



INTERCONNECTION FACILITIES STUDY REPORT

GEN-2016-145
(IFS-2016-002-55)

Published July 2021

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
09/17/2020	SPP	Initial draft report issued.
10/20/2020	SPP	Final report issued. Updated ILTCR eligibility.
01/07/2021	SPP	Updated final report issued. Updated cost allocation in Tables 1, 2, 3 and 6 based on DISIS Power Flow Reposting
07/28/2021	SPP	Updated final report issued. Updated Tables 3 and 6 based on DISIS Power Flow Reposting

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2016-145/IFS-2016-002-55 is for a 175 MW generating facility located in Texas County, OK. The Interconnection Request was studied in the DISIS-2016-002 Impact Study for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). This request was restudied in the DISIS-2016-002-2 Impact Study for ERIS. The Interconnection Customer's requested in-service date is October 1st, 2020.

The interconnecting Transmission Owner, American Electric Power (AEP), 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, Contingent 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.

COMPENSATION FOR AMOUNTS ADVANCED FOR NETWORK UPGRADE(S)

FERC Order ER20-1687-000 eliminated the use of Attachment Z2 revenue crediting as an option for compensation. The Incremental Long Term Congestion Right (ILTCR) process will be the sole process to compensate upgrade sponsors as of July 1st, 2020.

INTERCONNECTION CUSTOMER INTERCONNECTION FACILITIES

The Generating Facility is proposed to consist of 70 GE 2.5 MW Wind Turbine Generation Systems for a total generating nameplate capacity of 175 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 345/34.5 kV 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;
- An overhead 345 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the kV bus at existing Transmission Owner substation ("Riverside 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 communication 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>GEN-2016-133 thru 146 Interconnection (TOIF) (AEP) - 122665:</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.	\$1,388,819	11.1%	\$154,297	30 Months
Total	\$1,388,819		\$154,297	

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>GEN-2016-133 thru 146 Interconnection (Non-Shared NU) (AEP) - 122666:</u> Expand the 345 kV breaker and a half scheme, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work.	Ineligible	\$10,381,130	11.1%	\$1,153,343	30 Months
<u>GEN-2016-133 thru 146 Interconnection (Non-Shared NU) (OGE) – 122667:</u> At an existing EHV substation, update relay settings on an existing 345kV line to accommodate new protection settings.	Ineligible	\$15,000	100%	\$15,000	TBD
Total		\$10,396,130		\$1,168,343	

*Table 2: Non-Shared Network Upgrade(s)***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	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>Viola 345/138 kV Transformer CKT 2 (DISIS-2016-002-2) – 122792:</u> Install a new 345 kV terminal on a new rung consisting of two (2) breakers, four (4) switches, and two (2) control panels. Install a new 138 kV terminal on an existing rung consisting of one (1) breaker, three (3) switches, three (3) PTs, and one (1) 400/440 MVA 345-138 kV transformer with LTCs.	Eligible	\$9,204,587	1.74%	\$160,159	18 – 24 Months
Total		\$9,204,587		\$160,159	

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
<u>Blackberry – Wolfcreek 345 kV Ckt1 (AECD – 122765):</u> Build 86.15 miles of 345 kV line from Blackberry to Wolf Creek to achieve 1792/1792/1792/1792 (SN/SW/WN/WE) MVA ratings.	\$0	1/1/2026

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 Contingent 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 MISO 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)

Affected System Upgrades Description	Total Cost Estimate (\$)	Allocated Share (%)	Allocated Cost Estimate (\$)
<u>AECL Affected System Study Cycle Projects:</u> Rebuild the 18-mile-long Hamburg to Northboro 69 kV line to 336 ASCR.	\$7,434,000	1.62%	\$120,820
<u>AECL Affected System Study Cycle Projects:</u> Rebuild the 4.4-mile-long Phelps to Rockport 69 kV line to 336 ASCR.	\$1,817,000	1.63%	\$29,651
<u>AECL Affected System Study Cycle Projects:</u> Rebuild the 11.4-mile-long Linden to Phelps 69 kV line to 336 ASCR.	\$4,708,000	1.71%	\$80,308
<u>AECL Affected System Study Cycle Projects:</u> Rebuild the 4.136-mile-long Bevier to Macon Lake 69 kV line to 477 ASCR.	\$2,938,000	1.99%	\$58,391
<u>AECL Affected System Study Cycle Projects:</u> Rebuild the 2.2-mile-long Macon Lake to Axtell to Macon Tap 69 kV line to 477 ASCR.	\$1,562,000	2.13%	\$33,294
<u>AECL Affected System Study Cycle Projects:</u> Upgrade the 10.92-mile-section of Neosho to Sweetwater 69 kV line to 336 ASCR.	\$6,273,000	5.33%	\$334,434
<u>AECL Affected System Study Cycle Projects:</u> Add 0.08 p.u. series reactor on Washburn to Seligman 69 kV line.	\$675,000	5.76%	\$38,896
Total	\$25,407,000		\$695,794

