AFFECTED SYSTEM LIMITED OPERATION IMPACT STUDY REPORT

ASGI-2016-J426

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By SPP Generator Interconnections Dept.

REVISION HISTORY

Date	Author	Change Description
04/19/2017	SPP	Affected System Limited Operation Impact Study for Generator Interconnection ASGI-2016-J426 Report Issued

EXECUTIVE SUMMARY

Affected System Interconnection Customer "J426" has requested an Affected System Limited Operation System Impact Study (AS-LOIS) consistent with Southwest Power Pool Open Access Transmission Tariff (OATT) for 100 MW of wind generation to be interconnected with 100 MW of Energy Resource interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) to the Midcontinent Independent System Operator (MISO) transmission system footprint. The generator is planned to interconnect into the transmission system of Northern States Power (Xcel Energy) in Pipestone County, Minnesota. Affected System Interconnection Customer has requested this Affected System Limited Operation Interconnection Study (AS-LOIS) to determine the impacts of interconnecting to the transmission system under the following assumptions:

1. All planned transmission system improvements with ISD at the beginning of 2019 or earlier were included in the model used in the LOIS.
2. Gentleman – Thedford – Holt 345 kV ("R-Plan") Project was in-service after year end 2019.
3. SPP GEN-2015-023 Generation Interconnection Request was in-service after the in-service of the planned Gentleman – Thedford – Holt 345 kV ("R-Plan") Project.
4. Terminal equipment upgrades for Pahoja-Sioux Falls (identified in the AFS for J426) were not included.

This Affected System LOIS addresses the effects to the rest of the transmission system of interconnecting the generator for the system topology and conditions as expected in 1st Quarter of 2019. For this Affected System LOIS, only power-flow analysis was conducted. The Affected System 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 in **TABLE 3** with queue priority equal-to or higher-than the study project, request to go into commercial operation before all Network Upgrades identified within **TABLE 2** of this report are completed, this Affected System LOIS may need to be restudied to ensure that interconnection service remains available for the customer's request.

Power-flow analysis from this Affected System LOIS has determined that the J426 request can interconnect **100 MW ERIS** and **41MW NRIS** prior to the completion of the required Network Upgrades, listed within **TABLE 2** of this report, provided that the Network Upgrades are able to be placed in service should GEN-2015-023 and J426 both be in-service. 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 affected system limited operation service is available.

The Interconnection Customer requested an additional LOIS analysis in the event Pahoja – Sioux Falls 230kV terminal equipment is upgraded but the remaining projects in **TABLE 2** are not completed before J426's in-service date. Based on this additional analysis with the Pahoja – Sioux Falls 230Kv terminal equipment upgrade in-service, J426 request can interconnect **100 MW ERIS** and **100MW NRIS** prior to the completion of the remaining required Network Upgrades, listed within **TABLE 2.**

It should be noted that although this Affected System 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, the Customer may be required by the Transmission Provider 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 and short circuit analysis were not performed for this AS-LOIS study.

Nothing in this study should be construed as a guarantee of delivery or transmission service within Southwest Power Pool's (SPP) transmission system. 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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INTRODUCTION

PURPOSE

The purpose of this study is to evaluate the impacts to the SPP system from a new interconnection request on the MISO system and to determine the amount of interconnection capacity that is available under the specified conditions prior to completion of all interconnection facilities.

STUDY ASSUMPTIONS

Additionally, the Affected System Interconnection Customer has requested this Affected System LOIS analysis be conducted under the following assumptions:

1. All planned transmission system improvements with ISD at the beginning of 2019 or earlier were included in the model used in the LOIS.
2. Gentleman – Thedford – Holt 345 kV ("R-Plan") Project was in-service after year end 2019.
3. SPP GEN-2015-023 Generation Interconnection Request was in-service after the in-service of the planned Gentleman – Thedford – Holt 345 kV ("R-Plan") Project.
4. Terminal equipment upgrades for Pahoja-Sioux Falls (identified in the AFS for J426) were not included.

Gentleman – Thedford – Holt ("R-Plan") Project is currently scheduled to be in-service by 10/2019. Should any assumptions or scheduled in service dates change or be delayed, this Affected System Limited Operation Impact Study (AS-LOIS) will be required to be re-evaluated.

Only power flow analysis was conducted for this Affected System Limited Operation Interconnection Study. Limited Operation Studies are conducted under GIA Section 5.9.

The AS-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 within Southwest Power Pool's (SPP) transmission system. Should the Customer require transmission service, those rights should be requested through SPP's Open Access Same-Time Information System (OASIS).

