2751
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
541250,541320,541321,'1 ',1,1,1,   0.00000,   0.00000,2,'G07-018-3WT2',1,   1,1.0000
   0.00000,   0.12000,   100.00,   0.00000,   0.30000,   100.00,   0.00000,   0.12000,
100.00,1.03665, -16.2751
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
1.00000,   0.000,   0.000,     0.00,     0.00,     0.00, 0,      0, 1.10000, 0.90000,
1.10000, 0.90000,  33, 0, 0.00000, 0.00000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VSC DC LINE DATA
0 / END OF VSC DC LINE DATA, BEGIN SWITCHED SHUNT DATA
0 / END OF SWITCHED SHUNT DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

B.4 **Dynamics Data for GE units**

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:55
 SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
 2008 WINTER PEAK: • 2007 SOUTHWEST POWER POOL, INC.; RED DYN

 PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 541318 [G07-018-1   13.800] MODELS


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541318 G07-018-1    13.800 1  104721-104734  40977-40982

            MBASE     Z S O R C E         X T R A N       GENTAP
            114.0  0.00400+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
  7.20 0.036  0.60 0.069   5.49  0.00 2.2800 2.1700 0.2650 0.4800 0.1900 0.1450

                                  S(1.0)  S(1.2)
                                  0.0731  0.3945


 ** PSS2A **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C
O N S
           541318 G07-018-1    13.800 1  104777-104793  41001-41016    9978-9981
5672-5677

                   IC1 REMBUS1     IC2 REMBUS2       M       N
                     1       0       3       0       5       1

      TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
     5.000    5.000    0.000    5.000    0.000    5.000    0.515    1.000

      T8       T9       KS1      T1       T2       T3       T4       VSTMAX   VSTMIN
     0.500    0.100   30.000    0.150    0.030    0.150    0.030    0.100   -0.100


 ** EXAC2 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541318 G07-018-1    13.800 1  104845-104867  41065-41069

    TR       TB       TC       KA       TA     VAMAX   VAMIN     KB    VRMAX   VRMIN
   0.025    1.000    1.000    895.0    0.020 127.400-127.400     1.0    31.9    -27.7

        TE       KL       KH       KF       TF       KC       KD       KE       VLR
      0.700    3.900    0.000    0.040    1.000    0.000    0.000    1.000   11.240

                           E1      S(E1)     E2      S(E2)
                         3.2200   1.0700   4.3000   1.0800


 ** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
           541318 G07-018-1    13.800 1  104937-104945  41085-41087     9994

      R       T1       T2       T3    LOAD LIM    KT      VMAX    VMIN      DT
    0.050   0.400   0.100   3.000    1.000   2.000   1.000   0.000   0.000

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:55
 SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
 2008 WINTER PEAK: ⌐ 2007 SOUTHWEST POWER POOL, INC.; RED DYN

 PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 541319 [G07-018-2   13.800] MODELS


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           541319 G07-018-2    13.800 2  104735-104748  40983-40988

            MBASE     Z S O R C E         X T R A N       GENTAP
            114.0  0.00400+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
  7.20 0.036  0.60 0.069   5.49  0.00 2.2800 2.1700 0.2650 0.4800 0.1900 0.1450
```

```
                          S(1.0)  S(1.2)
                          0.0731  0.3945


 ** PSS2A **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C
O N S
            541319 G07-018-2    13.800 2  104794-104810  41017-41032    9982-9985
5678-5683

                    IC1 REMBUS1     IC2 REMBUS2       M       N
                      1       0       3       0       5       1

       TW1      TW2       T6       TW3      TW4       T7       KS2      KS3
      5.000    5.000    0.000    5.000    0.000    5.000    0.515    1.000

       T8       T9       KS1       T1       T2       T3       T4       VSTMAX   VSTMIN
      0.500    0.100    30.000    0.150    0.030    0.150    0.030    0.100    -0.100


 ** EXAC2 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            541319 G07-018-2    13.800 2  104868-104890  41070-41074

     TR       TB       TC       KA       TA     VAMAX   VAMIN      KB     VRMAX   VRMIN
   0.025    1.000    1.000    895.0    0.020 127.400-127.400      1.0     31.9    -27.7

        TE       KL       KH       KF       TF       KC       KD       KE       VLR
      0.700    3.900    0.000    0.040    1.000    0.000    0.000    1.000   11.240

                        E1      S(E1)     E2      S(E2)
                      3.2200   1.0700   4.3000   1.0800


 ** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
            541319 G07-018-2    13.800 2  104946-104954  41088-41090    9995

      R       T1      T2       T3    LOAD LIM   KT      VMAX     VMIN      DT
    0.050   0.400   0.100    3.000    1.000   2.000    1.000    0.000    0.000

      PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008   16:55
 SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
 2008 WINTER PEAK: ⌐ 2007 SOUTHWEST POWER POOL, INC.; RED DYN

