



INTERCONNECTION FACILITIES STUDY REPORT

GEN-2015-052
(IFS-2015-002-03)

Published January 2018

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
4/10/2017	SPP	Initial draft report issued.	
10/24/2017	SPP	Initial final report issued.	
1/12/2018	SPP	Initial final report revision 1 issued.	Include OKGE relay cost estimates

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2015-052/IFS-2015-002-03 is for a 300.00 MW generating facility located in Sumner County, Kansas. The Interconnection Request was studied in the DISIS-2015-002 Impact Study for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). Prior to an executed IFS agreement, the Interconnection Customer requested to withdraw NRIS per Section 4.4.1 of the Southwest Power Pool (SPP) Generator Interconnection Procedures (GIP), therefore ERIS-only was analyzed for this request in the DISIS-2015-002-1 Impact Restudy and DISIS-2015-002-2 Impact Restudy. The Interconnection Customer's requested in-service date is December 1, 2018.

The interconnecting Transmission Owner, Westar Energy, Inc. (WERE), performed a detailed IFS at the request of SPP. Additionally, the impacted neighboring Transmission Owner, Oklahoma Gas and Electric Company (OKGE), performed a detailed IFS at the request of SPP. The full report is included in Appendix A. SPP has determined that full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are completed.

The primary objective of the IFS is to identify necessary Transmission Owner Interconnection Facilities, Network Upgrade(s), other direct assigned upgrade(s), and associated upgrade lead times needed to grant the requested Interconnection Service at the specified 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 compensation in accordance with Attachment Z2 of the SPP OATT for the cost of SPP Network Upgrades, including any tax gross-up or any other tax-related payments associated with the Network Upgrades, that are not otherwise refunded to the Interconnection Customer. Compensation shall be in the form of either revenue credits or incremental Long Term Congestion Rights (iLTCR).

INTERCONNECTION CUSTOMER INTERCONNECTION FACILITIES

The Generating Facility is proposed to consist of one hundred-fifty (150) 2.0 MW Vestas wind generators for a total generating nameplate capacity of 300.00 MW.

The Interconnection Customer's Interconnection Facilities to be designed, procured, constructed, installed, maintained, and owned by the Interconnection Customer at its sole expense include:

- A 34.5kV collector system;
- Two (2) 345/34.5kV 120/160/200 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A less than one (<1) mile overhead 345kV line to connect the Interconnection Customer's substation to the POI at the 345 kV bus at a new WERE substation ("GEN-2015-052 Tap") to be owned and maintained by WERE. GEN-2015-052 Tap will be located approximately twenty-five (25) miles from Open Sky 345kV on the Open Sky – Rose Hill 345kV transmission circuit;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Equipment at the Interconnection Customer's substation necessary to maintain a power factor at the POI between 95% lagging and 95% leading, including approximately 23.6Mvars¹ of reactors to compensate for injection of reactive power into the transmission system under no/reduced generating conditions. The Interconnection Customer may use wind turbine manufacturing options for providing reactive power under no/reduced generation conditions. The Interconnection Customer will be required to provide documentation and design specifications demonstrating how the requirements are met.

The Interconnection Customer shall coordinate relay, protection, control, and communication system configurations and schemes with the Transmission Owner.

TRANSMISSION OWNER INTERCONNECTION FACILITIES AND NON-SHARED NETWORK UPGRADE(S)

To facilitate interconnection, the interconnecting Transmission Owner will perform work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities.

Table 1 lists the Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s) and provides an estimated lead time for completion of construction. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

¹ This approximate minimum reactor amount is needed for the current configuration of the wind farm as studied in the DISIS-2015-002 Impact Study.