PRIOR-QUEUED REQUESTS

This AS-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 in-service for this AS-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 the AS-LOIS

Project	Studied MW	Total MW	Fuel Source	POI	Status
G132	180	180	Wind	Ellendale Sub 230 kV	IA Fully Executed/Commercial Operation
G164	200	200	Wind	Lakefield Junction 345 kV substation	IA Fully Executed/Commercial Operation
G172	300	300	Wind	Adams Substation	IA Fully Executed/Commercial Operation
G255	100	100	Wind	Yankee Substation	IA Fully Executed/Commercial Operation
G261	667	667	Gas	Wilmarth Substation	IA Fully Executed/Commercial Operation
G263	105	105	Wind	Lakefield Generating Substation	IA Fully Executed/Commercial Operation
G287	200	200	Wind	Nobles County Substation	IA Fully Executed/Commercial Operation
G298	100	100	Wind	Wisdom - Triboji 161 kV	IA Fully Executed/Commercial Operation
G349	200	200	Wind	Brookings County Substation	IA Fully Executed/Commercial Operation
G358	36	36	Wind	Winco - Winnebago 161kV	IA Fully Executed/Commercial Operation
G362	200	200	Wind	Pleasant Valley Substation	IA Fully Executed/Commercial Operation
G370	205	205	Gas	Anson 4	IA Fully Executed/Commercial Operation
G380	150	150	Wind	Rugby 115kV Substation	IA Fully Executed/Commercial Operation
G386	100	100	Wind	Lakefield Substation 345kV	IA Fully Executed/Commercial Operation
G389	200	200	Gas	Elk River 230 kV substation	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
G426	101	101	Wind	Lakefield Junction - Triboji 161kV	IA Fully Executed/Commercial Operation
G514	150	150	Wind	Lakefield Station via Trimont G263 Interconnect	IA Fully Executed/Commercial Operation
G538	50	50	Wind	Lakefield Junction - Triboji 161kV	IA Fully Executed/Commercial Operation
G540	80	80	Wind	Adams - Lime Creek 161 kV	IA Fully Executed/Commercial Operation
G548	80	80	Wind	Barton 161kV Substation	IA Fully Executed/Commercial Operation
G549	20	20	Wind	Next to Williams Substation (69kV)	IA Fully Executed/Commercial Operation
G551	99	99	Wind	Rice 161 kV	IA Fully Executed/Commercial Operation
G573	80	80	Wind	Franklin 161 kV Substation	IA Fully Executed/Commercial Operation
G574	80	80	Wind	Franklin 161 kV Substation	IA Fully Executed/Commercial Operation
G575	40	40	Wind	Franklin 161 kV Substation	IA Fully Executed/Commercial Operation
G586	30	30	Wind	Xcel New Yankee Sub 34.5 kV	IA Fully Executed/Commercial Operation
G595	150	150	Wind	Lime Creek 161 kV Substation	IA Fully Executed/Commercial Operation
G602	32	32	Wind	Nobles County 115 kV Substation	IA Fully Executed/Commercial Operation
G604	44	44	Wind	Owatonna - County Line 69 kV	IA Fully Executed/Commercial Operation
G612	150	150	Wind	ITC Midwest Fernald 115 kV Substation	IA Fully Executed/Commercial Operation
G619	50	50	Wind	GRE Tamarac 41 kV Substation	IA Fully Executed/Commercial Operation
G620	19	19	Wind	Kenyon - Dodge 69 kV	IA Fully Executed/Commercial Operation
G621	20	20	Wind	Rock Tap – South Ridge 69kV	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
G667	13	13	Wind	Round Lake Tap 69kV	IA Fully Executed/Commercial Operation
G685	20	20	Wind	Lake Lillian-Atwater 69kV	IA Fully Executed/Commercial Operation
G735	200	200	Wind	Lime Creek Substation	IA Fully Executed/Commercial Operation
G736	200	200	Wind	Big Stone South 230kV Substation	IA Fully Executed/Commercial Operation
G741	8	8	Waste Heat	Alliant 69kV	IA Fully Executed/Commercial Operation
G752	150	150	Wind	Bison-Hettinger 230kV	IA Fully Executed/Commercial Operation
G788	49	49	Wind	Ladish 115kV	IA Fully Executed/Commercial Operation
G798	150	150	Wind	Fernald 115kV Substation	IA Fully Executed/Commercial Operation
G826	200	200	Wind	Lakefield Generation SW – Lakefield Junction 345kV	IA Fully Executed/Commercial Operation
G830	99	99	Wind	McHenry 115kV Substation	IA Fully Executed/Commercial Operation
G858	38	38	Wind	Black Oak 69 kV Substation	IA Fully Executed/Commercial Operation
G870	201	201	Wind	Hayward – Winnebago 161kV	IA Fully Executed/Commercial Operation
G929	60	60	Nuclear	Monticello	IA Fully Executed/Commercial Operation
G930	60	60	Coal	Sherco	IA Fully Executed/Commercial Operation
G947	99	99	Wind	Whispering Willows 161kV Substation	IA Fully Executed/Commercial Operation
G971	20	20	Wind	Cosmos Township 69kV	IA Fully Executed/Commercial Operation
G997	50	50	Wind	Minden Substation	IA Fully Executed/Commercial Operation
H007	41	41	Wind	Edgewood 69kV	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
H008	36	36	Wind	Richfield 69kV Substation	IA Fully Executed/Commercial Operation
H009	150	150	Wind	Traer – Marshalltown 161kV	IA Fully Executed/Commercial Operation
H021	138.6	138.6	Wind	Wellsburg 115kV Substation	IA Fully Executed/Commercial Operation
H071	40	40	Wind	Black Oak 69 kV Substation	IA Fully Executed/Commercial Operation
H078	121	121	Wind	New Sub in Laurel,IA	IA Fully Executed/Commercial Operation
H081	201	201	Wind	Brookings County – Lyon County 345kV	IA Fully Executed/Commercial Operation
H092	60	60	Coal	Boswell	IA Fully Executed/Commercial Operation
H096	50	50	Wind	Grand Junction – Perry 161kV	IA Fully Executed/Commercial Operation
J020	20	20	Diesel	SE corner of Hwy 12 & CR 17 E of Crow River	IA Fully Executed/Commercial Operation
J021	40	40	Diesel	305 11th St. E. & 1019 Armstrongs Ave. N.	IA Fully Executed/Commercial Operation
J075	150	150	Wind	Bauer - Rapson 345 kV	IA Fully Executed/Commercial Operation
J091	66	66	Wind	Lime Creek 161kV substation	IA Fully Executed/Commercial Operation
J110	7.5	7.5	Biomass	Glen Ullin	IA Fully Executed/Commercial Operation
J112	4.95	4.95	Wind	DPC Utica – Lewiston 69kV	IA Fully Executed/Commercial Operation
J161	155	155	Wind	Bauer - Rapson 345 kV	IA Fully Executed/Commercial Operation
J171	12	12	Biomass	Benson 115kV Substation	IA Fully Executed/Commercial Operation
J183	200	200	Wind	Split Rock Substation	IA Fully Executed/Commercial Operation
J191	101.2	101.2	Wind	Rolling Hills 345kV Substation	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
J200	75	75	Gas	RM Heskett Station 115kV & 41.6kV	IA Fully Executed/Commercial Operation
J201	20	20	Wind	Manning 138kV Substation	IA Fully Executed/Commercial Operation
J202	101	101	Wind	Atlanta - Tuscola 115 kV	IA Fully Executed/Commercial Operation
J226	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J227	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J228	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J229	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J230	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J231	70	70	Hydro	Ludington Substation	IA Fully Executed/Commercial Operation
J232	35	35	Coal	Baldwin Station	IA Fully Executed/Commercial Operation
J233	635	635	CC	Marshalltown 161kV	IA Fully Executed/Commercial Operation
J235	110	110	Wind	Bauer - Rapson 345 kV	IA Fully Executed/Commercial Operation
J238	725	725	Gas	Eagle Valley 138kV Substation	IA Fully Executed/Commercial Operation
J241	3.7	3.7	Hydro	Twin Falls Substation	IA Fully Executed/Commercial Operation
J249	180	180	Wind	MDU Tatanka Substation	IA Fully Executed/Commercial Operation
J256	8	8	Gas	NIPSCO Plymouth 69kV	IA Fully Executed/Commercial Operation
J262	100	100	Wind	Jamestown 345/115 kV substation	IA Fully Executed/Commercial Operation
J263	100	100	Wind	Jamestown 345/115 kV substation	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
J274	100	100	Wind	Tap Winterset – Creston 161kV	IA Fully Executed/Commercial Operation
J278	200	200	Wind	Pleasant Valley 161kV	IA Fully Executed/Commercial Operation
J279	(Uprate) 30	(Uprate) 30	Coal	Raun 345kV	IA Fully Executed/Commercial Operation
J285	250	250	Wind	Proposed O'Brien 345 kV Sub	IA Fully Executed/Commercial Operation
J289	20	20	Wind	161 kV substation on Winterset Junction to Creston 161 kV line	IA Fully Executed/Commercial Operation
J290	150	150	Wind	Tap Rugby – Glenboro 230kV	IA Fully Executed/Commercial Operation
J299	73	73	Gas	Wilmarth Substation	IA Fully Executed/Commercial Operation
J316	150	150	Wind	MDU Tatanka – Ellendale line	IA Fully Executed/Commercial Operation
J320	55	55	Gas	High Bridge 115 kV Sub	IA Fully Executed/Commercial Operation
J329	55	55	Hydro	Pella West 69 kV Substation	IA Fully Executed/Commercial Operation
J343	150	150	Wind	161 kV substation on Creston – Clarinda 161 kV line	IA Fully Executed/Commercial Operation
J344	169	169	Wind	161 kV substation on Poweshiek – Oskaloosa 161 kV line	IA Fully Executed/Commercial Operation
J382	48.3	48.3	Gas	Christiana Switching Station	IA Fully Executed/Commercial Operation
J385	100 (100 NRIS)	100 (100 NRIS)	Solar	Chisago 115kV Substation	IA Fully Executed/Commercial Operation
J391	50	50	Gas	MMU's N 7th Street substation	IA Fully Executed/Commercial Operation
J400	62.5	62.5	Solar	Lyon County 115kV Substation	IA Fully Executed/Commercial Operation
J405	40 (18.2 NRIS)	40 (18.2 NRIS)	Gas	MDU's existing Lewis & Clark Jct. 115kV Substation	IA Fully Executed/Commercial Operation
J407	200	200	Wind	Glenworth 161 kV substation	IA Fully Executed/Commercial

