INTERCONNECTION FACILITIES STUDY REPORT

GEN-2017-232

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By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
04/12/2023	SPP	Initial draft report issued.
05/02/2023	SPP	Updated upgrade information and cost for UIDs 156445 & 156471 in Table 3.
05/11/2023	SPP	Updated cost for UID 156498 and added TO facility study
07/05/2023	SPP	Cost revisions made for UID 156858 in Table 3.
08/02/2023	SPP	Final report issued.
07/02/2024	SPP	Upgrades revised to reflect latest study.

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request is for a 52.2 MW generating facility located in Bryan 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 June 01, 2020.

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 (18) Power Electronics FS3150M inverters for a total generating nameplate capacity of 52.2 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 138 kV transformation substation with associated 34.5 kV and 138 kV switchgear;

One 138/34.5 kV 36/48/60 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;

Approx. 0.25 mile 138 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 138 kV bus at existing Transmission Owner substation ("Brown 138kV 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
Brown 138kV GEN-2017-232 Interconnection (TOIF) (OGE) (143541): Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-232 (52.2 MW/Solar), into the Point of Interconnection (POI) at Brown 138kV ***Estimator Comments:** *No TOIF costs. Settings Upgrade at Brown Substation.*	$0	100%	$0	36 Months
Total	**$0**		**$0**	

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)	Estimated Lead Time
Brown 138kV GEN-2017-232 Interconnection (Non-Shared NU) (OGE) (143540): upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-232 (52.2 MW/Solar), into the Point of Interconnection (POI) at Brown 138kV	Ineligible	$15,000	100%	$15,000	6 Months

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)	Estimated Lead Time
Brown 138kV GEN-2017-232 Interconnection (Non-Shared NU) (SWPA)(143577): Potential interconnection impacts from the following generating facility, GEN-2017-232 (52.2 MW/Solar), into the Point of Interconnection (POI) at Brown 138kV	Ineligible	$40,000	100%	$40,000	12 Months
SPA Brown to Brown 138 kV Equipment Upgrade (DISIS-2017-002) (156498): Upgrade the terminal equipment at Brown SPA to achieve a minimum summer/emergency rating of 478 MVA.	Eligible	$537,000	100%	$537,000	36 Months
Total		**$592,000**		**$592,000**	

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
N/A	N/A	N/A	N/A	N/A	N/A
Total		**N/A**		**N/A**	

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
NA	**NA**	**NA**

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)	$0
Non-Shared Network Upgrade(s)	$592,000
Shared Network Upgrade(s)	$0
Affected System Upgrade(s)	$0
Total	**$592,000**

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).

FACILITY STUDY

for

IFS-2017-002-156496 Network Upgrades
For
DISIS-2017-002

Switch Out Border Line Reactor
In Beckham County
Oklahoma

March 21, 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 for Network Upgrades to satisfy the Facility Study Agreement executed by the requesting customer for SPP IFS-2017-002-1 for Network Upgrades. 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 the Network Upgrade are to install one 345kV Reactor breaker/switch, and associated relay and control equipment in Border substation. The total cost for OKGE to complete these upgrades is $1,790,448.

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Introduction

The Southwest Power Pool has requested a Facility Study for Network Upgrades within the service territory of OG&E Electric Services (OKGE) in Beckham County Oklahoma. The proposed Network Upgrade Facilities are for the addition of a 345kV breaker for the existing 50 Mvar reactor at Border substation in Beckham County, Oklahoma to allow for remote switching.

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.

Network Upgrade Facilities

The primary objective of this study is to identify network upgrades. The requirements for this Network Upgrade consist of installing a 345kV breaker for the existing 50 Mvar reactor at Border substation on the OG&E transmission system to allow for remote switching and to accommodate generator interconnection requests identified in SPP-GI DISIS-2016-002-1. These 345kV network upgrades shall be constructed and maintained by OKGE.

The total cost for OKGE to install one 345kV reactor breaker, and associated relay and control equipment to allow an existing 50 Mvar Reactor in Border substation to be remotely switched is estimated at $1,790,448.

