GEN-2016-020

Limited Operation Interconnection System Impact Study Report

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By Generator Interconnection

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
9/16/2020	SPP	Initial posting of Limited Operation System Impact Study of Cluster Group 1 requests: GEN-2016-020

CONTENTS

EXECUTIVE SUMMARY

The GEN-2016-020 Interconnection Customer has requested a Limited Operation System Impact Study (LOIS) under the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2016-020 has requested 148.4 MW of wind generation be interconnected with Energy Resource Interconnection Service (ERIS) into the transmission system of Western Farmers Electric Cooperative (WEFC) in Woodward County, Oklahoma. Interconnection Customer has requested this LOIS to determine the amount of interconnection service that is available under Limited Operation under system conditions with a temporary interconnection configuration with the Mooreland to Ft Supply and Mooreland to Noel 138kV circuits sharing a breaker terminal at Mooreland 138kV substation.

This LOIS addresses the effects of interconnecting the generator to the rest of the transmission system for the system topology and conditions as expected on December 15, 2020. GEN-2016-020 is requesting the interconnection of forty (40) GE 116 2.3 MW and twenty (20) GE 127 2.82 MW wind turbines and associated facilities interconnecting at Mooreland 138kV substation. For this LOIS, power flow and stability analyses were conducted.

Power flow and stability analysis from this LOIS has determined that GEN-2016-020 can interconnect 148.4 MW of wind generation with Energy Resource Interconnection Service (ERIS) on December 15, 2020 under Limited Operation.

It should be noted that while this LOIS analyzed many of the most probable contingencies, it is not an all-inclusive list that can account for every operational situation. Additionally, the generator may not be able to inject any power onto the Transmission System due to constraints that fall below the threshold of mitigation for a Generator Interconnection request. Because of this, 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-2016-020 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

The GEN-2016-020 Interconnection Customer has requested a Limited Operation System Impact Study (LOIS) under the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2016-020 has requested 148.4 MW of wind generation be interconnected with Energy Resource Interconnection Service (ERIS) into the transmission system of Western Farmers Electric Cooperative (WEFC) in Woodward County, Oklahoma. Interconnection Customer has requested this LOIS to determine the amount of interconnection service that is available under Limited Operation under system conditions with a temporary interconnection configuration with the Mooreland to Ft Supply and Mooreland to Noel 138kV circuits sharing a breaker terminal at Mooreland 138kV substation.

The purpose of this study is to evaluate the impacts of interconnecting GEN-2016-020 request with a total of 148.4 MW comprised of forty (40) GE 116 2.3 MW and twenty (20) GE 127 2.82 MW wind turbines and associated facilities interconnecting at Mooreland 138kV substation. The Interconnection Customer has requested this amount to be studied with Energy Resource Interconnection Service (ERIS) to commence on or around December 15, 2020.

Power flow and transient stability analyses were conducted for this LOIS in accordance with GIA Article 5.9: Limited Operation.

The LOIS 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 LOIS is commenced:

a) are directly interconnected to the Transmission System;
b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;
c) have a pending higher queued Interconnection Request to interconnect to the Transmission System listed in **Table 1**; or
d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Any changes to these assumptions, for example, one or more of the previously queued requests not included within this study executing an interconnection agreement and commencing commercial operation, may require a re-study of this LOIS at the expense of the Customer.

Nothing within this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service rights. Should the Customer require transmission service, those rights should be requested through SPP's Open Access Same-Time Information System (OASIS).

This LOIS study included prior queued generation interconnection requests. Those listed within **Table 1** are the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested December 15, 2020 in-service for this LOIS. Also listed in **Table 1** are both the amount of MWs of interconnection service expected at the effective

time of this study and the total MWs requested of interconnection service, the fuel type, the point of interconnection (POI), and the current status of each particular prior queued request.

