



INTERCONNECTION FACILITIES STUDY REPORT

GEN-2016-176
(IFS-2016-002-67)

Published November 2021

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
12/17/2019	SPP	Initial draft report issued.
1/22/2020	SPP	Final report issued. Reference changes made under Table 2 as GEN-2016-174 will be the first project to be constructed. Updated Affected System Upgrades Table 5 listing upgrade and cost individually.
8/27/2020	SPP	Updated final report issued. Updated Table 5 and Table 6.
11/10/21	SPP	Updated final report issued. Updating wording on Pages 1, 2, and 6 to reflect Modification Impact Study results. Updated Tables 5 and 6 to reflect updated ACEI AFS

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2016-176/IFS-2016-002-67 is for a 300.56 MW generating facility located in Washington County, KS. The Interconnection Request was initially studied in the DISIS-2016-002 Impact Study for Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS). Interconnection Customer had later chosen to drop NRIS. The Interconnection Request was also studied in a Modification Impact Study in which the turbine configuration and capacity changed. The Interconnection Customer's requested in-service date is November 30, 2021.

The interconnecting Transmission Owner, Evergy Kansas Central, 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 (TOIF), Non-Shared Network Upgrades, Shared Network Upgrades, Previous Network Upgrades, 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 eight (8) GE 2.32 MW + 100 X GE 2.82 MW Wind Turbine Generation Systems for a total generating nameplate capacity of 300.56 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 collection circuits;
- 34.5 kV to 345 kV transformation substation with associated 34.5 kV and 345 kV switchgear;
- One (1) 345/34.5 kV 204/272/340 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A thirty-seven (37) mile overhead 345 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 345 kV bus at existing Transmission Owner substation ("Stranger Creek 345 kV") 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. 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; and,
- All necessary relay, protection, control and communication systems required to protect Interconnection Customer's Interconnection Facilities and Generating Facilities and coordinate with Transmission Owner's relay, protection, control and communications systems.

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
<u>Transmission Owner Stranger Creek 345 kV Interconnection Substation:</u> Construct one (1) 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.	\$10,000	33.3%	\$3,333*	2 Months
Total	\$10,000		\$3,333*	

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	Z2 Type¹	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>Evergny Metrol Iatan 345 kV Interconnection Substation:</u> Protection equipment settings review, and setting changes. Review of protective settings for 87 th Street to Stranger Creek 345 kV line.	non-creditable	\$38,499	33.3%	\$12,833*	2 Months
Total		\$38,499		\$12,833*	

* This cost is shared by GEN-2016-149, GEN-2016-150 and GEN-2016-176 if all three choose to connect at same time. If all three connect at different times, the total cost will have to be applied to all three requests respectively.

NOTE: GEN-2016-176 will utilize GEN-2016-174 facilities and generator lead to the POI. If for any reason GEN-2016-174 does not proceed with interconnection, all cost associated with GEN-2016-174 interconnection will still be required for the remaining request(s).

¹ 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 Upgrade(s)

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.

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 4: 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 5** displays the current impact study costs provided by AECI 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 5: Interconnection Customer Affected System Upgrade(s)

Description	Total Cost Estimate	Allocated Share	Allocated Cost Estimate
Associated Electric Cooperative, Inc. (AECI) Affected System Study Cycle Projects: Rebuild the 11.4-mile-long Phelps to Rockport 69 kV line to 336 ACSR.	\$4,708,000	11.27%	\$530,375
AECI Affected System Study Cycle Projects: Rebuild the 18-mile-long Hamburg to Northboro 69 kV line to 336 ACSR.	\$7,434,000	11.84%	\$880,581
AECI Affected System Study Cycle Projects: Rebuild the 4.4-mile-long Phelps to Rockport 69 kV line to 336 ACSR.	\$1,817,000	11.73%	\$213,075
AECI Affected System Study Cycle Projects: Rebuild the 4.136-mile-long Bevier to Macon Lake 69 kV line for to 477 ACSR.	\$2,938,000	10.29%	\$302,419
AECI Affected System Study Cycle Projects: Rebuild the 2.2-mile-long Macon Lake to Axtell to Macon Tap 69 kV line to 477 ACSR.	\$1,562,000	8.94%	\$139,703
Total Affected System Upgrades	\$18,459,000		\$2,066,152

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 300.56 MW can be granted. Full Interconnection Service will be delayed until the TOIF, Non-Shared NU, Shared NU, Previous NU, Affected System Upgrades that are required for full interconnection service are completed. The Interconnection Customer's estimated cost responsibility for TOIF, Non-Shared NU and Affected System Upgrades that is required for full interconnection service is summarized in the table below.