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for [Insert Interconnection Amount] MW can be granted. Full Interconnection Service will be delayed until the TOIF, Non-Shared NU, Shared NU, Contingent NU, Affected System Upgrades that are required for full interconnection service are completed. The Interconnection Customer's estimated cost responsibility for [Insert all upgrades (TOIF, non-shared NU, shared NU, affected system, etc)] that is required for full interconnection service is summarized in the table below.

Table 6: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilitie Upgrade(s)	\$154,297
Non-Shared Network Upgrade(s)	\$1,168,343
Shared Network Upgrade(s)	\$160,159
Affected System Upgrade(s)	\$695,794
Total	\$2,178,593

*Use the following link for Quarterly Updates on upgrades from this report: <https://spp.org/spp-documents-filings/?id=18641>

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).



***Interconnection Facilities Study for
GI Cluster Impact Study
DISIS-2016-002
Riverside 345kV Station
Upgrades for Generation
Interconnection***

April 2020

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Summary

American Electric Power Southwest Transmission Planning (AEP) performed the following study at the request of the Southwest Power Pool (SPP) for SPP Generation Interconnection request DISIS-2016-002. Per the SPP Generator Interconnection Procedures (GIP), SPP requested that AEPW perform an Interconnection Facilities Studies (IFS) for Network Upgrade(s) in accordance with the Scope of Interconnection Facilities Study in GIP 8.10 and the Interconnection Facilities Study Procedures in accordance with GIP 8.13 for the following Network Upgrades:

- Riverside 345 kV Station Upgrades
 - Expand the 345 kV station at Riverside 345 kV station to facilitate the new generation interconnection.

Interconnection Facilities (See Figures 1 and 2)

Expand Riverside 345 kV Substation

AEP will expand the 345 kV breaker and a half scheme at Riverside 345 kV station to facilitate the new generation interconnection requests GEN-2016-133 thru GEN-2016-146.

The design and construction of the new station equipment will meet all AEP specifications for stations. Bus work and disconnect switches will be designed to accommodate the loading requirements, and circuit breakers will be rated to ensure adequate load and fault interrupting capability. AEP will own, operate and maintain the station.

Short Circuit Fault Duty Evaluation

It is standard practice for AEP 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.

In the AEP system, no breakers were found to exceed their interrupting capability after the addition of the generation and related facilities. Therefore, there are no short circuit upgrade costs associated with the DISIS-2016-002 interconnections.

Interconnection Costs

Listed below are the associated costs.

