

# GEN-2017-094

Interim Availability Interconnection System Impact Study

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By Generator Interconnection

# **REVISION HISTORY**

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
3/20/2019	Generator Interconnection		Initial Posting
5/24/2019	Generator Interconnection	Changed POI from tap of both Huron to Ft Thompson 230kV lines to just one of the lines	Second Posting
5/30/2019	Generator Interconnection	Corrected Appendix C for single tap. Corrected Table 10 reactor size needed.	Third Posting

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# **EXECUTIVE SUMMARY**

The GEN-2017-094 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-2017-094 has requested 200 MW of wind generation be interconnected with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) into the transmission system of Western Area Power Administration (WAPA) in Hand County, South Dakota. GEN-2017-094 has requested this IAISIS to determine the impacts of interconnecting to the transmission system before the DISIS-2017-001 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 October 6, 2020. GEN-2017-094 is requesting the interconnection of eighty (80) GE 2.5 MW wind turbines and associated facilities interconnecting at a new substation tapping Ft. Thompson - Huron 230 kV. For this IAISIS, power flow, stability and short circuit analyses were conducted. This IAISIS assumes only the higher queued projects listed within **Table 1** of this study might go into service before the completion of all Network Upgrades identified within **Table 2** of this report. If additional generation projects, listed within **Table 3**, with queue priority equal to or higher than the study project request rights to go into commercial operation before all Network Upgrades identified within **Table 2** of this report are completed, this 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-2017-094 can interconnect 200 MW of wind generation with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) on October 6, 2020, pending the completion of the required Network Upgrades, listed within **Table 2** of this report. Should any other projects, other than those listed within **Table 1** of this report, come into service, an additional study may be required to determine if any limited operation service is available. It should be noted that while this IAISIS analyzed many of the most probable contingencies, it is not an all-inclusive list that can account for every operational situation. Additionally, the generator may not be able to inject any power onto the Transmission System due to constraints that fall below the threshold of mitigation for a Generator Interconnection request. Because of this, it is likely that the Customers may be required to reduce their generation output to **0 MW** under certain system conditions to allow system operators to maintain the reliability of the transmission network.

In accordance with FERC Order 827 GEN-2017-094 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. 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.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

# PURPOSE

GEN-2017-094 (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 Western Area Power Administration (WAPA).

The purpose of this study is to evaluate the impacts of interconnecting GEN-2017-094 request with a total of 200 MW comprised of eighty (80) GE 2.5 MW and associated facilities interconnecting at a new substation tapping Ft. Thompson - Huron 230 kV in Hand County, South Dakota. 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 October 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 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 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** are the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested October 2020 in-service for this IAISIS. 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.

Project	MW	Total MW	Fuel Source	POI	Status
				Ft Thompson 69kV [Hyde	
GEN-2002-009IS	40.5	40.5	Wind	69kV]	Commercial Operation
GEN-2007-013IS	50	50	Wind	Wessington Springs 230kV	Commercial Operation
GEN-2007-014IS	100	100	Wind	Wessington Springs 230kV	Commercial Operation
GEN-2009-018IS	99.5	99.5	Wind	Groton 115kV	Commercial Operation
GEN-2010-003IS	34	34	Wind	Wessington Springs 230kV	Commercial Operation
GEN-2013-009IS	19.5	19.5	Wind	Redfield NW 115kV	Commercial Operation
GEN-2010-001IS	99	99	Wind	Bismarck-Glenham 230kV	On Schedule
GEN-2009-001IS	200	200	Wind	Groton-Watertown 345kV	On Schedule
GEN-2014-001IS	103.7	103.7	Wind	Sulphur 115kV	IA Pending
ASGI-2016-005	19.8	19.8	Wind	Tap White Lake - Stickeny 69kV	Affected Systems Facility Study Stage
ASGI-2016-006	19.8	19.8	Wind	Mitchell 115kV	Affected Systems Facility Study Stage
ASGI-2016-007	19.8	19.8	Wind	Kimball 69kV	Affected Systems Facility Study Stage
GEN-2016-017	250.7	250.7	Wind	Fort Thompson-Leland Olds 345kV	IA PENDING
GEN-2016-036	44.6	44.6	Wind	Granite Falls 115kV substation	FACILITY STUDY STAGE
GEN-2016-087	98.9	98.9	Wind	Bismark-Glenham 230 kV line	FACILITY STUDY STAGE
GEN-2016-092	175	175	Wind	Fort Thompson-Leland Olds 345kV	FACILITY STUDY STAGE
GEN-2016-094	200	200	Wind	Ft Thompson - Oahe 230kV	FACILITY STUDY STAGE

	Table 1: Generation	Requests	Included	within	IAISIS
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Project	MW	Total MW	Fuel Source	ΡΟΙ	Status
GEN-2016-164	7.92	7.92	Wind	Groton 115 kV substation	FACILITY STUDY STAGE
GEN-2017-094	200	200	Wind	Fort Thompson-Huron 230 kV	DISIS STAGE

 Table 1: Generation Requests Included within IAISIS

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-2017-094 will be included within the DISIS-2017-001 that will be studied in 2019 and posted the end of October 2019. Once posted the report will be located at the following Generation Interconnection Study URL: <a href="http://opsportal.spp.org/Studies/GenList?yearTypeId=154">http://opsportal.spp.org/Studies/GenList?yearTypeId=154</a>

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

 Service

Upgrade Project	Туре	Description	Status	Study Assignment
No upgrades are requi upgrades and active prio Should any higher que	red at this time or queued reque ued request wit possibl	. However, the study as ests from the DISIS-2010 thdraw, all associated u ly triggering a restudy.	sumes all previ 6-002 and prior pgrades are sub	ously assigned will go forward. oject to review;

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 or equally queued projects that were not included in this study are listed in **Table 3**. While this list is not all-inclusive, it is a list of the most probable and affecting prior-queued requests that were not included within this IAISIS, either because no request for an IAISIS has been made or the request is on suspension, etc.

Project	MW	Total MW	Fuel Source	ΡΟΙ	Status
No projects were excluded from this study.					

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

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 eighty (80) GE 2.5 MW wind turbines and associated facilities interconnecting at a new substation tapping Ft. Thompson - Huron 230 kV.

### 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 October 6, 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 (21SP)
- Year 5 (2021) Winter (21WP) peak
- Year 10 (2026) Summer (26SP) peak

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 is 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. Each interconnection request is also 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 LOIS, 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.

### <u>SPP Areas (69kV+):</u>

Transmission Owner	Voltage Criteria (System	Voltage Criteria
	Intact)	(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

### <u> Affected System Areas (115kV+):</u>

Transmission Owner	Voltage Criteria (System	Voltage Criteria
	Intact)	(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
АММО	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 may interconnect its generation into the SPP transmission system pending all current study and previously assigned upgrades outlined in the DISIS-2016-002. Should any other GI projects, other than those listed within **Table 1** of this report, come into service, an additional study may be required to determine if any limited operation service is available. ACCC results for the 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 WAPA footprint for NRIS.

### CURTAILMENT AND SYSTEM RELIABILITY

In no way does this study guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to **0 MW** under certain system conditions to allow system operators to maintain the reliability of the transmission network.

