SPP Southwest Power Pool

Impact Study For Generation Interconnection Request GEN-2006-026

SPP Tariff Studies
(#GEN-2006-026)

November, 2006

Executive Summary

<OMITTED TEXT> (Customer) has requested an Expedited Impact Study for the purpose of interconnecting 510MW(summer)/605MW(winter) of generation within the control area of Southwestern Public Service (d/b/a Xcel Energy) (SPS) in Lea County, New Mexico. The Customer's facility consists of a two-on-one combined cycle facility. The proposed point of interconnection by the Customer was a new substation on the Lea County – Midland County 230kV transmission line owned by SPS with all generating units connected to the 230kV bus.

This study and the accompanying stability study conducted by Pterra Consulting has determined the requirements to interconnect the 510MW/605MW of generation is a new 230/115kV substation. This modifies the original Customer request. The Customer request had to be modified because the Customer generating facility was found to be unstable for an outage of the 230kV line to Lea County under the proposed interconnection configuration.

The new interconnection substation will have 230kV terminals to Lea County and Midland County, 115kV terminals to Lea County and Maddox power station, and a 230/115kV autotransformer. Under this configuration, the two combustion turbines (CTs) will be connected to the 115kV bus and the steam turbine (ST) will be connected to the 230kV bus. It is assumed that obtaining all necessary right-of-way for the new switching station will not be a significant expense.

The total minimum cost for building the new 230/115kV substation required for stand alone interconnection is $7,694,050. Other Network Constraints in the SPS transmission system that may be verified with a transmission service request and associated studies are listed in Table 3. These Network Constraints are in the local area of the new generation when this generation is sunk throughout the SPP footprint for the Energy Resource (ER) Interconnection request. With a defined source and sink in a Transmission Service Request (TSR), this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. This cost does not include building the Customer's 230kV and 115kV facilities up to the high side of the generator step up (GSU) transformers, the point of the change of ownership. This cost does not include the results of a short circuit analysis, which will be conducted if the Customer enters into a Facility Study Agreement.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 510MW/605MW of generation with transmission system reinforcements within the SPS transmission system.

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 for future analyses including the determination of 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. If the loading of a facility is higher, the level of ATC will be lower.

The required interconnection costs listed in Table 2 and other upgrades associated with Network Constraints listed in Table 3 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 Expedited Impact Study for the purpose of interconnecting a 510MW (summer) / 605MW (winter) 2-on-1 combined cycle power plant within the control area of Southwestern Public Service Company (d/b/a Xcel Energy) (SPS). The plant site is located in Lea County, New Mexico near the existing SPS plant sites of Cunningham and Maddox as well as several SPS transmission lines that are interconnected to each of those plants. The proposed method of interconnection is to build a new 230/115kV substation to interconnect into the Lea County – Midland County 230kV line and nearby 115kV lines. The proposed in-service date is June 1, 2008.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant into the area transmission system. The Impact and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other direct assignment facilities needed to accept power into the grid at the interconnection receipt point.

The Customer originally requested to interconnect the entire 2-on-1 combined cycle plant into the Lea County – Midland County 230kV transmission line, which runs through the project site. This interconnection proved insufficient for interconnection of the plant. This interconnection was insufficient due to plant instability. The plant was found to be out-of-step for the outage of the 230kV line to Lea County.

The option of building a new 230kV line to Cunningham was considered. However, due to the length of time required to build 230kV lines in New Mexico because of the state's CCN process, it was determined that a new 230kV line could not be built in time for the requested in service date of June 1, 2008.

There are a number of 115kV lines that also run through or near the proposed plant site. It was found that a 115kV outlet from the proposed plant alleviated the angular instability problems associated with interconnection at only 230kV. The closest of the lines that run through the site is the Maddox-Lea County 115kV line. Powerflow analysis demonstrated that connection to some of the other 115kV lines in the area will be necessary for transmission service from the plant. It was determined that an optimum configuration consisted of placing the two combustion turbines on the 115 kV bus and leaving the one steam turbine on the 230kV bus. The 115kV and the 230kV buses will be connected by a 230/115kV 168MVA autotransformer

The requirements for interconnection of the 510/605MW combined cycle plant consist of building a new 230kV ring bus with four terminals to the Lea County Interchange, the Midland County Interchange, the steam turbine GSU, and the 230/115kV autotransformer. The 115kV bus in the substation which may be constructed as a five terminal ring bus will have terminals to the 230/115kV autotransformer, Lea County Interchange, Maddox power station, and terminals to each of the combustion turbines. It is assumed that obtaining all necessary right-of-way for the substation construction will not be a significant expense.

The total cost for building a new 230/115kV substation and associated transmission work is estimated at $7,694,050. These costs do include Customer facilities up to the point of interconnection. These costs are shown in Table 2. These costs do not include the costs associated with short circuit analysis. Short circuit analysis will be conducted if the Customer chooses to continue on with the request into a Facility Study.

Other Network Constraints in the SPS system that were identified are listed in Table 3. These estimates will be refined during the development of the facility study based on the final designs. This cost does not include building the 115kV and 230kV facilities from the Customer GSU to the new switching station. The Customer is responsible for these facilities up to the point of interconnection.

A preliminary one-line drawing of the interconnection and direct assigned facilities are shown in Figure 1.