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 Network Upgrade, no breakers were found to exceed their interrupting capability after the addition of the one breaker 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 this DISIS-2017-002 Network Upgrade.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2023 DOLLARS)
Lead time	20 months
OKGE – **Network Upgrades** at Border Sub. Install 1-345kV Reactor Breaker/switch and associated relay and control equipment.	$1,790,448
Total	**$1,790,448**

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March 21, 2023

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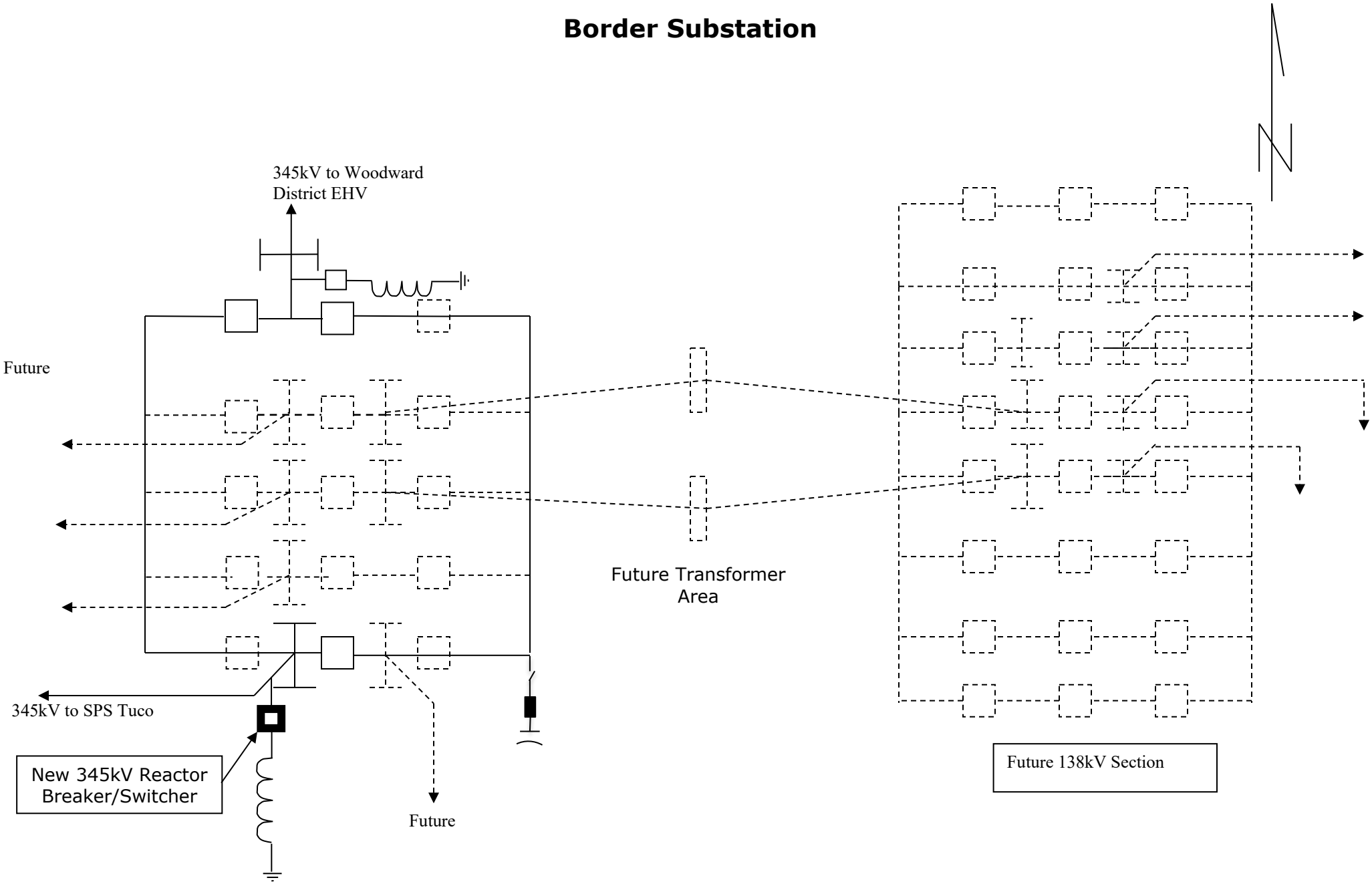
March 27, 2023

