



**TRI-STATE**

Generation and Transmission  
Association, Inc.

---

**FINAL**

**INTERCONNECTION FACILITIES STUDY REPORT**

Interconnection Request No. TI-15-0612  
30 MW Solar Photovoltaic (PV) Energy Generating Facility  
Point of Interconnection at new Tyrone Metering Station 115 kV Bus  
Las Animas County, Colorado

January 6, 2016

Prepared by Janson Ferrera, P.E.  
Burns & McDonnell Engineering Company, Inc.

Reviewed by Mark Stout, P.E.  
Tri-State Generation and Transmission Association, Inc.

**DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES**

THIS DOCUMENT WAS PREPARED BY TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC., IN ITS CAPACITY AS TRANSMISSION PROVIDER (TP), IN RESPONSE TO A GENERATOR INTERCONNECTION REQUEST. NEITHER TP, NOR ANY PERSON ACTING ON BEHALF OF TP: (A) MAKES ANY REPRESENTATION OR WARRANTY EXPRESS OR IMPLIED, WITH RESPECT TO THE USE OF ANY INFORMATION, METHOD, PROCESS, CONCLUSION, OR RESULT, INCLUDING FITNESS FOR A PARTICULAR PURPOSE; OR (B) ASSUMES RESPONSIBILITY FOR ANY DAMAGES OR OTHER LIABILITY, INCLUDING ANY CONSEQUENTIAL DAMAGES, RESULTING FROM USE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN.

## Table of Contents

1. EXECUTIVE SUMMARY .....	3
2. INTERCONNECTION OF THE GENERATING FACILITY .....	4
2.1 Scope of Work.....	4
2.2 Cost Estimates and Assumptions: .....	5
2.2.1 Work to be completed and paid for by the Interconnection Customer (Note: These costs are not included in this Facility Study Report).....	5
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).....	5
3. SCHEDULE.....	6
4. LIST OF APPENDICES.....	6

### Drawings:

- Appendix A-1: Tyrone 115 kV General Arrangement
- Appendix A-2: Tyrone 115 kV Site Plan
- Appendix A-3: Tyrone 115 kV Elevation
- Appendix B: Tyrone 115 kV AC One Line Diagram

### Cost Estimates:

- Appendix C-1: Transmission Line Cost Estimate
- Appendix C-2: Metering Station Cost Estimate

### Schedule:

- Appendix D: Project Milestones

### Historical Voltage Profile:

- Appendix E: Twelve Month Voltage Profile (Ludlow)

## 1. EXECUTIVE SUMMARY

This Interconnection Facilities Study report sets forth the scope of work, +/- 20% cost estimate, and schedule for the Transmission Provider (Tri-State) and the Interconnection Customer (IC) to interconnect a proposed 30 MW solar photovoltaic energy Generating Facility (GF) per Generator Interconnection Request No. TI-15-0612 (the Project) to the transmission system with a Point of Interconnection (POI) on the existing Ludlow Tap-Pinon Canyon 115 kV transmission line seven miles east of Ludlow Tap on the line to Pinon Canyon in Las Animas County, Colorado.

Based on the System Impact Study (SIS) Final Report dated September 8, 2015, the IC will construct a GF that consists of twelve (12) SMA SC2500 solar inverters located on a collector system that will be connected to a 115-34.5 kV step-up transformer.

As discussed herein, in order to interconnect the IC's proposed 30 MW GF to the 115 kV Ludlow Tap-Pinon Canyon transmission line, a new 115 kV metering station will need to be installed. The existing transmission line will be interconnected and routed to a manually operated three way switch. The third position on the switch will connect to a new metering station which will include one (1) 115 kV gang-operated disconnect switch, three (3) 115 kV surge arresters, buswork and POI metering equipment.

The total cost for the transmission interconnection and metering station at Tyrone is estimated at \$1.614 M, including a ten percent contingency, and is to be funded up-front by the IC. The target Commercial Operation Date is end of the year 2016 and is based on the Transmission Provider having obtained authorization to proceed, based on the effective date of the Engineering and Procurement (E&P) Agreement. Furthermore, this analysis assumes that no Network Upgrades will be required beyond the interconnection at the new Tyrone metering station.

Note that pursuant to section 2.4 of Attachment K to Tri-State's tariff, nothing in the request for interconnection shall constitute a request for transmission service or confer upon an Interconnection Customer any right to receive transmission service. Any inquiries regarding transmission service (firm or non-firm) and related studies should be directed to the OATT Administrator.

## **2. INTERCONNECTION OF THE GENERATING FACILITY**

### **2.1 Scope of Work**

Included with this Facility Study are: an electrical relaying and metering AC one-line diagram, a site plan, a general arrangement drawing, a section view, major material lists with cost estimates, an historical transmission voltage profile and a project schedule. These are located in Appendices A through E, and are supplied to the IC only (not to be posted on the OASIS for public use).

The IC's substation is expected to be over the fence from the Tyrone metering station. Pursuant to conversations with the IC, it is assumed that the IC's 115 kV overhead connection will enter into the Tyrone metering station area and connect to a new metering station dead-end structure.

