



Impact Study of Limited Operation for Generator Interconnection

GEN-2011-021

September 2013
Generator Interconnection Studies



Executive Summary

<OMITTED TEXT> (Interconnection Customer; GEN-2011-021) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 299.0 MW of wind generation to be interconnected as an Energy Resource (ER) and Network Resource (NR) into a transmission facility of Oklahoma Gas & Electric (OKGE) in Beaver County, Oklahoma. GEN-2011-021, under GIA Section 5.9, has requested this Limited Operation Interconnection Study (LOIS) to determine the impacts of interconnecting to the transmission system before all required Network Upgrades identified in the DISIS-2011-001 (or most recent iteration) Impact Study can be placed into service. For purposes of Limited Operation Interconnection Service, NR interconnection service is not allowed and thus will not be analyzed within this study.

The Customer has requested this LOIS to confirm that adequate interconnection service remains prior to completion of all required Network Upgrades, assuming a January 1, 2015, LOIS operation date. Additionally, two differing sensitivity scenarios requested and defined by the Customer were also analyzed and presented within the appendix, for informational purposes only.

This LOIS addresses the effects of interconnecting the plant to the rest of the transmission system for the system topology and conditions as expected on January 1, 2015. GEN-2011-021 is requesting the interconnection of one-hundred thirty (130) Siemens 2.3MW wind turbine generators and associated facilities into the new OKGE Beaver County 345kV substation. For the typical LOIS, both a power flow and transient stability analysis are conducted. The LOIS assumes that only the higher queued projects listed within Table 1 of this study might go into service before the completion of all Network Upgrades identified within Table 2 of this report. If additional generation projects, listed within Table 3, with queue priority equal to or higher than the study project request rights to go into commercial operation before all Network Upgrades identified within Table 2 of this report are completed, this LOIS may need to be restudied to ensure that interconnection service remains for the GEN-2011-021 request.

Power flow analysis from this LOIS has determined that the GEN-2011-021 request can interconnect a limited amount of generation as an Energy Resource prior to the completion of the required Network Upgrades, listed within Table 2 of this report. There is no more than 299.0 MW of Limited Operation Interconnection Service available. This determination is for the period of January 1, 2015 until the completion of the following Network Upgrades:

- Energy Resource Interconnection Service (ERIS) Network Upgrades
 - Beaver County – Buckner 345kV
 - Tatonga – Matthewson – Cimarron 345kV circuit #2
- Network Resource Interconnection Service (NRIS) Network Upgrades
 - Mooreland – FPL Switch – Woodward 138kV
 - Glass Mountain – Mooreland 138kV
 - Woodward – Woodward EHV 138kV
 - OKGE Woodward – WFEC Woodward 69kV

- Woodward 138/69/13.2kV transformer circuit #2

The ERIS Network Upgrades are currently scheduled for completion in January, 2017. The NRIS Network Upgrades in service date is as yet undetermined.

Transient stability analysis from this LOIS has determined that the transmission system will remain stable for all of the thirty-eight (38) selected faults for the limited operation interconnection of GEN-2011-021.

Should any other projects, other than those listed within either scenario of Table 1 of this report, come into service an additional study may be required to determine if any limited operation service is available.

It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

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Purpose

<OMITTED TEXT> (Interconnection Customer; GEN-2011-021) has requested a Limited Operation System Impact Study (LOIS) under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) for an interconnection request into an existing transmission facility of Oklahoma Gas & Electric (OKGE).

The Customer has requested this LOIS to confirm that adequate Energy Resource Interconnection Service (ERIS) remains prior to completion of all required Network Upgrades, assuming a January 1, 2015, LOIS operation date. Although NRIS was requested by the Customer, NRIS is not allowed under the terms of Limited Operation Interconnection Service, thus only ERIS analysis will be performed for this period of time.

Both power flow and transient stability analysis were conducted for this Limited Operation Interconnection Service. Limited Operation Studies are conducted under GIA Section 5.9.

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 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 requests not included within this study execute an interconnection agreement and commencing commercial operation, may require a re-study of this LOIS at the expense of the Customer.

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 LOIS study included prior queued generation interconnection requests. Those listed within Table 1 are the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested 1/2015 in-service of GEN-2011-021 for this LOIS. Also listed in Table 1 are both the amount of MWs of interconnection service expected at the effective time of this study and the total MWs requested of interconnection service, the fuel type, the point of interconnection (POI), and the current status of each particular prior queued request.

Table 1: Regional Generation Requests Included within LOIS by Scenario

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2001-014	19.2	96.0	Wind	Ft Supply 138kV	COMMERCIAL OPERATION
GEN-2001-037	20	100.0	Wind	FPL Moreland Tap 138kV	COMMERCIAL OPERATION
GEN-2001-039A	21	105.0	Wind	Tap Greensburg - Ft Dodge (Shooting Star Tap) 115kV	COMMERCIAL OPERATION
GEN-2002-008	192	240.0	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2002-009	64	80.0	Wind	Hansford 115kV	COMMERCIAL OPERATION
GEN-2002-022	48	240.0	Wind	Bushland 230kV	COMMERCIAL OPERATION
GEN-2002-025A	30	150.0	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2003-020	128	160.0	Wind	Martin 115kV	COMMERCIAL OPERATION
GEN-2004-014	31	154.5	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2005-008	24	120.0	Wind	Woodward 138kV	COMMERCIAL OPERATION
GEN-2005-012	50	250.0	Wind	Spearville 345kV	COMMERCIAL OPERATION
GEN-2006-006	42	205.5	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2006-020S	16	19.8	Wind	DWS Frisco 115kV	COMMERCIAL OPERATION
GEN-2006-021	21	101.0	Wind	Flat Ridge Tap 138kV	COMMERCIAL OPERATION
GEN-2006-024S	4	19.8	Wind	Buffalo Bear Tap 69kV	COMMERCIAL OPERATION
GEN-2006-044	160	160	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2006-046	27	131.0	Wind	Dewey 138kV	COMMERCIAL OPERATION
GEN-2006-047	48	240.0	Wind	Tap Bushland - Deaf Smith (Buffalo) 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2007-021	41	201.0	Wind	Tatonga 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-038	40	200.0	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-040	40	200.0	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2007-043	40	200.0	Wind	Minco 345kV	COMMERCIAL OPERATION
GEN-2007-044	60	300.0	Wind	Tatonga 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-048	80	400.0	Wind	Tap Amarillo S - Swisher 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-050	34	170.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2007-062	153	765.0	Wind	Woodward EHV 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-003	21	101.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2008-018	81	405.0	Wind	Finney 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-029	50	250.5	Wind	Woodward EHV 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-044	40	197.8	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2008-047	300	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA PENDING
GEN-2008-051	65	322.0	Wind	Potter County 345kV	COMMERCIAL OPERATION
GEN-2008-079	20	99.2	Wind	Tap Cudahy - Ft Dodge 115kV	COMMERCIAL OPERATION
GEN-2008-088	11	50.6	Wind	Vega 69kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-124	40	200.1	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-001	300	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-009	33	165.6	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2010-011	6	29.7	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2010-014	150	150	Wind	Hitchland 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-040	60	300.0	Wind	Cimarron 345kV	COMMERCIAL OPERATION

