GEN-2013-014 Impact Study for Modification Request of Generator Interconnection Request

November 2014
Generator Interconnection

SPP Southwest Power Pool

Executive Summary

This document reports on the findings of an impact restudy for Generator Interconnection Request, GEN-2013-014 in accordance with GIP 4.4.3. SPP has evaluated, with this Modification Request Impact Study (MRIS), the impacts to the Southwest Power Pool (SPP) Transmission System for a modification to the generator equipment to be installed.

The Customer is requesting the interconnection of fifteen (15) GE 1.7 MW MVA wind turbines and associated facilities with a project nameplate rating of 25.5 MW that is to be installed at the proposed Rosemont substation on the Pauline – Guide Rock 115kV line in Webster Co, Nebraska.

The generator interconnection request was included in the DISIS-2013-001 Definitive Impact Study which was posted in June, 2013. The results of DISIS-2013-001 determined that the GEN-2013-014 request can interconnect 25.5MW with the assumptions described in the DISIS 2013-001 report.

For this modification, the Customer requested to combine the GEN 2013-014 interconnection request with the GEN 2008-123N request so that both requests share the same generator lead. The point of interconnection to the SPP Transmission System does not change. The scenario assumes that both the higher queued projects listed within Table 2 of this study and additional generation projects listed within Table 4 might go into service with the completion of all Network Upgrades identified within Table 3 of this report.

Transient stability analysis for this study has determined that with the assigned upgrades, the transmission system will remain stable for the twelve (12) selected faults for the interconnection of GEN 2013-014. The request to combine the generation requests on the same shared generator lead does not constitute a Material Modification.

Since the analysis of the combined requests required only stability analysis, powerflow analysis was not performed again for this study and powerflow constraints have not been evaluated. For powerflow constraints, please refer to the latest version of DISIS-2013-001. At times, 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 Customer may be required to reduce its generation output to **0 MW** under certain system conditions to allow system operators to maintain the reliability of the transmission network.

With the assumptions outlined in this report and with all the required network upgrades identified in place, the GEN-2013-014 request should be able to reliably interconnect to the SPP transmission system.

If the Interconnection Customer wishes to continue to pursue this request for modification to the GEN-2013-014 Interconnection Request, a revised Interconnection Facilities Study will need to be performed by the Transmission Owner, Nebraska Public Power District.

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).

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Introduction

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Table *1*: Interconnection Request Evaluated

Request	Capacity (MW)	Generator Model	Fuel Source	Point of Interconnection
GEN 2013-014	25.5	GE 1.7	Wind	Rosemont 115kV (560137)

The system impact study 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 interconnection 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.

Transient Stability analysis of the combined requests was performed on the DISIS 2013-002-2 Group 9 cases.

Powerflow analysis was not performed for this study.

Table 2: GI Requests included in MRIS

Project	Total MW	Fuel	POI	Status
GEN-2002-023N	0.8	Wind	Harmony 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2003-021N	75	Wind	Ainsworth Wind Tap 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2004-023N	75	Coal	Columbus Co 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2006-020N	42	Wind	Bloomfield 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2006-037N1	75	Wind	Broken Bow 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2006-038N005	80	Wind	Broken Bow 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2006-038N019	80	Wind	Petersburg North 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2006-044N	40.5	Wind	North Petersburg 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2007-011N08	81	Wind	Bloomfield 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-086N02	200	Wind	Meadow Grove 230kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-119O	60	Wind	S1399 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-123N	89.7	Wind	Tap Guide Rock – Pauline 115kV (Rosemont)	IA FULLY EXECUTED/ON SCHEDULE
GEN-2009-040	73.8	Wind	Marshall 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-041	10.5	Wind	S1399 161kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-051	200	Wind	Tap Twin Church – Hoskins 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-018	73.6	Wind	Stelle City 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2011-027	120	Wind	Tap Twin Church – Hoskins 230kV (GEN- 2010-051 tap)	IA FULLY EXECUTED/ON SCHEDULE
GEN-2011-056	3.6	Hydro	Jeffrey 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2011-056A	3.6	Hydro	John 1 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2011-056B	4.5	Hydro	John 2 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-021	4.8	Gas	Terry Bundy Generating Station 115kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-002	50.6	Wind	Tap Sheldon – Folsom & Pleasant Hill 115kV CKT 2	TRANSITIONED TO IFS QUEUE
GEN-2013-008	1.2	Wind	Steele City 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2013-019	73.6	Wind	Tap Sheldon – Folsom & Pleasant Hill 115kV CKT 2 (GEN-2013-002 tap)	TRANSITIONED TO IFS QUEUE
GEN-2013-032	204	Wind	Neligh 115kV	TRANSITIONED TO IFS QUEUE
NPP Distributed (Broken Bow)	8.3		Broken Bow 115kV	
NPP Distributed (Burt County Wind)	12		Tekamah & Oakland 115kV	
NPP Distributed (Burwell)	3		Ord 115kV	
NPP Distributed (Columbus Hydro)	45		Columbus 115kV	

NPP Distributed (Ord)	11.9		Ord 115kV	
NPP Distributed (Stuart)	2.1		Ainsworth 115kV	

The analysis included all projects listed in both Table 2 and their assigned upgrades.