Project	Studied MW	Total MW	Fuel Source	POI	Status
					Operation
J411	300	300	Wind	LeHigh - Raun 345 kV Line	IA Fully Executed/Commercial Operation
J416	200	200	Wind	Emery - Blackhawk 345 kV Line	IA Fully Executed/Commercial Operation
J431	100	100	Wind	Goodland 138 / 69 kV substation	IA Fully Executed/Commercial Operation
MPC01200	98.9	98.9	Wind	Pomeroy Generating Station	IA Fully Executed/Commercial Operation for 54.9MW. IA Pending for remaining 44MW
MPC02100	99.3	99.3	Wind	R34 Expansion	IA Fully Executed/Commercial Operation
R15	80	80	Wind	Pomeroy 161 kV substation	IA Fully Executed/Commercial Operation
R23	100	100	Wind	Monona - Carroll 161 kV	IA Fully Executed/Commercial Operation
R26	146	146	Wind	MEC Cooper - Booneville 345 kV	IA Fully Executed/Commercial Operation
R34	250	250	Wind	Council Bluffs - Madison County 345 kV	IA Fully Executed/Commercial Operation
R35	80	80	Wind	Pomeroy Wind Farm Site	IA Fully Executed/Commercial Operation
R38	200	200	Wind	MEC Council Bluffs - Grimes 345 kV	IA Fully Executed/Commercial Operation
R39	500	500	Wind	Raun - Lakefield Junction	IA Fully Executed/Commercial Operation
R41	100	100	Wind	MEC Council Bluffs - Grimes 345 kV	IA Fully Executed/Commercial Operation
R42	250	250	Wind	Lehigh 345kV Substation	IA Fully Executed/Commercial Operation
R49	12	12	Wind	Pomeroy Generating Station	IA Fully Executed/Commercial Operation
R65	92	92	Wind	R34 Expansion	IA Fully Executed/Commercial Operation
GEN-2002-009IS (GI-0209)	40.5	40.5	Wind	Proposed O'Brien 345 kV Sub	IA Fully Executed/Commercial Operation