Table 6: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	\$3,333
Network Upgrades	\$12,833
AECI Affected System Upgrades	\$2,066,152
Total	\$2,082,318

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 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 Requests

SPP-GEN-2016-149

SPP-GEN-2016-150

SPP-GEN-2016-174

SPP-GEN-2016-176

December 2, 2019

Introduction

This report summarizes the scope of the Generation Interconnection Facility Study to evaluate the Generation Interconnection Requests for GEN-2016-149, GEN-2016-150, GEN-2016-174, and GEN-2016-176. Each request is proposing to build a 302 MW wind-powered generation facility in north east Kansas with an in-service date of December 31, 2019.

Southwest Power Pool Generation Interconnection Request:

Southwest Power Pool (SPP) GI requested Evergy Metro and Evergy Kansas Central perform an Interconnection Facility Study (IFS).

GI Request #	Point of Interconnection	Capacity (MW)	Fuel Type
GEN-2016-149	Stranger Creek 345 kV	302	Wind
GEN-2016-150	Stranger Creek 345 kV	302	Wind
GEN-2016-174	Stranger Creek 345 kV	302	Wind
GEN-2016-176	Stranger Creek 345 kV	302	Wind

Estimated Costs for TOIF and Network Upgrades

SPP-GEN-2016-149

Evergy Kansas Central:

Transmission Owner Interconnection Facilities (TOIF)

This estimated cost includes work necessary to install one (1) breaker, two (2) switches, three (3) standalone CT's, three (3) 345kV PT's, three (3) control panels to accept a transmission line from the Interconnection Customer's Generating Facility.

345kV Transmission Line Work

The estimated cost is for approximately 0.5 miles of new bundled 1590 Lapwing ACSR line with 64mm OPGW static wire, five (5) steel dead end structures, and one (1) steel H-Frame tangent.

345kV Stranger Creek Substation Work

The estimated cost is for upgrading Stranger Creek substation to a breaker and a half configuration consisting of eleven (11) breakers, three (3) wave traps, twenty-four (24) switches, three (3) standalone CT's, twelve (12) PT's, seven (7) CCVTs, and nineteen (19) control panels. The estimate also includes all other associated yard, cable, grounding, communication, and conduit work.

The total cost estimate for the required Network Upgrades and the Transmission Owner Interconnection Facilities (TOIF).

\$	\$45,194	TOIF (Transmission Line)
\$	\$1,023,228	TOIF (Substation)
\$	\$32,407	TOIF (AFUDC)
\$	\$1,760,297	345kV Transmission Line Work
\$	\$24,306,539	345kV Substation Work
\$	\$869,105	AFUDC
\$	0	Contingency
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\$	\$28,036,770	Total

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	8 Months
Procurement Time	9 Months
Construction Time	16 Months
Total Project Length	24 Months

Evergy Metro:

345kV Substation Work

The estimated cost includes one (1) new line panel, protection equipment settings review, and setting changes, if deemed necessary, at Iatan 345kV substation, as well as a review of protective settings for the 87th Street to Stranger Creek 345kV line, which Evergy Metro owns.

The total cost estimate for the required Network Upgrades and the Transmission Owner Interconnection Facilities (TOIF).

\$	0	TOIF
\$	0	345kV Transmission Line Work
\$	183,489	345kV Substation Work
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\$	183,489	Total

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	4 Months
Procurement Time	4 Months
Construction Time	4 Months
Total Project Length	10 Months

SPP-GEN-2016-150, SPP-GEN-2016-174, SPP-GEN-2016-176

These requests will share a generator lead with GEN-2016-149 from the customer facility to the Point of Interconnection. If for any reason GEN-2016-149 does not proceed with

interconnection, all costs associated with the GEN-2016-149 interconnection will still be required for the remaining request(s).

No additional infrastructure will be required at the point of interconnection beyond that identified for GEN-2016-149. Relaying setting changes will be required for each request.

Assuming these interconnections occur at the same time as GEN-2016-149, no additional costs will be needed to interconnect GEN-2016-150, GEN-2016-174, or GEN-2016-176.

Evergy Kansas Central:

345kV Stranger Creek Substation Work

The estimated cost includes relaying settings changes at the Stranger Creek 345kV substation identified for GEN-2016-149, after applicable protection data is received from GEN-2016-150, GEN-2016-174, or GEN-2016-176. No substation physical upgrades are needed by Evergy Kansas Central.

