



Impact Study of Limited Operation for Generator Interconnection Request

GEN-2008-079

May 2014
Generator Interconnection Studies



Executive Summary

<OMITTED TEXT> (Interconnection Customer; GEN-2008-079) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 98.9 MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility, Crooked Creek 115 kV, of Mid-Kansas Electric Company (MKEC) in Gray County, Kansas. GEN-2008-079, 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-2009-001 (or most recent iteration) Impact Study can be placed into service.

The Customer has requested this LOIS to re-evaluate and confirm that adequate interconnection service remains prior to completion of all required Network Upgrades, assuming an May 2014 LOIS operation date.

Prior limited operation analysis for GEN-2008-079, completed in May 2012, can be found at the following link:

http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008_Generation_Studies/LOIS_GEN-2008-079-3_5-7-12.pdf

The results of that analysis show that GEN-2008-079 could interconnect all 98.9 MW but was limited by both an Automatic Control System (ACS) and Special Protection System (SPS)¹ installed at the Crooked Creek 115 kV to monitor the loading on Cudahy – Crooked Creek 115 kV line. Due to area topology changes, construction of new lines and updated ratings on existing lines, the currently approved protection scheme may need to be re-visited.

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 May 2014, including the topology changes and updates mentioned in the preceding paragraph. GEN-2008-079 is requesting a re-evaluation of constraints associated with interconnecting at the MKEC Crooked Creek 115 kV substation. 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-2008-079 request.

Power flow analysis from this LOIS has determined that the GEN-2008-079 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 83.0 MW of

¹ Note that the ACS and SPS were not developed by the SPP Generation Interconnection Department.

Limited Operation Interconnection Service available. This determination is for the period of May 2014, until the completion of the following Energy Resource Interconnection Service Network Upgrades:

- Spearville 345/115 kV Transformer
- Spearville – North Fort Dodge 115 kV circuit #2
- North Fort Dodge – Fort Dodge 115 kV circuit #2
- Move Fort Dodge Terminal of Fort Dodge – Shooting Star Tap 115 kV to North Fort Dodge.
- Rebuild/Reconfiguration of North Fort Dodge 115 kV substation for breaker-and-a-half with six (6) 115 kV line terminals (Spearville 115 kV circuit 1 & 2, Fort Dodge 115 kV circuit 1 & 2, South Dodge 115 kV, and Shooting Star Tap 115 kV)

The ERIS Network Upgrades are currently scheduled for completion by End of Year 2014.

Transient stability analysis was not performed for this LOIS.

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-2008-079) 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 Mid-Kansas Electric Company (MKEC).

The Customer has requested this LOIS to re-evaluate and confirm that adequate Energy Resource Interconnection Service (ERIS) remains prior to completion of all required Network Upgrades, assuming an May 2014 LOIS operation date with injection into the Crooked Creek 115 kV Point of Interconnection (POI). Under the Generator Interconnection Agreement, GEN-2008-079 commenced commercial operation on a Limited Operation basis on November 2, 2011, but through a Temporary POI, the Haggard 115 kV. This Temporary POI was intended to perform as a solution to avoid the significant curtailment associated with the following limitations if operating through the Crooked Creek 115 kV POI. Currently for injection at the Crooked Creek 115 kV POI, this Generator Interconnection Request is limited by both an Automatic Control System (ACS) and Special Protection System (SPS)² installed at the Crooked Creek 115 kV to monitor the loading on Cudahy – Crooked Creek 115 kV line. Due to area topology changes, construction of new lines and updated ratings on existing lines, a restudy of this LOIS was considered.

Only power flow analysis was conducted for this LOIS. Transient analysis was not conducted for this LOIS. 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.

² Note that the ACS and SPS were not developed by the SPP Generation Interconnection Department.

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 May 2014 in-service of GEN-2008-079 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 POI, and the current status of each particular prior queued request.

Table 1: Regional GI Requests Included within LOIS

Project	MW Assumed In Service	Total MW	Fuel Source	POI	Status
GEN-2001-039A	105.0	105.0	Wind	Shooting Star Tap 115 kV	COMMERCIAL OPERATION
GEN-2002-008	120.0	240.0	Wind	Hitchland 345 kV	COMMERCIAL OPERATION
GEN-2002-025A	150.0	150.0	Wind	Spearville 230 kV	COMMERCIAL OPERATION
GEN-2004-014	100.0	154.5	Wind	Spearville 230 kV	COMMERCIAL OPERATION
GEN-2005-012	160.0	250.0	Wind	Ironwood 345 kV	COMMERCIAL OPERATION
GEN-2006-021	101.0	101.0	Wind	Flat Ridge 138 kV	COMMERCIAL OPERATION
GEN-2006-044	120.0	370.0	Wind	Hitchland 345 kV	COMMERCIAL OPERATION
GEN-2007-040	132.0	200.0	Wind	Buckner 345 kV	COMMERCIAL OPERATION
GEN-2008-018	250.0	250.0	Wind	Finney 345 kV	COMMERCIAL OPERATION
GEN-2008-051	161.0	322.0	Wind	Potter County 345 kV	COMMERCIAL OPERATION
Gray County Wind	110.0	110.0	Wind	Gray County Tap 115 kV	COMMERCIAL OPERATION
GEN-2008-079	98.9	98.9	Wind	Crooked Creek 115 kV	COMMERCIAL OPERATION
TOTAL	1607.9				

