GEN-2017-179

Interim Availability Interconnection System Impact Study

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By Generator Interconnection

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
July 2019	Generator Interconnection		Initial Posting

CONTENTS

EXECUTIVE SUMMARY

The GEN-2017-179 Interconnection Customer has requested an Interim Availability Interconnection System Impact Study (IAISIS) under Section 11A of Attachment V (Generator Interconnection Procedures - GIP) to the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2017-179 has requested that 222 MW of wind generation be interconnected with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) into the transmission system of Westar Energy, Inc. (WERE) in Sedgwick County, Kansas. GEN-2017-179 has requested this IAISIS to determine the impacts of interconnecting to the transmission system before the DISIS-2017-002 is completed.

This IAISIS addresses the effects of interconnecting the generator to the rest of the transmission system for the system topology and conditions as expected on December 1, 2020. GEN-2017-179 is requesting the interconnection of one-hundred eleven (111) GE 2.0 MW wind turbines and associated facilities interconnecting at the existing Gordon Evans 138 kV substation. For this IAISIS, power flow, stability and short circuit analyses were conducted. This IAISIS assumes only the higher queued projects listed within **Table 1 and Appendix E** and the Network Upgrades listed in **Appendix F** 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 IAISIS may need to be restudied to ensure that interconnection service remains for the customer's request.

Power flow and stability analysis from this IAISIS has determined that **GEN-2017-179** cannot interconnect 222 MW of wind generation with Energy Resource Interconnection Service (ERIS) or Network Resource Interconnection Service (NRIS) on December 1, 2020. The analysis determined that there will be 0MW of available interim capacity.

In accordance with FERC Order 827 GEN-2017-179 would be required to provide dynamic reactive power within the power factor range of 0.95 leading (absorbing Vars from the network) to 0.95 lagging (providing Vars to the network) at continuous rated power output at the high side of the generator substation. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

PURPOSE

GEN-2017-179 (Interconnection Customer) has requested an Interim Availability Interconnection System Impact Study (IAISIS) under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) for interconnection request into the integrated transmission system of Westar Energy, Inc. (WERE).

The purpose of this study is to evaluate the impacts of interconnecting GEN-2017-179 request with a total of 222 MW comprised of one-hundred eleven (111) GE 2.0 MW wind turbines and associated facilities interconnecting at the existing Gordon Evans 138 kV substation in Sedgwick County, Kansas. The Interconnection Customer has requested this amount to be studied with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) to commence on or around December 2020.

Power flow, transient stability, and short circuit analyses were conducted for this IAISIS in accordance with GIA Section 11A.

The IAISIS considers the Base Case as well as all Generating Facilities (and with respect to (c) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the IAISIS 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(s) to interconnect to the Transmission System listed in **Table 1 and Appendix E** and any identified Network Upgrades associated with such higher queued interconnection listed in **Appendix F**; 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 executing an interconnection agreement and commencing commercial operation, may require a re-study of this IAISIS 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 IAISIS study included prior queued generation interconnection requests. Those listed within **Table 1 and Appendix E** are the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested December 2020 in-service for this IAISIS. Also listed in **Table 1 and Appendix E** are the Studied Capacity Amount (MW) reflecting the expected amount at the effective time of this study, the Requested Capacity Amount (MW), the fuel type, the point of interconnection (POI), and the current status for each particular prior queued request.

Similar details for prior queued projects that are out of cluster group are available in Appendix A.

Table 1: In Cluster Group Generation Requests Included within IAISIS

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status
ASGI-2014-014	56.4	54.3	Thermal	FERGUSN2 69 kV	On Schedule
GEN-2002-004	199.5	199.5	Wind	Latham 345kV	Commercial Operation
GEN-2005-013	199.8	199.8	Wind	Caney River 345kV	Commercial Operation
GEN-2007-025	299.2	299.2	Wind	Viola 345kV	Commercial Operation
GEN-2008-013	299.04	299.04	Wind	Hunter 345kV	Commercial Operation
GEN-2008-098	99.5	99.5	Wind	Waverly 345kV	Commercial Operation
GEN-2009-025	59.8	59.8	Wind	TAP Deer Creek â€“ Sinclair 69kV	Commercial Operation
GEN-2010-003	99.5	99.5	Wind	Waverly 345kV	Commercial Operation
GEN-2010-005	299.2	299.2	Wind	Viola 345kV	On Schedule
GEN-2010-055	4.5	4.001	Gas	Wekiwa 138kV	Commercial Operation
GEN-2011-057	150	150	Wind	Creswell 138kV	Commercial Operation
GEN-2012-032	300	300	Wind	Rose Hill-(Ranch Road) Sooner (Open Sky) 345kV	Commercial Operation
GEN-2012-033	98.82	98.82	Wind	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	Commercial Operation
GEN-2012-041	121.5	98.001	CT	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	Commercial Operation
GEN-2013-012	147	120.004	Gas	Redbud 345kV	Commercial Operation
GEN-2013-028	552	420	Gas	Tap N Tulsa - GRDA 1 345kV	Commercial Operation
GEN-2013-029	299	299	Wind	Renfrow 345kV	Commercial Operation
GEN-2014-001	200.6	200.6	Wind	Tap Wichita - Emporia Energy Center 345kV	On Schedule
GEN-2014-028	35	28.001	CC	Riverton 161kV	Commercial Operation
GEN-2014-064	248.4	248.4	Wind	Otter 138kV	Commercial Operation

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status
GEN-2015-001	200	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	Commercial Operation
GEN-2015-015	154.56	154.56	Wind	Tap Medford Tap â€“ Coyote 138kV	Commercial Operation
GEN-2015-016	200	200	Wind	Tap Marmaton - Centerville 161kV	On Schedule
GEN-2015-024	220	220	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	Commercial Operation
GEN-2015-025	220	220	Wind	Tap Thistle â€“ Wichita 345kV Dbl CKT	Commercial Operation
GEN-2015-034	200	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	On Schedule
GEN-2015-047	300	300	Wind	Sooner 345kV	Commercial Operation
GEN-2015-052	300	300	Wind	Open Sky-Rose Hill 345kV	On Schedule
GEN-2015-062	4.51	4.51	Wind	Breckinridge 138kV, Bus #514815	On Schedule
GEN-2015-063	300	300	Wind	Woodring-Matthewson 345kV	Commercial Operation
GEN-2015-066	248.4	248.4	Wind	Sooner - Cleveland 345kV	On Suspension
GEN-2015-069	300	300	Wind	Union Ridge 230kV	Commercial Operation
GEN-2015-073	200.1	200.1	Wind	Emporia 345kV	On Schedule
GEN-2015-090	220	220	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	Commercial Operation
GEN-2016-009	29	29	Steam Turbine	Osage 69 kV Sub	On Schedule
GEN-2016-022	151.8	151.8	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA Pending
GEN-2016-031	1.5	1.5	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	Commercial Operation
GEN-2016-032	200	200	Wind	Cottonwood Creek-Marshall Tap 138 kV	On Suspension
GEN-2016-061	250.7	250.7	Wind	Sooner-Woodring 345 kV line	IA Pending
GEN-2016-068	250	250	Wind	Woodring 345kV	IA Pending
GEN-2016-071	200.1	200.1	Wind	Middleton Tap 138kV Substation	IA Pending
GEN-2016-073	220	220	WIND	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA Pending

This IAISIS was requested because the Interconnection Customer anticipates that the required studies will not be complete prior to the requested in-service date. **Table 2** below lists the required upgrade projects for which these requests have cost responsibility. GEN-2017-179 will be included within the DISIS-2017-002. Once posted the report will be located at the following Generation Interconnection Study URL: http://opsportal.spp.org/Studies/GenList?yearTypeId=154

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

Upgrade Project	Type	Description	Status	Study Assignment
Emporia - Wolf Creek 345kV Ckt 1	New Line	New 30.0 mile 345 kV line from Emporia to Wolf Creek. 1561/1793 MVA	IA Pending	DISIS-2016-001

It is important to emphasize that should any previously assigned upgrade become subject to restudy (via withdrawal of a higher queued request), this IAISIS will also be subject to restudy. Again, any changes to these assumptions, for example, one or more of the previously queued requests not included within this study executing an interconnection agreement and commencing commercial operation, may require a re-study of this IAISIS at the expense of the Interconnection Customer.

The higher 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 IAISIS, either because no request for an IAISIS has been made or the request is on suspension, etc.

Table 3: Higher Queued GI Requests not included within IAISIS

Project	MW	Total MW	Fuel Source	POI	Status
All requests queued to DISIS-2016-002 & DISIS-2017-001 were not included.					

Nothing in this System Impact Study constitutes a request for transmission service or grants the Interconnection Customer any rights to transmission service.

FACILITIES

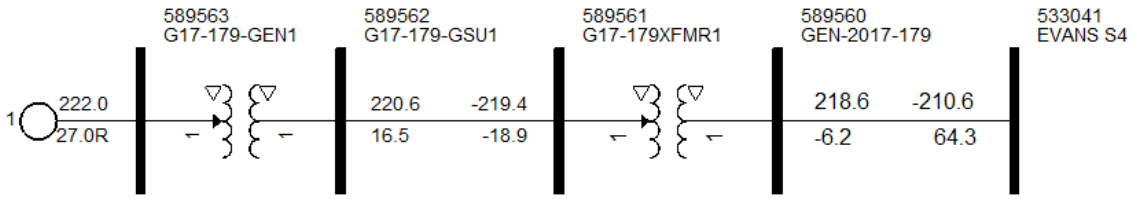
GENERATING FACILITY

The Interconnection Customer's request to interconnect one-hundred eleven (111) GE 2.0 MW wind turbines and associated facilities interconnecting at the existing Gordon Evans 138 kV substation.