#### Table 4: Thermal Constraints for Transmission Reinforcement Mitigation

	N/A			N/A	

#### Table 5: Voltage Constraints for Transmission Reinforcement Mitigation

N/A	N/A	

### Table 6: Thermal Constraints Not Requiring Additional Transmission Reinforcement Mitigation

	N/A				N/A

## 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**

Thirty (30) 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.

Cont.	Contingency Name	Description
NO.	Name	3 phase fault on G17-094-TAP (589324) to Ft Thompson (652507) 230kV
	FLT 01 G17	Ckt 1 near G17-094-TAP
	094TAP FTT	a. Apply fault at the G17-094-TAP 230kV hus
1	HOMP4 230	b. Clear fault after 5 cycles and trin the faulted line.
	kV 3PH	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.
	FLT 02 FTT	3 phase fault on Ft Thompson (652507) to Ft Thompson (652276)
	HOMP4 FTT	230/69kV Ckt 2. near Ft Thompson.
2	HOMP8 230	a. Apply fault at the Ft Thompson 230kV bus.
	69kV_3PH	b. Clear fault after 5 cycles and trip the faulted transformer.
		3 phase fault on Ft Thompson (652507) to G16-094-TAP (587764) 230kV
	FLT_03_FTT	Ckt 1, near Ft Thompson.
2	HOMP4_G16	a. Apply fault at the Ft Thompson 230kV bus.
3	094TAP_230	b. Clear fault after 5 cycles and trip the faulted line.
	kV_3PH	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 phase fault on Ft Thompson (652507) to Oahe (652519) 230kV Ckt 4,
	FLT_04_FTT	near Ft Thompson.
4	HOMP4_OAH E4_230kV_3	a. Apply fault at the Ft Thompson 230kV bus.
4		b. Clear fault after 5 cycles and trip the faulted line.
	PH	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.
	FLT_05_FTT	3 phase fault on Ft Thompson (652507) to Ft Thompson (652506)
HOMP4_FTT		230/345kV Ckt 1, near Ft Thompson.
5	HOMP3_230_	a. Apply fault at the Ft Thompson 230kV bus.
	345kV_3PH	b. Clear fault after 5 cycles and trip the faulted transformer.
		3 phase fault on Fort Thompson (652806) to G16-017-TAP (560074)
	FLT_06_FTT	345kV Ckt 1, near Fort Thompson.
6	HOM1LNX3_	a. Apply fault at the Fort Thompson 345kV bus.
-	G16017TAP_	b. Clear fault after 5 cycles and trip the faulted line.
	345kV_3PH	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.
	FLT 07 FTT	3 phase fault on Fort Thompson (652807) to Grand Prairie (652833)
	HOM2LNX3	345kV Ckt 1, near Fort Thompson.
7	GRPRAR2LN	a. Apply fault at the Fort Thompson 345kV bus.
	X3_345kV_3	b. Clear fault after 5 cycles and trip the faulted line.
	PH	c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		a. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.
		3 phase fault on Ft Thompson (652507) to Lake Platt (652516) 230kV Ckt
		1, near rt 1 nompson.
8		a. Apply fault at the Ft I nompson 230KV bus.
	rLA14_230K	b. Clear fault after 5 cycles and trip the faulted line.
	v_3PH	c. wait 20 cycles, and then re-close the line in (b) back into the fault.
		a. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.

Table 7: Contingencie	s Evaluated	for Interim	Service

Cont. No.	Contingency Name	Description
9	FLT_09_FTT HOMP4_FTR ANDL4_230k V_3PH	<ul> <li>3 phase fault on Ft Thompson (652507) to Ft Randal (652509) 230kV Ckt</li> <li>1, near Ft Thompson.</li> <li>a. Apply fault at the Ft Thompson 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
10	FLT_10_FTT HOMP4_WES SINGTON4_2 30kV_3PH	<ul> <li>3 phase fault on Ft Thompson (652507) to Wessington (652607) 230kV</li> <li>Ckt 1, near Ft Thompson.</li> <li>a. Apply fault at the Ft Thompson 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
11	FLT_11_FTT HOMP4_LET CHER4_230k V_3PH	<ul> <li>3 phase fault on Ft Thompson (652507) to Letcher (652606) 230kV Ckt 1, near Ft Thompson.</li> <li>a. Apply fault at the Ft Thompson 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
12	FLT_12_WES SINGTON4_S TORLA4_230 kV_3PH	<ul> <li>3 phase fault on Wessington (652607) to Storla (659122) 230kV Ckt 1, near Wessington.</li> <li>a. Apply fault at the Wessington 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
13	FLT_13_G17 094TAP_HU RON4_230kV _3PH	<ul> <li>3 phase fault on G17-094-TAP (589324) to Huron (652514) 230kV Ckt 1, near G17-094-TAP.</li> <li>a. Apply fault at the G17-094-TAP 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
14	FLT_14_HUR ON4_BRDLA ND4_230kV_ 3PH	<ul> <li>3 phase fault on Huron (652514) to Broadland (659205) 230kV Ckt 1, near Huron.</li> <li>a. Apply fault at the Huron 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
15	FLT_15_BRD LAND4_BRD LAND3_230_ 345kV_3PH	<ul> <li>3 phase fault on Broadland (659205) to Huron (659120) 230/345kV Ckt</li> <li>1, near Broadland.</li> <li>a. Apply fault at the Broadland 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted transformer.</li> </ul>
16	FLT_16_HUR ON4_HURON 7_230_115k V_3PH	3 phase fault on Huron (652514) to Huron (652515) 230/115kV Ckt 2, near Huron. a. Apply fault at the Huron 230kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
17	FLT_17_HUR ON7_HURON	3 phase fault on Huron (652515) to Huron (652284) 115/69kV Ckt 1, near Huron.

Cont. No.	Contingency Name	Description
	8_115_69kV_	a. Apply fault at the Huron 115kV bus.
	ЗРН	b. Clear fault after 5 cycles and trip the faulted transformer.
18	FLT_18_HUR ON7_BTAPW P7_115kV_3 PH	<ul> <li>3 phase fault on Huron (652515) to West Park B Tap (660009) 115kV Ckt</li> <li>1, near Huron.</li> <li>a. Apply fault at the Huron 115kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
19	FLT_19_HUR ON7_HURON WP7_115kV_ 3PH	<ul> <li>3 phase fault on Huron (652515) to Huron West Park (660003) 115kV Ckt</li> <li>1, near Huron.</li> <li>a. Apply fault at the Huron 115kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
20	FLT_20_HUR ON7_WOONS KT7_115kV_ 3PH	<ul> <li>3 phase fault on Huron (652515) to Woonsocket (652528) 115kV Ckt 1, near Huron.</li> <li>a. Apply fault at the Huron 115kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
21	FLT_21_HUR ON4_CARPE NTER4_230k V_3PH	<ul> <li>3 phase fault on Huron (652514) to Carpenter (652614) 230kV Ckt 1, near Huron.</li> <li>a. Apply fault at the Huron 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
22	FLT_22_HUR ON4_WATER TN4_230kV_ 3PH	<ul> <li>3 phase fault on Huron (652514) to Watertown (652530) 230kV Ckt 2, near Huron.</li> <li>a. Apply fault at the Huron 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
23	FLT_23_CAR PENTER4_W ATERTN4_2 30kV_3PH	<ul> <li>3 phase fault on Carpenter (652614) to Watertown (652530) 230kV Ckt 1, near Carpenter.</li> <li>a. Apply fault at the Carpenter 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>
24	FLT_24_WAT ERTN4_APPL EDORN4_23 0kV_3PH	<ul> <li>3 phase fault on Watertown (652530) to Appledorn (652582) 230kV Ckt</li> <li>1, near Watertown.</li> <li>a. Apply fault at the Watertown 230kV bus.</li> <li>b. Clear fault after 5 cycles and trip the faulted line.</li> <li>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.</li> <li>d. Leave fault on for 5 cycles, then trip the line in (b) and remove the fault.</li> </ul>

