SPP Southwest Power Pool

Impact Study for Generation Interconnection Request GEN–2008–002

SPP Tariff Studies
(#GEN-2008-002)

August 14, 2008

Executive Summary

<OMITTED TEXT> (Customer) has requested an Impact Study for the purpose of interconnecting 65MW of additional coal fired generation capacity within the control area of Kansas City Power and Light (KACP) located in Platte County, Missouri. The proposed point of interconnection is the Iatan 345kV substation. The proposed in-service date is January 1, 2009. This is an existing generating unit with a 650MW rating. The customer has requested to uprate the unit to 715MW rating.

This study has determined the requirements to interconnect the additional 65MW of generation at the Iatan 345kV bus.

A stability study was conducted by ABB Consulting and is included in Attachment 1. The stability study shows that the interconnection of proposed project does not have any adverse impact on the system stability in SPP area.

There are no estimated Direct Assigned Facilities or Network Upgrades necessary for the interconnection of GEN-2008-002.

The required interconnection costs listed in Table 2 do not include all 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.

Introduction

<OMITTED TEXT> (Customer) has requested an Impact Study for the purpose of interconnecting 65MW of additional coal fired generation capacity within the control area of Kansas City Power and Light (KACP) located in Platte County, Missouri. The proposed point of interconnection is the Iatan 345kV substation. The proposed in-service date is January 1, 2009. This is an existing generating unit with a 650MW rating. The customer has requested to uprate the unit to 715MW rating.

Interconnection Facilities

The Customer has requested interconnecting an additional 65MW within the control area of Kansas City Power and Light (KACP). The plant site is located in Platte County, Missouri and will be interconnected into the existing Iatan 345kV substation.

There are also several other facilities that are assumed to be in service for the interconnection of this request. These facilities are listed in the powerflow analysis section. If any of these facilities are not constructed or previous queued projects drop out of the queue, this request will need to be restudied.

Table 1. Interconnection Facilities

FACILITY	ESTIMATED COST (2008 DOLLARS)
CUSTOMER – 345/24kV equipment.	*
CUSTOMER – 345kV connection from GSU and reserve auxiliary to Iatan 345kV bus.	*
TOTAL	*

* Determined by Customer

Table 2. Network Upgrades

FACILITY	ESTIMATED COST (2008 DOLLARS)
None	
TOTAL	

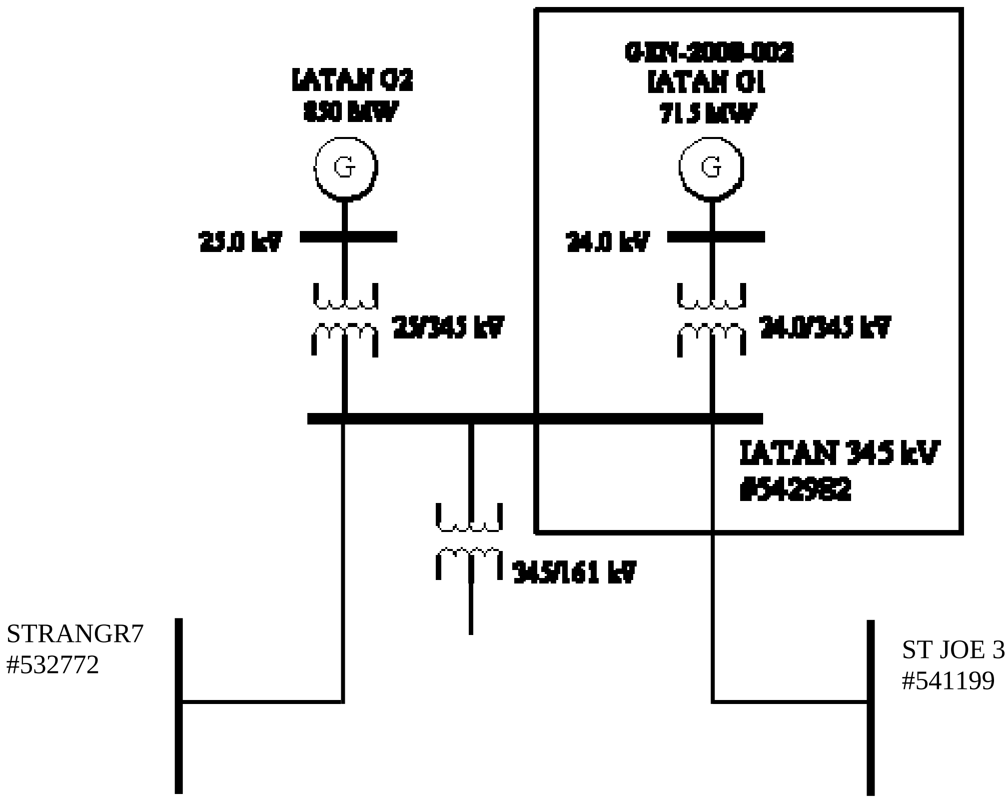

Figure 1. Proposed Interconnection Configuration
(Final design to be determined)

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2008 winter peak, 2009 summer and winter peak, 2012 summer and winter peak and 2017 summer peak models. 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 January 1, 2009. The available seasonal models used were through the 2017 Summer Peak of which is the end of the current SPP planning horizon.