INTERCONNECTION FACILITIES

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 cases used for this IAISIS 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 December 1, 2020. 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 IAISIS. 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 2016 series of 2017 ITP Near-Term study models including these seasonal models:

- Year 1 (2017) Winter Peak (17WP)
- Year 2 (2018) Spring (18G)
- Year 2 (2018) Summer Peak (18SP)
- Year 5 (2021) Light (21L)
- Year 5 (2021) Summer Peak (21SP)
- Year 5 (2021) Winter Peak (21WP)
- Year 10 (2026) Summer Peak (26SP)

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

For Variable Energy Resources (VER) (solar/wind) in each power flow case, 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 are dispatched at 20% nameplate of maximum generation. SPP 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, and Year 10 summer peak models are developed with peaking units dispatched at 100% of the nameplate rating and VERs dispatched at 20% of the nameplate rating. Additionally, each interconnection request is modeled separately at 100% nameplate for certain analyses.

All generators (VER and peaking) that requested NRIS are dispatched in an additional analysis into the interconnecting Transmission Owner's (T.O.) area at 100% nameplate with ERIS only requests at 80% nameplate. 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 IAISIS, only the previous 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 or equal to 100% of Rate A - normal) and for contingency (n-1) (greater than or equal to 100% of Rate B – emergency) conditions.

The overloads are then screened to determine which of 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 areas 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.

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)
AECI	0.95 – 1.05 pu	0.90 – 1.05 pu
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 IAISIS ACCC analysis indicates that the Interconnection Customer can not interconnect its generation into the SPP transmission system. ACCC results for the IAISIS can be found in **Table 4**, **Table 5,** and **Table 6**.

Constraints listed in **Table 6** do not require additional transmission reinforcement for Interconnection Service, but could require Interconnection Customer to reduce generation in operational conditions. These transmission constraints occur when this study's generation is dispatched into the SPP footprint for ERIS and AEPW, GRDA, KCPL, OKGE, and WERE footprint for NRIS.

Table 4: Thermal Constraints for Transmission Reinforcement Mitigation

Season	Dispatch Group	Source	Flow	Monitored Element	RATEA (MVA)	RATEB (MVA)	TDF	TC% LOADING	Max MW Available	Contingency
21L	08ALL	G17_179	1250	LACYGNE - WAVERLY7 345.00 345KV CKT 1	1141	1254	0.08584	109.5224	0	System Intact
21L	08NR	G17_179	1255	LACYGNE - WAVERLY7 345.00 345KV CKT 1	1141	1254	0.18597	100.0928	0	CANEYRV7 345.00 - NEOSHO 345KV CKT 1

Table 5: Voltage Constraints for Transmission Reinforcement Mitigation

			N/A						N/A	

Table 6: Thermal Constraints Not Requiring Additional Transmission Reinforcement Mitigation

Available upon request.

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 2016 series of Model Development Working Group (MDWG) dynamic study models including the 2017 winter, 2018 and 2026 summer peak dynamic cases. The cases were adapted to resemble the power flow study cases with regards to prior queued generation requests and topology. Finally, the prior queued and study generation was 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

Twenty-eight (28) contingencies were identified for use in this study. These faults are listed within **Table 7**: Contingencies Evaluated for Interim Service. 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.

With exception to transformers, the typical sequence of events for a three-phase and single-phase fault is as follows:

1. apply fault at particular location
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility
3. after an additional twenty (20) cycles, re-close the previous facility back into the fault
4. continue fault for five (5) additional cycles
5. trip the faulted facility and remove the fault

Transformer faults are typically only performed for three-phase faults, unless otherwise noted. Additionally the sequence of events for a transformer is to 1) apply a three-phase fault for five (5) cycles and 2) clear the fault by tripping the affected transformer facility. Unless otherwise noted there will be no re-closing into a transformer fault.

Table 7: Contingencies Evaluated for Interim Service

Cont. No.	Contingency Name	Description
1	FLT_01_ EVANSS4_ 45THST4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to 45Th St (533074) 138kV Ckt 1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
2	FLT_02_ 45THST4_ COWSKIN4_ 138kV_3PH	3 phase fault on 45Th St (533074) to Cowskin (533038) 138kV Ckt 1, near 45Th St. a. Apply fault at the 45Th St 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
3	FLT_03_ COWSKIN4_ CENTENN4_ 138kV_3PH	3 phase fault on Cowskin (533038) to Centennial (533034) 138kV Ckt 1, near Cowskin. a. Apply fault at the Cowskin 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
4	FLT_04_ CENTENN4_ WACON4_ 138kV_3PH	3 phase fault on Centennial (533034) to Waco N (533073) 138kV Ckt 1, near Centennial. a. Apply fault at the Centennial 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
5	FLT_05_ EVANSS4_ LAKERDG4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to Lakeridge (533053) 138kV Ckt 1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
6	FLT_06_ LAKERDG4_ HOOVERN4_ 138kV_3PH	3 phase fault on Lakeridge (533053) to Hoover North (533049) 138kV Ckt 1, near Lakeridge. a. Apply fault at the Lakeridge 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
7	FLT_07_ HOOVERN4_ HOOVERS4_ 138kV_3PH	3 phase fault on Hoover North (533049) to Hoover South (533050) 138kV Ckt Z1, near Hoover North. a. Apply fault at the Hoover North 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.

Cont. No.	Contingency Name	Description
8	FLT_08_ HOOVERS4_ INTERST4_ 138kV_3PH	3 phase fault on Hoover South (533050) to Interstate (533051) 138kV Ckt 1, near Hoover South. a. Apply fault at the Hoover South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
9	FLT_09_ EVANSS4_ EVANSN4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to Evans Energy Center North (533040) 138kV Ckt Z1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
10	FLT_10_ EVANSN4_ MAIZEW4_ 138kV_3PH	3 phase fault on Evans Energy Center North (533040) to Maize W (533390) 138kV Ckt 1, near Evans Energy Center North. a. Apply fault at the Evans Energy Center North 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
11	FLT_11_ MAIZEW4_ MAIZE4_ 138kV_3PH	3 phase fault on Maize W (533390) to Maize (533054) 138kV Ckt 1, near Maize W. a. Apply fault at the Maize W 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
12	FLT_12_ MAIZE4_ MAIZEE4_ 138kV_3PH	3 phase fault on Maize (533054) to Maize E (533391) 138kV Ckt 1, near Maize. a. Apply fault at the Maize 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
13	FLT_13_ MAIZEE4_ CHISHLM4_ 138kV_3PH	3 phase fault on Maize E (533391) to Chisholm (533035) 138kV Ckt 1, near Maize E. a. Apply fault at the Maize E 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
14	FLT_14_ EVANSN4_ SG12COL4_ 138kV_3PH	3 phase fault on Evans Energy Center North (533040) to Sedgwick County No. 12 Colwich (533065) 138kV Ckt 1, near Evans Energy Center North. a. Apply fault at the Evans Energy Center North 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
15	FLT_15_ SG12COL4_ BENTLEY4_ 138kV_3PH	3 phase fault on Sedgwick County No. 12 Colwich (533065) to Bentley (533015) 138kV Ckt 1, near Sedgwick County No. 12 Colwich. a. Apply fault at the Sedgwick County No. 12 Colwich 138kV bus. b. Clear fault after 5 cycles and trip the faulted line.

Cont. No.	Contingency Name	Description
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
16	FLT_16_ BENTLEY4_ HALSTD4_ 138kV_3PH	3 phase fault on Bentley (533015) to Halstead North Bus (533011) 138kV Ckt 1, near Bentley. a. Apply fault at the Bentley 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
17	FLT_17_ EVANSN4_ WICHITA7_ 138_345kV_ 3PH	3 phase fault on Evans Energy Center North (533040) to Wichita (532796) 138/345kV Ckt 1, near Evans Energy Center North. a. Apply fault at the Evans Energy Center North 138kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
18	FLT_18_ WICHITA7_ VIOLA7_ 345kV_3PH	3 phase fault on Wichita (532796) to Viola (532798) 345kV Ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
19	FLT_19_ WICHITA7_ BUFFALO7_ 345kV_3PH	3 phase fault on Wichita (532796) to Buffalo (532782) 345kV Ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
20	FLT_20_ WICHITA7_ RENO7_ 345kV_3PH	3 phase fault on Wichita (532796) to Reno County (532771) 345kV Ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
21	FLT_21_ WICHITA7_ G14001TAP_ 345kV_3PH	3 phase fault on Wichita (532796) to G14-001-TAP (562476) 345kV Ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
22	FLT_22_ G14001TAP_ EMPEC7_ 345kV_3PH	3 phase fault on G14-001-TAP (562476) to Emporia Energy Center (532768) 345kV Ckt 1, near G14-001-TAP. a. Apply fault at the G14-001-TAP 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.

