

Impact Study of Limited Operation for Generator Interconnection

GEN-2013-010

June 2015
Generator Interconnection



Revision History

Date	Author	Change Description
6/12/2015	SPP	Impact Study of Limited Operation for Generator Interconnection GEN-2013-010 Report Issued

Executive Summary

<OMITTED TEXT> (Customer; GEN-2013-010) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 99 MW of wind generation to be interconnected as an Energy Resource (ER) into the Transmission System of Sunflower Electric Power Corporation\Mid-Kansas Electric Company, LLC (SUNC\MKEC) in Rush County, Kansas. GEN-2013-010, under GIA Article 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-2014-002 (or most recent iteration) Impact Study can be placed into service.

This LOIS addresses the effects of interconnecting the generator to the transmission system for the system topology and conditions as expected on December 31, 2016. GEN-2013-010 is requesting the interconnection of thirty-three (33) Siemens SWT108 3.0 MW wind turbine generators and associated facilities interconnecting with a tap on the Spearville – Post Rock 345kV transmission line. For the typical LOIS, both a power flow and a 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 customer's request.

Power flow analysis from this LOIS has determined that the GEN-2013-010 request can interconnect 99 MW of generation as an Energy Resource prior to the completion of the required Network Upgrades, listed within Table 2 of this report. Should any other 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.

Transient stability analysis was not performed for this LOIS study. Transient stability analysis from DISIS-2014-002 did not reveal any additional upgrades in addition to the powerflow analysis.

It should be noted that although this LOIS analyzed many of the most probable contingencies, it is not an all-inclusive list that can account for every operational situation. Additionally, the generator may not be able to inject any power onto the Transmission System due to constraints that fall below the threshold of mitigation for a Generator Interconnection request. Because of this, it is likely that the Customers 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.

Any changes to these assumptions, for example, one or more of the previously queued requests not included within this study (listed in Table 3.) execute an interconnection agreement and commence commercial operation, may require a re-study of this LOIS at the expense of the Customer.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, 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) has requested a Limited Operation System Impact Study (LOIS) under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) for interconnection requests into the Transmission System of Sunflower Electric Power Corporation\Mid-Kansas Electric Company, LLC (SUNC\MKEC).

The purpose of this study is to reevaluate the impacts of interconnecting GEN-2013-010 request of 99 MW comprised of thirty-three (33) Siemens SWT108 3.0 MW wind turbine generators and associated facilities interconnecting with a tap on the Spearville – Post Rock 345kV transmission line. The Customer has requested this amount to be studied as an Energy Resource (ER) with Limited Operation Interconnection Service to commence on or around December of 2016.

Only power flow analysis was conducted for this Limited Operation Interconnection Service. Limited Operation Studies are conducted under GIA Article 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 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 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 12/2016 in-service of GEN-2013-010 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: Generation Requests Included within LOIS

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2001-039A	105.0	105.0	Wind	Shooting Star Tap 115kV	Commercial Operation
GEN-2002-025A	150.0	150.0	Wind	Spearville 230kV	Commercial Operation
GEN-2004-014	154.5	154.5	Wind	Spearville 230kV	Commercial Operation
GEN-2005-012	248.4	248.4	Wind	Ironwood 345kV	Commercial Operation
GEN-2006-021	100.0	100.0	Wind	Flat Ridge Tap 138kV	Commercial Operation
Gray County Wind (Montezuma)	110.0	110.0	Wind	Gray County Tap 115kV	
GEN-2006-006	205.5	205.5	Wind	Spearville 345kV	IA Executed/On Suspension
GEN-2007-040	200.0	200.0	Wind	Buckner 345kV	Commercial Operation
GEN-2008-018	250.0	250.0	Wind	Finney 345kV	Commercial Operation
GEN-2008-079	98.9	98.9	Wind	Crooked Creek 115kV	Commercial Operation
GEN-2010-009	165.6	165.6	Wind	Buckner 345kV	Commercial Operation
GEN-2010-045	197.8	197.8	Wind	Buckner 345kV	IA Executed/On Schedule
ASGI-2012-006	22.5	22.5	Steam	Tap Hugoton - Rolla 69kV	
GEN-2012-007	120.0	120.0	Gas	Rubart 115kV	Commercial Operation
GEN-2012-024	180.0	180.0	Wind	Clark County 345kV	Transitioned to IFS QUEUE
GEN-2014-049	200.0	200.0	Wind	Thistle 345kV	Transitioned to IFS QUEUE
GEN-2013-010	99.0	99.0	Wind	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV	Transitioned to IFS QUEUE