The analysis of the Customer's project indicates no overloaded elements for transmission systems under steady state and contingency conditions in the peak seasons. These network constraints are shown in Table 3.

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.

If any of these projects do not get constructed or if any prior queued generation interconnection request withdraws from the queue, this analysis will need to be re-evaluated.

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 (WESTAR), 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 (SPS), Western Farmers Electric Cooperative (WFEC), Western Resources (WERE), 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: Network Constraints

AREA	OVERLOADED ELEMENT
	NO OVERLOADED ELEMENTS

Table 4: Contingency Analysis

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
08WP	NONE				
09SP	NONE				
09WP	NONE				
12SP	NONE				
12WP	NONE				
17SP	NONE				

Note: 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. If the loading of a facility is higher, the level of ATC will be lower.

Stability Analysis

A transient stability analysis was conducted for the facility by ABB Consulting (ABB). The study is attached to this report. The stability analysis indicated that the interconnection of proposed project does not have any adverse impact on the system stability in SPP area.

This analysis assumed that the following projects were built and in service

If any of these projects do not get constructed or if any prior queued generation interconnection request withdraws from the queue, this analysis will need to be re-evaluated.

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-2008-002. 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.

POWER SYSTEMS DIVISION
GRID SYSTEMS CONSULTING

IMPACT STUDY FOR GENERATION INTERCONNECTION REQUEST GEN-2008-002

FINAL REPORT

REPORT NO.: 2008-11798-R1
Issued on: August 14, 2008

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Power Systems Division
Grid Systems Consulting
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ABB Inc – Grid Systems Consulting **Technical Report**

Southwest Power Pool	**No.** 2008-11798-R1	
Impact Study for Generation Interconnection request GEN-2008-002	8/14/2008	# Pages 29

Author(s):	**Reviewed by:**	**Approved by:**
Ashish Jain	William Quaintance	Willie Wong

Executive Summary

Southwest Power Pool (SPP) has commissioned ABB Inc to perform a generator interconnection study for an uprate to an existing coal fired steam turbine, interconnected into the Iatan 345kV bus in the control area of Kansas City Power and Light (KACP). The existing unit is a 650MW nominal unit. The Customer is now asking to uprate this plant to 715MW nominal rating.

The SPP system, prior-queued generators, and the proposed project are stable following all simulated faults except FLT_23_3PH_stuck. This is a three-phase fault with delayed clearing (stuck breaker), which falls under NERC Category D (extreme contingencies). This fault causes instability of many generators, including those at JEC, LEC, TEC, HEC, and EMPEC, in both the pre-project and post-project conditions. However, stability is not required following NERC Category D faults.

Based on the results of the stability analysis, it is concluded that the proposed capacity uprate (715 MW for summer peak & for winter peak) 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
0	Draft Report	06/29/08	Ashish Jain	William Quaintance	Willie Wong
1	Final Report	7/14/2008	Ashish Jain	William Quaintance	Willie Wong
DISTRIBUTION: Charles Hendrix – Southwest Power Pool					

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1 INTRODUCTION

Southwest Power Pool (SPP) has commissioned ABB Inc to perform a generator interconnection study for an uprate to an existing coal fired steam turbine, interconnected into the Iatan 345kV bus in the control area of Kansas City Power and Light (KACP). The existing unit is a 650MW nominal unit. The Customer is now asking to uprate this plant to 715MW nominal rating.

This coal fired steam turbine power plant was studied under two different system loading scenarios - 2008 winter peak and 2012 summer peak. The generator is modeled at bus #542957 and interconnecting at the existing Iatan 345kV bus (#542982).

The objective of the impact study is to evaluate the impact on system stability after uprating the steam turbine power plant and its effect on the nearby transmission system and generating stations. Figure 1-1 shows the power plant interconnecting station and Figure 1-2 shows the interconnection with the existing network.