Cont. No.	Contingency Name	Description
23	FLT_23_ WICHITA7_ BENTON7_ 345kV_3PH	3 phase fault on Wichita (532796) to Benton (532791) 345kV Ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
24	FLT_24_ EVANSS4_ LAKERDG4 SB_ 138kV_1PH	1 phase fault with stuck breaker on Evans Energy Center South (533041) to Lakeridge (533053) 138kV Ckt 1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 16 cycles, trip the faulted line and trip: Evans S (533041) - Evans N (533040) 138kV Ckt Z1
25	FLT_25_ EVANSN4_ MAIZEW4 SB_ 138kV_1PH	1 phase fault with stuck breaker on Evans Energy Center North (533040) to Maize W (533390) 138kV Ckt 1, near Evans Energy Center North. a. Apply fault at the Evans Energy Center North 138kV bus. b. Clear fault after 16 cycles, trip the faulted line and trip: Evans S (533041) - Evans N (533040) 138kV Ckt Z1
26	FLT_26_ WICHITA7_ BUFFALO7 SB_ 345kV_1PH	1 phase fault with stuck breaker on Wichita (532796) to Buffalo (532782) 345kV Ckt 2, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 16 cycles, trip the faulted line and trip: Wichita (532796) - Viola (532798) 345kV Ckt 1
27	FLT_27_ EVANSS4_ LAKERDG4 PO_ 138kV_3PH	Prior Outage with Evans N (533040) - Maize W (533390) 138 kV Ckt 1 out of service,followed by 3 phase fault on Evans Energy Center South (533041) to Lakeridge (533053) 138kV Ckt 1, near Evans Energy Center South. a. Open Evans N (533040) - Maize W (533390) 138 kV Ckt 1 then solve. b. Apply fault at the Evans Energy Center South bus. c. Clear fault after 5 cycles and trip the faulted line. d. Wait 20 cycles, and then re-close the line in (c) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (c) and remove the fault.
28	FLT_28_ WICHITA7_ RENO7 PO_ 345kV_3PH	Prior Outage with G14-001-TAP (562476) - Emporia Energy Center (532768) 345kV Ckt 1 out of service,followed by 3 phase fault on Wichita (532796) to Reno (514785) 345kV Ckt 1, near Wichita. a. Open G14-001-TAP (562476) - Emporia Energy Center (532768) 345kV Ckt 1 then solve. b. Apply fault at the Wichita bus. c. Clear fault after 5 cycles and trip the faulted line. d. Wait 20 cycles, and then re-close the line in (c) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (c) and remove the fault.

RESULTS

Results of the stability analysis are summarized in **Table 8**. These results are valid for GEN-2017-179 interconnecting with a generation amount up to 222 MW. Based on the stability results and with all network upgrades in service, GEN-2017-179 did not cause any stability problems and remained stable for all faults studied. No generators tripped or went unstable, and voltages recovered to acceptable levels.

Complete sets of plots for the stability analysis are available on request.

Table 8: Fault Analysis Results

	Contingency Number and Name	2017WP	2018SP	2026SP
1	FLT_01_EVANSS4_45THST4_138kV_3PH	Stable	Stable	Stable
2	FLT_02_45THST4_COWSKIN4_138kV_3PH	Stable	Stable	Stable
3	FLT_03_COWSKIN4_CENTENN4_138kV_3PH	Stable	Stable	Stable
4	FLT_04_CENTENN4_WACON4_138kV_3PH	Stable	Stable	Stable
5	FLT_05_EVANSS4_LAKERDG4_138kV_3PH	Stable	Stable	Stable
6	FLT_06_LAKERDG4_HOOVERN4_138kV_3PH	Stable	Stable	Stable
7	FLT_07_HOOVERN4_HOOVERS4_138kV_3PH	Stable	Stable	Stable
8	FLT_08_HOOVERS4_INTERST4_138kV_3PH	Stable	Stable	Stable
9	FLT_09_EVANSS4_EVANSN4_138kV_3PH	Stable	Stable	Stable
10	FLT_10_EVANSN4_MAIZEW4_138kV_3PH	Stable	Stable	Stable
11	FLT_11_MAIZEW4_MAIZE4_138kV_3PH	Stable	Stable	Stable
12	FLT_12_MAIZE4_MAIZEE4_138kV_3PH	Stable	Stable	Stable
13	FLT_13_MAIZEE4_CHISHLM4_138kV_3PH	Stable	Stable	Stable
14	FLT_14_EVANSN4_SG12COL4_138kV_3PH	Stable	Stable	Stable
15	FLT_15_SG12COL4_BENTLEY4_138kV_3PH	Stable	Stable	Stable
16	FLT_16_BENTLEY4_HALSTD4_138kV_3PH	Stable	Stable	Stable
17	FLT_17_EVANSN4_WICHITA7_138_345kV_3PH	Stable	Stable	Stable
18	FLT_18_WICHITA7_VIOLA7_345kV_3PH	Stable	Stable	Stable
19	FLT_19_WICHITA7_BUFFALO7_345kV_3PH	Stable	Stable	Stable
20	FLT_20_WICHITA7_RENO7_345kV_3PH	Stable	Stable	Stable
21	FLT_21_WICHITA7_G14001TAP_345kV_3PH	Stable	Stable	Stable
22	FLT_22_G14001TAP_EMPEC7_345kV_3PH	Stable	Stable	Stable
23	FLT_23_WICHITA7_BENTON7_345kV_3PH	Stable	Stable	Stable
24	FLT_24_EVANSS4_LAKERDG4SB_138kV_1PH	Stable	Stable	Stable
25	FLT_25_EVANSN4_MAIZEW4SB_138kV_1PH	Stable	Stable	Stable
26	FLT_26_WICHITA7_BUFFALO7SB_345kV_1PH	Stable	Stable	Stable
27	FLT_27_EVANSS4_LAKERDG4PO_138kV_3PH	Stable	Stable	Stable
28	FLT_28_WICHITA7_RENO7PO_345kV_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.

Fault contingencies were developed to verify that wind farms remain on line when the POI voltage is drawn down to 0.0 pu. These contingencies are shown in Table 9.

Table 9: LVRT Contingencies

Contingency Number and Name		Description
1	FLT_01_ EVANSS4_ 45THST4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to 45Th St (533074) 138kV Ckt 1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
5	FLT_05_ EVANSS4_ LAKERDG4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to Lakeridge (533053) 138kV Ckt 1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
9	FLT_09_ EVANSS4_ EVANSN4_ 138kV_3PH	3 phase fault on Evans Energy Center South (533041) to Evans Energy Center North (533040) 138kV Ckt Z1, near Evans Energy Center South. a. Apply fault at the Evans Energy Center South 138kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.

The required prior queued project wind farms remained online for the fault contingencies described in this section as well as the fault contingencies described in the Disturbances section of this report. GEN-2017-179 is found to be in compliance with FERC Order #661A.

POWER FACTOR ANALYSIS

In accordance with FERC Order 827 GEN-2017-179 will be required to provide dynamic reactive power within the power factor range of 0.95 leading (absorbing Vars from the network) to 0.95 lagging (providing Vars to the network) at continuous rated power output at the high side of the generator substation.

REDUCED WIND GENERATION ANALYSIS

A low wind analysis has been performed for the GEN-2017-179 Interconnection Request. SPP performed this low wind analysis for excessive capacitive charging current for the addition of the Interconnection Request facilities. The high side of the each Interconnection Customer's transformer will interconnect to The Point of Interconnection (POI).

The project generators and capacitors (if any) were turned off in the base case. The resulting reactive power injection into the transmission network comes from the capacitance of the project's transmission lines and collector cables is shown in **Figure C-1** and **Figure C-2**.

Final shunt reactor requirement for each project with the model information provided to SPP is shown in **Table 1**. It is the interconnection customer's responsibility to design and install the reactive compensation equipment necessary to control the reactive power injection at the POI. If an equivalent means of compensation is installed, the reactive power required may vary with system conditions (e.g. a higher compensation amount is required for voltages above unity at the POI and a lower compensation amount is required for voltages below unity at the POI).

Table 10: Summary of Reduced Wind Generation Analysis

Request	Point of Interconnection (POI)	Reactor Size (Mvar)
GEN-2017-179	Gordon Evans 138 kV substation	12.7

SHORT CIRCUIT ANALYSIS

The short circuit analysis was performed on the 2018 & 2026 Summer Peak power flow cases using the PSS/E ASCC program. Since the power flow model does not contain negative and zero sequence data, only three-phase symmetrical fault current levels were calculated at the point of interconnection up to and including five levels away.

Short Circuit Analysis was conducting using flat conditions with the following PSS/E ASCC program settings:

- BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
- GENERATOR P=0, Q=0
- TRANSFORMER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
- LINE CHARGING=0.0 IN +/-/0 SEQUENCE
- LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
- LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
- DC LINES AND FACTS DEVICES BLOCKED
- TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

RESULTS

The results of the short circuit analysis are shown in **Appendix D**: Short Circuit Analysis Results**.**

CONCLUSION

GEN-2017-179 (Interconnection Customer) has requested an Interim Availability Interconnection System Impact Study (IAISIS) under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 222 MW of wind generation to be interconnected with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) into the transmission system of Westar Energy, Inc. (WERE) in Sedgwick County, Kansas. The point of interconnection will be the existing Gordon Evans 138 kV substation. GEN-2017-179 under GIA Section 11A, has requested this Interim Availability Interconnection System Impact Study (IAISIS) to determine the impacts of interconnecting to the transmission system before all required Network Upgrades identified in the DISIS-2016-002 or DISIS-2017-001 Impact Study can be placed into service.

