

Impact Study of Limited Operation for Generator Interconnection

GEN-2013-032

April 2015
Generator Interconnection



Revision History

Date	Author	Change Description
4/8/2015	SPP	Impact Study of Limited Operation for Generator Interconnection GEN-2013-032 Report Issued

Executive Summary

<OMITTED TEXT> (Customer; GEN-2013-032) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 204 MW of wind generation to be interconnected as an Energy Resource (ER) into the Transmission System of Nebraska Public Power District (NPPD) in Antelope County, Nebraska. GEN-2013-032, 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-2013-002 (or most recent iteration) Impact Study can be placed into service.

This LOIS addresses the effects of interconnecting the generators to the rest of the transmission system for the system topology and conditions as expected on June 1, 2017. GEN-2013-032 is requesting the interconnection of one hundred twenty (120) GE 1.7 MW wind turbine generators and associated facilities at the Antelope 115kV 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 customer's request.

Power flow analysis from this LOIS has determined that the GEN-2013-032 request can interconnect 150 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. 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.

Transient stability analysis was not performed for this LOIS study. The results from DISIS 2013-002-2 remain valid.

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 Nebraska Public Power District (NPPD).

The purpose of this study is to reevaluate the impacts of interconnecting GEN-2013-032 request of 204 MW comprised of one hundred twenty (120) GE 1.7 MW wind turbine generators and associated facilities interconnecting at the Antelope 115kV substation in Antelope County, Nebraska. The Customer has requested this amount to be studied as an Energy Resource (ER) with Limited Operation Interconnection Service to commence on or around June of 2017.

Only power flow analysis was 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 pending higher queued Interconnection Request to interconnect to the Transmission System listed in Table 1; or
- d) have no Queue Position but have executed a GIA or requested that an unexecuted GIA 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 6/2017 in-service of GEN-2013-032 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-2002-023N	0.8	0.8	Wind	Harmony 115kV	Commercial Operation
GEN-2003-021N	75	75	Wind	Ainsworth Wind Tap 115kV	Commercial Operation
GEN-2004-023N	75	75	Coal	Columbus Co 115kV	Commercial Operation
GEN-2006-020N	42	42	Wind	Bloomfield 115kV	Commercial Operation
GEN-2006-037N1	75	75	Wind	Broken Bow 115kV	Commercial Operation
GEN-2006-038N005	80	80	Wind	Broken Bow 115kV	Commercial Operation
GEN-2006-038N019	80	80	Wind	Petersburg North 115kV	Commercial Operation
GEN-2006-044N	40.5	40.5	Wind	North Petersburg 115kV	Commercial Operation
GEN-2007-011N08	81	81	Wind	Bloomfield 115kV	Commercial Operation
GEN-2008-086N02	200.6	200.6	Wind	Tap Ft Randle - Columbus (Madison County) 230kV	Commercial Operation
GEN-2008-1190	60	60	Wind	S1399 161kV	Commercial Operation
GEN-2008-123N	89.7	89.7	Wind	Tap Guide Rock - Pauline 115kV	IA Executed/On Schedule
GEN-2009-040	72	72	Wind	Marshall 115kV	IA Executed/On Schedule
GEN-2010-041	10.5	10.5	Wind	S 1399 161kV	IA Executed/On Schedule
GEN-2011-018	73.6	73.6	Wind	Steele City 115kV	Commercial Operation
GEN-2011-056	3.6	3.6	Hydro	Jeffrey 115kV	Commercial Operation
GEN-2011-056A	3.6	3.6	Hydro	John 1 115kV	Commercial Operation
GEN-2011-056B	4.5	4.5	Hydro	John 2 115kV	Commercial Operation
GEN-2012-021	4.8	4.8	Gas	Terry Bundy Generating Station 115kV	Commercial Operation
NPPD Distributed (Broken Bow)	8.3	8.3	Heat	Broken Bow 115kV	Commercial Operation
NPPD Distributed (Burt County Wind)	12	12	Wind	Tekamah & Oakland 115kV	Commercial Operation
NPPD Distributed (Burwell)	3	3	Heat	Ord 115kV	Commercial Operation
NPPD Distributed (Columbus Hydro)	45	45	Hydro	Columbus 115kV	Commercial Operation
NPPD Distributed (North Platte - Lexington)	54	54	Hydro	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV	Commercial Operation
NPPD Distributed (Ord)	10.8	10.8	Heat	Ord 115kV	Commercial Operation
NPPD Distributed (Stuart)	2.1	2.1	Heat	Ainsworth 115kV	Commercial Operation
GEN-2013-002	50.6	50.6	Wind	Tap Sheldon-Folsom 115kV (GEN-2013-002 Tap)	TRANSITIONED TO IFS QUEUE
GEN-2013-008	1.2	1.2	Wind	Steele City 115kV	Commercial Operation
GEN-2013-014	25.5	25.5	Wind	Tap Guide Rock - Pauline (GEN-2008-123N Tap) 115kV	On Suspension
GEN-2013-019	73.6	73.6	Wind	Tap Sheldon-Folsom 115kV (GEN-2013-002 Tap)	TRANSITIONED TO IFS QUEUE
GEN-2013-032	204	204	Wind	Antelope 115kV	TRANSITIONED TO IFS QUEUE

This LOIS was required because the Customers are 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-2013-032 was included within the DISIS-2013-002 that was studied in fall 2013 and posted January 31, 2014. The cluster has been restudied since the original posting. These reports can be located at the following Generation Interconnection Study URL:

<http://sppoasis.spp.org/documents/swpp/transmission/GenStudies.cfm?YearType=2013> [Impact Studies](#)

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

Upgrade Project	Type	Description	Status
Twin Church - Dixon County 230kV	Assumed to be out of service for the study	Assigned to DISIS-2010-002 & DISIS-2011-001 Customers	In-Service date 10-24-2015

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. The higher or equally queued projects that were not included in this study are listed in Table 3. 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 an LOIS has been made or the request is on suspension, etc.

