Interconnection Facilities Study

GEN-2015-024
(IFS-2015-001-02)

January 2016

Generator Interconnection

SPP Southwest Power Pool

Revision History

Date	Author	Change Description
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1/26/2015	SPP	Final Interconnection Facilities Study Report Revision 0 Issued

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Interconnection Facilities Study Summary

Interconnection Facilities Study Introduction

This Interconnection Facilities Study for GEN-2015-024/IFS-2015-001-02 (Interconnection Request) is for a 220 MW wind farm facility located in Pratt County, Kansas. The Interconnection Request was studied in the DISIS-2015-001 Impact Study as an Energy Resource Interconnection Service (ERIS). 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 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 the OATT, which covers new generation interconnections on SPP's transmission system.

Westar Energy (WERE), on behalf of Prairie Wind Transmission (PWT) 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 December 1, 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 one-hundred-ten (110) General Electric (G.E.) 2.0 MW wind generators for a total nameplate generating capacity of 220MW. The 34.5kV collector system for this wind farm is planned to be connect to one (1) 345/34.5kV, 151/188/235MVA transformer at the Interconnection Customer owned substation. A

sixty (60) mile overhead 345kV transmission circuit will connect the Generating Facility from the Interconnection Customer owned substation to the Wichita-Thistle 345kV double circuit owned by PWT. The location of the new proposed substation in Sedgewick County, Kansas is approximately 10 miles from the WERE Wichita 345kV substation. 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 345kV substation tapping the Wichita-Thistle 345kV double circuit 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 57 Mvar[1] of reactors or install and utilize an equivalent means to compensate for injection of reactive power into the transmission system under no/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 Upgrade(s)

To facilitate interconnection, the interconnecting Transmission Owner, PWT, will need to construct a new substation including a 345kV breaker-and-a-half substation, eight (8) 3000A continuous ampacity rated 345kV circuit breakers, disconnect switches, structures, and any associated terminal equipment for the acceptance of the Interconnection Customer's Interconnection Facilities. Additionally, two (2) 25Mvar in-line reactors will be required on each terminal at the new 345kV substation for the Thistle 345kV lines. Currently, WERE estimates an Engineering and Construction (E&C) lead time of approximately ninety (90) weeks after a fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

At this time, Interconnection Customer is responsible for $33,199,661 of PWT 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 ($)	Allocated Percent (%)	Total Cost ($)
PWT Interconnection Substation - Transmission Owner Interconnection Facilities 345kV Substation work for a new line terminal position, disconnect switch, station post insulators, arrestors, dead end structure, and relay panels	$1,261,267	100%	$1,261,267
PWT Interconnection Substation - Non-Shared Network Upgrades 345kV Substation work for new substation, eight 345kV, 3000A circuit breakers, two (2) 25Mvar reactors, line relaying, disconnect switches, and associated	$31,938,394	100%	$31,938,394

[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.

equipment. Also includes all associated equipment and work to cut-in the new substation into the Wichita-Thistle 345kV double circuit line.			
Total	$33,199,661	100%	$33,199,661

Shared Network Upgrade(s)

The Interconnection Request was studied in the DISIS-2015-001 Impact Study as an Energy Resource Interconnection Service (ERIS) only 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 ($)	Allocated Percent (%)	Total Cost ($)
Currently not allocated Shared Network Upgrades	$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) 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 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 $33,199,661 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 220 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 $33,199,661.

Appendices

A: WERE Transmission Owner Interconnection Facilities Study Report

See next page for WERE Interconnection Facilities Study Report.

Generation Interconnection Facility Study

For

Generation Interconnection Request SPP-GEN-2015-024

December 3, 2015

Introduction

This report summarizes the results of a Generation Interconnection Facilities Study performed for the Southwest Power Pool (SPP) by Westar Energy (WR) on behalf of Prairie Wind Transmission (PWT) to evaluate a generation interconnection request for 220 MW of wind-powered generation in south central, Kansas, to the PWT transmission system. The proposed interconnection is on the Wichita-Thistle 345kV line #1 and line #2 near Cheney, Kansas. A System Impact Study has been completed for this project. The requested in-service date of the generating facility is December 1, 2016.