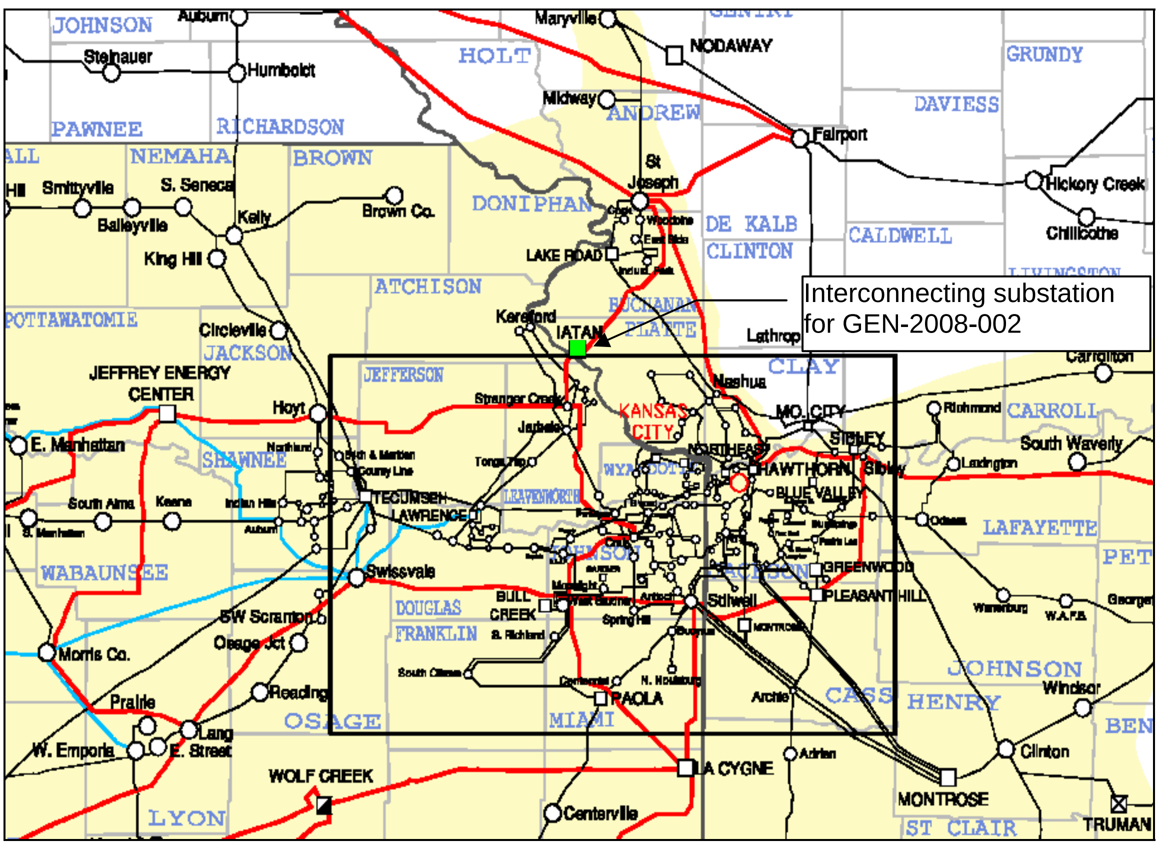

Figure 1-1 GEN-2008-002 Plant Location

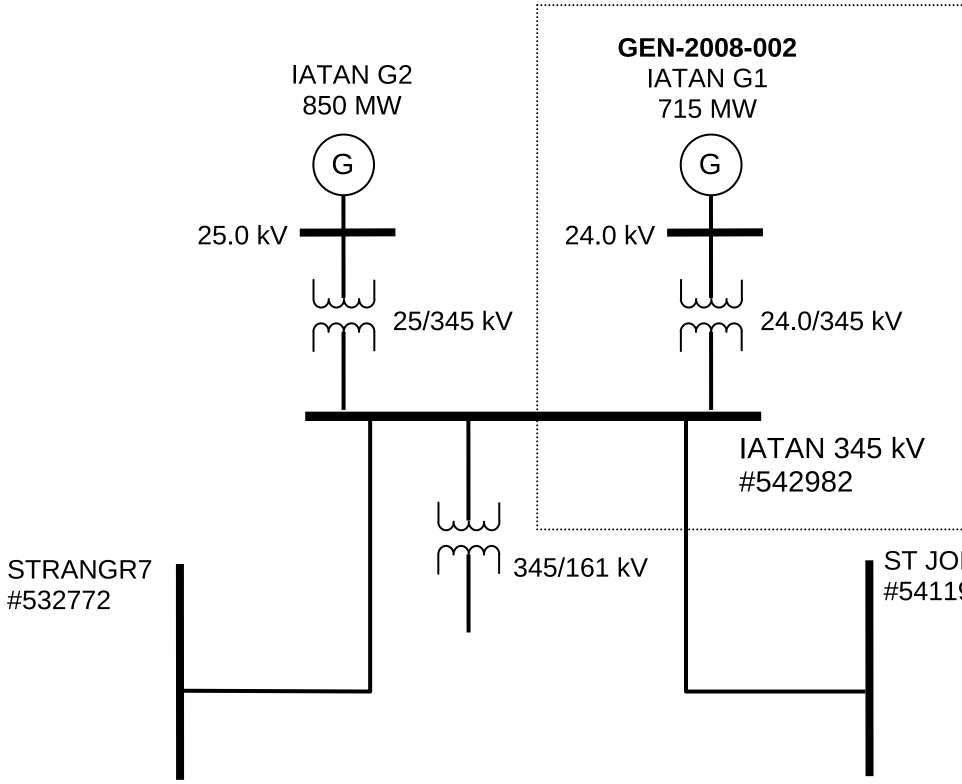

Figure 1-2 Plant One-line

2 STABILITY ANALYSIS

In this stability study, ABB investigated the stability of the system for a series of faults specified by SPP, which are in the vicinity of the proposed project. All of the simulations, except FLT_17, FLT_18, FLT_19, FLT_22_1PH_stuck, FLT_23_3PH_stuck, represent three-phase or single-phase faults cleared by primary protection in 3.5 cycles, re-closing after 30 more cycles with the fault still on, and then permanently clearing of the fault 3.5 cycles later with primary protection.