Table 1: Direct Assignment Facilities

Facility	ESTIMATED COST (2006 DOLLARS)
Customer – GSUs and associated facilities at 230kV, 115kV, and generator voltage	*
Total	*****

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

Table 2: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2006 DOLLARS)
SPS – Build 230/115kV Substation. Station to include four (4) 230kV terminals, (5) 115kV terminals, a 230/115kV, 168MVA autotransformer, associated breakers, switches, control relaying, high speed communications, all structures and metering and other related equipment	$6,011,028
SPS – Associated Transmission Work	$1,683,022
Total	**$7,694,0050**

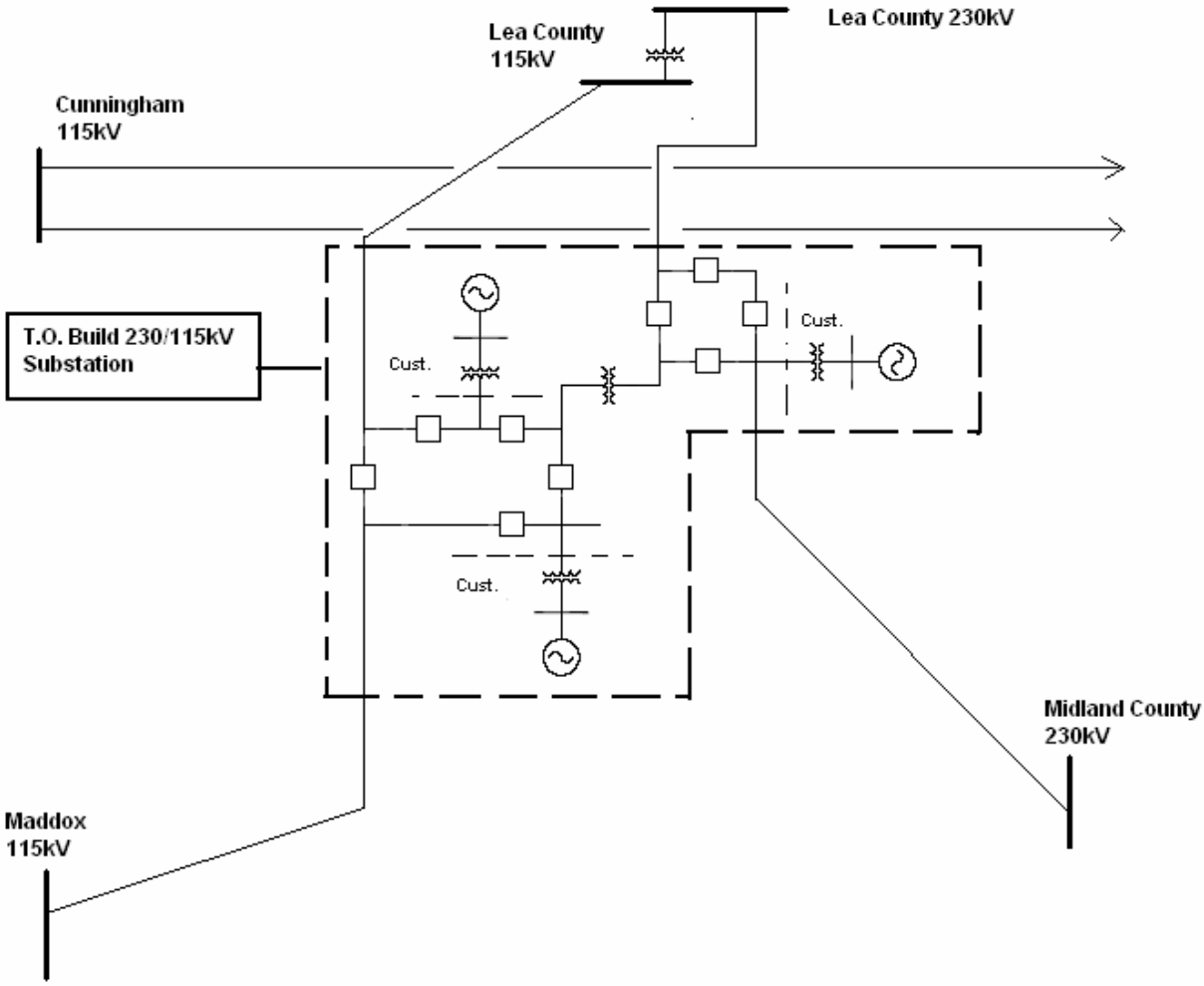

Figure 1: Proposed Interconnection
(Final substation design to be determined

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2008 & 2011 summer and winter peak, and 2016 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 June 1, 2008. The available seasonal models used were through the 2016 Summer Peak of which is the end of the current SPP planning horizon.

The analysis of the Customer's project indicates that, given the requested generation level of 510/605MW and location, additional criteria violations will occur on the existing SPS transmission systems under steady state and contingency conditions in the peak seasons.

Issues concerning the feasibility of this request pertain to the overloads noted on the SPS 115kV system that the Customer facility will interconnect. The Maddox-Lea County 115kV line and other lines may overload for steady state and contingency conditions. Mitigation of these constraints is beyond the scope of this study. Mitigation of these constraints as well as the other network constraints in Table 3 will be addressed when the Customer or other party requests transmission service for this facility under the SPP OATT.

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.

There are several other proposed generation additions in the general area of the Customer's facility. These local projects that were previously queued were assumed to be in service in this Impact Study. Those local projects that were previously queued and have advanced to nearly complete phases were included in this Impact Study.

