# INTERCONNECTION FACILITIES STUDY REPORT

GEN-2014-037

(IFS-2015-002-24)

Published November 2018

By SPP Generator Interconnections Dept.

# REVISION HISTORY

| DATE OR VERSION NUMBER | AUTHOR | CHANGE DESCRIPTION |
|---|---|---|
| 7/10/2017 | SPP | Initial draft report issued. |
| 6/19/2018 | SPP | Revised draft report issued due to DISIS-2015-002-4 results. |
| 10/25/2018 | SPP | Final report issued. Updated cost estimates, removed Previous Network Upgrade in Table 4 due to completion. |
| 11/13/2018 | SPP | Revised Final report issued. Updated cost estimates for Potter County Transformer. |

# CONTENTS

# SUMMARY

## INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2014-037/IFS-2015-002-24 is for a 200.00 MW generating facility located in Texas County, Oklahoma. The Interconnection Request was studied in the DISIS-2015-002 Impact Study, DISIS-2015-002-1 Impact Restudy and DISIS-2015-002-4 Impact Restudy for Energy Resource Interconnection Service (ERIS) only. The Interconnection Customer's requested in-service date is September 30, 2017.

The interconnecting Transmission Owner, Southwestern Public Service Company (SPS), performed a detailed IFS at the request of SPP. The full report is included in Appendix A. Oklahoma Gas and Electric Company (OGKE) performed a detailed IFS at the request of SPP for Non-Shared Network Upgrade(s). SPP has determined that full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) 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, 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 one-hundred (100) 2.0 MW Vestas V110 VCSS wind generators for a total generating nameplate capacity of 200.00 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;
- Two (2) 345/34.5 kV 66/88/110 MVA (ONAN/ONAF/ONAF) step-up transformers to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A seven (7) mile overhead 345 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 345 kV bus at a new SPS substation ("Optima Switching Station") to be owned and maintained by SPS. Optima Switching Station will be located approximately five-and-a-half (5.5) miles from Hitchland 345 kV on the Hitchland – Beaver County – Woodward 345 kV transmission circuit #1 and #2;
- 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 power factor at the POI between 95% lagging and 95% leading, including approximately 13.55 Mvars[1] of reactors to compensate for injection of reactive power into the transmission system under no/reduced generating conditions. The Interconnection Customer may use wind 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 the wind farm as studied in the DISIS-2015-002 Impact Study and restudies.

## *TRANSMISSION OWNER INTERCONNECTION FACILITIES AND NON-SHARED NETWORK UPGRADE(S)*

To facilitate interconnection, the interconnecting Transmission Owner and OKGE will perform work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities.

**Table 1** 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 in the event the SPP and Plains and Eastern Clean Line Interconnection Agreement is suspended, terminated, or withdrawn. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

*Table 1: Interconnection Customer TOIF and Non-Shared Network Upgrade(s) without Plains and Eastern Clean Line Interconnection*

| TOIF and Non-Shared Network Upgrades Description | Z2 Type[2] | Total Cost Estimate ($) | Allocated Percent (%) | Allocated Cost Estimate ($) | Estimated Lead Time |
|---|---|---|---|---|---|
| **SPS Optima Switching Station Interconnection Substation - Transmission Owner Interconnection Facilities:** 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. | N/A | $1,537,634 | 100% | $1,537,634 | 39 Months |
| **SPS Optima Switching Interconnection Substation - Non-Shared Network Upgrades:** Construct new breaker-and-a-half, eight (8) 345 kV 3000 continuous ampacity breakers, cut in transmission line and re-terminate, 50 Mvar reactors, acquire 160 acres of land, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. | Non-Creditable | $27,984,946 | 100% | $27,984,946 | |

[2] Indicates the method used for calculating credit impacts under Attachment Z2 of the Tariff.

| TOIF and Non-Shared Network Upgrades Description | Z2 Type[2] | Total Cost Estimate ($) | Allocated Percent (%) | Allocated Cost Estimate ($) | Estimated Lead Time |
|---|---|---|---|---|---|
| **OKGE Beaver County -Non-Shared Network Upgrades:** Expand Beaver County Substation and construct a new 100Mvar Static Var Compensator (SVC), Generator Step Up (GSU) transformer, one (1) 345 kV 3000 continuous ampacity breaker, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. | Creditable | $26,264,777 | 100% | $26,264,777 | 24 Months |
| **Total** | | **$55,787,357** | **100%** | **$55,787,357** | |

**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 after Plains and Eastern Clean Line Interconnection is in-service. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