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

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2010-051	200	200	Wind	Tap Twin Church-Hoskins 230kV	IA Fully Executed/On Suspension
GEN-2011-027	120	120	Wind	Hoskins 230kV	IA Fully Executed/On Suspension

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-2013-032 Interconnection Customer's request to interconnect a total of 204 MW is comprised of one hundred twenty (120) GE 1.7 MW wind turbine generators and associated facilities.

Interconnection Facilities

The POI for GEN-2013-032 Interconnection Customer is the Antelope 115kV substation (labeled as Neligh East in the one-line below) in Antelope County, Nebraska. 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.

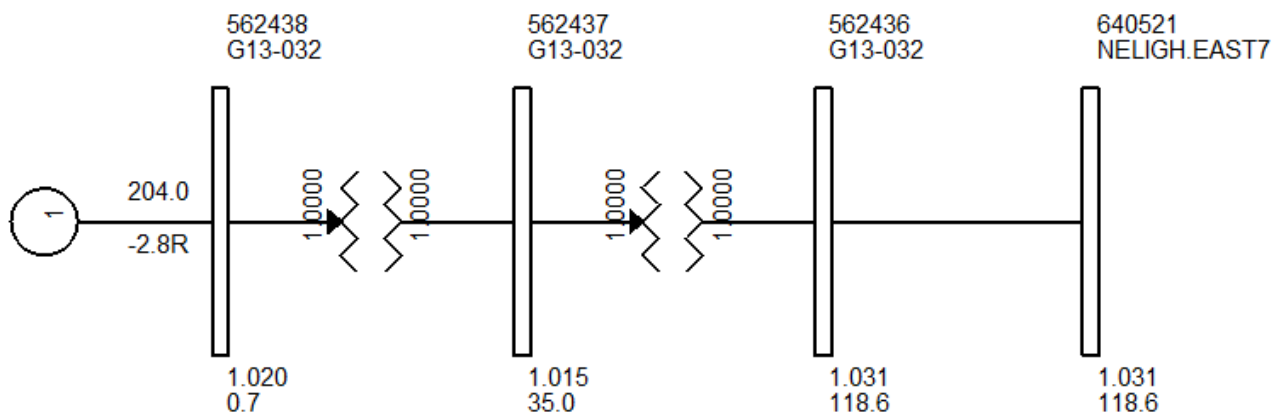


Figure 1: Proposed POI Configuration and Request Power Flow Model

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-2013-032 LOIS requested in-service date of June 1, 2017. 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 2014 series of transmission service request study models including the 2015 (spring, summer, and winter), 2020 and 2025 (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 (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 NPPD transmission system as requested before all required upgrades listed within the DISIS-2013-002 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 Table 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.

Power Flow Analysis

Table 4: Interconnection Constraints for Mitigation of GEN-2013-032 LOIS @ 204MW

Season	Dispatch Group	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
15G	09G13_032	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	114.85	150	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09G13_032	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	114.81	150	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	114.18	152	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	114.14	152	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	102.45	186	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	102.42	186	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	101.77	188	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	101.74	188	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1

Table 5: Additional Constraints of GEN-2013-032 LOIS @ 204MW

Season	Dispatch Group	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Contingency
15G	09ALL	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	116.15	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09ALL	TO->FROM	COUNTY LINE - NELIGH.EAST7115.00 115KV CKT 1	120	120	0.3879	116.13	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09ALL	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	115.47	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09ALL	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	120	0.3879	115.45	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09ALL	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	120	0.2038	106.87	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
15G	09ALL	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	120	0.2038	106.86	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
15G	09G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0675	110.83	NEB02WAPAB2
15G	09G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0675	110.73	GAVINS POINT - HARTINGTON 115KV CKT 1
15G	09G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0745	110.67	MANNING - SPIRIT MOUND 115KV CKT 1
15G	09	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0675	108.65	NEB02WAPAB2
15G	09	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0675	108.50	GAVINS POINT - HARTINGTON 115KV CKT 1
15G	09	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0745	108.25	MANNING - SPIRIT MOUND 115KV CKT 1
15G	09G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0745	105.33	BERSFORD - MANNING 115KV CKT 1
15G	09	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0745	102.87	BERSFORD - MANNING 115KV CKT 1
15G	09G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	120	120	0.0675	100.38	BELDEN - HARTINGTON 115KV CKT 1

Stability Analysis

Transient stability analysis was not performed for this LOIS study. The results from DISIS 2013-002-2 remain valid.

Conclusion

<OMITTED TEXT> (Interconnection Customer, GEN-2013-032) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for a total of 204 MW of wind generation to be interconnected as an Energy Resource (ER) into the Transmission System of Nebraska Public Power District (NPPD) in Antelope County, Nebraska. The point of interconnection will be the Antelope 115kV substation. GEN-2013-032, under GIA Section 5.9, have 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-2013-002 (or most recent iteration) Impact Study can be placed into service.

Power flow analysis from this LOIS has determined that GEN-2013-032 request can interconnect a maximum of 150MW 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. 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 2013-002-2 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.