Project Location and Existing Facilities

The project is located in Pratt County in south central Kansas. The proposed interconnection will be at a new 345kV breaker and a half substation on the Wichita-Thistle 345kV line #1 and line #2 near Cheney, Kansas. The substation will connect to customer facilities at 345kV. 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-2015-024 included within SPP DISIS-2015-001 assessing the reliability impact of the proposed generation interconnection. WR agrees with the study approach and findings of the DISIS as posted by SPP.

Interconnection Facilities

Interconnection to the PWT transmission system will be by way of a new 345kV breaker and half switching station on the existing Wichita-Thistle 345kV line #1 and line #2. The new substation terminal will look towards customer's facilities. Construction of this new substation terminal requires additional land adjacent to the existing transmission line right-of-way.

345 kV Substation Work

- Breaker and Half Substation (no metering or customer equipment included)
  The estimated cost includes eight (8) 345 kV breakers, eighteen (18) 345 kV switches, two (2) 345 kV reactor switches, three (3) stand alone CTs, nine (9) PTs, eight (8) 345 kV CCVTs, two (2) 345 kV 25 Mvar line reactors, new redundant primary relaying, relaying setting changes at Wichita and Thistle, and all associated site, yard, cable, grounding and conduit work.

- 345 kV Substation (Equipment on customer side of meter)
  The estimated cost includes three (3) 345 kV arresters, one (1) 3000A switch, three (3) 345 kV arrester stands, one (1) 345 kV full tension dead-end structure, and one (1) 3-phase bus support. The estimate also includes all other associated yard, cable, grounding, communication, and conduit work.

- 345 kV Interconnection Revenue Metering
  The estimated cost includes three (3) 345 kV VTs, three (3) 345 kV CTs, and revenue interconnection metering plus all associated yard and conduit work.

General Considerations

Additional consideration should be given to the following items:

- Neither Westar Energy nor Prairie Wind Transmission are the owner of the Thistle 345kV substation. Any facility modifications of any kind will need to be coordinated with the facility owner.
- The estimates contained in this document include 345kV line reactors to be placed on both of the terminals for the Thistle 345kV lines; studies are in progress to determine need and size of these line reactors.

345 kV Transmission Line Work

The estimated cost is for four (4) three-pole steel dead end and turning structures to connect both of the existing Wichita – Thistle 345 kV transmission lines (circuit #1 and #2) into the 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 Breaker and Half Substation and Transmission Line Work) is:

