System Impact Study for Interconnection of >Omitted Text< 300 MW Generation Facility

Southwest Transmission Planning

(#OAIP 02 003)

March 2003

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Executive Summary

>Omitted Text< has requested an Impact Study for the interconnection of a merchant plant at the Lawton Energy site in Lawton, Oklahoma. The plant will have a maximum output of 332 MW. The projected in service date is 2005.

The principal objectives of this study are to: 1) identify any system problems associated with the connection of the proposed plant, 2) determine potential system modifications that might be necessary to facilitate the installation of the plant while maintaining system reliability and stability, and 3) estimate the costs associated with those system modifications. The study includes a steady state contingency analysis, a transient stability analysis, and an analysis of whether the interrupting capabilities of the existing circuit breakers in the area are exceeded with the addition of this new generation.

For the purposes of this study, four seasons were studied, the 2005 summer & winter peaks and the 2008 summer & winter peaks. In each case all of the plant's output was delivered to American Electric Power's (AEP) Public Service Company of Oklahoma (PSO) service area.

The estimated cost of the transmission interconnection facilities for the new >Omitted Text< generation facility is $9.0 million. This cost includes interconnection costs on the AEP system including upgrades needed to correct short circuit problems caused by the >Omitted Text< generation. All estimated costs are in 2003 dollars.

The analysis in this document shows that to accommodate a transfer, upgrades may be required on the AEP 138 kV and 69 kV transmission systems to relieve certain criteria violations. These violations are listed in Tables 1 through 4 of the Steady State Analysis section. The analysis also shows that a number of facilities in other control areas are overloaded in the transfer case and not in the base case. Those facilities in the other control areas are not tabulated.

>Omitted Text< requested that the new plant be connected into AEP Public Service Company of Oklahoma's (PSO) transmission system with three new 138 kV lines from the new >Omitted Text< 138 kV Substation to points on PSO's 138 kV grid. The three lines would connect to PSO's Lawton 112th & Gore, Lawton Goodyear, and Lawton Republic Paper substations. The study was completed using the above scenario.

Alternatively, AEP has determined that in this particular case only two 138 kV lines are required to ensure acceptable stability and capacity to interconnect the >Omitted Text< generation to PSO. The lines needed would be from the new >Omitted Text< plant to PSO's Lawton 112th & Gore substation and to Lawton Goodyear substation. Both lines would require 1590 ACSR conductor.

Introduction

>Omitted Text< has requested an Impact Study for the interconnection of a merchant plant at the Lawton Energy site in Lawton, Oklahoma. The plant will have a maximum output of 332 MW. The projected in service date is 2005.

The principal objectives of this study are to: 1) identify any system problems associated with the connection of the proposed plant, 2) determine potential system modifications that might be necessary to facilitate the installation of the plant while maintaining system reliability and stability, and 3) estimate the costs associated with those system modifications. The study includes a steady state contingency analysis, a transient stability analysis, and an analysis of whether the interrupting capabilities of the existing circuit breakers in the area are exceeded with the addition of this new generation.

The steady-state analysis considers the impact of the new generation on transmission facility loading and transmission bus voltages for outages of single, double, and triple circuit transmission lines, autotransformers, and generators.

Stability analysis shows the effects of the new generation on the transient stability of Public Service Company of Oklahoma (PSO) and surrounding utility generators. Transient stability is concerned with recovery from faults on the transmission system that are in close proximity to generating facilities.

This study also includes a short circuit analysis that determines whether the interruption capabilities of existing circuit breakers are exceeded with the addition of the new generation.

As requested by >Omitted Text<, the interconnection of the new plant was studied with three new 138 kV lines from the new >Omitted Text< 138 kV Substation connecting into AEP Public Service Company of Oklahoma's (PSO) transmission system. The three lines would connect to PSO's Lawton 112th & Gore, Lawton Goodyear, and Lawton Republic Paper substations.

Interconnection Facilities

All of the facilities described below will be constructed using current AEP standards, practices, and processes.

Lawton Energy 138 kV Station

The proposed >Omitted Text< plant is to be interconnected with the transmission facilities, via a new 138 kV station adjacent to the plant which will be constructed by >Omitted Text< to provide the interface. The interconnection points between >Omitted Text< and AEP will be the transmission deadend towers inside the substation. The switching facility will consist of six 138 kV breakers in a ring bus configuration including three 138 kV line terminals and three generator terminals. The facility will include all metering, protection and SCADA systems. >Omitted Text< will provide the property and initial site preparation for the construction of the facility. >Omitted Text< will also build and own the station.

The design and construction of the switching station will meet all AEP specifications for stations. Support structures and line terminal equipment will be designed to terminate the respective circuits for the transmission lines which are described below. Bus work and disconnect switches will be designed to accommodate the loading requirements, and circuit breakers will be rated to ensure adequate load and fault interrupting capability. Metering equipment will be installed to monitor the plant output and will meet the required accuracy specifications. AEP will operate and maintain, at >Omitted Text<'s cost, the circuit breakers associated with AEP's lines.

Lawton 112th & Gore Substation

A 138 kV terminal will be added at Lawton 112th & Gore for the new 138 kV line to the Lawton Energy station. The addition of a sixth line to Lawton 112th & Gore will require that the 138 kV bus be split with a tie-breaker. The cost of this work is estimated to be $850,000.

As no detailed construction plan has been prepared at this stage, it is not possible to assess the impact of construction on operations, and vice versa, but it can be assumed some degree of clearance coordination will be required.

Lawton Energy – Lawton 112th & Gore & Lawton Energy – Lawton Goodyear 138 kV Double Circuit Transmission Line

AEP will construct a double circuit 138 kV transmission line from the new Lawton Energy facility to Lawton 112th & Gore and to Lawton Goodyear, a distance of approximately 1.9 miles. The line shall be supported predominantly on single pole steel or concrete structures, direct buried, double circuited in most locations, with several self-supporting anchor bolt foundations on an AEP acquired easement. The phase conductors shall be 795 ACSR with a 3/8" EHS steel shield wire. The cost of the new line construction including right-of-way is estimated to be $3,450,000.

Lawton 112th & Gore 138 kV Goodyear Terminal

AEP will add a 138 kV breaker in the Goodyear terminal at Lawton 112th & Gore substation. The cost of this breaker addition is estimated to be $280,000.

Goodyear 138 kV Substation

AEP will add a 138 kV breaker at Lawton Goodyear and split the existing 138 kV bus. The estimated cost of this bus and terminal work is $900,000. A more detailed cost review would be required prior to authorization of budget funds when a firm project scope is determined.

The control building at Lawton Goodyear is undersized. There is insufficient room for addition of any panels. Therefore, the building must either be expanded or additional enclosures must be built to accommodate panels required for this new breaker addition.

Lawton 112th & Gore – Lawton Goodyear 138 kV Transmission Line

AEP will rebuild the single circuit 138 kV transmission line from Lawton 112th & Gore to Lawton Goodyear, a distance of approximately 0.6 miles. The line shall be supported on single pole steel or concrete structures, primarily direct embedded, with a minimal number of anchor bolt foundations on an AEP acquired easement. The phase conductors shall be 795 ACSR with a 3/8" EHS steel shield wire. The cost for the rebuild is estimated to be $760,000.

Lawton Paperboard 138 kV

AEP will rebuild the 138 kV portion of Lawton Paperboard substation to accommodate the addition of the new 138 kV line to the Lawton Energy substation. This will require the addition of a three-breaker 138 kV ring bus. The estimated cost of this bus and terminal work is $1,280,000. This costs does not include any costs for the land necessary for expansion.

The existing Lawton Paperboard substation is essentially one distribution transformer tapped from a 138 kV line between Lawton 112th & Gore and Lawton Eastside. Adequate property exists west of the existing fenced station on which a new site could be developed and a three-breaker 138 kV ring bus facility could be constructed if Lawton Paperboard is in agreement. This should permit construction of the new transmission facilities with minimal interruption to existing service. After construction of new transmission station facilities, a new control building will have to be built to add several new relay panels. The existing substation does not have a control building. In summary, expansion of this station should incur minimal risk or difficulty.

The majority of this construction could be completed with minimal disturbance of existing operations, assuming the land adjacent to the existing station is available for construction.

Lawton Energy – Lawton Paperboard 138 kV Transmission Line

AEP will construct a single circuit 138 kV transmission line from Lawton Energy to Lawton Paperboard, a distance of approximately 1.2 miles. The line shall be supported primarily on single pole steel or concrete structures, with some being directly embedded: a few anchor bolt foundations also could be required. The line shall be built on an AEP acquired easement. The phase conductors shall be 1590 ACSR with a 3/8" EHS steel shield wire. The cost of the new line construction including right-of-way is estimated to be $1,350,000.

Lawton Eastside Breaker Replacement

AEP will replace 138 kV circuit breaker 1325B at Lawton Eastside due to short circuit ratings violations caused by the added generation of the Lawton Energy facility. Details of the analysis are discussed in the Short Circuit Analysis section. The estimated cost of the breaker replacement is $130,000.

Project Summary

The project costs detailed above are as summarized below:

Lawton 112th & Gore 138 kV Terminal	$ 850,000
Lawton Energy Double Circuit 138 kV Line	$3,450,000
Lawton 112th & Gore, Goodyear 138 kV Terminal	$ 280,000
Lawton Goodyear 138 kV Station	$ 900,000
Lawton 112th & Gore – Law. Goodyear 138 kV Line	$ 760,000
Lawton Paperboard 138 kV Station	$1,280,000
Lawton Energy – Lawton Paperboard 138 kV Line	$1,350,000
Lawton Eastside Breaker Replacement	$ 130,000

The total project cost for facilities described herein to connect the new >Omitted Text< Lawton Energy generation into the PSO transmission grid is estimated to be $9.0 million. These cost estimates are based on the project only as defined herein and should be considered conceptual estimates. Estimates will be prepared when the project scope and schedule are fully defined and may vary from these conceptual estimates.

Interconnection Costs

Listed below are the costs associated with interconnecting the >Omitted Text< Lawton Energy 332 MW generation facility to the transmission system.

SYSTEM IMPROVEMENT	COST (2003 DOLLARS)
Lawton 112th & Gore, split 138 kV bus and add 138 kV Terminal for new line	$850,000
Lawton Energy Double Circuit, 795 ACSR, 138 kV Line	$3,450,000
Lawton 112th & Gore, Add 138 kV Breaker to Lawton Goodyear Terminal	280,000
Lawton Goodyear, Add 138 kV breaker and split 138 kV bus	$900,000
Lawton 112th & Gore to Lawton Goodyear 138 kV line, rebuild with 795 ACSR	$760,000
Lawton Paperboard 138kV convert to ring bus	$1,280,000
Lawton Energy to Lawton Paperboard, 795 ACSR, 138 kV line	$1,350,000
Replace (1) 138 kV breaker at Lawton Eastside (1325B)	$130,000
TRANSMISSION INTERCONNECTION FACILITY TOTAL COSTS	$9,000,000

Additionally AEP looked at connecting the new >Omitted Text< facility with only two 138 kV lines. The lines would connect the new plant to Lawton Goodyear and Lawton 112th & Gore substations. The lines would be constructed with 1590 ACSR conductor. AEP has determined that due to the relatively small plant size and the short distance of the interconnection lines that under single contingency conditions stability can be maintained with the plant operating at maximum output. It was also determined that under single contingency analysis no new overloads besides those shown in tables 1 through 4 would occur and no additional circuit breakers would have to be replaced for exceeding their interrupting capabilities. The estimated cost of interconnecting the plant with two 138 kV lines is $ 7.1 Million. The configuration for this interconnection is shown in Figure 3.

