GEN-2008-098 & GEN-2010-003 Impact Restudy for Generator Modification (Turbine Change)

July 2015
Generator Interconnection

SPP Southwest Power Pool

Executive Summary

This document reports on the findings of a fourth restudy for the GEN-2008-098 & GEN-2010-003 interconnection request. The Interconnection Customer has requested this restudy to determine the effects of changing wind turbine generators from the previously studied Gamesa G114-2.0MW wind turbine generators to a combination of Gamesa G114-2.0MW & Gamesa G114-2.1MW wind turbine generators. Both projects are owned by the same customer and will generate up to 199.0MW using ninety (90) Gamesa G114-2.1MW wind turbine generators and five (5) Gamesa G114-2.0MW wind turbine generators. The two projects are collocated in Coffee County, Kansas for an aggregate of 199.0MW and share the same 34.5/345kV substation transformer that will connect the Customer's 345kV transmission line to the Point of Interconnection (POI), a new switching station on the Westar Energy (WERE) Wolf Creek to LaCygne 345kV transmission line. The interconnection customer has provided documentation that shows the Gamesa G114-2.1MW & Gamesa G114-2.0MW wind turbine generators each have a reactive capability of 0.95 lagging (providing VARS) and 0.95 leading (absorbing VARS) power factor.

The GEN-2008-098 & GEN-2010-003 interconnection request, using Vestas V90-1.8MW wind turbine generators, was initially studied in the DISIS-2010-001 Definitive Impact Study which was posted in July 2010. The Transmission Owner requested an additional analysis which was posted in January 2012 to determine operating limits for the Generating Facility for prior outage conditions of 345kV lines in the local area. The Customer requested a second restudy which was posted in April 2012 to determine the effects of changing from the Vestas V90-1.8MW wind turbine generators to the Vestas V100-1.8MW wind turbine generators. The Customer requested a third restudy which was posted in April 2014 to determine the effects of changing from the Vestas V100-1.8MW wind turbine generators to the Gamesa G114-2.0MW wind turbine generators.

This fourth restudy evaluates only the worst case season that has been observed in the previous restudies. The season evaluated is the 2015 Light Load Season.

At present the Transmission Owner has a Transmission Operations Directive (TOD) that adjusts the Wolf Creek generation following an outage of any one of the three 345kV transmission lines that terminate at the Wolf Creek 345kV bus. The Wolf Creek plant output is reduced to 800MW for these prior outage conditions in order to be able to withstand a second 345kV line outage. If this condition occurs, the GEN-2008-098/GEN-2010-003 facility must reduce to 0MW. This study shows that with the addition of GEN-2008-098 & GEN-2010-003 projects, the maximum allowable Wolf Creek generation output during periods when a 345kV line is out of service remains at 800MW. The results of this study show that during the conditions for which the TOD applies (i.e. the outage of the lines listed below) the output of GEN-2008-098 & GEN-2010-003 must be reduced to 0MW. The lines whose outage triggers this directive are:

- Wolf Creek – LaCygne 345kV line
    - After the interconnection of the study projects, the line segment between the study projects and LaCygne
- Wolf Creek – Benton 345kV line
- Wolf Creek – Rose Hill 345kV line

With the assumptions and operation requirements described above, study projects GEN-2008-098 & GEN-2010-003 utilizing the Gamesa G114-2.1MW & Gamesa G114-2.0MW wind turbine generator should be able to interconnect without causing any stability problems on the SPP transmission grid. In addition, consistent with Order #661A, the facilities will be required to maintain a 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection.

A power factor analysis was performed in this study. The facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VARs) power factor at the point of interconnection. The Customer is responsible for maintaining a 95% power factor at the point of interconnection. Additional capacitor banks or other reactive equipment may be required to meet this requirement depending on the design of the Generating Facility and its collector system.

With the assumptions outlined in this report and with all the required network upgrades from the GEN-2008-098 & GEN-2010-003 Generator Interconnection Agreement (GIA) in place, the GEN-2008-098 & GEN-2010-003 requests should be able to reliably interconnect to the SPP transmission grid.

Nothing within this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service rights. Should the Customer require transmission service, those rights should be requested through SPP's Open Access Same-Time Information System (OASIS).

This study did not analyze powerflow situations. For powerflow constraints, please refer to the latest version of DISIS-2010-001. At times, the generator may not be able to inject any power onto the Transmission System due to constraints that fall below the threshold of mitigation for a Generator Interconnection request. Because of this, it is likely that the Customer may be required to reduce its generation output to **0 MW** under certain system conditions (in addition to the ones mentioned earlier) to allow system operators to maintain the reliability of the transmission network.

I. Introduction

GEN-2008-098 & GEN-2010-003 Impact Restudy is a generator interconnection study performed to study the impacts of interconnecting the projects shown in Table I-1. The in-service date assumed for the generation addition is October 2015. This restudy is for a change from Gamesa G114-2.0MW wind turbine generators to Gamesa G114-2.1MW & Gamesa G114-2.0MW wind turbine generators.

Table I-1: Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2008-098 & GEN-2010-003	199.0	90 X Gamesa G114 2.1MW (532957&577200) 5 X Gamesa G114 2.0MW (532957)	Tap on Wolf Creek – LaCygne 345kV (532799)

The prior-queued and equally-queued requests shown in Table I-2 were included in this study and the wind and solar farms were dispatched to 100% of rated capacity.

Table I-2: Prior and Higher Queued Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2002-004	199.5	GE 1.5MW (532605, 532606)	Lathams 345kV (532800)
GEN-2005-013	199.8	Vestas V90 VCSS 1.8MW (532720)	Caney River 345kV (532780)
GEN-2007-025	299.2	GE 1.6MW (533123, 533124)	Viola 345kV (532798)
GEN-2008-013	299.04	GE XLE 1.68MW (515488, 515489)	Hunter 345kV (515476)
GEN-2008-021	1283	GENROU (532751)	Wolf Creek 345kV (532797)
GEN-2009-025	59.8	Siemens 93m 2.3MW (531005)	Tap Deer creek – Sinclair Blackwell 69KV (515528)
GEN-2010-005	299.2	GE 1.6MW (533125, 533126)	Viola 345kV (532798)
ASGI-2010-006	150	GE 1.5MW (301382)	Remington 138kV (301369)
GEN-2010-055	4.8	GENROU (560391)	Wekiwa 138kV (509757)
GEN-2011-057	150.0	Vestas V110 2.0MW (583173)	Creswell 138kV (532981)
GEN-2012-023	115	Siemens 101m 2.3MW (583363)	Viola 345kV (532798)

Table I-2: Prior and Higher Queued Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2012-027	150.66	GE 1.62MW (583393)	Shidler 138kV (510403)
GEN-2012-032	299.0	Siemens 108m 2.3MW (583433, 583436)	Tap Rose Hill-Sooner 345kV (515621)
GEN-2012-033	98.82	GE 1.62MW (583443)	Tap Bunch Creek-South 4th 138kV(514815)
GEN-2012-040	76.5	GE 1.7MW (583483)	Chilocco 138kV (521198)
GEN-2012-041	85.3 Summer 121.5 Winter	GENROU (583493)	Tap Rose Hill-Sooner 345kV (515576)
GEN-2013-012	4 x 168.0MW Summer 4 x 215MW Winter	GENROU (514910, 514911, 514912, 514942)	Redbud 345kV (514909)
GEN-2013-028	516.4 Summer 559.5 Winter	GENROU (583743, 583746)	Tap Tulsa N to GRDA1 345kV (562423)
GEN-2013-029	299.8	66 X GE 2.3MW (583753) 74 X Vestas V100 VCSS 2.00MW (583756)	Renfrow 345kV (515543)
GEN-2014-001	199.5	Gamesa 2.1MW (583853 & 583856)	Tap Wichita – Emporia 345kV (562476)
GEN-2014-028	256 Summer 259 Winter	GENROU (547643)	Riverton 161kV (547469)
GEN-2014-064	248.4	GE 2.3MW (584173)	Otter 138kV (514708)

The study included a stability analysis of the interconnection request. Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping relays disabled. The stability analysis was performed on a single seasonal model, the modified version of the 2015 light load case.

The stability analysis determines the impacts of the new interconnecting project on the stability and voltage recovery of the nearby systems and the ability of the interconnecting project to meet FERC Order 661A. If problems with stability or voltage recovery are identified, the need for reactive compensation or system upgrades is investigated. The three-phase faults and the single line-to-ground faults listed in Table III-1 were used in the stability analysis.

Nothing in this System Impact Study constitutes a request for transmission service or grants the Interconnection Customer any rights to transmission service.