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2010-045	40	197.8	Wind	Buckner 345kV	IA PENDING
GEN-2011-007	50	250.1	Wind	Tap Cimarron - Woodring (Matthewson) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-008	120	600.0	Wind	Clark County 345kV	IA PENDING
GEN-2011-010	21	100.8	Wind	Minco 345kV	COMMERCIAL OPERATION
Gray County Wind (Montezuma)	201	110.0	Wind	Gray County Tap 115kV	COMMERCIAL OPERATION
Llano Estacado (White Deer)	22	80.0	Wind	Llano Wind 115kV	COMMERCIAL OPERATION
SPS Distributed (Dumas 19th St)	16	20.0	Wind	Dumas 19th Street 115kV	COMMERCIAL OPERATION
SPS Distributed (Etter)	16	20.0	Wind	Etter 115kV	COMMERCIAL OPERATION
SPS Distributed (Moore E)	16	25.0	Wind	Moore East 115kV	COMMERCIAL OPERATION
SPS Distributed (Sherman)	20	20.0	Wind	Sherman 115kV	COMMERCIAL OPERATION
SPS Distributed (Spearman)	16	10.0	Wind	Spearman 69kV	COMMERCIAL OPERATION
SPS Distributed (TC-Texas County)	8	20.0	Wind	Texas County 115kV	COMMERCIAL OPERATION
GEN-2011-021	299.0	299.0	Wind	Beaver County 345kV	IA Pending

This LOIS was required because the Customer is requesting interconnection prior to the completion of all of their required upgrades listed within the latest iteration of their Definitive Interconnection System Impact Study (DISIS). Table 2 below lists the required upgrade projects for which this request has or shares cost responsibility. GEN-2011-021 was included within the DISIS-2011-001 that was last restudied in early 2013 and posted February 5, 2013. This report can be located here at the following GI Study URL:

http://spooasis.spp.org/documents/swpp/transmission/GenStudies.cfm?YearType=2011_Impact_Studies.

Table 2: Network Upgrade Projects not included (unless otherwise noted) but Required for Full Interconnection Service

Upgrade Project	Type	Description	Status
Beaver County – Buckner 345kV	ERIS DISIS-2011-001 Customers	Build approximately 90 miles of 345kV	Current Estimated In-Service date 1/1/2017
Tatonga – Matthewson – Cimarron 345kV circuit #2	ERIS DISIS-2011-001 Customers	Build second circuit at 3000A	Current Estimated In-Service date 1/1/2017
Mooreland – FPL Switch – Woodward 138kV	NRIS only	Rebuild approximately 12.2 miles of 138kV	Unknown Estimated In-Service date
Glass Mountain – Mooreland 138kV	NRIS only	Rebuild approximately 24 miles of 138kV	Unknown Estimated In-Service date
Woodward – Woodward EHV 138kV	NRIS only	Rebuild approximately 4.4 miles of 138kV	Unknown Estimated In-Service date
OKGE Woodward – WFEC Woodward 69kV	NRIS only	Per NTC 20003: Upgrade WFEC Woodward sub to 1200 A and reconductor from 336.4 ACSR to 795 ACSR	Unknown Estimated In-Service date
Woodward 138/69/13.2kV transformer circuit #2	NRIS only	Install second 138/69/13.2kV transformer	Unknown Estimated In-Service date

Any changes to these assumptions (for either scenario), for example, one or more of the previously queued requests not included within this study execute an interconnection agreement and

commencing commercial operation, may require a re-study of this LOIS at the expense of the Customer. The higher or equally queued projects that were not included in this study are listed in Table 3. While Table 3 is not all inclusive, it is a list of the most probable and affecting prior queued requests that were not included within this LOIS, either because no request for an LOIS has been made or the request is on suspension, etc.

Table 3: Higher or Equally Queued Group 2 (Hitchland Area) GI Requests not included within LOIS

Project	Remainder MW	Total MW	Fuel	POI	Status
GEN-2007-046	199.5	199.5	Wind	Hitchland 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-124T	42.0	42.0	Wind	TC-Keyes Texas County 69kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-012	104.5	104.5	Wind	Tap Moore County - Hitchland 345kV	IA Pending
GEN-2011-022	299.0	299.0	Wind	Hitchland 345kV	IA FULLY EXECUTED/ON SCHEDULE

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

Facilities

Generating Facility

GEN-2011-021 Interconnection Customer’s request to interconnect a total of 299.0 MW is comprised of one-hundred thirty (130) Siemens 2.3 MW wind turbine generators and associated interconnection facilities.

Interconnection Facilities

The POI for GEN-2011-021 Interconnection Customer is the OKGE Beaver County 345kV substation in Beaver County, Oklahoma. Figure 1 depicts the one-line diagram of the local transmission system including the POI as well as the power flow model representing the request.