EXISTING LAWTON AREA

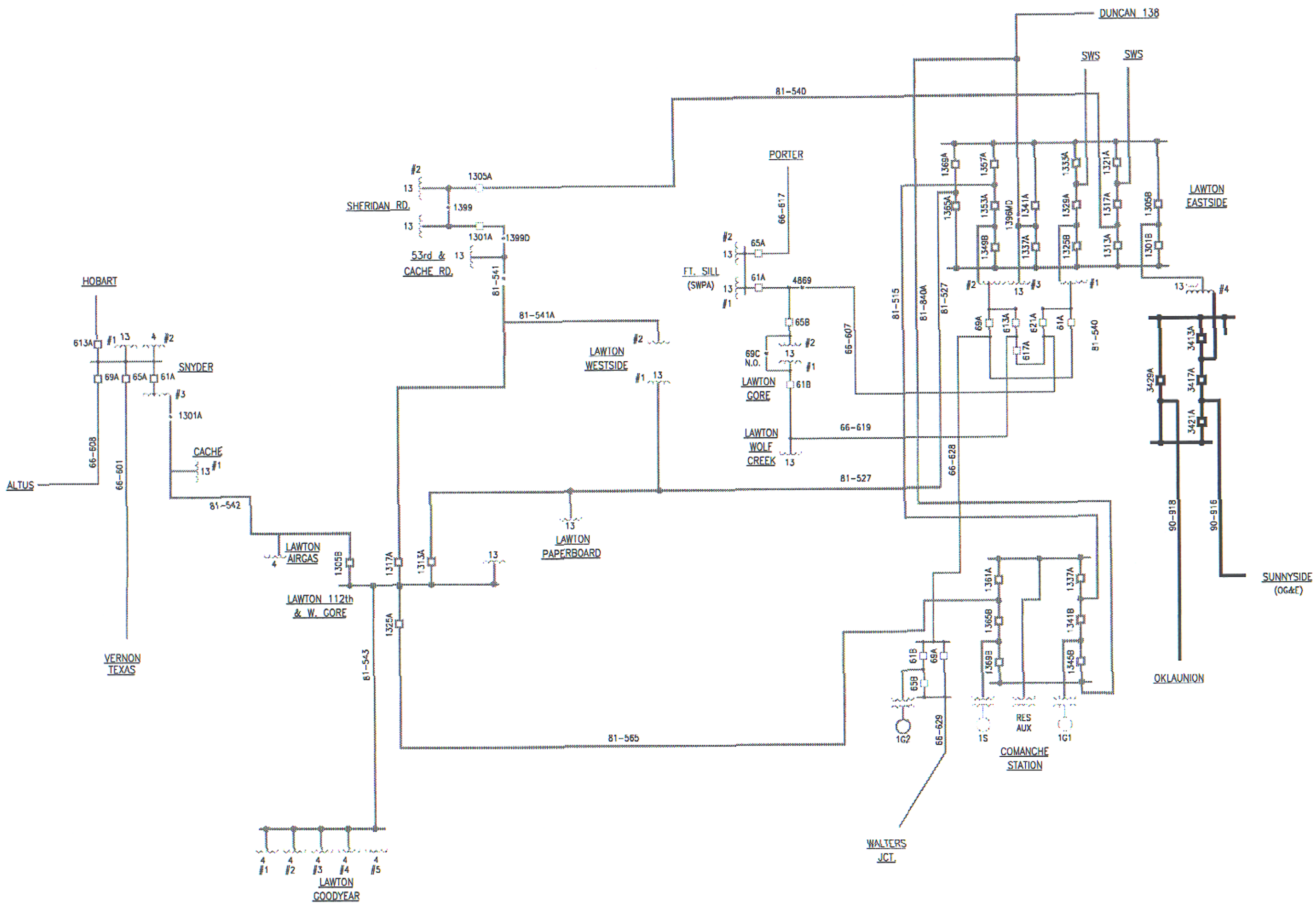


FIGURE 1

LAWTON AREA — WITH LAWTON ENERGY

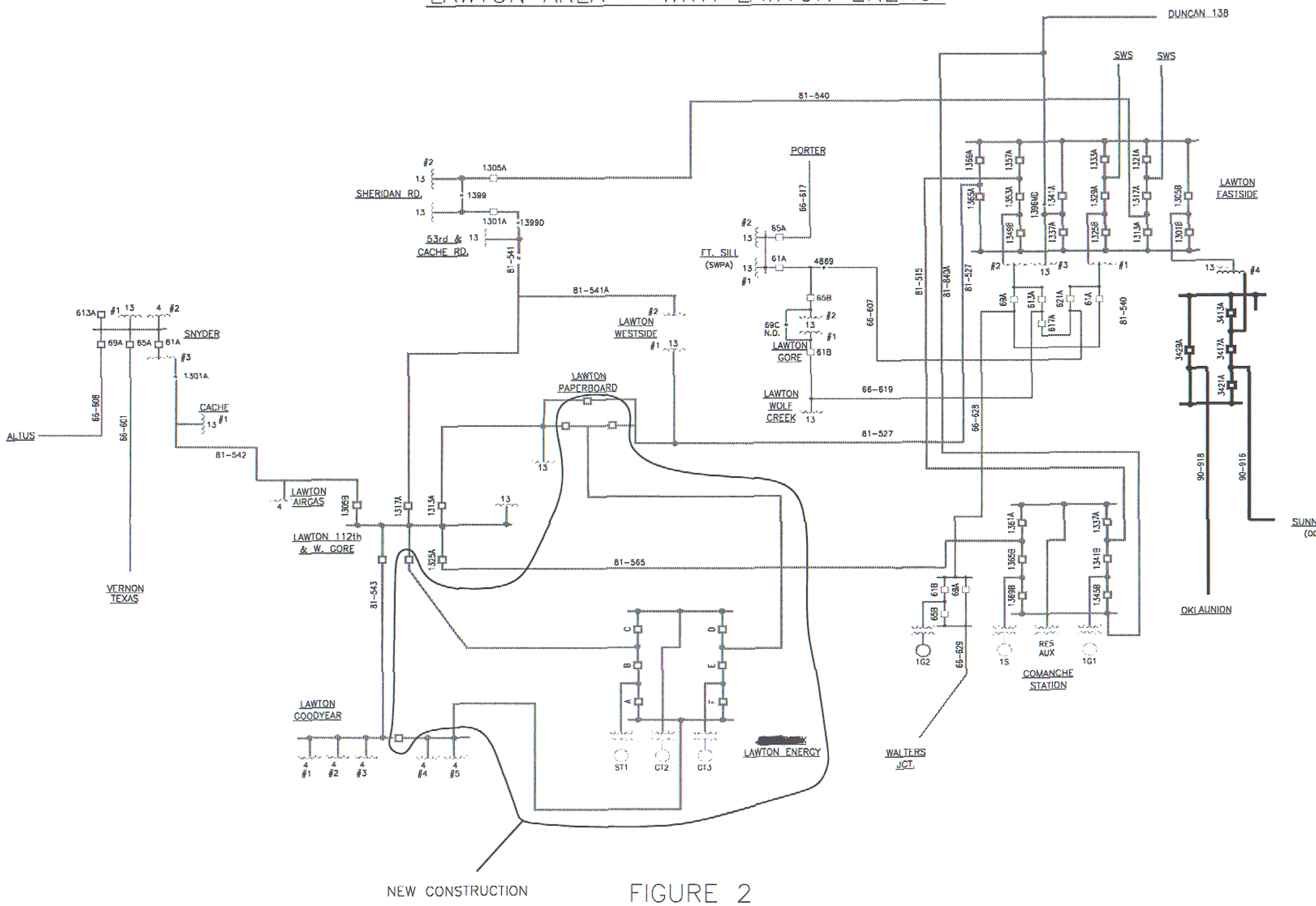


FIGURE 2

LAWTON AREA – WITH LAWTON ENERGY & TWO NEW 138KV LINES

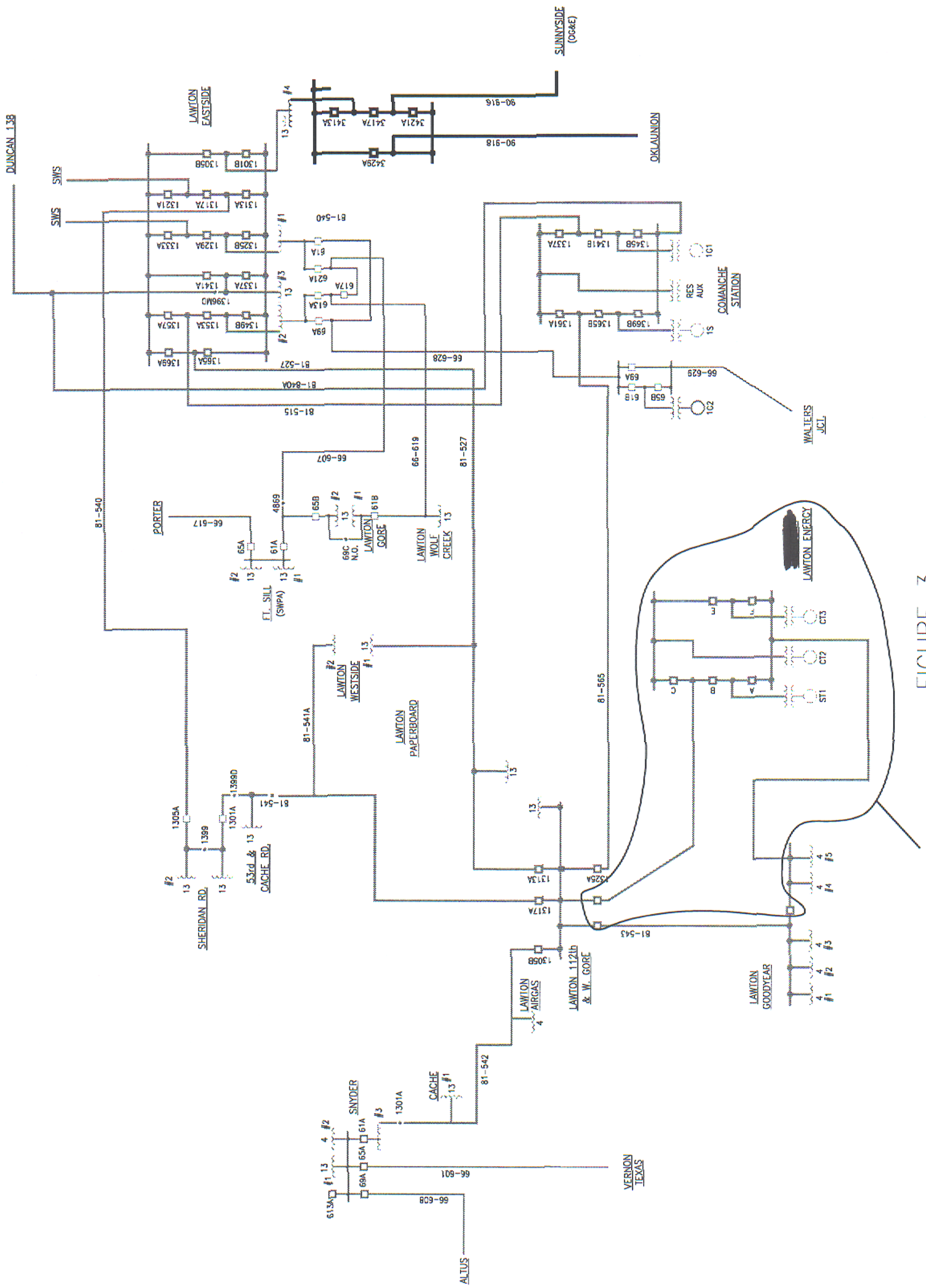


FIGURE 3

A. Steady State Analysis

Study Methodology

The AEP and Southwest Power Pool (SPP) criteria state that the following conditions be met in order to maintain a reliable and stable system.

