



***Impact Study
For
Generation Interconnection
Request
GEN-2006-008***

SPP Tariff Studies

(#GEN-2006-008)

December, 2006

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Pterra Consulting Inc. (Pterra) performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customer and SPP for SPP Generation Interconnection request Gen-2006-008.

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.

Interconnection Facilities

No new interconnection facilities were found to be needed because of the Impact Study. Costs for the Interconnection Facilities were given in the Feasibility Study. These estimates are repeated below in Table 1 and Table 2. These estimates will be refined in the Facility Study if the Customer executes a Facility Study Agreement for this request. Also, in the Facility Study, the Transmission Owner will conduct a short circuit analysis to determine if any circuit breaker's fault duty is exceeded due to the addition of the proposed generation facility. The costs from this study will also be detailed in the Facility Study.

Table 1: Direct Assignment Facilities

| Facility | ESTIMATED COST (2006 DOLLARS) |
|--|----------------------------------|
| Customer – 138kV, 18kV equipment | * |
| Customer – 138kV connection from GSU and reserve auxiliary to Arsenal Hill 138kV bus | \$950,000 |
| | |
| | |
| Total | * |

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

Table 2: Required Interconnection Network Upgrade Facilities

| Facility | ESTIMATED COST (2006 DOLLARS) |
|--|----------------------------------|
| AEP – Add 138kV terminal including one 138kV circuit breaker to the Arsenal Hill 138kV ring bus. | \$1,781,000 |
| AEP – Relocate Arsenal Hill-Linwood 138kV line entry point into Arsenal Hill 138kV ring bus | \$340,000 |
| | |
| Total | \$2,121,000 |

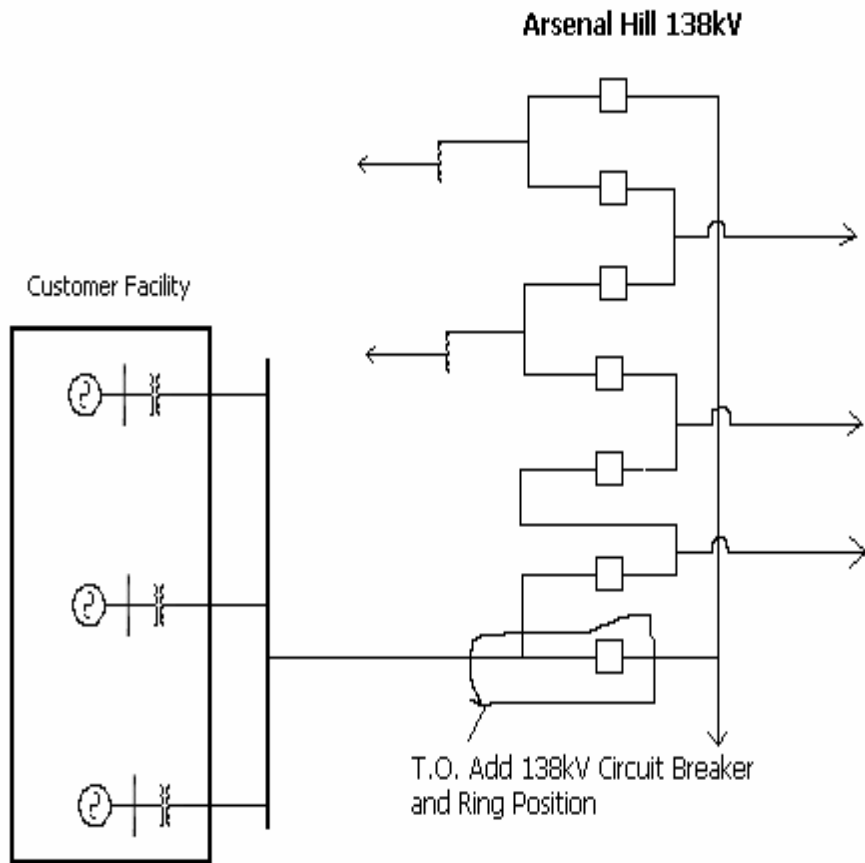


Figure 1: Proposed Interconnection
(Final substation design to be determined)

Pterra Consulting

Report No. R140-06

“Impact Study for Generation Interconnection Request GEN-2006-008”