Power flow analysis from this IAISIS has determined that the GEN-2017-179 request cannot interconnect 222 MW of generation with Energy Resource Interconnection Service (ERIS) or Network Resource Interconnection Service (NRIS) prior to the completion of the required Network Upgrades, listed within Table *2* of this report. However, full interconnection service is dependent on all previously assigned upgrades being in-service. Should any higher-queued requests withdraw from study, a restudy may be required. Furthermore, any upgrades assigned to those higher-queued requests would also be subject to restudy, which might trigger a restudy for this request. 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.

Additionally, GEN-2017-179 was found to be in compliance with FERC Order #661A when studied as listed within this report.

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 IAISIS 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.

APPENDICES

APPENDIX A: AFFECTED SYSTEM THERMAL POWER FLOW ANALYSIS (CONSTRAINTS FOR POTENTIAL TRANSMISSION REINFORCEMENT)

None.

APPENDIX B: AFFECTED SYSTEM VOLTAGE POWER FLOW ANALYSIS (CONSTRAINTS FOR POTENTIAL TRANSMISSION REINFORCEMENT)

None.

APPENDIX C: REDUCED WIND GENERATION ANALYSIS RESULTS

Below figures are from the 2017WP model with identified upgrades in-service. The other 2 cases (2018SP and 2026SP) were almost identical since the Interconnection Request facilities design is the same in all cases.

Figure C-1*:* GEN-2017-179 with generators turned off

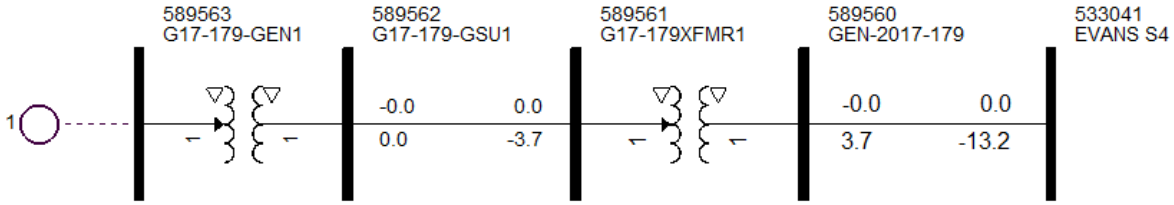
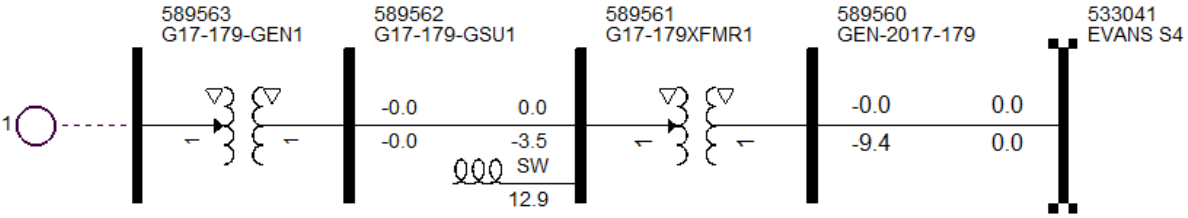


Figure C-2*:* GEN-2017-179 with generators turned off and shunt reactors added to the customer 34.5kV substation



APPENDIX D: SHORT CIRCUIT ANALYSIS RESULTS

18SP

PSS®E ASCC SHORT CIRCUIT CURRENTS THU, JUN 06 2019 11:40
2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2018S WITH MMWG 2017S

OPTIONS USED:
- FLAT CONDITIONS
  - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
  - GENERATOR P=0, Q=0
  - TRANSFOMRER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
  - LINE CHARGING=0.0 IN +/-/0 SEQUENCE
  - LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
  - LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
  - DC LINES AND FACTS DEVICES BLOCKED
  - TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

X---------- BUS ----------X			THREE PHASE FAULT /I+/	AN(I+)
533041	[EVANS S4	138.00] AMP	41023.4	-87.35
533040	[EVANS N4	138.00] AMP	41023.4	-87.35
533053	[LAKERDG4	138.00] AMP	18938.9	-85.63
533074	[45TH ST4	138.00] AMP	27811.9	-85.72
589560	[GEN-2017-179	138.00] AMP	3742.2	-85.05
532796	[WICHITA7	345.00] AMP	24938.9	-86.22
533038	[COWSKIN4	138.00] AMP	19291.1	-84.74
533049	[HOOVERN4	138.00] AMP	18721.6	-85.05
533065	[SG12COL4	138.00] AMP	21231.9	-85.77
533390	[MAIZEW 4	138.00] AMP	27573.4	-85.52
532771	[RENO 7	345.00] AMP	10815.0	-85.68
532782	[BUFFALO7	345.00] AMP	20987.7	-86.36
532791	[BENTON 7	345.00] AMP	19324.2	-85.76
532798	[VIOLA 7	345.00] AMP	13446.0	-85.30
533015	[BENTLEY4	138.00] AMP	10059.9	-85.08
533034	[CENTENN4	138.00] AMP	15994.2	-84.40
533050	[HOOVERS4	138.00] AMP	18721.6	-85.05
533054	[MAIZE 4	138.00] AMP	23250.2	-85.16
533788	[COWSKIN2	69.000] AMP	16483.5	-85.62
533805	[HOOVERN2	69.000] AMP	32375.7	-84.49
562476	[G14-001-TAP	345.00] AMP	11076.8	-85.03
515543	[RENFROW7	345.00] AMP	12510.4	-84.76
532768	[EMPEC 7	345.00] AMP	17639.5	-86.15
532783	[KINGMAN7	345.00] AMP	6856.2	-86.48
532794	[ROSEHIL7	345.00] AMP	18918.0	-85.85

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532797 [WOLFCRK7    345.00] AMP    15158.3   -86.94
532986 [BENTON 4    138.00] AMP    28351.7   -85.83
533011 [HALSTD 4    138.00] AMP     4230.0   -85.34
533016 [WWUPLNT4    138.00] AMP     7720.7   -84.68
533051 [INTERST4    138.00] AMP    17153.1   -84.44
533073 [WACO N 4    138.00] AMP    21796.9   -85.15
533075 [VIOLA  4    138.00] AMP    18421.7   -85.88
533391 [MAIZEE 4    138.00] AMP    21805.9   -84.98
533416 [RENO   3    115.00] AMP    21722.6   -85.70
533806 [HOOVERS2    69.000] AMP    32375.7   -84.49
533849 [VISTAPK2    69.000] AMP    17181.5   -81.72
533854 [WESTLNK2    69.000] AMP    15445.7   -84.76
533855 [WATER1 2    69.000] AMP    24247.6   -82.57
533874 [SG9STMK2    69.000] AMP    16165.9   -85.71
533879 [GODDTAP2    69.000] AMP     8145.7   -79.59
539801 [THISTLE7    345.00] AMP    16145.0   -85.70
583850 [GEN-2014-001345.00] AMP     7560.6   -84.76
587500 [GEN-2016-073345.00] AMP    15345.1   -85.93
587884 [G16-111-TAP 345.00] AMP     9195.0   -85.75
588364 [G16-153-TAP 345.00] AMP     7227.6   -85.60
515375 [WWRDEHV7    345.00] AMP    19279.4   -86.16
515476 [HUNTERS7    345.00] AMP    13083.4   -84.79
515544 [RENFROW4    138.00] AMP    13989.6   -85.04
515646 [GRNTWD 7    345.00] AMP    10995.8   -84.69
532769 [LANG   7    345.00] AMP    17419.3   -86.14
532770 [MORRIS 7    345.00] AMP    12771.5   -85.49
532774 [SWISVAL7    345.00] AMP    16350.9   -85.28
532784 [NINN1WF7    345.00] AMP     5704.5   -86.52
532792 [FR2EAST7    345.00] AMP     6637.5   -85.67
532799 [WAVERLY7    345.00] AMP    14122.7   -86.64
532800 [LATHAMS7    345.00] AMP    10449.2   -85.60
532988 [BELAIRE4    138.00] AMP    18857.1   -84.77
532990 [MIDIAN 4    138.00] AMP    10088.2   -80.45
533013 [MOUND  4    138.00] AMP     4816.9   -84.76
533024 [29TH   4    138.00] AMP    19636.2   -85.10
533035 [CHISHLM4    138.00] AMP    22420.1   -84.78
533036 [CLEARWT4    138.00] AMP    14350.7   -85.31
533044 [GILL E 4    138.00] AMP    25734.5   -85.24
533047 [GILL   4    138.00] AMP    25734.5   -85.24
533062 [ROSEHIL4    138.00] AMP    31358.6   -86.15
533072 [WACO   4    138.00] AMP    21796.9   -85.15
533413 [CIRCLE 3    115.00] AMP    18133.8   -85.14
533415 [DAVIS  3    115.00] AMP     8124.2   -82.44
533429 [MOUNDRG3    115.00] AMP     7032.4   -83.08
533438 [WMCPHER3    115.00] AMP    11677.1   -84.68
533653 [WOLFCRK2    69.000] AMP     5792.7   -87.18
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533736 [HALSTED2    69.000] AMP     5528.6   -85.35
533829 [PLAZA  2    69.000] AMP    27389.3   -82.70
533841 [SHERIDN2    69.000] AMP    22190.6   -82.28
533845 [GALE TP2    69.000] AMP     5320.8   -79.26
533846 [21ST   2    69.000] AMP    16086.3   -81.56
533847 [TYLER  2    69.000] AMP    18957.5   -84.41
533856 [WATER2 2    69.000] AMP    23891.0   -82.81
533880 [GODDARD2    69.000] AMP     6233.2   -80.96
539008 [MILAN_GOAB  138.00] AMP    10339.3   -78.01
539009 [CONWAY      138.00] AMP    11107.9   -77.61
539804 [THISTLE4    138.00] AMP    17329.5   -86.45
560053 [G15-052T    345.00] AMP    12996.4   -86.52
560072 [G16-005-TAP 345.00] AMP    12910.1   -84.06
585100 [GEN-2015-073345.00] AMP    13419.4   -85.52
587894 [G16-112-TAP 345.00] AMP     9123.8   -85.77
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26SP