Faults FLT_17, FLT_18 and FLT_19 are generation loss contingencies. Faults FLT_22_1PH_stuck and FLT_23_3PH_stuck are 1-phase and 3-phase delayed clearing (10.8 sec) faults.

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 an aperiodic system disturbance."

Stability analysis was performed using the PSS/E™ 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. Stability of asynchronous machines was monitored as well.

Single-phase 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 estimated 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.

Base Power Flow Cases

SPP supplied the following two (2) pre-project PSS/E power flow cases:

- *"gen-2008-002_08wp.sav"* representing the Winter Peak conditions of the SPP system for the year 2008
- *"gen-2008-002_12sp.sav"* representing Summer Peak conditions of the SPP system for the year 2012

The power flows in Pre-project conditions are shown in Figure 2-1 and Figure 2-2.

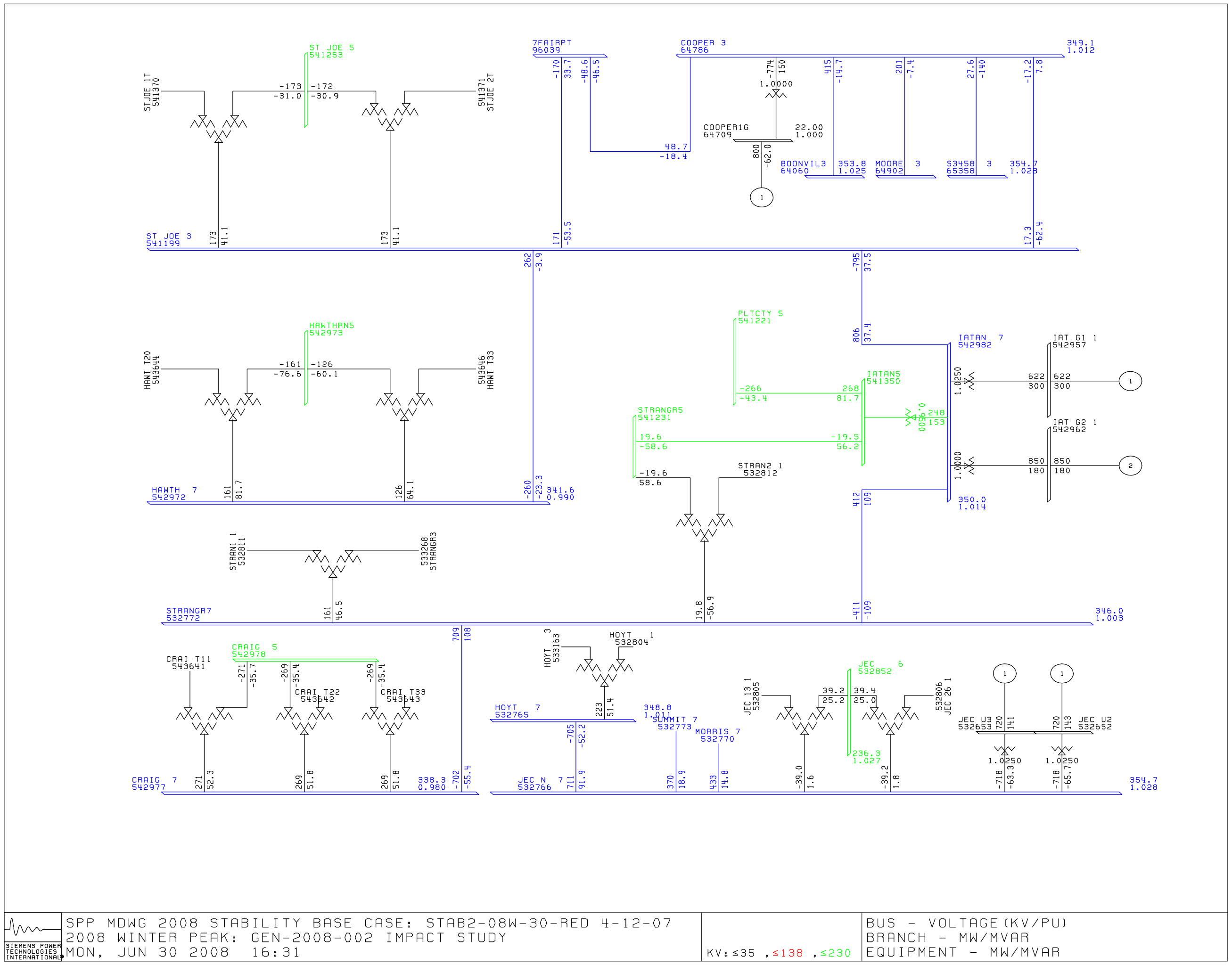

Figure 2-1 2008 Winter Peak case without uprating of GEN-2008-002