Table 1: Group 1 Generation Requests Included within LOIS

Gen Number	Fuel Type	MW Amount	Total MW	POI	Status
GEN-2001-014	Wind	94.5	94.5	Ft Supply 138kV	COMMERCIAL OPERATION
GEN-2001-037	Wind	102	102	FPL Moreland Tap 138kV	COMMERCIAL OPERATION
GEN-2005-008	Wind	120	120	Woodward 138kV	COMMERCIAL OPERATION
GEN-2006-024S	Wind	18.9	18.9	Buffalo Bear Tap 69kV	COMMERCIAL OPERATION
GEN-2006-046	Wind	130	130	Dewey 138kV	COMMERCIAL OPERATION
GEN-2007-021	Wind	200	200	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2007-043	Wind	200	200	Minco 345kV	COMMERCIAL OPERATION
GEN-2007-044	Wind	300	300	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2007-050	Wind	151.8	151.8	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2007-062	Wind	425	425	Woodward EHV 345kV	COMMERCIAL OPERATION
GEN-2008-003	Wind	101.2	101.2	Woodward EHV 138kV	COMMERCIAL OPERATION
GEN-2008-044	Wind	197.8	197.8	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2010-011	Wind	29.7	29.7	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2010-040	Wind	300	300	Cimarron 345kV	COMMERCIAL OPERATION
GEN-2011-010	Wind	100.8	100.8	Minco 345kV	COMMERCIAL OPERATION
GEN-2011-019	Wind	175	175	Woodward 345kV	ON SCHEDULE
GEN-2011-020	Wind	165	165	Woodward 345kV	ON SCHEDULE
GEN-2011-054	Wind	300	300	Cimarron 345kV	COMMERCIAL OPERATION
GEN-2014-002	Wind	10.53	10.53	Tatonga 345kV	COMMERCIAL OPERATION
GEN-2014-005	Wind	5.67	5.67	Minco 345kV	COMMERCIAL OPERATION
GEN-2014-020	Wind	100	100	Tuttle 138kV	COMMERCIAL OPERATION
GEN-2014-056	Wind	250	250	Minco 345kV	COMMERCIAL OPERATION
GEN-2015-029	Wind	161	161	Tatonga 345kV	ON SCHEDULE
GEN-2015-048	Wind	200	200	Cleo Corner 138kV	ON SCHEDULE
GEN-2015-057	Wind	100	100	Minco 345kV	COMMERCIAL OPERATION
GEN-2015-093	Wind	250	250	Gracemont 345kV	ON SUSPENSION
GEN-2015-095	Wind	176	176	DeGrasse 138kV	ON SCHEDULE
GEN-2016-003	Wind	248.4	248.4	Tap Badger - Woodward 345kV	ON SCHEDULE
GEN-2016-020	WIND	148.4	148.4	Mooreland 138kV	ON SCHEDULE
GEN-2016-045	Wind	499.1	499.1	Mathewson 345kV	ON SCHEDULE
GEN-2016-047	CT	469	469	Mustang 69kV	COMMERCIAL OPERATION
GEN-2016-057	Wind	499.1	499.1	Mathewson 345kV	ON SCHEDULE
GEN-2016-118	Wind	288	288	Dover Switchyard 138kV	IA PENDING
GEN-2016-131	Wind	2.5	2.5	Minco Substation 345kV	ON SCHEDULE

As Transmission Owner's Interconnection Facilities or Network Upgrades were not reasonably expected to be completed prior to the Commercial Operation Date of the GEN-2016-020 Generating

Facility, December 15, 2020, Interconnection Customer has requested this LOIS to determine the amount of interconnection service that is available under Limited Operation.

To accommodate the requested Commercial Operation Date, Transmission Owner and Interconnection Customer negotiated a temporary interconnection configuration with GEN-2016-020 utilizing an existing breaker terminal and both the Mooreland to Ft Supply and Mooreland to Noel 138kV circuits sharing a breaker terminal at Mooreland 138kV substation. These terminals are illustrated in Figure 1.