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PSS®E ASCC SHORT CIRCUIT CURRENTS          THU, JUN 06 2019  11:40
2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2026S WITH MMWG 2026S

OPTIONS USED:
    - FLAT CONDITIONS
         - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
         - GENERATOR P=0, Q=0
         - TRANSFOMRER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
         - LINE CHARGING=0.0 IN +/-/0 SEQUENCE
         - LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
         - LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0
IN +/-/0 SEQUENCE
         - DC LINES AND FACTS DEVICES BLOCKED
         - TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

                                  THREE PHASE FAULT
X---------- BUS ----------X          /I+/    AN(I+)
533041 [EVANS S4    138.00] AMP    41183.3   -87.37
533040 [EVANS N4    138.00] AMP    41183.3   -87.37
533053 [LAKERDG4    138.00] AMP    18974.3   -85.63
533074 [45TH ST4    138.00] AMP    27887.3   -85.73
589560 [GEN-2017-179138.00] AMP     3742.9   -85.05
532796 [WICHITA7    345.00] AMP    25222.8   -86.26
533038 [COWSKIN4    138.00] AMP    19330.8   -84.74
533049 [HOOVERN4    138.00] AMP    18758.1   -85.05
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533065 [SG12COL4    138.00] AMP    21283.4   -85.78
533390 [MAIZEW 4    138.00] AMP    27639.1   -85.52
532771 [RENO   7    345.00] AMP    11344.0   -85.94
532782 [BUFFALO7    345.00] AMP    21164.3   -86.38
532791 [BENTON 7    345.00] AMP    19393.8   -85.77
532798 [VIOLA   7   345.00] AMP    13673.5   -85.36
533015 [BENTLEY4    138.00] AMP    10077.2   -85.09
533034 [CENTENN4    138.00] AMP    16025.8   -84.40
533050 [HOOVERS4    138.00] AMP    18758.1   -85.05
533054 [MAIZE  4    138.00] AMP    23294.4   -85.16
533788 [COWSKIN2    69.000] AMP    16496.1   -85.63
533805 [HOOVERN2    69.000] AMP    32417.0   -84.49
562476 [G14-001-TAP 345.00] AMP    11108.1   -85.04
515543 [RENFROW7    345.00] AMP    12564.5   -84.77
532768 [EMPEC 7     345.00] AMP    17673.4   -86.14
532783 [KINGMAN7    345.00] AMP     6870.5   -86.48
532794 [ROSEHIL7    345.00] AMP    18969.9   -85.85
532797 [WOLFCRK7    345.00] AMP    15162.5   -86.94
532986 [BENTON 4    138.00] AMP    28425.4   -85.84
533011 [HALSTD 4    138.00] AMP     4256.8   -85.37
533016 [WWUPLNT4    138.00] AMP     7730.9   -84.69
533051 [INTERST4    138.00] AMP    17191.5   -84.44
533073 [WACO N 4    138.00] AMP    21896.7   -85.15
533075 [VIOLA  4    138.00] AMP    20193.9   -85.69
533391 [MAIZEE 4    138.00] AMP    21844.1   -84.98
533416 [RENO   3    115.00] AMP    24106.2   -86.05
533806 [HOOVERS2    69.000] AMP    32417.0   -84.49
533849 [VISTAPK2    69.000] AMP    17194.0   -81.72
533854 [WESTLNK2    69.000] AMP    15456.2   -84.76
533855 [WATER1 2    69.000] AMP    24269.6   -82.57
533874 [SG9STMK2    69.000] AMP    16178.1   -85.71
533879 [GODDTAP2    69.000] AMP     8148.7   -79.59
539801 [THISTLE7    345.00] AMP    16209.5   -85.69
583850 [GEN-2014-001345.00] AMP     7574.0   -84.76
587500 [GEN-2016-073345.00] AMP    15438.0   -85.94
587884 [G16-111-TAP 345.00] AMP     9509.0   -85.92
588364 [G16-153-TAP 345.00] AMP     7280.5   -85.62
515375 [WWRDEHV7    345.00] AMP    19331.4   -86.15
515476 [HUNTERS7    345.00] AMP    13116.6   -84.79
515544 [RENFROW4    138.00] AMP    14017.5   -85.01
515646 [GRNTWD 7    345.00] AMP    11037.0   -84.70
532769 [LANG   7    345.00] AMP    17452.4   -86.13
532770 [MORRIS 7    345.00] AMP    12801.4   -85.49
532774 [SWISVAL7    345.00] AMP    16364.1   -85.28
532784 [NINN1WF7    345.00] AMP     5713.8   -86.52
532792 [FR2EAST7    345.00] AMP     6679.9   -85.68
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532799 [WAVERLY7    345.00] AMP    14125.1   -86.64
532800 [LATHAMS7    345.00] AMP    10449.4   -85.60
532984 [SUMNER 4    138.00] AMP    10146.3   -82.80
532988 [BELAIRE4    138.00] AMP    18894.8   -84.77
532990 [MIDIAN 4    138.00] AMP    10103.8   -80.45
533013 [MOUND  4    138.00] AMP     4863.3   -84.81
533024 [29TH   4    138.00] AMP    19676.7   -85.10
533035 [CHISHLM4    138.00] AMP    22462.5   -84.79
533036 [CLEARWT4    138.00] AMP    14561.5   -85.27
533044 [GILL E 4    138.00] AMP    25883.2   -85.24
533047 [GILL   4    138.00] AMP    25883.2   -85.24
533062 [ROSEHIL4    138.00] AMP    31531.2   -86.15
533072 [WACO   4    138.00] AMP    21896.7   -85.15
533413 [CIRCLE 3    115.00] AMP    21038.6   -85.67
533415 [DAVIS  3    115.00] AMP     8539.0   -82.45
533429 [MOUNDRG3    115.00] AMP     7145.4   -83.13
533438 [WMCPHER3    115.00] AMP    14014.9   -85.46
533653 [WOLFCRK2    69.000] AMP     5792.7   -87.18
533736 [HALSTED2    69.000] AMP     5548.6   -85.37
533829 [PLAZA  2    69.000] AMP    27417.5   -82.70
533841 [SHERIDN2    69.000] AMP    22207.8   -82.28
533845 [GALE TP2    69.000] AMP     5322.1   -79.26
533846 [21ST   2    69.000] AMP    16097.9   -81.56
533847 [TYLER  2    69.000] AMP    18972.3   -84.41
533856 [WATER2 2    69.000] AMP    23912.4   -82.81
533880 [GODDARD2    69.000] AMP     6235.0   -80.96
539008 [MILAN_GOAB  138.00] AMP    10833.6   -77.47
539009 [CONWAY      138.00] AMP    11641.2   -77.08
539804 [THISTLE4    138.00] AMP    17384.3   -86.43
560053 [G15-052T    345.00] AMP    13006.9   -86.53
560072 [G16-005-TAP 345.00] AMP    12941.5   -84.05
585100 [GEN-2015-073345.00] AMP    13438.4   -85.52
587894 [G16-112-TAP 345.00] AMP     9390.9   -85.92
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APPENDIX E: OUT OF CLUSTER GROUP GENERATION REQUESTS INCLUDED WITHIN IAISIS