II. Facilities

The GEN-2008-098 & GEN-2010-003 projects are to be collocated in Coffee County, Kansas and are comprised of ninety (90) Gamesa G114-2.1MW wind turbine generators and five (5) Gamesa G114-2.0MW wind turbine generators for a maximum aggregate nameplate capacity of 199.0MW for both projects. Each turbine will be connected to a 34.5kV collector system that feeds a single shared 34.5/345kV substation transformer. This transformer will connect the Customer's 345kV transmission line to the Point of Interconnection (POI), a new switching station on the Westar Energy (WERE) Wolf Creek to LaCygne 345kV transmission line. A one-line drawing for the GEN-2008-098 & GEN-2010-003 generation interconnection requests are shown in Figure II-1.

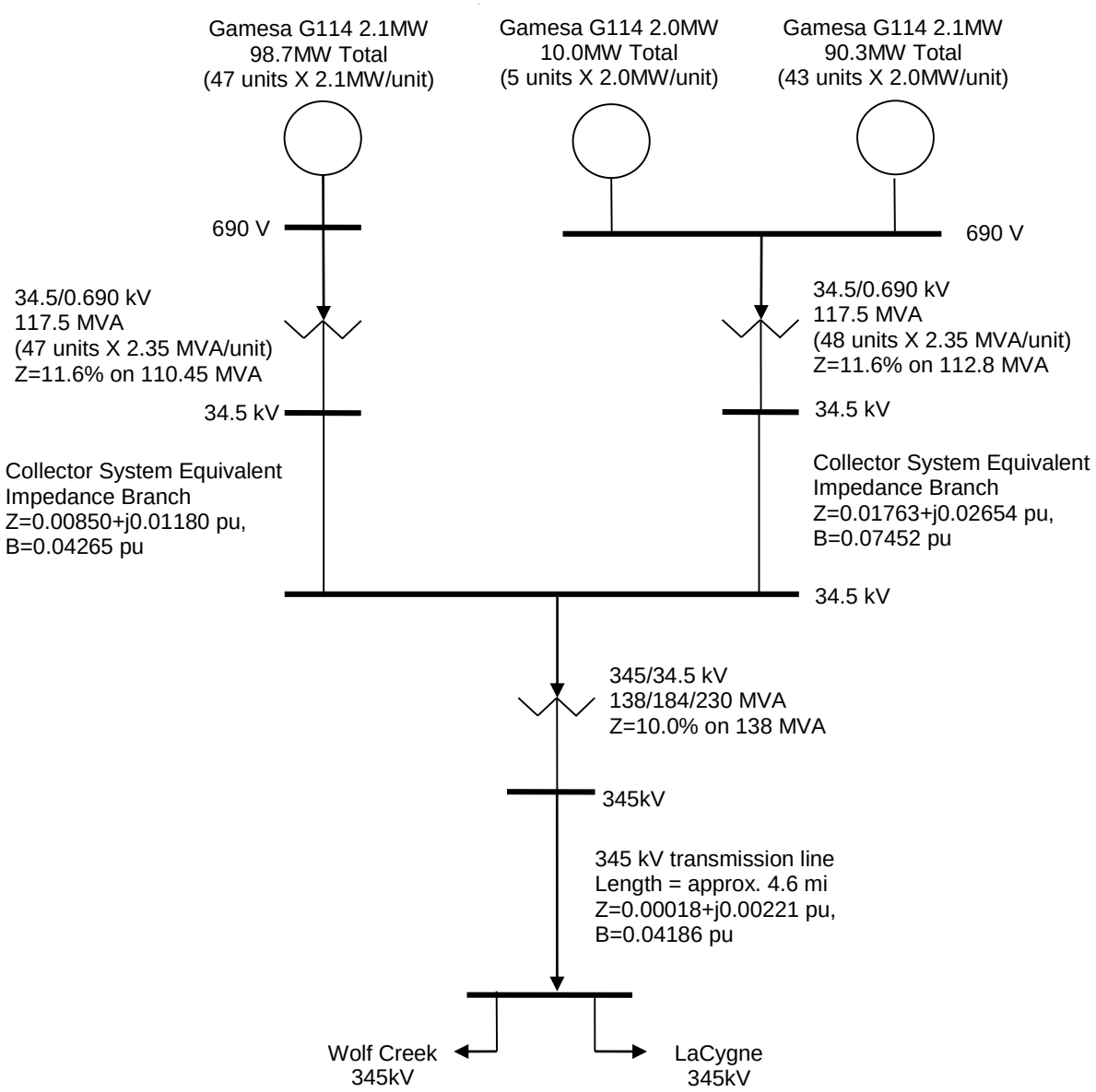

Figure II-1: GEN-2008-098 & GEN-2010-003 One-line Diagram

III. Stability Analysis

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bus voltages stay within planning criteria bandwidth during and after a disturbance while considering the addition of a generator interconnection request.

Model Preparation

Transient stability analysis was performed using a modified version of the 2014 series of Model Development Working Group (MDWG) dynamic study models including the 2015 light load seasonal model. The cases are then loaded with prior queued interconnection requests and network upgrades assigned to those interconnection requests. Finally the prior queued and study generation are dispatched into the SPP footprint. Initial simulations are then carried out for a no-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

Disturbances

One-hundred fifteen (115) contingencies were identified for use in this study and are listed in Table III-1. These contingencies included three-phase faults and single-phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying 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% of pre-fault voltage. This method is in agreement with SPP current practice.

Except for transformer faults and three-phase faults on lines out of the Wolf Creek power station, the typical sequence of events for a three-phase and a single-phase fault is as follows:

1. apply fault at particular location
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility
3. after an additional twenty (20) cycles, re-close the previous facility back into the fault
4. continue fault for five (5) additional cycles
5. trip the faulted facility and remove the fault

Transformer faults are typically modeled as three-phase faults, unless otherwise noted. The sequence of events for a transformer fault is as follows:

1. apply fault for five (5) cycles
2. clear the fault by tripping the affected transformer facility (unless otherwise noted there will be no re-closing into a transformer fault)

Three-phase faults on lines out of the Wolf Creek power station are typically modeled with the following sequence of events:

1. apply fault for five (5) cycles
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility
3. For faults on the Wolf Creek – Benton or Wolf Creek – Rosehill 345kV line, reclose into fault after 5 seconds (300 cycles) from the Benton (or Rosehill) substation only (no reclose at Wolf Creek).

   a. For faults on the Wolf Creek – GEN-2008-098 345kV line or the LaCygne – GEN-2008-098 345kV line there will be no reclose.
4. Continue fault for five (5) additional cycles
5. Trip the faulted facility and remove the faults

The control areas monitored are 520, 524, 525, 526, 531, 534, 536, 540, and 541.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
1	FLT_01_WAVERLY7_WOLFCRK7_345kV_3PH_NR	3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
2	FLT_02_WAVERLY7_WOLFCRK7_345kV_1PH	Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT_03_WAVERLY7_LACYGNE7_345kV_3PH_NR	3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
4	FLT_04_WAVERLY7_LACYGNE7_345kV_1PH	Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT_05_WOLFCRK7_WAVERLY7_345kV_3PH_NR	3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
6	FLT_06_WOLFCRK7_WAVERLY7_345kV_1PH	Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT_07_WOLFCRK7_ROSEHIL7_345kV_3PH_ER	3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
8	FLT_08_WOLFCRK7_ROSEHIL7_345kV_1PH	Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT_09_WOLFCRK7_BENTON7_345kV_3PH_ER	3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.
10	FLT_10_WOLFCRK7_BENTON7_345kV_1PH	Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT_11_ROSEHIL7_WOLFCRK7_345kV_3PH	3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT_12_ROSEHIL7_WOLFCRK7_345kV_1PH	*Single phase fault and sequence like previous*
13	FLT_13_ROSEHIL7_BENTON7_345kV_3PH	3 phase fault on the Benton 345kV (Bus 532791) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT_14_ROSEHIL7_BENTON7_345kV_1PH	*Single phase fault and sequence like previous*
15	FLT_15_ROSEHIL7_LATHAMS7_345kV_3PH	3 phase fault on the Lathams 345kV (Bus 532800) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT_16_ROSEHIL7_LATHAMS7_345kV_1PH	*Single phase fault and sequence like previous*
17	FLT_17_ROSEHIL7_OPENSKY7_345kV_3PH	3 phase fault on the Open Sky 345kV (Bus 515621) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
18	FLT_18_ROSEHIL7_OPENSKY7_345kV_1PH	*Single phase fault and sequence like previous*
19	FLT_19_BENTON7_WOLFCRK7_345kV_3PH	3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT_20_BENTON7_WOLFCRK7_345kV_1PH	*Single phase fault and sequence like previous*
21	FLT_21_BENTON7_WICHITA7_345kV_3PH	3 phase fault on the Benton 345kV (Bus 532791) to Wichita 345kV (Bus 532796) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT_22_BENTON7_WICHITA7_345kV_1PH	*Single phase fault and sequence like previous*
23	FLT_23_CANEYRV7_NEOSHO7_345kV_3PH	3 phase fault on the Caney River 345kV (Bus 532780) to Neosho 345V (Bus 532793) CKT 1, near Caney River. a. Apply fault at the Caney River 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT_24_CANEYRV7_NEOSHO7_345kV_1PH	*Single phase fault and sequence like previous*
25	FLT_25_RANCHRD7_SOONER7_345kV_3PH	3 phase fault on the Ranch Road 345kV (Bus 515576) to Sooner 345kV (Bus 514803) CKT 1, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT_26_RANCHRD7_SOONER7_345kV_1PH	*Single phase fault and sequence like previous*
27	FLT_27_LACYGNE7_WAVERLY7_345kV_3PH	3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT_28_LACYGNE7_WAVERLY7_345kV_1PH	*Single phase fault and sequence like previous*
29	FLT_29_LACYGNE7_WGRDNR7_345kV_3PH	3 phase fault on the LaCygne 345kV (Bus 542981) to West Gardner 345kV (Bus 542965) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT_30_LACYGNE7_WGRDNR7_345kV_1PH	*Single phase fault and sequence like previous*

