Limited Operational Impact Study For Generation Interconnection Request GEN-2008-079

SPP Generation Interconnection

(#GEN-2008-079)

April 2011

Executive Summary

<OMITTED TEXT> (Customer) has requested an Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of 99.2 MW of wind generation within the balancing authority of Mid-Kansas Electric Power Company (MKEC) in Gray County, Kansas. Customer has requested this Limited Operation Interconnection Study (LOIS) to determine the impacts of interconnecting its generating facility to the transmission system before all required Network Upgrades identified in the DISIS-2009-001-2 Impact Re-Study can be placed into service. Limited Operation Studies are conducted under GIA Section 5.9.

This study assumed that only the higher queued projects identified in Table 1 of this study might go into service before the completion of all Network Upgrades identified in DISIS-2009-001. If any additional generation projects not identified in Table 1 but with queue priority equal to or over GEN-2008-079 request to go into commercial operation before all Network Upgrades identified through the DISIS-2009-001-2 study process as required, then this study must be conducted again to determine whether sufficient limited interconnection capacity exists to interconnect the GEN-2008-079 interconnection request in addition to all higher priority requests in operation or pending operation. These projects are listed in Table 2.

A power flow analysis shows that the Customer's wind facility will be limited to an injection limit of 31MW until such time that the 115kV upgrades from Spearville – Judson Large identified in the latest DISIS-2009-001 Impact Study can be completed. Powerflow analysis was based on both summer and winter peak conditions and light loading cases.

The wind generation facility was studied with sixty-two (62) General Electric 1.6 MW wind turbine generators. This Impact study addresses the dynamic stability effects of interconnecting the plant to the rest of the MKEC transmission system for the system condition as it will be on December 31, 2011. Two seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. The cases studied were modified 2011 summer peak and 2011 winter peak cases that were adjusted to reflect system conditions at the requested in-service date. Each case was modified to include prior queued projects that are listed in the body of the report. Thirty (30) contingencies were identified for use in this study. The GE 1.6 MW wind turbines were modeled using information provided by the Customer.

Nothing in this study should be construed as a guarantee of transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service shall be requested on Southwest Power Pool's OASIS by the Customer.

1.0 Introduction

<OMITTED TEXT> (Customer) has requested an Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnection of 99.2 MW of wind generation within the balancing authority of Mid-Kansas Electric Power Company (MKEC) in Gray County, Kansas. Customer has requested this Limited Operation Interconnection Study (LOIS) to determine the impacts of interconnecting its generating facility to the transmission system before all required Network Upgrades identified in the DISIS-2009-001-2 Impact Study can be placed into service. Limited Operation Studies are conducted under GIA Section 5.9.

This Impact study addresses the dynamic stability effects of interconnecting the plant to the rest of the MKEC transmission system for the system condition as it will be on December 31, 2011. The wind generation facility was studied with sixty-seven (62) General Electric 1.6 MW wind turbine generators. Two seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. The cases studied were modified versions of the 2011 summer peak and 2011 winter peak to reflect the system conditions at the requested in-service date. Each case was modified to include prior queued projects that are listed in the body of the report. Thirty (30) contingencies were identified for this study.

2.0 Purpose

The purpose of this Limited Operation Interconnection Study (LOIS) is to evaluate the impact of the proposed interconnection on the reliability of the Transmission System. The LOIS considers the Base Case as well as all Generating Facilities (and with respect to (b) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the LOIS is commenced:

a) are directly interconnected to the Transmission System;
b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;
c) have a pending higher queued Interconnection Request to interconnect to the Transmission System listed in Table 1; or
d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Any changes to these assumptions, for example, one or more of the previously queued projects not included in this study signing an interconnection agreement, may require a re-study of this request 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.

3.0 Facilities

3.1 Generating Facility

The project was modeled as an equivalent wind turbine generator of 99.2 MW output. The wind turbine is connected to an equivalent 0.69/34.5KV generator step unit (GSU). The high side of the GSU is connected to the 34.5/115kV substation transformer. A 115kV transmission line connects the Customer’s substation transformer to the POI.

3.2 <u>Interconnection Facility</u>

The Point of Interconnection will be at a tap on the Transmission Owners Cudahy – Judson Large 115kv transmission line. Figure 1 shows the proposed POI. Figure 2 shows the Point of Interconnection.