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 l hereafter referred to as NERC Table l) 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 SPS, Sunflower Electric Cooperative, American Electric Power, and Western Farmers Electric Cooperative 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

NETWORK CONSTRAINTS
'CARLSBAD PLANT - PECOS INTERCHANGE 115KV CKT 1'
'CARLSBAD PLANT - POTASH JUNCTION INTERCHANGE 115KV CKT 1'
'CUNNINGHAM STATION 230/115KV TRANSFORMER CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'
'HBSGEN6 230 230/115KV TRANSFORMER CKT 1'
'POTASH JUNCTION INTERCHANGE 230/115KV TRANSFORMER CKT 1'

Table 4: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2008 SUMMER PEAK					
'CARLSBAD PLANT - POTASH JUNCTION INTERCHANGE 115KV CKT 1'	08sp	99	125.6	0	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'POTASH JUNCTION INTERCHANGE 230/115KV TRANSFORMER CKT 1'	08sp	172.5	114.1	123	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	08sp	249	129.4	394	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'
2008 WINTER PEAK					
'CUNNINGHAM STATION 230/115KV TRANSFORMER CKT 1'	08wp	168	129.0	0	HBSGEN3 115 - MADDOX 115KV CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	08wp	303	136.0	445	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'
'HBSGEN6 230 230/115KV TRANSFORMER CKT 1'	08wp	168	111.5	543	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'
2011 SUMMER PEAK					
'CARLSBAD PLANT - POTASH JUNCTION INTERCHANGE 115KV CKT 1'	11sp	99	134.9	0	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'POTASH JUNCTION INTERCHANGE 230/115KV TRANSFORMER CKT 1'	11sp	172.5	121.4	0	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	11sp	249	129.0	395	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'
2011 WINTER PEAK					
'CUNNINGHAM STATION 230/115KV TRANSFORMER CKT 1'	11wp	168	136.2	0	HBSGEN3 115 - MADDOX 115KV CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	11wp	303	140.0	432	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'
'HBSGEN6 230 230/115KV TRANSFORMER CKT 1'	11wp	168	119.7	505	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'

Table 4: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2016 SUMMER PEAK					
'CARLSBAD PLANT - POTASH JUNCTION INTERCHANGE 115KV CKT 1'	16sp	99	144.6	0	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'POTASH JUNCTION INTERCHANGE 230/115KV TRANSFORMER CKT 1'	16sp	172.5	129.3	0	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'POTASH JUNCTION INTERCHANGE 230/115KV TRANSFORMER CKT 1'	16sp	150	102.3	403	'BASE CASE'
'CUNNINGHAM STATION 230/115KV TRANSFORMER CKT 1'	16sp	168	105.5	467	HBSGEN3 115 - MADDOX 115KV CKT 1'
'CARLSBAD PLANT - PECOS INTERCHANGE 115KV CKT 1'	16sp	197	100.8	495	'CUNNINGHAM STATION - EDDY COUNTY INTERCHANGE 230KV CKT 1'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	16sp	226	102.1	499	'BASE CASE'
'HBSGEN3 115 - MADDOX PLANT 115KV CKT 1'	16sp	249	132.9	565	'HBSGEN6 230 - LEA COUNTY INTERCHANGE 230KV CKT 1'

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 stability study was performed by Pterra Consulting Engineers for this generation request. That study is appended to this study as Attachment 1.

The Customer originally requested interconnection into the Lea County – Midland County 230kV transmission line. The SPS transmission system steps down to 115kV at Midland County with no other 230kV outlets. The 115kV system runs for several miles through several delivery points and steps back up to 230kV at Borden County. It was found that for an outage of the 230kV line to Lea County that the combined cycle power plant was unstable. Under that contingency the only outlet for the plant was the 115kV system back into Borden County through Midland County. See Figure 2. below for generator angles for this contingency.