1) More probably contingency testing .... must conclude that

   a) All facility loadings are within their emergency ratings and all voltages are within their emergency limits (0.90-1.05 per unit) and
   b) Facility loadings can be returned to their normal limits within four hours

2) Less probable contingency testing .... shall conclude that

   a) Neither uncontrolled islanding, nor uncontrolled loss of large amounts of load will result.

More probable contingency testing is defined as losing any single piece of equipment or multi-circuit transmission lines. Less probable contingency testing involves the loss of any two critical pieces of equipment such as 345 kV autotransformers and generating units or the loss of critical transmission lines in the same right-of-way.

The 2002 series Southwest Power Pool 2005 summer and winter peak and 2008 summer and winter peak base cases were used to model the transmission network and system loads. These cases were modified to reflect known firm point-to-point transmission requests that have been approved.

Per information received from >Omitted Text<, the point of receipt of the generated capacity of the new plant called for 100% of the output to be sent to the PSO service area.

Using the created models and PTI's PSS/E program, single and select double contingency outages on the SPP system were analyzed to determine the necessary facilities to interconnect the proposed plant to the transmission system. This load flow analysis is described on the following pages.

Next, using the created models and the ACCC function of PTI's PSS/E program, single and select double contingency outages on the SPP system were analyzed. Facilities in the western AEP control area found to be overloaded in the transfer cases and not in the base cases were flagged and listed in Tables 1 through 4. A number of such facilities in other control areas were also found to be overloaded in the transfer case and not in the base case. Those facilities in the other control areas were not tabulated.

<u>Table 1</u> – Overloaded facilities in the AEPW control area for 2005 summer peak with >Omitted Text< facility connected and a 300 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	300 MW Transfer Case % Loading	Outaged Branch That Caused Overload
LAWTON 112TH & GORE TAP – LAWTON WESTSIDE NORTH TAP 138 KV	170	110.2	COMANCHE STATION TRIPLE CIRCUIT
DUNCAN 138/69 KV AUTOTRANSFORMER	55	107.5	COMANCHE – LAWTON DISPOSAL TAP
HUGO TO VALLEY TIMBER 138 KV	48	101.7	TUPELO (SWPA) TO ALLEN NG TAP 138 KV

Table 2 – Overloaded facilities in the AEPW control area for 2005 winter peak with >Omitted Text< facility connected and a 300 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	904 MW Transfer Case % Loading	Outaged Branch That Caused Overload
NONE			

Table 3 – Overloaded facilities in the AEPW control area for 2008 summer peak with >Omitted Text< facility connected and a 300 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	300 MW Transfer Case % Loading	Outaged Branch That Caused Overload
SNYDER TO CACHE 138 KV	105	111.0	SOUTHWEST STATION TO FORT COBB 138 KV
DUNCAN 138/69 KV AUTOTRANSFORMER	55	111.3	ANADARKO TO GEORGIA 138 KV (WFEC)
ONETA – BROKEN ARROW NORTH 138 KV	235	105.5	RIVERSIDE 345/138 KV AUTOTRANSFORMER
BROKEN ARROW 81ST TO BROKEN ARROW 101ST STREET TAP 138 KV	235	104.3	ONETA TO BROKEN ARROW NORTH 138 KV
ATOKA TO PITTSBURG 69 KV	42	100.6	LONE OAK TO S. MCALESTER TAP 138 KV
HUGO TO VALLEY TIMBER 69 KV	48	100.9	ALLEN NG TAP TO COLGATE TAP 138 KV
RIVERSIDE TO TPS 138 KV	187	101.7	RIVERSIDE 138 KV TRIPLE CIRCUIT
FIXICO TAP TO MAUD (OG&E) 138 KV	107	116.6	RIVERSIDE 138 KV TRIPLE CIRCUIT

Table 4 – Overloaded facilities in the AEPW control area for 2008 winter peak with >Omitted Text< facility connected and a 300 MW transfer to AEPW, which were not overloaded in the base case. These overloaded facilities may require mitigation in order to obtain transmission service. Transmission service must be requested from SPP before the actual transmission service upgrades required may be determined.

Branch Over 100% Rate B (Emergency Rating)	Rate B (MVA)	904 MW Transfer Case % Loading	Outaged Branch That Caused Overload
OWASSO WEST TO OWASSO NORTH 138 KV	179	101.5	NORTHEASTERN STATION 138 KV TRIPLE CIRCUIT

B. Stability Study

INTRODUCTION

At the request of >Omitted Text<, LLC, American Electric Power (AEP) has conducted a stability performance study to evaluate the feasibility of connecting up to 332 MW winter net of generation at a site near the Lawton 112th & West Gore 138 kV Station in Southwestern Oklahoma. The projected in-service date is June 2005. This report documents the stability performance study.

OVERVIEW OF GENERATION/TRANSMISSION FACILITIES

The connection of the proposed combined cycle generation facility in the vicinity of the 112th & West Gore Station is shown in Attachment 1 (Figure 1). The proposed 138 kV Lawton Energy Station was studied with three 138 kV outlets as shown per >Omitted Text<'s request. The generation project itself would consist of two combustion turbine-generators and one steam turbine generator connected into a new ring configured bus via separate generator step-up transformers and circuit breakers.

TESTING CRITERIA

AEP transient stability criteria for 138 kV connected generation facilities shown in Table 1 below specify the conditions and events for which stable operation is required (see AEP FERC Form 715 filing). In addition, satisfactory damping of generator post-disturbance power oscillations is required.

These testing criteria are used in time domain simulations to evaluate the stability performance of a proposed generation facility. For each disturbance, the resulting transmission system response is simulated and then analyzed to assess the impact of the disturbance scenarios on the proposed generators and the surrounding system.

Table 1

AEP Stability Testing Criteria for 138 kV Connected Generation

Prefault System Condition	Fault Disturbance Scenario
All Transmission Facilities in Service	3A Permanent single phase to ground fault with three phase breaker failure. Fault clearing by backup breakers.
	3B Permanent three phase to ground fault with unsuccessful HSR if applicable. Fault cleared by primary breakers.
	3C Three phase line opening without fault.
One Transmission Facility Out	3D Permanent three phase to ground fault with unsuccessful HSR, if applicable. Fault cleared by primary breakers.
	3E Three phase line opening without fault.

STUDY SCOPE

Dynamic simulations were conducted for selected event scenarios and various post-contingency network configurations.

Case 1-1 – No prior outages. Permanent phase-to-ground fault at 112th & West Gore 138 kV on line to Sheridan Rd. Fault clearing at Sheridan Rd end in 5 cycles with circuit breaker failure at 112th & West Gore. Backup clearing in 15 cycles removing entire 112th & West Gore Station. Proposed generation remains connected via Lawton Paperboard to Lawton Eastside 138 kV Station. (Criterion 3A)

Case 1-2 – Prior outage of Lawton Energy-112th & West Gore 138 kV. Permanent three phase fault at Lawton Energy 138 kV on line to Lawton Paperboard. Fault clearing in 5 cycles with no high speed reclosing. Proposed generation remains connected to 112th & West Gore Station via Lawton Goodyear. (Criterion 3D)

Case 1-3 – Prior outage of 112th & West Gore-Comanche Station 138 kV. Permanent three phase fault at Lawton Paperboard 138 kV on line to Lawton Eastside. Fault clearing in 5 cycles with no high speed reclosing. Proposed generation and 112th & West Gore Station remain connected to Lawton Eastside via Sheridan Rd 138 kV. (Criterion 3D)

Case 1-4 – Prior outage of Lawton Paperboard-Lawton Eastside 138 kV. Permanent three phase fault at 112th & West Gore 138 kV on line to Sheridan Rd. Fault clearing in 5 cycles with no high speed reclosing. Proposed generation and 112th & West Gore Station remain connected to Comanche Station 138 kV. (Criterion 3D)

Case 1-5 – Prior outage of Comanche Station-Lawton Eastside 138 kV. Permanent three phase fault at Comanche Station 138 kV on line to Comanche Tap. Fault clearing in 5 cycles with no high speed reclosing. Two of three generators at the Comanche Station Generating Plant remain connected to 112th & West Gore 138 kV. (Criterion 3D)

DYNAMICS BASE CASE

A dynamics base case representing Southwest Power Pool 2005 summer peak load conditions was used for this study. Lawton area station loads were decreased to their minimum. The Lawton Energy Generation Project was added to the base case using data and other information provided by >Omitted Text<, and was represented in this study as shown in Attachments 1 and 2.

STABILITY SIMULATION RESULTS

The stability performance study results are presented in Attachment 3 and are summarized below. Attachment 3 contains a case summary table and plots of the proposed Lawton Energy Project generator machine speeds, as well as speed plots of nearby existing generation, and selected bus voltages.

	TRANSIENT STABILITY	OSCILLATORY STABILITY
Case 1-1	Stable	Satisfactory
Case 1-2	Stable	Satisfactory
Case 1-3	Stable	Satisfactory
Case 1-4	Stable	Satisfactory
Case 1-5	Stable	Satisfactory

The transient and oscillatory stability performance of the proposed >Omitted Text< Plant was found to be acceptable. No adverse transient stability impacts were observed on the surrounding transmission system. Other cases with extended fault clearing times (not shown in this report) were simulated to check for the existence of adequate transient stability margins. To ensure satisfactory damping of post-disturbance power swings, power system stabilizers would be necessary on all three generators.

SUMMARY

- The study results show that from a stability perspective, the proposed >Omitted Text< generating plant totaling up to 332 MW may be accommodated. Power system stabilizers on all three generators are required.

- If the proposed generation project is built, follow-up stability studies by AEP would be required based on dynamics data and modeling for the proposed generating unit that have been revised to reflect equipment commissioning tests and field settings.

