

Interconnection Facilities Study For Generator Interconnection Request GEN-2014-056 (IFS-2014-002-21)

SPP Generator Interconnection Studies

> (#GEN-2014-056) (#IFS-2014-002-21)

> > **August 2015**

Revision History

Date	Author	Change Description	
7/27/2015	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued	
8/27/2015	SPP	Final Interconnection Facilities Study Report Revision 0 Issued	

Summary

Oklahoma Gas and Electric Company (OKGE) performed a detailed Interconnection Facilities Study at the request of Southwest Power Pool (SPP) for Generator Interconnection request GEN-2014-056/IFS-2014-002-21 (250.00 MW/Wind) located in Grady County, Oklahoma. The Interconnection Customer proposed in-service date for GEN-2014-056/IFS-2014-002-21 is December 31, 2016. SPP has proposed the full interconnection service in-service date will be after the assigned Interconnection Facilities upgrades are completed. Full Interconnection Service will require the Network Upgrades listed in the "Other Network Upgrades" section. The request for interconnection was placed with SPP in accordance with SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Phases of Interconnection Service

It is not expected that interconnection service will require phases however, interconnection service will not be available until all interconnection facilities and network upgrades can be placed in service.

Interconnection Customer Interconnection Facilities

The Interconnection Customer's generation facility consists of one hundred and twenty-five (125) G.E. 2.0MW wind turbines for a total generation capacity of 250.00 MW. The 34.5kV collector system for this wind farm is planned to be connected to one (1) 345/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. The high side of the 345/34.5kV GEN-2014-056/IFS-2014-002-21 Interconnection Customer's transformer will interconnect to the 345kV bus, the Point of Change of Ownership, at the prior queued Interconnection Customer's (GEN-2011-010/GEN-2014-005) substation by approximately twelve (12) miles of overhead 345kV transmission. GEN-2014-056/IFS-2014-002-21 will utilize the existing 345kV equipment between the Point of Change of Ownership and the Point of Interconnection (POI) at the OKGE Minco Substation, including the existing ten (10) miles of overhead 345kV transmission and related 345 kV breaker(s), switches, and related equipment allocated to GEN-2011-010/GEN-2014-005 currently located at the Minco 345 kV substation. A Shared Facilities Usage Agreement for the shared facilities with GEN-2011-010/GEN-2014-005 shall be required for Interconnection Service. These details will be determined during the negotiation phase of the Generator Interconnection Agreement.

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 existing 345kV bus at Oklahoma Gas and Electric Company (OKGE) owned Minco 345kV substation.

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 17.1 Mvar¹ of reactors to compensate for injection of reactive power into the transmission system under light wind conditions. 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 Upgrades

To allow interconnection the Transmission Owner will review, update and verify relaying at OKGE Minco Substation for acceptance of the Interconnection Customer's Interconnection Facilities. At this time, GEN-2014-056/IFS-2014-002-21 is responsible for \$40,000 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. **Table 1** displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Interconnection Substation - Transmission Owner Interconnection Facilities 345kV Substation work for relaying and relay verification	\$40,000	100%	\$40,000
Interconnection Substation - Network Upgrades 345kV Substation work for 1 345kV Breaker, line relaying, disconnect switches, and associated equipment	\$0	n/a	\$0
Total	\$40,000	100%	\$40,000

 Table 1: GEN-2014-056/IFS-2014-002-21 TOIF and Non-Shared Network Upgrades

Shared Network Upgrades

The Interconnection Customer was studied within the DISIS-2014-002 Impact Study and the DISIS-2014-002-1 Impact Restudy with Energy Resource Interconnection Service (ERIS) only. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. If higher queued interconnection customers 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 requests and the upgrades associated with those higher queued interconnection requests being placed in service. At this time, the Interconnection Customer is allocated the costs for Shared Network Upgrade listed in Table 2.

¹ This approximate amount of reactors is an approximate minimum amount needed for the current interconnection configuration of the wind farm. Please refer to the Interconnection Facilities Study Addendum for the Low Wind Analysis with the current interconnection configuration

Table 2: GEN-2014-056/IFS-2014-002-21 Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Currently GEN-2014-056/IFS-2014-002-21 is not allocated Shared Network Upgrades	\$0	n/a	\$0
Total	\$0	n/a	\$0

Other Network Upgrades

Certain Other Network Upgrades are currently not the cost responsibility of the Customer but will be required for full Interconnection Service. Currently, no Other Network Upgrades are assigned to GEN-2014-056/IFS-2014-002-21.

Depending upon the status of higher or equally queued customers, the Interconnection Customer'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 GEN-2014-056/IFS-2014-002-21 will be delayed until the Transmission Owner Interconnection Facilities Upgrades are constructed. The Interconnection Customer is responsible for \$40,000 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 250.00 MW, as requested by GEN-2014-056/IFS-2014-002-21, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-056/IFS-2014-002-21 for interconnection Service are estimated at \$40,000.