Submitted to

The Southwest Power Pool

December 2006



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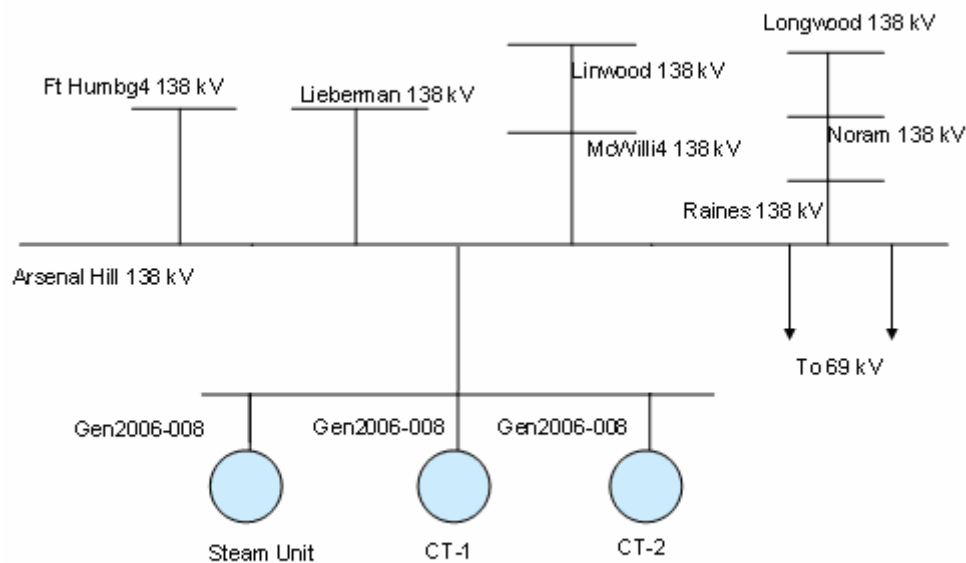
‘Impact Study for Generation Interconnection Request GEN- 2006-008’

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1. Executive Summary

The Southwest Power Pool (SPP) contracted Pterra LLC (Pterra) to perform stability analyses for a proposed 455 MW plant (summer rating) or 550 MW (winter rating). The plant (“the Project”) consists of two on one combined cycle power plant. Each combustion turbines (CTs) is rated 1/3 of the total capacity and the steam unit (STG) is rated 1/3 of the total capacity.

The Project would be located in Caddo Parish, Louisiana in the American Electric Power West control area. The point of interconnection will be at Arsenal Hill 138 kV switchyard. Presently, Arsenal Hill 138kV bus is configured as a six breaker ring bus. Addition of the proposed generation will add one breaker position to the ring. *Figure 1* shows the interconnection schematic for the proposed combined cycle plant.



**Arsenal Hill 138kV presently configured as a 6 breaker ring.
New generation will add one breaker position.**

Figure 1 Interconnection Scheme for GEN-2006-008 (the Project)

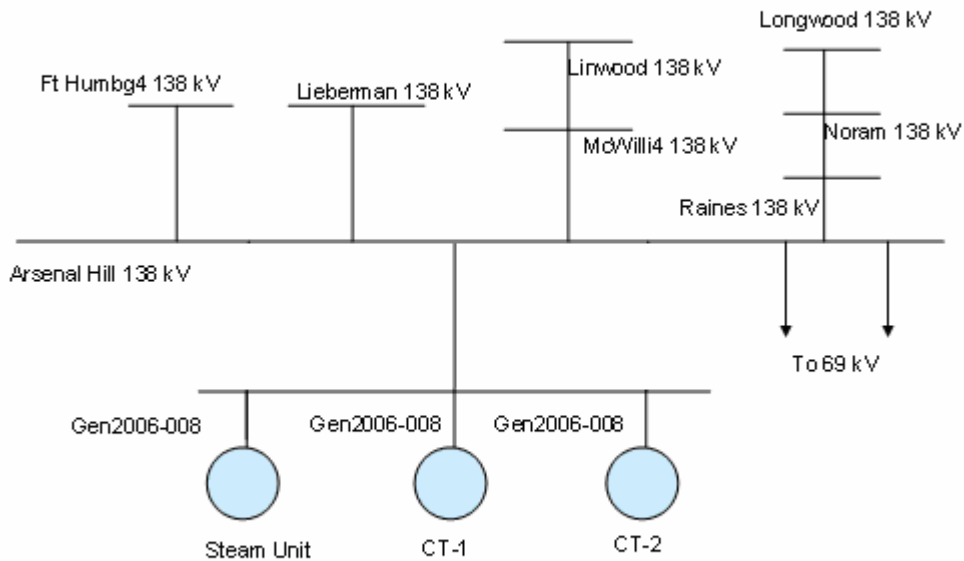
Sixteen (16) contingencies were considered for the transient stability simulations which included three phase faults as well as single-line-to-ground faults at the locations defined by SPP. The simulation runs are performed at 100% plant dispatch output with no upgrades.