*Table 2: Interconnection Customer TOIF and Non-Shared Network Upgrade(s) with Plains and Eastern Clean Line Interconnection In-service*

| TOIF and Non-Shared Network Upgrades Description | Z2 Type | Total Cost Estimate ($) | Allocated Percent (%) | Allocated Cost Estimate ($) | Estimated Lead Time |
|---|---|---|---|---|---|
| **SPS Optima Switching Station Interconnection Substation - Transmission Owner Interconnection Facilities:** 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. | N/A | $1,492,117 | 100% | $1,492,117 | 18 Months* |
| **SPS Optima Switching Interconnection Substation - Non-Shared Network Upgrades:** Construct two (2) 345 kV 3000 continuous ampacity breakers, cut in transmission line and re-terminate, 50 Mvar reactors, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. | Non-Creditable | $5,873,247 | 100% | $5,873,247 | |

| TOIF and Non-Shared Network Upgrades Description | Z2 Type | Total Cost Estimate ($) | Allocated Percent (%) | Allocated Cost Estimate ($) | Estimated Lead Time |
|---|---|---|---|---|---|
| **OKGE Beaver County - Non-Shared Network Upgrades:** Expand Beaver County Substation and construct a new 100Mvar Status Var Compensator (SVC), Generator Step Up (GSU) transformer, one (1) 345 kV 3000 continuous ampacity breaker, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. | Creditable | $26,264,777 | 100% | $26,264,777 | 24 Months |
| **Total** | | **$33,630,141** | **100%** | **$33,630,141** | |

*Engineering and Construction time is estimated based on Plains and Eastern Clean Line Interconnection starting first. Unforeseen delays associated with the Plains and Eastern Clean Line Interconnection Engineering and Construction could delay or impact the interconnection lead time for this Interconnection Request.

An Electro-magnetic Transient Program (EMTP) Study will be required after an executed Generator Interconnection Agreement (GIA) for both Optima Switching Station upgrades listed in **Table 1** and **Table 2** .

## *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 ($) | Allocated Percent (%) | Allocated Cost Estimate ($) |
|---|---|---|---|---|
| **SPS Potter County 345/230/13 kV Transformer CKT2:** Build second 345/230/13 kV transformer at Potter County. Along with this new 560 MVA transformer, install two (2) 345 kV circuit breakers, one (1) 230 kV circuit breaker and associated substation terminal equipment. | Creditable | $6,000,379 | 60.13% | $3,607,897 |
| **Total** | | **$6,000,379** | **60.13%** | **$3,607,897** |

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 listed in **Table 4** are currently not the cost responsibility of the Interconnection Customer but will be required for full Interconnection Service.

*Table 4: 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.

## CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 200.0 MW can be granted. Interconnection Service will be delayed until the Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) are completed. The Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) are summarized in the tables below.

*Table 5: Cost Summary without Plains and Eastern Clean Line Interconnection*

| Description | Allocated Cost Estimate |
|---|---|
| Transmission Owner Interconnection Facilities | $1,537,634 |
| Network Upgrades | $57,857,620 |
| **Total** | **$59,395,254** |

*Table 6: Cost Summary with Plains and Eastern Clean Line Interconnection In-Service*

| Description | Allocated Cost Estimate |
|---|---|
| Transmission Owner Interconnection Facilities | $1,492,117 |
| Network Upgrades | $35,745,921 |
| **Total** | **$37,238,038** |

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

See next page for the Transmission Owner's Interconnection Facilities Study Report.

# Facilities Study For Southwest Power Pool (SPP)

GEN-2014-037
Total Output is 200 MW
Texas County, Oklahoma



Xcel Energy Services, Inc.

Transmission Planning South
February 8, 2016
R1 October 28, 2016
R2 June 26, 2017

## Executive Summary

Interconnection Customer (IC) in 2015 requested a facility study to determine the required physical assets needed to interconnect its proposed wind energy facility to the Southwestern Public Service Company (SPS) transmission network. IC also requested the interconnection be located in in Texas County, Oklahoma. The new wind generating facility has a net capacity of 200 MW, and the IC requested commercial operation date is 09-30-2017. To interconnect the IC's generating facility to the SPS transmission system, SPS determined that a new 345 kV substation (Optima) needs to be constructed approximately 5 miles northeast of Hitchland on SPS' 345 kV line J07.

