



Interconnection Facilities Study

**GEN-2015-015
(IFS-2015-001-14)**

May 2016

Generator Interconnection



SPP *Southwest
Power Pool*

Revision History

Date	Author	Change Description
4/14/2016	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued
5/11/2016	SPP	Final Facilities Study Report Revision 0 Issued

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Interconnection Facilities Study Summary

Interconnection Facilities Study Introduction

This Interconnection Facilities Study for GEN-2015-015/IFS-2015-001-14 (Interconnection Request) is for a 154.56 MW wind farm facility located in Grant County, Oklahoma. The Interconnection Request was studied in the DISIS-2015-001 Impact Study and DISIS-2015-001-1 Impact Restudy as an Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) request. Cost allocation was updated for the Interconnection Request in the DISIS-2015-001-2 Impact Restudy. Since the posting of the DISIS-2015-001 Impact Study the Interconnection Customer has executed the Interconnection Facilities Study Agreement per Appendix 4 or Appendix 4A and has provided deposit securities as required by the Section 8.9 of the Generator Interconnection Produce (GIP) to proceed to the Interconnection Facilities Study. The GIP is covered under Attachment V of the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT). The request for interconnection was placed with SPP by the requesting customer (Interconnection Customer) in accordance with OATT, which covers new generation interconnections on SPP's transmission system.

Oklahoma Gas and Electric Company (OKGE) performed a detailed Interconnection Facilities Study at the request of SPP for the Interconnection Request. Interconnection Customer's original in service date for the Interconnection Request is July 31, 2016. SPP has proposed the full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s) are completed. Full interconnection service will require Network Upgrade(s) listed in the "Other Network Upgrade(s)" section.

The primary objective of the Interconnection Facilities Study (IFS) is to identify necessary Transmission Owner Interconnection Facilities, network upgrade(s), other direct assigned upgrade(s), and associated upgrade lead times needed for the additional of the requested Interconnection Service into the SPP Transmission System at the specific Point of Interconnection (POI).

Phase(s) of Interconnection Service

It is not expected that Interconnection Service will occur in phases. However, Interconnection Service will not be available until all Interconnection Facilities and Network Upgrade(s) can be placed in service.

Credits/Compensation for Amounts Advanced for Network Upgrade(s)

Interconnection Customer shall be entitled to either credits or potentially Long Term Congestion Rights (LTCR), otherwise known as compensation, in accordance with Attachment Z2 of the SPP Tariff for any Network Upgrades, including any tax gross-up or any other tax-related payments associated with the Network Upgrades, and not refunded to the Interconnection Customer.

Interconnection Customer Interconnection Facilities

The Interconnection Request's Generation Facility is currently proposed to consist of sixty-four (64) 2.3 MW Siemens Wind Turbines (SWT) with additional wind turbine vendor "Power Boost" feature, in which the wind turbine nameplate MW rating increases from 2.3 MW to 2.415 MW. The total

generating nameplate is 154.56 MW. The 34.5kV collector system for this wind farm is planned to be connect to one (1) 138/34.5kV 102/136/170 MVA (ONAN/ONAF/ONAF) Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. A seven (7) mile overhead 138kV transmission circuit will connect the Generating Facility from the Interconnection Customer owned substation to the new OKGE owned and maintained Substation tapping the Medford Tap – Coyote 138kV transmission line. The location of the new proposed substation in Grant County is approximately eleven (11) miles from Medford Tap 138kV on the Medford Tap – Coyote 138kV line. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Interconnection (POI) at the new 138kV substation tapping the Medford Tap – Coyote 138kV transmission line.