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-2008-079 was included within the DISIS-2009-001 that was last restudied and posted November 18, 2013. This report can be located here at the following GI Study

URL: http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2009_Generation_Studies/DISIS-2009-001-6_11-18-13.pdf.

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

Upgrade Project	Type	Description	Status
Spearville – Clark County – Thistle – Wichita 345 kV double circuit	Priority Project	Build Spearville – Clark County – Thistle – Wichita 345 kV double circuit	On Schedule for 12/2014 ISD
Thistle – Woodward 345 kV double circuit	Priority Project	Build Thistle – Woodward 345 kV double circuit	On Schedule for 12/2014
Spearville 345/115 kV Transformer	ERIS GI Upgrade	Add new 345/115 kV Transformer	TBD
Spearville – North Fort Dodge 115 kV circuit #2	ERIS GI Upgrade	Build approximately 30 miles of new 115kV	TBD
North Fort Dodge – Fort Dodge 115 kV circuit #2	ERIS GI Upgrade	Build approximately 5 miles of new 115 kV	TBD
Reterminate Fort Dodge – Shooting Star Tap 115 kV	ERIS GI Upgrade	Move Fort Dodge Terminal of Fort Dodge – Shooting Star Tap 115 kV to North Fort Dodge.	TBD

Upgrade Project	Type	Description	Status
Rebuild/Reconfigure North Fort Dodge 115 kV for breaker-and-a-half	ERIS GI Upgrade	Rebuild/Reconfiguration of North Fort Dodge 115 kV substation for breaker-and-a-half with six (6) 115 kV line terminals (Spearville 115 kV circuit 1 & 2, Fort Dodge 115 kV circuit 1 & 2, South Dodge 115 kV, and Shooting Star Tap 115 kV)	TBD

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 Regional GI Requests not included within LOIS

Project	MW Not Included	Total MW	Fuel	POI	Status
GEN-2002-008	120.0	240.0	Wind	Hitchland 345 kV	COMMERCIAL OPERATION
GEN-2004-014	54.5	154.5	Wind	Spearville 230 kV	COMMERCIAL OPERATION
GEN-2005-012	90.0	250.0	Wind	Spearville 230 kV	COMMERCIAL OPERATION
GEN-2006-006	205.5	205.5	Wind	Spearville 230 kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2006-044	250.0	370.0	Wind	Hitchland 345 kV	COMMERCIAL OPERATION
GEN-2007-011	135.0	135.0	Wind	Syracuse 115 kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2007-038	200.0	200.0	Wind	Spearville 345 kV	IA FULLY EXECUTED/ON SCHEDULE FOR 2015 ISD
GEN-2007-040	68.0	200.0	Wind	Buckner 345 kV	COMMERCIAL OPERATION
GEN-2007-062	765.0	765.0	Wind	Woodward 345 kV	IA FULLY EXECUTED/ON SCHEDULE FOR 12/2014 ISD
GEN-2008-017	300.0	300.0	Wind	Setab 345 kV	IA FULLY EXECUTED/ON SCHEDULE FOR 2015 ISD
GEN-2008-051	161.0	322.0	Wind	Potter County 345 kV	COMMERCIAL OPERATION
GEN-2008-092	201.0	201.0	Wind	Post Rock 230 kV	IA FULLY EXECUTED/ON SCHEDULE FOR 12/2014 ISD
GEN-2008-124	200.1	200.1	Wind	Spearville 230 kV	IA FULLY EXECUTED/ON SCHEDULE FOR 2016 ISD
TOTAL		2750.1			

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-2008-079 Interconnection Customer's request is to interconnect forty-three (43) Siemens 2.3 MW wind turbine generators totaling 98.9 MW.

Interconnection Facilities

The POI for GEN-2008-079 Interconnection Customer is the MKEC Crooked Creek 115 kV substation in Gray County, Kansas. 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.