- This study addresses the impact of the proposed generation independent of any other merchant generation additions to the AEP System in the vicinity with the exception of those that have executed an Interconnection Agreement or those that have requested an unexecuted Interconnection Agreement be filed with FERC. If an Interconnection Agreement for a new generation facility in the general vicinity is executed or significant transmission network changes occur within AEP or adjacent systems, prior to the execution of an Interconnection Agreement for this facility, then a new study would be required to reassess the impact of this generation addition, and the study results contained in this report would no longer be valid.

Attachment 1

Transmission Diagrams

LAWTON AREA – WITH LAWTON ENERGY

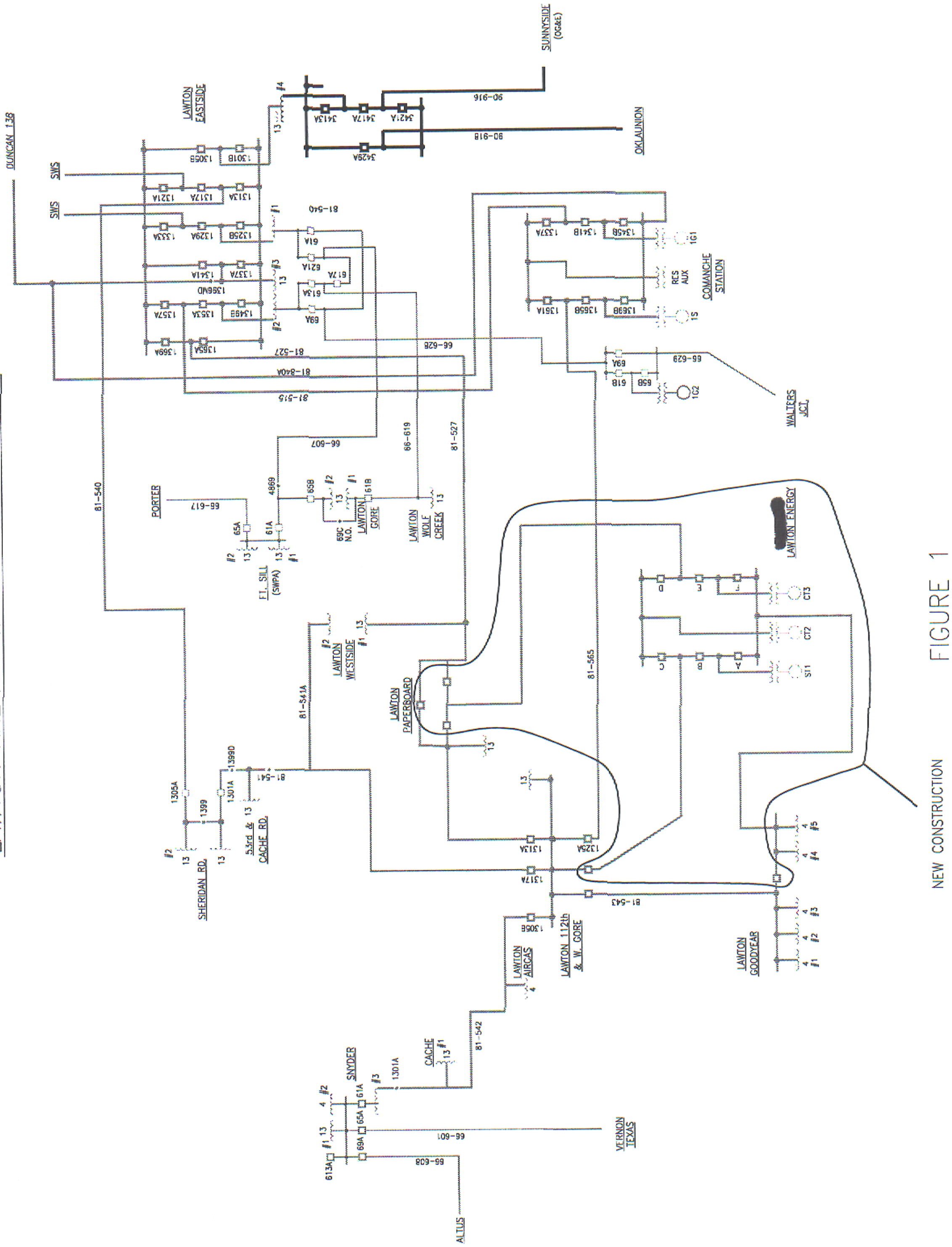


FIGURE 1

Attachment 2

>Omitted Text< Generation

Dynamics Data

GENROU -- GT1 & GT2

Round Rotor Generator Model
(Quadratic Saturation)

Value	Description
112.4	Base MVA
0.0037	R_a
6.40	T'_{do} (>0) (sec)
0.041	T''_{do} (>0) (sec)
0.51	T'_{qo} (>0) (sec)
0.079	T''_{qo} (>0) (sec)
5.568	Inertia, H
0	Speed damping, D
1.84	X_d
1.77	X_q
0.25	X'_d
0.45	X'_q
0.185	$X''_d = X''_q$
0.135	X_1
0.0555	S(1.0)
0.3437	S(1.2)
0.11878	GSU Z pu 100 MVA Base

X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_1, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

IBUS, 'GENROU', I, T'_{do}, T''_{do}, T'_{qo}, T''_{qo}, H, D, X_d, X_q, X'_d, X'_q, X''_d, X_1, S(1.0), S(1.2)/

GAST2A -- GT1 & GT2

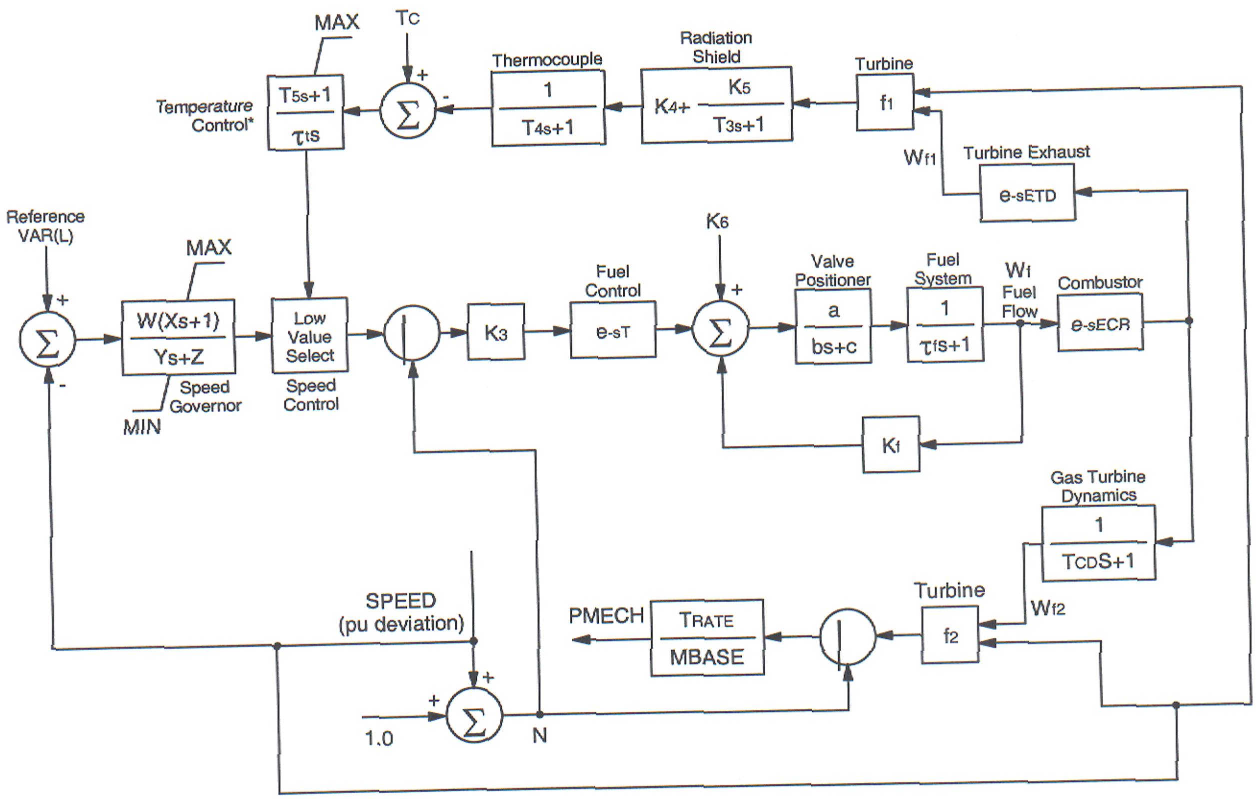
Gas Turbine Model

Value	Description
25	W - governor gain (1/droop) (on turbine rating)
0	X (sec) governor lead time constant
0.02	Y (sec) (>0) governor lag time constant
1.0	Z - governor mode: 1 - Droop 0 - ISO
0.04	E_{TD} (sec)
0.2	T_{CD} (sec)
88.65	T_{RATE} turbine rating (MW)
0.125	T (sec)
1.0	MAX (pu) limit (on turbine rating)
0	MIN (pu) limit (on turbine rating)
0.01	E_{CR} (sec)
0.77	K_3
1.0	a (>0) valve positioner
0.05	b (sec) (>0) valve positioner
1.0	c valve positioner
0.4	τ_f (sec) (>0)
0	K_f
0.2	K_5
0.8	K_4
15.0	T_3 (sec) (>0)
2.5	T_4 (sec) (>0)
1650	τ_t (sec) (>0)
3.3	T_5 (sec) (>0)
950	a_{f1}
550	b_{f1}
-0.3	a_{f2}
1.3	b_{f2}
0.5	c_{f2}
1006	Rated temperature, T_R (°F)
0.23	Minimum fuel flow, K_6 (pu)
1006	Temperature control, T_C (°F)

IBUS, 'GAST2A', I, W, X, Y, Z, E_{TD}, T_{CD}, T_{RATE}, T, MAX, MIN, E_{CR}, K_3, a, b, c, τ_f, K_f, K_5, K_4, T_3, T_4, τ_t, T_5, a_{f1}, b_{f1}, a_{f2}, b_{f2}, c_{f2}, T_R, K_6, T_C/

GAST2A -- GT1 & GT2

Gas Turbine Model



$$f_1 = T_R - a_{f1}(1. - w_{f1}) - b_{f1}(speed)$$

$$f_2 = T_R - a_{f2}(1. - w_{f2}) - b_{f2}(speed)$$

*Temperature control output is set to output of speed governor when temperature control input changes from positive to negative.