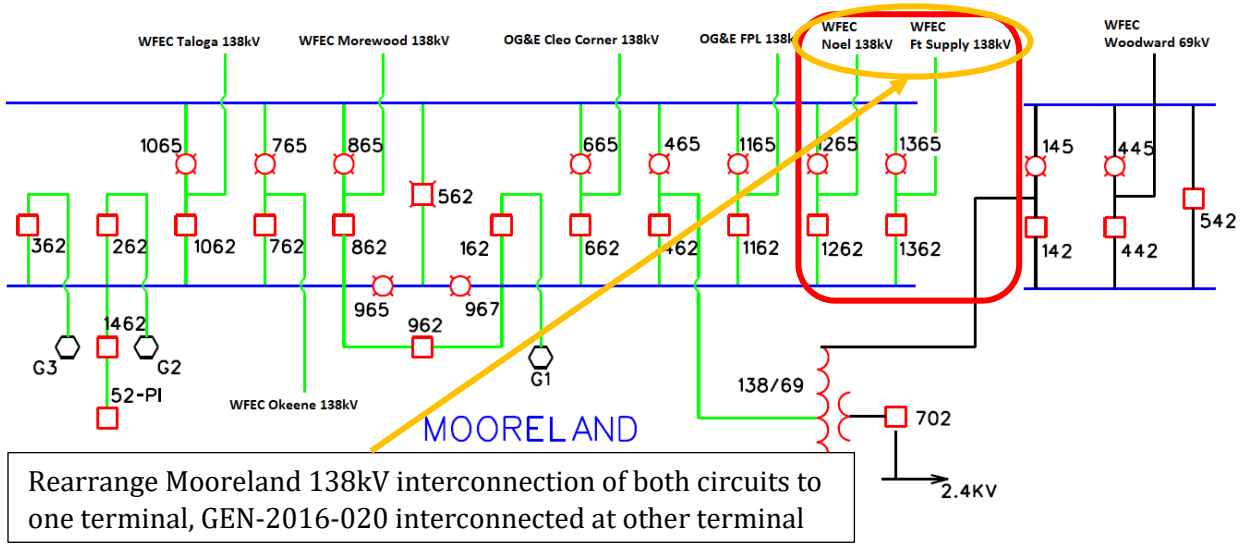


Figure 1: Existing WFEC Mooreland Switch Station

This temporary configuration is anticipated to transition to a permanent configuration scheduled for completion around July 2022 dependent on the ability to take outages of the Mooreland 138 kV facilities. These terminals are illustrated in Figure 2.