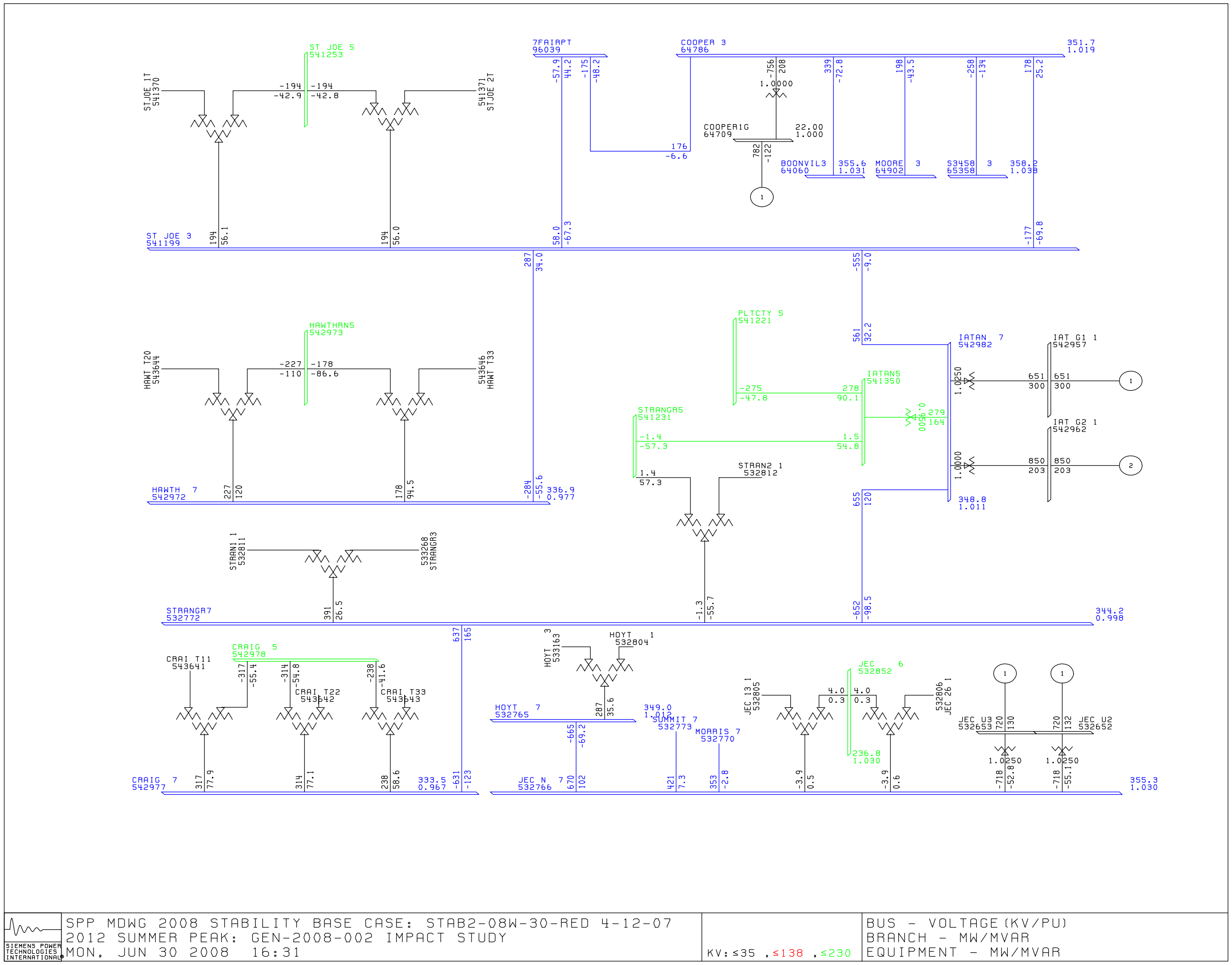

Figure 2-2 2012 Summer Peak case without uprating of GEN-2008-002

GEN-2008-002 Power Flow Cases

The proposed GEN-2008-002 project is an existing coal fired steam turbine interconnected into the Iatan 345kV bus in the control area of Kansas City Power and Light (KACP). The existing unit is a 650MW nominal unit. The Customer is now asking to uprate this plant to 715MW nominal rating. The generator is connected with the 345 kV grid via 24/345 kV transformer. The proposed project was dispatched against the generation in Areas 520(APEW), 524(OKGE), 526(SPS), 536(WERE). The details of model development are described in Appendix A.

Thus two Post-project power flow cases were established:

- *Gen-2008-002_08WP_POST.SAV – 2008 winter peak case*
- *Gen-2008-002_12SP_POST.SAV – 2012 summer peak case*

Figure 2-3 and Figure 2-4 show power flow one-line diagrams with the GEN-2008-002 project for 2008 winter peak and 2012 summer peak system conditions respectively.