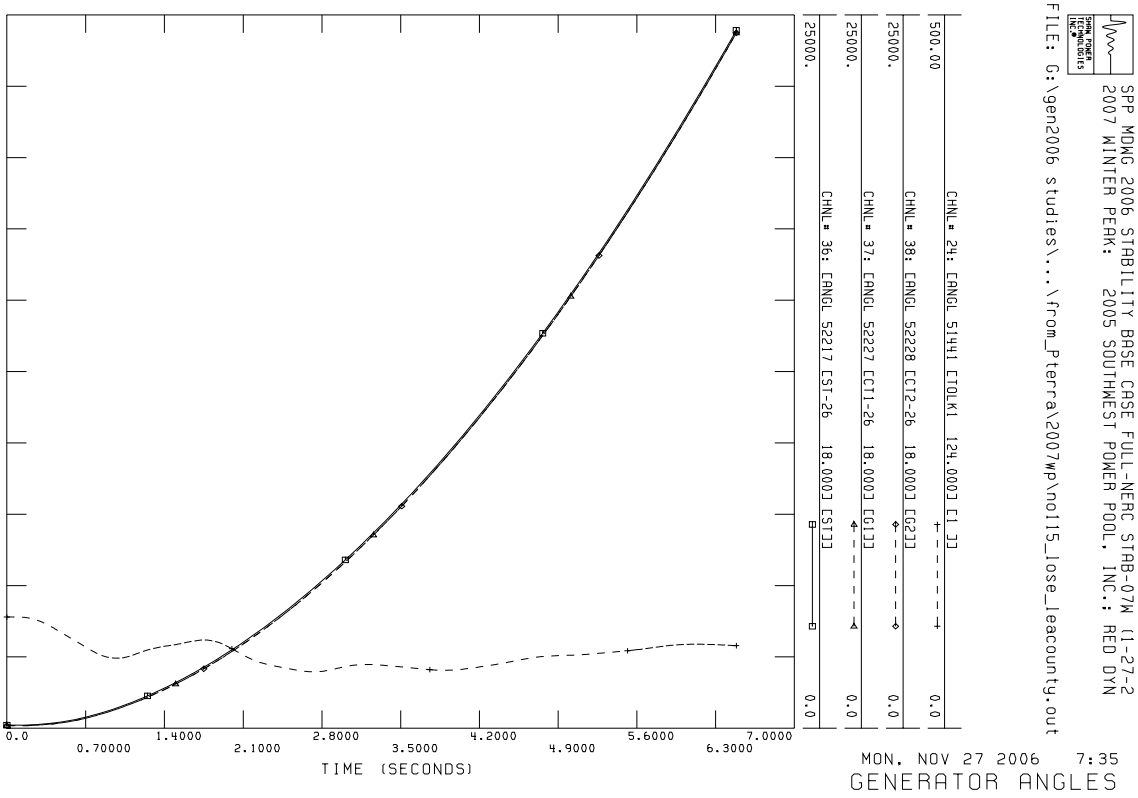

FIGURE 2. Study Project Generator Angles for Loss of Lea County 230kV line (original configuration)

It was apparent that an additional outlet from 230kV bus was necessary to alleviate the angular instability of the Customer generating units. A new 230kV line to Cunningham (approximately 5 miles) would satisfy this requirement, but governmental CCN requirements in New Mexico would probably not allow this line to be built in time for the in service requirements of the plant.

Due to the number of 115kV lines running through the area, a 115kV bus was modeled with an autotransformer connecting the 115kV and the 230kV bus. For the minimum interconnection configuration necessary for stability, only the closest 115kV line to the site, the Maddox-Lea County 115kV line was split and brought into the new 115kV bus. Since all of the load in the area is connected to the 115kV or lower transmission system, the two combustion turbines were modeled to be connected to the 115kV bus to alleviate possible and probable overloading on the 230/115kV autotransformers in the area. The outage of the Lea County 230kV line was simulated again and the units were stable. See Figure 3. below.

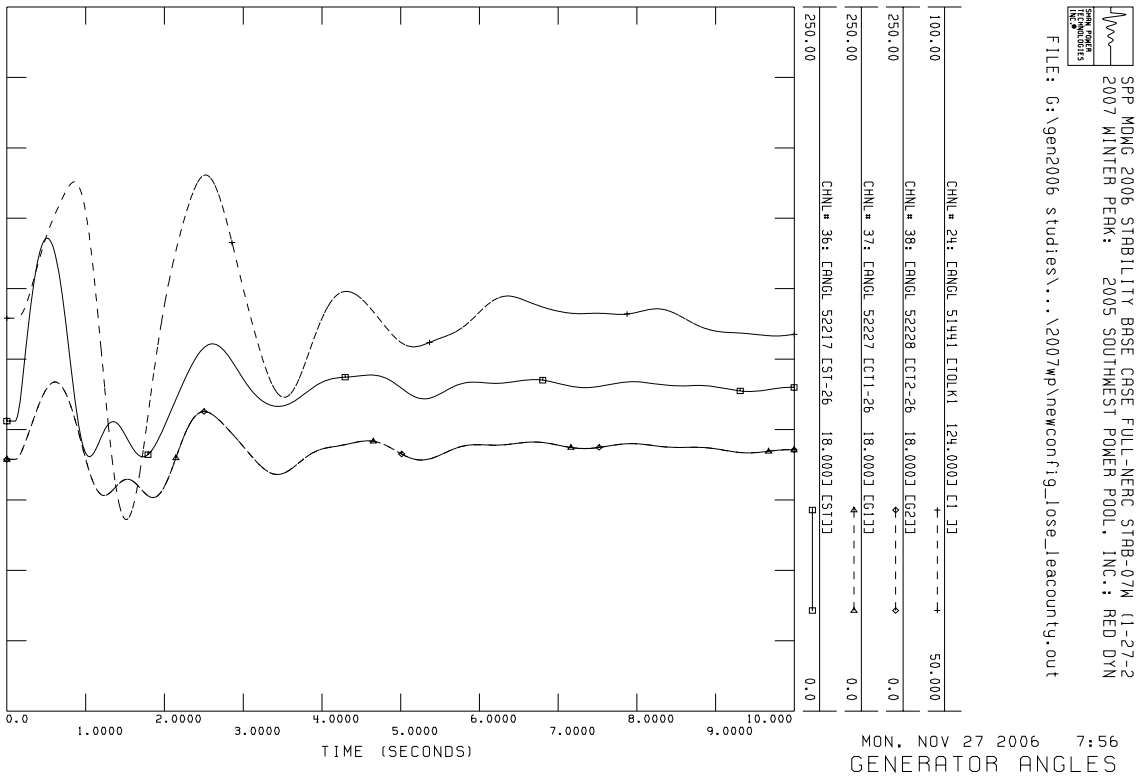

FIGURE 3. Study Project Generator Angles for Loss of Lea County 230kV line (with 115kV auto)

Additional contingencies were simulated with this configuration. Please see Table 5. for additional contingencies run for this configuration. These contingencies were taken from the Stability study conducted by Pterra. The plant was determined to be stable for all contingencies.