Border Substation



FACILITY STUDY

for

Generation Interconnection Request 2017-232

52.2 MW Solar Generating Facility
In Bryan County
Oklahoma

February 10, 2023

Chris Rich
Staff 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-2017-232. 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 request is for adding a new 52.2 MW solar facility to a Point of Interconnection established by GEN-2016-030. No new or additional facilities on the OG&E system are necessary to accommodate the additional generation. The new generating facility will require updated relay settings and electrical modeling work at OG&E Brown substation estimated at $15,000. OG&E will need to be notified 4 months prior to energization to accommodate the update to relay settings and electrical modeling.

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Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting a solar generating facility within the service territory of OG&E Electric Services (OKGE) in Bryan County Oklahoma. The proposed 138kV point of interconnection is at Brown Substation in Bryan County. This substation is owned by OKGE. No new or additional facilities on the OG&E system are necessary to accommodate the additional generation. The new generating facility will utilize existing gen-tie established by Gen 2016-030. The cost for updating relay settings and electrical modeling work at OG&E Brown substation is estimated at $15,000. OG&E will need to be notified 4 months prior to energization to accommodate the update to relay settings and electrical modeling.

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. There are no OG&E requirements for the Transmission Owner Interconnection Facilities at the substation to be developed for GEN-2017-232.

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 52.2MW 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-2017-232 interconnection.

Table 1: Required Interconnection Network Upgrade Facilities

Facility	ESTIMATED COST (2023 DOLLARS)
Lead Time	4 months
OKGE – **Interconnection Facilities**- No new interconnection facilities necessary	**$0**
OKGE – **Network Upgrades** Update relay settings and records in Brown substation	**$15,000**
OKGE – Land or ROW	No Additional ROW
Total	**$15,000**