The Southwest Power Pool (SPP) evaluated the request (GEN-2014-037) to interconnect the wind generation facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS-2015-002), which was initially posted in April 2016, reposted in August 2016 and again in November 2016. The interconnection request was studied using one hundred (100) turbines, which are Vestas V110 2.0 MW each wind turbines for a total of 200 MW. The IC is required to build 345 kV transmission line from their substation wind farm facility to the SPS's new Optima Substation. The IC will be required to maintain a Power Factor between 0.95 lagging and 0.95 leading at the Point of Interconnection (POI).

SPP requires that each generator shall implement automatic Under Frequency Load Shedding (UFLS) according to the SPP UFLS Plan for SPS found in the Xcel Energy Interconnection Guidelines For Transmission Interconnected Producer-Owned Generation Greater Than 20 MW at the following link:

http://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Files/PDF/Interconnection/Interconnections-POL-TransmissionInterconnectionGuidelineGreat20MW.pdf.

To fulfill this requirement, coordination with Xcel Energy is required during the under-frequency relay-setting phase for the generation. The Interconnection Customer is required to report their generation off-nominal frequency tripping relay settings to SPP and SPS. SPS specifies that generators shall not trip at frequencies above 58.5 Hz unless exceptions in the Transmission Provider Criteria are met. The Interconnection Customer agrees that the energy generating units installed at this interconnection will not be tripped for under-frequency conditions above 58.5 Hz in compliance with Transmission Provider criteria. This means that the generation subject to this Interconnection Agreement may not trip for under-frequency conditions on the transmission system until all under-frequency load shedding relays have operated. SPS will also require that the Interconnection Customer be in compliance with all applicable criteria, guidelines, standards, requirements, regulations, and procedures issued by the North American Electric Reliability Corporation (NERC), SPP, and the Federal Energy Regulatory Commission (FERC) or their successor organizations.

The Interconnection Customer is responsible for funding of the Network Upgrades, Interconnection Facilities and Direct Assigned Transmission Owner Interconnection Facilities; inclusive of all costs required for the 345 kV to interconnect at SPS's Optima Substation.

The shared network upgrades will be determined at a later date by SPP and may impact the total overall costs for interconnection of the IC.

The location that the Interconnection Customer will connect to also has another interconnection, a transmission customer proposing to connect to Optima. Depending on who connects first, the cost of the upgrades for this Interconnection Customer can vary. It is anticipated that the entire process of building a new 345 kV, Breaker and a Half with 16-breakers and 8-terminals at Optima for the acceptance of the IC

facility output and the network upgrades allocated to this project will require approximately 39 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. The IC's cost for the interconnection of this Wind Farm facility is shown below in Table 1 with the detailed description of the estimated cost is shown in Table 3.

**Table 1, Cost Summary[a]**

| | **Without Clean Line** | **With** |
|---|---|---|
| Shared Network Upgrades Total: | **$ TBD** | **$ TBD** |
| Network Upgrades: | **$27,984,946.00** | **$5,873,247.00** |
| Transmission Owner Interconnection Facilities: | **$1,537,634.00** | **$1,492,117.00** |
| **Total:** | **$29,522,580.00** | **$7,365,364.00** |

[a] The cost estimates are 2017 dollars with an accuracy level of ±20%.

## General Description of SPS[b] Facilities

1. **Construction of New Optima Substation:** See Appendix A, Figure A-1 for general vicinity location map.

   1.1. **Location:** Customer will build a new 345 kV line from their substation to SPS's new 345 kV Optima Substation Breaker and a Half design, which includes eight (8) 345 kV breakers. Appendix A, Figure A-2, shows a preliminary one-line of Optima Substation. If Clean Line precedes Customer's connection, two (2) 345 kV breakers will be required a shown in the preliminary one-line of Optima Substation in Figure A-3.

   1.2. **Bus Design: The bus will be a breaker and a half construction,** designed **with the number of** terminals to minimize crossing of incoming and outgoing lines.

   1.3. **Line Terminals:** The 345 kV lines and static wire terminals will be designed to accommodate 14,000 pounds per phase conductor (28,000 Bundle) at maximum tension, with a maximum 15-degree pull off from normal.

   **1.4.** **Relay and Protection Scheme**: For the Interconnection Customer, the new 345 kV breaker line terminal primary protection to the interconnection customer 345 kV transmission line will use line current differential relaying over optical fiber installed in the static of the customer's 345 kV transmission line. Secondary relaying will use mirrored bit, Permissive Overreaching Transfer Trip (POTT) over the optical fiber. An SEL 411L and an SEL 311C will be used as primary and secondary relays, respectively. The SEL 351S will be used for breaker SCADA closing conditions for the 345 kV breakers and for breaker failure.