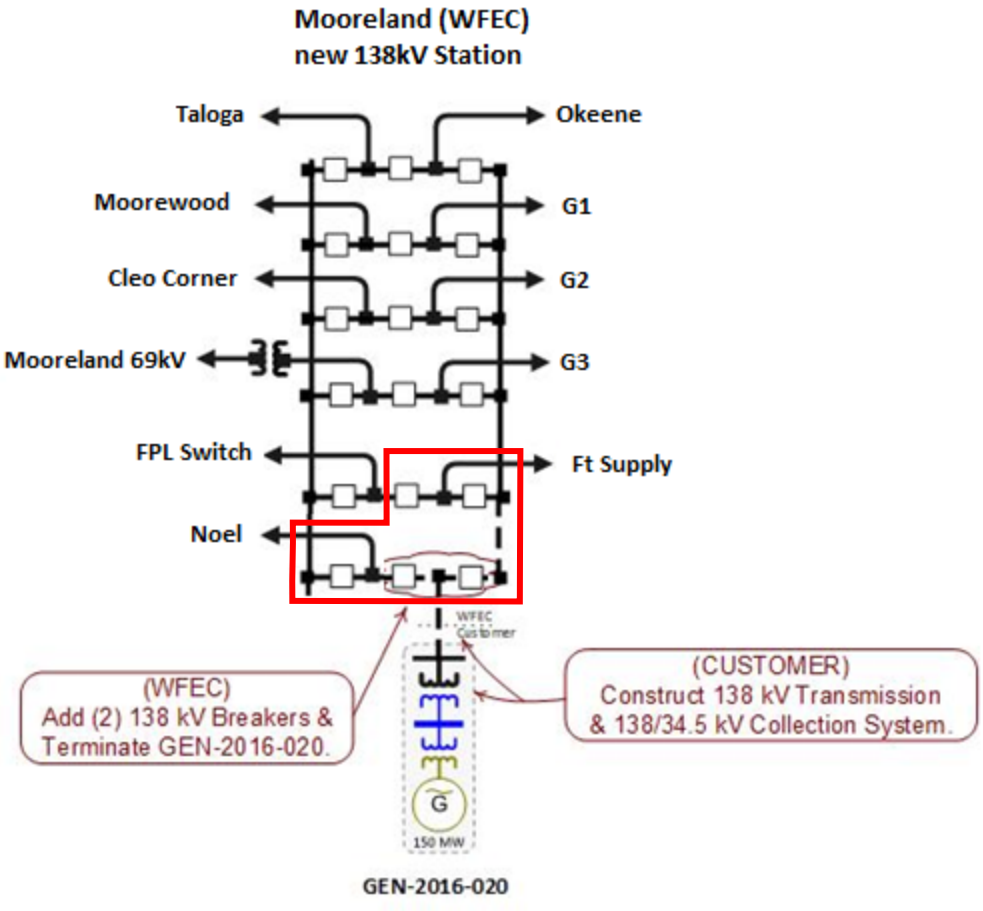


Figure 2: Proposed WFEC Mooreland Switch Station

Table 2 below lists the required Transmission Owner's Interconnection Facilities or Network Upgrades for which GEN-2016-020 requires to be in-service prior to full Commercial Operation.

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

Upgrade Project	Type	Description	Status
New Mooreland Interconnection Substation: Permanent Configuration for GEN-2016-020	Transmission Owner's Interconnection Facilities and Network Upgrades constructed by Transmission Owner	138 kV line terminal, line switches, dead end structures, line relaying, communications, revenue metering, line arrestors, and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer's Generating Facility. Breaker and a half terminal with two (2) 138 kV 2000 continuous ampacity breakers, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials.	Scheduled for 4/16/2021 completion
Completion of Transmission Owner's New Mooreland Interconnection Substation	Network Upgrades constructed by Transmission Owner	Finish all work needed to complete the New Mooreland Interconnection Substation.	Scheduled for 7/1/2022 completion
Oklahoma Gas and Electric Company (OKGE) Interconnection Substation	Network Upgrades constructed by other transmission owning entity	Update relay settings and records	TBD

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

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

Project	MW	Total MW	Fuel Source	POI	Status
No equally or higher queued projects were excluded from this study.					

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

FACILITIES

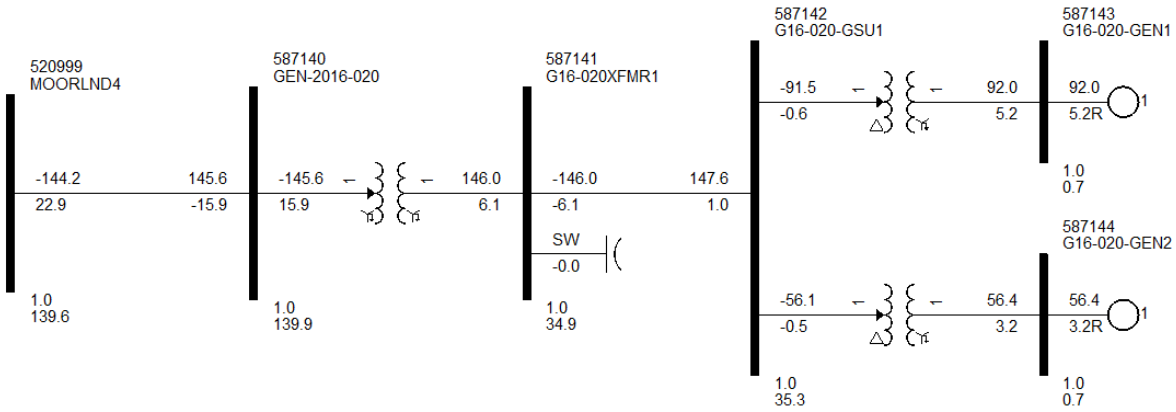
GENERATING FACILITY

The Interconnection Customer's request to interconnect a generating facility with a capacity of 148.4 MW comprised of forty (40) GE 116 2.3 MW and twenty (20) GE 127 2.82 MW wind turbines and associated facilities interconnecting at Mooreland 138kV 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 LOIS 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 15, 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 LOIS. If for some reason, construction on these projects is delayed or discontinued, a restudy may be needed to determine the interconnection service availability of the Customer.