Cont.	Contingency	Description		
No.	Name	Description		
	FLT_25_WAT	3 phase fault on Watertown (652530) to Watertown (652529)		
25	ERTN4_WAT	230/345kV Ckt 1, near Watertown.		
25	ERTN3_230_	a. Apply fault at the Watertown 230kV bus.		
	345kV_3PH	b. Clear fault after 5 cycles and trip the faulted transformer.		
		Prior Outage with Fort Thompson (652807) - Grand Prairie (652833)		
26		345kV Ckt 1 out of service, followed by 3 phase fault on Wessington		
	FLT 26 WES	(652607) to Storla (659122) 230kV Ckt 1, near Wessington.		
	SINGTON4 S	a. Open Fort Thompson (652807) - Grand Prairie (652833) 345kV Ckt 1		
	TORLA4PO_	then solve.		
	230kV_3PH	b. Apply fault at the Wessington 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.		
		Prior Outage with Fort Thompson (652807) - Grand Prairie (652833)		
	FLT_27_WAT ERTN4_APPL EDORN4PO_	(652520) to Appledorp (652502) 220kV (kt 1, noor Watertown		
		(052550) to Appletof II (052502) 250KV CKt 1, field Water town.		
27		a. Open Fort monipson (052007) - Grand France (052055) 545KV CKt 1		
27		h Annly fault at the Watertown bus		
	230kV_3PH	c. Clear fault after 5 cycles and trin 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.		
		1 phase fault with stuck breaker on Huron (652514) to Watertown		
		(652530) 230kV Ckt 2, near Huron.		
	FLT_28_HUR	a. Apply fault at the Huron 230kV bus.		
28	UN4_WATEK	b. Clear fault after 16 cycles, trip the faulted line and trip:		
	1N456_230K	Trip Huron (652514) to Carpenter (652614) 230kV Ckt 1 line		
	V_IFN	Trip Huron 230/115/13.3kV (652514/652515/652281) Transformer Ckt		
		1		
		1 phase fault with stuck breaker on G17-094-TAP (589324) to Ft		
	FLT_29_G17	Thompson (652507) 230kV Ckt 1, near G17-094-TAP.		
29	094TAP_FTT	a. Apply fault at the G17-094-TAP 230kV bus.		
-	HOMP4SB_2	b. Clear fault after 16 cycles, trip the faulted line and trip:		
	30kV_1PH	Trip Fort Thompson (652507) to G16-094-TAP (587764) 230kV Ckt 2 line		
		(towards Oahe)		
		1 phase fault with stuck breaker on Huron (652514) to Watertown		
		(652530) 230kV Ckt 2, near Huron.		
		a. Apply fault at the Huron 230kV bus.		
		D. Clear fault after 16 cycles, trip the faulted line and trip:		
	FLI_3U_HUR	$\begin{array}{c} 1 \text{ Fip Watertown (652530) to Blair (652503) 230KV CKt 1 line \\ \text{Trip Watertown 220 / 115 / 12 2bW (652520 / 652521 / 652220) \end{array}$		
30	TNASE 2201-	111p vrater towil 230/113/13.2KV (032330/052331/052237) Transformer Clt 1		
	V 1DH	Trin Watertown (652530) to Watertown Canacitor (652620) 220bV Cbt 7		
	v_1111	$\lim_{n \to \infty} water town (052550) to water town capacitor (052050) 250KV CKt Z$		
		Trin Watertown 230/345/13 8kV (652530/652529/652237)		
		Transformer Ckt 1		
		Trip Watertown 230/20kV (652530/652539) Transformer Ckt 1 (SVC)		

### RESULTS

Results of the stability analysis are summarized in **Table 8**. These results are valid for GEN-2017-094 interconnecting with a generation amount up to 200 MW. Based on the stability results and with all network upgrades in service, GEN-2017-094 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.

	Contingency Number and Name	2017WP	2018SP	2026SP
1	FLT_01_G17094TAP_FTTHOMP4_230kV_3PH	Stable	Stable	Stable
2	FLT_02_FTTHOMP4_FTTHOMP8_230_69kV_3PH	Stable	Stable	Stable
3	FLT_03_FTTHOMP4_G16094TAP_230kV_3PH	Stable	Stable	Stable
4	FLT_04_FTTHOMP4_OAHE4_230kV_3PH	Stable	Stable	Stable
5	FLT_05_FTTHOMP4_FTTHOMP3_230_345kV_3PH	Stable	Stable	Stable
6	FLT_06_FTTHOM1LNX3_G16017TAP_345kV_3PH	Stable	Stable	Stable
7	FLT_07_FTTHOM2LNX3_GRPRAR2LNX3_345kV_3PH	Stable	Stable	Stable
8	FLT_08_FTTHOMP4_LAKPLAT4_230kV_3PH	Stable	Stable	Stable
9	FLT_09_FTTHOMP4_FTRANDL4_230kV_3PH	Stable	Stable	Stable
10	FLT_10_FTTHOMP4_WESSINGTON4_230kV_3PH	Stable	Stable	Stable
11	FLT_11_FTTHOMP4_LETCHER4_230kV_3PH	Stable	Stable	Stable
12	FLT_12_WESSINGTON4_STORLA4_230kV_3PH	Stable	Stable	Stable
13	FLT_13_G17094TAP_HURON4_230kV_3PH	Stable	Stable	Stable
14	FLT_14_HURON4_BRDLAND4_230kV_3PH	Stable	Stable	Stable
15	FLT_15_BRDLAND4_BRDLAND3_230_345kV_3PH	Stable	Stable	Stable
16	FLT_16_HURON4_HURON7_230_115kV_3PH	Stable	Stable	Stable
17	FLT_17_HURON7_HURON8_115_69kV_3PH	Stable	Stable	Stable
18	FLT_18_HURON7_BTAPWP7_115kV_3PH	Stable	Stable	Stable

#### Table 8: Fault Analysis Results

	Contingency Number and Name	2017WP	2018SP	2026SP
19	FLT_19_HURON7_HURONWP7_115kV_3PH	Stable	Stable	Stable
20	FLT_20_HURON7_WOONSKT7_115kV_3PH	Stable	Stable	Stable
21	FLT_21_HURON4_CARPENTER4_230kV_3PH	Stable	Stable	Stable
22	FLT_22_HURON4_WATERTN4_230kV_3PH	Stable	Stable	Stable
23	FLT_23_CARPENTER4_WATERTN4_230kV_3PH	Stable	Stable	Stable
24	FLT_24_WATERTN4_APPLEDORN4_230kV_3PH	Stable	Stable	Stable
25	FLT_25_WATERTN4_WATERTN3_230_345kV_3PH	Stable	Stable	Stable
26	FLT_26_WESSINGTON4_STORLA4PO_230kV_3PH	Stable	Stable	Stable
27	FLT_27_WATERTN4_APPLEDORN4PO_230kV_3PH	Stable	Stable	Stable
28	FLT_28_HURON4_WATERTN4SB_230kV_1PH	Stable	Stable	Stable
29	FLT_29_G17094TAP_FTTHOMP4SB_230kV_1PH	Stable	Stable	Stable
30	FLT_30_HURON4_WATERTN4SB_230kV_1PH	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**.