   An SEL 411L will display the line voltage, line amps, MW, MVAR, and fault location. A communication relay will be installed and for other functions as required.

   **1.5.** **Revenue Metering:** An individual billing meter will be installed at Optima Substation on the 345 kV line terminal serving the IC's interconnection, which meets the standards: ANSI C12.1 accuracy class 0.2 (3-PT's IEEE C57.13 accuracy class 0.3 and 3-CT's IEEE C57.13 accuracy class 0.15) for full 3-phase 4-wire metering. There will be two meters per line terminal: one will be primary and the other will be back up, each will have full 4 quadrant metering. Pulses out of the primary billing meter will be sent via SCADA to the Transmission Owner's Control Center in Amarillo, Texas.

   **1.6.** **Disturbance Monitoring Device:** A Disturbance Fault Recorder (DFR), capable of recording faults, swings, and long term trending, will be installed to monitor and record conditions in the substation and on the transmission lines. The disturbance equipment shall also be equipped with a GPS time synching clock. This equipment will have communication capability with a dedicated communication circuit. The disturbance equipment will have its own dedicated communications circuit. Phasor Measurement Units may also be installed at Optima on the interconnections.

   **1.7.** **Remote Terminal Unit (RTU):** A new RTU will be utilized with communications for the new substation. A Communication SEL Relay will be installed for relay communications and other functions as required; these costs will be directly assigned to the IC. The IC will provide and

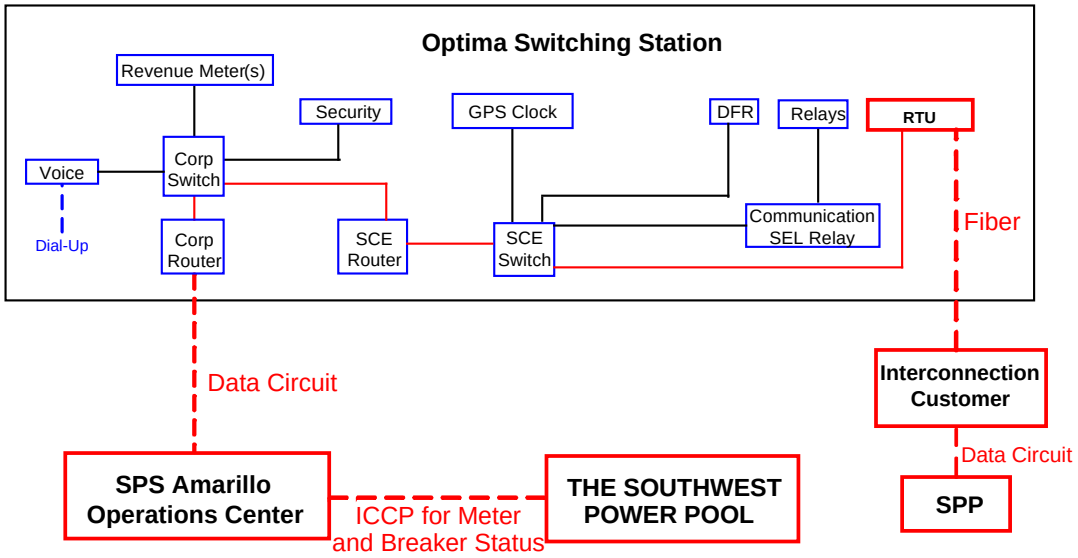
[b] All modifications to SPS facilities will be owned, maintained and operated by SPS.

install an RTU for metering and telemetry at the IC's facility as required by the latest Xcel Energy Interconnection Guidelines.

**1.8.** **Communications:** To meet its Communications obligations, the Interconnection Customer shall be responsible for making arrangements with the local phone company to provide a communication circuit as required by the Transmission Owner. Transmission Owner equipment may include, but is not limited to the following: relay communication equipment, RTU, and disturbance monitoring equipment at Optima Substation. Prior to any construction, the IC is required to contact the Transmission Owner substation-engineering department for all communication details and provide detail of the method to be used in communication.

The following communications schematic diagram, which includes communication equipment information for the IC, Transmission Provider (Southwest Power Pool) and Transmission Owner (Southwestern Public Service), is provided to assist the Parties as a template.

A schematic outlining the proposed communications is provided below:




Interconnection Customer shall be responsible for providing fiber optic communication circuit installed in the overhead transmission line static wire from the customer substation to Optima Substation for protective relaying and for transmitting metering and status data to SPS. Utilizing this fiber optic connection, SPS will establish a direct connection to the IC's RTU.