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2001-014	94.5	19.825	Wind	Ft Supply 138kV	Commercial Operation	01 - Woodward
GEN-2001-037	102	21.001	Wind	FPL Moreland Tap 138kV	Commercial Operation	01 - Woodward
GEN-2005-008	120	57	Wind	Woodward 138kV	Commercial Operation	01 - Woodward
GEN-2006-024S	18.9	4.001	Wind	Buffalo Bear Tap 69kV	Commercial Operation	01 - Woodward
GEN-2006-046	130	47	Wind	Dewey 138kV	Commercial Operation	01 - Woodward
GEN-2007-021	200	40.002	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward
GEN-2007-043	200	40.001	Wind	Minco 345kV	Commercial Operation	01 - Woodward
GEN-2007-044	300	65.002	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward
GEN-2007-050	170.2	78.001	Wind	Woodward EHV 138kV	Commercial Operation	01 - Woodward
GEN-2007-062	425	86.002	Wind	Woodward EHV 345kV	Commercial Operation	01 - Woodward
GEN-2008-003	101.2	45	Wind	Woodward EHV 138kV	Commercial Operation	01 - Woodward
GEN-2008-044	197.8	114.001	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward
GEN-2010-011	29.7	6.001	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward
GEN-2010-040	300	60.002	Wind	Cimarron 345kV	Commercial Operation	01 - Woodward
GEN-2011-010	100.8	23	Wind	Minco 345kV	Commercial Operation	01 - Woodward
GEN-2011-019	175	175	Wind	Woodward EHV 345kV	On Schedule	01 - Woodward
GEN-2011-020	165	165	Wind	Woodward EHV 345kV	On Schedule	01 - Woodward
GEN-2011-054	300	60.002	Wind	Cimarron 345kV	Commercial Operation	01 - Woodward
GEN-2014-002	10.53	3.001	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward
GEN-2014-003	15.04	4.001	Wind	Tatonga 345kV	Commercial Operation	01 - Woodward

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2014-005	5.67	2.001	Wind	Minco 345kV	Commercial Operation	01 - Woodward
GEN-2014-020	100	100	Wind	Tuttle 138kV	Commercial Operation	01 - Woodward
GEN-2014-056	250	50.001	Wind	Minco 345kV	Commercial Operation	01 - Woodward
GEN-2015-029	161	33.001	Wind	Tatonga 345kV	On Schedule	01 - Woodward
GEN-2015-048	200	40.001	Wind	Cleo Corner 138kV	On Suspension	01 - Woodward
GEN-2015-057	100	20.001	Wind	Minco 345kV	Commercial Operation	01 - Woodward
GEN-2015-093	250	50.002	Wind	Gracemont 345kV	On Suspension	01 - Woodward
GEN-2015-095	176	36.001	Wind	Tap Mooreland - Knob Hill 138kV	On Schedule	01 - Woodward
GEN-2016-003	248.4	50.001	Wind	BadgerÂ-Woodward EHV Dbl Ckt 345kV	IA Pending	01 - Woodward
GEN-2016-020	150	30.001	WIND	Moreland 138kV Substation	On Schedule	01 - Woodward
GEN-2016-045	499.1	101.002	Wind	Mathewson 345kV	Facility Study Stage	01 - Woodward
GEN-2016-047	469	413	CT	Mustang 69kV	On Schedule	01 - Woodward
GEN-2016-057	499.1	101.002	Wind	Mathewson 345kV	Facility Study Stage	01 - Woodward
ASGI-2013-001	11.5	3.001	Wind	Highland Tap 115 kV	On Schedule	02 - Hitchland
GEN-2002-008	240	49.003	Wind	Hitchland 345kV	Commercial Operation	02 - Hitchland
GEN-2002-009	80	16.001	Wind	Hansford 115kV	Commercial Operation	02 - Hitchland
GEN-2002-022	239.2	123.321	Wind	Bushland 230kV	Commercial Operation	02 - Hitchland
GEN-2003-020	159	32.002	Wind	Martin 115kV	Commercial Operation	02 - Hitchland
GEN-2006-020S	19.8	4.001	Wind	DWS Frisco 115kV	Commercial Operation	02 - Hitchland
GEN-2006-044	370	74.004	Wind	Hitchland 345kV	Commercial Operation	02 - Hitchland
GEN-2007-046	200	41.002	Wind	Hitchland 115kV	Commercial Operation	02 - Hitchland
GEN-2008-047	300	60.002	Wind	Hitchland-Woodward EHV Dbl Ckt (Beaver County) 345kV	Commercial Operation	02 - Hitchland

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2008-051	322	124.39	Wind	Potter County 345kV	Commercial Operation	02 - Hitchland
GEN-2010-001	300	60.002	Wind	Hitchland-Woodward EHV Dbl Ckt (Beaver County) 345kV	Commercial Operation	02 - Hitchland
GEN-2010-014	358.8	73.002	Wind	Hitchland 345kV	On Schedule	02 - Hitchland
GEN-2011-014	201	41.001	Wind	Beaver CountyÂ- Woodward EHV Dbl Ckt (Badger) 345kV	Commercial Operation	02 - Hitchland
GEN-2011-022	299	60.002	Wind	Hitchland 345kV	On Schedule	02 - Hitchland
GEN-2013-030	300	60.001	Wind	Hitchland-Woodward EHV Dbl Ckt (Beaver County) 345kV	On Schedule	02 - Hitchland
GEN-2015-082	200	40.001	Wind	Beaver CountyÂ- Woodward EHV Dbl Ckt (Badger) 345kV	On Schedule	02 - Hitchland
GEN-2016-070	5.3	2.001	Wind	Majestic 115 kV Substation	On Schedule	02 - Hitchland
ASGI-2012-006	22.5	18.901	Steam	ABBK 2 69 kV	On Schedule	03 - Spearville
ASGI-2015-001	6.13	5.001	Thermal	NINNESC3 115 kV	On Schedule	03 - Spearville
GEN-2001-039A	105	37	Wind	Shooting Star Tap 115kV	Commercial Operation	03 - Spearville
GEN-2002-025A	150	38	Wind	Spearville 230kV	Commercial Operation	03 - Spearville
GEN-2004-014	154.5	31.001	Wind	Spearville 230kV	Commercial Operation	03 - Spearville
GEN-2005-012	248.4	98.001	Wind	Clark County-Spearville Ckt 1 (Ironwood) 345kV	Commercial Operation	03 - Spearville
GEN-2006-021	100	33	Wind	Flat Ridge Tap 138kV	Commercial Operation	03 - Spearville
GEN-2007-040	200	40.001	Wind	Buckner 345kV	Commercial Operation	03 - Spearville
GEN-2008-018	250	50.062	Wind	Finney 345kV	Commercial Operation	03 - Spearville
GEN-2008-079	98.9	30	Wind	Crooked Creek 115kV	Commercial Operation	03 - Spearville
GEN-2008-124	200.1	41.001	Wind	Clark County-Spearville Ckt 1 (Ironwood) 345kV	Commercial Operation	03 - Spearville
GEN-2010-009	165.6	34.001	Wind	Buckner 345kV	Commercial Operation	03 - Spearville
GEN-2011-008	600	120.003	Wind	Clark County 345kV	Commercial Operation	03 - Spearville
GEN-2011-016	200.1	41.001	Wind	Clark County-Spearville Ckt 2 345kV	On Suspension	03 - Spearville

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2012-007	120	120	Gas	Rubart 115kV	Commercial Operation	03 - Spearville
GEN-2012-024	180	36.001	Wind	Clark County 345kV	Commercial Operation	03 - Spearville
GEN-2015-021	20	20	Solar	Johnson Corner 115kV	On Schedule	03 - Spearville
GEN-2016-016	78.2	16.001	Wind	North Kinsley 115 kV	Facility Study Stage	03 - Spearville
GEN-2016-046	299	60.001	Wind	Clark County-Ironwood 345kV	Facility Study Stage	03 - Spearville
ASGI-2013-004	36.6	30.603	Gas	MORRIS-3 115 kV	On Schedule	04 - Northwest Kansas
GEN-2001-039M	99	38	Wind	Central Plains Tap 115kV	Commercial Operation	04 - Northwest Kansas
GEN-2003-006A	201	89	Wind	Elm Creek 230kV	Commercial Operation	04 - Northwest Kansas
GEN-2003-019	249.3	96.001	Wind	Smoky Hills Tap 230kV	Commercial Operation	04 - Northwest Kansas
GEN-2008-092	200.5	41.002	Wind	Post Rock 230kV	Commercial Operation	04 - Northwest Kansas
GEN-2009-008	198.9	66	Wind	South Hays 230kV	Commercial Operation	04 - Northwest Kansas
GEN-2009-020	48.3	10.001	Wind	Tap Nekoma - Bazine (Walnut Creek) 69kV	Commercial Operation	04 - Northwest Kansas
GEN-2010-057	201	201	Wind	Rice County 230kV	Commercial Operation	04 - Northwest Kansas
GEN-2013-033	27	27	Gas	Goodman Energy Center 115kV	Commercial Operation	04 - Northwest Kansas
GEN-2014-025	2.41	1.001	Wind	Tap Nekoma - Bazine (Walnut Creek) 69kV	Commercial Operation	04 - Northwest Kansas
GEN-2015-064	197.8	40.001	Wind	Mingo 115kV	On Schedule	04 - Northwest Kansas
GEN-2015-065	202.4	41.001	Wind	Mingo 345kV	On Schedule	04 - Northwest Kansas