	Contingency Number and Name	Description
1	FLT_01_G17094TAP_FTTHOMP4_230kV_3PH	3 phase fault on G17-094-TAP (589324) to Ft Thompson (652507) 230kV Ckt 1, near G17-094-TAP

#### Table 9: LVRT Contingencies

	Contingency Number and Name	Description
13	FLT_13_G17094TAP_HURON4_230kV_3PH	3 phase fault on G17-094-TAP (589324) to Huron (652514) 230kV Ckt 1, near G17-094-TAP

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-2017-094 is found to be in compliance with FERC Order #661A.

# POWER FACTOR ANALYSIS

In accordance with FERC Order 827 GEN-2017-094 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-2017-094 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 10**. 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.

Request	Point of Interconnection (POI)	Reactor Size (Mvar)
GEN-2017-094	G17-094-TAP 230kV (589324)	9.5

#### Table 10: Summary of Reduced Wind Generation Analysis

# 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-2017-094 (Interconnection Customer) has requested an Interim Availability Interconnection System Impact Study (IAISIS) under the Southwest Power Pool Open Access Transmission Tariff (OATT) for 200 MW of wind generation to be interconnected with Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) into the transmission system of Western Area Power Administration (WAPA) in Hand County, South Dakota. The point of interconnection will be a new substation tapping Ft. Thompson – Huron 230 kV. GEN-2017-094 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-2017-001 Impact Study can be placed into service.

Power flow analysis from this IAISIS has determined that the GEN-2017-094 request can interconnect 200 MW of generation with Energy Resource Interconnection Service (ERIS) and 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-2017-094 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.



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-2017-094 with generators turned off





#### APPENDIX D: SHORT CIRCUIT ANALYSIS RESULTS

18SP
PSS®E ASCC SHORT CIRCUIT CURRENTS TUE, MAY 07 2019 11:25
2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2018S WITH MMWG 2017S

OPTIONS	USED:
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- 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 PHAS	E FAULT
Х	BUS	X		/I+/	AN(I+)
589324	[G17-094-TAP	230.00]	AMP	7691.4	-83.85
589320	[GEN-2017-094	1230.00]	AMP	7691.4	-83.85
652507	[FTTHOMP4	230.00]	AMP	19478.3	-85.60
652514	[HURON 4	230.00]	AMP	11041.8	-83.75
587764	[G16-094-TAP	230.00]	AMP	12634.5	-84.81
652276	[FTTHOMP8	69.000]	AMP	3619.3	-87.16
652506	[FTTHOMP3	345.00]	AMP	9028.0	-86.65
652509	[FTRANDL4	230.00]	AMP	10698.7	-83.87
652515	[HURON 7	115.00]	AMP	15334.8	-83.52
652516	[LAKPLAT4	230.00]	AMP	5552.1	-82.55
652519	[OAHE 4	230.00]	AMP	13243.2	-85.27
652530	[WATERTN4	230.00]	AMP	14244.5	-84.62
652540	[BIGBND14	230.00]	AMP	11650.9	-85.38
652541	[BIGBND24	230.00]	AMP	11661.7	-85.45
652606	[LETCHER4	230.00]	AMP	4705.0	-83.81
652607	[WESSINGTON 4	1230.00]	AMP	5790.2	-84.60
652614	[CARPENTER 4	230.00]	AMP	6893.3	-83.42
659205	[BRDLAND4	230.00]	AMP	9980.7	-84.12
587760	[GEN-2016-094	1230.00]	AMP	12319.6	-84.79
640540	[MEADOWGROVE4	1230.00]	AMP	5005.6	-83.12
652277	[LAKPLAT8	69.000]	AMP	4007.8	-87.21
652284	[HURON 8	69.000]	AMP	3658.4	-87.70
652488	[PHILTAP4	230.00]	AMP	3640.1	-82.69
652503	[BLAIR 4	230.00]	AMP	9833.8	-83.76
652510	[FTRANDL7	115.00]	AMP	12252.2	-83.40
652520	[OAHE 7	115.00]	AMP	11172.3	-86.54
652521	[SULLYBT4	230.00]	AMP	6392.8	-83.74
652523	[SIOUXFL4	230.00]	AMP	12800.7	-84.96
652526	[UTICAJC4	230.00]	AMP	7780.0	-82.99
652528	[WOONSKT7	115.00]	AMP	5197.9	-77.57
652529	[WATERTN3	345.00]	AMP	10434.8	-85.48