Table 5. Stability Results with Minimum Configuration

No.	Contingency	Description	Winter Peak 2007	Summer Peak 2011
1	FLT13PH	Three phase fault on the Lea County – Yoakum (52205-51891) 230kV line near Lea County.	Stable	Stable
2	FLT21PH	Single phase fault on the Lea County – Yoakum (52205-51891) 230kV line near Lea County.	Stable	Stable
3	FLT33PH	Three phase fault on the Lea County – Cunningham (52205-52209) 230kV line near Lea County.	Stable	Stable
4	FLT41PH	Single phase fault on the Lea County – Cunningham (52205-52209) 230kV line near Lea County.	Stable	Stable
5	FLT53PH	Three phase fault on the Cunningham-Eddy County (52209-52185) 230kV line near Eddy County.	Stable	Stable
6	FLT61PH	Single phase fault on the Cunningham-Eddy County (52209-52185) 230kV line near Eddy County.	Stable	Stable
7	FLT73PH	Three phase fault on the Cunningham-Potash Junction (52209-52253) 230kV line near Cunningham.	Stable	Stable
8	FLT81PH	Single phase fault on the Cunningham-Potash Junction (52209-52253) 230kV line near Cunningham.	Stable	Stable
9	FLT93PH	Three phase fault on the GEN-2006-026 station – Lea County (52210-52205) 230kV line near GEN-2006-026 station.	Stable	Stable
10	FLT101PH	Single phase fault on the GEN-2006-026 station – Lea County (52210-52205) 230kV line near GEN-2006-026 station.	Stable	Stable

No.	Contingency	Description	Winter Peak 2007	Summer Peak 2011
11	FLT113PH	Three phase fault on the GEN-2006-026 station – Midland (52210-52105) 230kV line near GEN-2006-026 station.	Stable	Stable
12	FLT121PH	Single phase fault on the GEN-2006-026 station – Midland (52210-52105) 230kV line near GEN-2006-026 station.	Stable	Stable
13	FLT133PH	Three phase fault on the Eddy County – Tolk 345kV line near Eddy County (52186-51440).	Stable	Stable
14	FLT141PH	Single phase fault on the Eddy County – Tolk 345kV line near Eddy County (52186-51440).	Stable	Stable
15	FLT173PH	Three phase fault on the GEN-2006-026 plant – Maddox 115kV line near GEN-2006-026 (52220-52360).	Stable	Stable
16	FLT181PH	Single phase fault on the GEN-2006-026 plant – Maddox 115kV line near GEN-2006-026 (52220-52360).	Stable	Stable
17	FLT193PH	Three phase fault on the Cunningham – Maddox 115kV line near Maddox (52208-52360).	Stable	Stable
18	FLT203PH	Single phase fault on the Cunningham – Maddox 115kV line near Maddox (52208-52360).	Stable	Stable
19	FLT233PH	Three phase fault on the GEN-2006-026 230/115kV autotransformer	Stable	Stable

The entire Stability Study conducted by Pterra can be found in Attachment 1. The Pterra study concentrated on the configuration of bringing two more 115kV lines into the plant (from Cunningham Power Station) that also ran by the project site. It is assumed these lines will be needed for transmission service to alleviate the overloads seen in Table 4. However, the minimum configuration is also studied in faults FLT253PH, FLT263PH, FLT273PH, and FLT283PH.

Conclusion

The minimum cost of interconnecting the Customer's interconnection request is estimated at $7,694,050 for SPS's interconnection Network Upgrade facilities listed in Table 2. These costs exclude upgrades of other transmission facilities SPS listed in Table 3 of which are Network Constraints. At this time, the cost estimates for other Direct Assignment facilities including those in Table 1 have not been defined by the Customer. As stated earlier, the local projects that were previously queued are assumed to be in service in this Impact Study.

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.

These interconnection costs do not include any cost that may be associated with short circuit analysis. A short circuit study will be conducted if the Customer signs a Facility Study Agreement.

The required interconnection costs listed in Table 2 and other upgrades associated with Network Constraints listed in Table 3 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.

FIGURE 4. MAP OF THE LOCAL AREA

ATTACHMENT 1. – STABILITY STUDY

Pterra Consulting

Report No. R133-06

"Impact Study for Generation Interconnection Request GEN-2006-026"

Submitted to

The Southwest Power Pool

November 2006

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Report No. R133-06

"Impact Study for Generation Interconnection Request GEN-2006-026"

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1. Executive Summary

The Southwest Power Pool (SPP) contracted Pterra LLC (Pterra) to perform stability analyses for a proposed 510 MW plant (summer rating) or 605 MW (winter rating). The plant ("the Project") consists of two on one combined cycle power plant. Each combustion turbines (CTs) is rated 25% of the total capacity and the steam unit (STG) is rated 50% of the total capacity.

The Project would be located in Lea County, New Mexico in Southwest Power Pool (SWPS d/b/a Xcel Energy Control Area). *Figure 1* shows the interconnection schematic for the proposed combined cycle plant.