SPS will not serve as a proxy for communication from the IC to SPP.

## 2. Transmission Work:

2.1 The SPS transmission design group prior to any construction by the Interconnection Customer or its contractor on any customer 345 kV transmission lines, or doing work in close proximity to any SPS transmission line, will require an engineering review of the customer's design. It is the Interconnection Customer's responsibility to initiate the design review in a timely manner before construction of any transmission line begins. If the review has not been made or the design at any of the aforementioned locations is deemed inadequate, the crossing(s) and or termination into the interchange will be delayed until the matters are resolved. SPS will not be held responsible for these delays.

## 3. Right-Of-Way:

**3.1** **Permitting**: The IC will be responsible for any permitting and right of way of their substation and their transmission line from their substation to the Point of Interconnection at SPS's Substation.

**3.2** **Construction Power and Retail Service:** It is the sole responsibility of the IC to make arrangements for both construction and station power. The IC needs to make arrangements for retail service from the local retail provider. Retail provider and Customer will be responsible for making any necessary transmission service arrangements as required under the SPP OATT.

## 4. Project and Operating Concerns:

**4.1** Close work between the Transmission group, the IC's personnel and local operating groups will be imperative in order to meet any in-service date that has been established.

**4.2** The IC will be required to maintain a Power Factor between 0.95 lagging and a 0.95 leading at the Point of Interconnection (POI). All capacitors required will be installed on the lower voltage bus 34.5 kV at IC's substation. This is required to maintain acceptable dynamic voltage rise as per latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Producer-Owned Generation Greater than 20 MW. If switched reactive devices are used on the IC's system, they need to be switched in stages where the voltage rise is less than 3%.

**5. Fault or Short Circuit Study:** The available fault current at the interconnection location using the 2015 MDWG 2020S with MMWG 2019S on the 345 kV at Optima Substation located approximately 5.5 miles northeast of Hitchland on circuit J-12 and J-13, without any contribution from the new generator facilities, is shown in Table 2.

**Table 2, - Available fault current at interconnection location**

| Short Circuit Information without contribution from new Generator Facilities (GEN 2014-037) or Clean Line | | | | |
|---|---|---|---|---|
| Fault Location | Fault Current (Amps) | | Impedance (Ω) | |
| | Line-to-Ground | 3–Phase | $Z^+$ | $Z^0$ |
| 345 kV Bus | 3,036 | 9,922 | 1.43 + j20.02 | 4.26 + j25.18 |

## 6. Estimated Construction Costs:

**6.1 Estimated Cost "without" Clean Line Interconnection at Optima Substation:** The projects required for the interconnection of 200 MW Wind Generation facilities consist of the projects summarized in the table below.

**Table 3, Required Interconnection Projects w/o Clean Line[c]**

| Project | Description | Estimated Cost |
|---|---|---|
| | **Shared Network Upgrades:** | |
| 1 | The shared network upgrades: (GEN-2014-037) | $ TBD |
| | **Subtotal:** | **$ TBD** |
| | **Network Upgrades (funded by IC)** | |
| 2 | Communication Equipment (DFR, RTU and other related items) | $ 413,822 |
| 3 | Land Approximately 160 acre | $ 394,937 |
| 4 | New Substation – Breaker and a Half (Optima) | $ 21,075,194 |
| 5 | Install 50 MVARs Reactors. See EMTP paragraph below | $ 1,937,400 |
| 6 | Tap Into and Out of Optima Substation (J12 & J13) | $ 4,163,593 |
| | **Subtotal:** | **$27,984,946.00** |
| | **Transmission Owner Interconnection Facilities (funded by and direct assigned to the IC)** | |
| 7 | Communications [d] | *$ See footnote* |
| 8 | Line Arrestors, Metering and Other Related Items | $1,537,634 |
| | **Subtotal:** | **$1,537,634.00** |
| | **Total Cost** | **$29,522,580.00** |

An Electro-magnetic Transient Program (EMTP) Study will be required after an IA is signed. This will finalize any 345 kV or higher voltage shunt reactor sizes, cost and delivery. See item # 5 above.

**Engineering and Construction:** An engineering and construction schedule for this project is estimated at approximately 39 months w/o Clean Line interconnection being started first. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. This is applicable after all required agreements are signed and internal approvals are granted.

All additional cost for work not identified in this study is the sole responsibility of the IC unless other arrangements are made.

[c] The cost estimates are 2015 dollars with an accuracy level of ±20%.