REVISED FACILITY STUDY

for

Generation Interconnection Request 2014-056

New Wind Generating Facility In Grady County Near Minco, Oklahoma

July 9, 2015

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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-2014-056. 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 relay work at Minco substation. The total cost for OKGE to complete the relay work at Minco substation, the interconnection facility, is estimated at \$40,000.

Table of Contents

Table of Contents	3
Introduction	4
Interconnection Facilities	5
Interconnection Costs	6
One-Line diagram of Interconnection	7

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 Grady County Oklahoma. The proposed 345kV point of interconnection is at Minco substation in Grady County Oklahoma. This substation is owned by OKGE.

The cost for the relay work at Minco Substation, the required interconnection facility, is estimated at \$40,000.

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.

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. There are no requirements for additional interconnection facilities at the existing Minco substation. However, OKGE will have to complete relay work and verification at Minco Substation for the acceptance of GEN-2014-056's additional 250MW interconnection service amount..

The total cost for OKGE to complete the relay work in Minco substation, the interconnection facility, is estimated at \$40,000. The Customer is responsible for this 345kV line up to the point of interconnection. This cost does not include the Customer's 345-34.5kV 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 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-2014-056 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2015 DOLLARS)
OKGE – Interconnection Facilities - No new interconnection facilities required.	\$0
OKGE – Network Upgrades	\$0
OKGE – Relay settings and field testing	\$40,000
Total	\$40,000

Prepared by Andrew R. Aston, P.E. Lead Engineer, Transmission Planning OG&E Electric Services July 9, 2015

Reviewed by: *Steve M Hardebeck P. E.* Manager, Transmission Planning OG&E Utility Technical Support

Minco Substation



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Interconnection Facilities Study Addendum

Low Wind Analysis GEN-2014-056/IFS-2014-002-21

July 2015 Generator Interconnection



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Low Wind Analysis

An updated low wind analysis has been performed for the GEN-2014-056 Interconnection Request. The Point of Interconnection (POI) configuration change and the large size of the GEN-2014-056 Interconnection Request (250 MW) caused SPP to perform this updated analysis for excessive capacitive charging current for the addition of the GEN-2014-056 facilities. The high side of the 345/34.5kV GEN-2014-056/IFS-2014-002-21 Interconnection Customer's transformer will interconnect to the 345kV bus, the Point of Change of Ownership, at the prior queued Interconnection Customer's (GEN-2011-010/GEN-2014-005) substation by approximately twelve (12) miles of overhead 345kV transmission. GEN-2014-056/IFS-2014-002-21 will utilize the existing 345kV equipment between the Point of Change of Ownership and the Point of Interconnection (POI) at the OKGE Minco Substation, including the existing ten (10) miles of overhead 345kV transmission and related 345 kV breaker(s), switches, and related equipment allocated to GEN-2011-010/GEN-2014-005 currently located at the Minco 345 kV substation

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.

The 13.0Mvar low wind shunt reactor that is previously assigned to GEN-2011-010/GEN-2014-005 was added at the GEN-2014-005/GEN-2011-010 Interconnection Request's 34.5kV bus for its contributions for size estimation of the GEN-2014-056 low wind shunt reactor. **Figure 2** displays adding the previously assigned low wind reactors. Shunt reactors were added at the study project substation 34.5 kV bus to bring the Mvar flow into the Minco 345kV substation down to approximately zero as show in **Figure 3**. Final shunt reactor requirement for GEN-2014-056 is approximately 17.1 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 (2015WP and 2025SP) were almost identical since the Interconnection Request facilities design is the same in all cases.



Figure 1: GEN-2014-056 with generator off and no shunt reactor(s)

Figure 2: GEN-2014-056 with generators off and previously assigned shunt reactor(s)





Figure 3: GEN-2014-056 with generators turned off and shunt reactors added to the low side of the GEN-2014-056 substation 345/34.5kV transformer

Table 1: Low Wind/No Wind Analysis

Request	Size (MW)	Point of Interconnection	Shunt Reactive Mvar Requirement
GEN-2014-056	250	Minco 345kV	17.1

Conclusion

A low wind analysis has been performed for the GEN-2014-056 Interconnection Request. The Point of Interconnection (POI) configuration change and large size of the GEN-2014-056 Interconnection Request (250MW) caused SPP to perform this low wind analysis.

In addition to the 13.0Mvar for low wind reactors assigned to GEN-2011-010/GEN-2014-005, the low wind analysis has determined the need for the GEN-2014-056 Interconnection Request to install approximately 17.1Mvars of reactor bank(s).