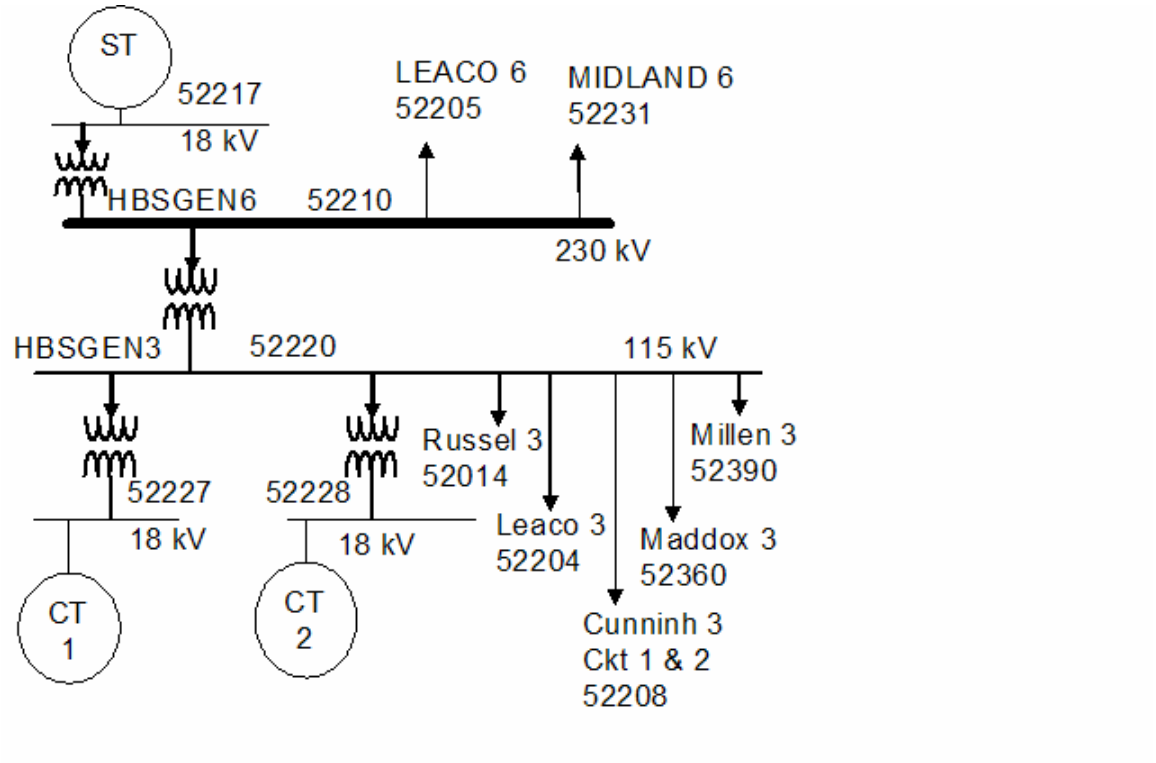

Figure 1 Interconnection Scheme for GEN-2006-026 (the Project) to the SWPS

Twenty-eight (28) contingencies were considered for the transient stability simulations which included three phase faults as well as single-line-to-ground faults at the locations defined by SPP. The simulation runs are performed at 100% MW plant dispatch with no upgrades.

The stability simulation shows stable results for both 2007 Winter Peak and 2011 Summer Peak dispatch scenarios.

Two additional scenarios were also studied in the simulation runs. The first scenario considers N-1-1 type contingencies where GEN-2006-026 230/115kV autotransformer is previously out of service. The simulation shows that the SPP system is stable; however, the Project's STG unit is unstable and is tripped out of step (the CT's units remain on line) in both the winter 2007 and summer 2011 cases. The contingency was tested at 300 and 200 MW plant capacity for winter 2007 conditions and the STG still tripped at 300 MW but was stable for 200 MW. This contingency demonstrates that an interconnection at only 230kV would not result in a stable plant and that an additional outlet is necessary for stability.

The second scenario considers a minimalist approach for interconnection of the plant. This scenario assumes that only two (2) 115kV lines are interconnected into the plant. These two lines are created by splitting the closest 115kV line to the plant, the Lea County-Maddox 115kV line. The simulations are stable and the Project CT's and STG remain on line. The minimal interconnection is shown below in Figure 2.

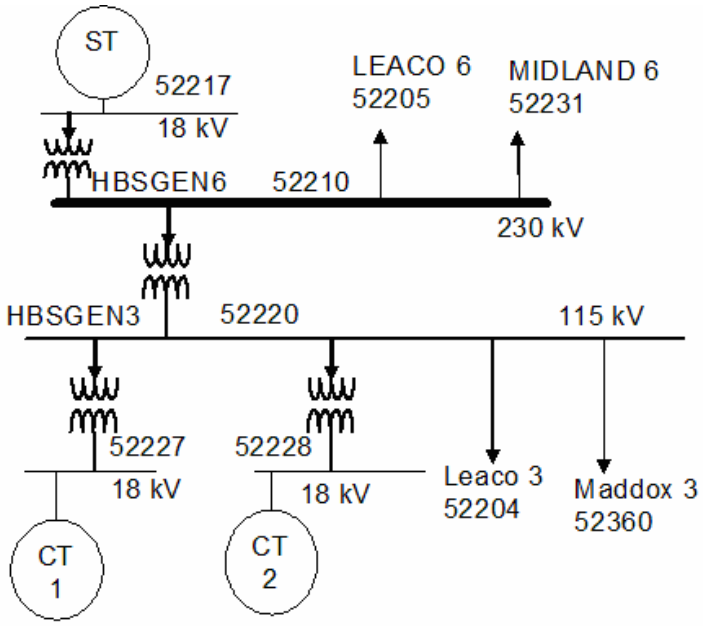

Figure 2 Minimal Interconnection Scheme for GEN-2006-026 (the Project) to the SWPS

2. Introduction

2.1 Project Overview

The Southwest Power Pool (SPP) contracted Pterra LLC (Pterra) to perform stability analyses for a proposed 510 MW plant (summer rating) or 605 MW (winter rating). The plant ("the Project") consists of two on one combined cycle power plant. Each combustion turbines (CT's) is rated 25% of the total capacity and the steam unit (STG) is rated 50% of the total capacity. The Project would be located in Lea County, New Mexico in Southwest Power Pool (SWPS d/b/a Xcel Energy Control Area).

This STG will be interconnected into the existing Lea County – Midland 230kV line and the CT's will be connected to the 115 kV network by interconnecting the existing Lea County-Maddox 115kV, Cunningham-Taylor 115kV, and Cunningham-Denver City 115kV lines. There will be a ring bus on the 230kV side and a breaker-and-a half configuration on the 115kV side. Figure3 shows the interconnection schematic for the proposed combined cycle plant.