Table 4 below lists transmission facilities updates considered for inclusion in the study cases. The listed in-service facilities were included in the study cases and facilities with a future in-service date were excluded.

Table 4: Upgrade Project Updates Considered in Study Cases

Upgrade Project	Type	Description	Status
DeGrasse 345 kV Substation	Regional Reliability	Tap the double-circuit 345 kV line from Woodward to Thistle to construct and interconnect the new DeGrasse substation. Install any 345 kV substation facilities needed for the new 345/138 kV transformer.	In-Service
DeGrasse 345/138 kV Transformer	Regional Reliability	Install new 345/138 kV transformer at the new DeGrasse substation.	In-Service
DeGrasse - Knob Hill 138 kV New Line	Regional Reliability	Construct new 138 kV line from the new DeGrasse substation to Knob Hill.	In-Service
DeGrasse 138 kV Substation (OGE)	Regional Reliability	Tap the existing 138 kV line from Mooreland to Rose Valley and terminate both end points into the new DeGrasse substation. OGE and Western Farmers Electric Cooperative shall decide who shall build how much of these Network Upgrades and shall provide such information, along with specific cost estimates for each DTO's portion of the Network Upgrades, to SPP in its response to this NTC.	In-Service
DeGrasse 138 kV Substation (WFEC)	Regional Reliability	Tap the existing 138 kV line from Mooreland to Rose Valley and terminate both end points into the new DeGrasse substation. WFEC and Oklahoma Gas and Electric Company shall decide who shall build how much of these Network Upgrades and shall provide such information, along with specific cost estimates for each DTO's portion of the Network Upgrades, to SPP in its response to this NTC.	Scheduled for 12/1/2024 completion

POWER FLOW ANALYSIS

Power flow analysis from this LOIS evaluated whether GEN-2016-020 can interconnect 148.4 MW of wind generation with Energy Resource Interconnection Service (ERIS) on December 15, 2020.

The power flow analysis observed thermal constraints with the base study system conditions following specific contingencies. These constraints were found to be mitigated with a system adjustment of the Woodward Phase Shifting Transformer phase angle set point from 5 degrees to 0 degrees. This system adjustment was applied to the base study models as an alternate base study system condition. This alternate base study system condition did not result in any observed constraints and the adjustment is an acceptable mitigation.

Power flow analysis has determined that GEN-2016-020 can interconnect 148.4 MW of wind generation with Energy Resource Interconnection Service (ERIS) on December 15, 2020 under Limited Operation.

The full power flow report can be found as an attachment to this document.

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 (20) contingencies were identified for use in this study. These faults are listed within Table 5. These contingencies included three-phase faults and single-phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

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 seven (7) 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 seven (7) 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 sixteen (16) 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 5: Contingencies Evaluated for Limited Operation Service