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 these requests have cost responsibility. GEN-2013-010 is included within the DISIS-2014-002 that was studied in fall 2014 and posted January 31, 2015. The cluster has been restudied since the original posting. These reports can be located here at the following GI Study URL:

http://sppoasis.spp.org/documents/swpp/transmission/GenStudies.cfm?YearType=2014_Impact_Studies.

Table 2: Upgrade Projects not included but Required for Full Interconnection Service

Upgrade Project	Type	Description	Status
Clark County 100Mvar SVC	Most recent iteration of DISIS 2014-002.	Interconnection upgrade for DISIS 2014-002 Customers	Not authorized to begin construction
Rebuild Knoll – Post Rock 230kV CKT 1	Most recent iteration of DISIS 2014-002.	Interconnection upgrade for DISIS 2014-002 Customers	Not authorized to begin construction
Replace Terminal Equipment for Buckner – Spearville 345kV CKT 1	Most recent iteration of DISIS 2010-002. Previous Network Upgrade not responsibility of Customer but required to support full interconnection.	Interconnection upgrade for DISIS 2010-002 Customers	Current Estimated In-Service date of 12/31/2016
Viola – Sumner County 138kV CKT 1	Assumed to be out of service for the study	2014 ITPNT (SPP-NTC-200296)	Current Estimated In-Service date of 6/1/2020

Table 3 contains a list of equally or higher queued Interconnection Requests that were not included in this analysis. Any changes to these assumptions, for example, one or more of the previously queued requests not included within this analysis executes an interconnection agreement and commences commercial operation, may require a re-study of this LOIS at the expense of the

Customer. While this list 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 Limited operation has been made or the request is on suspension, etc.

Table 3: Higher or Equally Queued GI Requests not included within LOIS

Project	Remainder MW	Total MW	Fuel	POI	Status
GEN-2008-124	200.1	200.1	Wind	Ironwood 345kV	IA Executed/On Schedule
GEN-2011-008	600.0	600.0	Wind	Clark County 345kV	IA Executed/On Schedule
GEN-2011-016	200.1	200.1	Wind	Spearville 345kV	Transitioned to IFS QUEUE
GEN-2011-017	299.0	299.0	Wind	Tap Spearville - Post Rock (GEN-2011-017T) 345kV	IA 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.

Facilities

Generating Facility

GEN-2013-010 Interconnection Customer's request to interconnect a total of 99 MW is comprised of thirty-three (33) Siemens SWT108 3.0 MW wind turbine generators and associated interconnection facilities.

Interconnection Facilities

The POI for GEN-2013-010 Interconnection Customer is a tap on the Spearville – Post Rock 345kV transmission line in Rush 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 requests.

