INTERCONNECTION FACILITIES STUDY REPORT

GEN-2016-073

IFS-2016-001-48

Published February 2022

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
05/24/2019	SPP	Initial draft report issued.
06/24/2019	SPP	Final report issued.
01/07/2020	SPP	Revised final report per DISIS-2016-001-5. Removed Wolf Creek-Emporia Shared NU in Table 3. Added Contingent Network Upgrade table in report.
02/24/2022	SPP	Revised final report issued. Removed "Wolf Creek – Blackberry" from Table 4 based on latest reposting.

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2016-073/IFS-2016-001-48 is for a 220 MW generating facility located in Kingman County, Kansas. The Interconnection Request was studied in the DISIS-2016-001 Impact Study for Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS). The Interconnection Connection Request was also studied in Impact Restudies for Energy Resource Interconnection Service (ERIS). The Interconnection Customer's original requested commercial operation date is 12/31/2017 and the revised commercial operation date in the Facilities Study Agreement is 11/01/2018.

The interconnecting Transmission Owner, Westar Energy (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 interconnect facilities (TOIF), non-shared network upgrades, shared network upgrades, contingent network upgrades, previously allocated, and affected system upgrades that are required for full interconnection service are completed.

The primary objective of the IFS is to identify necessary Transmission Owner Interconnection Facilities, Network Upgrades, other direct assigned upgrades, cost estimates, and associated upgrade lead times needed to grant the requested Interconnection Service.

PHASE(S) OF INTERCONNECTION SERVICE

It is not expected that Interconnection Service will occur in phases. However, full 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 creditable-type 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 ten (110) GE 2.0 MW wind turbines for a total generating nameplate capacity of 220 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:

- 34.5 kV underground cable collector circuits;
- 34.5 kV to 345 kV transformation substation with associated 34.5 kV and 345 kV switchgear;
- One (1) 345/34.5 kV, 147/196/245 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnectin Customer at the Interconnection Customer's substation;
- A 22 mile overhead 345 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 345 kV bus at new Transmission Owner's substation Thistle – Wichita Dbl Ckt ("Buffalo Flats 345kV") that is owned and maintained by Transmission Owner;
- 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 composite power delivery at continuous rated power output at the high-side of the generator substation at a power factor within the range of 95% lagging and 95% leading in accordance with Federal Energy Regulatory Commission (FERC) Order 827. Additionally approximately 8.4 Mvars[1] of reactors will be required to compensate for injection of reactive power into the transmission system under no/reduced generating conditions. The Interconnection Customer may use 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.

[1] This approximate minimum reactor amount is needed for the current configuration of GEN-2016-073 as studied in the DISIS-2016-001 Impact Study and Restudies.

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 and **Table 2** 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.

Table 1: Transmission Owner Interconnection Facilities (TOIF)

Transmission Owner Interconnection Facilities (TOIF)	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)	Estimated Lead Time
WERE Buffalo Flats 345kV Interconnection Substation: Construct a new 345 kV 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.	$1,166,344	100%	$1,166,344	20 months
Total	**$1,166,344**		**$1,166,344**	

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	Z2 Type[2]	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)	Estimated Lead Time
WERE Buffalo Flats 345kV Interconnection Substation: Construct a new 345kV breaker and a half configuration, one (1) 345 kV 4000 amp breaker, two (2) 345 kV 3000 amp switches, three (3) 345 kV VTs, three (3) 3000 amp stand alone CTs, one (1) 345 kV breaker control panel, one (1) Line Relay Panel, cut in transmission line and re-terminate, acquire land, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials.	Non-Creditable	$1,192,896	100%	$1,192,896	20 months
Total		**$1,192,896**		**$1,192,896**	

[2] Indicates the method used for calculating credit impacts under Attachment Z2 of the Tariff.

SHARED NETWORK UPGRADE(S)

The Interconnection Customer's share of costs for Shared Network Upgrades is estimated in **Table 3** below.

Table 3: Interconnection Customer Shared Network Upgrades

Shared Network Upgrades Description	Z2 Type	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)	Estimated Lead Time
None	N/A	$0	N/A	$0	N/A
Total		**$0**		**$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.

CONTINGENT NETWORK UPGRADE(S)

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

Table 4: Interconnection Customer Contingent Network Upgrade(s)

Contingent Network Upgrade(s) Description	Current Cost Assignment	Estimated In-Service Date
None	N/A	N/A

PREVIOUS NETWORK UPGRADE(S)

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

Table 5: Interconnection Customer Previous Network Upgrade(s)

Previous Network Upgrade(s) Description	Current Cost Assignment	Estimated In-Service Date
None	$0	N/A

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 Previous Network Upgrades.

AFFECTED SYSTEM UPGRADE(S)

To facilitate interconnection, the Affected System Transmission Owner will be required to perform the facilities study work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities. **Table 6** displays the current impact study costs as part of the Affected System Impact review. The Affected System facilities study could provide revised costs and will provide each Interconnection Customer's allocation responsibilities for the upgrades.