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
31	FLT_31_LACYGNE7_NEOSHO7_345kV_3PH	3 phase fault on the LaCygne 345kV (Bus 542981) to Neosho 345kV (Bus 532793) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT_32_LACYGNE7_NEOSHO7_345kV_1PH	*Single phase fault and sequence like previous*
33	FLT_33_LACYGNE7_STILWEL7_345kV_3PH	3 phase fault on the LaCygne 345kV (Bus 542981) to Stilwell 345kV (Bus 542968) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT_34_LACYGNE7_STILWEL7_345kV_1PH	*Single phase fault and sequence like previous*
35	FLT_35_WGRDNR7_SWISVAL7_345kV_3PH	3 phase fault on the Swissvale 345kV (Bus 532774) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT_36_WGRDNR7_SWISVAL7_345kV_1PH	*Single phase fault and sequence like previous*
37	FLT_37_WGRDNR7_STILWEL7_345kV_3PH	3 phase fault on the Stilwell 345kV (Bus 542968) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT_38_WGRDNR7_STILWEL7_345kV_1PH	*Single phase fault and sequence like previous*
39	FLT_39_WGRDNR7_CRAIG7_345kV_3PH	3 phase fault on the Craig 345kV (Bus 542977) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT_40_WGRDNR7_CRAIG7_345kV_1PH	*Single phase fault and sequence like previous*
41	FLT_41_SOONER7_WOODRNG7_345kV_3PH	3 phase fault on the Sooner 345kV (Bus 514803) to Woodring 345kV (Bus 514715) CKT 1, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT_42_SOONER7_WOODRNG7_345kV_1PH	*Single phase fault and sequence like previous*

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
43	FLT_43_SOONER7_CLEVLND7_345kV_3PH	3 phase fault on the Cleveland 345kV (Bus 512694) to Sooner 345kV (Bus 514803) CKT 1, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT_44_SOONER7_CLEVLND7_345kV_1PH	*Single phase fault and sequence like previous*
45	FLT_45_WICHITA7_G14001TAP_345kV_3PH	3 phase fault on the GEN-2014-001 Tap 345kV (Bus 562476) to Wichita 345KV (Bus 532796) CKT 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT_46_WICHITA7_G14001TAP_345kV_1PH	*Single phase fault and sequence like previous*
47	FLT_47_G14001TAP_EMPEC7_345kV_3PH	3 phase fault on the GEN-2014-001 Tap 345kV (Bus 562476) to Emporia Energy Center 345kV (Bus 532768) CKT 1, near GEN-2014-001 Tap. a. Apply fault at the GEN-2014-001 Tap 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT_48_G14001TAP_EMPEC7_345kV_1PH	*Single phase fault and sequence like previous*
49	FLT_49_WICHITA7_RENO7_345kV_3PH	3 phase fault on the Reno 345kV (Bus 532771) to Wichita 345KV (Bus 532796) CKT 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT_50_WICHITA7_RENO7_345kV_1PH	*Single phase fault and sequence like previous*
51	FLT_51_WICHITA7_VIOLA7_345kV_3PH	3 phase fault on the Viola 345kV (Bus 532798) to Wichita 345KV (Bus 532796) CKT 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT_52_WICHITA7_VIOLA7_345kV_1PH	*Single phase fault and sequence like previous*
53	FLT_53_WICHITA7_THISTLE7_345kV_3PH	3 phase fault on the Thistle 345kV (Bus 539801) to Wichita 345KV (Bus 532796) CKT 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT_54_WICHITA7_THISTLE7_345kV_1PH	*Single phase fault and sequence like previous*