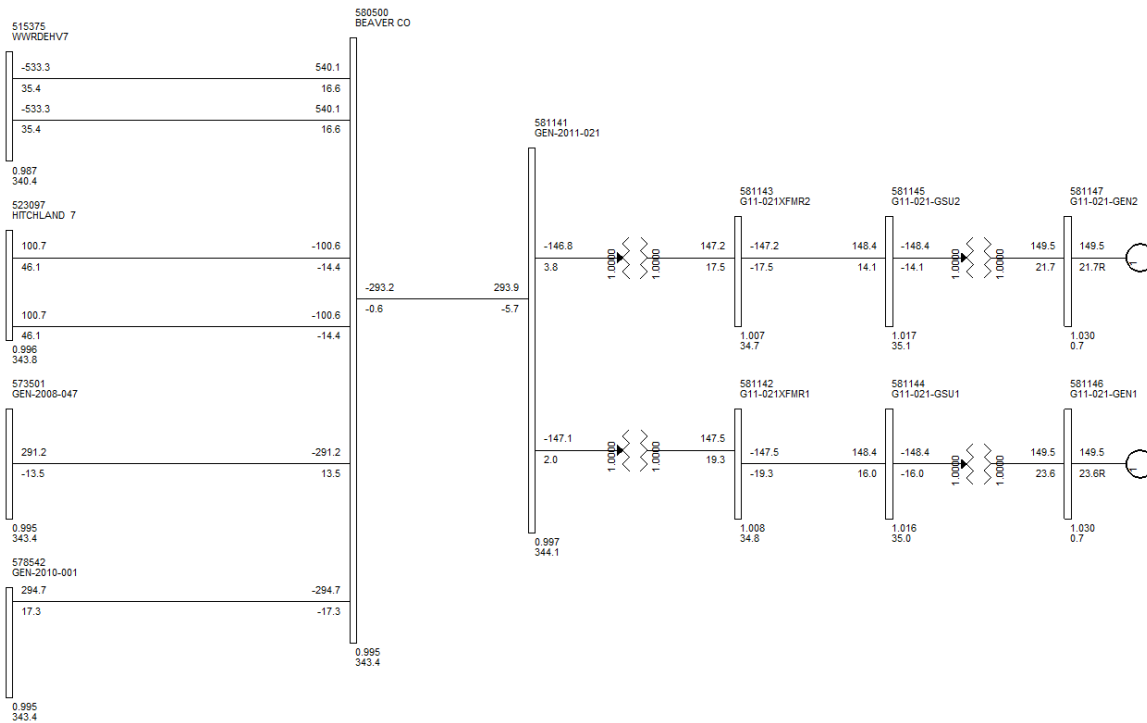


Figure 1: Proposed POI Configuration and Request Power Flow Model

Base Case Network Upgrades

The Network Upgrades included within the cases used for this LOIS study are those facilities that are a part of the SPP Transmission Expansion Plan or the Balanced Portfolio projects that have in-service dates prior to the GEN-2011-021 LOIS requested in-service date of January 1, 2015. These facilities have an approved Notification to Construct (NTC), or are in construction stages and expected to be in-service at the effective time of this study. No other upgrades were included for this LOIS. If for some reason, construction on these projects is delayed or discontinued, a restudy may be needed to determine the interconnection service availability of the Customer.

Power Flow Analysis

Power flow analysis is used to determine if the transmission system can accommodate the injection from the request without violating thermal or voltage transmission planning criteria.

Model Preparation

Power flow analysis was performed using modified versions of the 2012 series of transmission service request study models including the 2013 (spring, summer, and winter) seasonal models. To incorporate the Interconnection Customer's request, a re-dispatch of existing generation within SPP was performed with respect to the amount of the Customer's injection and the interconnecting Balancing Authority. This method allows the request to be studied as an Energy Resource Interconnection Request (ERIS). For this LOIS, only the previous queued requests listed in Table 1 were assumed to be in-service.

Study Methodology and Criteria

The ACCC function of PSS/E is used to simulate contingencies, including single and multiple facility (i.e. breaker-to-breaker, etc.) outages, within all of the control areas of SPP and other control areas external to SPP and the resulting data analyzed. This satisfies the "more probable" contingency testing criteria mandated by NERC and the SPP criteria.

The contingency set includes all SPP control area branches and ties 69kV and above, first tier Non-SPP control area branches and ties 115 kV and above, any defined contingencies for these control areas, and generation unit outages for the SPP control areas with SPP reserve share program redispatch.

The monitor elements include all SPP control area branches, ties, and buses 69 kV and above, and all first tier Non-SPP control area branches and ties 69 kV and above. NERC Power Transfer Distribution Flowgates for SPP and first tier Non-SPP control area are monitored. Additional NERC Flowgates are monitored in second tier or greater Non-SPP control areas. Voltage monitoring was performed for SPP control area buses 69 kV and above.

Results

Power flow analysis from this LOIS has determined that the GEN-2011-021 request can interconnect a limited amount of generation as an Energy Resource prior to the completion of the required Network Upgrades, listed within Table 2 of this report. ACCC results for this LOIS can be found below in

Table 4: Interconnection Constraints of GEN-2011-021 LOIS @ 299.0MW and Table 5. Under the assumptions defined by this LOIS, there is no more than 299.0 MW of Limited Operation Interconnection Service available. These determinations are for the period of January 1, 2015 until the completion of the following required Network Upgrades listed within Table 2. The ERIS Network Upgrades are scheduled for completion in January, 2017, and the NRIS Network Upgrades in service dates are undetermined at this time.

Should any other GI projects, other than those listed within Table 1 of this report, come into service an additional study may be required to determine if any limited operation service is available.

Since ER analysis doesn't provide for transmission reinforcements for issues in which the affecting GI request has less than a 20% TDF, Table 5 is provided for informational purposes only so that the Customer understands there may be times when they may be required to reduce their output to maintain system reliability.

Additional sensitivity analysis was requested by the Customer and is provided within the appendix for informational purposes only.

Curtailment and System Reliability

In no way does this study guarantee limited operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer may be required to reduce their generation output to 0 MW under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Table 4: Interconnection Constraints of GEN-2011-021 LOIS @ 299.0MW

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
13G	02G11_021		Non-Converged*					-NA-	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021		Non-Converged*					-NA-	Beaver County – Woodward 345kV Dbl Ckt
			None					299.0	

* Although these contingencies do not solve, they are not limiting because they are classified as a Category C type contingency. The Customer should be aware that there a high probability of curtailment associated with these contingencies.