Project	Studied MW	Total MW	Fuel Source	POI	Status
GEN-2003-021N	75	75	Wind	161 kV substation on Winterset Junction to Creston 161 kV line	IA Fully Executed/Commercial Operation
GEN-2004-023N	75	75	Coal	MDU Tatanka – Ellendale line	IA Fully Executed/Commercial Operation
GEN-2005-008IS (GI-0508)	49.5	49.5	Wind	High Bridge 115 kV Sub	IA Fully Executed/Commercial Operation
GEN-2006-015IS (GI-0615)	49.5	49.5	Wind	Pella West 69 kV Substation	IA Fully Executed/Commercial Operation
GEN-2006-020N	42	42	Wind	161 kV substation on Creston – Clarinda 161 kV line	IA Fully Executed/Commercial Operation
GEN-2006-037N1	75	75	Wind	161 kV substation on Poweshiek – Oskaloosa 161 kV line	IA Fully Executed/Commercial Operation
GEN-2006-038N005	80	80	Wind	Christiana Switching Station	IA Fully Executed/Commercial Operation
GEN-2006-038N019	80	80	Wind	Petersburg North 115kV	IA Fully Executed/Commercial Operation
GEN-2006-044N	40.5	40.5	Wind	North Petersburg 115kV	IA Fully Executed/Commercial Operation
GEN-2007-011N08	81	81	Wind	Bloomfield 115kV	IA Fully Executed/Commercial Operation
GEN-2007-013IS (GI-0713)	50	50	Wind	Wessington Springs 230kV	IA Fully Executed/Commercial Operation
GEN-2007-014IS (GI-0714)	100	100	Wind	Wessington Springs 230kV	IA Fully Executed/Commercial Operation
GEN-2007-015IS (GI-0715)	100	100	Wind	Hilken 230kV	IA Fully Executed/Commercial Operation
GEN-2007-017IS (GI-0717)	166	166	Wind	Ft. Thompson-Grand Island 345kV	IA Fully Executed/On Schedule
GEN-2007-018IS (GI-0718)	234	234	Wind	Ft. Thompson-Grand Island 345kV	IA Fully Executed/On Schedule
GEN-2007-023IS (GI-0723)	49.5	49.5	Wind	Formit-Summit 115kV	IA Fully Executed/On Suspension
GEN-2007-027IS (GI-0727)	99	99	Wind	Bismarck-Garrison 230kV #1	IA Fully Executed/On Suspension
GEN-2008-086N02	201	201	Wind	Meadow Grove 230kV	IA Fully Executed/Commercial Operation
GEN-2008-119O	60	60	Wind	S1399 161kV	IA Fully Executed/Commercial Operation
GEN-2008-123N	89.7	89.7	Wind	Tap Pauline-Hildreth (Rosemont)	IA Fully Executed/On