Table 6: Interconnection Customer Affected System Upgrade(s)

Affected System Upgrades Description	Total Cost Estimate ($)	Allocated Share (%)	Allocated Cost Estimate ($)
None	$0	N/A	$0
Total	**$0**		**$0**

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 220 MW can be granted. Full Interconnection Service will be delayed until the transmission owner interconnect facilities (TOIF), non-shared network upgrades, shared network upgrades, contingent network upgrades, previously allocated, and affected system upgrades that are required for full interconnection service are completed. The Interconnection Customer's estimated cost responsibility is summarized in the table below.

Table 7: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	$1,166,344
Network Upgrades	$1,192,896
Total	**$2,359,240**

APPENDICES

A: TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT AND NETWORK UPGRADES REPORT(S)

See next page for the Transmission Owner's Interconnection Facilities Study Report and Network Upgrades Report(s).

Generation Interconnection Facility Study

For

Generation Interconnection Request SPP-GEN-2016-073

September 18, 2017

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 will occur at the existing Buffalo Flats substation built for GEN-2015-024. GEN-2016-073 is proposing to connect to a new 345 kV terminal at the Buffalo Flats substation. A System Impact Study has been completed for this project. The requested in-service date of the generating facility is November 11, 2018.

Project Location and Existing Facilities

The project is located in Pratt County in south central Kansas. The proposed interconnection will be on new 345kV generator lead, which will connect at the Buffalo Flats 345kV breaker and a half substation on the Wichita-Thistle 345kV line #1 and line #2 near Cheney, Kansas. Figure 1 shows the approximate location of the project.

DISIS Study Review

WR has reviewed the steady-state, short-circuit, and dynamic study results for GEN-2016-073 included within SPP DISIS-2016-001 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 new 345kV generator lead, which will connect to the Buffalo Flats 345kV breaker and half switching station as seen in Figure 2.

A new 345 kV terminal must be constructed on an existing rung at the Buffalo Flats substation for the new generator lead.

345 kV Substation Work

- The estimated cost includes one (1) 345 kV 4000 A breaker, two (2) 345 kV 3000 A switches, three (3) 345 kV VTs, three (3) 3000 A stand alone CTs, one (1) 345 kV breaker control panel, one (1) Line Relay Panel, and all associated site, yard, grounding, and conduit work

The total cost estimate for Stand Alone Network Upgrades (345 kV Substation Relay Work) is:

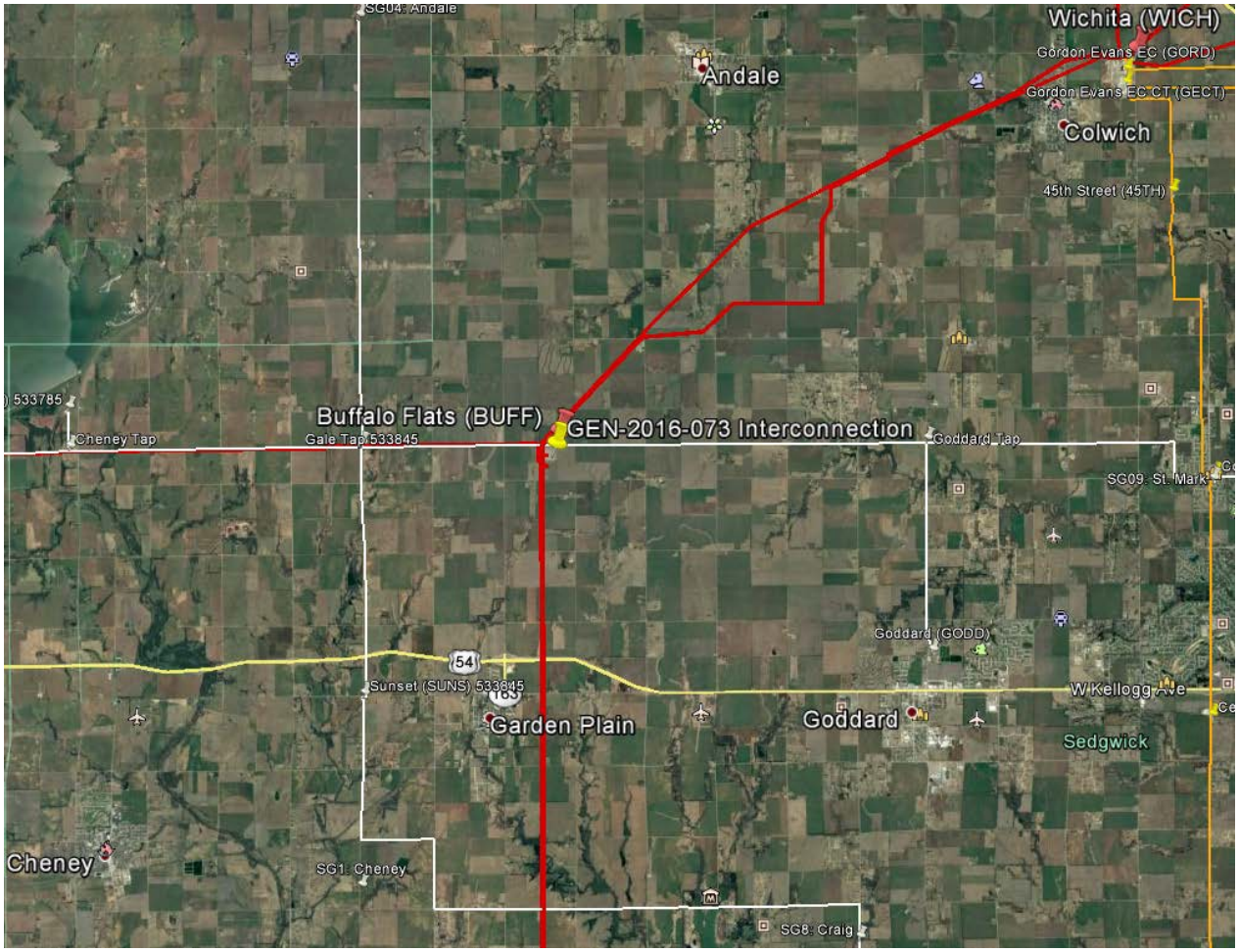
$ 2,115,526 345 kV Substation Work
$ 63,851 AFUDC
$ 179,862 Contingency
$ 2,359,239