Table 5: Additional Constraints of GEN-2011-021 LOIS @ 299.0MW (Not for mitigation within LOIS but possible curtailment issues)

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
13SP 13G	00G11_021 02G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.088 to 0.047	207.3 to 100.1	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1 including area 138kV
13G	02G11_021	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	268	287	0.083	115.4 to 110.6	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1 including area 138kV
13SP 13WP	00G11_021	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.045 to 0.036	144.2 To 100.0	Thistle – Wichita 345kV Dbl Ckt
13SP 13WP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.045 to 0.036	174.2 to 124.0	Thistle – Wichita 345kV Dbl Ckt
13SP	00G11_021	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	95.6	95.6	0.036	141.8	Thistle – Wichita 345kV Dbl Ckt

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 modified versions of the 2012 series of Model Development Working Group (MDWG) dynamic study models including the 2014 (summer and winter) seasonal models. The cases are then adapted to resemble the power flow study cases with regards to prior queued generation requests and topology. Finally the prior queued and study generation 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

The thirty-eight (38) contingencies were identified for use in this study. These faults are listed within Table 6. 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.

With exception to transformers, the typical sequence of events for a three-phase and 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 only performed for three-phase faults, unless otherwise noted. Additionally the sequence of events for a transformer is to 1) apply a three-phase fault for five (5) cycles and 2) clear the fault by tripping the affected transformer facility. Unless otherwise noted there will be no re-closing into a transformer fault.

Table 6: Contingencies Evaluated for Limited Operation of GEN-2011-021

Contingency Number and Name		Description
1	FLT_01_BEAVERCO_HITCLAND7_345kV_3PH	3-Phase fault on the Beaver Co – Hitchland 345kV CKT 1 near the Beaver Co 345kV bus.
2	FLT_02_BEAVERCO_HITCLAND7_345kV_1PH	Single-phase fault similar to previous fault.
3	FLT_03_BEAVERCO_WOODWARD_345kV_3PH	3-Phase fault on the Beaver Co – Woodward 345kV CKT 1 near the Beaver Co 345kV bus.

Contingency Number and Name		Description
4	FLT_04_BEAVERCO_WOODWARD_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
5	FLT_05_HITCHLAND_FINNEY_345kV_3PH	<i>3-Phase fault on the Hitchland – Finney 345kV near the Hitchland 345kV bus.</i>
6	FLT_06_HITCHLAND_FINNEY_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
7	FLT_07_HITCHLAND_POTTERCO_345kV_3PH	<i>3-Phase fault on the Hitchland – Potter Co 345kV near the Hitchland 345kV bus.</i>
8	FLT_08_HITCHLAND_POTTERCO_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
9	FLT_09_HITCHLAND_OCHILTREE_230kV_3PH	<i>3-Phase fault on the Hitchland – Ochiltrie 230kV near the Hitchland 230kV bus.</i>
10	FLT_10_HITCHLAND_OCHILTREE_230kV_1PH	<i>Single-phase fault similar to previous fault.</i>
11	FLT_11_HITCHLAND_MOORECO_230kV_3PH	<i>3-Phase fault on the Hitchland – Moore Co 230kV near the Hitchland 230kV bus.</i>
12	FLT_12_HITCHLAND_MOORECO_230kV_1PH	<i>Single-phase fault similar to previous fault.</i>
13	FLT_13_HITCHLAND_TEXASCO_115kV_3PH	<i>3-Phase fault on the Hitchland – Texas Co 115kV CKT 1 near the Hitchland 115kV bus.</i>
14	FLT_14_HITCHLAND_TEXASCO_115kV_1PH	<i>Single-phase fault similar to previous fault.</i>
15	FLT_15_HITCHLAND_TEXASCO_115kV_3PH	<i>3-Phase fault on the Hitchland – Texas Co 115kV CKT 2 near the Hitchland 115kV bus.</i>
16	FLT_16_HITCHLAND_TEXASCO_115kV_1PH	<i>Single-phase fault similar to previous fault.</i>
17	FLT_17_HITCHLAND_DWSFRISCO_115kV_3PH	<i>3-Phase fault on the Hitchland – DWS Frisco 115kV near the Hitchland 115kV bus.</i>
18	FLT_18_HITCHLAND_DWSFRISCO_115kV_1PH	<i>Single-phase fault similar to previous fault.</i>
19	FLT_19_HITCHLAND_HANSFORD_115kV_3PH	<i>3-Phase fault on the Hitchland – Hansford 115kV near the Hitchland 115kV bus.</i>
20	FLT_20_HITCHLAND_HANSFORD_115kV_1PH	<i>Single-phase fault similar to previous fault.</i>
21	FLT_21_WOODWARD_TATONGA_345kV_3PH	<i>3-Phase fault on the Woodward – Tatonga 345kV near the Woodward 345kV bus.</i>
22	FLT_22_WOODWARD_TATONGA_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
23	FLT_23_WOODWARD_THISTLE_345kV_3PH	<i>3-Phase fault on the Woodward – Thistle 345kV CKT 1 near the Woodward 345kV bus.</i>
24	FLT_24_WOODWARD_THISTLE_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
25	FLT_25_WOODWARD_WOODWARD_138kV_3PH	<i>3-Phase fault on the Woodward – Woodward EHV 138 kV CKT 1 near the Woodward 138kV bus.</i>
26	FLT_26_WOODWARD_WOODWARD_138kV_1PH	<i>Single-phase fault similar to previous fault.</i>
27	FLT_27_WOODWARD_WOODWARD_138kV_3PH	<i>3-Phase fault on the Woodward – Woodward EHV 138 kV CKT 2 near the Woodward 138kV bus.</i>
28	FLT_28_WOODWARD_WOODWARD_138kV_1PH	<i>Single-phase fault similar to previous fault.</i>
29	FLT_29_WOODWARD_IODINE_138kV_3PH	<i>3-Phase fault on the Woodward – Iodine 138 kV near the Woodward 138kV bus.</i>
30	FLT_30_WOODWARD_IODINE_138kV_1PH	<i>Single-phase fault similar to previous fault.</i>
31	FLT_31_WOODWARD_FPLSWITCH_138kV_3PH	<i>3-Phase fault on the Woodward – FPL Switch 138 kV near the Woodward 138kV bus.</i>
32	FLT_32_WOODWARD_FPLSWITCH_138kV_1PH	<i>Single-phase fault similar to previous fault.</i>
33	FLT_33_TATONGA_NORTHWEST_345kV_3PH	<i>3-Phase fault on the Tatonga – Northwest 345kV near the Tatonga 345kV bus.</i>
34	FLT_34_TATONGA_NORTHWEST_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
35	FLT_35_HITCHLAND_HITCHLAND_345_230kV_3PH	<i>3-Phase fault on the Hitchland 345/230kV transformer near the Hitchland 345kV bus.</i>
36	FLT_36_HITCHLAND_HITCHLAND_230_115kV_3PH	<i>3-Phase fault on the Hitchland 230/115kV transformer near the Hitchland 230kV bus.</i>
37	FLT_37_WOODWARD_WOODWARD_345_138kV_3PH	<i>3-Phase fault on the Woodward 345/138kV transformer near the Woodward 345kV bus.</i>