[d] It is the Requester's responsibility to provide both the data circuit and communication circuits, see Section 1.8.

**6.2 Estimated Cost with Clean Line Interconnection at Optima Substation:** The projects required for the interconnection of 200 MW Wind Generation facilities consist of the projects summarized in the table below.

**Table 4, Required Interconnection Projects with Clean Line[e]**

| Project | Description | Estimated Cost |
|---|---|---|
| | **Shared Network Upgrades:** | |
| 1 | The shared network upgrades: (GEN-2014-037) | $ TBD |
| | **Subtotal:** | **$ TBD** |
| | **Network Upgrades (funded by IC)** | |
| 2 | Communication Equipment (DFR, RTU and other related items) | $ 801,685 |
| 3 | 2 new 345 kV breakers at Optima | $ 3,134,162 |
| 4 | Install 50 MVARs Reactors. See EMTP paragraph below | $ 1,937,400 |
| | | |
| | **Subtotal:** | **$5,873,247.00** |
| | **Transmission Owner Interconnection Facilities (funded by and direct assigned to the IC)** | |
| 7 | Communications [f] | *$ See footnote* |
| 8 | Line Arrestors, Metering and Other Related Items | $1,492,117 |
| | **Subtotal:** | **$1,492,117.00** |
| | **Total Cost** | **$7,365,364.00** |

An Electro-magnetic Transient Program (EMTP) Study will be required after an IA is signed. This will finalize any 345 kV or higher voltage shunt reactor sizes, cost and delivery. See item # 4 above.

**Engineering and Construction:** An engineering and construction schedule for this project is estimated at approximately 18 months with Clean Line interconnection being started first. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. This is applicable after all required agreements are signed and internal approvals are granted.

All additional cost for work not identified in this study is the sole responsibility of the IC unless other arrangements are made.

[e] The cost estimates are 2015 dollars with an accuracy level of ±20%.

[f] It is the Requester's responsibility to provide both the data circuit and communication circuits, see Section 1.8.