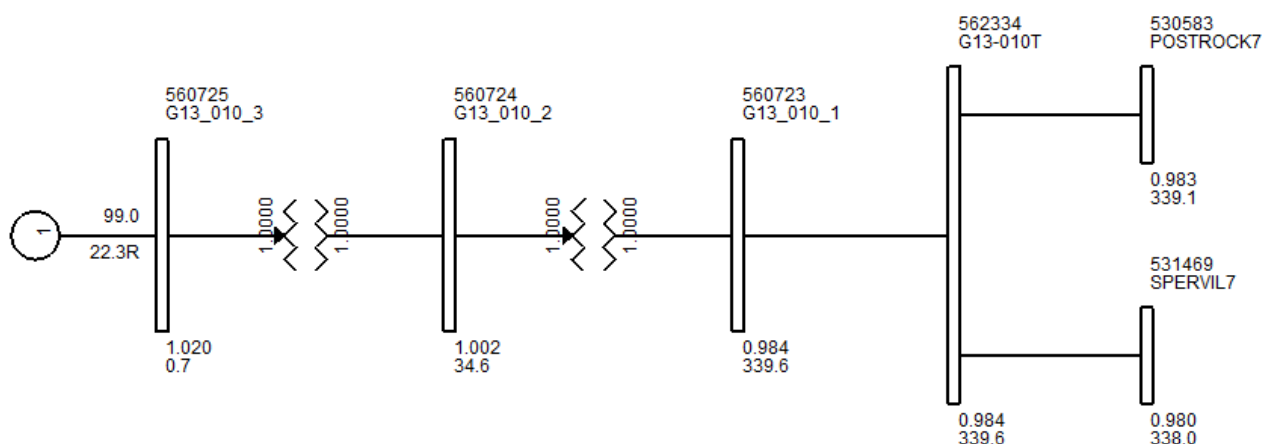


Figure 1: Proposed POI Configuration and Request Power Flow Model

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-2013-010 LOIS requested in-service date of December 31, 2016. 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 2015 (summer and winter) seasonal models from the 2014 series of transmission service request study models. The models represent the models used in the latest iteration of the DISIS-2014-002 Impact Study for which the Interconnection Request was studied. Interconnection Request listed in Table 3 were removed and were assumed to be not in service prior to the date of Limited Operation (12/31/2016). 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 (ERIS) Interconnection Request. 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

The LOIS ACCC analysis indicates that the Customers can interconnect their generation into the SUNC/MKEC transmission system as requested before all required upgrades listed within the DISIS-2014-002 study can be placed into service. 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.

ACCC results for the LOIS can be found in Table 4 and 5 below. Table 5 has the overloads that are less than 20% TDF and are not for mitigation. Generator Interconnection Energy Resource analysis doesn't mitigate for those issues in which the affecting GI request has less than a 20% OTDF, Table

5 is provided for informational purposes only so that the Customer understands there may be operational conditions when they may be required to reduce their output to maintain system reliability.

Curtailment and System Reliability

In no way does this study guarantee 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 for Mitigation of GEN-2013-010 LOIS @ 99MW

Season	Dispatch Group	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
All			N/A					99	

Table 5: Additional Constraints of GEN-2013-010 LOIS @ 99MW

Season	Dispatch Group	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
15SP	03ALL	-	Non Converged	0	0	0.32703	-	DBL-CLRK-THI
15G	03ALL	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.03975	162.8228	DBL-THIS-WIC
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.04101	137.8504	DBL-THIS-WIC
15SP	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	115.1	115.1	0.03685	137.4455	DBL-IRON-CLR
15G	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03663	135.8474	DBL-CLRK-THI
15WP	03ALL	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.0393	134.856	DBL-THIS-WIC
15G	03ALL	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	138.6	143.4	0.03975	133.6997	DBL-THIS-WIC
15WP	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03631	132.211	DBL-CLRK-THI
15G	03ALL	TO->FROM	HAYS PLANT - SOUTH HAYS 115KV CKT 1	83	99	0.06801	130.9931	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15SP	03ALL	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	110	0.03991	130.7853	DBL-THIS-WIC
15G	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	134.6	0.03663	129.1919	DBL-CLRK-THI
15SP	03ALL	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	127.2	136.7	0.03991	127.6606	DBL-THIS-WIC
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03746	127.4647	NORTHWEST - TATONGA7 345.00 345KV CKT 1
15SP	03ALL	FROM->TO	GREENSBURG - SUN CITY 115KV CKT 1	115.1	115.1	0.03685	124.3254	DBL-IRON-CLR
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03746	124.2987	SPSCONT-05B
15G	03ALL	FROM->TO	GREENSBURG - SUN CITY 115KV CKT 1	134.6	134.6	0.03663	124.2525	DBL-CLRK-THI
15G	03ALL	FROM->TO	HAYS PLANT - VINE STREET 115KV CKT 1	80	88	0.06801	123.9276	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15WP	03ALL	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	143.4	143.4	0.0393	123.7601	DBL-THIS-WIC
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03746	123.7033	SPSCONT-04
15G	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03663	121.3477	DBL-IRON-CLR
15WP	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03631	117.8595	DBL-IRON-CLR
15SP	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	115.1	115.1	0.03685	117.7733	DBL-IRON-CLR
15SP	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	115.1	115.1	0.03685	117.6982	DBL-SPRVL-CL
15G	03ALL	FROM->TO	CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1	143	143	0.03975	117.4436	DBL-THIS-WIC
15G	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	134.6	0.03663	116.2284	DBL-IRON-CLR
15WP	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	148.2	0.03631	115.5116	DBL-CLRK-THI
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03746	114.8526	TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1