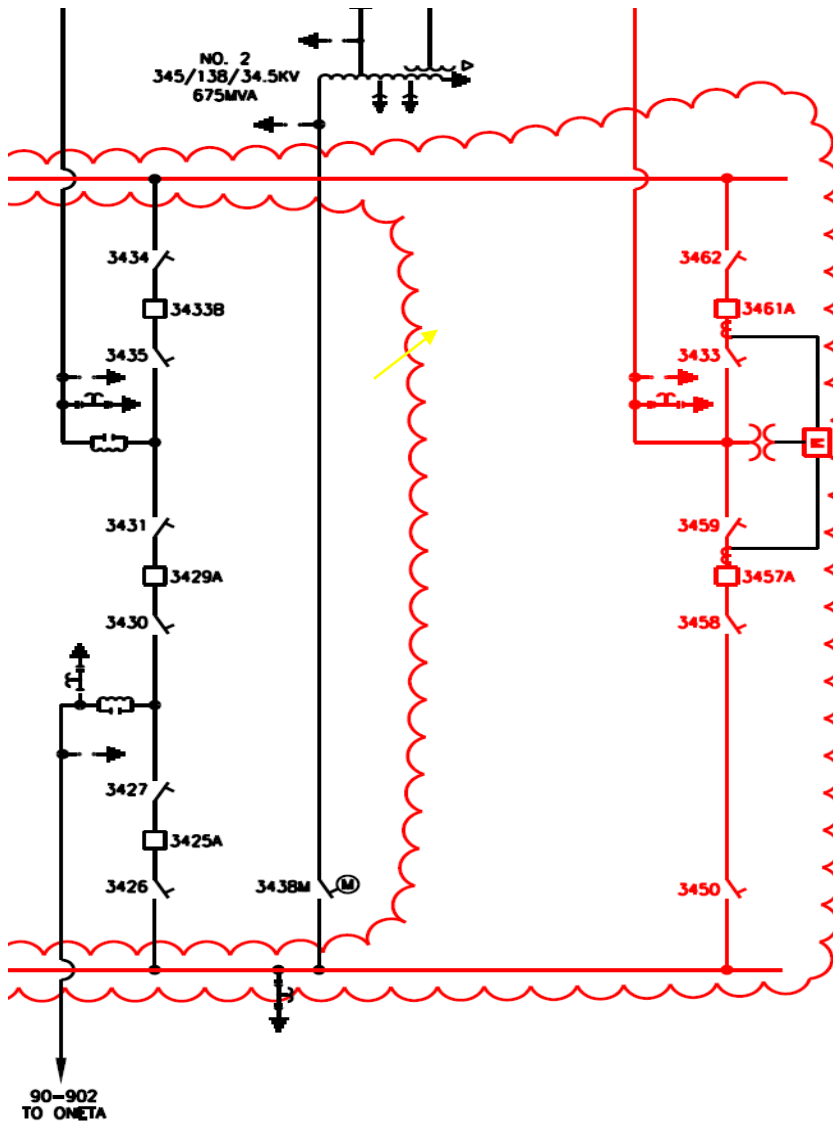
SYSTEM IMPROVEMENT	COST (2019 DOLLARS)
Expand Riverside 345 kV station. (Network Upgrades)	\$10,381,130
Gen-2016-133 thru GEN-2016-146 Transmission Owner Interconnection Facilities (TOIF)	\$1,388,819
TRANSMISSION INTERCONNECTION FACILITY TOTAL COSTS	\$11,769,949

TABLE 1

Project Lead Time

Project in-service date is projected to be 30 months after the issuance of Authorization to Proceed from the Interconnection Customer

Riverside 345 kV Station





FACILITY STUDY

for

Generation Interconnection Request 2016-133thru146

2.5GW Wind Generating Facilities
In Tulsa County
Oklahoma

February 5, 2020

Adam Snapp, PE
Lead Engineer
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-2016-133 through Gen-2016-146. 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 requirements for interconnection consist of updating relay settings at Redbud substation. The total cost for OKGE to update settings at Redbud 345kV substation, the interconnection facility, is estimated at \$15,000 per update.

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Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting wind generating facilities within the service territory of American Electric Power (AEP) in Tulsa County Oklahoma. The proposed 345kV point of interconnection to Oklahoma Gas and Electric (OKGE) is at Redbud Substation in Oklahoma County Oklahoma. This substation is owned by OKGE.

The cost for updating relay settings on an existing terminal at Redbud 345kV Substation, the required interconnection facility, is estimated at \$15,000 per relay settings update.

Network Constraints in the Southwest Public Service (SPS), AEP, OKGE and Western Farmers Electric Cooperative (WFEC) systems may be verified with a transmission service request and associated studies.

Interconnection Facilities

The total cost for OKGE to update relay settings at a terminal in Redbud Substation, the interconnection facility, is estimated at \$15,000. The line between AEP's Riverside location and OKGE's Redbud substation is already established. Since this facility study covers multiple GI requests, it must be stated that these settings will need to be updated each time a new generating facility is brought into AEP Riverside 345kV. If Gen 2016-133 thru 146 are brought online at one time, the relay settings at Redbud substation will only need to be updated once. If they are brought online in stages, the settings will need to be updated for each stage.