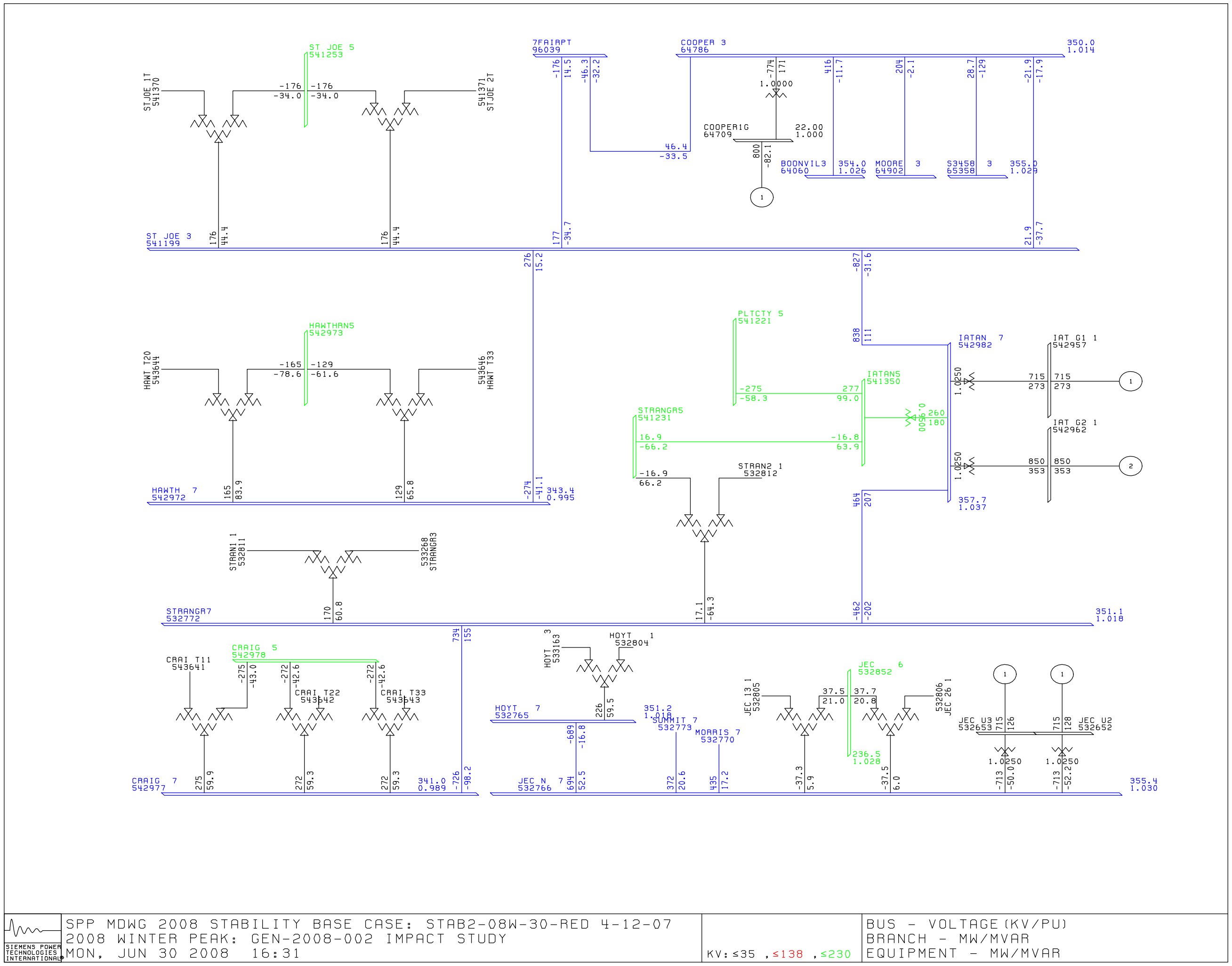

Figure 2-3 2008 Winter Peak case with uprating of GEN-2008-002

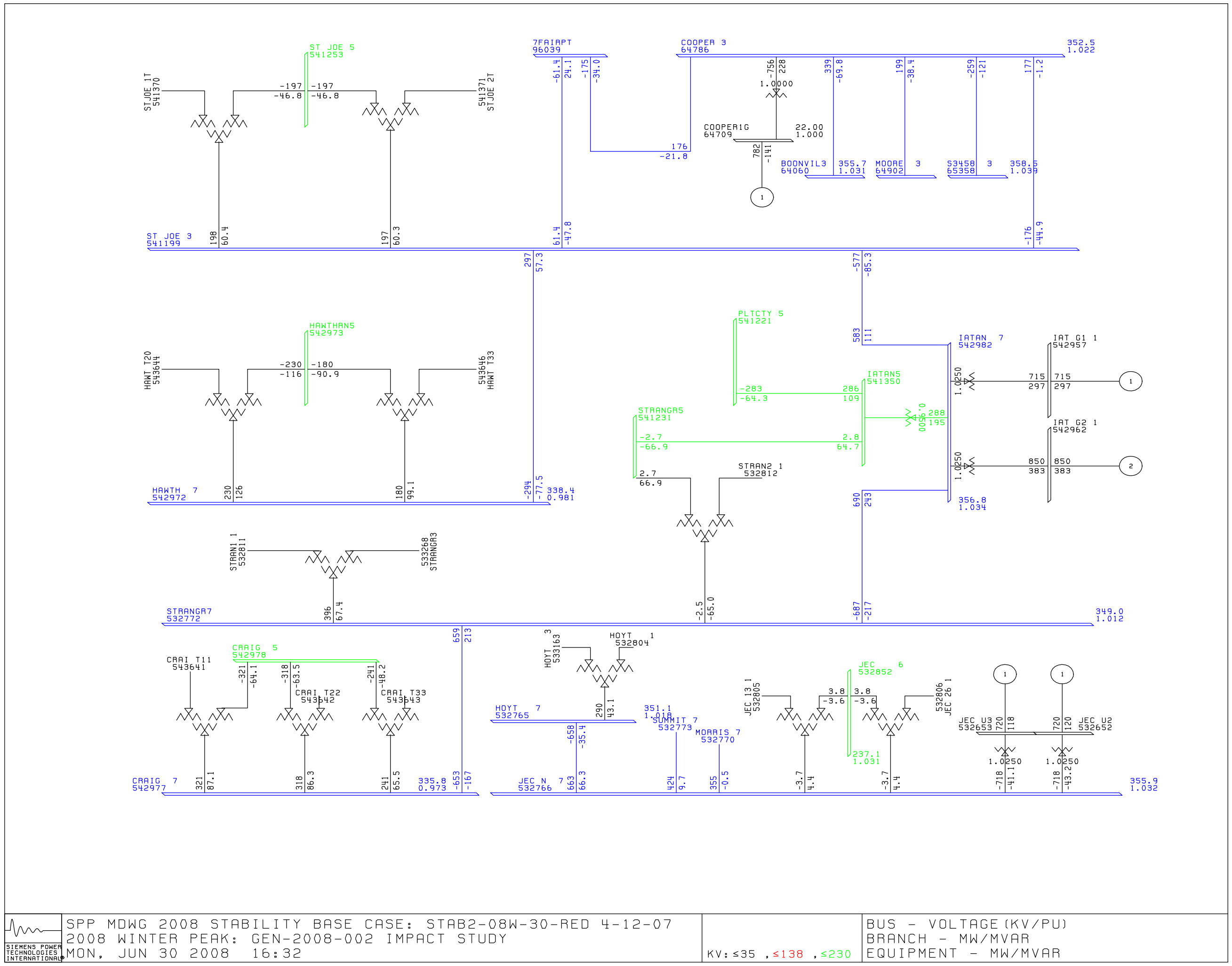

Figure 2-4 2012 Summer Peak case with uprating of GEN-2008-002

Stability Model

SPP provided the stability databases in the form of PSS/E dynamic data files - "*gen-2008-002_08wp.dyr*" to model the 2008 Winter Peak, and "*gen-2008-002_12sp.dyr*" to model the 2012 Summer Peak configuration. Command files were also provided to compile and link user-written models. These files are compatible with PSS/E version 30.2.1.

SPP provided the dynamic data for the proposed GEN-2008-002 project. The "GENROU" round rotor generator model, "ESAC8B" exciter model and "PSS2A" stabilizer model were used to represent the proposed generator are given in Appendix - A.

The details of power flow and stability model representations for GEN-2008-002 are included in Appendix B.

Simulated Faults

Table 2-1 lists the disturbances simulated for stability analysis.

Table 2-1 List of Faults for Stability Analysis

Fault #	Fault Description
FLT_1_1PH	Single Phase fault at Stranger Creek on the Stranger Creek (#532772) – Iatan (#542982) 345kV line Run fault for 3.6 cycles; reclose after 25 cycles and lockout
FLT_2_3PH	Three Phase fault at Stranger Creek on the Stranger Creek (#532772) – Iatan (#542982) 345kV line Run fault for 3.6 cycles and lockout
FLT_3_1PH	Single Phase fault at St. Joe on the St. Joe (#541199) – Iatan (#542982) 345kV line Run fault for 3.6 cycles; reclose after 25 cycles and lockout
FLT_4_3PH	Three Phase fault at St. Joe on the St. Joe (#541199) – Iatan (#542982) 345kV line Run fault for 3.6 cycles and lockout