652531	[WATERTN7	115.00]	AMP	12260.4	-85.11
652535	[REDFELD7	115.00]	AMP	4088.9	-74.95
652565	[SIOUXCY4	230.00]	AMP	19287.7	-84.64
652582	[APPLEDORN 4 2	230.00]	AMP	7088.7	-82.36
652609	[LETCHER7	115.00]	AMP	6024.1	-83.27
652630	[WATERTNCAP 42	230.00]	AMP	14244.5	-84.62
652806	[FTTHOM1-LNX3]	345.00]	AMP	9028.0	-86.65
652807	[FTTHOM2-LNX3]	345.00]	AMP	9028.0	-86.65
655153	[MOS-AMES-ER8	69.000]	AMP	3548.7	-86.78
659120	[BRDLAND3	345.00]	AMP	4026.4	-86.66
659122	STORLA 4	230.00]	AMP	5443.2	-84.09
659196	[CARPENTER 8	69.000]	AMP	3173.4	-87.93
659295	SDPRAIRWND 4	230.00]	AMP	4465.4	-84.80
660003	[HURONWP7	115.00]	AMP	9975.4	-81.00
660009	BTAP WP7	115.00]	AMP	14897.2	-82.84
560074	[G16-017-TAP	345.00]	AMP	5934.8	-86.53
563230	[GEN-2015-089]	230.00]	AMP	5323.7	-82.21
602004	SPLT RK4	230.00]	AMP	12418.4	-84.96
620314	BIGSTON4	230.00]	AMP	16352.3	-85.17
640133	COLMBUS4	230.00]	AMP	10785.6	-84.81
640349	SPENCER7	115.00]	AMP	4517.9	-74.22
640386	TWIN CH4	230.00]	AMP	8417.7	-82.78
648506	[PR BRZ 4	230.00]	AMP	3475.6	-83.88
652175	[G09_001IST	345.00]	AMP	6292.2	-86.13
652224	[BLAIR 8	69.000]	AMP	2498.9	-87.96
652242	[WATERT18	69.000]	AMP	3868.9	-87.11
652285	[SULLYBT8	69.000]	AMP	2373.8	-87.79
652291	[REDFELD8	69.000]	AMP	2764.3	-83.36
652398	[VFODNES4	230.00]	AMP	6939.1	-83.65
652463	[WH SWAN7	115.00]	AMP	11950.6	-83.09
652475	[BONESTL7	115.00]	AMP	3462.6	-75.32
652476	EAGLEBT7	115.00]	AMP	1935.3	-77.40
652484	[NUNDRWD4	230.00]	AMP	3343.0	-82.38
652486	[PHILIP 4	230.00]	AMP	3067.8	-82.38
652491	[IRVSIMM7	115.00]	AMP	7929.5	-83.62
652500	[ARLNGTN7	115.00]	AMP	4283.0	-76.41
652501	[ARMOUR 7	115.00]	AMP	4110.4	-75.73
652504	[BROOKNG7	115.00]	AMP	7127.5	-81.03
652513	[HANLON 4	230.00]	AMP	5878.6	-84.28
652522	[SUMMIT-7	115.00]	AMP	4566.6	-75.48
652524	[SIOUXFL7	115.00]	AMP	25327.1	-84.12
652536	[RASMUSN4	230.00]	AMP	6565.6	-82.44
652550	[GRANITF4	230.00]	AMP	12956.0	-82.56
652564	[SIOUXCY3	345.00]	AMP	14794.1	-85.23
652566	[SIOUXCY5	161.00]	AMP	20203.1	-84.32
652567	[DENISON4	230.00]	AMP	4273.0	-79.62

652568	[GROTONSOUTH 115.00]	AMP	17501.9	-85.12
652578	[PAHOJA 4 230.00]	AMP	7216.2	-82.56
652600	[ASH TAP 115.00]	AMP	8417.8	-83.70
652604	[APPLEDORN 8 69.000]	AMP	2499.1	-89.04
652626	[UTICAJC7 115.00]	AMP	8651.1	-82.73
652821	[SULLYBT-LNX3230.00]	AMP	6392.8	-83.74
652829	[WATERTN-LNX3345.00]	AMP	10434.8	-85.48
652833	[GRPRAR2-LNX3345.00]	AMP	7286.1	-86.08
655063	[SW341-ER8 69.000]	AMP	3604.2	-87.06
655066	[SW352-ER8 69.000]	AMP	3642.9	-87.55
655067	[SW353-ER8 69.000]	AMP	3646.8	-87.59
655073	[MOS-CRPN-ER869.000]	AMP	2432.4	-84.42
655158	[MOS-HYDE-ER869.000]	AMP	2112.3	-78.12
655250	[CHMBRLAN-ER869.000]	AMP	1580.2	-72.02
655328	[BIGBEND-ER8 69.000]	AMP	2778.6	-78.11
655352	[AMES-ER8 69.000]	AMP	1260.3	-66.71
655355	[WOONSKT-ER8 69.000]	AMP	3549.7	-83.44
655385	[MOS-LKPL-ER869.000]	AMP	3993.3	-87.11
655412	[CRPNTR-ER8 69.000]	AMP	2814.1	-86.22
655417	[ROSWELL-ER7 115.00]	AMP	2601.1	-78.66
658088	[WTREAST7 115.00]	AMP	9487.4	-81.26
658094	[WTRPELI7 115.00]	AMP	8441.6	-80.55
659123	[STORLA 7 115.00]	AMP	6423.3	-81.55
659421	[BRDLAND-LNX3345.00]	AMP	4026.4	-86.66
659900	[EAGLE 4 230.00]	AMP	7081.2	-81.57
660002	[REDFLD 7 115.00]	AMP	4360.8	-79.49
660004	[MITCHEL7 115.00]	AMP	5861.5	-79.28
660008	[MITCLNW7 115.00]	AMP	5483.7	-79.18
660012	[HURON WP 869.000]	AMP	5502.0	-87.18
560347	[G10-051-TAP 230.00]	AMP	7030.1	-84.04
587130	[GEN-2016-017345.00]	AMP	5889.0	-86.51
587540	[ASGI1606 115.00]	AMP	5483.7	-79.18
587750	[GEN-2016-092345.00]	AMP	5347.3	-85.74
602008	[MINVALT4 230.00]	AMP	12823.5	-82.68
602009	[MNVLTAP4 230.00]	AMP	12784.7	-82.68
603009	[GRANT 7 115.00]	AMP	3944.9	-76.11
603012	[LAWRENC7 115.00]	AMP	28597.0	-84.68
603016	[SPLT RK7 115.00]	AMP	36114.1	-85.02
619975	[GRE-WILLMAR4230.00]	AMP	5182.2	-80.47
620214	[BIGSTON7 115.00]	AMP	12268.4	-84.24
620322	[BSSOUTH4 230.00]	AMP	16335.5	-85.34
620325	[BROWNSV4 230.00]	AMP	5904.5	-82.16
635200	[RAUN 3 345.00]	AMP	25196.6	-85.70
635223	[PLYMOTH5 161.00]	AMP	19767.8	-83.79
640126	[E.COL. 4 230.00]	AMP	9230.9	-84.55
640131	[COLMB.W4 230.00]	AMP	9357.8	-84.38