Cont. No.	Contingency Name	Description
1	FAULT__--1-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the FT.SUPPLY to MOORLND4 138 kV line and MOORLND4 to Noel 138 kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
2	FAULT__--2-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to OKEENE 138 kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
3	FAULT__--3-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to MOREWOOD 138 kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
4	FAULT__--4-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to Cleo Corner 138 kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
5	FAULT__--5-P1_2-Windfarm138kV	3 phase fault near WINDFRM4 138 kV cleared by opening the WINDFRM4 to WOODWRD 138 kV line. a. Apply fault at the WINDFRM4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
6	FAULT__--6-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to TALOGA 138 kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
7	FAULT__--7-P1_3-Mooreland138kV	3 phase fault on MOORELAND to MOORELAND2 138/69/17kV Transformer 1, near MOORELND 138kV. a. Apply fault at the MOORELND 138kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Cont. No.	Contingency Name	Description
8	FAULT__--8-P1_3-DeGrasse138kV	3 phase fault on DEGRASSE7 to DEGRASSE4 345/138/17kV Transformer 1, near DEGRASSE4 138 kV. a. Apply fault at the DEGRASSE7 138kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
9	FAULT__--9-P6_1_1-Buffalo345kV	Prior Outage of BUFFALO to WICHITA 345kV Ckt 1 3 phase fault, near BUFFALO cleared by opening the BUFFALO to WICHITA 345kV Ckt 2 a. Apply fault at the BUFFALO 345 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
10	FAULT__--10-P6_1_1-Mooreland138kV	Prior Outage of MOORELAND to TALOGA 138kV circuit 3 phase fault, near MOORELAND cleared by opening the MOORLND4 to FT SUPPLY 138 kV line and MOORLND4 to NOEL 138 kV line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
11	FAULT__--11-P6_1_1-Mooreland138kV	Prior Outage of MOORELAND to PIC 138kV circuit 3 phase fault, near MOORELAND cleared by opening the MOORLND4 to FT SUPPLY 138 kV line and MOORLND4 to NOEL 138 kV line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
12	FAULT__--12-P6_1_1-Mooreland138kV	Prior Outage of MOORELAND to BEARCAT 138kV circuit 3 phase fault near MOORELAND cleared by opening the MOORLND4 to FT SUPPLY 138 kV line and MOORLND4 to NOEL 138 kV line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
13	FAULT__--13-P6_1_1-Mooreland138kV	Prior Outage of MOORELAND to GLASSMTN 138kV circuit 3 phase fault, near MOORELAND cleared by opening the MOORLND4 to FT SUPPLY 138 kV line and MOORLND4 to NOEL 138 kV line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.
14	FAULT__--14-P6_1_1-Mooreland138kV	Prior Outage of WINDFRM to WOODWARD 138kV circuit 3 phase fault, near MOORELAND cleared by opening the MOORLND4 to FT SUPPLY 138 kV line and MOORLND4 to NOEL 138 kV line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove the fault.

Cont. No.	Contingency Name	Description
15	FAULT__--15-P4_2-Mooreland138kV	Single line to ground fault with stuck breaker near MOORLND4 138 kV cleared by opening: Mooreland unit 3, Mooreland unit 2, Mooreland to Taloga 138kV line, Mooreland to Okeene 138kV line, Mooreland to Moorewood 138kV line. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 16 cycles and trip the faulted line.
16	FAULT__--16-P4_3-Mooreland138kV	Single line to ground fault with stuck breaker near MOORLND4 138 kV cleared by opening: Mooreland unit 1, Mooreland to Cleo Corner 138kV line, Mooreland 138/69 kV transformer, Mooreland to WINDFRM4 138kV line Mooreland to Noel 138kV line, Mooreland to Ft. Supply 138kV line, Mooreland to GEN-2016-020 line a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 16 cycles and trip the faulted line.
17	FAULT__--17-P4_2-DeGrasse	Single line to ground fault with stuck breaker near DEGRASSE 345 kV cleared by opening the DEGRASSE to THISTLE CKT 1 & 2 345kV lines. a. Apply fault at the DEGRASSE 138 kV bus. b. Clear fault after 16 cycles and trip the faulted line.
18	FAULT__--18-P4_2-DeGrasse	Single line to ground fault with stuck breaker near DEGRASSE 345 kV cleared by opening the DEGRASSE to WOODWARD CKT 1 & 2 345kV lines. a. Apply fault at the DEGRASSE 138 kV bus. b. Clear fault after 16 cycles and trip the faulted line.
19	FAULT__--19-P4_3-DeGrasse	Single line to ground fault with stuck breaker near DEGRASSE7 cleared by opening the DEGRASSE7 to DEGRASSE4 345/138/17kV Transformer and DeGrasse to Thistle CKT 2 345 kV line. a. Apply fault at the DEGRASSE7 138kV bus. b. Clear fault after 16 cycles and trip the faulted transformer.
20	FAULT__--20-P4_3-DeGrasse	Single line to ground fault with stuck breaker near DEGRASSE7 cleared by opening the DEGRASSE7 to DEGRASSE4 345/138/17kV Transformer and DeGrasse to WOODWARD CKT1 345 kV line. a. Apply fault at the DEGRASSE7 138kV bus. b. Clear fault after 16 cycles and trip the faulted transformer.