 PLANT MODELS

 REPORT FOR ALL MODELS                      BUS 541320 [G07-018-3   13.800] MODELS


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            541320 G07-018-3    13.800 3  104749-104762  40989-40994

             MBASE     Z S O R C E        X T R A N       GENTAP
             114.0  0.00400+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD      XQ     X'D     X'Q    X''D    XL
  7.20 0.036  0.60 0.069   5.49  0.00 2.2800 2.1700 0.2650 0.4800 0.1900 0.1450

                          S(1.0)  S(1.2)
                          0.0731  0.3945


 ** PSS2A **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C
O N S
            541320 G07-018-3    13.800 3  104811-104827  41033-41048    9986-9989
5684-5689

                    IC1 REMBUS1     IC2 REMBUS2       M       N
                      1       0       3       0       5       1

       TW1      TW2       T6       TW3      TW4       T7       KS2      KS3
      5.000    5.000    0.000    5.000    0.000    5.000    0.515    1.000

       T8       T9       KS1       T1       T2       T3       T4       VSTMAX   VSTMIN
      0.500    0.100    30.000    0.150    0.030    0.150    0.030    0.100    -0.100


 ** EXAC2 **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            541320 G07-018-3    13.800 3  104891-104913  41075-41079
```

```
    TR       TB       TC       KA       TA     VAMAX   VAMIN      KB    VRMAX   VRMIN
  0.025    1.000    1.000    895.0    0.020 127.400-127.400      1.0    31.9    -27.7

        TE       KL       KH       KF       TF       KC       KD       KE       VLR
      0.700    3.900    0.000    0.040    1.000    0.000    0.000    1.000   11.240

                                  E1       S(E1)      E2       S(E2)
                                3.2200    1.0700    4.3000    1.0800


 ** GAST **     BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S      VAR
             541320 G07-018-3     13.800 3  104955-104963  41091-41093      9996

      R       T1       T2       T3    LOAD LIM   KT      VMAX     VMIN      DT
    0.050   0.400   0.100    3.000    1.000    2.000    1.000    0.000    0.000

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, MAR 18 2008  16:55
 SPP MDWG 2007 STABILITY BASE CASE: STAB2-08W-30-RED 4-12-07
 2008 WINTER PEAK: ⌐ 2007 SOUTHWEST POWER POOL, INC.; RED DYN

 PLANT MODELS

 REPORT FOR ALL MODELS                         BUS 541321 [G07-018-4   13.800] MODELS


 ** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
             541321 G07-018-4     13.800 4  104763-104776  40995-41000

              MBASE      Z S O R C E         X T R A N       GENTAP
              114.0  0.00400+J 0.19000  0.00000+J 0.00000  1.00000

  T'D0 T''D0  T'Q0 T''Q0     H    DAMP   XD      XQ      X'D     X'Q    X''D    XL
  7.20 0.036  0.60 0.069   5.49  0.00 2.2800 2.1700 0.2650 0.4800 0.1900 0.1450

                                       S(1.0)  S(1.2)
                                       0.0731  0.3945


 ** PSS2A **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S      V A R S      I C
O N S
             541321 G07-018-4     13.800 4  104828-104844  41049-41064     9990-9993
5690-5695

                     IC1 REMBUS1      IC2 REMBUS2        M        N
                       1       0        3       0        5        1

      TW1       TW2       T6       TW3       TW4       T7       KS2       KS3
     5.000     5.000     0.000     5.000     0.000     5.000     0.515     1.000

      T8        T9       KS1       T1        T2        T3        T4       VSTMAX    VSTMIN
     0.500     0.100    30.000     0.150     0.030     0.150     0.030     0.100    -0.100

 ** EXAC2 **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
             541321 G07-018-4     13.800 4  104914-104936  41080-41084

    TR       TB       TC       KA       TA     VAMAX   VAMIN      KB    VRMAX   VRMIN
  0.025    1.000    1.000    895.0    0.020 127.400-127.400      1.0    31.9    -27.7

        TE       KL       KH       KF       TF       KC       KD       KE       VLR
      0.700    3.900    0.000    0.040    1.000    0.000    0.000    1.000   11.240

                                  E1       S(E1)      E2       S(E2)
                                3.2200    1.0700    4.3000    1.0800

 ** GAST **     BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S      VAR
             541321 G07-018-4     13.800 4  104964-104972  41094-41096      9997

      R       T1       T2       T3    LOAD LIM   KT      VMAX     VMIN      DT
    0.050   0.400   0.100    3.000    1.000    2.000    1.000    0.000    0.000
```

Appendix C Plots for 2008 Winter Peak Stability Simulations

C.1 Plots for Siemens units

C.2 Plots for GE units

Appendix D Plots for 2012 Summer Peak Stability Simulations

D.1 Plots for Siemens units

D.2 Plots for GE units