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February 10, 2023

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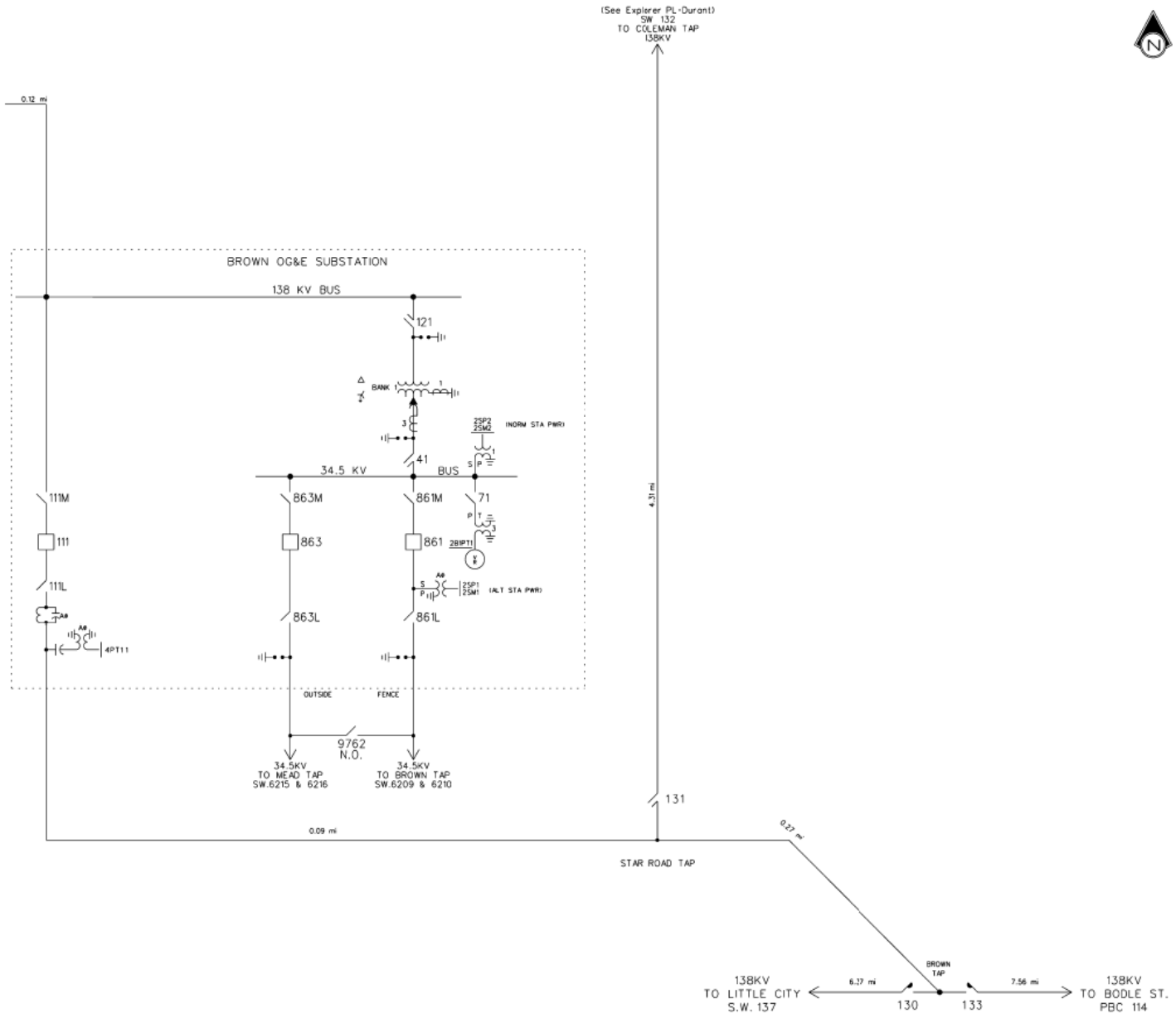
February 11, 2023

Brown(OGE) Substation



Facility Study
for GEN-2017-232

52.2 MW Solar Facility

New Interconnection Near Brown Substation

on 138kV Line OGE Brown to SPA Brown

May 11, 2023

Summary

At the request of Southwest Power Pool (SPP), Southwestern Power Administration (SWPA) performed the following Facility Study. This Facility Study is in regard to SPP Generation Interconnection request GEN-2017-232, SPA Brown to Brown 138kV Equipment Upgrade. From SPP's DISIS_Results_Workbook_DIS1702-1-PowerFlow_Final workbook, the generation interconnection request consists of a 52.2MW solar generation facility interconnecting on OG&E's Brown-SPA's Brown 138kV line, near SWPA's Brown Substation located near Brown, Oklahoma.

1. Introduction

The SPP has requested a Facility Study for the purpose of interconnecting a 52.2MW solar generating facility near SWPA's Brown Substation on OG&E's 138kV line, OGE Brown to SPA Brown. The interconnection request will require upgrade of SWPA's Brown Substation of the following equipment:

1. Main and aux bus conductor
2. Bypass circuit breaker bay 02 disconnect switches 01 and 03
3. Circuit breaker bay 42 disconnect switches 41, 43, and 47
4. Circuit breaker bay 42 metering class current transformers
5. Circuit breaker bays 02 and 42 conductor
6. Circuit breaker bays 02 and 42 protective relay settings update and review

The estimated upgrade cost is $825,000 (UID 156498). In addition to the above interconnection requested cost estimate, SWPA estimates protective relay setting coordination and setting review cost is $40,000 (UID 143577).

2. Existing Interconnection Facilities Review

The existing facility thermal ratings and circuit breaker interrupting capabilities will establish the necessary facility upgrades to accommodate the interconnection request as described in Sections 2.1 and 2.2 below.

2.1. Power Flow Constraints

OG&E's OGE Brown to SPA Brown 138kV transmission line has the following seasonal thermal ratings.

