



INTERCONNECTION FACILITIES STUDY REPORT

GEN-2016-147
(IFS-2016-002-33)

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By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
01/19/2021	SPP	Initial draft report issued.
02/03/2021	SPP	Updated draft report posted. Added Tri-State Facility Study to Appendix A
02/19/2021	SPP	Final report issued with no changes
07/28/2021	SPP	Updated final report issued. Updated Tables 3, 5 and 6 based on updated MISO AFS and DISIS Power Flow Reposting

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2016-147/IFS-2016-002-33 is for a 40 MW generating facility located in Cheyenne, NE. The Interconnection Request was studied in the DISIS-2016-002 Impact Study for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). This request was restudied in the DISIS-2016-002 Impact Study for ERIS. The Interconnection Customer's requested in-service date is December 31st, 2019.

The interconnecting Transmission Owner, Tri-State, 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 twenty (20) Solar Inverters for a total generating nameplate capacity of 40 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 115 kV transformation substation with associated 34.5 kV and 115 kV switchgear;
- One 345/34.5 kV 27/36/45 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A .5 mile overhead 115 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 115 kV bus at existing Transmission Owner substation ("Sidney 115 kV") that is owned and maintained by Transmission Owner;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Equipment at the Interconnection Customer's substation necessary to maintain a composite power delivery at continuous rated power output at the high-side of the generator substation at a power factor within the range of 95% lagging and 95% leading in accordance with Federal Energy Regulatory Commission (FERC) Order 827. The Interconnection Customer may use Turbine manufacturing options for providing reactive power under no/reduced generation conditions. The Interconnection Customer will be required to provide documentation and design specifications demonstrating how the requirements are met; and,
- All necessary relay, protection, control and communication systems required to protect Interconnection Customer's Interconnection Facilities and Generating Facilities and coordinate with Transmission Owner's relay, protection, control and communications systems.

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

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

Table 1 and **Table 2** lists the Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s) and provides an estimated lead time for completion of construction. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

Table 1: Transmission Owner Interconnection Facilities (TOIF)

Transmission Owner Interconnection Facilities (TOIF)	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>GEN-2016-147 Interconnection (TOIF) (TriState) – 122684:</u> Construct one (1) 115 kV line terminal, line switches, dead end structure, line relaying, communications, revenue metering, line arrestor, and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer's Generating Facility.	\$1,636,796	100%	\$1,636,796	18 Months
Total	\$1,636,796		\$1,636,796	

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>GEN-2016-147 Interconnection (Non-Shared NU) (Tristate) – 122687:</u> Construct one (1) 230 kV power circuit breaker, two (2) 115 kV power circuit breakers, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials.	Ineligible	\$2,155,837	100%	\$2,155,837	18 Months
Total		\$2,155,837		\$2,155,837	

*Table 2: Non-Shared Network Upgrade(s)***SHARED NETWORK UPGRADE(S)**

The Interconnection Customer's share of costs for Shared Network Upgrades is estimated in **Table 3** below.

Table 3: Interconnection Customer Shared Network Upgrade(s)

Shared Network Upgrades Description	ILTCR	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<u>None</u>	N/A	\$0	N/A	\$0	N/A
Total		\$0		\$0	

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 Upgrad

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
NTC 200220 (R-Plan): Build new 222 mile, 345 kV line from Gentleman – Cherry Co – Holt Co. Build new 345 kV substations at Cherry Co and Holt Co. Terminal upgrades at Gentleman.	\$0	04/01/2024

Depending upon the status of higher- or equally-queued customers, the Interconnection Request’s in-service date is at risk of being delayed or Interconnection Service is at risk of being reduced until the in-service date of these Contingent Network Upgrades.

AFFECTED SYSTEM UPGRADE(S)

To facilitate interconnection, the Affected System Transmission Owner will be required to perform the facilities study work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities. **Table 5** displays the current impact study costs provided by MISO as part of the Affected System Impact review. The Affected System facilities study could provide revised costs and will provide each Interconnection Customer's allocation responsibilities for the upgrades.