640134	[KELLY 7	115.00]	AMP	17099.6	-82.37
640305	ONEILL 7	115.00]	AMP	3856.2	-71.22
640343	SHELCRK4	230.00]	AMP	10327.6	-85.15
640387	[TWIN CH7	115.00]	AMP	10517.7	-83.16
640404	[WAYSIDE4	230.00]	AMP	2713.1	-82.54
652209	[SUMMIT-8	69.000]	AMP	2669.2	-83.95
652225	BROOKNG8	69.000]	AMP	2910.9	-86.48
652235	SIOUXFL8	69.000]	AMP	3877.4	-87.07
652243	FAITH 7	115.00]	AMP	2296.1	-78.85
652249	[ARMOUR 8	69.000]	AMP	2427.0	-83.83
652259	[EAGLEBE8	69.000]	AMP	1631.8	-82.04
652260	[EAGLEBW8	69.000]	AMP	2133.2	-81.08
652271	[ARLNGTN8	69.000]	AMP	2620.9	-84.06
652278	[HANLON18	69.000]	AMP	3008.2	-88.01
652279	[HANLON28	69.000]	AMP	3008.2	-88.01
652287	[RASMUSN8	69.000]	AMP	3158.5	-87.68
652397	[VFODNES7	115.00]	AMP	6256.5	-85.63
652399	VFODNES8	69.000]	AMP	4193.1	-87.94
652438	FORMAN 7	115.00]	AMP	6499.1	-82.04
652474	AURORA 7	115.00]	AMP	4422.2	-76.51
652478	[GREGORY7	115.00]	AMP	2111.9	-73.95
652481	[MIDLAND7	115.00]	AMP	3252.2	-78.14
652485	[NUNDRWD7	115.00]	AMP	5651.8	-82.71
652487	[PHILIP 7	115.00]	AMP	5027.0	-81.48
652489	[PIERRE 7	115.00]	AMP	7976.3	-83.31
652502	[BERSFRD7	115.00]	AMP	3167.4	-73.94
652505	[FLANDRU7	115.00]	AMP	4045.4	-74.87
652512	[GROTON 7	115.00]	AMP	17501.6	-85.12
652518	[MTVERN 7	115.00]	AMP	4240.6	-77.42
652525	[TYNDALL7	115.00]	AMP	3737.9	-74.85
652527	[WHITLOK4	230.00]	AMP	4795.4	-83.54
652532	[GR PRAIRIE	3345.00]	AMP	7286.1	-86.08
652533	[BRISTOL7	115.00]	AMP	4593.6	-75.14
652534	[ORDWAY 7	115.00]	AMP	9326.6	-77.90
652537	[WHITE 3	345.00]	AMP	21573.6	-86.04
652538	[WHITE 7	115.00]	AMP	9233.9	-86.22
652551	[GRANITF7	115.00]	AMP	17351.1	-82.38
652554	[MORRIS 4	230.00]	AMP	4800.1	-81.91
652561	[DENISON5	161.00]	AMP	5230.7	-80.84
652563	[SPENCER5	161.00]	AMP	9017.2	-80.51
652574	[SIOUXCY8	69.000]	AMP	17613.9	-79.64
652583	[DENISON8	69.000]	AMP	10947.7	-78.27
652588	[CLEVELD4	230.00]	AMP	4728.8	-82.20
652591	[HANLON 7	115.00]	AMP	5473.6	-84.67
652864	[SIOUXCY-LN>	(3345.00]	AMP	14794.1	-85.23
652884	[NUNDRWD-LN>	(3230.00]	AMP	3343.0	-82.38

655040	[MOS-ASTR-ER869.000]	AMP	1259.3	-78.08
655054	[MOS-RDFL-ER869.000]	AMP	2021.3	-75.36
655056	[SW313-ER8 69.000]	AMP	1555.8	-73.87
655059	[MOS-ASHT-ER869.000]	AMP	1614.7	-70.13
655064	[SW343-ER8 69.000]	AMP	3580.8	-87.12
655072	[SW373-ER8 69.000]	AMP	2287.3	-70.34
655080	[MOS-HLTP-ER869.000]	AMP	1305.3	-68.15
655108	[MOS-RVLE-ER869.000]	AMP	2631.1	-76.48
655111	[SW714-ER8 69.000]	AMP	2627.7	-70.24
655231	[HURON-ER8 69.000]	AMP	2343.7	-68.79
655236	[MORNINGS-ER869.000]	AMP	1861.3	-71.75
655238	[FRANKFRT-ER869.000]	AMP	2037.9	-78.12
655294	[MORITZ-ER8 69.000]	AMP	2066.1	-82.10
655329	[GANNVALL-ER869.000]	AMP	831.5	-61.13
655334	[OKOBOJO-ER8 69.000]	AMP	2363.5	-87.70
655373	[MOS-SLY2-ER869.000]	AMP	2370.1	-87.75
655377	[SW1145-ER7 115.00]	AMP	24115.7	-83.35
655384	[NWPS8645-ER869.000]	AMP	1551.9	-73.93
655386	[MOS-RVR1-ER869.000]	AMP	2084.0	-75.08
655418	[FREEMAN-ER7 115.00]	AMP	2551.0	-77.40
655419	[SW561-ER7 115.00]	AMP	5629.0	-79.16
658090	[WTRTNPP 115.00]	AMP	8954.9	-80.63
658092	[WTRWEST7 115.00]	AMP	8305.7	-80.37
658120	[GARFLD 7 115.00]	AMP	6938.2	-80.71
659160	[GROTON 3 345.00]	AMP	6083.2	-86.01
659275	[GROTONB7 115.00]	AMP	17070.2	-85.15
659376	[DRY CREEK 4230.00]	AMP	2606.1	-82.69
659420	[ANTELOP-LNX3345.00]	AMP	15863.0	-87.42
659424	[LELAND2-LNX3345.00]	AMP	16131.4	-86.96
659716	[MAPLETAP-L07115.00]	AMP	13047.4	-74.72
659901	[EAGLE 8 69.000]	AMP	13570.6	-82.27
660001	[ABDNSBT7 115.00]	AMP	7879.6	-82.76
660005	[TRIPP 7 115.00]	AMP	4225.6	-78.82
660007	[MENNOJT7 115.00]	AMP	6516.2	-80.66
660026	[NAPA JCT7 115.00]	AMP	7689.9	-78.95

#### 26SP

PSS®E ASCC SHORT CIRCUIT CURRENTS TUE, MAY 07 2019 11:25 2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL MDWG 2026S WITH MMWG 2026S

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OPTIONS USED:
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- 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 PHAS	E FAULT
Х	BUS	X		/I+/	AN(I+)
589324	[G17-094-TAP	230.00]	AMP	7696.4	-83.84
589320	[GEN-2017-094	1230.00]	AMP	7696.4	-83.84
652507	[FTTHOMP4	230.00]	AMP	19503.0	-85.59
652514	[HURON 4	230.00]	AMP	11056.3	-83.75
587764	[G16-094-TAP	230.00]	AMP	12643.1	-84.81
652276	[FTTHOMP8	69.000]	AMP	3619.5	-87.16
652506	[FTTHOMP3	345.00]	AMP	9034.8	-86.64
652509	FTRANDL4	230.00]	AMP	10725.9	-83.85
652515	HURON 7	115.00]	AMP	15333.3	-83.54
652516	[LAKPLAT4	230.00]	AMP	5556.2	-82.54
652519	OAHE 4	230.00]	AMP	13250.2	-85.27
652530	WATERTN4	230.00]	AMP	14397.9	-84.65
652540	BIGBND14	230.00]	AMP	11658.6	-85.38
652541	BIGBND24	230.00]	AMP	11669.3	-85.45
652606	[LETCHER4	230.00]	AMP	4713.8	-83.80
652607	[WESSINGTON 4	230.00]	AMP	5795.5	-84.60
652614	[CARPENTER 4	230.00]	AMP	6904.3	-83.42
659205	BRDLAND4	230.00]	AMP	9992.3	-84.12
587760	[GEN-2016-094	1230.00]	AMP	12327.7	-84.79
640540	[MEADOWGROVE4	230.00]	AMP	5010.4	-83.11
652277	[LAKPLAT8	69.000]	AMP	4008.4	-87.21
652284	[HURON 8	69.000]	AMP	3658.4	-87.70
652488	[PHILTAP4	230.00]	AMP	3640.6	-82.69
652503	[BLAIR 4	230.00]	AMP	9884.8	-83.76
652510	[FTRANDL7	115.00]	AMP	12277.9	-83.37
652520	[OAHE 7	115.00]	AMP	11188.7	-86.74
652521	[SULLYBT4	230.00]	AMP	6395.4	-83.74
652523	[SIOUXFL4	230.00]	AMP	12944.5	-84.94
652526	[UTICAJC4	230.00]	AMP	7834.4	-82.96
652528	[WOONSKT7	115.00]	AMP	5199.6	-77.56
652529	[WATERTN3	345.00]	AMP	10624.3	-85.51
652531	[WATERTN7	115.00]	AMP	12330.6	-85.10
652535	[REDFELD7	115.00]	AMP	4089.5	-74.95
652565	[SIOUXCY4	230.00]	AMP	19432.4	-84.62
652582	[APPLEDORN 4	230.00]	AMP	7115.5	-82.36
652609	[LETCHER7	115.00]	AMP	6032.1	-83.26