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.

16 weeks	Engineering Time
48 weeks	Procurement Time
16 weeks	Construction Time
80 **weeks Total**	

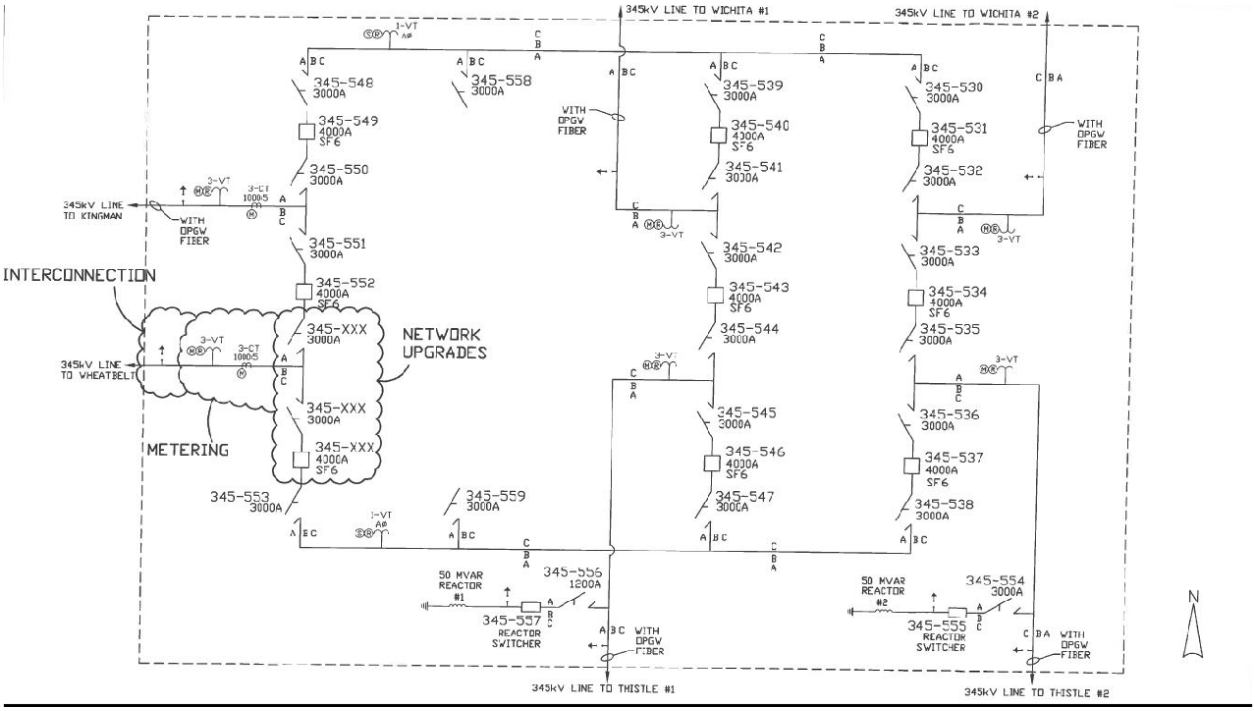
Westar Energy also maintains its own Facility Connection Requirements, which may be found at (http://www.oasis.oati.com/WR/index.html).

Figure 1 – Interconnection Map



The proposed interconnection project is at the Buffalo Flats 345 kV substation

Figure 2 – Substation One-line



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-2016-073 Interconnection 345 kV) using PSS/E's activity ASCC. The 2018 Summer Peak case from the 2017 Series MDWG Classical, Max Fault Short-Circuit models were used. All GEN-2015-024, GEN-2015-025, GEN-2015-090, and GEN-2016-073 Wind Farm generation facilities were 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:

2018 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
19025.3	1168.7	13621.6	8139.7	0.00058 +j 0.00877	0.00059 +j 0.00880	0.00421 +j 0.01888