RESULTS

Results of the stability analysis are summarized in **Table 6**. These results are valid for GEN-2016-020 interconnecting with a generation amount up to 148.4 MW.

Table 6: Fault Analysis Results

	Contingency Number and Name	2017WP	2018SP	2026SP
1	FAULT__--1-P1_2-Mooreland138kV	Stable	Stable	Stable
2	FAULT__--2-P1_2-Mooreland138kV	Stable	Stable	Stable
3	FAULT__--3-P1_2-Mooreland138kV	Stable	Stable	Stable
4	FAULT__--4-P1_2-Mooreland138kV	Stable	Stable	Stable
5	FAULT__--5-P1_2-Windfarm138kV	Stable	Stable	Stable
6	FAULT__--6-P1_2-Mooreland138kV	Stable	Stable	Stable
7	FAULT__--7-P1_3-Mooreland138kV	Stable	Stable	Stable
8	FAULT__--8-P1_3-DeGrasse138kV	Stable	Stable	Stable
9	FAULT__--9-P6_1_1-Buffalo345kV	Stable	Stable	Stable
10	FAULT__--10-P6_1_1-Mooreland138kV	Stable	Stable	Stable
11	FAULT__--11-P6_1_1-Mooreland138kV	Stable	Stable	Stable
12	FAULT__--12-P6_1_1-Mooreland138kV	Stable	Stable	Stable
13	FAULT__--13-P6_1_1-Mooreland138kV	Stable	Stable	Stable
14	FAULT__--14-P6_1_1-Mooreland138kV	Stable	Stable	Stable
15	FAULT__--15-P4_2-Mooreland138kV	Stable	Stable	Stable
16	FAULT__--16-P4_3-Mooreland138kV	Stable	Stable	Stable
17	FAULT__--17-P4_2-DeGrasse	Stable	Stable	Stable
18	FAULT__--18-P4_2-DeGrasse	Stable	Stable	Stable
19	FAULT__--19-P4_3-DeGrasse	Stable	Stable	Stable
20	FAULT__--20-P4_3-DeGrasse	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 7.

Table 7: LVRT Fault Events

Contingency Number and Name		Description
1	FAULT__--1-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the FT.SUPPLY to MOORLND4 138 kV line and MOORLND4 to Noel 138 kV line.
2	FAULT__--2-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to OKEENE 138 kV line.
3	FAULT__--3-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to MOREWOOD 138 kV line.

Contingency Number and Name		Description
4	FAULT__--4-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to Cleo Corner 138 kV line.
5	FAULT__--5-P1_2-Windfarm138kV	3 phase fault near WINDFRM4 138 kV cleared by opening the WINDFRM4 to WOODWRD 138 kV line.
6	FAULT__--6-P1_2-Mooreland138kV	3 phase fault near MOORLND4 138 kV cleared by opening the MOORLND4 to TALOGA 138 kV line.
7	FAULT__--7-P1_3-Mooreland138kV	3 phase fault on MOORELAND to MOORELAND2 138/69/17kV Transformer 1, near MOORELND 138kV.

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-2016-020 is found to be in compliance with FERC Order #661A.

POWER FACTOR ANALYSIS

Analysis was not conducted. In accordance with FERC Order 827 GEN-2016-020 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.

SHORT CIRCUIT ANALYSIS

The short circuit analysis was not performed again for this restudy. Prior analysis results remain the same.

CONCLUSION

The GEN-2016-020 Interconnection Customer has requested a Limited Operation System Impact Study (LOIS) the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2016-020 has requested 148.4 MW of wind generation be interconnected with Energy Resource Interconnection Service (ERIS) into the transmission system of Western Farmers Electric Cooperative (WEFC) in Woodward County, Oklahoma.

Power flow and stability analysis from this LOIS has determined that the GEN-2016-020 request can interconnect 148.4 MW of generation with Energy Resource Interconnection Service (ERIS) under Limited Operation prior to the completion of the required Network Upgrades, listed within Table *2* of this report.

Additionally, GEN-2016-020 was found to be in compliance with FERC Order #661A when studied as listed within this report.

Nothing in this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service.