The Interconnection Customer will be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the POI, including approximately 6.2 Mvar¹ of reactors to compensate for injection of reactive power into the transmission system under no/light wind conditions. The Siemens Wind Turbines specified by the Interconnection Customer to be used for this Generating Facility have a manufacturer's option for providing reactive power under no wind conditions. The Interconnection Customer may use this option to either meet (or partially meet) these requirements, but will need to provide documentation and design specifications showing the requirements are met. Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s)

To facilitate interconnection, the interconnecting Transmission Owner, OKGE, will need to construct a new substation including a 138kV ring bus, three (3) 2000A continuously rated 138kV circuit breakers, disconnect switches, structures, and any associated terminal equipment for the acceptance of the Interconnection Customer's Interconnection Facilities. Currently, OKGE estimates an Engineering and Construction (E&C) lead time of approximately five (5) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Interconnection Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

The DISIS-2015-001-1 Impact Restudy identified the need for mitigation of the Non-Shared Network Upgrade(s) Renfrow (OKGE) – Renfrow (WFEC) 138kV circuit #1. OKGE identified terminal equipment upgrades required for this mitigation. Western Farmers Electric Cooperative (WFEC) reviewed their equipment during the Interconnection Facility Study for the requested mitigation thermal amount. WFEC's review observed no additional WFEC equipment replacement would be required for this mitigation.

Currently, OKGE estimates an Engineering and Construction (E&C) lead time of approximately five (5) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Interconnection Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

¹ This approximate minimum reactor amount is needed for the current configuration of the wind farm as studied in the DISIS-2015-001 Impact Study.

At this time, Interconnection Customer is responsible for \$3,340,000 of OKGE Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s). **Table 1** displays the estimated costs for TOIF and Non-Shared Network Upgrade(s).

Table 1: Interconnection Customer TOIF and Non-Shared Network Upgrade(s)

TOIF and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
OKGE Interconnection Substation: Transmission Owner Interconnection Facilities 138kV Substation work for line terminal, line switch, dead end structure, line relaying, and revenue metering	\$410,000	100%	\$410,000
OKGE Interconnection Substation - Non-Shared Network Upgrades 138kV Substation work for new ring bus, three 138kV, 2000A circuit breakers, line relaying, disconnect switches, and associated equipment. Also includes all associated equipment and work to cut-in the new substation into the Coyote Tap – Medford 138kV line.	\$2,840,000	100%	\$2,840,000
Non-Shared Network Upgrade - Renfrow – Renfrow 138kV circuit #1: Replace current transformer – voltage transformer combo with metering current transformer – voltage transformer to achieve at least 184 MVA (Emergency Rating)	\$90,000	100%	\$90,000
Total	\$3,340,000	100%	\$3,340,000

Shared Network Upgrade(s)

The Interconnection Request was studied in the DISIS-2015-001 Impact Study as an Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) request. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. If higher queued Interconnection Request(s) withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers’ allocation of Shared Network Upgrades. All studies have been conducted on the basis of higher queued Interconnection Request(s) and the Network Upgrade(s) associated with those higher queued Interconnection Requests being placed in service. At this time, the Interconnection Customer is allocated the following cost listed in **Table 2** for Shared Network Upgrade.

Table 2: Interconnection Customer Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
None	\$0	n/a	\$0
Total	\$0	n/a	\$0

Other Network Upgrade(s)

Certain Other Network Upgrades are currently not the cost responsibility of the Interconnection Customer but will be required for full Interconnection Service.

1) Currently no Other Network Upgrades

Depending upon the status of higher or equally queued customers, the Interconnection Request's in-service date is at risk of being delayed or their Interconnection Service is at risk of being reduced until the in-service date of these Other Network Upgrades.

Conclusion

Interconnection Service for the Interconnection Request will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$3,340,000 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 154.56 MW, as requested by the Interconnection Customer can be allowed.

At this time the total allocation of costs assigned to Interconnection Customer for interconnection Service are estimated at \$3,340,000.

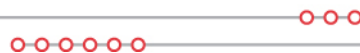
Addendum



Interconnection Facilities Study Addendum

Low Wind Analysis GEN-2015-015/IFS-2015-001-14

**April 2016
Generator Interconnection**



Revision History

Date	Author	Change Description
4/14/2015	SPP	Low Wind Analysis Completed

Low Wind Analysis

A low wind analysis has been performed for the GEN-2015-015 (154.56 MW/ Wind) Interconnection Request. SPP performed this low wind analysis for excessive capacitive charging current for the addition of the GEN-2015-015 facilities. The high side of the 138/34.5kV GEN-2015-015/IFS-2015-001-14 Interconnection Customer’s transformer will interconnect to The Point of Interconnection (POI). The POI will be at a new 138kV bus built for the new substation tapping Medford Tap – Coyote 138kV by an approximately seven (7) mile overhead 138kV transmission line.

