INTERCONNECTION FACILITIES STUDY REPORT

GEN-2015-069

(IFS-2015-002-06)

Published March 2017

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
5/15/2017	SPP	Initial draft report issued.	

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2015-069/IFS-2015-002-06 is for a 300.00 MW generating facility located in Dickenson and Marion Counties, 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. 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) 230/34.5kV 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 sixteen (16) mile overhead 230kV line to connect the Interconnection Customer's substation to the POI at the 345 kV (230kV operating) bus at an existing WERE substation ("Union Ridge") that is owned and maintained by WERE;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Interconnection Customer facilities connecting to the POI including the two 230/34.5kV customer substation transformers and 230kV generator lead shall be built and insulated for 345kV operation since the POI is built at 345kV but currently operating at 230kV;
- Equipment at the Interconnection Customer's substation necessary to maintain a power factor at the POI between 95% lagging and 95% leading, including approximately 29.6Mvars[1] 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
WERE Union Ridge Interconnection Substation: Transmission Owner Interconnection Facilities Construct one (1) 345 kV (230kV operating) line terminal, line switches, dead end structure, line relaying, communications, revenue metering, line arrestor and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer's Generating Facility.	$600,000	100%	$600,000	90 Weeks
WERE Union Ridge Interconnection Substation - Non-Shared Network Upgrades Construct one (1) 345kV (230kV operating) 3000 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.	$2,155,752	100%	$2,155,752	
Total	**$2,755,752**	**100%**	**$2,755,752**	

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 ($)	Allocated Percent (%)	Total Cost Estimate ($)
Currently none	$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	$2,155,752
Total	**$2,755,752**

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: 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-2015-069

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 central Kansas. The proposed interconnection is at the Union Ridge 230kV substation near Hope, 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 Dickinson County in central Kansas. The proposed interconnection is on the WR transmission system at the existing Union Ridge 230kV substation near Hope, Kansas. Figure 1 shows the regional transmission facilities. Figure 2 shows a preliminary one-line diagram for the interconnection addition at the Union Ridge 230kV substation.

DISIS Study Review

WR has reviewed the steady-state, short-circuit, and dynamic study results for GEN-2015-069 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 the existing Union Ridge 230kV substation. Please note that Union Ridge is constructed for 345 kV but currently operated at 230 kV, and the existing 230-115kV transformer is also a dual high side voltage (230 kV and 345 kV). It was constructed in this manner to allow for a future rebuild of Summit-Union Ridge-Morris Co. for 345 kV operation. The interconnection customer would be expected to construct the generator lead to allow for 345 kV operation, and it would be prudent to plan the collector substation for potential future 345 kV operation.

345 kV Substation Work

- *Network Upgrades:* Union Ridge substation is built to 345kV standards and operated at 230kV. Add a 345kV line terminal to include (1) 345kV breaker, (2) 345kV GOAB disconnect switches, and a dual breaker control panel; relocate the static wire to terminate on the new dead-end.
- *Customer Side of Metering Equipment:* Add a line terminal for the windfarm GI. This will include a motor operated switch, bus support, lightning arresters, dead-end, bus and jumpers, and line panel.
- *Metering Equipment:* Add metering equipment for the windfarm GI. This will include metering VT's, metering CT's, bus support, bus and jumpers, and metering panel.
- Construct foundations, conduit, and groundmat to accommodate the major equipment as listed below. Install steel, equipment, and control cable. Verify, checkout, and energize.

Major Equipment:

Network Upgrades
1 – 345kV, 3000A, 50kA SF6 Circuit Breaker
2 – 345kV, 3000A, GOAB Disconnect Switch
1 – Breaker Control Panel

Customer Side of Metering Equipment
1 – 345kV, 3000A, GOAB Disconnect Switch & Steel
3 – 345kV Lightning Arrester & Steel
3 – 345kV Station Post Insulator & Steel
1 – 345kV Heavy Dead End DE01 & Anchor Bolt Cage

Metering Equipment
3 – 345kV Voltage Transformer & Steel
3 – 345kV Current Transformer & Steel
3 – 345kV Station Post Insulator & Steel

