INTERCONNECTION FACILITIES STUDY REPORT

GEN-2016-022

(IFS-2016-001-29)

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By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
05/24/2019	SPP	Initial draft report issued.
6/24/2019	SPP	Final report issued.
1/6/2020	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.
2/24/2022	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-2016-022/IFS-2016-001-29 is for a 151.80 MW generating facility located in Kay County, Oklahoma. The Interconnection Request was studied in the DISIS-2016-001 Impact Study and Restudies for Energy Resource Interconnection Service (ERIS). The Interconnection Customer's original requested commercial operation date is 12/31/2017 and the commercial operation date in the Facilities Study Agreement is 11/30/2018.

The interconnecting Transmission Owner, Oklahoma Gas & Electric (OKGE), 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, 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 forty-four (44) Vestas V126 3.45 MW wind generators for a total generating nameplate capacity of 151.80 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:

- 34.5kV underground cable collection circuits;
- 34.5kV to 345kV transformation substation with associated 34.5kV and 345kV switchgear;
- One (1) 345/34.5 kV 100/133/166 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A 6.3 mile overhead 345kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 345kV bus at existing Transmission Owner substation "Ranch Road" 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 9.6 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-2016-022 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
OKGE 345kV Ranch Road Interconnection Substation: Update relay protection.	$10,000	100%	$10,000	2 Months
Total	**$10,000**		**$10,000**	

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
None	N/A	$0	N/A	$0	N/A
Total		**$0**		**$0**	

[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
OKGE: Ranch Road – Sooner 345kV CKT 1: Upgrade terminal equipment. Install two (2) 345kV 3000 amp switches at the existing Sooner 345kV substation	Creditable	$255,000	99.02%	$252,505	9 Months
Total		**$255,000**		**$252,505**	

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 151.80 MW can be granted. Full Interconnection Service will be delayed until the TOIF, Non-Shared NU, Shared NU, Contingent NU, Previous NU and Affected System upgrades that are required for full interconnection service are completed. The Interconnection Customer's estimated cost responsibility for TOIF and Shared Network Upgrades are summarized in the table below.

Table 7: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	$10,000
Network Upgrades	$252,505
Total	**$262,505**

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).

REVISED FACILITY STUDY

for

Generation Interconnection Request 2016-022

151.8 MW Wind Generating Facility
In Kay County
Oklahoma

July 24, 2017

Andrew R. Aston, 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-2016-022. 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 updating the relay protection at Ranch Road Substation. The total cost for OKGE to update the relay protection in Ranch Road substation, the interconnection facility, is estimated at $10,000.

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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 Kay County Oklahoma. The proposed 345kV point of interconnection is at Ranch Road Substation in Kay County Oklahoma. This substation is owned by OKGE.

The cost for adding GEN-2016-022 to an existing 345kV terminal to Ranch Road Substation, the required interconnection facility, is estimated at $10,000.

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.

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. The requirements for interconnection consist of updating relay protection in Ranch Road Substation. This 345kV addition shall be constructed and maintained by OKGE. The Customer did not propose a route of its 345kV line to serve its 345kV facilities. It is assumed that obtaining all necessary right-of-way for the line into the new OKGE 345kV substation facilities will not be a significant expense.

The total cost for OKGE to update relay protection at an existing 345kV terminal in Ranch Road Substation, the interconnection facility, is estimated at $10,000. This cost does not include building the 345kV line from the Customer substation into Ranch Road Substation. The Customer is responsible for this 345kV line up to the point of interconnection. This cost does not include the Customer's 345-34.5kV substation and the cost estimate should be determined by the Customer.

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 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-2016-022 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