Season	Dispatch Group	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
15SP	03ALL	FROM->TO	HAYS PLANT - VINE STREET 115KV CKT 1	80	88	0.06827	113.7961	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03746	111.7617	SPSCONT-05A
15G	03ALL	FROM->TO	GREENSBURG - SUN CITY 115KV CKT 1	134.6	134.6	0.03663	111.365	DBL-IRON-CLR
15G	03ALL	TO->FROM	KNOLL - N HAYS3 115.00 115KV CKT 1	80	88	0.06801	109.5858	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15WP	03ALL	FROM->TO	HAYS PLANT - VINE STREET 115KV CKT 1	80	88	0.0683	108.8324	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15SP	03ALL	FROM->TO	GREENSBURG - SUN CITY 115KV CKT 1	115.1	115.1	0.03685	104.8108	DBL-SPRVL-CL
15WP	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	148.2	0.03631	103.856	DBL-IRON-CLR
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03061	103.4675	RENFROW7 345.00 - VIOLA 7 345.00 345KV CKT 1
15G	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03663	102.8636	DBL-SPRVL-CL
15G	03ALL	TO->FROM	N HAYS3 115.00 - VINE STREET 115KV CKT 1	83	99	0.06801	102.4423	KNOLL 230 - POSTROCK6 230.00 230KV CKT 1
15WP	03ALL	FROM->TO	GREENSBURG - SUN CITY 115KV CKT 1	160.9	160.9	0.03631	100.7017	DBL-CLRK-THI
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03435	100.5909	G13-010T 345.00 - POST ROCK 345KV CKT 1
15G	03ALL	TO->FROM	GREENSBURG - SSTARTP3 115.00 115KV CKT 1	119.5	134.6	0.03663	99.8	DBL-SPRVL-CL
15WP	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	119.5	119.5	0.03631	99.3	DBL-SPRVL-CL
15SP	03ALL	TO->FROM	MEDICINE LODGE - SUN CITY 115KV CKT 1	115.1	115.1	0.03685	98.4	DBL-SPRVL-CL
15G	03ALL	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	133	153	0.03061	98.1	VIOLA 7 345.00 - WICHITA 345KV CKT 1
15WP	03ALL	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	398.4	398.4	0.06601	97.1	DBL-CLRK-THI
15G	03ALL	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	398.4	398.4	0.06543	96.7	DBL-CLRK-THI
15WP	03ALL	FROM->TO	CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1	143	143	0.0393	96	DBL-THIS-WIC

Stability Analysis

Transient stability analysis was not performed for this LOIS study. The results from DISIS 2014-002 remain valid.

Conclusion

<OMITTED TEXT> (Interconnection Customer, GEN-2013-010) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 99 MW of generation to be interconnected as an Energy Resource (ER) into the Transmission System of Sunflower Electric Power Corporation\Mid-Kansas Electric Company, LLC (SUNC\MKEC) in Rush County, Kansas. The point of interconnection will be a tap on the Spearville – Post Rock 345kV transmission line. GEN-2013-010, under GIA Article 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-2014-002 (or most recent iteration) Impact Study can be placed into service.

Power flow analysis from this LOIS has determined that GEN-2013-010 request can interconnect their generation as an Energy Resource prior to the completion of the required Network Upgrades, listed within Table 2 of this report. Should any other 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. Refer to Table 4 for the Limited Operation Interconnection Service available due to interconnection constraints.

Transient stability analysis was not performed for this LOIS study. The results from DISIS 2014-002 remain valid.

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.