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

2. Introduction

2.1 Project Overview

The Southwest Power Pool (SPP) contracted Pterra LLC (Pterra) to perform stability analyses for a proposed 455 MW plant (summer rating) or 550 MW (winter rating). The plant (“the Project”) consists of two on one combined cycle power plant. Each combustion turbines (CT’s) is rated 1/3 of the total capacity and the steam unit (STG) is rated 1/3 of the total capacity. The Project would be located in Caddo Parish, Louisiana in the American Electric Power West control area. The point of interconnection will be at Arsenal Hill 138 kV switchyard. Presently, the Arsenal Hill 138kV switchyard is a six breaker ring bus. The proposed generation will add one breaker position to the ring.



**Arsenal Hill 138kV presently configured as a 6 breaker ring.
New generation will add one breaker position.**

Figure 2 Interconnection Plan for GEN-2006-008 (the Project)

2.2 Objective

The objective of the study is to determine the impact on system stability of connecting the Project to SPP’s 138 kV transmission system. 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.

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.

Generation within the SPP footprint will be displaced due to Project's injection in order to conduct the analysis. 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 |
| 54208 SWS3-1 | Turn off 238 MW | 54206 SWS1-1 | Turn off 80 MW |
| 54944 HSL 9G | Turn off 45 MW | 54207 SWS2-1 | Turn off 80 MW |
| 54945 HSL 10G | Turn off 45 MW | 54208 SWS3-1 | Reduce by 100 MW |
| 55000 MCLN | Turn off 132 MW | 55000 MCLN | Turn off 160 MW |
| 55996 MORLND1 | Turn off 47 MW | 54944 HSL 9G | Turn off 45 MW |
| 55997 MORLND2 | Reduce by 43 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

Sixteen (16) 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 | Fault on the Arsenal Hill (#53386) – Lieberman (#53420) 138kV line, near Arsenal Hill. | Stable | Stable |
| 2 | FLT21PH | 1-phase fault Same as FLT13PH above | Stable | Stable |
| 3 | FLT33PH | Fault on the Arsenal Hill (#53386) – Longwood (#53423) (via Raines and Noram), 138kV line, near Arsenal Hill. | Stable | Stable |
| 4 | FLT41PH | 1-phase fault Same as FLT33PH above. | Stable | Stable |
| 5 | FLT53PH | Fault on the Arsenal Hill (#53386) – Linwood (#53422)(via McWillie), 138kV line, near Arsenal Hill. | Stable | Stable |
| 6 | FLT61PH | 1-phase fault Same as FLT53PH above. | Stable | Stable |
| 7 | FLT73PH | Fault on the Arsenal Hill (#53386) – Fort Humbug (#53409), 138kV line, near Arsenal Hill. | Stable | Stable |
| 8 | FLT81PH | 1-phase fault Same as FLT73PH above. | Stable | Stable |
| 9 | FLT93PH | Fault on the Arsenal Hill 138/69kV autotransformer on the 138kV bus. | Stable | Stable |
| 10 | FLT101PH | 1-phase fault Same as FLT93PH above. | Stable | Stable |
| 11 | FLT113PH | Fault on the Longwood (#53424) – El Dorado (#99294) 345kV line near Longwood. | Stable | Stable |
| 12 | FLT121PH | 1-phase fault Same as FLT113PH above. | Stable | Stable |
| 13 | FLT133PH | Fault on the Southwest Shreveport (#53454) – Diana (#53528) 345kV line near SW Shreveport. | Stable | Stable |
| 14 | FLT141PH | 1-phase fault Same as FLT113PH above. | Stable | Stable |

| No. | Contingency | Description | Winter Peak 2007 | Summer Peak 2011 |
|-----|-------------|--|------------------|------------------|
| 15 | FLT153PH | Fault on the Southwest Shreveport (#53454) – Dolet Hills (#50045) 345kV line near SW Shreveport. | Stable | Stable |
| 16 | FLT161PH | 1-phase fault Same as FLT153PH above. | 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.

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.