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).

Facilities

Generating Facility

GEN-2013-014 Interconnection Customer's request to interconnect a total of 25.5 MW is comprised of fifteen (15) GE 1.7 MW wind turbines and associated interconnection facilities. The Customer has asked to combine this request on the same generator lead as GEN 2008-123N. Both GEN-2008-123N and GEN-2013-014 interconnect at the proposed Rosemont 115kV substation.

Interconnection Facilities

The Point of Interconnection for GEN-2013-014 Interconnection Customer is through the proposed Rosemont115kV substation on the Pauline – Guiderock 115kV line in Webster 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.

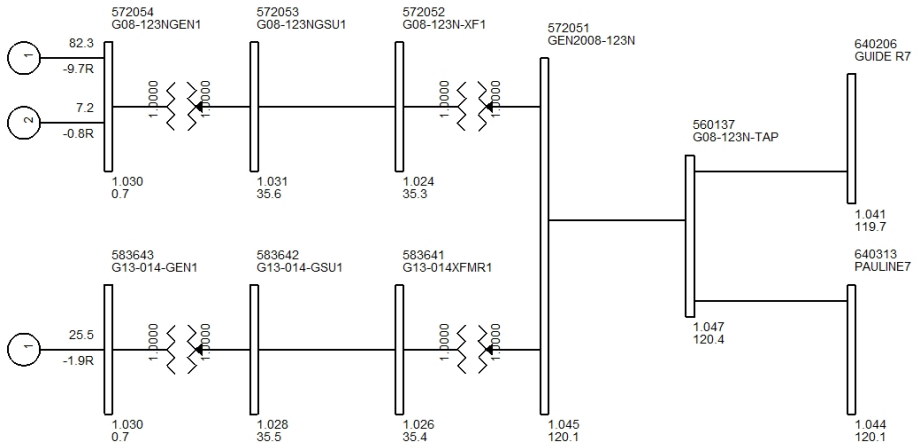

Figure 1: Proposed POI Configuration and Request Power Flow Model

Base Case Network Upgrades

The Network Upgrades included within the are those facilities that are a part of the SPP Transmission Expansion Plan or the Balanced Portfolio projects, have an approved Notice to Construct (NTC), , or are assigned to interconnection customers as described in the DISIS 2013-001. 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.

Powerflow Analysis

The analysis of the modification of did not require powerflow analysis. Please see the latest iteration of DISIS-2013-001 for powerflow analysis, constraints, and upgrades required.

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 2013 series of Model Development Working Group (MDWG) dynamic study models including the 2014 winter, 2015 summer, and 2024 summer peak dynamic cases. The cases are then loaded with prior queued interconnection requests and network upgrades assigned to those interconnection requests. Finally the prior queued and study generation are 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

Twelve (12) contingencies were identified for use in this study and are listed in Table 5. 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.

Except for transformer faults, the typical sequence of events for a three-phase and a single-phase fault is as follows:

1. apply fault at particular location
2. continue fault for five (6.5) cycles, clear the fault by tripping the faulted facility
3. trip the faulted facility and remove the fault

Transformer faults are typically modeled as three-phase faults, unless otherwise noted. The sequence of events for a transformer fault is as follows:

1. apply fault for five (5) cycles
2. clear the fault by tripping the affected transformer facility (unless otherwise noted there will be no re-closing into a transformer fault)