The project generators and capacitors (if any) were turned off in the base case as show in **Figure 1**. The resulting reactive power injection into the transmission network comes from the capacitance of the project’s transmission lines and collector cables.

Shunt reactors were added at the study project substation 34.5 kV bus to bring the Mvar flow into the POI down to approximately zero as show in **Figure 3**. Final shunt reactor requirement for GEN-2015-015 is approximately 6.2 Mvars. The one-line diagram in **Figure 3** shows actual Mvar output at the specific voltages in the base case. The results shown are for the 2025SP case.

The other two cases (2016WP and 2017SP) were almost identical since the Interconnection Request facilities design is the same in all cases.

Figure 1: GEN-2015-015 with generator off and no shunt reactor(s)

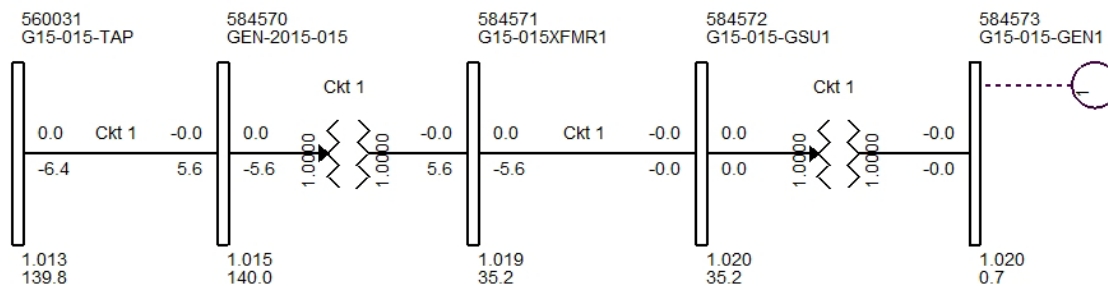


Figure 2: GEN-2015-015 with generators turned off and shunt reactors added to the low side of the GEN-2015-015 substation 138/34.5kV transformer

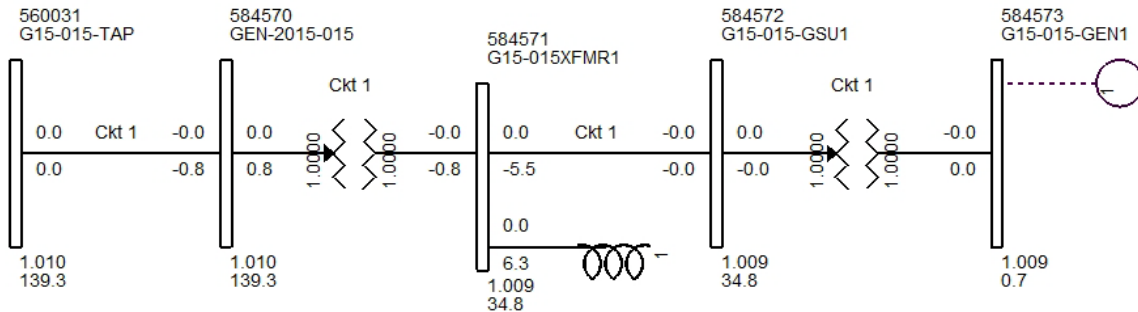


Table 1: Low Wind/No Wind Analysis

Request	Size (MW)	Point of Interconnection	Shunt Reactive Mvar Requirement
GEN-2015-015	154.56	Tap Medford Tap – Coyote 138kV	6.2

Conclusion

A low wind analysis has been performed for the GEN-2015-015 Interconnection Request. SPP performed this low wind analysis for excessive capacitive charging current for the addition of the GEN-2015-015 facilities.