Contingency Number and Name		Description
38	FLT_38_WOODWARD_WOODWARD_138_69kV_3PH	3-Phase fault on the Woodward 138/69kV transformer near the Woodward 138kV bus.

NOTE: The faults denoted by an asterisk (*) were adjusted to allow for no re-closing into the fault. Some 345kV faults on these lines have special operating procedures for re-closing into a three-phase fault.

Power Factor Analysis

Power factor analysis for reactor sizing was not performed for this study.

Results

Results of the transient stability analysis are summarized within Table 7. These results are valid for Customers interconnecting up to 299.0 MW, including specified reactive equipment. The results indicate that the transmission system remains stable for all contingencies studied. The plots will be made available upon request.

Table 7: Fault Analysis Results for Limited Operation of GEN-2011-021

	Contingency Number and Name	2014SP	2014WP
1	FLT_01_BEVERCO_HITCLAND7_345kV_3PH	Stable	Stable
2	FLT_02_BEVERCO_HITCLAND7_345kV_1PH	Stable	Stable
3	FLT_03_BEVERCO_WOODWARD_345kV_3PH	Stable	Stable
4	FLT_04_BEVERCO_WOODWARD_345kV_1PH	Stable	Stable
5	FLT_05_HITCLAND_FINNEY_345kV_3PH	Stable	Stable
6	FLT_06_HITCLAND_FINNEY_345kV_1PH	Stable	Stable
7	FLT_07_HITCLAND_POTTERCO_345kV_3PH	Stable	Stable
8	FLT_08_HITCLAND_POTTERCO_345kV_1PH	Stable	Stable
9	FLT_09_HITCLAND_OCHILTREE_230kV_3PH	Stable	Stable
10	FLT_10_HITCLAND_OCHILTREE_230kV_1PH	Stable	Stable
11	FLT_11_HITCLAND_MOORECO_230kV_3PH	Stable	Stable
12	FLT_12_HITCLAND_MOORECO_230kV_1PH	Stable	Stable
13	FLT_13_HITCLAND_TEXASCO_115kV_3PH	Stable	Stable
14	FLT_14_HITCLAND_TEXASCO_115kV_1PH	Stable	Stable
15	FLT_15_HITCLAND_TEXASCO_115kV_3PH	Stable	Stable
16	FLT_16_HITCLAND_TEXASCO_115kV_1PH	Stable	Stable
17	FLT_17_HITCLAND_DWSFRISCO_115kV_3PH	Stable	Stable
18	FLT_18_HITCLAND_DWSFRISCO_115kV_1PH	Stable	Stable
19	FLT_19_HITCLAND_HANSFORD_115kV_3PH	Stable	Stable
20	FLT_20_HITCLAND_HANSFORD_115kV_1PH	Stable	Stable
21	FLT_21_WOODWARD_TATONGA_345kV_3PH	Stable	Stable
22	FLT_22_WOODWARD_TATONGA_345kV_1PH	Stable	Stable
23	FLT_23_WOODWARD_THISTLE_345kV_3PH	Stable	Stable
24	FLT_24_WOODWARD_THISTLE_345kV_1PH	Stable	Stable
25	FLT_25_WOODWARD_WOODWARD_138kV_3PH	Stable	Stable
26	FLT_26_WOODWARD_WOODWARD_138kV_1PH	Stable	Stable
27	FLT_27_WOODWARD_WOODWARD_138kV_3PH	Stable	Stable
28	FLT_28_WOODWARD_WOODWARD_138kV_1PH	Stable	Stable
29	FLT_29_WOODWARD_IODINE_138kV_3PH	Stable	Stable
30	FLT_30_WOODWARD_IODINE_138kV_1PH	Stable	Stable
31	FLT_31_WOODWARD_FPLSWITCH_138kV_3PH	Stable	Stable

Contingency Number and Name		2014SP	2014WP
32	FLT_32_WOODWARD_FPLSWITCH_138kV_1PH	Stable	Stable
33	FLT_33_TATONGA_NORTHWEST_345kV_3PH	Stable	Stable
34	FLT_34_TATONGA_NORTHWEST_345kV_1PH	Stable	Stable
35	FLT_35_HITCHLAND_HITCHLAND_345_230kV_3PH	Stable	Stable
36	FLT_36_HITCHLAND_HITCHLAND_230_115kV_3PH	Stable	Stable
37	FLT_37_WOODWARD_WOODWARD_345_138kV_3PH	Stable	Stable
38	FLT_38_WOODWARD_WOODWARD_138_69kV_3PH	Stable	Stable

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.

Fault contingencies were developed to verify that wind farms remain on line when the POI voltage is drawn down to 0.0 pu. These contingencies are shown in Table 8.

Table 8: LVRT Contingencies for GEN-2011-021 under Scenario A (Conservative)

Contingency Number and Name		Description
1	FLT_01_BEVERCO_HITCLAND7_345kV_3PH	<i>3-Phase fault on the Beaver Co – Hitchland 345kV CKT 1 near the Beaver Co 345kV bus.</i>
2	FLT_02_BEVERCO_HITCLAND7_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>
3	FLT_03_BEVERCO_WOODWARD_345kV_3PH	<i>3-Phase fault on the Beaver Co – Woodward 345kV CKT 1 near the Beaver Co 345kV bus.</i>
4	FLT_04_BEVERCO_WOODWARD_345kV_1PH	<i>Single-phase fault similar to previous fault.</i>

The required prior queued project wind farms remained online for the fault contingencies described in this section as well as the fault contingencies described in the Disturbances section of this report. GEN-2011-021 is found to be in compliance with FERC Order #661A.