## Appendix A

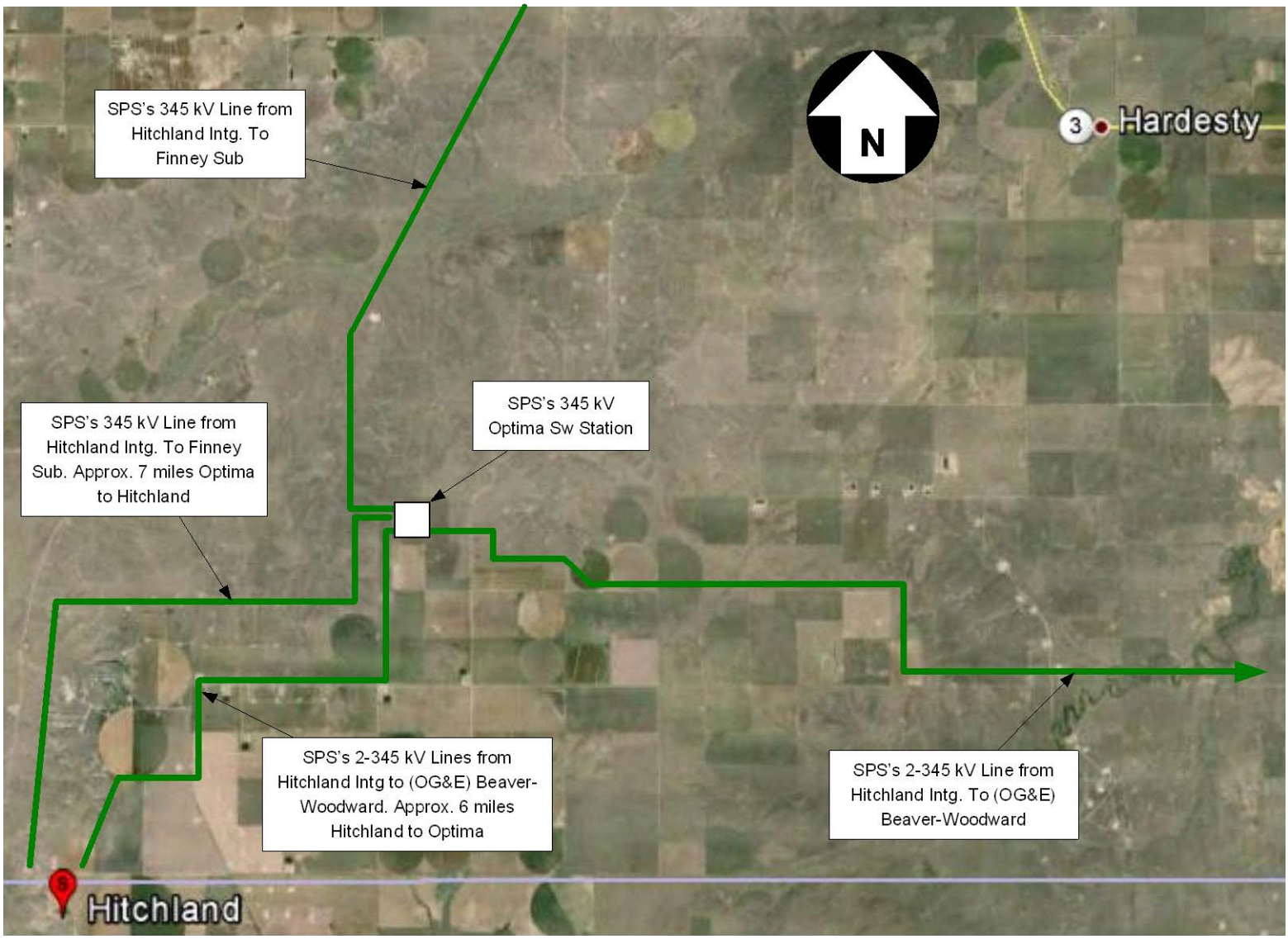



Figure A-1. Approximate location of Optima Substation and IC's Wind Farm

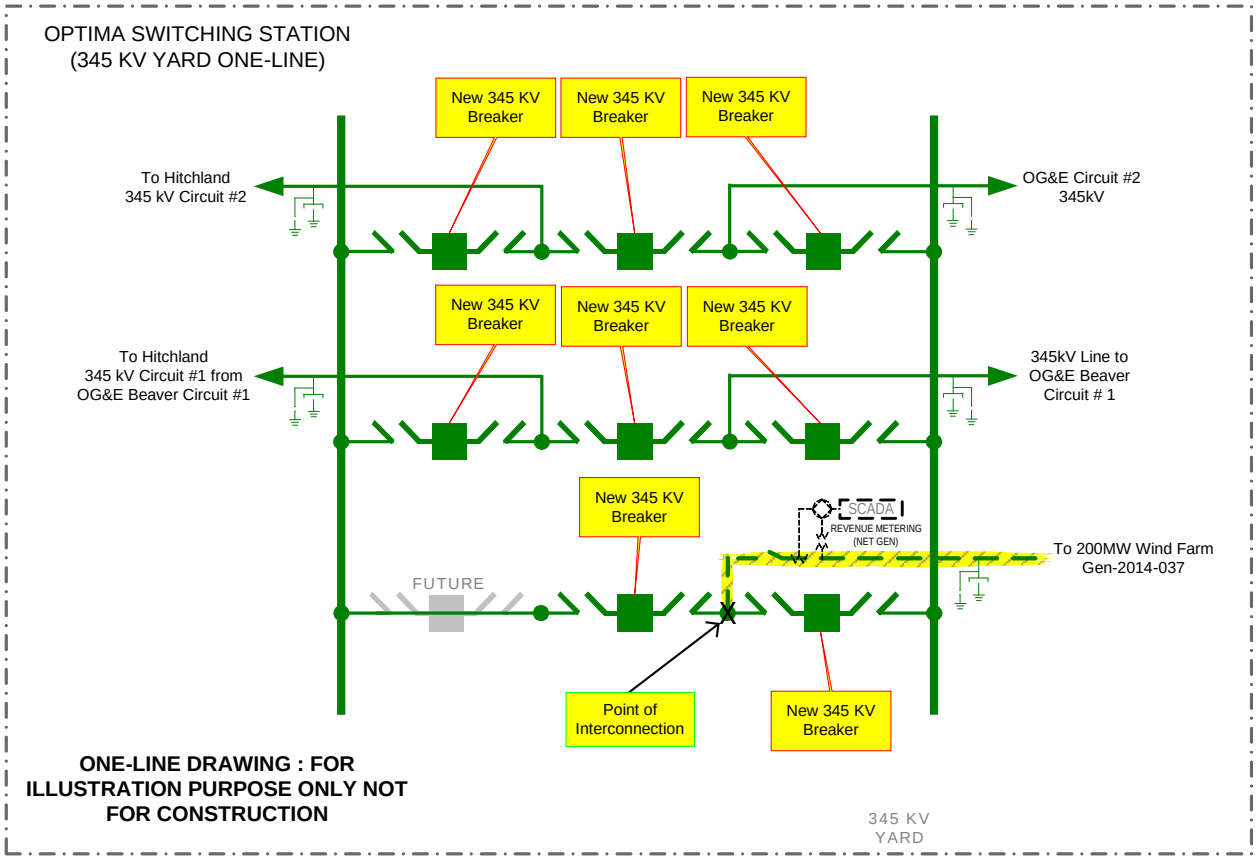