Project	Studied MW	Total MW	Fuel Source	POI	Status
				115kV	Schedule for 2017
GEN-2008-129	80	80	CT	Pleasant Hill 161kV	IA Fully Executed/Commercial Operation
GEN-2009-001IS (GI-0901)	200	200	Wind	Groton-Watertown 345kV	IA Fully Executed/On Schedule
GEN-2009-018IS (GI-0918)	100	100	Wind	Groton 115kV	IA Fully Executed/Commercial Operation
GEN-2009-026IS (GI-0926)	106.5	106.5	Wind	Dickinson-Heskett 230kV	IA Fully Executed/On Schedule
GEN-2009-040	73.8	73.8	Wind	Tap Smittyville-Knob Hill 115kV	IA Fully Executed/Commercial Operation
GEN-2010-001IS (GI-1001)	99	99	Wind	Bismarck-Glenham 230kV	IA Fully Executed/On Schedule
GEN-2010-003IS (GI-1003)	34	34	Wind	Wessington Springs 230kV	IA Fully Executed/Commercial Operation
GEN-2010-007IS (GI-1007)	172.5	172.5	Wind	Antelope 345kV	IA Fully Executed/On Suspension
GEN-2010-036	4.6	4.6	Hydro	6th Street 115kV	IA Fully Executed/Commercial Operation
GEN-2010-041	10.5	10.5	Wind	S1399 161kV	IA Fully Executed/On Schedule
GEN-2010-051	200	200	Wind	Tap Twin Church-Hoskins 230kV	IA Fully Executed/On Schedule for 2018
GEN-2011-011	50	50	Coal	Iatan 345kV	IA Fully Executed/Commercial Operation
GEN-2011-018	73.6	73.6	Wind	Steele City 115kV	IA Fully Executed/Commercial Operation
GEN-2011-027	120	120	Wind	Tap Twin Church-Hoskins 230kV	IA Fully Executed/On Schedule for 2018
GEN-2011-056	3.6	3.6	Hydro	Jeffrey 115kV	IA Fully Executed/Commercial Operation
GEN-2011-056A	3.6	3.6	Hydro	John 1 115kV	IA Fully Executed/Commercial Operation
GEN-2011-056B	4.5	4.5	Hydro	John 2 115kV	IA Fully Executed/Commercial Operation
GEN-2012-006IS (GI-1206)	141	141	Gas	Williston-Charlie Creek 230kV	IA Fully Executed/On Schedule
GEN-2012-012IS (GI-1212)	75	75	Wind	Wolf Point-Circle 115kV	On Suspension
GEN-2012-014IS (GI-1214)	99	99	Wind	Groton 115kV	IA Fully Executed/On Schedule
GEN-2012-021	4.8	4.8	Gas	Terry Bundy Generating Station 115kV	IA Fully Executed/Commercial Operation

Project	Studied MW	Total MW	Fuel Source	POI	Status
GEN-2013-001IS (GI-1301)	90	90	Wind	Summit-Watertown 115kV	IA Fully Executed/On Suspension
GEN-2013-002	50.6	50.6	Wind	Tap Sheldon-Folsom & Pleasant Hill 115kV CKT 2	IA Fully Executed/On Suspension
GEN-2013-008	1.2	1.2	Wind	Steele City 115kV (GEN-2011-018 POI)	IA Fully Executed/Commercial Operation
GEN-2013-009IS (GI-1309)	19.5	19.5	Wind	Redfield 69kV	IA Fully Executed/Commercial Operation
GEN-2013-019	73.6	73.6	Wind	Tap Sheldon-Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	IA Fully Executed/On Suspension
GEN-2013-032	204	204	Wind	Antelope 115kV	IA Fully Executed/On Schedule for 2017
GEN-2014-001IS (GI-1401)	103	103	Wind	Newell-Maurine 115kV	IA Fully Executed/On Suspension
GEN-2014-003IS (GI-1403)	91	91	Wind	Culbertson 115kV	IA Fully Executed/On Schedule
GEN-2014-004	4	4	Wind	Steele City 115kV (GEN-2011-018 POI)	IA Fully Executed/Commercial Operation
GEN-2014-004IS (GI-1404)	384.2	384.2	Wind	Charlie Creek 345kV	IA Pending
GEN-2014-006IS (GI-1406)	113.28	113.28	Gas	Williston 115kV	IA Fully Executed/On Schedule for 2016
GEN-2014-010IS (GI-1410)	150	150	Wind	Neset 115kV	IA Fully Executed/On Schedule for 2016
GEN-2014-013	73.5	73.5	Wind	Meadow Grove (GEN-2008-086N2 Sub) 230kV	IA Fully Executed/Commercial Operation
GEN-2014-014IS (GI-1414)	149.73	149.73	Wind	Belfield-Rhame 230kV	IA Fully Executed/On Schedule for 2016
GEN-2014-021	300	300	Wind	Nebraska City - Mullin Creek 345kV	IA Fully Executed/On Schedule for 2017
GEN-2014-031	35.8	35.8	Wind	Meadow Grove 230kV	IA Fully Executed/Commercial Operation
GEN-2014-032	10.2	10.2	Wind	Meadow Grove 230kV	IA Fully Executed/ Commercial Operation
GEN-2014-039	73.4	73.4	Wind	Friend 115kV	IA Fully Executed/On Schedule for 2017
GEN-2015-005	200.1	200.1	Wind	Nebraska City – Sibley 345kV	IA Fully Executed/Commercial Operation
GEN-2015-007	160	160	Wind	Hoskins 345kV	IA Fully Executed/On Schedule for 2019
J426	100	100	Wind	Chanarambie substation 35.4 kV	IA Fully Executed/On Schedule for 2017

This AS-LOIS was required because the Affected System Interconnection Customer is requesting interconnection prior to the completion of all of higher queued assigned required upgrades listed within the latest iteration of SPP Affected System Impact Study for MISO DPP-2015-FEB-West. **TABLE 2** lists the required upgrade projects for which these requests have impacts. J426 was included in SPP Affected System Impact Study for MISO DPP-2015-FEB-West that was studied in July 2016.