FLT_5_1PH	Single Phase fault at Stranger Creek on the Stranger Creek (#532772) – Craig (#542977) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_6_3PH	Three Phase fault at Stranger Creek on the Stranger Creek (#532772) – Craig (#542977) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_7_1PH	Single Phase fault at Stranger Creek on the Stranger Creek (#532772) – Hoyt (#532765) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_8_3PH	Three Phase fault at Stranger Creek on the Stranger Creek (#532772) – Hoyt (#532765) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_9_1PH	Single Phase fault at St. Joe on the St. Joe (#541199) – Cooper(#64786) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_10_3PH	Three Phase fault at St. Joe on the St. Joe (#541199) – Cooper(#64786) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_11_1PH	Single Phase fault at St. Joe on the St. Joe (#541199) – Fairport(#96039) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_12_3PH	Three Phase fault at St. Joe on the St. Joe (#541199) – Fairport(#96039) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_13_1PH	Single Phase fault at the Midpoint on the Cooper(#64786) – Fairport(#96039) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_14_3PH	Three Phase fault at the Midpoint on the Cooper(#64786) – Fairport(#96039) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_15_1PH	Single Phase fault at St. Joe on the St. Joe (#541199) – Hawthorn(#542972) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_16_3PH	Three Phase fault at St. Joe on the St. Joe (#541199) – Hawthorn(#542972) 345kV line Run fault for 3.6 cycles; reclose after 26 cycles and lockout
FLT_17	Trip Iatan Unit #1
FLT_18	Trip Iatan Unit #2