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 SPPOATT.

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 re-closer 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 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-2016-133 thru 146 interconnection(s).

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2020 DOLLARS)
OKGE – Interconnection Facilities - At an existing EHV substation, update relay settings on an existing 345kV line to accommodate new protection settings.	\$15,000 each time a generating facility or set of generating facilities is brought online at AEP Riverside.
OKGE – Network Upgrades	\$0
Total	\$15,000 * x

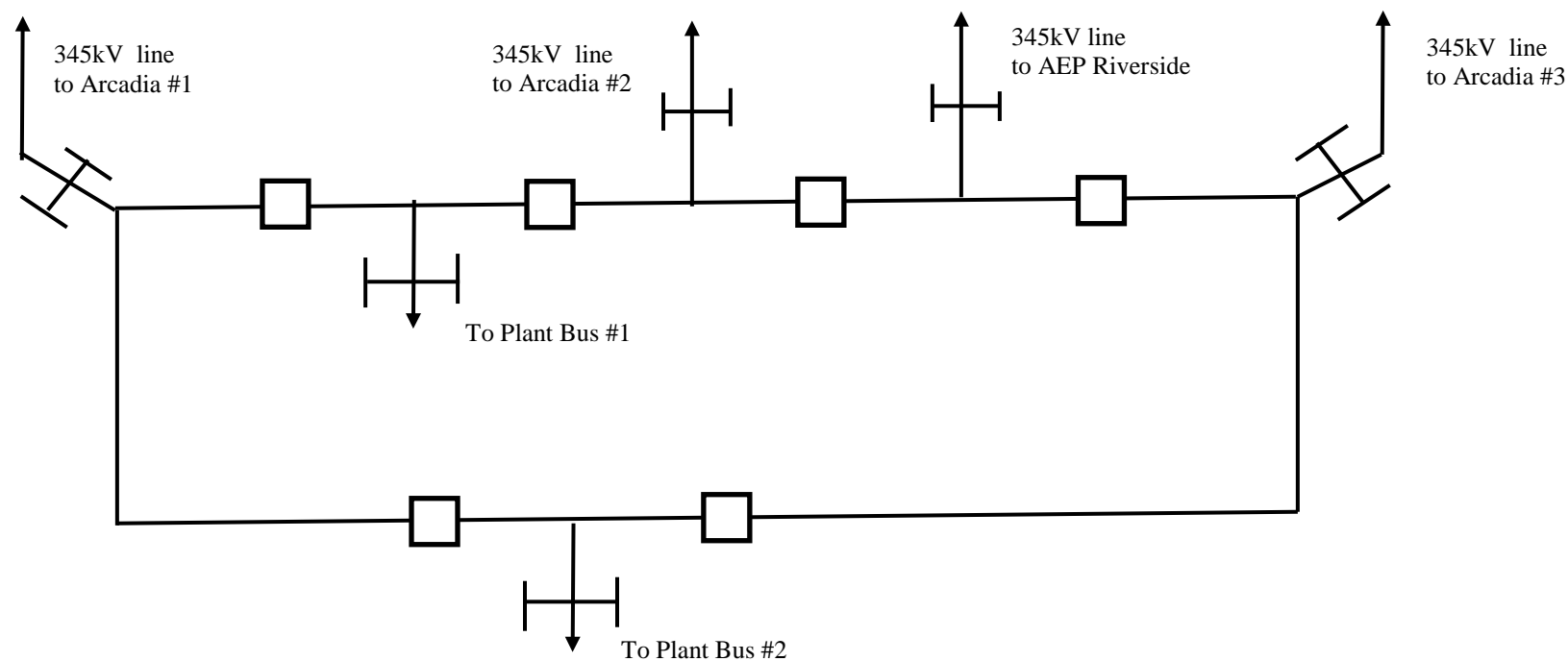
Prepared by Adam Snapp, P.E.
Lead Engineer, Transmission Planning
OG&E Electric Services

February 13, 2020

Reviewed by:

Steve M. Hardebeck, P.E.
Manager, Transmission Planning

Redbud Substation





Interconnection Facilities Study

Network Upgrades associated with DISIS-2016-002-2

September 2020

Introduction

This report summarizes the scope of the Interconnection Facilities Analysis for Network Upgrade(s) to determine costs related to the addition of the SPP-GI DISIS-2016-002-2 Interconnection Request(s) mentioned below.