PSS2A -- GT1 & GT2

IEEE Dual-Input Stabilizer Model

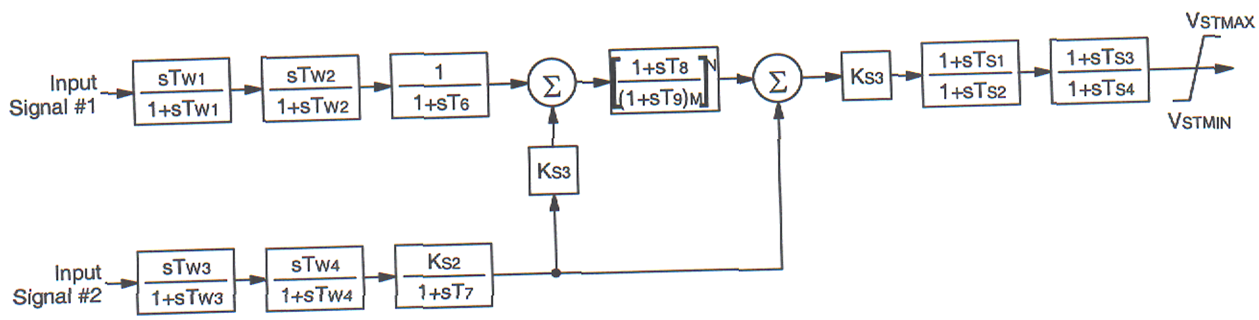
Value	Description
1	ICS1, first stabilizer input code: 1 - rotor speed deviation (pu) 2 - bus frequency deviation (pu) 3 - generator electric power on MBASE base (pu) 4 - generator accelating power (pu) 5 - bus voltage (pu) 6 - derivative of pu bus voltage
0	REMBUS1, first remote bus number
3	ICS2, second stabilizer input code: 1 - rotor speed deviation (pu) 2 - bus frequency deviation (pu) 3 - generator electric power on MBASE base (pu) 4 - generator accelating power (pu) 5 - bus voltage (pu) 6 - derivative of pu bus voltage
0	REMBUS2, second remote bus number
5	M, ramp tracking filter
1	N, ramp tracking filter

Value	Description
2	T_{W1} (>0)
2	T_{W2}
0	T_6
2	T_{W3} (>0)
0	T_{W4}
2	T_7
0.18	K_{S2}
1.0	K_{S3}
0.5	T_8
0.1	T_9 (>0)
15	K_{S1}
0.15	T_1
0.03	T_2
0.15	T_3
0.03	T_4
0.1	V_{STMAX}
-0.1	V_{STMIN}

IBUS, 'PSS2A', I, ICS1, REMBUS1, ICS2, REMBUS2, M, N, T_{W1}, T_{W2}, T_6, T_{W3}, T_{W4}, T_7, K_{S2}, K_{S3}, T_8, T_9, K_{S1}, T_1, T_2, T_3, T_4, V_{STMAX}, V_{STMIN}/

PSS2A -- GT1 & GT2

IEEE Dual-Input Stabilizer Model



EXAC2 -- GT1 & GT2

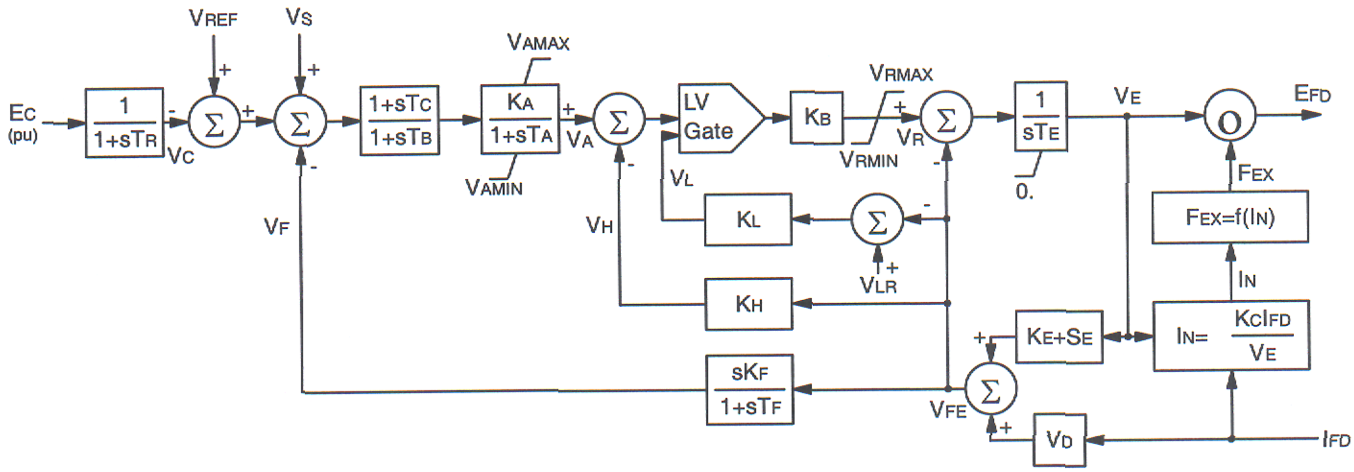
IEEE Type AC2 Excitation System

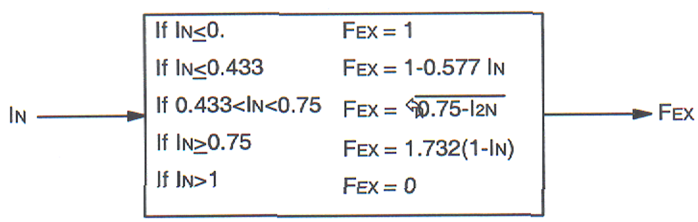
Value	Description
0.01	T_R (sec)
1	T_B (sec)
1	T_C (sec)
1000	K_A
0.01	T_A (sec)
10.2	V_{AMAX}
-10.2	V_{AMIN}
1	K_B
8.9	V_{RMAX}
-8.9	V_{RMIN}
1.2	$T_E>0$ (sec)
4.0	K_L
0	K_H
0.05	K_F
1	$T_F>0$ (sec)
0.1	K_C
1.63	K_D
1	K_E
13.67	V_{LR}
2.88	E_1
0	$S_E(E_1)$
3.84	E_2
0.04	$S_E(E_2)$

IBUS, 'EXAC2', I, T_R, T_B, T_C, K_A, T_A, V_{AMAX}, V_{AMIN}, K_B, V_{RMAX}, V_{RMIN}, T_E, K_L, K_H, K_F, T_F, K_C, K_D, K_E, V_{LR}, E_1, $S_E(E_1)$, E_2, $S_E(E_2)$/

EXAC2 -- GT1 & GT2

IEEE Type AC2 Excitation System





$V_S = VOTHSG + VUEL + VOEL$

GENROU -- ST

Round Rotor Generator Model
(Quadratic Saturation)

Value	Description
207	Base MVA
0.0025	R_a
8.70	T'_{do} (>0) (sec)
0.049	T''_{do} (>0) (sec)
1.0	T'_{qo} (>0) (sec)
0.08	T''_{qo} (>0) (sec)
5.30	Inertia, H
0	Speed damping, D
2.03	X_d
1.98	X_q
0.19	X'_d
0.34	X'_q
0.17	$X''_d = X''_q$
0.10	X_1
0.11	S(1.0)
0.42	S(1.2)
0.07083	GSU Z pu 100 MVA Base

X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_1, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

IBUS, 'GENROU', I, T'_{do}, T''_{do}, T'_{qo}, T''_{qo}, H, D, X_d, X_q, X'_d, X'_q, X''_d, X_1, S(1.0), S(1.2)/

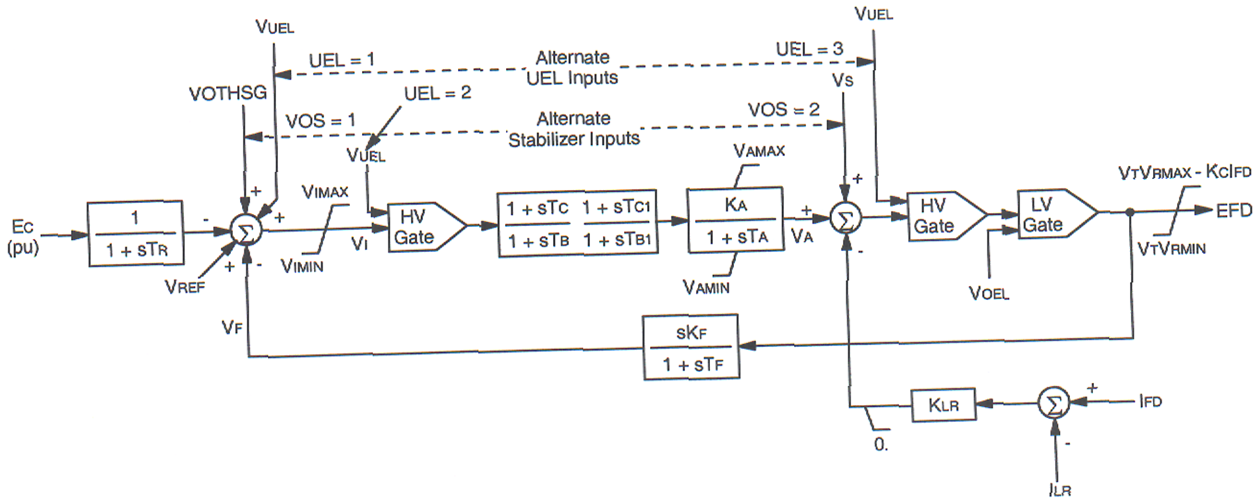
ESST1A -- ST

IEEE Type ST1A Excitation System

Value	Description
1	UEL (1, 2, or 3)
1	VOS (1 or 2)

Value	Description
0	T_R (sec)
0.18	V_{IMAX}
-0.18	V_{IMIN}
5.0	T_C (sec)
167.0	T_B (sec)
1.0	T_{C1} (sec)
1.0	T_{B1} (sec)
1000	K_A
0.01	T_A (sec)
6.054	V_{AMAX}
-5.146	V_{AMIN}
6.054	V_{RMAX}
-5.146	V_{RMIN}
0	K_C
0	K_F
1.0	$T_F > 0$ (sec)
0	K_{LR}
1.0	I_{LR}

IBUS, 'ESST1A', I, UEL, VOS, T_R, V_{IMAX}, V_{IMIN}, T_C, T_B, T_{C1}, T_{B1}, K_A, T_A, V_{AMAX}, V_{RMAX}, V_{RMIN}, K_C, K_F, T_F, K_{LR}, I_{LR}/