652630	[WATERTNCAP 4	230.00]	AMP	14397.9	-84.65
652806	[FTTHOM1-LNX3	345.00]	AMP	9034.8	-86.64
652807	[FTTHOM2-LNX3	345.00]	AMP	9034.8	-86.64
655153	[MOS-AMES-ER8	869.000]	AMP	3548.9	-86.78
659120	[BRDLAND3	345.00]	AMP	4028.8	-86.66
659122	[STORLA 4	230.00]	AMP	5449.4	-84.09
659196	[CARPENTER 8	69.000]	AMP	3174.0	-87.93
659295	[SDPRAIRWND 4	230.00]	AMP	4468.3	-84.79
660003	[HURONWP7	115.00]	AMP	9975.9	-81.01
660009	[BTAP WP7	115.00]	AMP	14894.2	-82.86
560074	[G16-017-TAP	345.00]	AMP	5937.2	-86.53
563230	[GEN-2015-089	230.00]	AMP	5347.3	-82.18
602004	[SPLT RK4	230.00]	AMP	12552.4	-84.94
620314	[BIGSTON4	230.00]	AMP	16468.4	-85.17
640133	[COLMBUS4	230.00]	AMP	10826.0	-84.80
640349	[SPENCER7	115.00]	AMP	4520.8	-74.20
640386	[TWIN CH4	230.00]	AMP	8440.2	-82.76
648506	[PR BRZ 4	230.00]	AMP	3477.4	-83.88
652175	[G09_001IST	345.00]	AMP	6325.5	-86.14
652224	[BLAIR 8	69.000]	AMP	2499.8	-87.96
652242	- [WATERT18	69.000]	AMP	3873.1	-87.11
652285	SULLYBT8	69.000]	AMP	2373.9	-87.79
652291	[REDFELD8	69.000]	AMP	2764.5	-83.36
652398	[VFODNES4	230.00]	AMP	6980.7	-83.64
652463	[WH SWAN7	115.00]	AMP	11975.6	-83.06
652475	[BONESTL7	115.00]	AMP	3464.2	-75.31
652476	[EAGLEBT7	115.00]	AMP	1935.6	-77.41
652484	[NUNDRWD4	230.00]	AMP	3347.0	-82.36
652486	[PHILIP 4	230.00]	AMP	3068.5	-82.38
652491	[IRVSIMM7	115.00]	AMP	7938.2	-83.75
652500	[ARLNGTN7	115.00]	AMP	4293.5	-76.39
652501	[ARMOUR 7	115.00]	AMP	4112.5	-75.72
652504	[BROOKNG7	115.00]	AMP	7163.0	-81.03
652513	[HANLON 4	230.00]	AMP	5900.5	-84.27
652522	[SUMMIT-7	115.00]	AMP	4621.9	-75.31
652524	[SIOUXFL7	115.00]	AMP	25743.8	-84.07
652536	[RASMUSN4	230.00]	AMP	6586.7	-82.42
652550	[GRANITF4	230.00]	AMP	13042.0	-82.55
652564	[SIOUXCY3	345.00]	AMP	14873.9	-85.22
652566	[SIOUXCY5	161.00]	AMP	20380.7	-84.30
652567	[DENISON4	230.00]	AMP	4283.4	-79.61
652568	[GROTONSOUTH	115.00]	AMP	17532.5	-85.12
652578	[РАНОЈА 4	230.00]	AMP	7277.9	-82.55
652600	[ASH TAP	115.00]	AMP	8427.9	-83.84
652604	[APPLEDORN 8	69.000]	AMP	2500.1	-89.05
652626	[UTICAJC7	115.00]	AMP	8767.3	-82.61

652821	[SULLYBT-LNX3230.00]	AMP	6395.4	-83.74
652829	[WATERTN-LNX3345.00]	AMP	10624.3	-85.51
652833	[GRPRAR2-LNX3345.00]	AMP	7296.5	-86.08
655063	[SW341-ER8 69.000]	AMP	3604.2	-87.06
655066	[SW352-ER8 69.000]	AMP	3642.9	-87.55
655067	[SW353-ER8 69.000]	AMP	3646.8	-87.59
655073	[MOS-CRPN-ER869.000]	AMP	2432.8	-84.42
655158	[MOS-HYDE-ER869.000]	AMP	2112.3	-78.12
655250	[CHMBRLAN-ER869.000]	AMP	1580.3	-72.02
655328	[BIGBEND-ER8 69.000]	AMP	2778.7	-78.11
655352	[AMES-ER8 69.000]	AMP	1260.3	-66.71
655355	[WOONSKT-ER8 69.000]	AMP	3550.1	-83.44
655385	[MOS-LKPL-ER869.000]	AMP	3993.9	-87.11
655412	[CRPNTR-ER8 69.000]	AMP	2814.6	-86.22
655417	[ROSWELL-ER7 115.00]	AMP	2602.6	-78.66
658088	[WTREAST7 115.00]	AMP	9529.1	-81.23
658094	[WTRPELI7 115.00]	AMP	8474.6	-80.53
659123	[STORLA 7 115.00]	AMP	6426.8	-81.55
659421	[BRDLAND-LNX3345.00]	AMP	4028.8	-86.66
659900	[EAGLE 4 230.00]	AMP	7127.7	-81.52
660002	[REDFLD 7 115.00]	AMP	4303.3	-79.64
660004	[MITCHEL7 115.00]	AMP	5870.1	-79.26
660008	[MITCLNW7 115.00]	AMP	5490.8	-79.16
660012	HURON WP 869.000	AMP	5502.0	-87.18
560347	G10-051-TAP 230.00	AMP	7041.3	-84.03
587130	GEN-2016-017345.00	AMP	5891.3	-86.51
587540	[ASGI1606 115.00]	AMP	5490.8	-79.16
587750	[GEN-2016-092345.00]	AMP	5349.1	-85.74
602008	[MINVALT4 230.00]	AMP	12906.0	-82.68
602009	[MNVLTAP4 230.00]	AMP	12866.6	-82.67
603009	GRANT 7 115.00	AMP	3950.0	-76.09
603012	[LAWRENC7 115.00]	AMP	28999.5	-84.64
603016	[SPLT RK7 115.00]	AMP	36582.4	-84.99
619975	[GRE-WILLMAR4230.00]	AMP	5216.3	-80.48
620214	[BIGSTON7 115.00]	AMP	12389.5	-84.17
620322	[BSSOUTH4 230.00]	AMP	16453.8	-85.34
620325	[BROWNSV4 230.00]	AMP	5885.1	-82.09
635200	[RAUN 3 345.00]	AMP	25314.3	-85.69
635223	[PLYMOTH5 161.00]	AMP	19932.4	-83.76
640126	[E.COL. 4 230.00]	AMP	9260.8	-84.54
640131	[COLMB.W4 230.00]	AMP	9391.2	-84.37
640134	[KELLY 7 115.00]	AMP	17171.1	-82.34
640305	[ONEILL 7 115.00]	AMP	3857.9	-71.21
640343	[SHELCRK4 230.00]	AMP	10362.1	-85.14
640387	[TWIN CH7 115.00]	AMP	10539.5	-83.14
640404	[WAYSIDE4 230.00]	AMP	2714.0	-82.53
640305 640343 640387 640404	[ONEILL 7 115.00] [SHELCRK4 230.00] [TWIN CH7 115.00] [WAYSIDE4 230.00]	AMP AMP AMP AMP	3857.9 10362.1 10539.5 2714.0	-71.21 -85.14 -83.14 -82.53