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
55	FLT_55_NEOSHO7_7BLACKBERRY_345kV_3PH	3 phase fault on the Blackberry 345kV (Bus 300739) to Neosho 345kV (Bus 532793) CKT 1, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT_56_NEOSHO7_7BLACKBERRY_345kV_1PH	*Single phase fault and sequence like previous*
57	FLT_57_NEOSHO7_DELWARE7_345kV_3PH	3 phase fault on the Delaware 345kV (Bus 510380) to Neosho 345kV (Bus 532793) CKT 1, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT_58_NEOSHO7_DELWARE7_345kV_1PH	*Single phase fault and sequence like previous*
59	FLT_59_STILWEL7_PECULR7_345kV_3PH	3 phase fault on the Peculiar 345kV (Bus 541198) to Stilwell 345kV (Bus 542968) CKT 1, near Stilwell. a. Apply fault at the Stilwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT_60_STILWEL7_PECULR7_345kV_1PH	*Single phase fault and sequence like previous*
61	FLT_61_SWISVAL7_EMPEC7_345kV_3PH	3 phase fault on the Emporia Energy Center 345kV (Bus 532768) to Swissvale 345kV (Bus 532774) CKT 1, near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
62	FLT_62_SWISVAL7_EMPEC7_345kV_1PH	*Single phase fault and sequence like previous*
63	FLT_63_EMPEC7_MORRIS7_345kV_3PH	3 phase fault on the Emporia Energy Center 345kV (Bus 532768) to Morris County 345KV (Bus 532770) CKT 1, near Emporia Energy Center. a. Apply fault at the Emporia Energy Center 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
64	FLT_64_EMPEC7_MORRIS7_345kV_1PH	*Single phase fault and sequence like previous*
65	FLT_65_STILWEL7_STILWEL5_345_161kV_3PH	3 phase fault on the Stilwell 345kV (Bus 542968) to Stilwell 161kV (Bus 542969) to Stilwell Tertiary 13.8kV (Bus 543647) CKT 11, near Stilwell 345kV. a. Apply fault at the Stilwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
66	FLT_66_WGRDNR7_WGARDNR5_345_161kV_3PH	3 phase fault on the West Gardner 345kV (Bus 542965) to West Gardner 161kV (Bus 542966) to West Gardner Tertiary 13.8kV (Bus 543649) CKT 11, near West Gardner 345kV. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
67	FLT_67_SWISVAL7_SWISVAL6_345_230kV_3PH	3 phase fault on the Swissvale 345kV (Bus 532774) to Swissvale 230kV (Bus 532856) to Swissvale Tertiary 14.4kV (Bus 532815) CKT 1, near Swissvale 345kV. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
68	FLT_68_NEOSHO7_NEOSHOS4_345_138kV_3PH	3 phase fault on the Neosho 345kV (Bus 532793) to Neosho 138kV (Bus 533020) to Neosho Tertiary 13.8kV (Bus 532824) CKT 1, near Neosho 345kV. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
69	FLT_69_ROSEHIL7_ROSEHIL4_345_138kV_3PH	3 phase fault on the Rose Hill 345kV (Bus 532794) to Rose Hill 138kV (Bus 533062) to Rose Hill Tertiary 13.8kV (Bus 532831) CKT 11, near Rose Hill 345kV. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
70	FLT_70_BENTON7_BENTON4_345_138kV_3PH	3 phase fault on the Benton 345kV (Bus 532791) to Benton 138kV (Bus 532986) to Benton Tertiary 13.8kV (Bus 532821) CKT 1, near Benton 345kV. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
71	FLT_71_WICHITA7_EVANSN4_345_138kV_3PH	3 phase fault on the Wichita 345kV (Bus 532796) to Gordon Evans 138kV (Bus 533040) to Wichita Tertiary 13.8kV (Bus 532829) CKT 1, near Wichita 345kV. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
72	FLT_72_POWWWC_WOLFCRK7_BENTON7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.
73	FLT_73_POWWWC_WOLFCRK7_BENTON7_345kV_1PH	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
74	FLT_74_POWWWC_WOLFCRK7_ ROSEHIL7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.
75	FLT_75_POWWWC_WOLFCRK7_ ROSEHIL7_345kV_1PH	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
76	FLT_76_POWWWC_BENTON7_W OLFCRK7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.
77	FLT_77_POWWWC_BENTON7_W OLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
78	FLT_78_POWWWC_ROSEHIL7_W OLFCRK7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
79	FLT_79_POWWWC_ROSEHIL7_WOLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
80	FLT_80_POLCWW_WOLFCRK7_WAVERLY7_345kV_3PH_NR	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Trip generation projects GEN-2008-098 & GEN-2010-003.
81	FLT_81_POLCWW_WOLFCRK7_WAVERLY7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Trip generation projects GEN-2008-098 & GEN-2010-003. d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
82	FLT_82_POLCWW_WOLFCRK7_BENTON7_345kV_3PH_ER	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.
83	FLT_83_POLCWW_WOLFCRK7_BENTON7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
84	FLT_84_POLCWW_WOLFCRK7_ROSEHIL7_345kV_3PH_ER	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.
85	FLT_85_POLCWW_WOLFCRK7_ROSEHIL7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
86	FLT_86_POLCWW_WAVERLY7_WOLFCRK7_345kV_3PH_NR	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Trip generation projects GEN-2008-098 & GEN-2010-003.
87	FLT_87_POLCWW_WAVERLY7_WOLFCRK7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Trip generation projects GEN-2008-098 & GEN-2010-003. d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
88	FLT_88_POLCWW_BENTON7_WOLFCRK7_345kV_3PH_ER	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
89	FLT_89_POLCWW_BENTON7_WOLFCRK7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
90	FLT_90_POLCWW_ROSEHIL7_WOLFCRK7_345kV_3PH_ER	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.
91	FLT_91_POLCWW_ROSEHIL7_WOLFCRK7_345kV_1PH	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
92	FLT_92_PORHWC_WOLFCRK7_WAVERLY7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
93	FLT_93_PORHWC_WOLFCRK7_WAVERLY7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
94	FLT_94_PORHWC_WOLFCRK7_BENTON7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
95	FLT_95_PORHWC_WOLFCRK7_BENTON7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
96	FLT_96_PORHWC_WAVERLY7_WOLFCRK7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
97	FLT_97_PORHWC_WAVERLY7_WOLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
98	FLT_98_PORHWC_BENTON7_WOLFCRK7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Benton end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Benton end of the line in (b) and remove fault.
99	FLT_99_PORHWC_BENTON7_WOLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
100	FLT_100_PORHWC_WAVERLY7_LACYGNE7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
101	FLT_101_PORHWC_WAVERLY7_LACYGNE7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
102	FLT_102_PORHWC_LACYGNE7_WAVERLY7_345kV_3PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
103	FLT_103_PORHWC_LACYGNE7_WAVERLY7_345kV_1PH	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** *Single phase fault and sequence like previous*
104	FLT_104_POBNWC_WOLFCRK7_WAVERLY7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
105	FLT_105_POBNWC_WOLFCRK7_WAVERLY7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
106	FLT_106_POBNWC_WOLFCRK7_ROSEHIL7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
107	FLT_107_POBNWC_WOLFCRK7_ROSEHIL7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
108	FLT_108_POBNWC_WAVERLY7_WOLFCRK7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
109	FLT_109_POBNWC_WAVERLY7_WOLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
110	FLT_110_POBNWC_ROSEHIL7_WOLFCRK7_345kV_3PH_ER	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the Rose Hill end of the line in (b) and remove fault.
111	FLT_111_POBNWC_ROSEHIL7_WOLFCRK7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
112	FLT_112_POBNWC_WAVERLY7_LACYGNE7_345kV_3PH_NR	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
113	FLT_113_POBNWC_WAVERLY7_LACYGNE7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
114	FLT_114_POBNWC_LACYGNE7_WAVERLY7_345kV_3PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
115	FLT_115_POBNWC_LACYGNE7_WAVERLY7_345kV_1PH	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** *Single phase fault and sequence like previous*

Results

The stability analysis was performed and the results are summarized in Table III-2.

Based on the dynamic results and with all project and network upgrades in service, there were no stability problems found during any of the simulations. No generators tripped or went unstable, and voltages recovered to acceptable levels.

Table III-2: Stability Analysis Results

Contingency Number and Summary		2015LL
1	3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
2	Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
3	3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
4	Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
5	3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
6	Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
7	3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK

Table III-2: Stability Analysis Results

	Contingency Number and Summary	2015LL
8	Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
9	3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
10	Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
11	3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
12	*Single phase fault and sequence like previous*	OK
13	3 phase fault on the Benton 345kV (Bus 532791) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill.	OK
14	*Single phase fault and sequence like previous*	OK
15	3 phase fault on the Lathams 345kV (Bus 532800) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill.	OK
16	*Single phase fault and sequence like previous*	OK
17	3 phase fault on the Open Sky 345kV (Bus 515621) to Rose Hill 345kV (Bus 532794) CKT 1, near Rose Hill.	OK
18	*Single phase fault and sequence like previous*	OK
19	3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
20	*Single phase fault and sequence like previous*	OK
21	3 phase fault on the Benton 345kV (Bus 532791) to Wichita 345kV (Bus 532796) CKT 1, near Benton.	OK
22	*Single phase fault and sequence like previous*	OK
23	3 phase fault on the Caney River 345kV (Bus 532780) to Neosho 345V (Bus 532793) CKT 1, near Caney River.	OK
24	*Single phase fault and sequence like previous*	OK
25	3 phase fault on the Ranch Road 345kV (Bus 515576) to Sooner 345kV (Bus 514803) CKT 1, near Ranch Road.	OK
26	*Single phase fault and sequence like previous*	OK
27	3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne.	OK
28	*Single phase fault and sequence like previous*	OK
29	3 phase fault on the LaCygne 345kV (Bus 542981) to West Gardner 345kV (Bus 542965) CKT 1, near LaCygne.	OK
30	*Single phase fault and sequence like previous*	OK
31	3 phase fault on the LaCygne 345kV (Bus 542981) to Neosho 345kV (Bus 532793) CKT 1, near LaCygne.	OK
32	*Single phase fault and sequence like previous*	OK
33	3 phase fault on the LaCygne 345kV (Bus 542981) to Stilwell 345kV (Bus 542968) CKT 1, near LaCygne.	OK
34	*Single phase fault and sequence like previous*	OK
35	3 phase fault on the Swissvale 345kV (Bus 532774) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner.	OK
36	*Single phase fault and sequence like previous*	OK
37	3 phase fault on the Stilwell 345kV (Bus 542968) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner.	OK
38	*Single phase fault and sequence like previous*	OK
39	3 phase fault on the Craig 345kV (Bus 542977) to West Gardner 345kV (Bus 542965) CKT 1, near West Gardner.	OK
40	*Single phase fault and sequence like previous*	OK

Table III-2: Stability Analysis Results

	Contingency Number and Summary	2015LL
41	3 phase fault on the Sooner 345kV (Bus 514803) to Woodring 345kV (Bus 514715) CKT 1, near Sooner.	OK
42	*Single phase fault and sequence like previous*	OK
43	3 phase fault on the Cleveland 345kV (Bus 512694) to Sooner 345kV (Bus 514803) CKT 1, near Sooner.	OK
44	*Single phase fault and sequence like previous*	OK
45	3 phase fault on the GEN-2014-001 Tap 345kV (Bus 562476) to Wichita 345KV (Bus 532796) CKT 1, near Wichita.	OK
46	*Single phase fault and sequence like previous*	OK
47	3 phase fault on the GEN-2014-001 Tap 345kV (Bus 562476) to Emporia Energy Center 345kV (Bus 532768) CKT 1, near GEN-2014-001 Tap.	OK
48	*Single phase fault and sequence like previous*	OK
49	3 phase fault on the Reno 345kV (Bus 532771) to Wichita 345KV (Bus 532796) CKT 1, near Wichita.	OK
50	*Single phase fault and sequence like previous*	OK
51	3 phase fault on the Viola 345kV (Bus 532798) to Wichita 345KV (Bus 532796) CKT 1, near Wichita.	OK
52	*Single phase fault and sequence like previous*	OK
53	3 phase fault on the Thistle 345kV (Bus 539801) to Wichita 345KV (Bus 532796) CKT 1, near Wichita.	OK
54	*Single phase fault and sequence like previous*	OK
55	3 phase fault on the Blackberry 345kV (Bus 300739) to Neosho 345kV (Bus 532793) CKT 1, near Neosho.	OK
56	*Single phase fault and sequence like previous*	OK
57	3 phase fault on the Delaware 345kV (Bus 510380) to Neosho 345kV (Bus 532793) CKT 1, near Neosho.	OK
58	*Single phase fault and sequence like previous*	OK
59	3 phase fault on the Peculiar 345kV (Bus 541198) to Stilwell 345kV (Bus 542968) CKT 1, near Stilwell.	OK
60	*Single phase fault and sequence like previous*	OK
61	3 phase fault on the Emporia Energy Center 345kV (Bus 532768) to Swissvale 345kV (Bus 532774) CKT 1, near Swissvale.	OK
62	*Single phase fault and sequence like previous*	OK
63	3 phase fault on the Emporia Energy Center 345kV (Bus 532768) to Morris County 345KV (Bus 532770) CKT 1, near Emporia Energy Center.	OK
64	*Single phase fault and sequence like previous*	OK
65	3 phase fault on the Stilwell 345kV (Bus 542968) to Stilwell 161kV (Bus 542969) to Stilwell Tertiary 13.8kV (Bus 543647) CKT 11, near Stilwell 345kV.	OK
66	3 phase fault on the West Gardner 345kV (Bus 542965) to West Gardner 161kV (Bus 542966) to West Gardner Tertiary 13.8kV (Bus 543649) CKT 11, near West Gardner 345kV.	OK
67	3 phase fault on the Swissvale 345kV (Bus 532774) to Swissvale 230kV (Bus 532856) to Swissvale Tertiary 14.4kV (Bus 532815) CKT 1, near Swissvale 345kV.	OK
68	3 phase fault on the Neosho 345kV (Bus 532793) to Neosho 138kV (Bus 533020) to Neosho Tertiary 13.8kV (Bus 532824) CKT 1, near Neosho 345kV.	OK