Conclusion

<OMITTED TEXT> (Interconnection Customer, GEN-2011-021) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 299.0 MW of wind generation to be interconnected as an Energy Resource (ER) and Network Resource (NR) into a transmission facility of Oklahoma Gas & Electric (OKGE) in Beaver County, Oklahoma. The point of interconnection will be the Beaver County 345kV substation. GEN-2011-021, under GIA Section 5.9, has requested this Limited Operation Interconnection Study (LOIS) to determine the impacts of interconnecting to the transmission system before all required Network Upgrades identified in the DISIS-2011-001 (or most recent iteration) Impact Study can be placed into service.

Power flow analysis from this LOIS has determined that the GEN-2011-021 request can interconnect prior to the completion of the required Network Upgrades, listed within Table 2 of this report. There is no more than 299.0 MW of Limited Operation Interconnection Service available only as an Energy Resource for the period of January 1, 2015 until the completion of the following Network Upgrades:

- Energy Resource Interconnection Service (ERIS) Network Upgrades
 - Beaver County – Buckner 345kV
 - Tatonga – Matthewson – Cimarron 345kV circuit #2
- Network Resource Interconnection Service (NRIS) Network Upgrades
 - Mooreland – FPL Switch – Woodward 138kV
 - Glass Mountain – Mooreland 138kV
 - Woodward – Woodward EHV 138kV
 - OKGE Woodward – WFEC Woodward 69kV
 - Woodward 138/69/13.2kV transformer circuit #2

After these network upgrades are completed, limited operation may be available until such time that higher queued projects listed in Table 3 come into service.

Transient stability analysis indicates that the transmission system will remain stable for the contingencies listed within Table 6 with the addition of GEN-2011-021 generation. Additionally, GEN-2011-021 was found to be in compliance with FERC Order #661A when studied as listed within this report.

Any changes to these assumptions, for example, one or more of the previously queued requests not included within this study execute an interconnection agreement and commencing commercial operation, may require a re-study of this LOIS 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

Additional sensitivity scenarios were requested by the Customer for this Limited Operation System Impact Study. These results will be presented for informational purposes only.

For this analysis, the Customer requested two scenarios, a high wind-highly constrained system scenario (Extreme Scenario) and a highly constrained system scenario (Constrained Scenario). For both of these scenarios the Customer provided a list of the requests and amounts to be included. The analysis and results of each scenario are presented below.

Extreme Scenario (High Wind-Highly Constrained System)

The following Table lists the requests and their amounts that were to be included within this scenario.

Table 9: Regional Generation Requests Included within the Extreme LOIS

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2001-014	77.0	96.0	Wind	Ft Supply 138kV	COMMERCIAL OPERATION
GEN-2001-037	82.0	100.0	Wind	FPL Moreland Tap 138kV	COMMERCIAL OPERATION
GEN-2001-039A	84.0	105.0	Wind	Tap Greensburg - Ft Dodge (Shooting Star Tap) 115kV	COMMERCIAL OPERATION
GEN-2002-008	240.0	240.0	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2002-009	80.0	80.0	Wind	Hansford 115kV	COMMERCIAL OPERATION
GEN-2002-022	192.0	240.0	Wind	Bushland 230kV	COMMERCIAL OPERATION
GEN-2002-025A	121.0	150.0	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2003-020	160.0	160.0	Wind	Martin 115kV	COMMERCIAL OPERATION
GEN-2004-014	124.0	154.5	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2005-008	96.0	120.0	Wind	Woodward 138kV	COMMERCIAL OPERATION
GEN-2005-012	200.0	250.0	Wind	Spearville 345kV	COMMERCIAL OPERATION
GEN-2006-006	missi	205.5	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2006-020S	19.8	19.8	Wind	DWS Frisco 115kV	COMMERCIAL OPERATION
GEN-2006-021	81.0	101.0	Wind	Flat Ridge Tap 138kV	COMMERCIAL OPERATION
GEN-2006-024S	16.0	19.8	Wind	Buffalo Bear Tap 69kV	COMMERCIAL OPERATION
GEN-2006-044	160.0	370.0	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2006-046	104.0	131.0	Wind	Dewey 138kV	COMMERCIAL OPERATION
GEN-2006-047	192.0	240.0	Wind	Tap Bushland - Deaf Smith (Buffalo) 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2007-021	161.0	201.0	Wind	Tatonga 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-038	160.0	200.0	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-040	160.0	200.0	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2007-043	160.0	200.0	Wind	Minco 345kV	COMMERCIAL OPERATION
GEN-2007-044	240.0	300.0	Wind	Tatonga 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-048	320.0	400.0	Wind	Tap Amarillo S - Swisher 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-050	136.0	170.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2007-062	400.0	765.0	Wind	Woodward EHV 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-003	81.0	101.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2008-018	350.0	405.0	Wind	Finney 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-029	200.0	250.5	Wind	Woodward EHV 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-044	160.0	197.8	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2008-047	300.0	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA PENDING
GEN-2008-051	258.0	322.0	Wind	Potter County 345kV	COMMERCIAL OPERATION
GEN-2008-079	80.0	99.2	Wind	Tap Cudahy - Ft Dodge 115kV	COMMERCIAL OPERATION
GEN-2008-088	41.0	50.6	Wind	Vega 69kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-124	160.0	200.1	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-001	300.0	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-009	133.0	165.6	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2010-011	10.0	29.7	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2010-014	150.0	358.8	Wind	Hitchland 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-040	240.0	300.0	Wind	Cimarron 345kV	COMMERCIAL OPERATION
GEN-2010-045	159.0	197.8	Wind	Buckner 345kV	IA PENDING
GEN-2011-007	200.0	250.1	Wind	Tap Cimarron - Woodring (Matthewson) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-008	300.0	600.0	Wind	Clark County 345kV	IA PENDING
GEN-2011-010	81.0	100.8	Wind	Minco 345kV	COMMERCIAL OPERATION
GEN-2011-014	201.0	201.0	Wind	Beaver County 345kV	IA PENDING
Gray County Wind (Montezuma)	88.0	110.0	Wind	Gray County Tap 115kV	COMMERCIAL OPERATION
Llano Estacado (White Deer)	64.0	80.0	Wind	Llano Wind 115kV	COMMERCIAL OPERATION
SPS Distributed (Dumas 19th St)	20.0	20.0	Wind	Dumas 19th Street 115kV	COMMERCIAL OPERATION
SPS Distributed (Etter)	20.0	20.0	Wind	Etter 115kV	COMMERCIAL OPERATION
SPS Distributed (Moore E)	25.0	25.0	Wind	Moore East 115kV	COMMERCIAL OPERATION
SPS Distributed (Sherman)	20.0	20.0	Wind	Sherman 115kV	COMMERCIAL OPERATION
SPS Distributed (Spearman)	10.0	10.0	Wind	Spearman 69kV	COMMERCIAL OPERATION
SPS Distributed (TC-Texas County)	20.0	20.0	Wind	Texas County 115kV	COMMERCIAL OPERATION
GEN-2011-021	299.0	299.0	Wind	Beaver County 345kV	IA Pending