Table 5: Interconnection Customer Affected System Upgrade(s)

Affected System Upgrades Description	Total Cost Estimate (\$)	Allocated Share (%)	Allocated Cost Estimate (\$)
<u>None</u>	\$0	N/A	\$0
Total	\$0		\$0

CONCLUSION

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

Table 6: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilitie Upgrade(s)	\$1,636,796
Non-Shared Network Upgrade(s)	\$2,155,837
Shared Network Upgrade(s)	\$0
Affected System Upgrade(s)	\$0
Total	\$3,792,633

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

A draft Generator Interconnection Agreement will be provided to the Interconnection Customer consistent with the final results of this IFS report. The Transmission Owner and Interconnection Customer will have 60 days to negotiate the terms of the GIA consistent with the SPP Open Access Transmission Tariff (OATT).

APPENDICES

A: TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT AND NETWORK UPGRADES REPORT(S)

See next page for the Transmission Owner's Interconnection Facilities Study Report and Network Upgrades Report(s).



INTERCONNECTION FACILITIES STUDY REPORT

Interconnection Request No. GEN-2016-147
40MW Solar Generating Facility
Point of Interconnection at Sidney 115 kV Bus
Cheyenne County, Nebraska

Rev. 0 –May 5, 2020

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Drawings:

- Appendix A-1: Sidney 115kV General Arrangement
- Appendix A-2: Sidney 115kV Elevations
- Appendix B: Sidney 115kV One Line Diagram

Cost Estimates:

- Appendix C: Cost Estimate Summary

Schedule:

- Appendix D: Substation Construction Schedule

1. EXECUTIVE SUMMARY

This Interconnection Facilities Study (FacS) report sets forth the scope of work, +/- 20% cost estimate, and schedule for the Transmission Provider (TP, “Tri-State”) and the Interconnection Customer (IC) to interconnect a proposed 40MW solar Generating Facility (GF) per Generator Interconnection Request (GIR) No. GEN-2016-147 (the Project) via one 0.5 mile 115kV line to the Transmission System at existing Sidney substation (POI) in Cheyenne county, Nebraska.

Based on the Definitive Interconnection System Impact Study Report DISIS-2016-002 dated August 20, 2018, the IC will construct a GF that consists of twenty (20) GE 2MW solar inverters and one (1) 34.5-115kV transformer. The proposed in service date in the DISIS is 12/31/2019. A new date will be provided to the IC.

As discussed herein, Tri-State requires that in order to interconnect the IC’s proposed new 40MW solar GF to Transmission System, a new 115 kV bay and metering unit will need to be installed at Sidney substation. The total cost of the TP installation at Sidney substation is estimated at **\$3.8 million** (+/-20%), comprised of the TP Interconnection Facilities (TPIF \$1.64M, non-reimbursable) plus TP Network Upgrades (TPNU \$2.16M, reimbursable) to be funded up-front by the IC, with approximately **18 months** required to complete the work. This date is based upon the TP having obtained authorization to proceed under a signed Large Generator Interconnection Agreement (LGIA) or an Engineering and Procurement (E&P) Agreement. Furthermore, this assumes that no Network Upgrades will be required beyond this interconnection at Sidney substation and to be refined in future as feasible. The cost estimates in the DISIS report were based on an incorrect assumed bus arrangement at Sidney and the estimate totals may differ.

Note that per section 2.4 of the Large Generator Interconnection Procedure (LGIP), nothing in this LGIP shall constitute a request for transmission service or confer upon an Interconnection Customer any right to receive transmission service. Any inquiries regarding transmission service and related studies should be directed to the OATT Administrator.

As of the date of this report, GEN-2016-147 has proceeded through SPP’s LGIP requesting Network Resource Interconnection Service (NRIS). Any facility constructed cannot be interconnected until transmission arrangements have been secured.