- GEN-2016-100
- GEN-2016-101
- GEN-2016-111
- GEN-2016-112
- GEN-2016-114
- GEN-2016-119
- GEN-2016-122
- GEN-2016-128
- GEN-2016-133 thru 146
- GEN-2016-153

Southwest Power Pool Generation Interconnection Request:

Per the SPP Generator Interconnection Procedures (GIP), SPP has requested that Evergy perform an Interconnection Facilities Study (IFS) for Network Upgrade(s) in accordance with the Scope of Interconnection Facilities Study GIP Section 8.10 and the Interconnection Facilities Study Procedures in accordance with GIP Section 8.11 for the following Interconnection Request(s):

Network Upgrade	Description	SCERT UID	DISIS Estimate
Hoyt - JEC 345kV Rebuild	Rebuild the existing JEC - Hoyt 345 kV line as double circuit 345 kV with normal/minimal emergency rating of 1792 MVA. Network upgrade shared by four requests: GEN-2016-111, GEN-2016-112, GEN-2016-114, GEN-2016-22.	122705	\$49,284,648.00
Viola 345/138kV Transformer CKT 2	Build second 345/138/13.8kV transformer at Viola.	122792	\$9,038,339.00
Reno 345/115 kV Transformer Ckt 1	Replace existing Reno transformer with one rated 400/440.	122793	\$4,683,106.00
Reno 345/115 kV Transformer Ckt 2	Replace existing Reno transformer with one rated 400/440	122794	\$4,683,106.00

Hoyt – Jeffrey EC 345kV Rebuild

345kV Transmission Line

The estimated cost is for 24.3 miles of single 345kV circuit with new bundled 1590 Lapwing ACSR line with 64mm OPGW static wire, eight (8) steel dead end structures, one-hundred forty-three (143) steel tangent structures, four (4) steel running angle structures, and no distribution underbuild.

345kV Substation

At Hoyt 345kV substation, the estimated cost is for removal of the wavetrap, replace line arrestors, add fiber, and upgrade groundmat.

At Jeffrey EC 345kV substation, the estimated cost is for removal the wavetrap, replace line arrestors, and add fiber.

Total Cost

The total cost estimate for this Network Upgrade is:

\$	49,140,587	345kV Transmission Line
\$	490,863	345kV Substation
\$	153,427	AFUDC
\$	0	Contingency
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\$	49,784,877	Total

