



**INTERCONNECTION
FACILITIES STUDY
REPORT**

GEN-2017-155

Published April 2023

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
04/13/2023	SPP	Initial draft report issued.
05/24/2023	SPP	Final report issued.
07/24/2023	SPP	Table 5 revised to reflect updated AEI costs.

CONTENTS

Revision History	i
Summary	1
Introduction	1
Phase(s) of Interconnection Service	1
Compensation for Amounts Advanced for Network Upgrade(s).....	1
Interconnection Customer Interconnection Facilities	2
Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s)	3
Shared Network Upgrade(s)	4
Contingent Network Upgrade(s).....	4
Affected System Upgrade(s)	5
Conclusion.....	5
Appendices	6
A: Transmission Owner’s Interconnection Facilities Study Report and Network Upgrades Report(s).....	7

SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request is for a 300 MW generating facility located in Muskogee County, OK. The Interconnection Request was studied in the DISIS-2017-002 Impact Study for ERIS. The Interconnection Customer's requested in-service date is December 01, 2027.

The interconnecting Transmission Owner, Oklahoma Gas & Electric Company (OGE), 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 (150) 2.0 General Electric wind turbines for a total generating nameplate capacity of 300 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 201/268/335 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- Approx. 140 miles 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 ("Muskogee 345kV Substation") 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 inverter 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>Muskogee 345kV GEN-2017-155 Interconnection (TOIF) (OGE) (143413):</u> Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-155 (300 MW/Wind), into the Point of Interconnection (POI) at Muskogee 345kV	\$1,591,654	100%	\$1,591,654	36 Months
Total	\$1,591,654		\$1,591,654	

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>Muskogee 345kV GEN-2017-155 Interconnection (Non-Shared NU) (AEP) (143574):</u> Potential interconnection impacts from the following generating facility, GEN-2017-155 (300 MW/Wind), into the Point of Interconnection (POI) at Muskogee 345kV	Ineligible	\$250,000	100%	\$250,000	36 Months
<u>Muskogee 345kV GEN-2017-155 Interconnection (Non-Shared NU) (OGE)(143412):</u> Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-155 (300 MW/Wind), into the Point of Interconnection (POI) at Muskogee 345kV	Ineligible	\$14,198,232	100%	\$14,198,232	36 Months

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
Total		\$14,448,232		\$14,448,232	

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>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
Total		<u>NA</u>		<u>NA</u>	

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>NA</u>	<u>NA</u>	<u>NA</u>

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 either MISO or 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)

Affected System Upgrades Description	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)
NA	NA	NA	NA
Total	NA		NA

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 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 full interconnection service is summarized in the table below.

Table 6: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities Upgrade(s)	\$1,591,654
Non-Shared Network Upgrade(s)	\$14,448,232
Shared Network Upgrade(s)	\$0
Affected System Upgrade(s)	\$0
Total	\$16,039,886

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).



**AEP Generation Interconnection
Facilities Study Report
for
GEN-2017-155
Clarksville 345 kV station
Beckham County, Texas**

March 2023

1 Facilities Study Summary

American Electric Power (AEP) Southwest Transmission Planning performed the following study at the request of the Southwest Power Pool (SPP) for SPP Generation Interconnection request GEN-2017-155. Per the SPP Generator Interconnection Procedures (GIP), SPP requested that AEP perform an Interconnection Facilities Studies (IFS) for Network Upgrade(s) in accordance with Section 8.11 for the following Interconnection and/or Network Upgrade(s):

- AEP Clarksville 345 kV
 - Update line relay settings for remote end (OGE Muskogee) generator interconnection

1.1 Project Description

Per the GEN-2017-155 study request, AEP proposes to update line relay settings at the AEP Clarksville 345 kV station in Beckham County, Oklahoma (Figure 1).

1.2 AEP's Scope of Work to Facilitate Interconnection

- To accommodate the generation request at the Clarksville 345 kV station, AEP will update the line relay settings for remote end (OGE Muskogee) generator interconnection
- It is understood that the Interconnection Customers are responsible for the cost of all of this work.

1.3 Short Circuit 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 additional short circuit upgrade costs associated with the DISIS-2017-002, GEN-2017-155 interconnection.

1.4 Stability Analysis

- Based on the results of the 2017-002 DISIS short circuit and stability report, AEP is not aware of any instances where the system does not meet TPL-001 stability performance requirements for the planning events and generation dispatch conditions that were considered in this DISIS study.