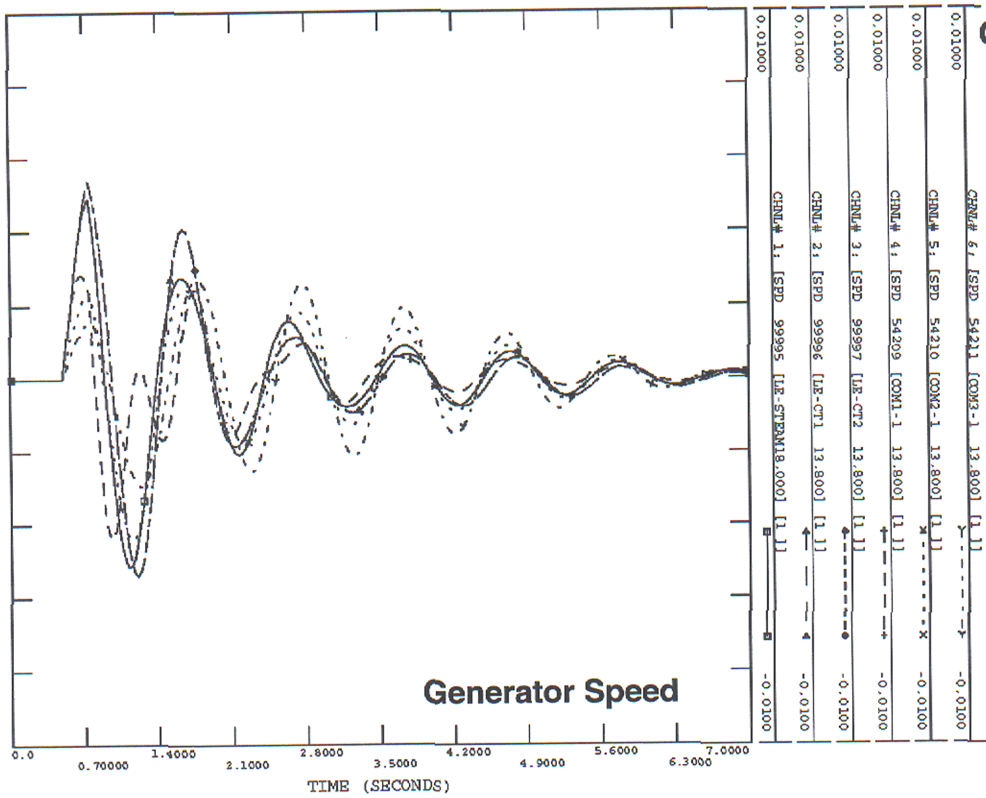
Attachment 3

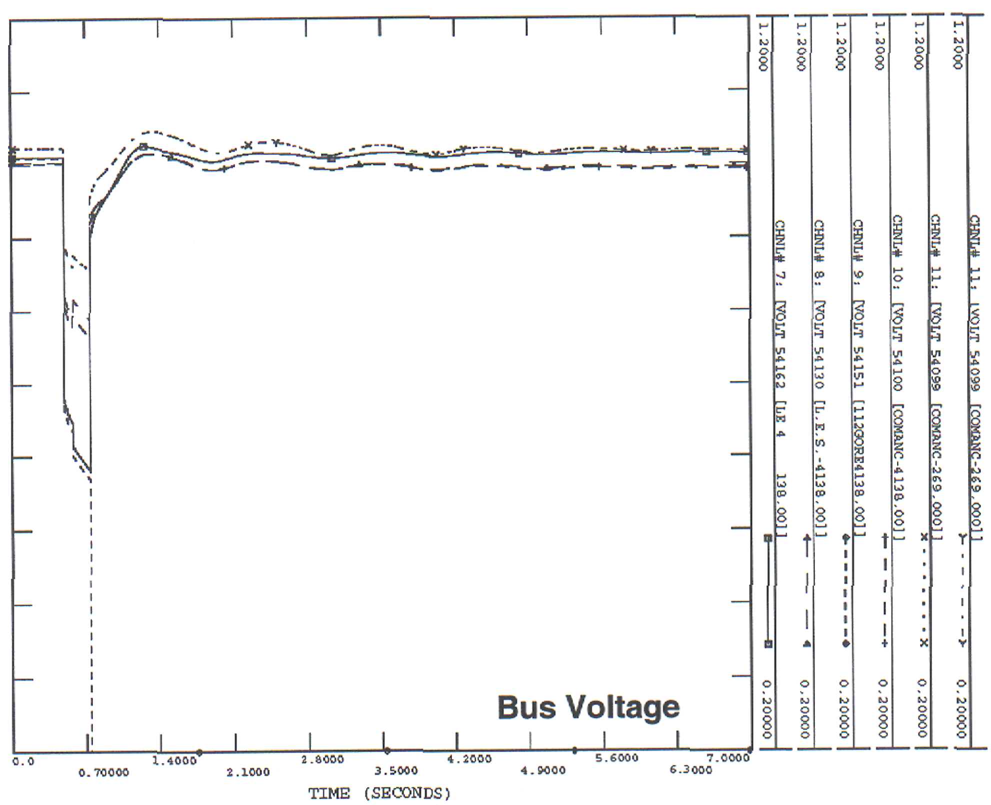
Results –

Individual Case Plots

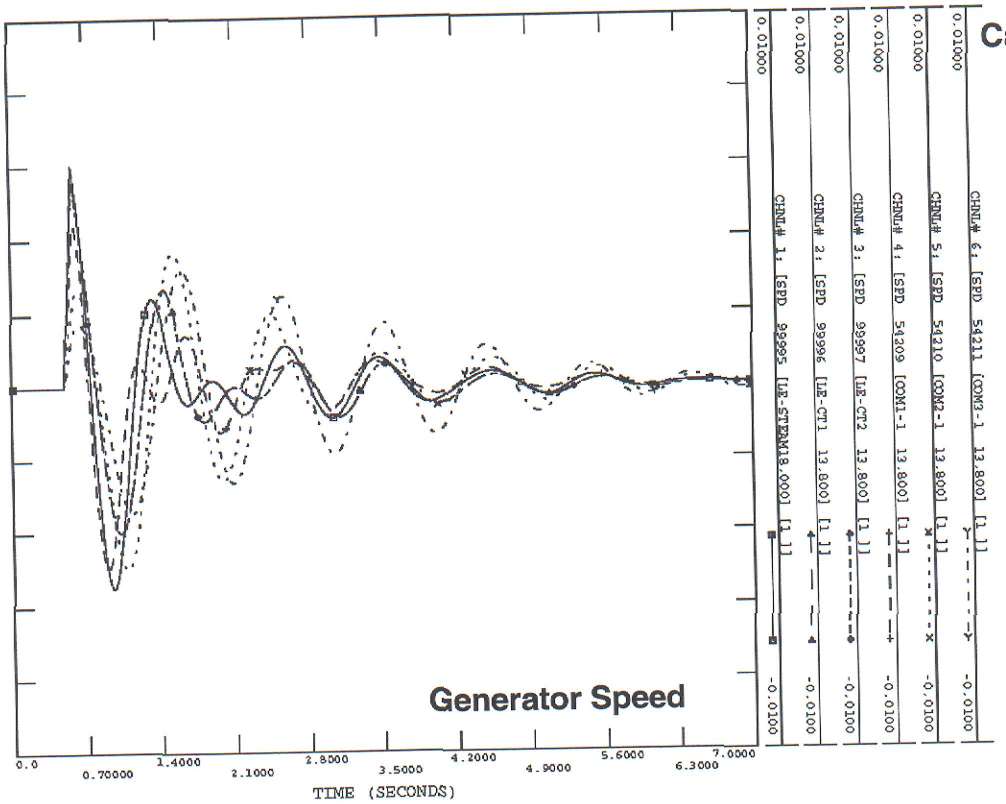
Case Number	Prior Outage	Faulted Line/Transformer	Fault Type	Comments on Study Results	
				Transient	Oscillatory
Case 1-1	None	112th & W Gore-Sheridan 138 kV, 112th & W Gore 138 kV Station	1 Phase Delayed	Stable	Satisfactory
Case 1-2	>Omitted Text<-112th & W Gore 138 kV	>Omitted Text<-Paperboard 138 kV	3 Phase	Stable	Satisfactory
Case 1-3	112th & W Gore-Comanche Station 138 kV	Paperboard-Lawton Eastside 138 kV	3 Phase	Stable	Satisfactory
Case 1-4	Paperboard-Lawton Eastside 138 kV	112th & W Gore-Sheridan 138 kV	3 Phase	Stable	Satisfactory
Case 1-5	Comanche Station-Lawton Eastside 138 kV	Comanche Station-Comanche Tap 138 kV	3 Phase	Stable	Satisfactory

Case 1-1

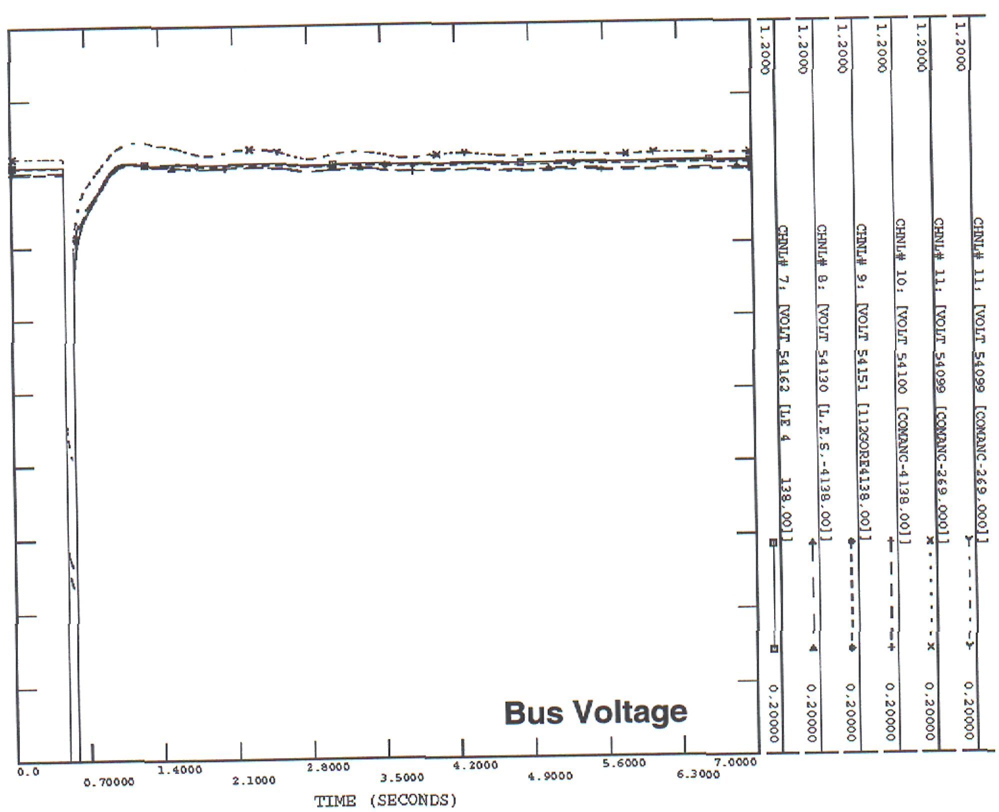

Generator Speed
0.01000
-0.0100
CHNL# 1: [SPD 99995 [LE-STEAM18.000] [1]]
CHNL# 2: [SPD 99996 [LE-CT1 13.800] [1]]
CHNL# 3: [SPD 99997 [LE-CT2 13.800] [1]]
CHNL# 4: [SPD 54209 [COM1-1 13.800] [1]]
CHNL# 5: [SPD 54210 [COM2-1 13.800] [1]]
CHNL# 6: [SPD 54211 [COM3-1 13.800] [1]]
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
TIME (SECONDS)


Bus Voltage
1.2000
0.20000
CHNL# 7: [VOLT 54162 [LE 4 138.00]]
CHNL# 8: [VOLT 54130 [L.E.S.-4138.00]]
CHNL# 9: [VOLT 54151 [1123ORE4138.00]]
CHNL# 10: [VOLT 54100 [COMANC-4138.00]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
TIME (SECONDS)