Table 2: Upgrade Projects Not Included but Required for Full Interconnection Service

Upgrade Project	Type	Description	Status	Study Assignment
Gentleman – Thedford – Holt County 345kV ("R-Plan") Project	New line, transformer, and substation	Build approximately two hundred twenty seven (227) miles of new 345kV from Gentleman – Holt County. Install Thedford 345/115/13kV transformer, and built Holt County Substation	New ISD scheduled for 10/1/2019	2012 SPP Integrated Transmission Plan – 10 Year Assessment (ITP10)
Pahoja – Sioux Falls 230kV CKT 1	Terminal Equipment	Replace terminal equipment	Facility Study Stage	DPP-2015-FEB-West

The higher or equally-queued projects that were not included within certain seasons 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 AS-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 in Certain Seasons and Scenarios within Affected System LOIS

Project	MW	Total MW	Fuel Source	POI	Status
GEN-2015-023	300.7	300.7	Wind	Holt County 345kV Substation	IA Fully Executed/On Schedule for 2019

FACILITIES

GENERATING FACILITY

The Generation Facility is proposed to consist of one-hundred fifty (50) 2.0 MW Vestas V110 wind generators for a total generating nameplate capacity of 100 MW. The original in-service date was 09/01/2016.

INTERCONNECTION FACILITIES

The POI for J426 is through Xcel's Chanarambie 34.5 kV substation in Pipestone County, Minnesota. **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: J426 Power Flow Model

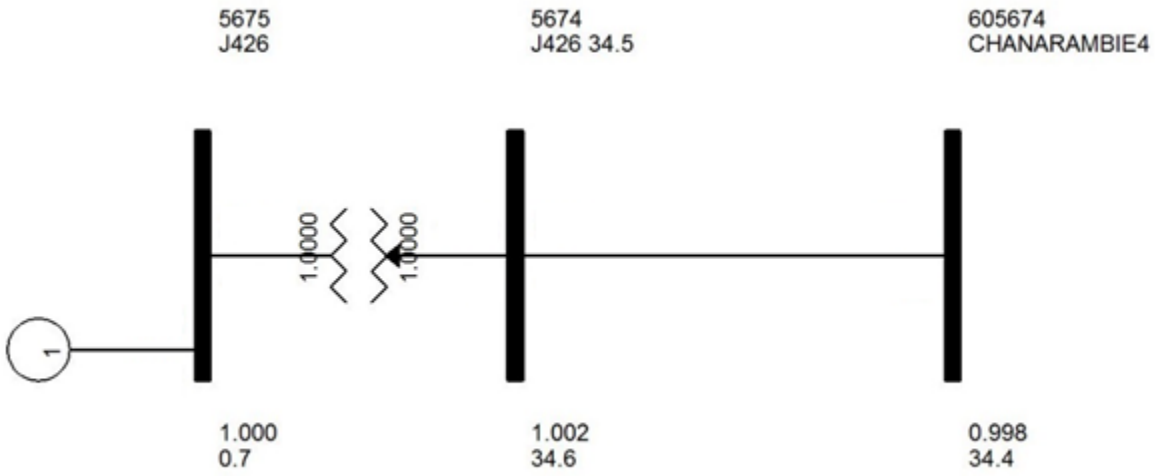

Figure 2: Proposed POI Configuration and Request Power Flow Model

BASE CASE NETWORK UPGRADES

The Network Upgrades included within the cases used for this Affected System LOIS study are those facilities that are a part of the SPP Transmission Expansion Plan, Balanced Portfolio, or Integrated System (IS) Integration Study projects that have in-service dates prior to the customer's requested in-service date. 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 AS-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 series of 2016 ITP Near-Term study models including these seasonal models:

- Year 1 (2016) Winter Peak (16WP)
- Year 2 (2017) Spring (17G)
- Year 2 (2017) Summer Peak (17SP)
- Year 5 (2020) Light (20L)
- Year 5 (2020) Summer (SP)
- Year 5 (2020) Winter (WP) peak

To incorporate the Interconnection Customers' request, a re-dispatch of existing generation within SPP and MISO was performed with respect to the amount of the Customers' injection.

For Variable Energy Resources (VER) (solar/wind) in each power flow case, Energy Resource Interconnection Service (ERIS), is evaluated for the generating plants within a geographical area of the interconnection request(s) for the VERs dispatched at 100% nameplate of maximum generation. The VERs in the remote areas is dispatched at 20% nameplate of maximum generation. SPP projects are dispatched across the SPP footprint using load factor ratios. MISO projects are dispatched across the SPP footprint using load factor ratios.