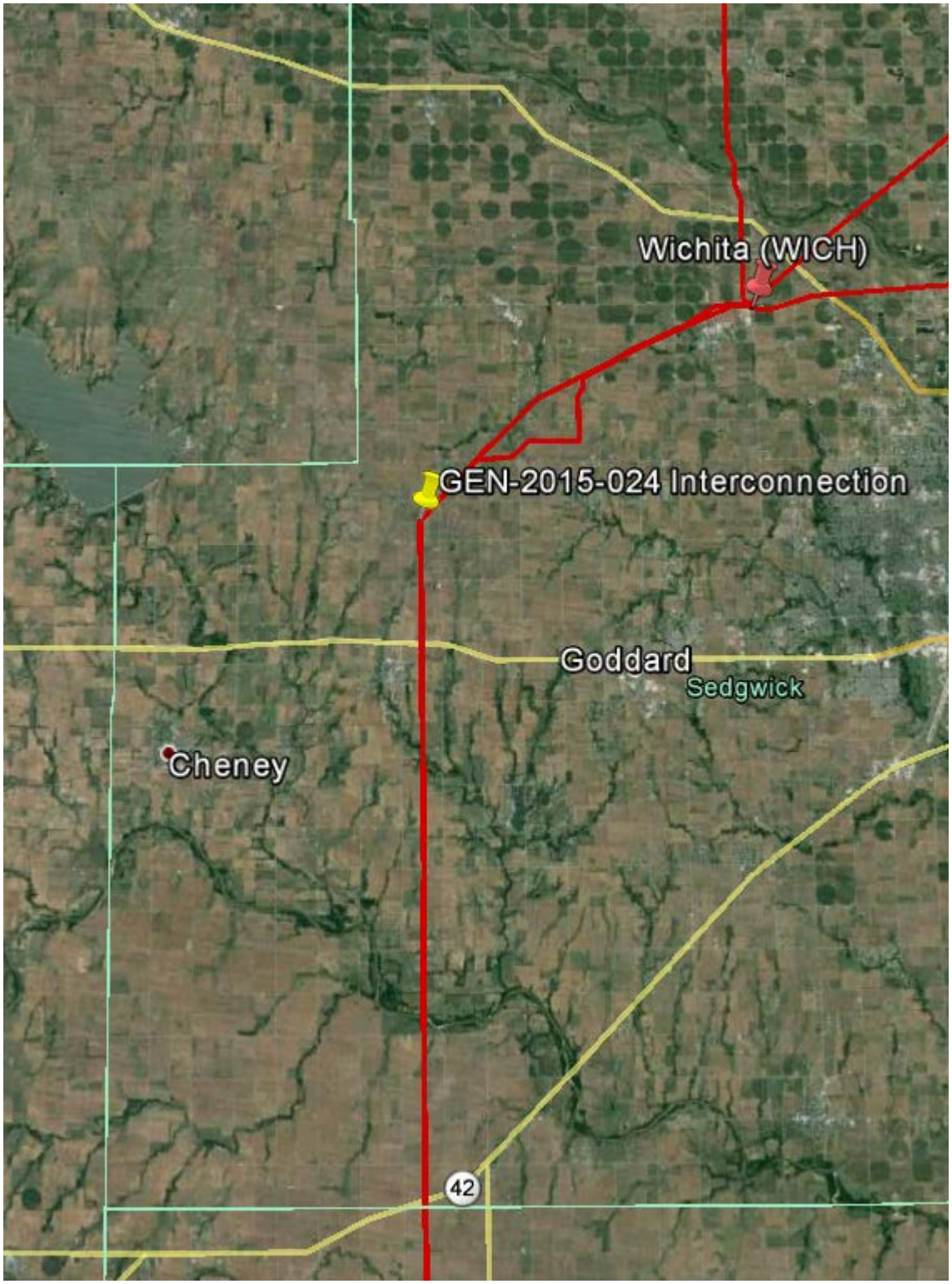
$ 25,324,455 345 kV Substation Work
$ 997,986 345 kV Transmission Line Work
$ 2,485,088 AFUDC
$ 4,392,132 Contingency
$ 33,199,661