Season	**Summer Normal**	**Summer Emergency**	**Spring/Fall Normal**	**Spring/Fall Emergency**	**Winter Normal**	**Winter Emergency**
Line Rating (Amps)	558	600	558	600	600	600
Line Rating (MVA)	133	143	133	143	143	143

The request is for facility line rating upgrade of SWPA's Brown Substation bay 42, OGE Brown to SPA Brown, equipment to summer emergency rating of 478 MVA (2,000 amps) or higher.

SWPA's Brown Substation bay 42, OGE Brown to SPA Brown, has the following summer emergency facility ratings limited by the elements shown in the table below.

Equipment	**Circuit Breaker**	**Disconnect Switches**	**Metering CTs**	**Bus/ Jumpers**	**Relay Settings**
Summer Emergency Rating (Amps)	2000	1200	600	738	1800
Summer Emergency Rating (MVA)	478	287	143	176	430

SWPA's Brown Substation bypass breaker bay 02 has the following summer emergency facility ratings limited by the elements shown in the table below.

Equipment	Circuit Breaker	Disconnect Switches	Bus/ Jumpers	Relay Settings
Summer Emergency Rating (Amps)	2000	1200	1304	1800
Summer Emergency Rating (MVA)	478	287	311	430

As shown in the tables above, SWPA's Brown Substation bays 02 and 42 will require upgrade of the following:

1. Five Disconnect Switches
2. Three Metering CTs
3. Main and Aux Bus, including bay jumpers and bus conductor
4. Protective Relay Settings Update and Review

2.2. Short-Circuit Constraints

SWPA's circuit breakers 42 and 02 at SWPA's Brown Substation have interrupting capability of 40kA. The highest fault current for the subject line is approximately 8kA. The increase in fault current capability due to the subject interconnection request is expected to be less than 1kA for a 52.2MW solar generating facility interconnection, therefore no need for upgrade of circuit breakers due to interrupting capability.

3. Required Interconnection Facility Upgrades

In order to accommodate the facility line rating of 478 MVA for the OGE Brown to SPA Brown 138kV transmission line, SWPA's Brown substation will require upgrade of five disconnect switches, three metering CTs, the main bus, the aux bus, bay jumpers/bus, and protective relay settings. Below is a summary of estimated costs for the requested upgrade.

GEN-2017-232, UID 156498 SPA Brown to Brown 138kV Equipment Upgrade	$825,000	36 months
GEN-2017-232, UID 143577 Facilitate the interconnection of GEN-2017-232, Protective Relay Coordination	$40,000	12 months

UID 156498 cost estimate has been increased due to recent inflationary cost increases for materials that SWPA has experienced. The cost estimate and SPP SCERT have been updated.

Interconnection requests with Southwestern shall be in accordance with SPP's Tariff Attachment AD, Article I, Section 14, (c) and (d), as shown below. In addition, Southwestern's deadline of 36 months does not begin with SPP's approval, but upon the interconnecting party's signed construction agreement with Southwestern. As stated in Southwestern's Interconnection Request Procedures, Southwestern's Interconnection Request Procedures is a two-step process. First, a Facility Study Agreement between the interconnecting party and Southwestern begins the process. Second, a Construction Agreement between the interconnecting party and Southwestern starts the second phase of the project. The anticipated lead time/deadline will be established in the construction agreement and will not start until all construction funds are received by Southwestern.

> ***"(c) Southwestern agrees to coordinate transmission planning and construction activities with SPP, but reserves the right to plan and construct modifications or additions to Southwestern's transmission facilities without***

the approval of SPP, and to approve or disapprove the requests by others to plan and construct such modifications or additions.

(d) No interconnections to Southwestern's transmission facilities shall be made without written contractual agreements between Southwestern and the interconnecting party which satisfy Southwestern's NEPA requirements and which establish the terms and conditions of the interconnection. Such agreements shall be made pursuant to Southwestern's then-current Interconnection Request Procedure as posted on Southwestern's web site."