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

TOIF and Non-Shared Network Upgrades Description	Allocated Cost Estimate (\$)	Allocated Percent (%)	Total Cost Estimate (\$)	Estimated Lead Time
<u>WERE GEN-2015-052 Tap Interconnection Substation: Transmission Owner Interconnection Facilities</u> Construct one (1) 345 kV line terminal, line switches, dead end structure, line relaying, communications, revenue metering, line arresstor and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer’s Generating Facility.	\$600,000	100%	\$600,000	90 Weeks
<u>WERE GEN-2015-052 Tap Interconnection Substation - Non-Shared Network Upgrades</u> Construct three (3) 345kV 4000 continuous ampacity breakers, cut in transmission line and re-terminate, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. Allowance for Funds Used During Construction (AFUDC) and Contingency funds are included in this cost estimate.	\$14,982,434	100%	\$14,982,434	
<u>OKGE Open Sky Substation - Non-Shared Network Upgrades</u> Verify relay settings	\$20,000	100%	\$20,000	2 months
Total	\$15,602,434	100%	\$15,602,434	

SHARED NETWORK UPGRADE(S)

The Interconnection Customer’s share of costs for Shared Network Upgrades is estimated in **Table 2** below.

Table 2: Interconnection Customer Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost Estimate (\$)	Allocated Percent (%)	Total Cost Estimate (\$)
<u>Currently none</u>	\$0	N/A	\$0
Total	\$0	N/A	\$0

All studies have been conducted assuming that higher-queued Interconnection Request(s) and the associated Network Upgrade(s) will be placed into service. If higher-queued Interconnection Request(s) withdraw from the queue, suspend or terminate service, the Interconnection Customer’s share of costs may be revised. Restudies, conducted at the customer’s expense, will determine the Interconnection Customer’s revised allocation of Shared Network Upgrades.

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 None

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

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 300.00 MW can be granted. Interconnection Service will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are completed. The Interconnection Customer’s estimated cost responsibility for Transmission Owner Interconnection Facilities, Non-Shared Network Upgrades is summarized in the table below.

Table 3: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	\$600,000
Network Upgrades	\$15,002,434
Total	\$15,602,434

A draft Generator Interconnection Agreement will be provided to the Interconnection Customer consistent with the final results of this IFS report. The Transmission Owner and Interconnection Customer will have 60 days to negotiate the terms of the GIA consistent with the SPP Open Access Transmission Tariff (OATT).

APPENDICES

A: WERE TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT

See next page for the Transmission Owner's Interconnection Facilities Study Report.



Generation Interconnection Facility Study

For

**Generation Interconnection Request
SPP-GEN-2015-052**

August 19, 2016

Introduction

This report summarizes the results of a Generation Interconnection Facilities Study performed for the Southwest Power Pool (SPP) by Westar Energy (WR) to evaluate a generation interconnection request for 300 MW of wind-powered generation in south central, Kansas, to the transmission system. The proposed interconnection is on the Rose Hill – Open Sky – Ranch Road – Sooner 345kV line near Oxford, Kansas. A System Impact Study has been completed for this project. The requested in-service date of the generating facility is December 1, 2018.

Project Location and Existing Facilities

The project is located in Sumner County in south central Kansas. The proposed interconnection will be at a new switching station tapping the Rose Hill – Open Sky – Ranch Road – Sooner 345 kV line. The location for this new station is approximately 25 miles from Open Sky 345 kV on the Open Sky – Rose Hill 345 kV line. Figure 1 shows the approximate location of the project. Figure 2 shows a preliminary one-line diagram for the new 345kV breaker and a half substation.

DISIS Study Review

WR has reviewed the steady-state, short-circuit, and dynamic study results for GEN-2015-052 included within SPP DISIS-2015-002-1 assessing the reliability impact of the proposed generation interconnection. WR agrees with the study approach and findings of the DISIS as posted by SPP. However, it should be noted that the 717 MVA terminal equipment limitations identified for Emporia Energy Center-Swissvale and Swissvale-West Gardner 345 kV lines has been increased to 956 MVA. The identified loading levels for the Group 8 Cluster analysis will not overload the facilities at the new rating.

Interconnection Facilities

Interconnection to the WR transmission system will be by way of a new 345kV switching station on the existing Rose Hill – Open Sky 345kV line.