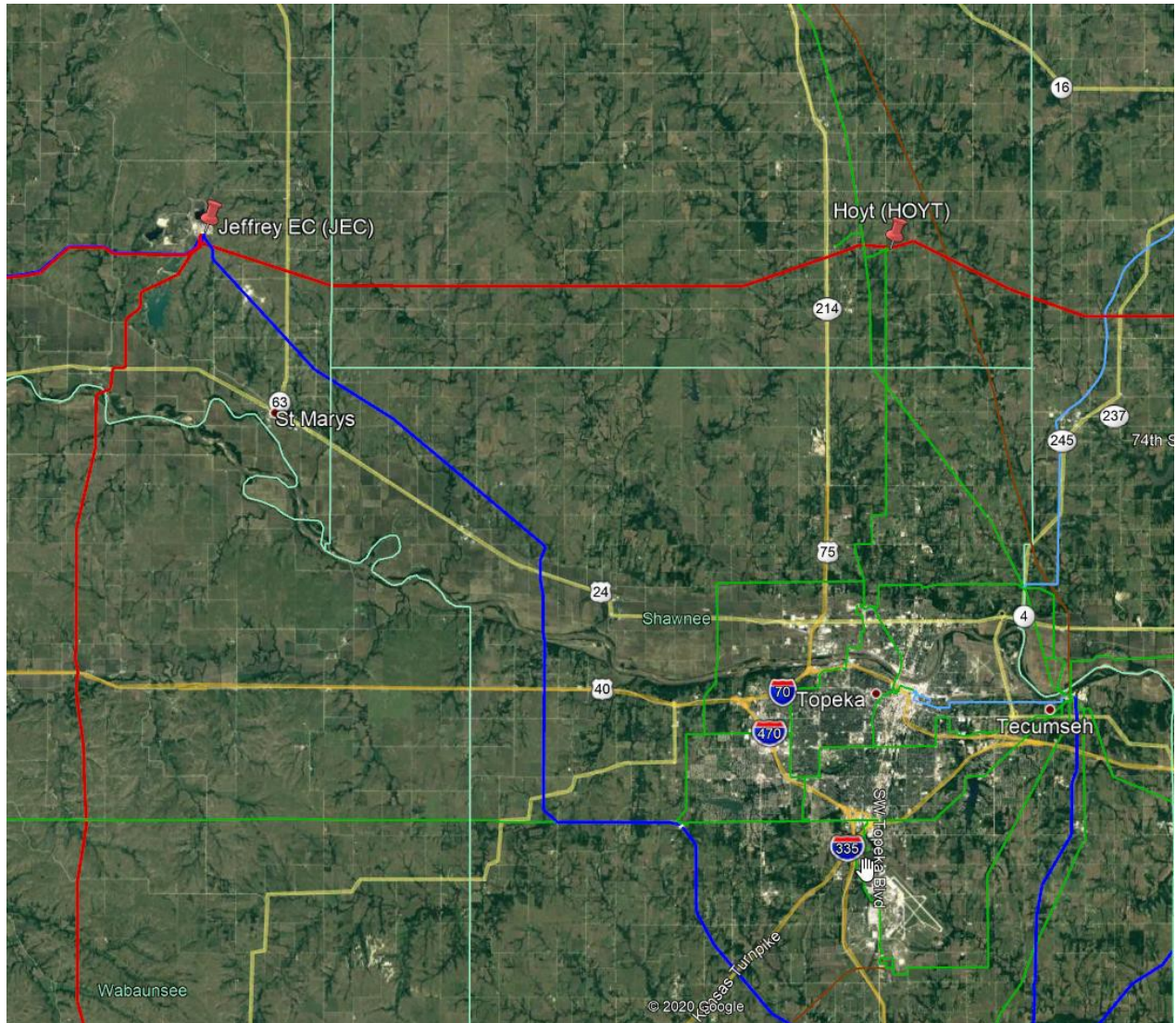
This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are very significant and the accuracy of this estimate at the time of actual settings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

Time Estimate

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

Engineering Time	12	Months
Procurement Time	12	Months
Construction Time	12	Months
<hr/>		
Total Project Length	24-36	Months

Figure 1 – Hoyt-Jeffrey EC 345kV Line



Viola 345-138kV TX-2 Transformer Addition

345kV and 138kV Substation

At Viola 345kV substation, the estimated cost is for a new 345kV terminal on a new rung consisting of two (2) breakers, four (4) switches, and two (2) control panels. Also, at Viola 138kV substation, the estimated cost is for a new 138kV terminal on an existing rung consisting of one (1) breaker, three (3) switches, three (3) PTs, and one (1) 400/440 MVA 345-138kV transformer with LTCs.

Total Cost

The total cost estimate for this Network Upgrade is:

\$	9,177,056	345kV and 138kV Substation
\$	27,531	AFUDC
\$	0	Contingency
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\$	9,204,587	Total