The low wind analysis has determined the need for the GEN-2015-015 Interconnection Request to install approximately 6.2Mvars of reactor bank(s).

Appendices

A: OKGE Transmission Owner Interconnection Facilities Study Report

See next page for OKGE Interconnection Facilities Study Report.



FACILITY STUDY

for

Generation Interconnection Request 2015-015

New Wind Generating Facility
In Grant County
Oklahoma

October 20, 2014

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Transmission Planning
OG&E Electric Services

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Oklahoma Gas and Electric (OG&E) performed the following Facility Study to satisfy the Facility Study Agreement executed by the requesting customer for SPP Generation Interconnection request Gen-2015-015. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system. The requirements for interconnection consist of building a new substation with three new 138kV breakers, a terminal for the wind farm line, and terminating the Medford Tap to Coyote 138kV line into and out of the substation. The total cost for OKGE to build the new substation with three new 138kV breakers, terminating the Medford Tap to Coyote line into and out of the substation and a terminal for the wind farm line in a new Substation, the interconnection facility, is estimated at \$3,250,000.

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Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting a wind generating facility within the service territory of OG&E Electric Services (OKGE) in Grant County Oklahoma. The proposed 138kV point of interconnection is at a new substation in Grant County. This substation will be owned by OKGE. The cost for adding a new 138kV terminal to a new substation, the required interconnection facility, is estimated at \$410,000.

Network Constraints in the Southwest Public Service (SPS), OKGE and Western Farmers Electric Cooperative (WFEC) systems may be verified with a transmission service request and associated studies.

Other Network Constraints in the American Electric Power West (AEPW), Southwest Public Service (SPS), OKGE and Western Farmers Electric Cooperative (WFEC) systems may be verified with a transmission service request and associated studies.

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. The requirements for interconnection consist of adding a new 138kV terminal in a new substation. This 138kV addition shall be constructed and maintained by OKGE. It is assumed that obtaining all necessary right-of-way for the line into the new OKGE 138kV substation facilities will be performed by the interconnection customer.

The total cost for OKGE to add a new 138kV terminal in a new substation, the interconnection facility, is estimated at \$410,000. This cost does not include building the 138kV line from the Customer substation into the new substation. The Customer is responsible for this 138kV line up to the point of interconnection. This cost does not include the Customer's 138-34.5kV substation and the cost estimate should be determined by the Customer.

This Facility Study does not guarantee the availability of transmission service necessary to deliver the additional generation to any specific point inside or outside the Southwest Power Pool (SPP) transmission system. The transmission network facilities may not be adequate to deliver the additional generation output to the transmission system. If the customer requests firm transmission service under the SPP Open Access Transmission Tariff at a future date, Network Upgrades or other new construction may be required to provide the service requested under the SPP OATT.

The costs of interconnecting the facility to the OKGE transmission system are listed in Table 1.

Short Circuit Fault Duty Evaluation

It is standard practice for OG&E to recommend replacing a circuit breaker when the current through the breaker for a fault exceeds 100% of its interrupting rating with re-closer de-rating applied, as determined by the ANSI/IEEE C37.5-1979, C37.010-1979 & C37.04-1979 breaker rating methods.

For this generator interconnection, no breakers were found to exceed their interrupting capability after the addition of the Customer’s 154.6 MW generation and related facilities. OG&E found no breakers that exceeded their interrupting capabilities on their system. Therefore, there is no short circuit upgrade costs associated with the Gen-2015-015 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2015 DOLLARS)
OKGE – Interconnection Facilities - Add a single 138kV line terminal to a new substation. Dead end structure, line switch, line relaying, revenue metering including CTs and PTs	\$410,000
OKGE – Network Upgrades purchase land, install 3-138kV 2000A breakers, terminate 2 existing transmission lines at new terminals, line relaying, disconnect switches, and associated equipment.	\$2,840,000
OKGE - Right-of-Way for 138kV terminal addition	No Additional ROW
Total	\$3,250,000

Prepared by Andrew R. Aston, PE

October 20, 2015

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New 138kV Substation in Grant County