The control areas monitored are 525, 526, 531, 534, 536, and 640

Table 2: Contingencies Evaluated

	Contingency Number and Name	Description
1	FLT_01_G08123NTAP_Pauline_115kV_3PH	*3-Phase fault on the GEN 2008-0123N tap - Pauline 115kV line near the GEN 2008-0123N tap 115kV bus.*
2	FLT_02_G08123NTAP_GuideRock_115kV_3PH	*3-Phase fault on the GEN 2008-0123N tap – Guide Rock 115kV line near the GEN 2008-0123N tap 115kV bus.*
3	FLT_03_Pauline_Hasting_115kV_3PH	*3-Phase fault on the Pauline – Hastings 115kV line near the Pauline 115kV bus.*
4	FLT_04_Pauline_Hildreth_115kV_3PH	*3-Phase fault on the Pauline – Hildreth 115kV line near the Pauline 115kV bus.*
5	FLT_05_Pauline_Pauline3_115_345kV_3PH	*3-Phase fault on the Pauline 345kV/115kV transformer near the Pauline 115kV bus.*
6	FLT_06_Pauline3_Axtell_345kV_3PH	*3-Phase fault on the Pauline – Axtell 345kV line near the Pauline 345kV bus.*
7	FLT_07_Pauline3_Moore_345kV_3PH	*3-Phase fault on the Pauline – Moore 345kV line near the Pauline 345kV bus.*
8	FLT_08_GuideRock_Superior_115kV_3PH	*3-Phase fault on the Guide Rock - Superior 115kV line near the Guide Rock 115kV bus.*
9	FLT_09_Superior_Hebron_115kV_3PH	*3-Phase fault on the Superior - Hebron 115kV line near the Superior 115kV bus.*
10	FLT_10_Hebron_HebronNorth_115kV_3PH	*3-Phase fault on the Hebron –Hebron North 115kV line near the Herbron 115kV bus.*
11	FLT_11_HebronNorth_Fairbury_115kV_3PH	*3-Phase fault on the Hebron North - Fairbury 115kV line near the Hebron North 115kV bus.*
12	FLT_12_HebronNorth_CarletonJunction_115kV_3PH	*3-Phase fault on the Hebron North – Carleton Junction 115kV line near the Hebron North 115kV bus.*

Transient Stability Results

Results of the stability analysis are summarized in Table 6. These results are valid for ASGI-2013-004 interconnecting with a generation amount up to 27.6 MW (summer peak) and 36.6 MW (winter peak). The results indicate that the transmission system remains stable for all contingencies studied in both the LOIS and DISIS scenarios. The plots will be available upon request.

Table 3: Fault Analysis Results

		DISIS-2013-002		
	Contingency Number and Name	2014WP	2015SP	2024SP
1	FLT_01_G08123NTAP_Pauline_115kV_3PH	Stable	Stable	Stable
2	FLT_02_G08123NTAP_GuideRock_115kV_3PH	Stable	Stable	Stable
3	FLT_03_Pauline_Hasting_115kV_3PH	Stable	Stable	Stable
4	FLT_04_Pauline_Hildreth_115kV_3PH	Stable	Stable	Stable
5	FLT_05_Pauline_Pauline3_115_345kV_3PH	Stable	Stable	Stable
6	FLT_06_Pauline3_Axtell_345kV_3PH	Stable	Stable	Stable
7	FLT_07_Pauline3_Moore_345kV_3PH	Stable	Stable	Stable
8	FLT_08_GuideRock_Superior_115kV_3PH	Stable	Stable	Stable
9	FLT_09_Superior_Hebron_115kV_3PH	Stable	Stable	Stable
10	FLT_10_Hebron_HebronNorth_115kV_3PH	Stable	Stable	Stable
11	FLT_11_HebronNorth_Fairbury_115kV_3PH	Stable	Stable	Stable
12	FLT_12_HebronNorth_CarletonJunction_115kV_3PH	Stable	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. The required prior queued project wind farms remained online for the fault contingencies described in the Disturbances section of this report.

Conclusion

The SPP GEN-2013-014 Modification Request Impact Study evaluated the impact of interconnecting the projects shown below.

Table *4*: Interconnection Requests

Request	Capacity (MW)	Generator Model	Fuel Source	Point of Interconnection
GEN 2013-014	25.5	GE 1.7MW	Wind	GEN 2008-123N tap 115kV (560137)

With all Base Case Network Upgrades in service and previously assigned Network Upgrades in service, the GEN 2013-014 project was found to remain on line, and the transmission system was found to remain stable for all conditions studied. All generators in the monitored areas remained stable for all of the modeled disturbances. The request to combine the generator leads for GEN-2008-123N and GEN 2013-014 is not considered a Material Modification.

Any changes to the assumptions made in this study, for example, one or more of the previously queued requests withdraw or execute an interconnection agreement and commence commercial operation, may require a re-study at the expense of the Customer.

If the Interconnection Customer wishes to continue to pursue this request for modification to the GEN-2013-014 Interconnection Request, a revised Interconnection Facilities Study will need to be performed by the Transmission Owner, Nebraska Public Power District.

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 A

Plots of Machines and Buses within the Monitored Areas

(Additional Plots Available upon request)