Table III-2: Stability Analysis Results

	Contingency Number and Summary	2015LL
69	3 phase fault on the Rose Hill 345kV (Bus 532794) to Rose Hill 138kV (Bus 533062) to Rose Hill Tertiary 13.8kV (Bus 532831) CKT 11, near Rose Hill 345kV.	OK
70	3 phase fault on the Benton 345kV (Bus 532791) to Benton 138kV (Bus 532986) to Benton Tertiary 13.8kV (Bus 532821) CKT 1, near Benton 345kV.	OK
71	3 phase fault on the Wichita 345kV (Bus 532796) to Gordon Evans 138kV (Bus 533040) to Wichita Tertiary 13.8kV (Bus 532829) CKT 1, near Wichita 345kV.	OK
72	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
73	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
74	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
75	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
76	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
77	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
78	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
79	**Prior Outage of Wolf Creek to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
80	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
81	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK

Table III-2: Stability Analysis Results

Contingency Number and Summary		2015LL
82	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
83	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
84	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
85	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
86	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
87	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
88	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
89	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
90	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
91	**Prior Outage of LaCygne to Waverly Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
92	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
93	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
94	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK

Table III-2: Stability Analysis Results

	Contingency Number and Summary	2015LL
95	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
96	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
97	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
98	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
99	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Benton 345kV (Bus 532791) to Wolf Creek 345KV (Bus 532797) CKT 1, near Benton.	OK
100	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
101	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
102	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne.	OK
103	**Prior Outage of Wolf Creek to Rose Hill Ckt 1 & Wolf Creek output reduced to 800MW net.** *Single phase fault and sequence like previous*	OK
104	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
105	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
106	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK
107	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Wolf Creek.	OK

Table III-2: Stability Analysis Results

	Contingency Number and Summary	2015LL
108	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
109	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to Wolf Creek 345KV (Bus 532797) CKT 1, near Waverly.	OK
110	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
111	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on the Rose Hill 345kV (Bus 532794) to Wolf Creek 345KV (Bus 532797) CKT 1, near Rose Hill.	OK
112	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
113	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** Single phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near Waverly.	OK
114	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** 3 phase fault on Waverly 345kV (Bus 532799) to LaCygne 345KV (Bus 542981) CKT 1, near LaCygne.	OK
115	**Prior Outage of Wolf Creek to Benton Ckt 1 & Wolf Creek output reduced to 800MW net.** *Single phase fault and sequence like previous*	OK

The stability results exhibited large, lightly damped, oscillations for disturbances near Wolf Creek Generating Station. For the system intact conditions, the oscillations with the largest signal amplitudes were observed with the contingency FLT_05_WOLFCRK7_WAVERLY7_345kV_3PH_NR. For the prior outage conditions with Wolf Creek reduced to 800MW (net output), the oscillations with the largest signal amplitudes were observed with the contingency FLT_102_PORHWC_LACYGNE7_WAVERLY7_345kV_3PH. The plots of Wolf Creek Generating Station rotor angle, terminal voltage, and power output for these disturbances are provided in appendix A.

The Southwest Power Pool Disturbance Performance Requirements, approved by the Transmission Working Group at the August 2013 meeting, established minimum requirements for machine rotor angle damping and transient voltage recovery. These requirements specify that Machine Rotor Angles shall exhibit well damped angular oscillations and acceptable power swings following a disturbance on the Bulk Electric System for all NERC Category A, B and C events. The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met: Damping Ratio ≥ 0.0081633 (0.81633%).

A modal analysis was performed for these two disturbances (FLT_05 & FLT_102) to ensure adequate damping to meet the SPP disturbance performance requirements. The modes were calculated using the Siemens PTI PSS/E auxiliary program PSSPLT on the time interval from 0.6 (the moment the fault was cleared) to 20 Seconds with the Fit by Least Squares calculation method. The modes that have a magnitude relative to the oscillation amplitude and exhibit a small damping ratio are the modes which result in a lightly damped response. The modal eigenvalues and eigenvectors of Wolf Creek Generation Station rotor angle, terminal voltage, and power output are shown in Table III-3. The modes shown include those with larger magnitudes (cutoff of 0.01) and exhibit the smaller damping ratios (cutoff of 5%).

These results indicate that SPP disturbance performance requirement, Damping Ratio ≥ 0.81633%, is met with the smallest Damping Ratio calculated at 3.112%.

The Damping Ratio (ζ) is calculated by the following equation:

$$\zeta = \frac{-\sigma}{\sqrt{\sigma^2 + \omega^2}}$$

Where:

$$\sigma = real\ part\ of\ the\ eigenvalue$$
$$\omega = imaginary\ part\ of\ the\ eigenvalue$$

Table III-3: Modal Analysis Results

Cont. Num.	Channel	Season	Real	Imaginary	Eigenvalue Magnitude	Angle	Damping Ratio %	Freq. (HZ)
05	ANGL532751[WCGS U1 25.000]1	2015LL	-0.181293	5.45712	8.7303	9.38	3.320	0.869
05	ANGL532751[WCGS U1 25.000]1	2015LL	-0.332551	7.1163	0.87615	-16.72	4.668	1.133
102	ANGL532751[WCGS U1 25.000]1	2015LL	-0.168853	5.42256	0.18702	-153.52	3.112	0.863
05	ETRM532751[WCGS U1 25.000]1	2015LL	-0.250685	5.4336	6.95E-02	-150.09	4.609	0.865
05	POWR532751[WCGS U1 25.000]1	2015LL	-0.185753	5.4602	1.6861	4.06	3.400	0.869
05	POWR532751[WCGS U1 25.000]1	2015LL	-0.240584	7.14227	0.16573	-127.99	3.367	1.137
102	POWR532751[WCGS U1 25.000]1	2015LL	-0.187948	5.4344	7.71E-02	-142.16	3.456	0.865

FERC LVRT Compliance

FERC Order #661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI that draw the voltage down at the POI to 0.0 pu.

Contingencies 1, 3, 86, 96, 100, 108, and 112 in Table III-2 simulated the LVRT contingencies. GEN-2008-098 & GEN-2010-003 met the LVRT requirements by staying on line and the transmission system remained stable.

IV. Conclusion

The SPP GEN-2008-098 & GEN-2010-003 Impact Restudy evaluated the impact of interconnecting the projects shown below.

Table V-1: Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2008-098 & GEN-2010-003	199.0	90 X Gamesa G114 2.1MW (532957&577200)	Tap on Wolf Creek – LaCygne 345kV (532799)
		5 X Gamesa G114 2.0MW (532957)	

With all Base Case Network Upgrades in service and previously assigned Network Upgrades in service, the GEN-2008-098 & GEN-2010-003 projects were found to remain on line, and the transmission system was found to remain stable for all conditions studied.

The GEN-2008-098 & GEN-2010-003 projects are required to maintain a power factor requirement of the pro-forma standard 0.95 leading (absorbing) to 0.95 lagging (supplying) at the Point of Interconnection.

Low Voltage Ride Through (LVRT) analysis showed the study generators did not trip offline due to low voltage when all Network Upgrades are in service.

All generators in the monitored areas remained stable for all of the modeled disturbances.