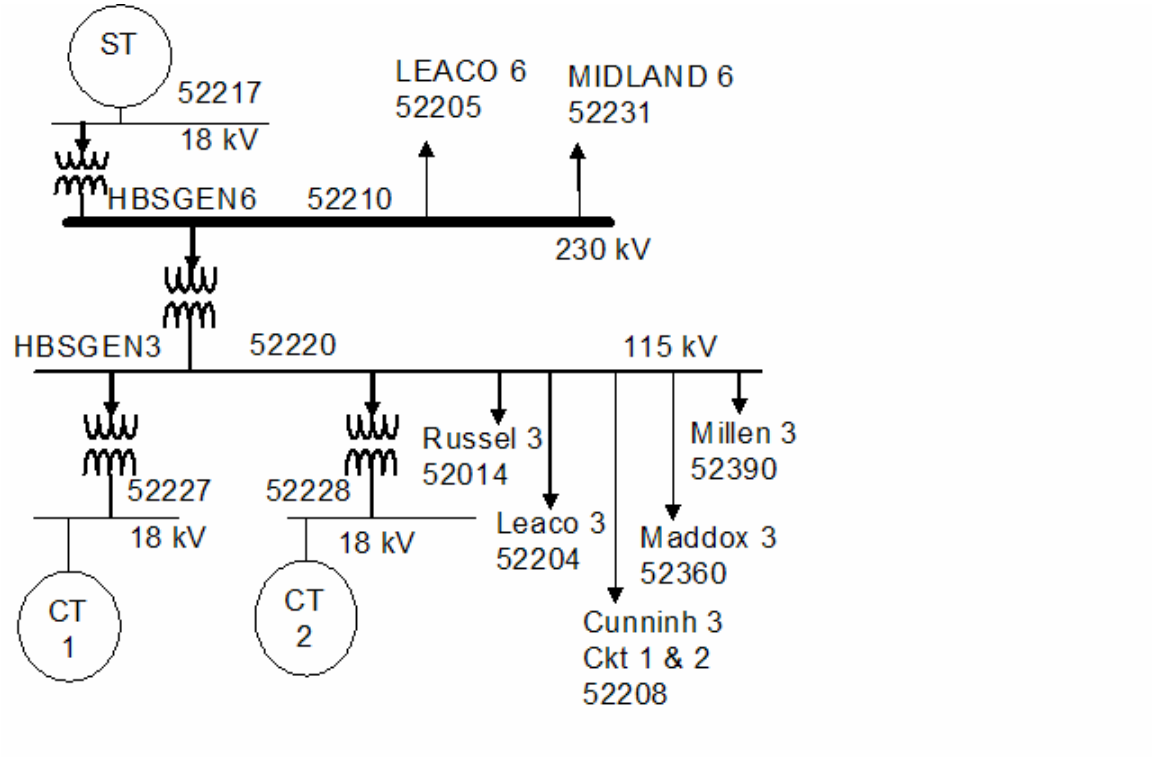

Figure 3 Interconnection Plan for GEN-2006-026 (the Project) to the SPP System

2.2 Objective

The objective of the study is to determine the impact on system stability of connecting the Project to SPP's 230/115 kV transmission system. The stability results may also include reduced stability runs to determine the maximum MW with no upgrades.

3. Stability Analysis

The study was performed with two dispatch scenarios provided by SPP:

1. 2007 Winter Peak Case and
2. 2011 Summer Peak Case.

SWPS generation will be displaced due to Project injection in order to maintain current area interchange totals. Table 1 shows this MW allocation provided by SPP.

Table 1 Re-dispatch for the Project

Winter Peak 2007		Summer Peak 2011	
Plant	Action	Plant	Action
50912 Nichols 2	Turn off 41 MW	51443 Tolk 3	Turn off 316 MW
53703 Knox Lee 5	Turn off 225 MW	50911 Nichols 1	Turn off 104 MW
54998 McClain 1	Turn off 140 MW	51442 Tolk 2	Reduce by 90 MW
56662 LEC 4	Turn off 100 MW	--	--
57955 Lacyne 1	Reduce by 50 MW	--	--
57956 Lacyne 2	Reduce by 50 MW	--	--

In addition to the base cases and interconnection configuration, SPP provided the Project data consisting of generating units and their generating step-up transformers. This data is included in Appendix A of this report for the STG and CT's, respectively.

3.1 Contingencies Simulated

Twenty-eight (28) contingencies were considered for the transient stability simulations which included three phase faults as well as single-line-to-ground faults at the locations defined by SPP.

Single-line-to-ground faults were simulated by applying a fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60-65 % of pre-fault voltage.

Table 2 shows the list of simulated contingencies. SPP provided the fault clearing time and the time delay before re-closing for all the study contingencies.

Table 2 List of Simulated Contingencies and Result Summary of Dynamic Response for 2007 Winter Peak and 2011 Summer Peak Scenarios

No.	Contingency	Description	Winter Peak 2007	Summer Peak 2011
1	FLT13PH	Three phase fault on the Lea County – Yoakum (52205-51891) 230kV line near Lea County.	Stable	Stable
2	FLT21PH	Single phase fault and sequence like Cont. No. 1	Stable	Stable
3	FLT33PH	Three phase fault on the Lea County – Cunningham (52205-52209) 230kV line near Lea County.	Stable	Stable
4	FLT41PH	Single phase fault and sequence like Cont. No. 3	Stable	Stable
5	FLT53PH	Three phase fault on the Cunningham-Eddy County (52209-52185) 230kV line near Eddy County.	Stable	Stable
6	FLT61PH	Single phase fault and sequence like Cont. No. 5	Stable	Stable
7	FLT73PH	Three phase fault on the Cunningham-Potash Junction (52209-52253) 230kV line near Cunningham.	Stable	Stable
8	FLT81PH	Single phase fault and sequence like Cont. No. 7	Stable	Stable
9	FLT93PH	Three phase fault on the GEN-2006-026 station – Lea County (52210-52205) 230kV line near GEN-2006-026 station.	Stable	Stable