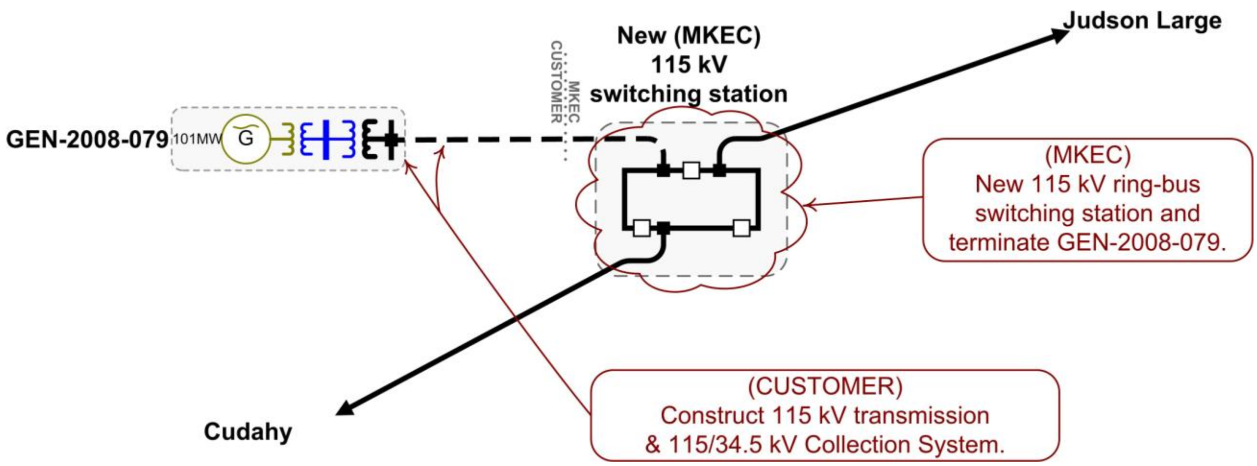

Figure 1: GEN-2008-079 Facility and Proposed Interconnection Configuration

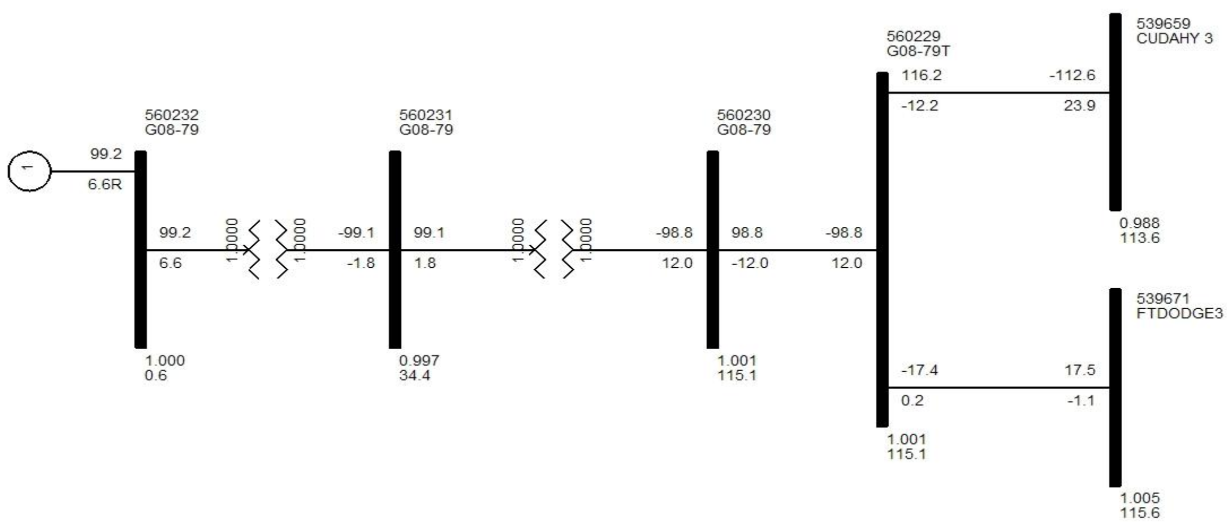

Figure 2: GEN-2008-079 Bus Interconnection

4.0 <u>Power Flow Analysis</u>

A powerflow analysis was conducted for the Interconnection Customer's facility using a modified version of the 2011 spring, 2012 summer, and 2012 winter seasonal models. The output of the Interconnection Customer's facility was offset in the model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ERIS) Interconnection Request. This analysis was conducted assuming that previous queued requests listed in Table 1 were in-service.