Case 1-2

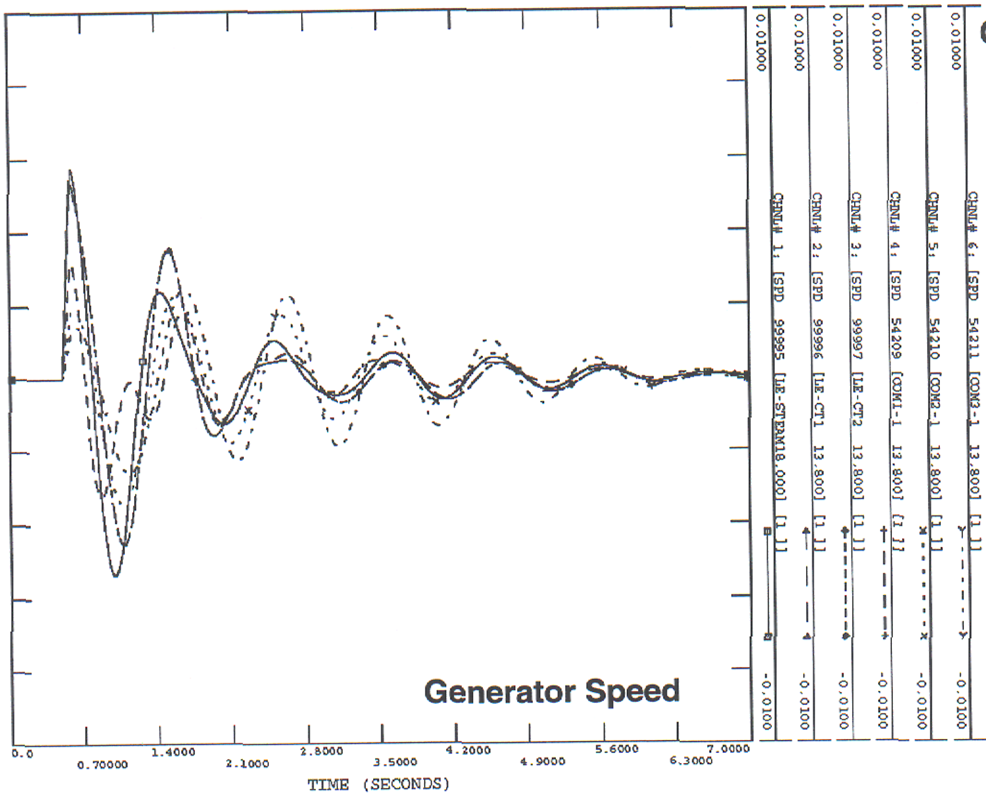


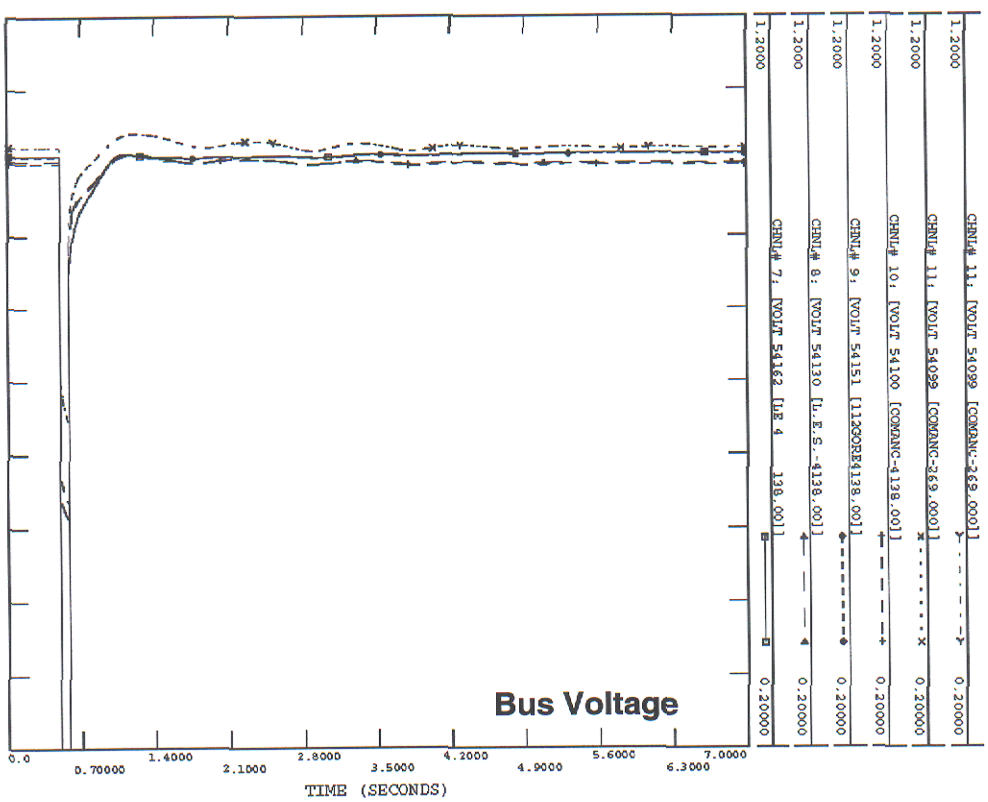
Generator Speed
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
CHNL# 1: [SPD 99995 [LE-STEAM18.000] [1]]
CHNL# 2: [SPD 99996 [LE-CT1 13.800] [1]]
CHNL# 3: [SPD 99997 [LE-CT2 13.800] [1]]
CHNL# 4: [SPD 54209 [COM1-1 13.800] [1]]
CHNL# 5: [SPD 54210 [COM2-1 13.800] [1]]
CHNL# 6: [SPD 54211 [COM3-1 13.800] [1]]
0.01000
-0.0100



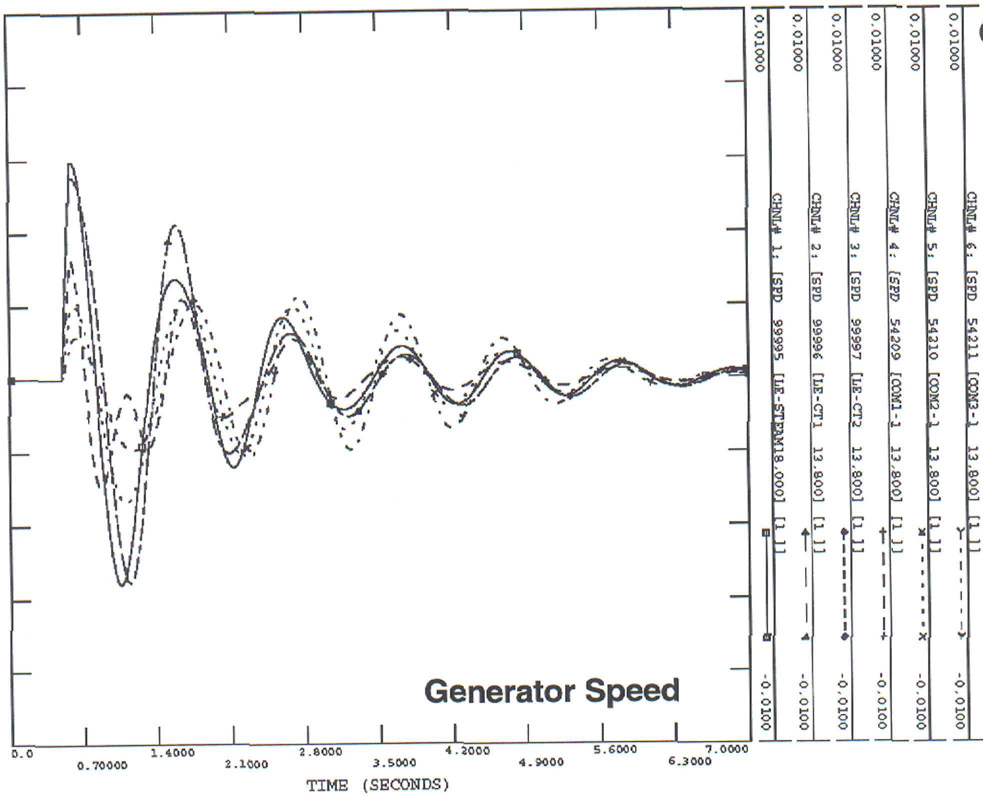
Bus Voltage
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
CHNL# 7: [VOLT 54162 [LE 4 138.00]]
CHNL# 8: [VOLT 54130 [L.E.S.-4138.00]]
CHNL# 9: [VOLT 54151 [112ORE4138.00]]
CHNL# 10: [VOLT 54100 [CONANC-4138.00]]
CHNL# 11: [VOLT 54099 [CONANC-269.000]]
CHNL# 11: [VOLT 54099 [CONANC-269.000]]
1.2000
0.20000

Case 1-3

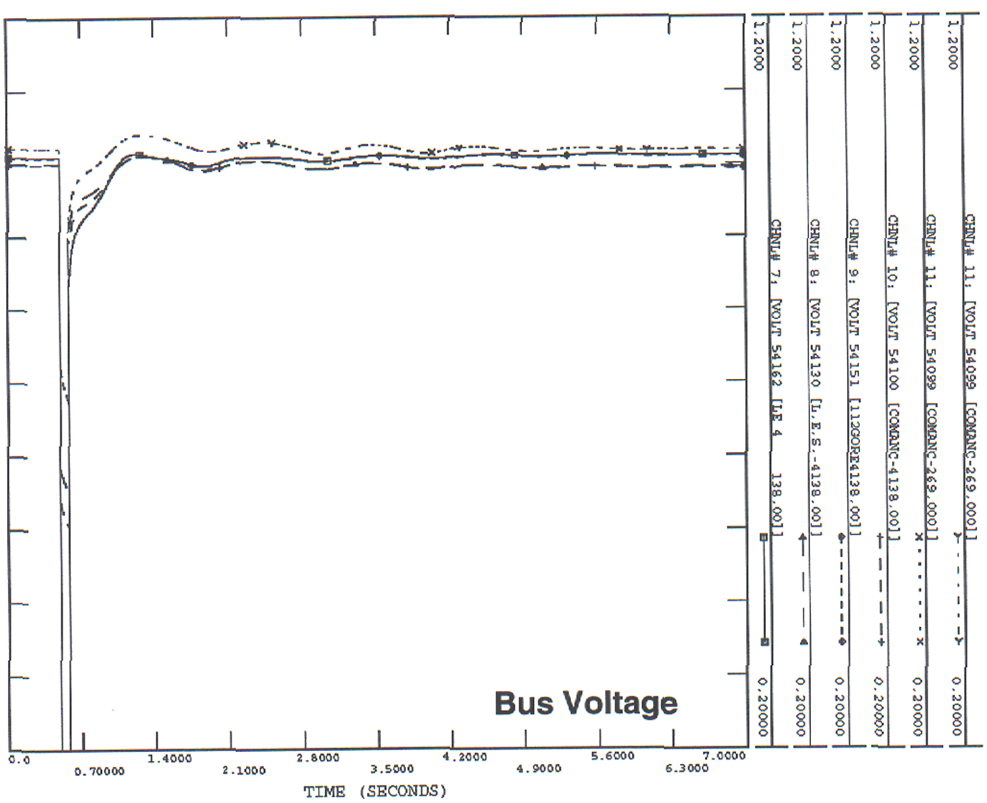

Generator Speed
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
0.01000
-0.0100
CHNL# 1: [SPD 99995 [LE-STEAM18.000] [1 1]
CHNL# 2: [SPD 99996 [LE-CT1 13.800] [1 1]
CHNL# 3: [SPD 99997 [LE-CT2 13.800] [1 1]
CHNL# 4: [SPD 54209 [COM1-1 13.800] [1 1]
CHNL# 5: [SPD 54210 [COM2-1 13.800] [1 1]
CHNL# 6: [SPD 54211 [COM3-1 13.800] [1 1]