345 kV Substation Work

The estimated cost includes three (3) 345 kV 4000 A breakers, nine (9) 345 kV 3000 A switches, three (3) stand alone CTs, six (6) PTs, three (3) 345 kV CCVTs, six (6) 345 kV control panels, new RTU, relaying setting changes at Rose Hill, and all associated site, yard, cable, grounding, and conduit work.

345 kV Transmission Line Work

The estimated cost is for two (2) steel tangent structures to connect the existing Rose Hill – Open Sky 345 kV transmission line to the interconnection substation plus associated foundations and labor.

138 kV Transmission Line Work

The estimated cost is for two (2) steel dead end structures and four (4) tangent structures on the Oxford – Sumner 138 kV line to accommodate the placement of the new interconnection substation plus associated foundations and labor.

The total cost estimate for Transmission Owner Interconnection Facilities (Interconnection Metering) and Stand Alone Network Upgrades (345 kV Substation and Transmission Line Work) is:

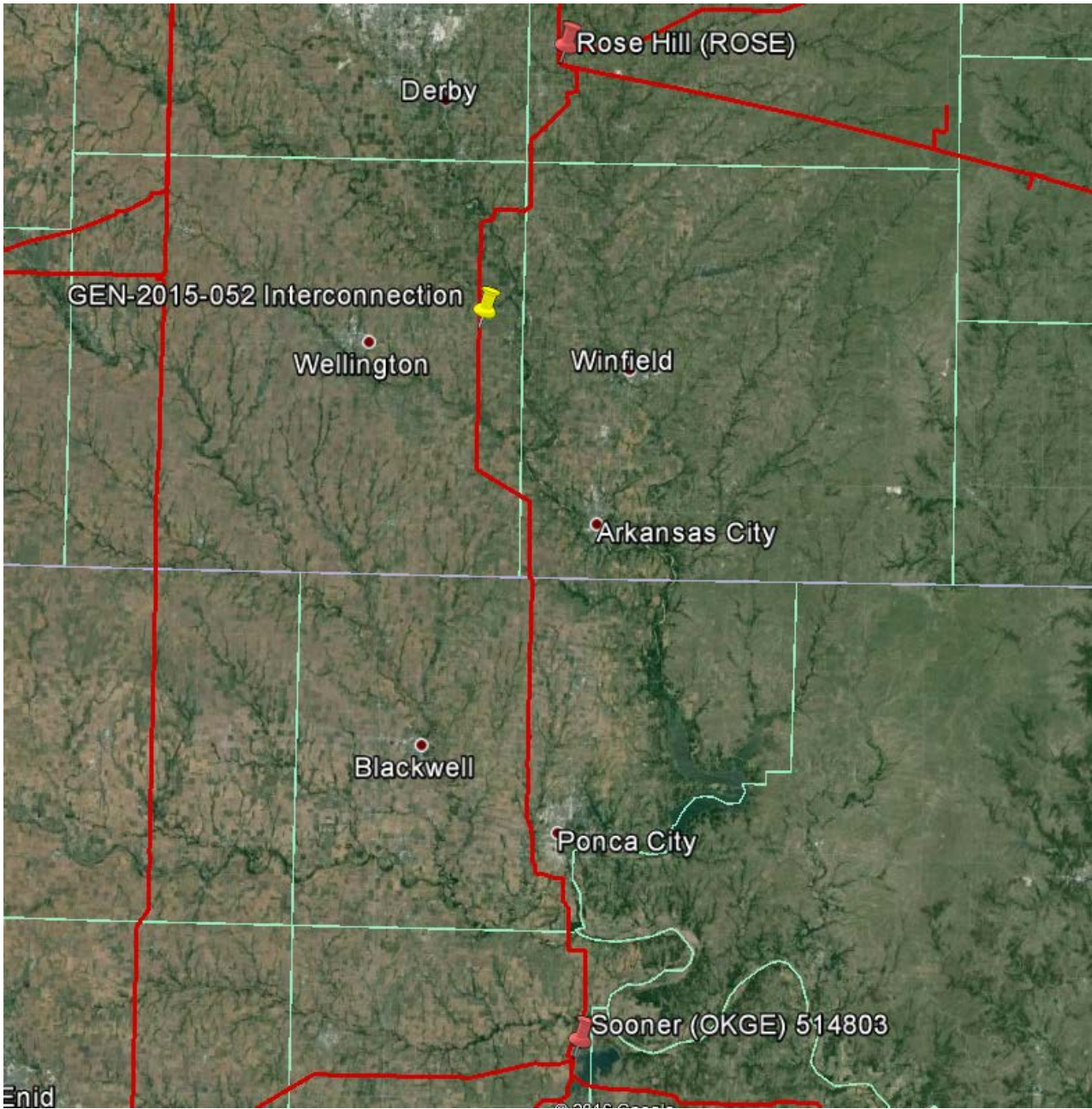
\$ 11,025,458 345 kV Substation Work
\$ 1,127,841 345 kV & 138 kV Transmission Line Work
\$ 385,227 AFUDC
\$ 3,043,908 Contingency
\$ 15,582,434