Peaking units are not dispatched in the Year 2 spring and Year 5 light, or in the "High VER" summer and winter peaks. To study peaking units' impacts, the Year 1 winter peak, Year 2 summer peak, and Year 5 summer and winter peaks, models are developed with peaking units dispatched at 100% of the nameplate rating and VERs dispatched at 20% of the nameplate rating. Each interconnection request is also modeled separately at 100% nameplate for certain analyses.

All SPP generators (VER and peaking) that requested Network Resource Interconnection Service (NRIS) are dispatched in an additional analysis into the interconnecting Transmission Owner's (T.O.) area at 100% nameplate with Energy Resource Interconnection Service (ERIS) only requests at 80% nameplate. All MISO generators (VER and peaking) that requested Network Resource Interconnection Service (NRIS) are dispatched based on their respective NRIS amounts in an additional analysis into the MISO transmission system. This method allows for identification of network constraints that are common between regional groupings to have affecting requests share the mitigating upgrade costs throughout the cluster.

For this LOIS, only the previously queued requests listed in **TABLE 1** were assumed to be in-service at 100% dispatch.

STUDY METHODOLOGY AND CRITERIA

THERMAL OVERLOADS

Network constraints are found by using PSS/E AC Contingency Calculation (ACCC) analysis with PSS/E MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels previously mentioned.

For Energy Resource Interconnection Service (ERIS), thermal overloads are determined for system intact (n-0) (greater than 100% of Rate A - normal) and for contingency (n-1) (greater than 100% of Rate B – emergency) conditions.

The overloads are then screened to determine which generator interconnection requests have at least:

- 3% Distribution Factor (DF) for system intact conditions (n-0),
- 20% DF upon outage based conditions (n-1), or
- 3% DF on contingent elements that resulted in a non-converged solution.

Interconnection Requests that requested Network Resource Interconnection Service (NRIS) are also studied in a separate NRIS analysis to determine if any constraint measured greater than or equal to a 3% DF. If so, these constraints are also considered for transmission reinforcement under NRIS.
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 monitored 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.

Notwithstanding, should any facility be identified by MISO using MISO Constraint Identification Criteria as being affected by a study request, such as “Outlet” constraints or other specific criteria, review and mitigation of those constraints may also be required.

The SPP Permanent List of Flowgates are included within SPP Planning studies and can be reviewed on the SPP OASIS website. The direct link to the current Permanent Flowgate list is as follows:
https://www.oasis.oati.com/SWPP/SWPPdocs/Permanent_flowgates.xls

VOLTAGE

For non-converged power flow solutions that are determined to be caused by lack of voltage support, appropriate transmission support will be determined to mitigate the constraint.

After all thermal overload and voltage support mitigations are determined; a full ACCC analysis is then performed to determine voltage constraints. The following voltage performance guidelines are used in accordance with the Transmission Owner local planning criteria.

SPP Areas (69kV+):

Transmission Owner	Voltage Criteria (System Intact)	Voltage Criteria (Contingency)
AEPW	0.95 – 1.05 pu	0.92 – 1.05 pu

GRDA	0.95 – 1.05 pu	0.90 – 1.05 pu
SWPA	0.95 – 1.05 pu	0.90 – 1.05 pu
OKGE	0.95 – 1.05 pu	0.90 – 1.05 pu
OMPA	0.95 – 1.05 pu	0.90 – 1.05 pu
WFEC	0.95 – 1.05 pu	0.90 – 1.05 pu
SWPS	0.95 – 1.05 pu	0.90 – 1.05 pu
MIDW	0.95 – 1.05 pu	0.90 – 1.05 pu
SUNC	0.95 – 1.05 pu	0.90 – 1.05 pu
KCPL	0.95 – 1.05 pu	0.90 – 1.05 pu
INDN	0.95 – 1.05 pu	0.90 – 1.05 pu
SPRM	0.95 – 1.05 pu	0.90 – 1.05 pu
NPPD	0.95 – 1.05 pu	0.90 – 1.05 pu
WAPA	0.95 – 1.05 pu	0.90 – 1.05 pu
WERE L-V	0.95 – 1.05 pu	0.93 – 1.05 pu
WERE H-V	0.95 – 1.05 pu	0.95 – 1.05 pu
EMDE L-V	0.95 – 1.05 pu	0.90 – 1.05 pu
EMDE H-V	0.95 – 1.05 pu	0.92 – 1.05 pu
LES	0.95 – 1.05 pu	0.90 – 1.05 pu
OPPD	0.95 – 1.05 pu	0.90 – 1.05 pu

SPP Buses with more stringent voltage criteria:

Bus Name/Number	**Voltage Criteria (System Intact)**	**Voltage Criteria (Contingency)**
TUCO 230kV 525830	0.925 – 1.05 pu	0.925 – 1.05 pu
Wolf Creek 345kV 532797	0.985 – 1.03 pu	0.985 – 1.03 pu
FCS 646251	1.001 – 1.047 pu	1.001 – 1.047 pu