2. INTERCONNECTION OF THE GENERATING FACILITY

2.1 Scope of Work

The documents in support of a LGIA include electrical relaying and metering AC one-line diagram, general arrangement drawing, section view, major material lists with cost estimates, and project schedule. These are in Appendices A through D, which are supplied to the IC only (not to be posted on the OASIS for Public use).

The proposed installation includes 115kV bi-directional revenue (POI) metering, 115kV line protection, and breaker control. Primary protection (relaying and the interrupting device) for the IC's step-up transformer will be provided by the IC in its substation yard. Equipment in the Sidney substation will only provide backup protection for the transformer in the event of equipment failure or malfunction in IC's facility. To facilitate protective relaying, SCADA, and metering between the Sidney substation 115kV yard and the IC GF, an OPGW with 48-strand single-mode fiber will be installed with the 0.5-mile generation line. The IC must also provide access to analog, indicating, control, and data circuits as required to integrate the Project into the design and operation of the Tri-State control system.

The Transmission Provider's Interconnection Facilities (TPIF) are comprised of the equipment that is installed between the Point of Interconnection (POI) (tap point into the main bus) and the Point of Change of Ownership (PCO) (Interconnecting Customer line termination on the new dead-end). The estimate includes all site work and necessary substation equipment such as grounding, conduit, cable, insulators, foundations, support steel, bus work, site preparation, yard work, and fencing inside the yard. The estimate does not include the access roads or any site work outside the TP's facilities. The estimate does not include the purchase of any land and assumes that all county and environmental permits will be obtained by the IC.

The Transmission Provider's Network Upgrades (TPNU) are comprised of the new equipment that is installed on the TP's side of the POI.

These estimates assume that all work will be done by the TP's personnel or TP's construction contractors.

2.2 Cost Estimates and Assumptions:

The layout of the proposed modifications and additions to the Sidney Substation are shown on the attached One-Line Diagram (Appendix B) and General Arrangement (Appendix A).

