# Impact Study of Limited Operation for Generator Interconnection

# GEN-2013-008

**October 2013**
**Generator Interconnection Studies**

SPP Southwest Power Pool

# Executive Summary

<OMITTED TEXT> (Interconnection Customer; GEN-2013-008) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 200.0 MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of Nebraska Public Power District (NPPD) in Jefferson County, Nebraska. GEN-2013-008, 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-2013-001 (or most recent iteration) Impact Study can be placed into service.

The Customer has requested this LOIS to confirm that adequate interconnection service remains prior to completion of all required Network Upgrades, assuming a November 1, 2013, LOIS operation date.

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 November 1, 2013. GEN-2013-008 is requesting an uprate of GEN-2011-018 at the NPPD Steele City 115kV 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-2013-008 request.

Power flow analysis from this LOIS has determined that the GEN-2013-008 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 1.2 MW of Limited Operation Interconnection Service available. This determination is for the period of November 1, 2013 until the completion of the following Network Upgrades:

- Energy Resource Interconnection Service (ERIS) Network Upgrades
  - Dixon County – Rasmussen 230kV
  - Harbine – Crete 115kV

The ERIS Network Upgrades are currently scheduled for completion at an undetermined date.

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.

# Table of Contents

# Purpose

<OMITTED TEXT> (Interconnection Customer; GEN-2013-008) 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 Nebraska Public Power District (NPPD).

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 November 1, 2013, LOIS operation date.

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 November 1, 2013 in-service of GEN-2013-008 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 |
|---|---|---|---|---|---|
| NPPD Distributed (Broken Bow) | 8.30 | 8.30 | Heat | Broken Bow 115kV | COMMERCIAL OPERATION |
| NPPD Distributed (Burwell) | 3.00 | 3.00 | Heat | Ord 115kV | COMMERCIAL OPERATION |
| NPPD Distributed (Ord) | 10.80 | 10.80 | Heat | Ord 115kV | COMMERCIAL OPERATION |
| NPPD Distributed (Stuart) | 2.10 | 2.10 | Heat | Ainsworth 115kV | COMMERCIAL OPERATION |
| NPPD Distributed (Columbus Hydro) | 45.00 | 45.00 | Hydro | Columbus 115kV | COMMERCIAL OPERATION |
| WAPA SEAMS (Gavins Pt Hydro) | 92.00 | 92.00 | Hydro | Gavins Point (WAPA) 115kV | COMMERCIAL OPERATION |
| WAPA SEAMS (Ft Randle Hydro) | 347.00 | 347.00 | Hydro | Ft Randle (WAPA) 230kV & 115kV | COMMERCIAL OPERATION |
| WAPA SEAMS (Spirit Mound Heat) | 104.00 | 104.00 | Heat | Spirit Mound (WAPA) 115kV | COMMERCIAL OPERATION |
| NPPD Distributed (Beatrice Power Station) | 250.00 | 250.00 | Heat | Beatrice Power Station 115kV | COMMERCIAL OPERATION |
| GEN-2002-023N | 0.80 | 0.80 | Wind | Harmony 115kV | COMMERCIAL OPERATION |
| GEN-2003-021N | 75.00 | 75.00 | Wind | Ainsworth Wind Tap 115kV | COMMERCIAL OPERATION |
| GEN-2004-005N | 30.00 | 30.00 | Wind | St Francis 115kV | IA FULLY EXECUTED/ON SUSPENSION |
| GEN-2004-023N | 75.00 | 75.00 | Heat | Columbus Co 115kV | COMMERCIAL OPERATION |
| GEN-2006-020N | 42.00 | 42.00 | Wind | Bloomfield 115kV | COMMERCIAL OPERATION |
| GEN-2006-038N005 | 80.00 | 80.00 | Wind | Broken Bow 115kV | COMMERCIAL OPERATION |
| GEN-2006-038N019 | 80.00 | 80.00 | Wind | Petersburg North 115kV | COMMERCIAL OPERATION |
| GEN-2007-011N08 | 81.00 | 81.00 | Wind | Bloomfield 115kV | COMMERCIAL OPERATION |
| GEN-2008-119O | 60.00 | 60.00 | Wind | S1399 161kV | COMMERCIAL OPERATION |
| GEN-2006-037N1 | 75.00 | 75.00 | Wind | Broken Bow 115kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2006-044N | 40.50 | 40.50 | Wind | North Petersburg 115kV | COMMERCIAL OPERATION |
| GEN-2008-086N02 | 200.00 | 200.00 | Wind | Tap Ft Randle - Columbus (Madison County) 230kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2008-123N | 89.70 | 89.70 | Wind | Tap Guide Rock - Pauline 115kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2009-040 | 73.80 | 73.80 | Wind | Marshall 115kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2010-041 | 10.50 | 10.50 | Wind | S 1399 161kV | IA PENDING |
| GEN-2010-051 | 200.00 | 200.00 | Wind | Tap Twin Church - Hoskins 230kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2011-018 | 73.60 | 73.60 | Wind | Steele City 115kV | IA FULLY EXECUTED/ON SCHEDULE |
| GEN-2011-027 | 120.00 | 120.00 | Wind | Hoskins 230kV | IA PENDING |
| GEN-2013-008 | 1.2 | 1.2 | Wind | Steele City 115kV | FACILITY STUDY STAGE |

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-2013-008 was included within the DISIS-2013-001 that was last restudied and posted August 31, 2013. This report can be located here at the following GI Study URL: http://sppoasis.spp.org/documents/swpp/transmission/GenStudies.cfm?YearType=2013_Impact_Studies.