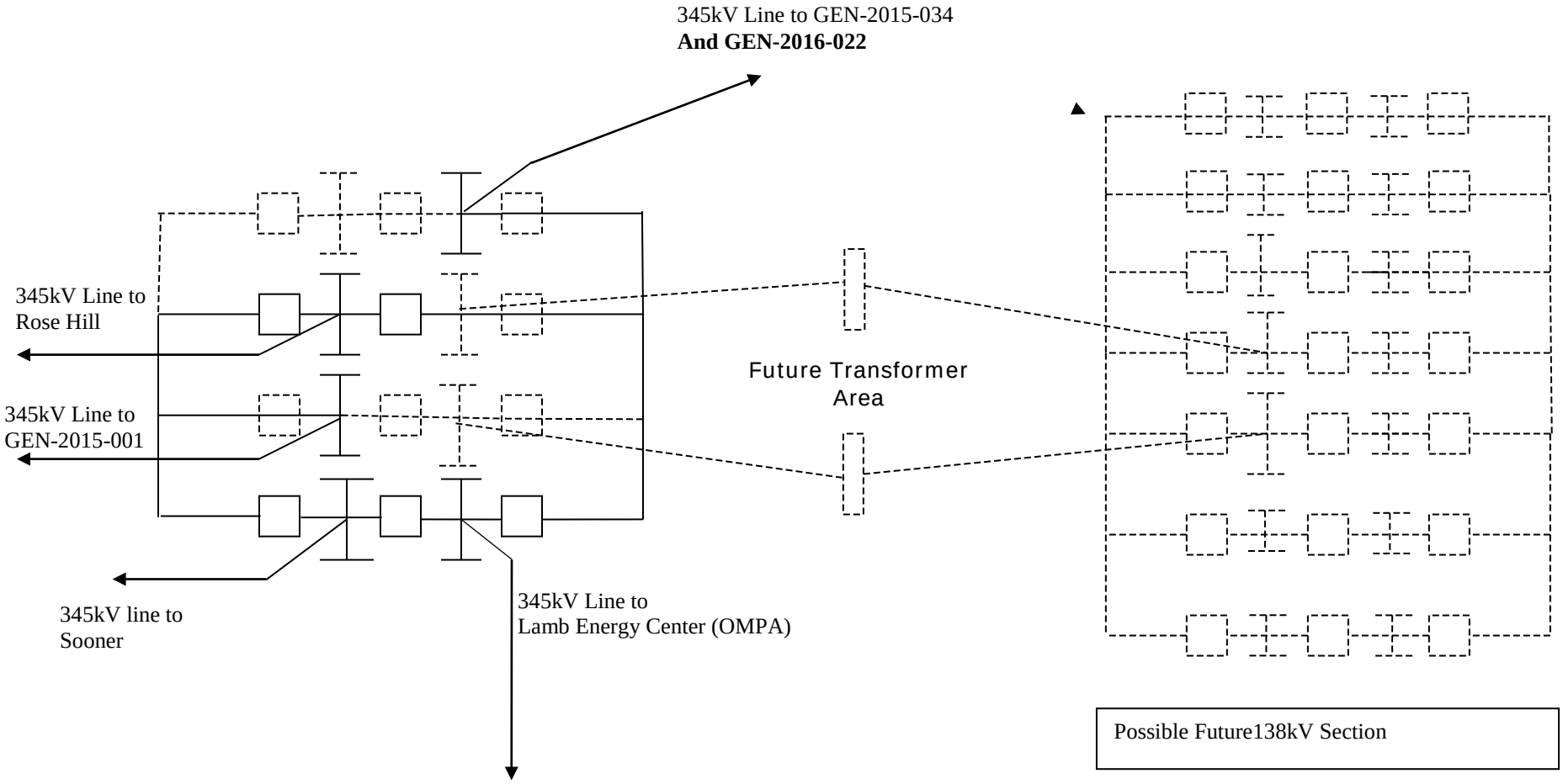
Facility	ESTIMATED COST (2017 DOLLARS)
OKGE – **Interconnection Facilities**- Update relay protection.	**$10,000**
OKGE – **Network Upgrades** at an existing EHV sub, Install 5-345kV 3000A breaker, line relaying, disconnect switches, and associated equipment	**$0**
OKGE - Right-of-Way for 345kV terminal addition	No Additional ROW
Total	**$0**

Prepared by Andrew R. Aston, P.E. July 24, 2017
Lead Engineer, Transmission Planning
OG&E Electric Services

Reviewed by:

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

Ranch Road Substation



FACILITY STUDY

for

Network Upgrade Request, GI Cluster Impact Restudy DISIS-2016-001-2

Ranch Road to Sooner 345kV substations
In Noble and Kay County
Oklahoma

February 12, 2019

Daryl Huslig
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 network upgrade. The request for a network upgrade was placed with SPP in accordance SPP's Open Access Transmission Tariff. The requirements for the network upgrade consist of replacing two 2000A switches at Sooner 345kV with 3000A rated equipment. The total cost for OKGE to replace two switches at Sooner 345kV substitution is estimated at $255,000.

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Introduction

The Southwest Power Pool has requested a network upgrade for the purpose of upgrading the ratings between Ranch Road 345kV and Sooner 345kV substations in Kay and Noble County Oklahoma, respectively. Both substations are owned by OKGE.

The cost for OKGE to replace two switches at Sooner 345kV substitution is estimated at $255,000.

Network Upgrade Facilities

The primary objective of this study is to identify network upgrade facilities. The requirements for the network upgrade consists of replacing two switches at Sooner 345kV with 3000A ratings. The new branch ratings for Ranch Road to Sooner 345kV will be 1716 MVA normal, 1793 MVA emergency for both summer and winter seasons. The next most limiting series element in the Ranch Road to Sooner 345kV branch will be the 2-1590 ACSR jumpers on the breakers at Sooner 345kV. This 345kV addition shall be constructed and maintained by OKGE.