No.	Contingency	Description	Winter Peak 2007	Summer Peak 2011
10	FLT101PH	Single phase fault and sequence like Cont. No. 9	Stable	Stable
11	FLT113PH	Three phase fault on the GEN-2006-026 station – Midland (52210-52105) 230kV line near GEN-2006-026 station.	Stable	Stable
12	FLT121PH	Single phase fault and sequence like Cont. No. 11	Stable	Stable
13	FLT133PH	Three phase fault on the Eddy County – Tolk 345kV line near Eddy County (52186-51440).	Stable	Stable
14	FLT141PH	Single phase fault and sequence like Cont. No. 13	Stable	Stable
15	FLT153PH	Three phase fault on the GEN-2006-026 plant – Cunningham 115kV line near GEN-2006-026 (52220-52208).	Stable	Stable
16	FLT161PH	Single phase fault and sequence like Cont. No. 15	Stable	Stable
17	FLT173PH	Three phase fault on the GEN-2006-026 plant – Maddox 115kV line near GEN-2006-026 (52220-52360).	Stable	Stable
18	FLT181PH	Single phase fault and sequence like Cont. No. 17	Stable	Stable
19	FLT193PH	Three phase fault on the Cunningham – Maddox 115kV line near Maddox (52208-52360).	Stable	Stable
20	FLT201PH	Single phase fault and sequence like Cont. No. 19	Stable	Stable
21	FLT213PH	With the GEN-2006-026 230/115kV autotransformer previously out of service; Three phase fault on the GEN-2006-026 station – Lea County (52210-52205) 230kV line near GEN-2006-026 station.	STG is out-of-step.	STG is out-of-step.

No.	Contingency	Description	Winter Peak 2007	Summer Peak 2011
22	FLT221PH	Single phase fault and sequence like Cont. 21.	STG is out-of-step.	STG is out-of-step.
22A		Same as Cont. No. 21 but with the Project at 300 MW	STG is out-of-step	Not tested
22B		Same as Cont. No. 21 but with the Project at 200 MW	Stable	Not tested
23	FLT233PH	Three phase fault on the GEN-2006-026 station 230/115 kV transformer (52210-52220).	Stable	Stable
24	FLT241PH	Single phase fault and sequence like Cont. 23	Stable	Stable
25	FLT253PH	With only the Lea County-Maddox 115kV line interconnected into GEN-2006-026; Three phase fault on the GEN-2006-026 station – Lea County (52210-52205) 230kV line near GEN-2006-026 station.	Stable	Stable
26	FLT263PH	With only the Lea County-Maddox 115kV line interconnected into GEN-2006-026; Three phase fault on the GEN-2006-026 station – Maddox (52220-52360) 115kV line near GEN-2006-026 station.(Repeat contingency #17)	Stable	Stable
27	FLT273PH	With only the Lea County-Maddox 115kV line interconnected into GEN-2006-026; Three phase fault on the GEN-2006-026 station – Lea County (52220-52204) 115kV line near GEN-2006-026 station.	Stable	Stable
28	FLT283PH	With only the Lea County-Maddox 115kV line interconnected into GEN-2006-026; Three phase fault on the CT high side GSU. Trip CT after 5 cycles	Stable	Stable

3.2 Simulation Results and Conclusion

Stability simulations were performed with a 0.5-second steady-state run followed by the appropriate disturbance as described in Table 2. Simulations were run for 20-second duration. Simulation plots are provided in a separate CD-ROM.

The stability simulation shows stable results for both 2007 Winter Peak and 2011 Summer Peak dispatch scenarios.

Two additional scenarios were also studied in the simulation runs. The first scenario considers N-1-1 type contingencies (Nos. 21 and 22) where GEN-2006-026 230/115kV autotransformer is previously out of service. This scenario was chosen specifically to determine if the plant would be stable if it was only interconnected into the Lea County – Midland 230kV bus with no connection to the 115kV system. The simulation shows that the SPP system is stable; however, the Project's STG unit is unstable and is tripped out of step (the CT's units remain on line) in both the winter 2007 and summer 2011 cases. Therefore, it is determined that the 115kV connection is necessary to make the plant stable for loss of the Lea County 230kV line.

Contingency 21 was tested at 300 and 200 MW plant capacity for winter 2007 conditions and the STG still tripped at 300 MW but was stable for 200 MW.

The second scenario (contingencies 25, 26, 27 and 28) considers that with a 115kV interconnection, what the minimum amount of 115kV lines are necessary to make the plant stable. The scenario considers only that the Lea County – Maddox 115kV line is interconnected into the GEN-2006-026 station. The simulations are stable and the Project CT's and STG remain on line. Therefore, the only costs to chargeable to the interconnection of the plant will be the addition of the Lea County and Maddox 115kV line terminals along with the 230/115kV autotransformer and the 230kV ring bus.

The additional 115kV lines and terminals may be necessary for the plant to receive transmission service. However, that issue will be dealt with when the Customer requests transmission service under the Southwest Power Pool Open Access Transmission Tariff.

Appendix A. The Project Data

STEAM TURBINE DATA (STG)

COMBUSTION TURBINE DATA (CT)

Appendice B. Simulation Plots

Stability simulations are run and plotted by Power-Tek and provided in a separate CD ROM.