The Southwest Power Pool (SPP) Criteria states that:

> "The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable NERC Reliability Standards for transmission planning. All MDWG power flow models shall be tested to verify compliance with the System Performance Standards from NERC Table 1 – Category A."

The ACCC function of PSS/E was used to simulate single contingencies in portions of or all of the control area of MKEC and other control areas within SPP and the resulting data analyzed. This satisfies the "more probable" contingency testing criteria mandated by NERC and the SPP criteria.

Higher queued projects listed in Table 2 were not modeled as in service. If any of these come in service, this study will need to be performed again to determine if any limited interconnection service is available.

Table 1: Prior Queued Projects Included

Project	MW
Montezuma	110
GEN-2002-025A	150
GEN-2001-039M	99
GEN-2006-021	100
GEN-2003-019	250
GEN-2001-039A	105
GEN-2005-012	160

The projects listed in Table 2 are higher or equally queued projects that are <u>not</u> included in this analysis. <u>If any of these projects come into service, this study will need to be re-performed to determine if any limited capacity is available</u>.

Table 2: Prior Queued Projects Not Included

Project	MW
GEN-2004-014	150
GEN-2005-012	90
GEN-2006-006	205
GEN-2007-038	200
GEN-2007-040	200
GEN-2008-018	405

The ACCC analysis indicates that as a result of the Customer's project at full nameplate power the MKEC transmission system will experience thermal overloads as shown in Table 1.

The GEN-2008-079 will be restricted to 31MW injection limits assuming all projects listed in Table 1 come on line and assuming projects listed in Table 2 do not come on line before all network upgrades can be constructed.

It can be seen that the prior queued project GEN-2001-039A has a large impact on the GEN-2008-079 project. GEN-2001-039A is scheduled for COD on 12/31/2011. If GEN-2001-039A does not meet this COD, GEN-2008-079 may operate at these higher levels until such time that GEN-2001-039A meets COD.

Table 3: ACCC Analysis without Spearville-PostRock 345kV Ckt 1

SEASON	SOURCE	DIRECTION	MONTCOMMONNAME	RATEA	RATEB	TDF	TC%LOADING	**MW Available**	MW Available (without G01-39A)(Estimate Only)	CONTNAME
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5808	130.9102	**31.0824**	68	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5808	129.7236	**33.7281**	70	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5808	125.8596	**42.3433**	83	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5808	124.6819	**44.9691**	88	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5808	124.3821	**45.6375**	89	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5808	123.2042	**48.2638**	92	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER PLANT - CIMARRON RIVER TAP 115KV CKT 1	83.9	89.6	0.4900	117.8637	**67.3369**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER PLANT - CIMARRON RIVER TAP 115KV CKT 1	83.9	89.6	0.4900	116.5147	**69.8035**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.3492	113.8154	**48.7644**	100	HOLCOMB - SPEARVILLE 345KV CKT 1
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2145	113.1214	**35.6350**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2145	112.6433	**37.9803**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.2430	110.1784	**45.7593**	100	SPP-SUNC-14
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.3492	108.8176	**67.2992**	100	HOLCOMB - SPEARVILLE 345KV CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.3492	107.3426	**72.7694**	100	HOLCOMB - SPEARVILLE 345KV CKT 1
11G	G08_079	FROM->TO	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1	165.1	177.7	0.7706	106.8081	**84.3006**	100	CUDAHY - G08-79T 115.00 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5826	105.7617	**87.1920**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.2430	105.1582	**72.5120**	100	SPP-SUNC-14
11G	G08_079	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.2145	104.8368	**78.4390**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.2956	104.7009	**79.4071**	100	GEN531447 1-HOLCOMB GENERATOR
11G	G08_079	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.2145	104.3204	**80.7409**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3	120.7	129.5	0.2430	103.6864	**80.3552**		SPP-SUNC-14

			115.00 115KV CKT 1						100	
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2152	102.9689	**85.4832**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.3289	102.3740	**90.6535**	100	G01_039AT 115.00 - GREENSBURG 115KV CKT 1
11G	G08_079	FROM->TO	G01_039AT 115.00 - GREENSBURG 115KV CKT 1	120.7	129.5	0.4058	102.3114	**92.6240**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	G01_039AT 115.00 - GREENSBURG 115KV CKT 1	120.7	129.5	0.4058	101.4057	**95.5142**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5826	100.8179	**98.1819**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1