The total cost for OKGE to replace two switches at Sooner 345kV substation is estimated at $255,000.

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

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 a 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 the network upgrade are listed in Table 1.

Short Circuit Fault Duty Evaluation

It is standard practice for OKGE 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. The available fault current did not exceed the breaker rating. No breakers needed to be replaced.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2019 DOLLARS)
OKGE – **Network Upgrades** at existing Sooner 345kV sub, Install 2-345kV 3000A switches.	**$255,000**
Total	**$255,000**

Prepared by Daryl Huslig, P.E. February 12, 2019
Lead Engineer, Transmission Planning
OG&E Electric Services

Reviewed by:

Steve Hardebeck, P.E.
Manager, Transmission Planning

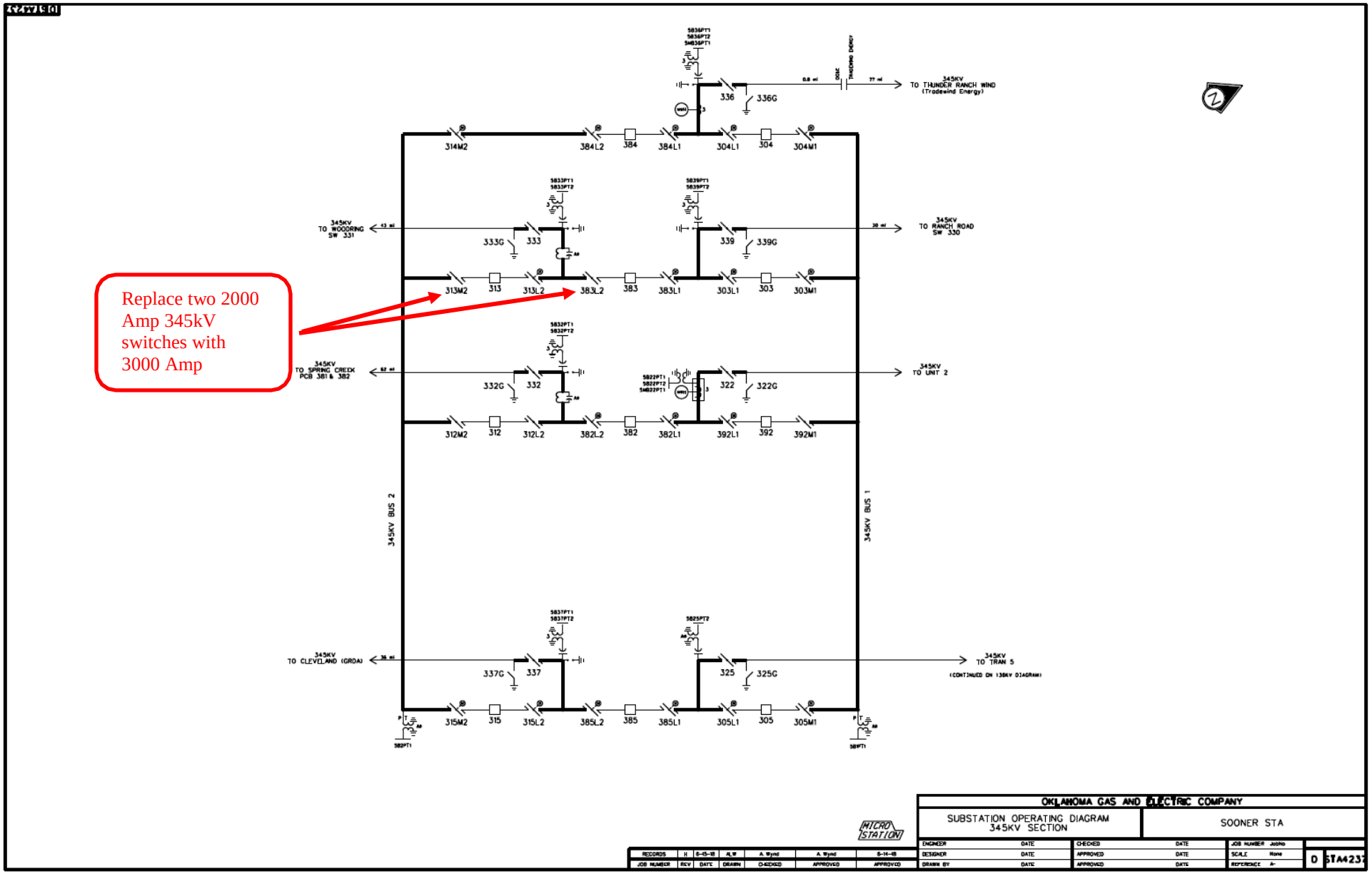

Figure 1 – Sooner 345kV One-line diagram