1.5 Interconnection Cost of Facilities Included in the Facilities Study:

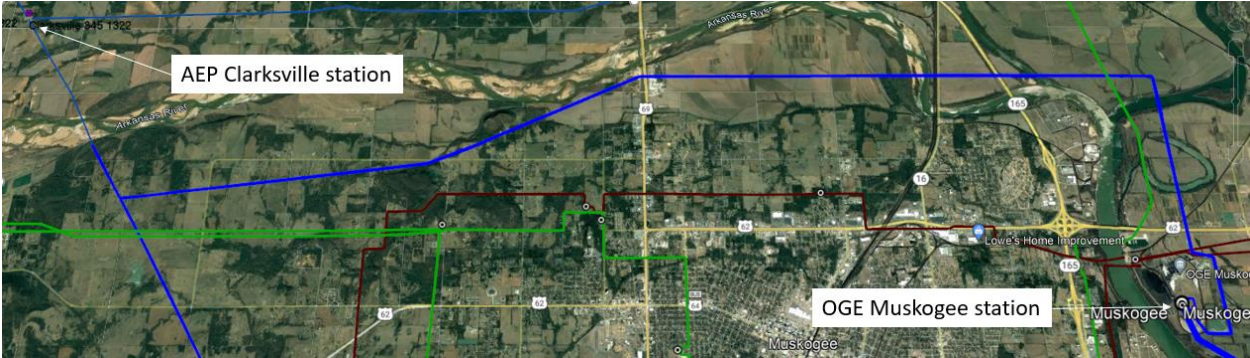
Update Line Relay Settings at AEP Pittsburg station	\$10,000
Total Cost	\$10,000

The estimates do not include the impact that delays in obtaining ROW, permits, or other approvals may have.

1.6 Project Lead time

Project in-service date is projected to be 12 months after the issuance of Authorization to Proceed from the Interconnection Customer.

Figure 1: Geographic Map





FACILITY STUDY

for

Generation Interconnection Request 2017-155

300 MW Wind Generating Facility
In Muskogee County
Oklahoma

March 9, 2023

Chris Rich P.E.
Transmission Planning Engineer
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-2017-155. 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 adding one 345kV breaker, line reactor, a terminal for the wind farm line, associated metering, protection, and communications in Muskogee substation. In addition, an engineering EMTP study will need to be completed. Costs for any mitigation steps taken due to EMTP study results will need to be added to the facility study's estimate. The total cost for OKGE to add one 345kV breakers, 345kV line reactor, 345kV reactor switch/breaker, 0.55 miles of Transmission and a new line terminal for a new Wind Farm at Muskogee 345kV substation and have an EMTP study at Muskogee 345kV substation, the interconnection facility, is estimated at \$15,789,886. If the EMTP study results show that the line reactor is not needed, then it will not be added and this facility study's estimate will be reduced.

Table of Contents

Table of Contents	3
Introduction	4
Interconnection Facilities	5
Interconnection Costs	6
One-Line diagram of Interconnection	7
Map of Point of Interconnection	8

Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting a wind generating facility within the service territory of OG&E Electric Services (OKGE) in Muskogee County Oklahoma. The proposed 345kV point of interconnection is at Muskogee Substation in Muskogee County. This substation is owned by OKGE. The cost for adding a new 345kV terminal to Muskogee Substation, the required interconnection facility, is estimated at \$1,591,654.

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

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

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. The requirements for interconnection consist of adding a new 345kV terminal in an existing substation and building 0.55 miles of transmission line to the edge of OKGE property. This 345kV addition shall be constructed and maintained by OKGE. It is assumed that obtaining all necessary right-of-way for the line to the new OKGE 345kV POI will be performed by the interconnection customer.

An EMTP study will be required for Gen-2017-155 due to the length of the gen-tie at 140 miles. Costs for any mitigation steps revealed by the EMTP study results may require the facility study's estimate to be adjusted. The total cost for OKGE to build Transmission to the POI, add one new 345kV breaker, a line reactor and a 345kV terminal to Muskogee substation, the interconnection facility, is estimated at \$15,789,886. This cost does not include building the 345kV line from the Customer substation to the POI, the transmission dead-end structure at the edge of the property. The Customer is responsible for their gen-tie up to the point of interconnection. OKGE recommends the customer come into Muskogee from the south side of the existing 345kV river crossing and then north to the POI situated on land owned by OKGE. A map of the proposed routing into the POI is shown on page 8.

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 SPP OATT.