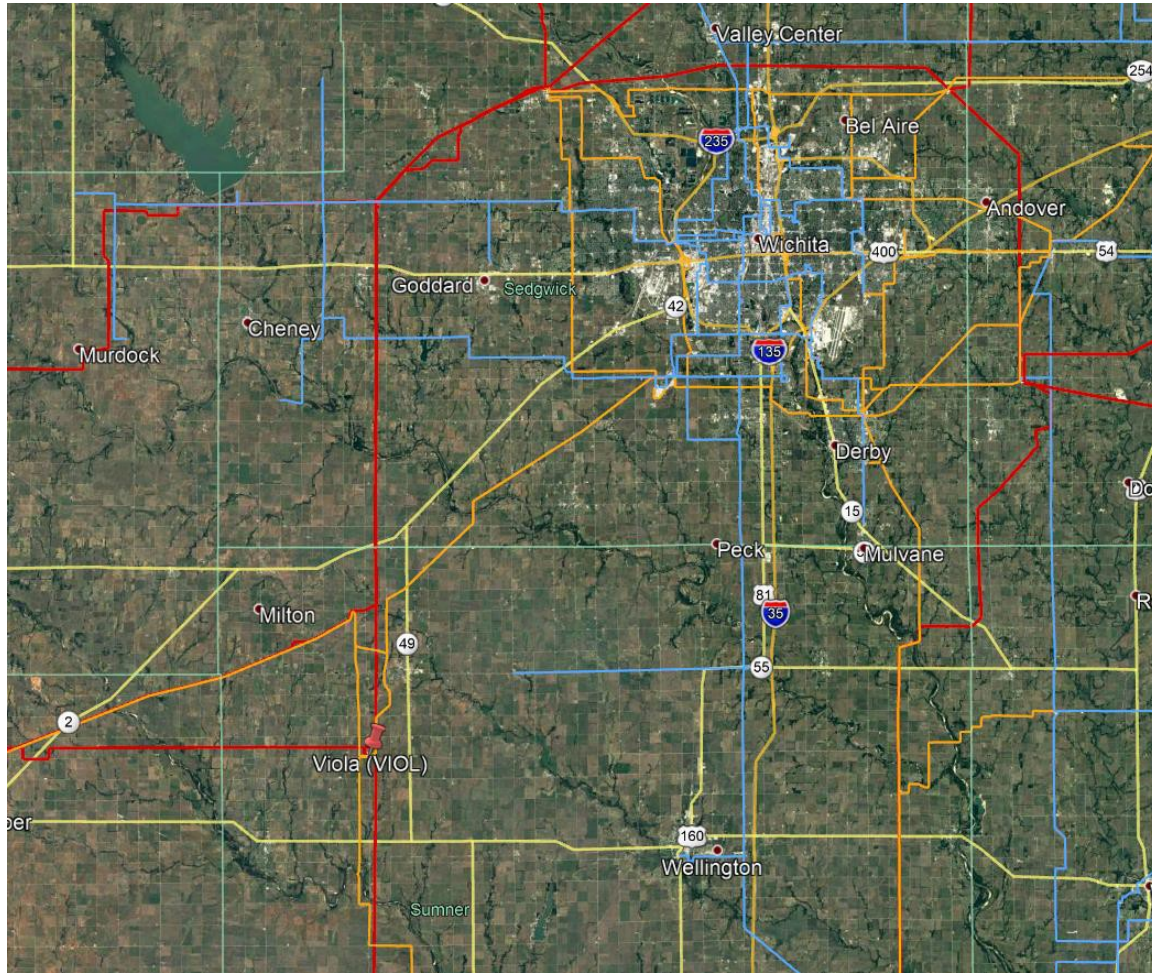
This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are very significant and the accuracy of this estimate at the time of actual settings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

Time Estimate

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

Engineering Time	6	Months
Procurement Time	12	Months
Construction Time	6	Months
<hr/>		
Total Project Length	18-24	Months

Figure 2 – Viola Substation



Reno County 345-115kV TX-1 Transformer Replacement

345kV and 115kV Substation

At Reno County 345kV and 115kV substation, the estimated cost is for one (1) 345-115kV 400/440 MVA transformer with LTCs, and removal of the existing transformer.

Total Cost

The total cost estimate for this Network Upgrade is:

\$	4,669,098	Substation
\$	14,007	AFUDC
\$	0	Contingency
<hr/>		
\$	4,683,105	Total