Bus Voltage
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
1.2000
0.20000
CHNL# 7: [VOLT 54162 [LE 4 138.00]]
CHNL# 8: [VOLT 54130 [L.E.S.-4138.00]]
CHNL# 9: [VOLT 54151 [112GORE4138.00]]
CHNL# 10: [VOLT 54100 [COMANC-4138.00]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]

Case 1-4

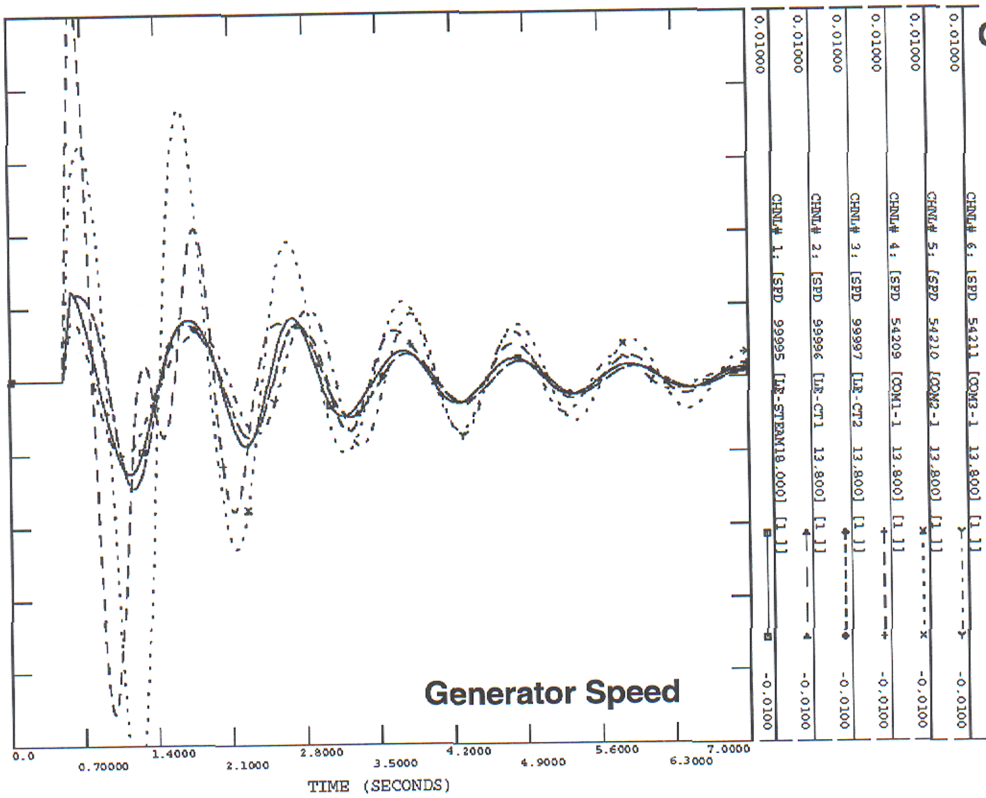


Generator Speed
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
TIME (SECONDS)
CHNL# 1: [SPD 99995 [LE-STEAM18.000] [1]]
CHNL# 2: [SPD 99996 [LE-CT1 13.800] [1]]
CHNL# 3: [SPD 99997 [LE-CT2 13.800] [1]]
CHNL# 4: [SPD 54209 [COM1-1 13.800] [1]]
CHNL# 5: [SPD 54210 [COM2-1 13.800] [1]]
CHNL# 6: [SPD 54211 [COM3-1 13.800] [1]]
0.01000
-0.0100

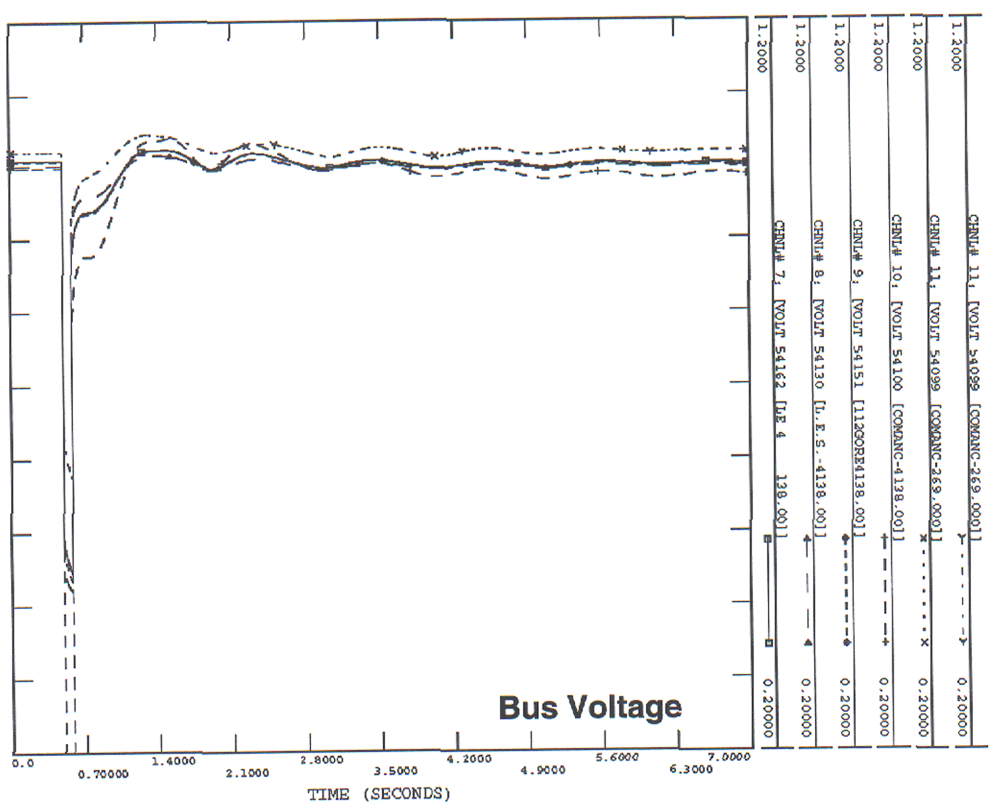


Bus Voltage
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
TIME (SECONDS)
CHNL# 7: [VOLT 54162 [LE 4 138.00]]
CHNL# 8: [VOLT 54130 [L.E.S.-4138.00]]
CHNL# 9: [VOLT 54151 [112GORE4138.00]]
CHNL# 10: [VOLT 54100 [COMANC-4138.00]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
1.2000
0.20000

Case 1-5



Generator Speed
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
CHNL# 1: [SPD 99995 [LR-STEAM18.000] [1]]
CHNL# 2: [SPD 99996 [LR-CT1 13.800] [1]]
CHNL# 3: [SPD 99997 [LR-CT2 13.800] [1]]
CHNL# 4: [SPD 54209 [COM1-1 13.800] [1]]
CHNL# 5: [SPD 54210 [COM2-1 13.800] [1]]
CHNL# 6: [SPD 54211 [COM3-1 13.800] [1]]
0.01000
-0.0100



Bus Voltage
TIME (SECONDS)
0.0
0.70000
1.4000
2.1000
2.8000
3.5000
4.2000
4.9000
5.6000
6.3000
7.0000
CHNL# 7: [VOLT 54162 [LE 4 138.00]]
CHNL# 8: [VOLT 54130 [L.E.S.-4138.00]]
CHNL# 9: [VOLT 54151 [112GORE4138.00]]
CHNL# 10: [VOLT 54100 [COMANC-4138.00]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
CHNL# 11: [VOLT 54099 [COMANC-269.000]]
1.2000
0.20000

C. Short Circuit Study

Scope

The subject of this study is >Omitted Text<'s proposed 332 MW power plant in Lawton, Oklahoma near Lawton's Goodyear plant. This power plant will connect into the Public Service Company of Oklahoma (PSO) local 138kV transmission system via three 138kV lines. One line from >Omitted Text< to Lawton 112th and Gore, one line to Lawton Paperboard and one line to Lawton Goodyear plant. The purpose of this study is to assess the impact of the addition of the proposed generation on the available fault current in the PSO system, and to determine whether or not the interrupting rating of PSO circuit breakers, circuit switchers, and power fuses would be exceeded as a result of the addition.

The software used to study >Omitted Text<'s proposed plant at Lawton has the ability to calculate ANSI X/R ratios for bus and close in faults and to perform a breaker rating study in batch mode for determining the short-circuit duty imposed on circuit-interrupting devices. The base short-circuit case used was a Southwest Power Pool (SPP) 2005 case. This case includes prior IPP generation and related system improvements. This case was modified for the additional system change requirements for the injection of 332 MW of generation into the PSO transmission system.

Model Data for the 332 MW Case

The following facilities were modeled in the short-circuit case to determine the impact of 332 MW on available short-circuit levels:

- The >Omitted Text< 138 kV generating facility will comprise of a single 180 MW steam generator and two 90 MW Gas turbine generators.
- A 138kV line from >Omitted Text< generating facility to PSO's Lawton 112th and Gore substation.
- A 138kV line from >Omitted Text< generating facility to PSO's Lawton Paperboard substation
- A 138kV line from >Omitted Text< generating facility to PSO's Lawton Goodyear substation

Method

The batch short-circuit and breaker rating program was then used to place a three-phase-to-ground and a single-phase-to-ground close in fault on each transmission line connected to each breaker modeled in the short-circuit case. For each breaker, the worst-case fault current level was compared to the breaker rating. This was performed with the above facilities excluded and then performed again with the above facilities included for comparative purposes.

Conclusion

It is standard practice for AEP to recommend replacing a circuit breaker when the current through the breaker for a fault exceeds 100% of its interrupting rating with recloser de-rating applied, as determined by the ANSI/IEEE C37.5-1979, C37.010-1979 & C37.04-1979 breaker rating methods.

In the PSO system, the following Lawton Eastside equipment were found to exceed their interrupting capability after the addition of the 332 MW of generation and related facilities:

Lawton Eastside Equipment	Base Case without Generator % Of Interrupting Rating	Base Case with Generator % Of Interrupting Rating
Breaker 1325B (138 kV)	93.3	117.4