Budgetary Estimate:
Network Upgrades
$1,182,062 Transmission
Customer Side of Metering Equipment
$931,130 Transmission
Metering Equipment
$642,560 Transmission

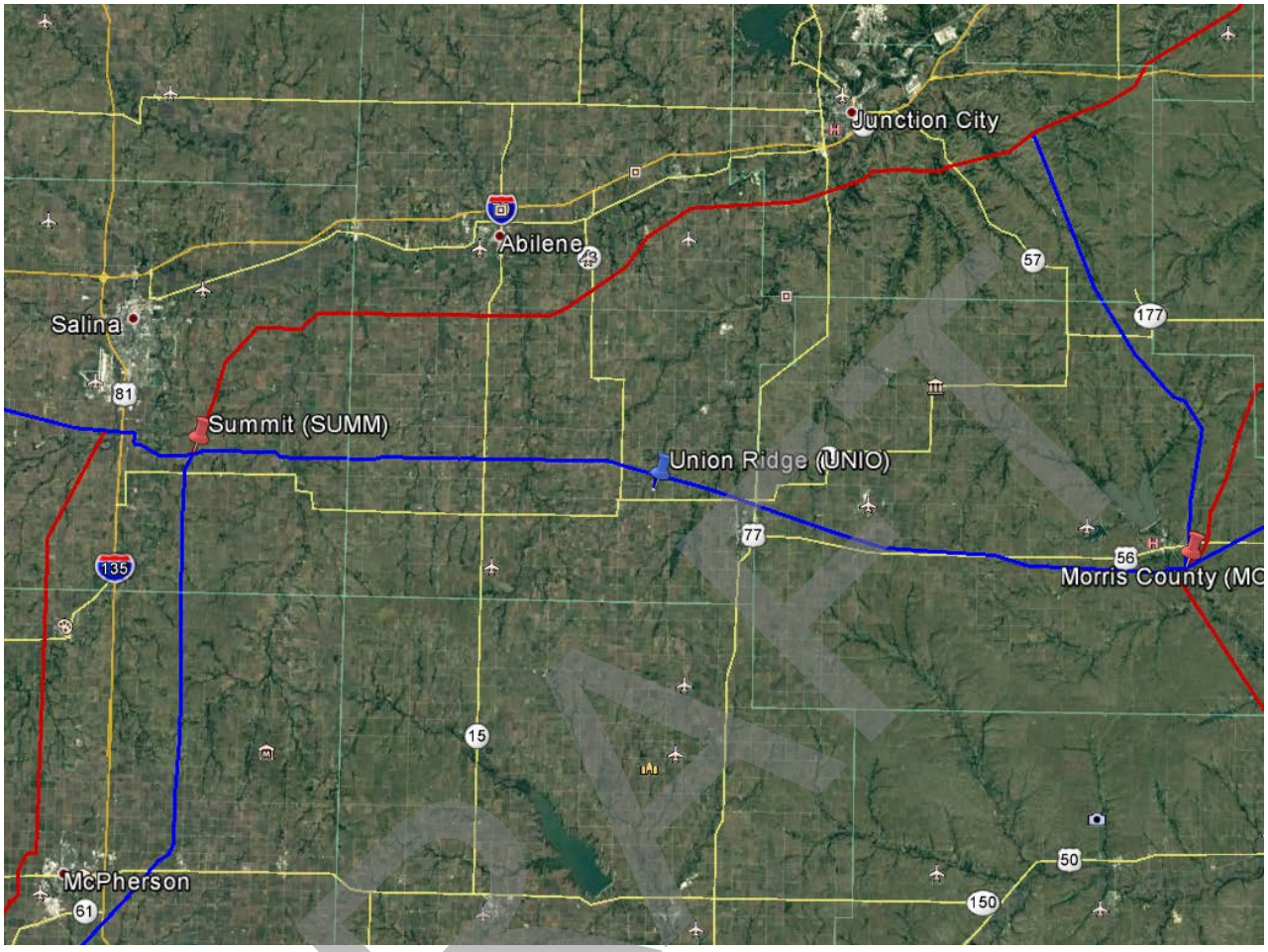
$	**2,137,129**	**345 kV Substation Work**
$	**0**	**345 kV Transmission Line Work**
$	**143,664**	**AFUDC**
$	**474,959**	**Contingency**
$	**2,755,752**	