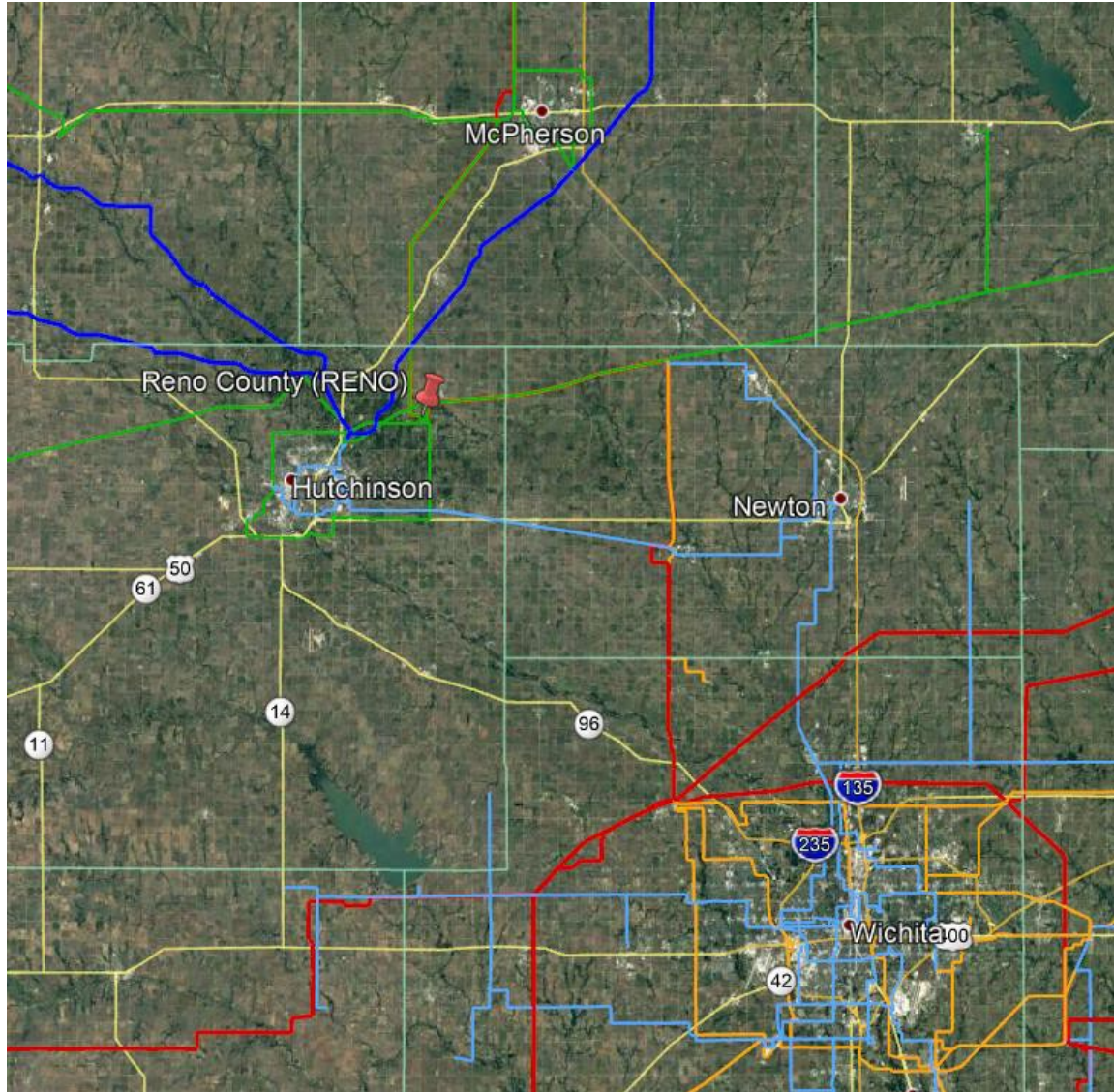
This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are very significant and the accuracy of this estimate at the time of actual settings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

Time Estimate

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Engineering Time	6	Months
Procurement Time	12	Months
Construction Time	6	Months
<hr/>		
Total Project Length	18-24	Months

Figure 3 – Reno County Substation



Reno County 345-115kV TX-2 Transformer Replacement

345kV and 115kV Substation

At Reno County 345kV and 115kV substation, the estimated cost is for one (1) 345-115kV 400/440 MVA transformer with LTCs, and removal of the existing transformer.

Total Cost

The total cost estimate for this Network Upgrade is:

\$	4,669,098	Substation
\$	14,007	AFUDC
\$	0	Contingency
<hr/>		
\$	4,683,105	Total

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.

Time Estimate

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

Engineering Time	6	Months
Procurement Time	12	Months
Construction Time	6	Months
<hr/>		
Total Project Length	18-24	Months