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 300MW 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-2017-155 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2023 DOLLARS)
Lead Time	36 months
OKGE – Interconnection Facilities - Add a single 345kV line terminal to Muskogee Substation. Dead end structure, line switch, line relaying, revenue metering including CTs and PTs	\$1,591,654
OKGE- Reactive Interconnection Facilities - Add line reactor, FIS, 345kV Reactor switch/breaker, relaying and protection	\$9,234,000
OKGE – Network Upgrades at Muskogee sub, build Transmission, install 1-345kV 3000A breaker, line relaying, disconnect switches, and associated equipment.	\$4,964,231
OKGE - Right-of-Way for 345kV terminal addition	No Additional ROW
Total	\$15,789,886

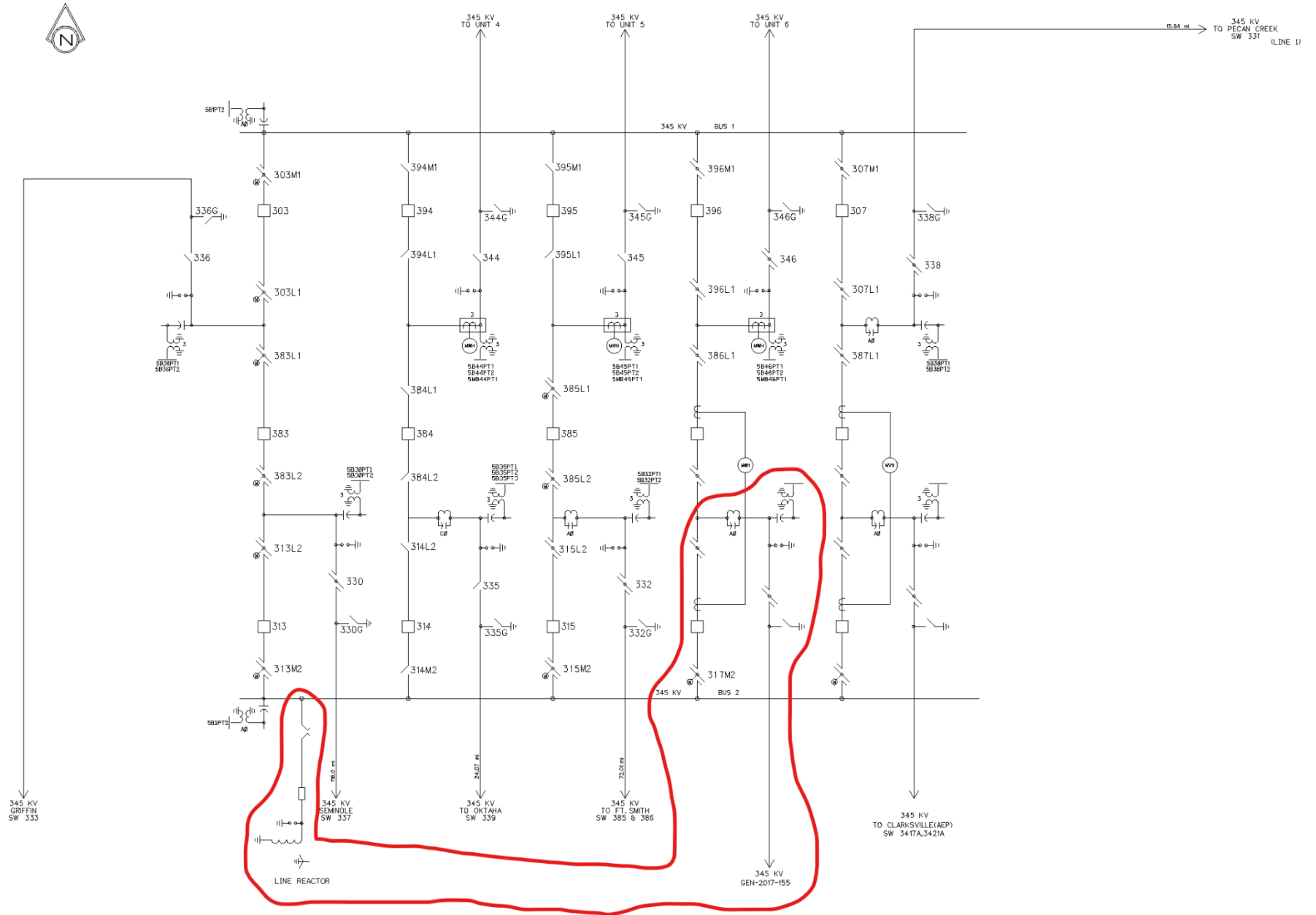
Prepared by:
Chris Rich, P.E.
Transmission Planning Engineer
richcs@oge.com

March 9, 2023

Reviewed by:
Adam Snapp, P.E.
Manager- Transmission Planning
snappad@oge.com

March 11, 2023

MUSKOGEE 345kV SUBSTAION



MUSKOGEE POI