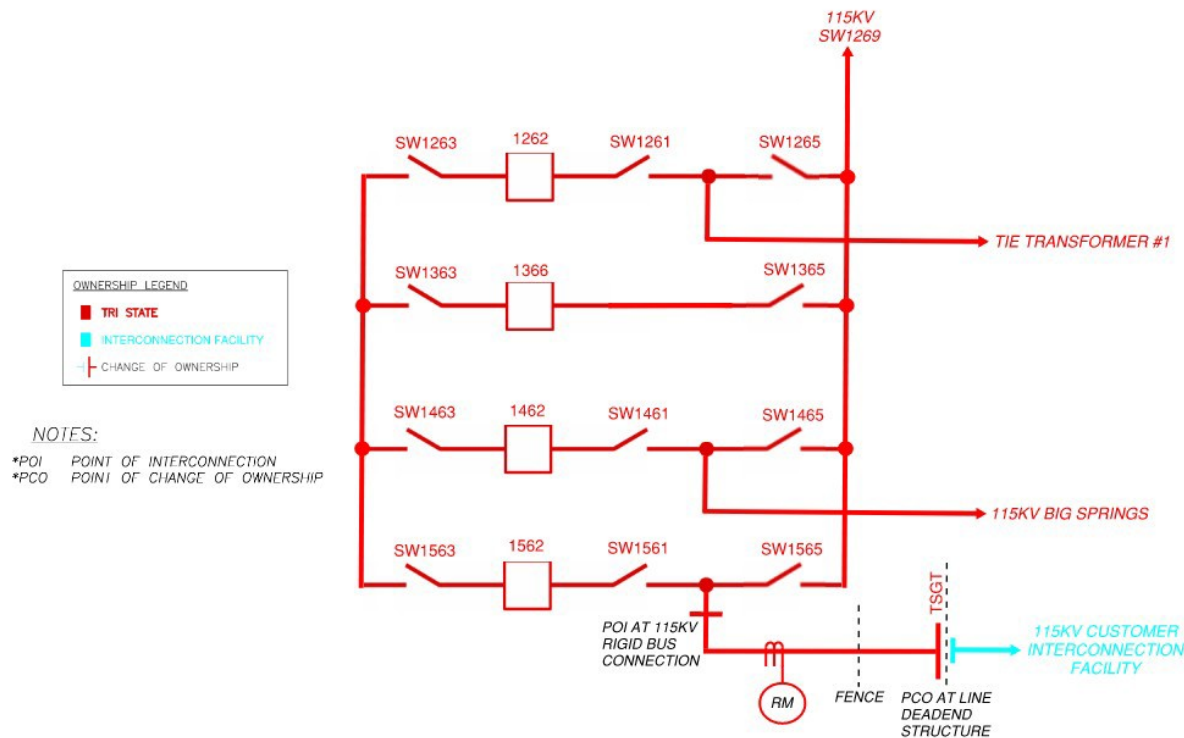


Figure 1. Switching One Line Diagram with PCO and POI

2.2.1 Work to be completed and paid for by the Interconnection Customer (Note: these costs are not included in the estimates identified in this FacS Report)

- Engineer, purchase, construct and own equipment associated with the Generating Facility and all Interconnection Facilities installed outside of Sidney substation station up to the Point of Change of Ownership (PCO at line dead-end structure), as indicated on the Figure 1.
- One (1) 34.5/115kV step up transformer.
- One (1) 115kV fault interrupting device (transformer 115kV side breaker).
- One (1) 115kV gang operated disconnect switch (for line entrance and transformer breaker).
- One (1) vertically configured full tension monopole deadend structure located outside of Sidney substation fence at a mutually agreed location inside the Transmission Provider's property line for IC GF line termination ("IC's Monopole Dead-end Structure").
 - The vertically configured full tension monopole deadend structure shall create zero line angle with the TP's A-frame deadend structure, unless another location is mutually agreed upon by the parties in writing.
- Relaying and control for 115kV step up transformer.
- Relaying and control for the 115kV transmission line to Transmission Provider's Sidney substation including one (1) SEL-411L primary and one (1) SEL-311L secondary relay (with appropriate current and potential contributions as needed).

- SCADA RTU (suitable for DNP3 protocol) for interfacing with the Transmission Provider's control and monitoring communications circuits (over OPGW).
- Interconnection Customer to supply Transmission Provider with copies of design specifications, relay settings, RTU configuration, and test reports for the 115kV step up transformer, 115kV circuit breaker, 115kV line relays, 115kV instrument transformers, and preliminary design drawings for review/coordination, and final "as built" documents.
- Land costs, access roads and any costs associated with obtaining state or local permits for the Project.
- Provide access to analog, indicating, control and data circuits, as required to integrate into the design and operation of the TP's control system.
- Engineer, purchase, construct and own equipment associated with the Generating Facility and all Interconnection Facilities installed outside of Sidney substation up to the Point of Change of Ownership (PCO at a vertically configured full tension monopole deadend structure located outside of the substation fence, as indicated on Figure 1 (Switching Oonline).

2.2.2 Interconnection Facilities to be completed and owned by the Transmission Provider and paid for by the Interconnection Customer (with cost being non-refundable per the LGIP)

- One (1) 115kV dead-end A-frame structure (for Interconnection Customer's generation tie line termination).
- TP shall string the last span from the Interconnection Customer's vertically configured full dead-end monopole (referenced in 2.2.1.) to IC's Monopole Dead-end Structure, install all jumpers, and splice the OPGW at the base of the monopole.
- Three (3) 115kV surge arresters.
- Three (3) 115 kV metering potential transformers and three (3) 115 kV high accuracy metering current transformers for bi-directional metering.
- Relay panels for the Interconnection Customer's 115kV line including SEL-411L primary relay, SEL-311L secondary relay, SEL-351S breaker failure and control relay, and SEL-735 REV/PQ meter.
- One (1) 115kV power circuit breaker.
- Three (3) 115kV three phase gang disconnect switches and associated structures.
- Station RTU modifications and interface.
- Station DFR modifications and interface.
- Associated access roads, grading work, drainage structures, equipment, including conduit, cable, foundations, structures, etc.
- Civil work.
- Associated equipment, including conduit, cable, bus work, foundations, grounding, structures, etc.