Table 4: ACCC Analysis with Spearville-PostRock 345kV Ckt 1

SEASON	SOURCE	DIRECTION	MONTCOMMONNAME	RATEA	RATEB	TDF	TC%LOADING	**MW Available**	MW Available (without G01-39A)(Estimate Only)	CONTNAME
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5831	133.3864	**29.2311**	67	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5831	132.3557	**30.1252**	70	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5831	128.3203	**37.1059**	84	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5831	127.2952	**39.3825**	87	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5831	126.8406	**40.3921**	89	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5831	125.8178	**42.6635**	92	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER PLANT - CIMARRON RIVER TAP 115KV CKT 1	83.9	89.6	0.4920	120.9413	**61.8614**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER PLANT - CIMARRON RIVER TAP 115KV CKT 1	83.9	89.6	0.4920	119.7815	**63.9737**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2137	112.2788	**39.5427**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2137	111.8498	**41.6550**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	FROM->TO	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1	165.1	177.7	0.7805	110.9285	**75.1189**	100	CUDAHY - G08-79T 115.00 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.2423	109.7634	**47.8249**	100	SPP-SUNC-14
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.5849	108.5285	**81.1158**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.2423	104.7416	**74.6611**	100	SPP-SUNC-14

11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.2950	104.6378	**79.6436**	100	GEN531447 1-HOLCOMB GENERATOR
11G	G08_079	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.2137	103.9546	**82.3055**	100	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
11G	G08_079	FROM->TO	CUDAHY - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5849	103.5718	**92.0912**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.2137	103.4808	**84.4255**	100	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.2423	103.2894	**82.4216**	100	SPP-SUNC-14
11G	G08_079	TO->FROM	CIMARRON RIVER TAP - KISMET 3 115.00 115KV CKT 1	120.7	129.5	0.5849	102.0991	**95.3521**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	105.2	105.2	0.2144	102.0684	**89.8495**	100	JUDSON LARGE - NORTH JUDSON LARGE SUB 115KV CKT 1
11G	G08_079	TO->FROM	CUDAHY - G08-79T 115.00 115KV CKT 1	120.7	129.5	0.3258	100.6985	**97.2234**	100	G01_039AT 115.00 - GREENSBURG 115KV CKT 1

5.0 Stability Analysis

5.1 Contingencies Simulated

Thirty (30) contingencies were considered for the transient stability simulations. These contingencies included three phase faults and single phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying a fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

The faults that were defined and simulated are listed in Table 3 below.