This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are very significant and the accuracy of this estimate at the time of actual settings cannot be assured.

20 weeks Engineering Time
40 weeks Procurement Time
30 weeks Construction Time
90 weeks Total

Westar Energy also maintains its own Facility Connection Requirements, which may be found at (<http://www.oasis.oati.com/WR/index.html>).

Figure 1 – Interconnection Map



The proposed interconnection project is 27 miles from Rose Hill 345kV substation.

Results of Short Circuit Analysis

As a part of this Facility Study, a short circuit study was performed to determine the available fault current at the interconnection bus (GEN-2015-052 Interconnection 345 kV) using PSS/E's activity ASCC. The 2017 Summer Peak case from the 2016 Series MDWG Classical, Max Fault Short-Circuit models were used. All GEN-2015-052 Wind Farm generation was taken out of service for this analysis and all other transmission facilities are in service. As a result, the numbers generated represent the available utility interconnection fault current:

2017 Summer:

3-PH FAULT		1-PH FAULT		THEVENIN IMPEDANCE (PU on 100 MVA and bus base KV)		
AMP	MVA	AMP	MVA	Positive Sequence	Negative Sequence	Zero Sequence
11312.95	6760.14	8814.95	5267.44	0.00091 +j 0.01476	0.00092 +j 0.01476	0.00621 +j 0.02686

B: OKGE TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT

See next page for the Transmission Owner's Interconnection Facilities Study Report.



FACILITY STUDY

for

Generation Interconnection Request 2015-052

300 MW Wind Generating Facility
In Sumner County
Kansas

January 14, 2016

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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-2015-052. 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 request is for adding 300MW at a new interconnection substation to be owned by WERE on the Open Sky to Rose Hill 345kV line. The requirement for the addition of 300MW at the new station on the Open Sky to Rose Hill 345kV line at Open Sky substation is to update relay settings. The cost for checking and verifying relay settings is \$20,000. No new or additional facilities are necessary for OG&E to accommodate the additional generation.

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Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting an additional 300MW of wind generation to a new Point of Interconnection within the service territory Westar Energy (WERE) in Sumner County Oklahoma. The proposed 345kV point of interconnection is at a point on a new generator lead connecting to a new point of interconnection at approximately 25 miles from Open Sky Substation on the Open Sky to Rose Hill 345kV line. Network Constraints in the American Electric Power West (AEPW), Oklahoma Gas & Electric (OKGE), Westar Energy (WERE), 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 for OG&E.

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 recloser 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 300MW 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-2015-052 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2016 DOLLARS)
OKGE – Interconnection Facilities - No new interconnection facilities necessary	\$0
OKGE – Network Upgrades No new network upgrades necessary	\$0
OKGE – Relay settings verification	\$20,000
Total	\$20,000

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January 14, 2016

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New WERE 345kV Switching Station