Injection limits were discovered for the High Wind – Highly Constrained scenario. Overloads on the Tatonga-Northwest 345kV line limited the injection capability to 130MW. The results of that analysis can be found within Table 10.

A further sensitivity of a maximum output of 130MW was performed. At this level GEN-2011-021 no longer experiences injection constraints as shown within Table 11. Table 12 shows some of the constraints with a TDF between 3% and 20%. Although not limiting within this LOIS, these constraints can be provided to the Customer on an informational basis to provide guidance to possible curtailment constraints.

Table 10: Constraints for GEN-2011-021 for Extreme Scenario

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
Constraints above 20% transmission distribution factor									
13G	02G11_021		Non-Converged*					-NA-	Beaver County – Woodward 345kV Dbl Ckt
13G	02G11_021		Non-Converged*					-NA-	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.219	103.1	130	SPP-AEPW-32:
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.220	102.0	189	SPP-SWPS-01:
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.219	102.0	190	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.221	101.7	209	THISTLE7 345.00 - WICHITA 345KV CKT 1
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.221	101.7	209	THISTLE7 345.00 - WICHITA 345KV CKT 2
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.231	100.7	261	FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.233	100.1	293	THISTLE7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
13G	02G11_021	TO->FROM	NORTHWEST - TATONGA7 345.00 345KV CKT 1	1195	1195	0.233	100.1	293	THISTLE7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 2
Constraints below 20% transmission distribution factor									
13G	02G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.085 to 0.048	210.1 to 132.3	-NA-	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Hitchland – Beaver 345kV Dbl Ckt
13SP	00G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.088 to 0.061	109.4 to 102.6	-NA-	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Hitchland – Beaver 345kV Dbl Ckt
13G	02G11_021	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	268	287	0.085 to 0.050	133.0 to 100.2	-NA-	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Hitchland – Beaver 345kV Dbl Ckt
13WP	00G11_021	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.045	134.4	-NA-	Thistle – Wichita 345kV Dbl Ckt
13SP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.045	162.9	-NA-	Thistle – Wichita 345kV Dbl Ckt
13SP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.036	116.3	-NA-	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	318.7	350.6	0.040	103.4	-NA-	Tolk Unit 1 or 2 Outage
13G	02G11_021	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	330.3	355.3	0.038	134.4	-NA-	POST ROCK - SPEARVILLE 345KV CKT 1
13SP	00G11_021	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	95.6	95.6	0.036	134.2	-NA-	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	133	153	0.035	108.4	-NA-	TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
13G	02G11_021	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	133	153	0.035	113.1	-NA-	TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1

* Although these contingencies do not solve, they are not limiting because they are classified as a Category C type contingency. The Customer should be aware that there a high probability of curtailment associated with these contingencies.

Table 11: Interconnection Constraints for Mitigation of GEN-2011-021 LOIS @ 130.0MW

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
Constraints above 20% transmission distribution factor									
13G	02G11_021		Non-Converged*					-NA-	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	FROM->TO	Finney Switching Station – Holcomb 345kV	956	1052	0.509	102.8	130.0	Beaver County – Woodward 345kV Dbl Ckt

Table 12: Additional Constraints of GEN-2011-021 LOIS @ 130.0MW (Not for mitigation within LOIS but possible curtailment issues)

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
Constraints below 20% transmission distribution factor								
13G	02G11_021	FROM->TO	ELK CITY 230KV (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	287	287	0.095	111.2	Beaver County – Woodward 345kV Dbl Ckt
13G	02G11_021	FROM->TO	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1	319	351	0.095	105.6	Beaver County – Woodward 345kV Dbl Ckt
13G	02G11_021	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	319	351	0.085	108.9	Beaver County – Woodward 345kV Dbl Ckt
13G	02G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.085 to 0.048	236.3 to 125.9	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Hitchland – Beaver 345kV Dbl Ckt
13G	02G11_021	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	268	287	0.083 to 0.050	148.5 to 100.0	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1
13WP	00G11_021	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.045	126.6	Thistle – Wichita 345kV Dbl Ckt
13SP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.045	154.0	Thistle – Wichita 345kV Dbl Ckt
13WP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.036	109.4	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	318.7	350.6	0.040	102.6	Tolk Unit 1 or 2 Outage
13G	02G11_021	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	330.3	355.3	0.038	130.3	POST ROCK - SPEARVILLE 345KV CKT 1
13SP	00G11_021	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	95.6	95.6	0.036	127.2	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	133	153	0.035	122.6	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1
13G	02G11_021	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	133	153	0.035	127.4	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1

Constrained Scenario (Highly Constrained System)

The following Table lists the requests and their amounts that were to be included within this scenario.