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2016-067	73.6	15.001	Wind	Mingo 345kV	On Schedule	04 - Northwest Kansas
ASGI-2010-010	42.15	42.195	Gas	LE-NRTH_INT3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2010-020	30	6.001	Wind	ASGI-10-20T 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2010-021	15	3.001	Wind	ASGI-10-21T 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2011-003	10	2.001	Wind	HENDRICKS 2 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2011-004	19.8	4.001	Wind	SP-CROSBY 2 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2012-002	18.15	4.001	Wind	FE-CLVS_INT3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2013-002	18.4	4.001	Wind	FE-TUCMCARI3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2013-003	18.4	4.001	Wind	FE-CLVS_INT3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2013-005	1.65	1.001	Wind	FE-CLVS_INT3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2015-002	2	1.001	Wind	SP-YUMA 2 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
ASGI-2016-002	0.35	0.35	Wind	SP-YUMA 2 69 kV	On Schedule	06 - South Texas Panhandle / New Mexico
ASGI-2016-004	5	1.401	Wind	PALO_DURO 3 115 kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2001-033	180.29	115.253	Wind	San Juan Tap 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2001-036	80	51.37	Wind	Norton 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2006-018	167.22	165.81	CT	TUCO 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2006-026	508	510	Gas	Hobbs 230kV & Hobbs 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2008-022	299.65	61.003	Wind	Eddy County-Tolk (Crossroads) 345kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2010-006	205	165	Gas	Jones 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2010-046	56	45.001	Gas	TUCO 230kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2011-025	80	16.001	Wind	Tap Floyd County - Crosby County 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2011-045	205	168	NG CT	Jones 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2011-046	27	22.001	Diesel CT	Tucumcari 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2011-048	175	175	CT	Mustang 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2012-001	61.2	13.001	Wind	Tap Grassland Â- Borden County 230 kv	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2012-020	477.1	97.002	Wind	TUCO 230kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2012-034	7	7	CT	Mustang 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2012-035	7	7	CT	Mustang 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2012-036	7	7	CT	Mustang 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2012-037	203	195	CT	TUCO 345kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2013-016	203	195	CT	TUCO 345kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2013-022	25	25	Solar	Norton 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2013-027	150	150	Wind	Tolk - Yoakum 230kV	Commercial Operation	06 - South Texas Panhandle / New Mexico

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2014-033	70	56.293	Solar	Chaves County 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2014-034	70	56.293	Solar	Chaves County 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2014-035	30	24.001	Solar	Chaves County 115kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2014-040	320	64.001	Wind	Castro 115kV	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2015-014	150	30.001	Wind	Tap Cochran - Lehman 115kV substation	Commercial Operation	06 - South Texas Panhandle / New Mexico
GEN-2015-020	99.96	80.001	Solar	Oasis 115kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2015-041	5	5	CT	TUCO 345kV	Facility Study Stage	06 - South Texas Panhandle / New Mexico
GEN-2015-056	101.2	21.001	WIND	Eddy County-Tolk (Crossroads) 345kV	On Schedule	06 - South Texas Panhandle / New Mexico
GEN-2016-015	100	80.001	Solar	Andrews County 230kV	Facility Study Stage	06 - South Texas Panhandle / New Mexico
GEN-2016-056	200	40.001	Wind	Carlisle 230kV	Facility Study Stage	06 - South Texas Panhandle / New Mexico
GEN-2016-062	250.7	51.001	Wind	Andrews County 230kV	Facility Study Stage	06 - South Texas Panhandle / New Mexico

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2016-069	31.35	26.001	Solar	Chaves County 115kV	Facility Study Stage	06 - South Texas Panhandle / New Mexico
GEN-2001-026	74.25	15.661	Wind	Washita 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2002-005	120	24.99	Wind	Red Hills Tap 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2003-004	100	20.001	Wind	Washita 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2003-005	100	20.953	Wind	Anadarko - Paradise (Blue Canyon) 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2003-022	120	29	Wind	Clinton Junction-Weatherford Southeast 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2004-020	27	6.001	Wind	Clinton Junction-Weatherford Southeast 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2004-023	20.6	5.001	Wind	Washita 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2005-003	30.6	7.001	Wind	Washita 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2006-002	100.8	21.002	Wind	Sweetwater 230kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2006-035	225	46.002	Wind	Sweetwater 230kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2006-043	99	20.001	Wind	Sweetwater 230kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2007-052	150	135	Gas	Anadarko 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2008-023	150	60.001	Wind	Hobart Junction 138kV	Commercial Operation	07 - Southwestern Oklahoma

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2008-037	100.8	21.001	Wind	Tap Washita - Blue Canyon Wind 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2011-037	7	2.001	Wind	Blue Canyon 5 138kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2011-049	250.7	51.001	Wind	Border 345kV	On Schedule	07 - Southwestern Oklahoma
GEN-2012-028	74.8	15.001	Wind	Gotebo 69kV	Commercial Operation	07 - Southwestern Oklahoma
GEN-2015-004	52.9	11.001	Wind	Border 345kV	On Schedule	07 - Southwestern Oklahoma
GEN-2015-013	119.95	119.95	Solar	Snyder 138kV	On Suspension	07 - Southwestern Oklahoma
GEN-2015-055	40	32.001	Solar	Erick 138kV Substation	On Schedule	07 - Southwestern Oklahoma
GEN-2015-071	200	40.001	Wind	Chisholm 345kV	On Schedule	07 - Southwestern Oklahoma
GEN-2016-037	300	60.001	Wind	Chisholm-Gracemont 345kV	Facility Study Stage	07 - Southwestern Oklahoma
GEN-2016-051	9.8	2.001	Wind	Clinton Junction-Weatherford Southeast 138kV	On Schedule	07 - Southwestern Oklahoma
GEN-2003-021N	75	24.001	Wind	Ainsworth Wind Tap 115kV	Commercial Operation	09 - Nebraska
GEN-2004-023N	75	75	Coal	Columbus Co 115kV	Commercial Operation	09 - Nebraska
GEN-2006-020N	42	14	Wind	Bloomfield 115kV	Commercial Operation	09 - Nebraska
GEN-2006-037N1	74.8	26	Wind	Broken Bow 115kV	Commercial Operation	09 - Nebraska
GEN-2006-038N005	80	28	Wind	Broken Bow 115kV	Commercial Operation	09 - Nebraska
GEN-2006-038N019	80	28	Wind	Petersburg North 115kV	Commercial Operation	09 - Nebraska
GEN-2006-044N	40.5	14	Wind	North Petersburg 115kV	Commercial Operation	09 - Nebraska

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2007-011N08	81	28	Wind	Bloomfield 115kV	Commercial Operation	09 - Nebraska
GEN-2007-017IS	200	200	Wind	GR PRAIRIE 3 345 kV	On Schedule	09 - Nebraska
GEN-2007-018IS	200	200	Wind	GR PRAIRIE 3 345 kV	On Schedule	09 - Nebraska
GEN-2008-086N02	201	70.2	Wind	Meadow Grove 230kV	Commercial Operation	09 - Nebraska
GEN-2008-119O	60	21	Wind	S1399 161kV	Commercial Operation	09 - Nebraska
GEN-2008-123N	89.7	18.001	Wind	Tap Pauline - Hildreth (Rosemont) 115kV	Commercial Operation	09 - Nebraska
GEN-2009-040	73.8	23	Wind	Tap Smittyville - Knob Hill 115KV	Commercial Operation	09 - Nebraska
GEN-2010-041	10.5	3.001	Wind	S1399 161kV	On Schedule	09 - Nebraska
GEN-2010-051	200	40.001	Wind	Hoskins-Twin Church 230kV	Commercial Operation	09 - Nebraska
GEN-2011-018	73.6	73.6	Wind	Steele City 115kV	Commercial Operation	09 - Nebraska
GEN-2011-027	120	120	Wind	Hoskins-Twin Church 230kV	Commercial Operation	09 - Nebraska
GEN-2011-056	3.6	3.6	Hydro	Jeffrey 115kV	Commercial Operation	09 - Nebraska
GEN-2011-056A	3.6	3.6	Hydro	John 1 115kV	Commercial Operation	09 - Nebraska
GEN-2011-056B	4.5	4.5	Hydro	John 2 115kV	Commercial Operation	09 - Nebraska
GEN-2012-021	4.8	4.8	Gas	Terry Bundy Generating Station 115kV	Commercial Operation	09 - Nebraska
GEN-2013-002	50.6	60.721	Wind	Monolith 115kV	On Suspension	09 - Nebraska
GEN-2013-008	1.2	1.001	Wind	Steele City 115kV	Commercial Operation	09 - Nebraska
GEN-2013-019	73.6	88.321	Wind	Monolith 115kV	On Suspension	09 - Nebraska
GEN-2013-032	204	41.001	Wind	Antelope 115kV	On Schedule	09 - Nebraska
GEN-2014-004	3.96	1.001	Wind	Steele City 115kV	Commercial Operation	09 - Nebraska
GEN-2014-013	73.5	73.5	Wind	Meadow Grove 230kV	Commercial Operation	09 - Nebraska
GEN-2014-031	35.8	35.8	Wind	Meadow Grove 230kV	Commercial Operation	09 - Nebraska
GEN-2014-032	10.22	10.22	Wind	Meadow Grove 230kV	Commercial Operation	09 - Nebraska
GEN-2014-039	73.39	73.39	Wind	Friend 115kV	On Schedule	09 - Nebraska