The estimated cost for the **Transmission Provider's Interconnection Facilities is \$1.64 Million**; a copy of the estimate is attached as Appendix C.

2.2.3 Network Upgrades to be completed and owned by the Transmission Provider and initially paid for by Interconnection Customer (with cost being refundable per the LGIP)

- One (1) 230kV power circuit breaker.
- Two (2) 115kV power circuit breakers.
- One (1) 230kV three phase gang disconnect switch and associated structure.
- Three (3) 115kV three phase gang disconnect switches and associated structures.
- One (1) single phase 230kV CCVT.
- Two (2) single phase 115kV CCVT's.
- Three (3) 115kV surge arresters.
- Relay panels for bus tie relaying, including one SEL-421 primary relay and one SEL-311C secondary relay.
- Relay panels for four (4) SEL-351S breaker failure relays for 115kV and 230kV breakers relaying and control.
- Four (4) 115kV three phase gang disconnect switches and associated structures.
- Three (3) 115kV surge arresters.
- One (1) 115kV bus differential relay panel.
- Station RTU modifications and interface.
- Station DFR modifications and interface.
- One (1) DC battery and charger.
- Associated equipment, including conduit, cable, bus work, foundations, grounding, structures, etc.

The estimated cost of the **Transmission Provider's Network Upgrades construction is \$2.16 Million**; a copy of the estimate is attached as Appendix C.

TOTAL Costs for TP Construction at Sidney substation to Interconnect IC 115 kV Line:

- **\$3.8 Million**

NOTE: The additional costs that the IC will be responsible for include TP labor associated with witnessing the testing and commissioning activities that will be required at the IC's GF prior to the ISD (relaying and synchronizing equipment), and also during synchronizing and verification of GF's compliance with the TP's voltage control and reactive power capability criteria, final POI metering checks, etc. See the DISIS report for additional details regarding this criteria. These costs have not been specifically estimated for in this FacS report but are expected to be within the +/-20% accuracy assumed for this FacS. This estimate does not include any shared network upgrades listed in DISIS-2016-002 dated August 20, 2018.

3. GENERATING FACILITY PERFORMANCE VERIFICATION

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 Interconnecting Customer will be required to provide data that demonstrates compliance with Tri-State's reactive criteria as a milestone in the Generator Interconnection Agreement.

4. SCHEDULE

A project schedule is attached (Appendix D) for the installation of the interconnection facilities. The schedule starts with the receipt of authorization to proceed. Typically, this authorization could be made in the form of the receipt of funds and execution of an E&P agreement to be followed by a timely execution of the LGIA, or with the receipt of funds and execution of a LGIA. **The estimated duration from the receipt of authorization to proceed to the back-feed In Service Date (ISD) is approximately 18 months,** and may be subject to modification based upon resource availability. The final Commercial Operation Date (COD – to sell power) is yet to be decided. The Commercial Operation Date (COD) for this GIR project will depend upon the commissioning time required by the IC for its generation facilities (solar panels, etc.); it has been assumed for the purposes of this FacS report and schedule that this will take approximately 2 to 3 months, and that there will be some time required for the TP to witness portions of the commissioning activities as it pertains to the POI interconnection at IC's facility. About six weeks of contingency has also been built into the schedule, allowing for delays to TP's construction.

6. LIST OF APPENDICES – SUPPLIED FOR IC ONLY (NOT FOR OASIS POSTING)

Drawings:

- GEN-2016-147 FacS Appendix A-1_General Arrangement
- GEN-2016-147 FacS Appendix A-2_Elevations
- GEN-2016-147 FacS Appendix B_ One Line

Cost Estimates:

- GEN-2016-147 FacS Appendix C_TP IF & NU Cost Est Summary

Schedule:

- GEN-2016-147 FacS Appendix D_Substation Construction Schedule