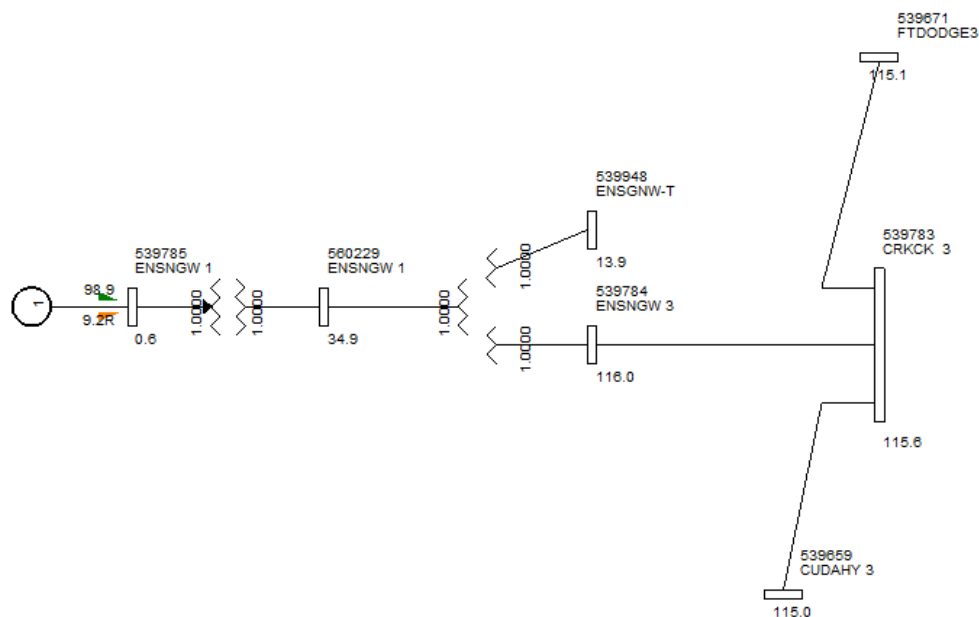


Figure 1: Proposed POI Configuration and Request

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-2008-079 LOIS requested in-service date of May 2014, with the exceptions detailed below. 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.

Additionally the following assumptions for system topology were made. It was assumed that the following upgrades would be in-service for this analysis:

- Woodward – TUCO Interchange 345 kV
- Hitchland – Woodward 345 kV double circuit

It was also assumed that the following upgrades were not in-service for this analysis:

- Spearville – Clark – Thistle – Wichita 345 kV double circuit
- Thistle – Woodward 345 kV double circuit
- The projects listed within Table 2 of this LOIS

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 2013 series of study models including the 2014 (spring (modified as follows), summer, and winter) seasonal models. The 2014 spring season was modified to incorporate topology that is expected to be in service by May, 2014. This is to simulate the lighter loadings between the summer and winter peaking seasons. 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-2008-079 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 Tables 4 and 5. Under the assumptions defined by this LOIS, there is no more than 83 MW of Limited Operation Interconnection Service available. These determinations are for the period of May 2014 until the completion of the following required Network Upgrades listed within Table 2. The ERIS Network Upgrades are scheduled for completion at an undetermined date at this time.

Should any other GI requests or increases in generating amounts, 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% Transmission Distribution Factor (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.

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-2008-079 LOIS

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
14G	G0879LOIS	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	134.6	0.380	104.1	83	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
14G	G0879LOIS	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	134.6	0.380	102.8	88	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1
14G	G0879LOIS	FROM->TO	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.380	101.9	92	NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1
14G	G0879LOIS	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.380	100.5	96	SPEARVILLE (SPEARVL6) 230/115/13.8KV TRANSFORMER CKT 1

Table 5: Additional Constraints of GEN-2008-079 LOIS (Not for mitigation within LOIS but possible curtailment issues)

Season	Dispatch Group	Flow	Overloaded Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
			None					

Stability Analysis

Transient stability analysis was not performed for this study.

Conclusion

<OMITTED TEXT> (Interconnection Customer, GEN-2008-079) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 98.9 MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of Mid-Kansas Electric Company (MKEC) in Gray County, Kansas. The point of interconnection will be the Crooked Creek 115 kV substation. GEN-2008-079, 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-2009-001 (or most recent iteration) Impact Study can be placed into service.

Power flow analysis from this LOIS has determined that the GEN-2008-079 request can interconnect prior to the completion of the required Network Upgrades, listed within Table 2 of this report. There is no more than **83 MW** of Limited Operation Interconnection Service available as an Energy Resource for the period of May, 2014, until the completion of the following Network Upgrades:

- Spearville – Clark – Thistle – Wichita 345 kV double circuit
- Thistle – Woodward 345 kV double circuit
- Spearville 345/115 kV Transformer
- Spearville – North Fort Dodge 115 kV circuit #2
- North Fort Dodge – Fort Dodge 115 kV circuit #2
- Reterminate Fort Dodge – Shooting Star Tap 115 kV
- Rebuild/Reconfigure North Fort Dodge 115 kV for breaker-and-a-half

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.

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.