Affected System Areas (115kV+):

Transmission Owner	**Voltage Criteria (System Intact)**	**Voltage Criteria (Contingency)**
EES-EAI	0.95 – 1.05 pu	0.90 – 1.05 pu
LAGN	0.95 – 1.05 pu	0.90 – 1.05 pu
EES	0.95 – 1.05 pu	0.90 – 1.05 pu
AMMO	0.95 – 1.05 pu	0.90 – 1.05 pu
CLEC	0.95 – 1.05 pu	0.90 – 1.05 pu
LAFA	0.95 – 1.05 pu	0.90 – 1.05 pu
LEPA	0.95 – 1.05 pu	0.90 – 1.05 pu
XEL	0.95 – 1.05 pu	0.90 – 1.05 pu
MP	0.95 – 1.05 pu	0.90 – 1.05 pu
SMMPA	0.95 – 1.05 pu	0.90 – 1.05 pu
GRE	0.95 – 1.05 pu	0.90 – 1.10 pu
OTP	0.95 – 1.05 pu	0.90 – 1.05 pu
OTP-H (115kV+)	0.97 – 1.05 pu	0.92 – 1.10 pu
ALTW	0.95 – 1.05 pu	0.90 – 1.05 pu
MEC	0.95 – 1.05 pu	0.90 – 1.05 pu

MDU	0.95 – 1.05 pu	0.90 – 1.05 pu
SPC	0.95 – 1.05 pu	0.95 – 1.05 pu
DPC	0.95 – 1.05 pu	0.90 – 1.05 pu
ALTE	0.95 – 1.05 pu	0.90 – 1.05 pu

The constraints identified through the voltage scan are then screened for the following for each interconnection request. 1) 3% DF on the contingent element and 2) 2% change in pu voltage. In certain conditions, engineering judgement was used to determine whether or not a generator had impacts to voltage constraints.

RESULTS

The LOIS ACCC analysis indicates that the Affected System Interconnection Customer can interconnect its generation into the MISO transmission system at **100 MW ERIS** and **41 MW NRIS** before all required upgrades listed within the SPP Affected System Impact Study for MISO DPP-2015-FEB-West 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.

The Interconnection Customer requested an additional LOIS analysis in the event Pahoja – Sioux Falls 230kV terminal equipment is upgrade but the remaining projects in **TABLE 2** are not completed J426's in-service. Based on this additional analysis with the Pahoja – Sioux Falls 230kv terminal equipment upgrade in-service, J426 request can interconnect **100 MW ERIS** and **100MW NRIS** prior to the completion of the remaining required Network Upgrades, listed within **TABLE 2.**

ACCC results for the LOIS can be found in **TABLE 4** and **TABLE 5** Power flow analysis results assume system conditions as of 1st Quarter of 2019 without GEN-2015-023 and without advancing in-service for Network Upgrade(s) mentioned in **TABLE 2**.

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, the Customer may be required by the Transmission Provider 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 Transmission Reinforcement Mitigation J426 ERIS @ 100 MW and NRIS @ 41 MW without GEN-2015-023 as of 1st Quarter 2019

Season	Dispatch Group	Source	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
17SP	00NR	J426	TO->FROM	PAHOJA - SIOUX FALLS 230KV CKT 1	341.8	341.8	0.04514	101.1	**41**	SIOUXCY - SPLIT ROCK 345KV CKT 1

Table 5: Interconnection Constraints for Transmission Reinforcement Mitigation J426 ERIS @ 100 MW and NRIS @ 100 MW Pahoja – Sioux Falls 230kV upgrade in-service and without GEN-2015-023 as of 1st Quarter 2019

Season	Dispatch Group	Source	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
				Currently none						

STABILITY ANALYSIS

Transient stability analysis was not performed for this AS-LOIS study. The results from DISIS 2016-001 remain valid.

CONCLUSION

Power-flow analysis from this Affected System LOIS has determined that the J426 request can interconnect **100 MW ERIS** and **41MW NRIS** prior to the completion of the required Network Upgrades, listed within **TABLE 2** of this report, provided that the Network Upgrades are able to be placed in service should GEN-2015-023 and J426 both be in-service. 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 affected system limited operation service is available.

The Interconnection Customer requested an additional LOIS analysis in the event Pahoja – Sioux Falls 230kV terminal equipment is upgrade but the remaining projects in **TABLE 2** are not completed before J426's in-service date. Based on this additional analysis with the Pahoja – Sioux Falls 230kv terminal equipment upgrade in-service, J426 request can interconnect **100 MW ERIS** and **100MW NRIS** prior to the completion of the remaining required Network Upgrades, listed within **TABLE 2.**

Although this Affected System LOIS analyzed many of the most probable contingencies, it cannot account for every operational situation. Additionally, the generator may not be able to inject any power into the Transmission System due to constraints that fall below the threshold of mitigation for a Generator Interconnection request. Because of this, the Customer may be required by the Transmission Provider 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 and short circuit analysis were not performed for this LOIS study.

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 study should be construed as a guarantee of delivery or transmission service within Southwest Power Pool's (SPP) transmission system. 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.