Any changes to the assumptions made in this study, for example, one or more of the previously queued requests withdraw, may require a re-study at the expense of the Customer.

Nothing in this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service.

APPENDIX A

PLOTS
(Additional Plots Available upon request)

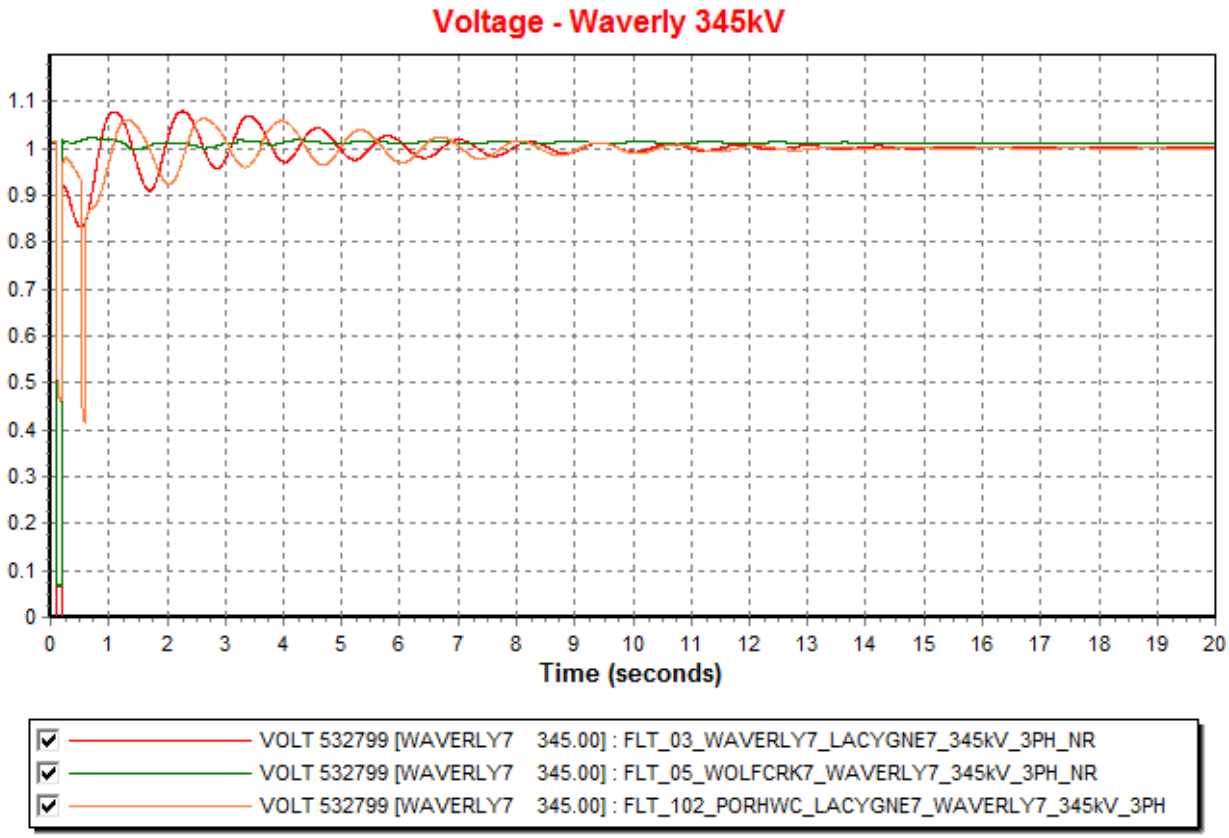

Figure A-1: GEN-2008-098 & GEN-2010-003 345kV POI Voltage

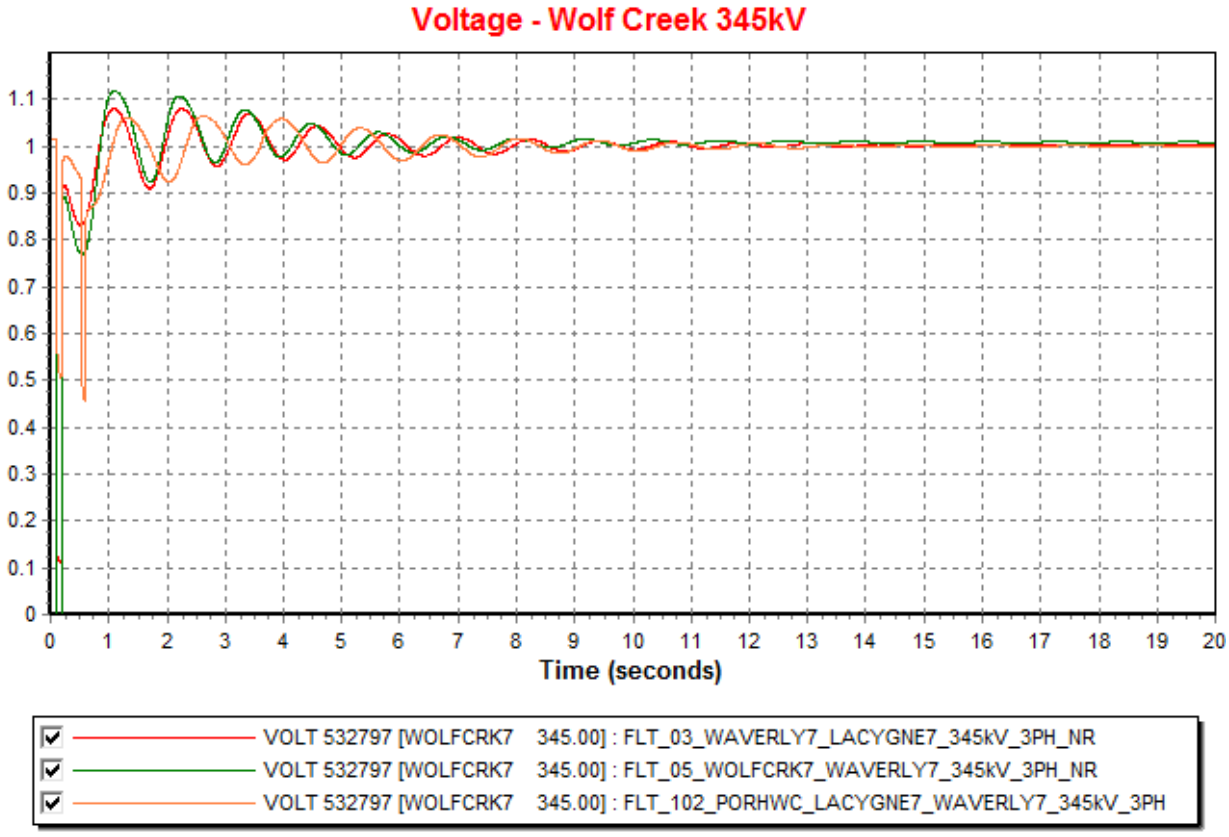

Figure A-2: Wolf Creek 345kV Voltage

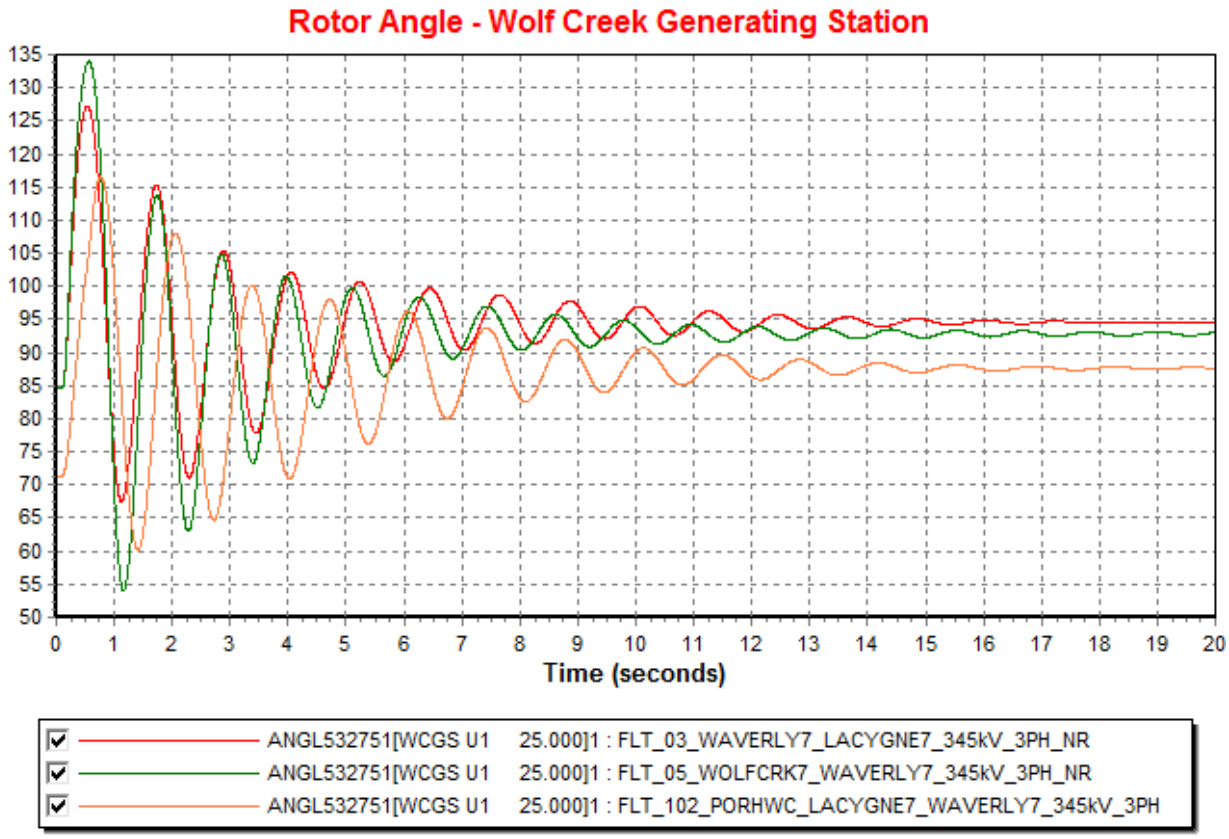

Figure A-3: Wolf Creek Generating Station Rotor Angle

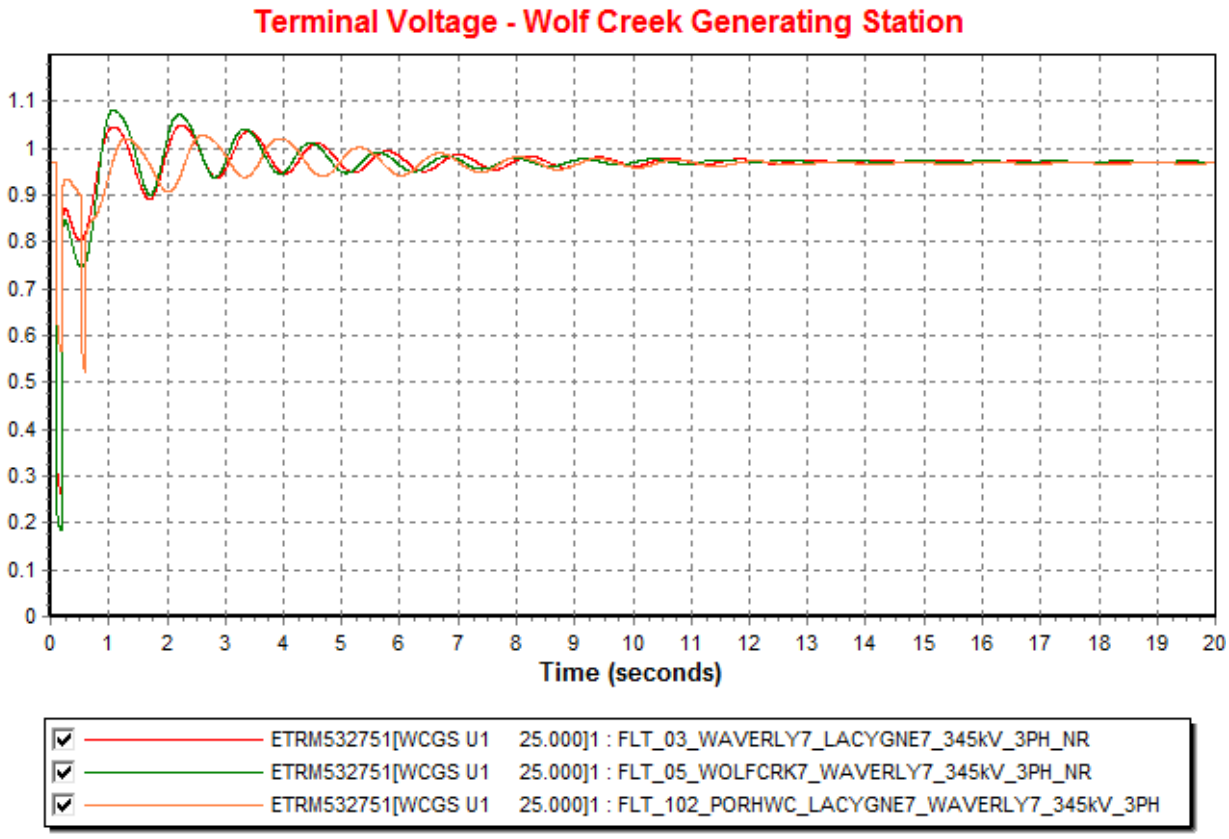

Figure A-4: Wolf Creek Generating Station Terminal Voltage

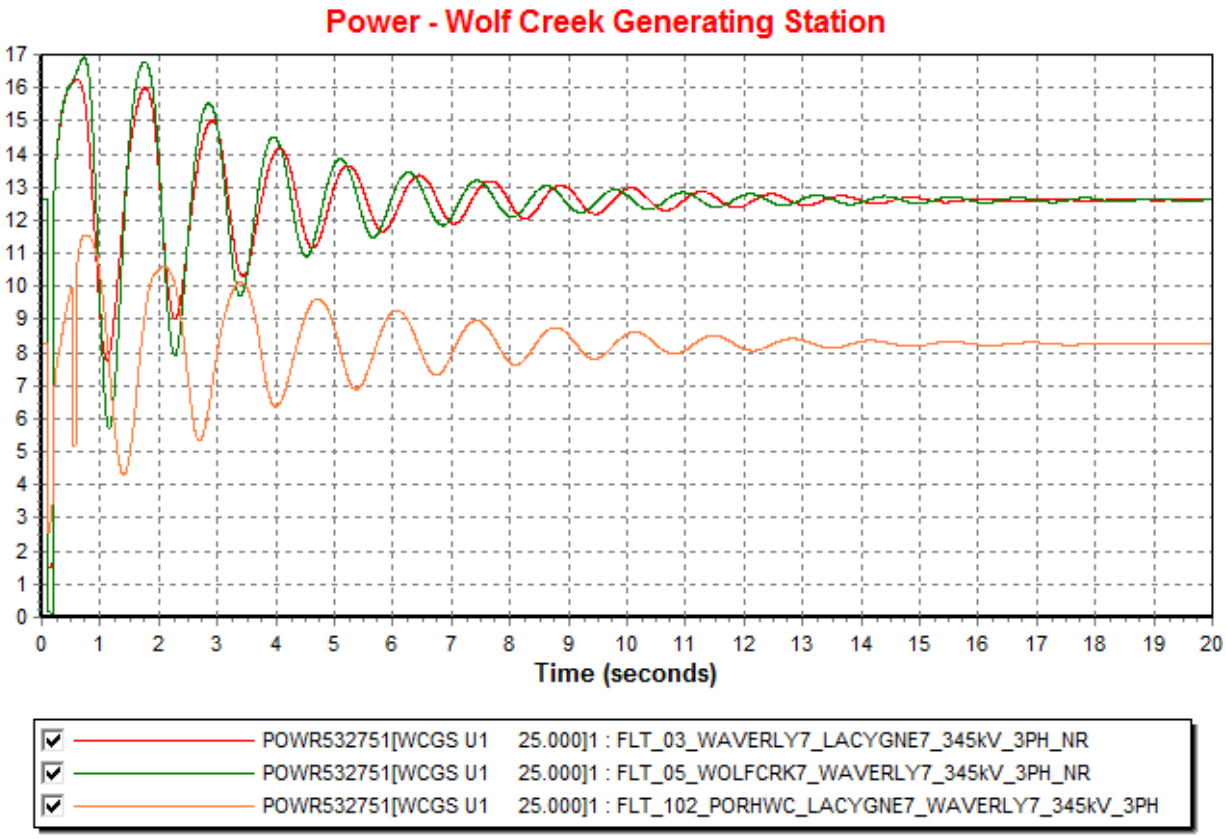

Figure A-5: Wolf Creek Generating Station Power

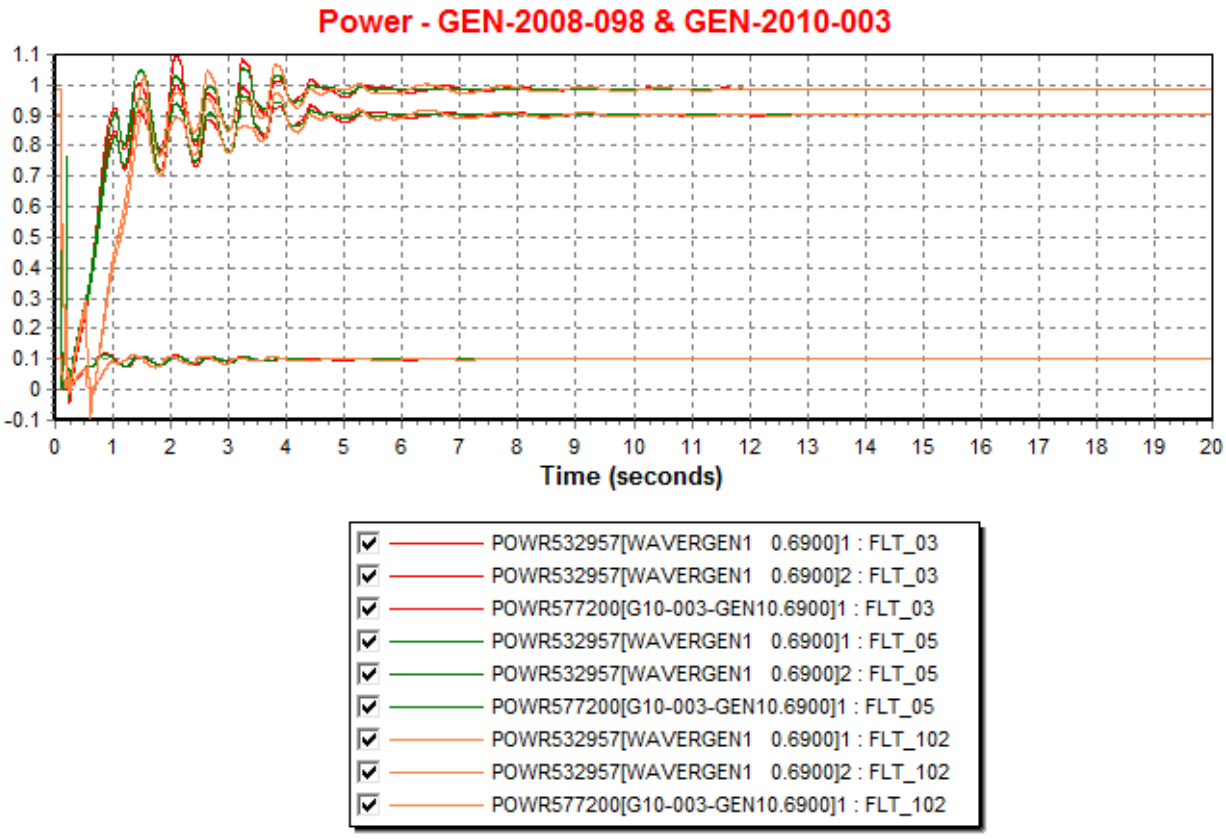

Figure A-6: GEN-2008-098 & GEN-2010-003 Power

APPENDIX B

TRANSIENT VOLTAGE DETAILS
(Available upon request)

APPENDIX C

POWER FACTOR ANALYSIS
(Available upon request)

APPENDIX D

PROJECT MODELS

GEN-2008-098 & GEN-2010-003 (Gamesa G114 2.0MW & Gamesa G114 2.1MW Wind Turbine Generator)

PSS/E 32 Power Flow Data

```
@! Tap Lacygne-Wolf Creek (Anderson County/Waverly) 345kV
@! ********** GEN-2008-098 & GEN-2010-003 **********
@! POI @ Waverly 345kV 532799
@! Gamesa V114 2.0MW & 2.1MW
@! Pmax=199.0MW
@!
@! 0.95PF Range (Qgen=Qmax=Qmin +/-32.8684)
@!
Version 32
@!
@! ---------- Bus Data ----------
BAT_SPLT,532799,572091,'GEN-2008-098', 345.00,;