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	

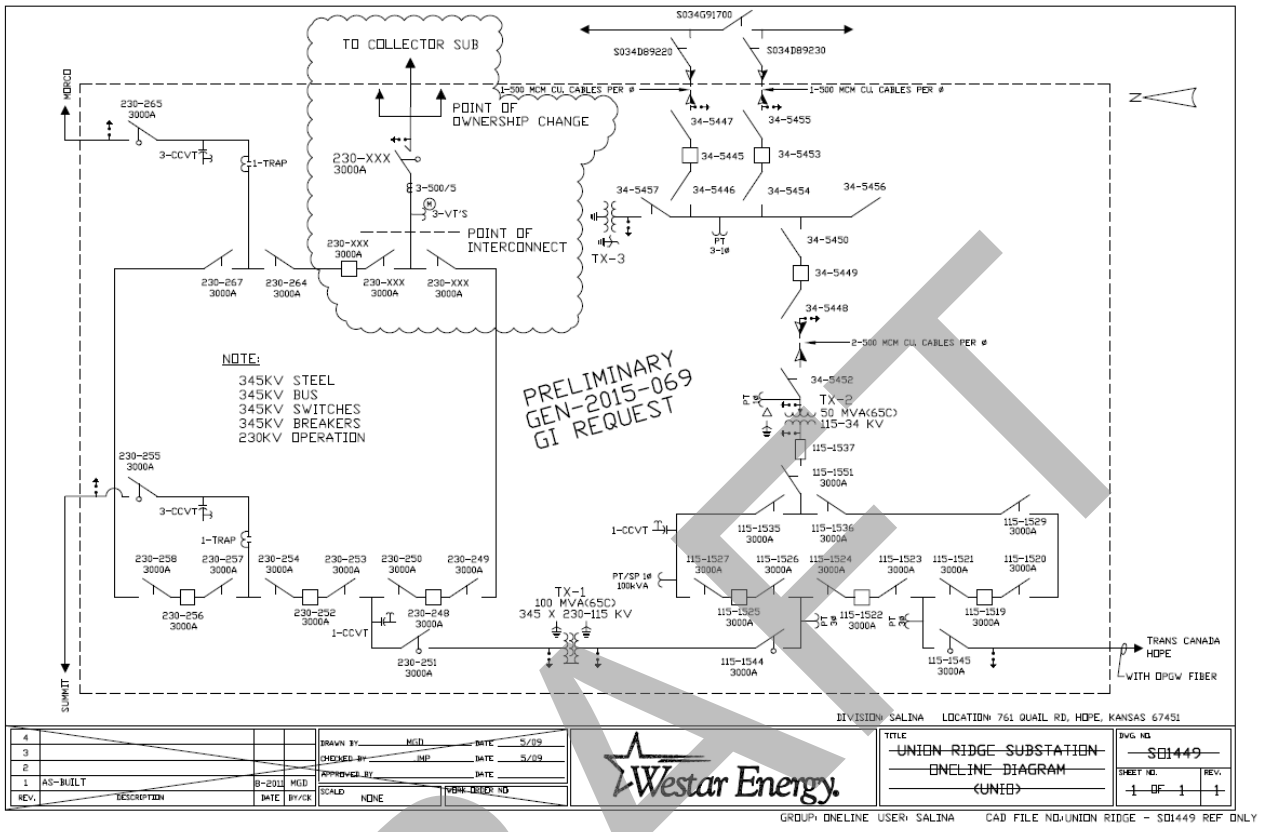
Westar Energy also maintains its own Facility Connection Requirements, which may be found at (http://www.oasis.oati.com/WR/index.html).

Figure 1 – Interconnection Map



The proposed interconnection project is at Union Ridge 230kV 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 (Union Ridge 230 kV bus 532874) using PSS/E's activity ASCC. The 2017 Summer Peak case from the 2017 Series MDWG Classical, Max Fault Short-Circuit models were used. All GEN-2015-069 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
7300.90	2908.47	6128.18	2441.29	0.00414 +j 0.03413	0.00414 +j 0.03416	0.00982 +j 0.05326