Table 5: Contingencies Evaluated

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Holcomb 345kV / 115kV autotransformer near the 345 kV bus (531449). a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
2	FLT03-3PH	3 phase fault on the Spearville 345kV / 230kV autotransformer near the 345 kV bus (531469). a. Apply fault at the Spearville 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
3	FLT05-3PH	3 phase fault on the Spearville 230kV / 115kV autotransformer near the 230 kV bus (539695). a. Apply fault at the Spearville 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
4	FLT07-3PH	3 phase fault on the Post Rock 345kV / 230kV transformer, near the 345 kV bus (530583). a. Apply fault at the Post Rock 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
5	FLT09-3PH	3 phase fault on the Spearville (531469) to Holcomb (531449) 345kV lines, near Spearville. a. Apply fault at the Spearville 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.
6	FLT10-1PH	*Single phase fault and sequence like previous*
7	FLT11-3PH	3 phase fault on the Judson Large (539671) to Dodge City Beef (539645) 115kV line, near Judson Large. a. Apply fault at the Judson Large 115kV 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.
8	FLT12-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
9	FLT13-3PH	3 phase fault on the Judson Large (539671) to GEN-2001-039A Tap (579025) 115kV line, near Judson Large. a. Apply fault at the Judson Large 115kV 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.
10	FLT14-1PH	*Single phase fault and sequence like previous*
11	FLT15-3PH	3 phase fault on the Spearville (539695) to Mullergren (539679) 230kV line, near Spearville. a. Apply fault at the Spearville 230kV 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	FLT16-1PH	*Single phase fault and sequence like previous*
13	FLT17-3PH	3 phase fault on the Mullergren (539679) to South Hays (530582) 230kV line, near Mullergren. a. Apply fault at the Mullergren 230kV 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	FLT18-1PH	*Single phase fault and sequence like previous*
15	FLT19-3PH	3 phase fault on the Mullergren (539679) to Circle (532871) 230kV line, near Mullergren. a. Apply fault at the Mullergren 230kV 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	FLT20-1PH	*Single phase fault and sequence like previous*
17	FLT21-3PH	3 phase fault on the Judson Large (539671) to North Jusdson Large (539771) 115kV line, near Judson Large. a. Apply fault at the Judson Large 115kV 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.
18	FLT22-1PH	*Single phase fault and sequence like previous*
19	FLT23-3PH	3 phase fault on the Spearville (531469) to Post Rock (530583) 345kV line, near Spearville. a. Apply fault at the Spearville 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	FLT24-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
21	FLT25-3PH	3 phase fault on the Cimarron River Tap (539652) to Cimarron Plant (539654) 115kV line, near Cimarron River Tap. a. Apply fault at the Cimarron River Tap 115kV 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	FLT26-1PH	*Single phase fault and sequence like previous*
23	FLT27-3PH	3 phase fault on the Cimarron River Tap (539652) to East Liberal (539672) 115kV line, near Cimarron River Tap. a. Apply fault at the Cimarron River Tap 115kV 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	FLT28-1PH	*Single phase fault and sequence like previous*
25	FLT29-3PH	3 phase fault on the Spearville (539694) to North Judson Large (539771) 115kV line, near Spearville. a. Apply fault at the Spearville 115kV 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	FLT30-1PH	*Single phase fault and sequence like previous*
27	FLT31-3PH	3 phase fault on the GEN-2008-079T (573029) to Judson Large (539671) 115kV line, near GEN-2008-079T. a. Apply fault at the GEN-2008-079T 115kV 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	FLT32-1PH	*Single phase fault and sequence like previous*
29	FLT33-3PH	3 phase fault on the GEN-2008-079T (573029) to Cudahy (539659) 115kV line, near GEN-2008-079T. a. Apply fault at the GEN-2008-079T 115kV 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	FLT34-1PH	*Single phase fault and sequence like previous*

5.2 Further Model Preparation

The base cases contain prior queued projects as shown in Table 1.

The wind generation from the study customer and the previously queued customers were dispatched into the SPP footprint.

Initial simulations were carried out on both base cases and cases with the added generation for a no-disturbance run of 20 seconds to verify the numerical stability of the model. All cases were confirmed to be stable.

A stability analysis showed that the Customer's wind facility cannot interconnect until the Balanced Portfolio Project, Spearville-Post Rock 345kV Line, is in-service.

5.3 Results

Results of the stability analysis are summarized in Table 6. The results indicate that for all contingencies studied the transmission system remains stable.

Table 6: Results of Simulated Contingencies

Cont. No.	Cont. Name	Description	2011 Summer	2011 Winter
1	FLT01-3PH	3 phase fault on the Holcomb 345kV / 115kV autotransformer near the 345 kV bus (531449).	Stable	Stable
2	FLT03-3PH	3 phase fault on the Spearville 345kV / 230kV autotransformer near the 345 kV bus (531469).	Stable	Stable
3	FLT05-3PH	3 phase fault on the Spearville 230kV / 115kV autotransformer near the 230 kV bus (539695).	Stable	Stable
4	FLT07-3PH	3 phase fault on the Post Rock 345kV / 230kV transformer, near the 345 kV bus (530583).	Stable	Stable
5	FLT09-3PH	3 phase fault on the Spearville (531469) to Holcomb (531449) 345kV lines, near Spearville.	Stable	Stable
6	FLT10-1PH	*Single phase fault and sequence like previous*	Stable	Stable
7	FLT11-3PH	3 phase fault on the Judson Large (539671) to Dodge City Beef (539645) 115kV line, near Judson Large.	Stable	Stable
8	FLT12-1PH	*Single phase fault and sequence like previous*	Stable	Stable
9	FLT13-3PH	3 phase fault on the Judson Large (539671) to GEN-2001-039A Tap (579025) 115kV line, near Judson Large.	Stable	Stable
10	FLT14-1PH	*Single phase fault and sequence like previous*	Stable	Stable
11	FLT15-3PH	3 phase fault on the Spearville (539695) to Mullergren (539679) 230kV line, near Spearville.	Stable	Stable
12	FLT16-1PH	*Single phase fault and sequence like previous*	Stable	Stable
13	FLT17-3PH	3 phase fault on the Mullergren (539679) to South Hays (530582) 230kV line, near Mullergren.	Stable	Stable