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	

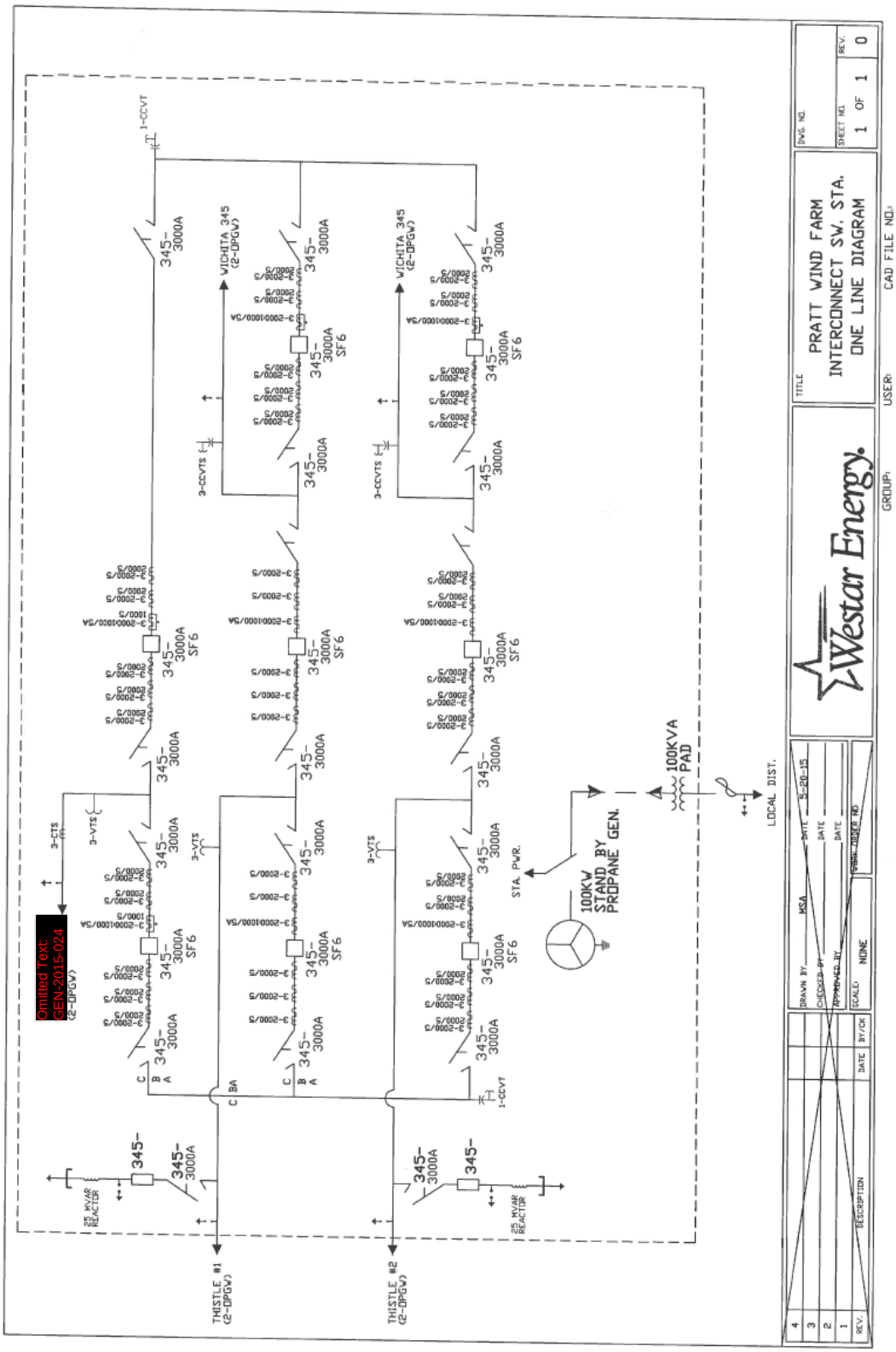
Westar Energy also maintains its own Facility Connection Requirements, which may be found at (http://www.oasis.oati.com/WR/index.html).

Figure 1 – Interconnection Map



The proposed interconnection project is 10 miles from Wichita 345kV substation.

Figure 2 – Preliminary One-Line Diagram



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-2015-024 Interconnection 345 kV) using PSS/E's activity ASCC. The 2015 and 2020 Summer Peak cases from the 2015 Series MDWG Classical, Max Fault Short-Circuit models were used. All GEN-2015-024 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:

2015 Summer:

- For a 3-Phase fault at the GEN-2015-024 Interconnection, the fault current is estimated to be 17922 Amps.
- For a Phase-to-Ground fault at the GEN-2015-024 Interconnection, the fault current is estimated to be 14018 Amps.

THEVENIN IMPEDANCE, X/R (OHM) Z+:0.713+j11.091, 15.54478 Z-:0.718+j11.091, 15.44131 Z0:3.766+j20.128, 5.34410

2020 Summer:

- For a 3-Phase fault at the GEN-2015-024 Interconnection, the fault current is estimated to be 18139 Amps.
- For a Phase-to-Ground fault at the GEN-2015-024 Interconnection, the fault current is estimated to be 14165 Amps.

THEVENIN IMPEDANCE, X/R (OHM) Z+:0.704+j10.959, 15.55616 Z-:0.709+j10.959, 15.46156 Z0:3.757+j19.950, 5.31078