BAT_MOVEBRN,532954,532799,1,572091,1,;
BAT_BUS_DATA_2,572091,1,,,, 345.00,,,'GEN-2008-098',;
BAT_BUS_DATA_2,532954,1,,,,  34.50,,,'WAVERTX1',;
BAT_BUS_DATA_2,532960,1,,,,  34.50,,,'WAVERGSU1',;
BAT_BUS_DATA_2,532957,2,,,,   0.69,,,'WAVERGEN1',;
BAT_SPLT,532954,577198,'GEN-2010-003',  34.50,;
BAT_BUS_DATA_2,577198,1,,,,  34.50,,,'GEN-2010-003',;
BAT_BUS_DATA_2,577200,2,,,,   0.69,,,'G10-003-GEN1',;
@!
@! ---------- Generator Data ----------
BAT_PLANT_DATA,532957,, 1.000,,;
BAT_PLANT_DATA,577200,, 1.000,,;
 BAT_MACHINE_DATA_2,532957,'1',1,,,,,0,  90.30, 9.0,  9.0000,  9.0000,  90.30,13.545,  90.300, 0.006616, 0.1582594,,,,,,,, 1.00,;
 BAT_MACHINE_DATA_2,532957,'2',1,,,,,0,  10.00, 1.0,  1.0000,  1.0000,  10.00, 1.500,  10.000, 0.006301, 0.1507237,,,,,,,, 1.00,;
 BAT_MACHINE_DATA_2,577200,'1',1,,,,,0,  98.70,10.0, 10.0000, 10.0000,  98.70,14.805,  98.700, 0.006616, 0.1582594,,,,,,,, 1.00,;
@!
@! ---------- Unit Transformers ----------
BAT_TWO_WINDING_DATA_3,572091,532954,'1',1,,,,,,33,,,,1,0,1,2,1, 0.00499, 0.09988, 138.00,,,,,, 230.00, 230.00, 230.00,,,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_3,532960,532957,'1',1,,,,,, 5,,,,1,0,1,2,1, 0.01023, 0.11555, 112.80,,,,,, 112.80, 112.80, 112.80,,,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_3,577198,577200,'1',1,,,,,, 5,,,,1,0,1,2,1, 0.01023, 0.11555, 110.45,,,,,, 110.45, 110.45, 110.45,,,,,,,,,,,,,,;
@!
@! ---------- Collector Cables ----------
BAT_BRANCH_DATA,532799,572091,'1',1,,,,,,  0.00018, 0.00221, 0.04186,,,,,,,,  4.60,,,,,;