Fault #	Fault Description
FLT_19	Trip Jeffrey Energy Center Unit #2 (681MW) - - 714.54 MW – 532652
FLT_20_1PH	Single Phase fault at Iatan on the St. Joe (#541199) – Iatan (#542982) 345kV line Run fault for 3.6 cycles; reclose after 25 cycles and lockout
FLT_21_3PH	Three Phase fault at Iatan on the St. Joe (#541199) – Iatan (#542982) 345kV line Run fault for 3.6 cycles; and lockout
FLT_22_1PH_stuck	Stuck breaker/delayed clearing -- Single Phase fault at Iatan on the St. Joe – Iatan 345kV line Run fault for 10.8 cycles and lockout
FLT_23_3PH_stuck	Stuck breaker/delayed clearing -- Three Phase fault at Iatan on the St. Joe – Iatan 345kV line Run fault for 10.8 cycles and lockout.
FLT_24_3PH	Three Phase fault at Iatan on the Stranger Creek (#532772) -- Iatan (#542982) 345kV line Run fault for 3.6 cycles and lockout

2.3 STUDY RESULTS

All three phase and single phase faults listed above were simulated. Responses of the plant (GEN-2008-002), nearby prior-queued projects, and other nearby generators were monitored. For the listed faults, generators in the nearby area of project were having undamped oscillations, similar for the pre project cases as well. SPP has provided the modification in the PSS2A dynamic model as pss2a-LAC1-542955.dyr & pss2a-LAC2-542956.dyr for generator connected at the 542955 & 542956 (LAC G1 & LAC G2). The oscillations damped down to after the modifications. The details of the models are given in the Annexure – A. The results for the simulated disturbances are summarized in Table 2-2. Plots showing the simulation results are included in Appendix B.

The results of the simulations indicate that GEN-2008-002 and all other generators in the vicinity of the project will be stable following all simulated faults except for FLT_23_3PH_stuck. Several generators are unstable following this fault on both pre-project and post-project conditions. This type of fault falls into NERC Category D, which are extreme contingencies that do not require stability. Hence, the interconnection of proposed project does not have any adverse impact on the system stability in SPP area.

Table 2-2: Results of Stability Simulations

	2008 Winter Peak		2012 Summer Peak	
FAULT	**Pre-project**	**Post-project**	**Pre-project**	**Post-project**
NO_FLT	STABLE	STABLE	STABLE	STABLE
FLT_1_1PH	STABLE	STABLE	STABLE	STABLE
FLT_2_3PH	STABLE	STABLE	STABLE	STABLE
FLT_3_1PH	STABLE	STABLE	STABLE	STABLE
FLT_4_3PH	STABLE	STABLE	STABLE	STABLE
FLT_5_1PH	STABLE	STABLE	STABLE	STABLE
FLT_6_3PH	STABLE	STABLE	STABLE	STABLE
FLT_7_1PH	STABLE	STABLE	STABLE	STABLE
FLT_8_3PH	STABLE	STABLE	STABLE	STABLE
FLT_9_1PH	STABLE	STABLE	STABLE	STABLE
FLT_10_3PH	STABLE	STABLE	STABLE	STABLE
FLT_11_1PH	STABLE	STABLE	STABLE	STABLE
FLT_12_3PH	STABLE	STABLE	STABLE	STABLE
FLT_13_1PH	STABLE	STABLE	STABLE	STABLE
FLT_14_3PH	STABLE	STABLE	STABLE	STABLE
FLT_15_1PH	STABLE	STABLE	STABLE	STABLE
FLT_16_3PH	STABLE	STABLE	STABLE	STABLE
FLT_17	STABLE	STABLE	STABLE	STABLE
FLT_18	STABLE	STABLE	STABLE	STABLE
FLT_19	STABLE	STABLE	STABLE	STABLE
FLT_20_1PH	STABLE	STABLE	STABLE	STABLE
FLT_21_3PH	STABLE	STABLE	STABLE	STABLE
FLT_22_1PH_STUCK	STABLE	STABLE	STABLE	STABLE
FLT_23_3PH_STUCK	UNSTABLE	UNSTABLE	UNSTABLE	UNSTABLE

3 CONCLUSIONS

The objective of this study is to evaluate the power system stability after uprating the GEN-2008-002 steam plant. The study is performed for two system scenarios: 2008 Winter Peak and 2012 Summer Peak.

The results indicated that following simulated faults for uprating of plan capacity of IATAN G1 from 650 MW to 715 MW does not have any adverse impact on the system stability in SPP area.

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 - Load Flow and Stability Data

APPENDIX B - Plots for Stability Simulations with Gen-2007-002