652209	[SUMMIT-8	69.000]	AMP	2994.6	-80.00
652225	BROOKNG8	69.000]	AMP	2914.4	-86.48
652235	SIOUXFL8	69.000]	AMP	3883.2	-87.07
652243	FAITH 7	115.00]	AMP	2296.4	-78.85
652249	ARMOUR 8	69.000]	AMP	2427.4	-83.83
652259	- [EAGLEBE8	69.000]	AMP	1631.9	-82.04
652260	- EAGLEBW8	69.000]	AMP	2133.4	-81.08
652271	- [ARLNGTN8	69.000]	AMP	2623.3	-84.06
652278	- [HANLON18	69.000]	AMP	3009.9	-88.01
652279	- [HANLON28	69.000]	AMP	3009.9	-88.01
652287	RASMUSN8	69.000]	AMP	3160.0	-87.68
652397	VFODNES7	115.00]	AMP	6272.3	-85.63
652399	_ [VFODNES8	69.000]	AMP	4197.6	-87.94
652474	AURORA 7	115.00]	AMP	4433.7	-76.50
652478	_ [GREGORY7	115.00]	AMP	2112.3	-73.95
652481	[MIDLAND7	115.00]	AMP	3253.6	-78.14
652485	- [NUNDRWD7	115.00]	AMP	5858.4	-82.69
652487	「PHILIP 7	115.00]	AMP	5032.2	-81.46
652489	_ [PIERRE 7	115.00]	AMP	7985.4	-83.44
652502	- [BERSFRD7	115.00]	AMP	3902.6	-75.50
652505	- [FLANDRU7	115.00]	AMP	4053.9	-74.85
652512	GROTON 7	115.00]	AMP	17532.1	-85.12
652518	MTVERN 7	115.00]	AMP	4242.3	-77.41
652525	TYNDALL7	115.00]	AMP	3767.7	-74.76
652527	- WHITLOK4	230.00	AMP	4798.1	-83.54
652532	[GR PRAIRIE 3	3345.00]	AMP	7296.5	-86.08
652533	[BRISTOL7	115.00]	AMP	4606.5	-75.10
652534	ORDWAY 7	115.00]	AMP	9334.6	-77.89
652537	[WHITE 3	345.00]	AMP	23604.8	-86.31
652538	WHITE 7	115.00]	AMP	9319.4	-86.28
652551	[GRANITF7	115.00]	AMP	17457.5	-82.35
652554	[MORRIS 4	230.00]	AMP	4789.8	-81.93
652561	[DENISON5	161.00]	AMP	5241.9	-80.83
652563	SPENCER5	161.00]	AMP	10257.9	-82.21
652574	[SIOUXCY8	69.000]	AMP	17677.3	-79.60
652583	[DENISON8	69.000]	AMP	10977.5	-78.23
652588	[CLEVELD4	230.00]	AMP	4769.6	-82.21
652591	[HANLON 7	115.00]	AMP	5484.1	-84.66
652864	[SIOUXCY-LNX3	3345.00]	AMP	14873.9	-85.22
652884	[NUNDRWD-LNX3	3230.00]	AMP	3347.0	-82.36
655040	[MOS-ASTR-ER8	369.000]	AMP	1259.5	-78.07
655054	[MOS-RDFL-ER8	369.000]	AMP	2021.4	-75.36
655056	[SW313-ER8	69.000]	AMP	1556.0	-73.86
655059	[MOS-ASHT-ER8	369.000]	AMP	1614.8	-70.13
655064	[SW343-ER8	69.000]	AMP	3580.7	-87.12
655072	[SW373-ER8	69.000]	AMP	2287.5	-70.33

655080	[MOS-HLTP-ER869.000]	AMP	1305.4	-68.15
655108	[MOS-RVLE-ER869.000]	AMP	2633.0	-76.48
655111	[SW714-ER8 69.000]	AMP	2629.5	-70.22
655231	[HURON-ER8 69.000]	AMP	2343.7	-68.79
655236	[MORNINGS-ER869.000]	AMP	1861.3	-71.75
655238	[FRANKFRT-ER869.000]	AMP	2038.0	-78.12
655294	[MORITZ-ER8 69.000]	AMP	2066.6	-82.10
655329	[GANNVALL-ER869.000]	AMP	831.5	-61.13
655334	[OKOBOJO-ER8 69.000]	AMP	2363.6	-87.70
655373	[MOS-SLY2-ER869.000]	AMP	2370.2	-87.75
655377	[SW1145-ER7 115.00]	AMP	24492.8	-83.29
655384	[NWPS8645-ER869.000]	AMP	1551.9	-73.93
655386	[MOS-RVR1-ER869.000]	AMP	2084.1	-75.08
655418	[FREEMAN-ER7 115.00]	AMP	2560.8	-77.34
655419	[SW561-ER7 115.00]	AMP	5631.7	-79.15
658090	[WTRTNPP 115.00]	AMP	8992.0	-80.60
658092	[WTRWEST7 115.00]	AMP	8337.7	-80.35
658120	[GARFLD 7 115.00]	AMP	6945.8	-80.83
659160	[GROTON 3 345.00]	AMP	6102.6	-86.01
659171	[ROBERTS CO 7115.00]	AMP	3286.8	-76.07
659275	[GROTONB7 115.00]	AMP	17098.4	-85.15
659376	[DRY CREEK 4230.00]	AMP	2606.3	-82.69
659420	[ANTELOP-LNX3345.00]	AMP	15902.4	-87.40
659424	[LELAND2-LNX3345.00]	AMP	16167.5	-86.95
659716	[MAPLETAP-L07115.00]	AMP	13154.6	-74.61
659901	[EAGLE 8 69.000]	AMP	13649.1	-82.18
660001	[ABDNSBT7 115.00]	AMP	7870.1	-82.79
660005	[TRIPP 7 115.00]	AMP	4237.9	-78.77
660007	[MENNOJT7 115.00]	AMP	6574.0	-80.55
660026	[NAPA JCT7 115.00]	AMP	7941.0	-78.75