Table 13: Regional Generation Requests Included within the Constrained Scenario

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2001-014	77.0	96.0	Wind	Ft Supply 138kV	COMMERCIAL OPERATION
GEN-2001-037	82.0	100.0	Wind	FPL Moreland Tap 138kV	COMMERCIAL OPERATION
GEN-2001-039A	84.0	105.0	Wind	Tap Greensburg - Ft Dodge (Shooting Star Tap) 115kV	COMMERCIAL OPERATION
GEN-2002-008	240.0	240.0	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2002-009	80.0	80.0	Wind	Hansford 115kV	COMMERCIAL OPERATION
GEN-2002-022	192.0	240.0	Wind	Bushland 230kV	COMMERCIAL OPERATION
GEN-2002-025A	121.0	150.0	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2003-020	160.0	160.0	Wind	Martin 115kV	COMMERCIAL OPERATION
GEN-2004-014	124.0	154.5	Wind	Spearville 230kV	COMMERCIAL OPERATION
GEN-2005-008	96.0	120.0	Wind	Woodward 138kV	COMMERCIAL OPERATION
GEN-2005-012	200.0	250.0	Wind	Spearville 345kV	COMMERCIAL OPERATION
GEN-2006-020S	19.8	19.8	Wind	DWS Frisco 115kV	COMMERCIAL OPERATION
GEN-2006-021	81.0	101.0	Wind	Flat Ridge Tap 138kV	COMMERCIAL OPERATION
GEN-2006-024S	16.0	19.8	Wind	Buffalo Bear Tap 69kV	COMMERCIAL OPERATION
GEN-2006-044	160.0	370.0	Wind	Hitchland 345kV	COMMERCIAL OPERATION
GEN-2006-046	104.0	131.0	Wind	Dewey 138kV	COMMERCIAL OPERATION
GEN-2006-047	192.0	240.0	Wind	Tap Bushland - Deaf Smith (Buffalo) 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2007-021	161.0	201.0	Wind	Tatonga 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-038	160.0	200.0	Wind	Spearville 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-040	160.0	200.0	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2007-043	160.0	200.0	Wind	Minco 345kV	COMMERCIAL OPERATION
GEN-2007-048	320.0	400.0	Wind	Tap Amarillo S - Swisher 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2007-050	136.0	170.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2007-062	400.0	765.0	Wind	Woodward EHV 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-003	81.0	101.0	Wind	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2008-018	350.0	405.0	Wind	Finney 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2008-044	160.0	197.8	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2008-047	300.0	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA PENDING
GEN-2008-051	258.0	322.0	Wind	Potter County 345kV	COMMERCIAL OPERATION
GEN-2008-079	80.0	99.2	Wind	Tap Cudahy - Ft Dodge 115kV	COMMERCIAL OPERATION
GEN-2008-088	41.0	50.6	Wind	Vega 69kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-001	300.0	300.0	Wind	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-009	133.0	165.6	Wind	Buckner 345kV	COMMERCIAL OPERATION
GEN-2010-011	10.0	29.7	Wind	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2010-014	150.0	358.8	Wind	Hitchland 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-040	240.0	300.0	Wind	Cimarron 345kV	COMMERCIAL OPERATION

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2011-007	200.0	250.1	Wind	Tap Cimarron - Woodring (Matthewson) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-008	300.0	600.0	Wind	Clark County 345kV	IA PENDING
GEN-2011-010	81.0	100.8	Wind	Minco 345kV	COMMERCIAL OPERATION
GEN-2011-014	201.0	201.0	Wind	Beaver County 345kV	IA PENDING
Gray County Wind (Montezuma)	88.0	110.0	Wind	Gray County Tap 115kV	COMMERCIAL OPERATION
Llano Estacado (White Deer)	64.0	80.0	Wind	Llano Wind 115kV	COMMERCIAL OPERATION
SPS Distributed (Dumas 19th St)	20.0	20.0	Wind	Dumas 19th Street 115kV	COMMERCIAL OPERATION
SPS Distributed (Etter)	20.0	20.0	Wind	Etter 115kV	COMMERCIAL OPERATION
SPS Distributed (Moore E)	25.0	25.0	Wind	Moore East 115kV	COMMERCIAL OPERATION
SPS Distributed (Sherman)	20.0	20.0	Wind	Sherman 115kV	COMMERCIAL OPERATION
SPS Distributed (Spearman)	10.0	10.0	Wind	Spearman 69kV	COMMERCIAL OPERATION
SPS Distributed (TC-Texas County)	20.0	20.0	Wind	Texas County 115kV	COMMERCIAL OPERATION
GEN-2011-021	299.0	299.0	Wind	Beaver County 345kV	IA Pending

At 299.0 MW, the GEN-2011-021 interconnection did not cause injection constraints. The results of that analysis can be found within Table 14. Table 15 shows some of the constraints with a TDF between 3% and 20%. Although not limiting within this LOIS, these constraints can be provided to the Customer on an informational basis to provide guidance to possible curtailment constraints.

Table 14: Constraints for GEN-2011-021 for Constrained Scenario

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
Constraints above 20% transmission distribution factor									
13G	02G11_021		Non-Converged*					-NA-	Beaver County – Woodward 345kV Dbl Ckt
13G	02G11_021		Non-Converged*					-NA-	Thistle – Wichita 345kV Dbl Ckt

* Although these contingencies do not solve, they are not limiting because they are classified as a Category C type contingency. The Customer should be aware that there a high probability of curtailment associated with these contingencies.

Table 15: Additional Constraints of GEN-2011-021 LOIS @ 299.0MW (Not for mitigation within LOIS but possible curtailment issues)

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
Constraints below 20% transmission distribution factor								
13G	02G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.085 to 0.048	209.4 to 110.2	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Hitchland – Beaver 345kV Dbl Ckt
13SP	00G11_021	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.088 to 0.061	104.4 to 100.2	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Mooreland Units 2 or 3 Outage
13G	02G11_021	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	268	287	0.083 to 0.057	132.6 to 100.2	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1 and Mooreland Units 2 or 3 Outage
13WP	00G11_021	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.045	130.5	Thistle – Wichita 345kV Dbl Ckt
13SP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.045	158.4	Thistle – Wichita 345kV Dbl Ckt
13WP	00G11_021	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	95.6	0.036	112.8	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	330.3	355.3	0.038	113.5	POST ROCK - SPEARVILLE 345KV CKT 1
13SP	00G11_021	FROM->TO	FLATRDG3 - HARPER 138KV CKT 1	95.6	95.6	0.036	130.6	Thistle – Wichita 345kV Dbl Ckt
13G	02G11_021	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	133	153	0.035	110.1	NORTHWEST - TATONGA7 345.00 345KV CKT 1
13G	02G11_021	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	133	153	0.035	114.9	Various; Most Limiting is NORTHWEST - TATONGA7 345.00 345KV CKT 1