BAT_BRANCH_DATA,532954,532960,'1',1,,,,,,  0.01763, 0.02654, 0.07452,,,,,,,,      ,,,,,;
BAT_BRANCH_DATA,532954,577198,'1',1,,,,,,  0.00850, 0.01180, 0.04265,,,,,,,,      ,,,,,;
@!
@END
```

PSS/E 32 Dynamics Data

```
/ ***** GEN-2008-098 & GEN-2010-003 *****
/ Gamesa 2.0MW & 2.1MW EXtQ v4.8 Release (GXX048_v32.lib)
/ Gamesa 2.1MW
532957 'USRMDL' '1' 'GXX048' 1  1  8  45  0  94
 45  1  43  0  8  1  1  1
 0.00 0.00 15.00
 0.00 0.90 0.90 0.90 0.90 0.90 0.90
 0.150 1.750 1.750 1.750 1.750 1.750 16.000
 1.10 1.10 1.20 1.20 2.00
 16.000 15.000 1.500 0.017 0.017
 0.950 0.950 0.950 0.950 0.950
 0.500 0.500 0.500 0.500
 1.050 1.050 1.050 1.050 1.050
 0.500 0.500 0.500 0.500 /
/ Gamesa 2.0MW
532957 'USRMDL' '2' 'GXX048' 1  1  8  45  0  94
 46  1  5  0  8  1  1  1
 0.00 0.00 15.00
 0.00 0.90 0.90 0.90 0.90 0.90 0.90
 0.150 1.750 1.750 1.750 1.750 1.750 16.000
 1.10 1.10 1.20 1.20 2.00
 16.000 15.000 1.500 0.017 0.017
 0.950 0.950 0.950 0.950 0.950
 0.500 0.500 0.500 0.500
 1.050 1.050 1.050 1.050 1.050
 0.500 0.500 0.500 0.500 /
/ Gamesa 2.1MW
577200 'USRMDL' '1' 'GXX048' 1  1  8  45  0  94
 45  1  47  0  8  1  1  1
 0.00 0.00 15.00
 0.00 0.90 0.90 0.90 0.90 0.90 0.90
 0.150 1.750 1.750 1.750 1.750 1.750 16.000
 1.10 1.10 1.20 1.20 2.00
 16.000 15.000 1.500 0.017 0.017
 0.950 0.950 0.950 0.950 0.950
 0.500 0.500 0.500 0.500
 1.050 1.050 1.050 1.050 1.050
 0.500 0.500 0.500 0.500 /
/
```

APPENDIX E

TRANSMISSION ONE-LINES
(Available upon request)