Figure A-2. One-line Diagram of New Optima Substation w/o Clean Line

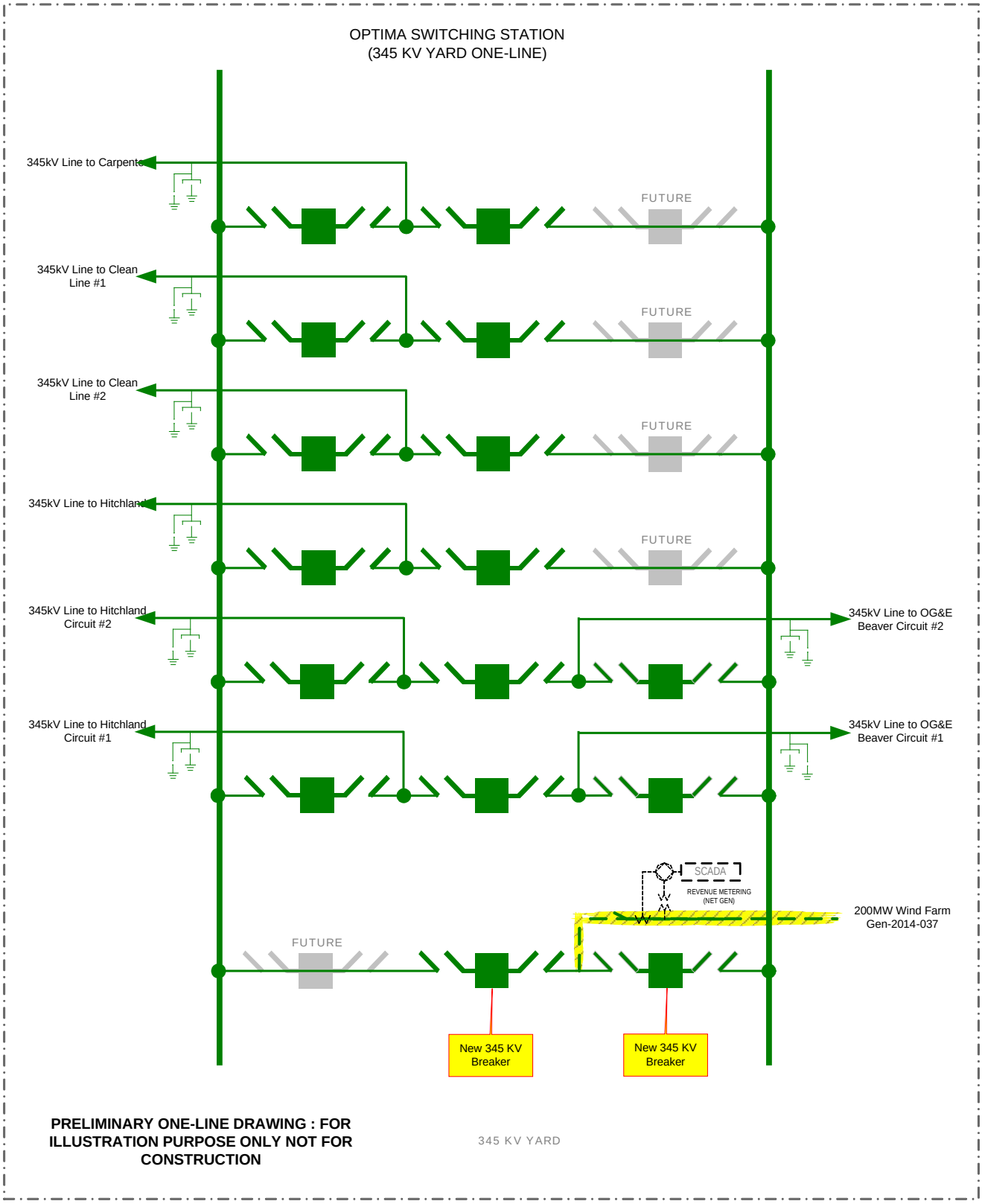



Figure A-3. One-line Diagram of New Optima Substation with Clean Line

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