Cont. No.	Cont. Name	Description	2011 Summer	2011 Winter
14	FLT18-1PH	*Single phase fault and sequence like previous*	Stable	Stable
15	FLT19-3PH	3 phase fault on the Mullergren (539679) to Circle (532871) 230kV line, near Mullergren.	Stable	Stable
16	FLT20-1PH	*Single phase fault and sequence like previous*	Stable	Stable
17	FLT21-3PH	3 phase fault on the Judson Large (539671) to North Jusdson Large (539771) 115kV line, near Judson Large.	Stable	Stable
18	FLT22-1PH	*Single phase fault and sequence like previous*	Stable	Stable
19	FLT23-3PH	3 phase fault on the Spearville (531469) to Post Rock (530583) 345kV line, near Spearville.	Stable	Stable
20	FLT24-1PH	*Single phase fault and sequence like previous*	Stable	Stable
21	FLT25-3PH	3 phase fault on the Cimarron River Tap (539652) to Cimarron Plant (539654) 115kV line, near Cimarron River Tap.	Stable	Stable
22	FLT26-1PH	*Single phase fault and sequence like previous*	Stable	Stable
23	FLT27-3PH	3 phase fault on the Cimarron River Tap (539652) to East Liberal (539672) 115kV line, near Cimarron River Tap.	Stable	Stable
24	FLT28-1PH	*Single phase fault and sequence like previous*	Stable	Stable
25	FLT29-3PH	3 phase fault on the Spearville (539694) to North Judson Large (539771) 115kV line, near Spearville.	Stable	Stable
26	FLT30-1PH	*Single phase fault and sequence like previous*	Stable	Stable
27	FLT31-3PH	3 phase fault on the GEN-2008-079T (573029) to Judson Large (539671) 115kV line, near GEN-2008-079T.	Stable	Stable
28	FLT32-1PH	*Single phase fault and sequence like previous*	Stable	Stable
29	FLT33-3PH	3 phase fault on the GEN-2008-079T (573029) to Cudahy (539659) 115kV line, near GEN-2008-079T.	Stable	Stable
30	FLT34-1PH	*Single phase fault and sequence like previous*	Stable	Stable

5.4 <u>FERC LVRT Compliance</u>

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.

Two fault contingencies were developed to verify that the wind farm will remain on line when the POI voltage is drawn down to 0.0 pu. These contingencies are shown in Table 7.

Table 7: LVRT Fault Contingencies

Cont. Name	Description
FLT31-3PH	3 phase fault on the GEN-2008-079T (573029) to Judson Large (539671) 115kV line, near GEN-2008-079T. a. Apply fault at the GEN-2008-079T 115kV 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.
FLT33-3PH	3 phase fault on the GEN-2008-079T (573029) to Cudahy (539659) 115kV line, near GEN-2008-079T. a. Apply fault at the GEN-2008-079T 115kV 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.

The project wind farm remained online for the fault contingencies described in this section and for all the fault contingencies described in section 6.2. GEN-2008-079 is found to be in compliance with FERC Order #661A.

6.0 Conclusion

<OMITTED TEXT> (Customer) has requested an Limited Operation Impact Study for limited interconnection service of 99.2 MW of wind generation within the balancing authority of Mid-Kansas Electric Power Company (MKEC) in Gray County, Kansas, in accordance with the Article 5.9 of the Standard GIA.

The GEN-2008-079 will be restricted to 31MW injection limits assuming all projects listed in Table 1 come on line and assuming projects listed in Table 2 do not come on line before all network upgrades can be constructed.

The results of this study show that the wind generation facility and the transmission system remain stable for all contingencies studied. Also, GEN-2008-079 is found to be in compliance with FERC Order #661A.

The projects listed in Table 2 are higher or equally queued projects that are not included in this analysis. If any of these projects come into service, this study will need to be re-performed to determine if any limited capacity is available.

The estimates do not include any costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer requests transmission service through Southwest Power Pool's OASIS. It should be noted that the models used for simulation do not contain all SPP transmission service.