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

| Upgrade Project | Type | Description | Status |
|---|---|---|---|
| Harbine – Crete 115kV | GI Upgrade | Build approximately 35 miles of new 115kV | Not currently authorized |
| Dixon County – Rasmussen 230kV | GI Upgrade | Build approximately 40 miles of new 230kV | Not currently authorized |

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 1 (Woodward Area) GI Requests not included within LOIS*

| Project | Remainder MW | Total MW | Fuel | POI | Status |
|---|---|---|---|---|---|
| GEN-2010-044 | 99 | 99 | Wind | Harbine 115kV | IA PENDING |
| GEN-2011-055 | 52.80 | 52.80 | Wind | South Sterling Wind Project | FACILITY STUDY STAGE |
| GEN-2011-056A | 3.60 | 3.60 | Hydro | CNPPID Hydro | IA FULLY EXECUTED/COMMERCIAL OPERATION |
| GEN-2011-056B | 4.50 | 4.50 | Hydro | CNPPID Hydro | IA FULLY EXECUTED/COMMERCIAL OPERATION |
| GEN-2012-018 | 200.00 | 200.00 | Wind | Rattlesnake Creek | FACILITY STUDY STAGE |
| GEN-2012-021 | 4.80 | 4.80 | CT | Lincoln Electric Uprate | 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-2013-008 Interconnection Customer's request to interconnect a total of 1.2 MW by uprating twelve G.E. 1.6MW turbines to 1.7 MW.

## Interconnection Facilities

The POI for GEN-2013-008 Interconnection Customer is the NPPD Steele City 115kV substation in Jefferson 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 request.

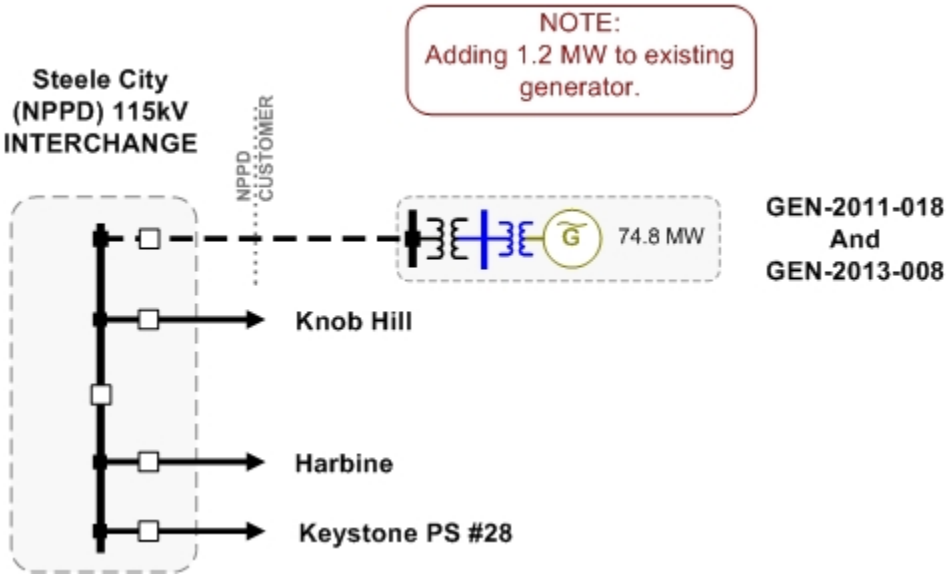


*Figure 1: Proposed POI Configuration and Request*

## 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-2013-008 LOIS requested in-service date of November 1, 2013. 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-2013-008 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 1.2MW of Limited Operation Interconnection Service available. These determinations are for the period of November 1, 2013 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 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-2013-008 LOIS @ 1.2MW*

| Season | Dispatch Group | Flow | Overloaded Element | RATEA (MVA) | RATEB (MVA) | TDF | TC% LOADING | Max MW Available | Contingency |
|---|---|---|---|---|---|---|---|---|---|
| | | | None | | | | | 299.0 | |

*Table 5: Additional Constraints of GEN-2013-008 LOIS @ 1.2MW (Not for mitigation within LOIS but possible curtailment issues)*

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

Southwest Power Pool, Inc. Table 5: Additional Constraints of GEN-2013-008 LOIS @ 1.2MW (Not for mitigation within

| Season | Dispatch Group | Flow | Overloaded Element | RATE A (MVA) | RATEB (MVA) | TDF | TC% LOADING | Contingency |
|---|---|---|---|---|---|---|---|---|
| | | | None | | | | | |

Stability Analysis

# Stability Analysis

Transient stability analysis was not performed for this study.

# Conclusion

<OMITTED TEXT> (Interconnection Customer, GEN-2013-008) has requested a Limited Operation System Impact Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 200 MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of Nebraska Public Power District (NPPD) in Jefferson County, Nebraska. The point of interconnection will be the Steele City 345kV substation. GEN-2013-008, 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-2013-001 (or most recent iteration) Impact Study can be placed into service.

Power flow analysis from this LOIS has determined that the GEN-2013-008 request can interconnect prior to the completion of the required Network Upgrades, listed within Table 2 of this report. There is no more than **1.2** MW of Limited Operation Interconnection Service available only as an Energy Resource for the period of November 1, 2013 until the completion of the following Network Upgrades:

- Energy Resource Interconnection Service (ERIS) Network Upgrades
    - Dixon – Rasmussen 230kV
    - Harbine – Crete 115kV

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.