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2015-007	160	32.001	Wind	Hoskins 345kV	On Schedule	09 - Nebraska
GEN-2015-023	300.72	300.72	Wind	Grand Prairie-Grand Island (Holt County NE) 345kV	On Schedule	09 - Nebraska
GEN-2015-076	158.4	32.002	Wind	Belden 115kv Substation	On Suspension	09 - Nebraska
GEN-2015-087	66	66	Wind	Hebron-Fairbury 115 kV	On Suspension	09 - Nebraska
GEN-2015-088	300	300	Wind	Moore-Pauline 345kV	On Schedule	09 - Nebraska
GEN-2015-089	200	40.001	Wind	Utica 230 kV Substation	On Schedule	09 - Nebraska
GEN-2016-021	300	60.001	WIND	Hoskins 345kV	Facility Study Stage	09 - Nebraska
GEN-2016-023	150.53	31.002	Wind	Laramie River Station-Sidney 345kV	Facility Study Stage	09 - Nebraska
GEN-2016-029	150.53	31.002	Wind	Laramie River Station-Sidney 345kV	Facility Study Stage	09 - Nebraska
GEN-2016-043	230	46.001	Wind	Hoskins 345kV	On Schedule	09 - Nebraska
GEN-2016-050	250.7	51.001	Wind	Axtell â€“ Post Rock 345 kV	Facility Study Stage	09 - Nebraska
GEN-2016-075	50	10.001	Wind	Fort Thompson-Grand Island (Grand Prairie) 345kV	Facility Study Stage	09 - Nebraska
GEN-2013-011	30	24.001	Coal	Turk 138kV	Commercial Operation	12 - Northwest Arkansas
GEN-2016-013	10	8.001	CT	LaRussell Energy Center 161kV	Facility Study Stage	12 - Northwest Arkansas
GEN-2016-014	10	8.971	CT	LaRussell Energy Center 161kV	Facility Study Stage	12 - Northwest Arkansas
ASGI-2016-003	12	10.001	Diesel	Paola 161 kV	On Schedule	13 - Northeast Kansas / Northwest Missouri
GEN-2008-129	80	64.002	CT	Pleasant Hill 161kV	Commercial Operation	13 - Northeast Kansas / Northwest Missouri
GEN-2010-036	5.9	5.9	Hydro	6th Street 115kV	Commercial Operation	13 - Northeast Kansas / Northwest Missouri

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2011-011	50	50	Coal	Iatan 345kV	Commercial Operation	13 - Northeast Kansas / Northwest Missouri
GEN-2014-021	300	300	Wind	Nebraska City-Mullen Creek (Holt County MO) 345kV	Commercial Operation	13 - Northeast Kansas / Northwest Missouri
GEN-2015-005	200.11	41.002	Wind	Mullen Creek-Sibley (Ketchum) 345kV	Commercial Operation	13 - Northeast Kansas / Northwest Missouri
ASGI-2015-006	9	8.001	Solar	TUPELO 4 138 kV	On Schedule	14 - South Central Oklahoma
GEN-2011-040	110	110	Wind	Pooleville-Ratliff (Carter County) 138kV	Commercial Operation	14 - South Central Oklahoma
GEN-2011-050	109.8	22.001	Wind	Tap Rush Springs Â- Marlow 138kV	Commercial Operation	14 - South Central Oklahoma
GEN-2012-004	41.4	41.4	Wind	Pooleville-Ratliff (Carter County) 138kV	Commercial Operation	14 - South Central Oklahoma
GEN-2013-007	100	100	Wind	Tap Prices Falls - Carter 138kV	Commercial Operation	14 - South Central Oklahoma
GEN-2014-057	250	50.001	Wind	Lawton East Side-Sunnyside (Terry Road) 345kV	Commercial Operation	14 - South Central Oklahoma
GEN-2015-036	303.6	62.002	Wind	Johnston County 345kV	On Schedule	14 - South Central Oklahoma
GEN-2015-045	20	20	Battery	Lawton East Side-Sunnyside (Terry Road) 345kV	On Schedule	14 - South Central Oklahoma
GEN-2015-092	250	50.002	Wind	Lawton East Side-Sunnyside (Terry Road) 345kV	On Schedule	14 - South Central Oklahoma
GEN-2016-028	100	20.001	Wind	Clayton 138 kV Sub	On Schedule	14 - South Central Oklahoma

Project	Requested Capacity Amount (MW)	Studied Capacity Amount (MW)	Fuel Type	POI	Status	Cluster Group
GEN-2016-030	100	100	Solar	Brown 138kV	On Schedule	14 - South Central Oklahoma
GEN-2016-063	200	200	Wind	Hugo-Sunnyside 345 kV	On Schedule	14 - South Central Oklahoma
ASGI-2016-005	19.8	4.001	Wind	MTVERNN8 69 kV	On Schedule	15 - Eastern South Dakota
ASGI-2016-006	19.8	4.001	Wind	MITCLNW 115 kV	On Schedule	15 - Eastern South Dakota
ASGI-2016-007	19.8	4.001	Wind	MTVERNN8 69 kV	On Schedule	15 - Eastern South Dakota
GEN-2009-001IS	200	200	Wind	G09_001IST 345 kV	On Schedule	15 - Eastern South Dakota
GEN-2010-001IS	99	99	Wind	CAMPBELL 4 230 kV	On Schedule	15 - Eastern South Dakota
GEN-2014-001IS	103.7	21.001	Wind	Sulphur 115kV	IA Pending	15 - Eastern South Dakota
GEN-2016-017	250.7	51.001	Wind	Fort Thompson-Leland Olds 345kV	On Schedule	15 - Eastern South Dakota
GEN-2009-026IS	106.5	106.5	Wind	HEBRON 4 230 kV	On Schedule	16 - Western North Dakota
GEN-2012-012IS	75	75	Wind	Circle - Wolf PT 115 kV	On Suspension	16 - Western North Dakota
GEN-2014-006IS	113.28	113.328	Gas	PNSCOLLECTR7 115 kV	On Schedule	16 - Western North Dakota
GEN-2014-010IS	150	150	Wind	NESET 7 115 kV	On Schedule	16 - Western North Dakota
GEN-2014-014IS	149.73	149.73	Wind	DAGLUM 4 230 kV	On Schedule	16 - Western North Dakota
GEN-2015-046	300	60.001	Wind	Tande 345kV	On Schedule	16 - Western North Dakota
GEN-2015-096	150	30.001	Wind	Brady 230kV substation	Commercial Operation	16 - Western North Dakota
GEN-2016-004	201.6	201.6	Wind	Leland Olds 230 kV	Facility Study Stage	16 - Western North Dakota
GEN-2016-052	3.3	1.001	Wind	Hilken 230kV	Facility Study Stage	16 - Western North Dakota
GEN-2016-053	3.3	1.001	Wind	Hilken 230kV	Facility Study Stage	16 - Western North Dakota
GEN-2016-054	3.4	1.001	Wind	Springs 230kV	Facility Study Stage	17 - Western South Dakota
GEN-2016-007	100.05	21.001	Wind	Valley City 115 kV	Facility Study Stage	18 - Eastern North Dakota

APPENDIX F: HIGHER QUEUED ASSIGNED UPGRADES INCLUDED IN THE MODELS

Assigned Study	Upgrade Name
DISIS-2015-002	Beatrice - Harbine 115 kV Ckt 1
DISIS-2015-002	Belvidere - Fairbury 115 kV CKT 1
DISIS-2015-002	Border 345 kV 100 MVAR Capacitive Reactive Power Support
DISIS-2015-002	Cleo Corner - Cleo Plnt Tap 138 kV CKT 1
DISIS-2015-002	Cleveland - Silver City 138 kV CKT 1
DISIS-2015-002	Deaf Smith - Plant X 230 kV Ckt 1 Rebuild
DISIS-2015-002	Deaf Smith 230 kV 60 MVAR Capacitive Reactive Power Support
DISIS-2015-002	Dickinson 230/115 kV CKT 2
DISIS-2015-002	Gavins Point - Yankon Junction 115 kV
DISIS-2015-002	Grapevine - Wheeler 230 kV Ckt 1 Terminal Equipment (SPS)
DISIS-2015-002	Newhart - Plant X 230 kV Ckt 1 Rebuild
DISIS-2015-002	Oklaunion 345 kV 100 MVAR Capacitive Reactive Power Support
DISIS-2015-002	Sweetwater - Wheeler 230 kV Ckt 1 Rebuild (AEPW)
DISIS-2015-002	Sweetwater - Wheeler 230 kV Ckt 1 Terminal Equipment (SPS)
DISIS-2016-001	Ranch Road - Sooner 345 kV Ckt 1 Terminal Upgrades
DISIS-2016-001	Sidney - Keystone 345 kV Ckt 2
DISIS-2016-001	Beaver County - Clark County 345 kV CKT 1 New Line
DISIS-2016-001	Keystone - Gentleman 345 kV CKT 2
DISIS-2016-001	Tolk - Crawfish Draw 345 kV CKT 1 New Line
DISIS-2016-001	Tolk - Potter County 345 kV CKT 1 New Line
DISIS-2016-001	Cottonwood Creek - G16-032-Tap 138 kV Ckt 1 Rebuild
DISIS-2016-001	Andrews 230/115/13 kV Transformer CKT 1
DISIS-2016-001	Andrews 230/115/13 kV Transformer CKT 2
DISIS-2016-001	Border - Chisholm 345 kV CKT 1 New Line
DISIS-2016-001	Crawfish Draw 345 kV Substation
DISIS-2016-001	Greenburg 115 kV 10 MVAR Capacitive Reactive Power Support
DISIS-2016-001	Oklaunion 345 kV 20 MVAR Capacitive Reactive Power Support
DISIS-2016-001	Shamrock 69 kV 10 MVAR Capacitive Reactive Power Support