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

\$	0	345kV Transmission Line Work
\$	10,000	345kV Substation Work
\$	0	AFUDC
\$	0	Contingency
<hr/>		
\$	10,000	Total

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	1 Month
Procurement Time	0 Months
Construction Time	1 Month
Total Project Length	2 Months

Evergy Metro:

345kV Substation Work

The estimated cost includes protection equipment settings review and setting changes, if deemed necessary, at Iatan 345kV substation, as well as a review of protective settings for the 87th Street to Stranger Creek 345kV line, which Evergy Metro owns.

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

\$	0	TOIF
\$	0	345kV Transmission Line Work

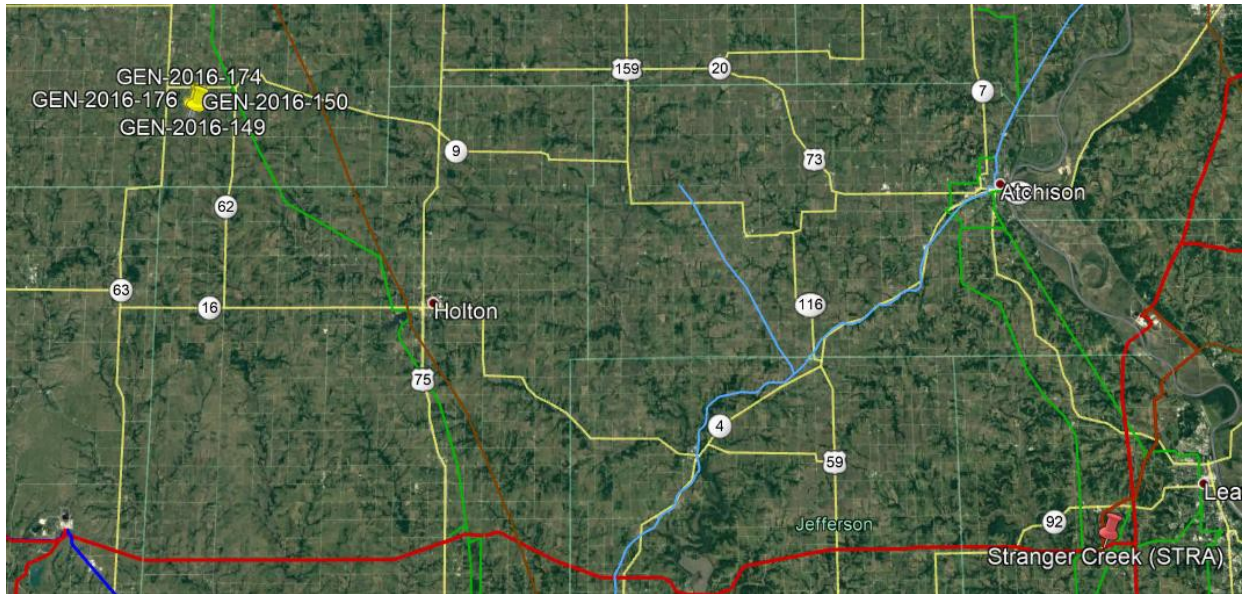
\$	38,499	345kV Substation Work
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\$	38,499	Total

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	1 Month
Procurement Time	0 Months
Construction Time	1 Month
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Total Project Length	2 Months

These estimates are 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 significant and the accuracy of these estimates at the time of actual settings cannot be assured.

Figure 1 – Interconnection Map



The proposed interconnection project is located approximately 80 miles from the Stranger Creek 345 kV substation.

Results of Short Circuit Analysis

Available Fault Current at Point of Interconnection:

As a part of this Interim Facility Study, a short circuit study was performed to determine the available fault current at the interconnection bus using PSS/E's activity ASCC. The 2020 Summer Peak case from the 2019 Series MDWG Classical, Max Fault Short-Circuit models was used. The GEN-2016-149, GEN-2016-150, GEN-2016-174, GEN-2016-176 wind farm generation facility 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:

2020 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
25714.7	15366.02	22963.1	13721.80	0.000470+j0.006621	0.000482+j0.006638	0.001512+j0.008904

Evaluation of Breaker Interrupting Capability:

Evergy Metro reviewed short circuit analysis for the Iatan 345 kV substation to determine if the added generation would cause the available fault currents to exceed the interrupting capability of any existing circuit breakers. The fault currents are within circuit breaker interrupting capability with the addition of the GEN-2016-149, GEN-2016-150, GEN-2016-174, GEN-2016-176 wind farm.