The proposed installation includes 115 kV bi-directional revenue (POI) metering and associated SCADA and telecommunications equipment. Primary protection (relaying and circuit switcher) for the IC's step-up transformer will be provided by the IC in its substation yard. There will be no equipment in the Tyrone metering station yard that will provide protection for the transformer in the event of equipment failure or malfunction in the IC's facility. Metering data will be accessed through a satellite phone mounted in the cabinet on the metering station dead-end structure.

Tri-State will have operational control of the IC's 115 kV circuit switcher via Tri-State's installed SCADA, and the IC will have dispatch authority of the circuit switcher. The IC will provide DC power to Tri-State's SCADA from the IC's facilities. Additional communications circuits may be required between the Tyrone metering station and the IC's GF and will be identified when the final designs are completed for the Project.

This Facility Study assumes that the GF will trip offline whenever the 115 kV transmission source is out-of-service. If the facility is not designed to do so, Tri-State will design and install a transfer trip scheme to accomplish the task. The cost for such a scheme has not been included in this report.

Station service power (the load requirement when the solar facility is not generating) will be provided from the 115 kV system and will be metered using the bi-directional revenue meter installed at the Tyrone metering station.

The enclosed estimate includes all site work such as grounding and conduit installation inside the Tyrone metering station yard. The estimate also includes the driveway extending from the main site access road to the metering station site, but not any other site work outside the metering station yard. The estimate does not include the purchase of any land, and assumes that all county and environmental permits will be obtained by the IC.

Interconnection to the transmission line involves: 1) removal of two existing wood H-frame structures, 2) installation of two 3-pole wood dead-end structures in the line right-of-way, and 3) installation of one manually operated three way switch, associated steel pole and foundation installed in the 115 kV Ludlow Tap-Pinon Canyon transmission line. The estimate assumes that

all work will be done by the Transmission Provider's personnel and that the necessary transmission line outages can be taken for construction.

## **2.2 Cost Estimates and Assumptions:**

The layout of the proposed metering station is shown on the attached AC One-Line Diagram (Appendix B) and General Arrangement (Appendix A-1).

### **2.2.1 Work to be completed and paid for by the Interconnection Customer (Note: these costs are not included in this Facility Study Report)**

- Design, purchase, construct and own equipment associated with the Generating Facility and all Interconnection Facilities installed outside of the Tyrone metering station up to the Point of Change of Ownership (PCO at Tyrone metering station dead-end structure), as indicated on the attached AC one-line diagram (Appendix B).
- Install a circuit switcher, associated isolation disconnect switch and relaying for the GF's main 115-34.5 kV transformer and 115 kV tie line protection.
- Purchase land and obtain all state and 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 Transmission Provider's control system.
- Provide DC power for Transmission Provider's SCADA.

### **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)**

#### Metering Station Scope:

- Install one (1) 115 kV dead-end structure (same as metering structure).
- Install one (1) 115 kV line disconnect switch.
- Install three (3) 115 kV combination CT/PT metering unit instrument transformers for bi-directional metering.
- Install two (2) NEMA 4 outdoor enclosures to house Transmission Provider's metering, SCADA, and telecomm equipment, including testing/checkout/ commissioning.
- Install three (3) 115 kV surge arresters.
- Install all other necessary metering station equipment including but not limited to grounding, conduit and cable, foundations, support steel, static protection and cable bus.

#### Transmission Line Scope:

- Remove two (2) wood pole H-frame structures.
- Install two (2) 3-pole wood dead-end structures with guy anchors.
- Install a foundation supported steel switch structure.
- Install manually operated 3-way switch.

Total estimated cost for the above metering station and transmission line facilities is \$1.614 M and includes a ten percent contingency. Detailed cost estimates for the metering station and transmission line modifications are included in Appendices C-1 and C-2.

**NOTE:** Additional costs that the IC will be responsible for include Transmission Provider labor associated with witnessing the testing and commissioning activities that will be required at the IC's GF prior to the in service date (relaying and synchronizing equipment), and also during synchronizing and verification of GF's compliance with the Transmission Provider's voltage control and reactive power criteria, final POI metering checks, etc. See the previously issued final SIS report (September 8, 2015) for additional details regarding these criteria. Costs for these activities have not been estimated in this Facility Study but are expected to be within the +/-20% accuracy assumed by this report. While all cost estimates are expected to be within a +/-20% accuracy, the IC will be responsible for actual installed costs.

### **3. SCHEDULE**

A milestone schedule is attached (Appendix D) for the new Tyrone metering station interconnection facilities. The back-feed in service date is estimated to be September 2016, and may be subject to modification based upon resource availability. The final Commercial Operation Date is end of the year 2016. The Commercial Operation Date will depend on the commissioning time required by the IC for its generation facilities (solar panels, etc.) and has been assumed, for the purposes of this Facility Study report and schedule, to take approximately 2 to 3 months, including time required for the Transmission Provider to witness portions of the commissioning activities.

### **4. LIST OF APPENDICES – Supplied to IC only (not for OASIS posting)**

#### Drawings:

- Appendix A-1: General Arrangement
- Appendix A-2: Site Plan
- Appendix A-3: Elevation
- Appendix B: AC One Line

#### Cost Estimates:

- Appendix C-1: Transmission Line Cost Estimate
- Appendix C-2: Metering Station Cost Estimate

#### Schedule:

- Appendix D: Project Milestones

#### Historical Voltage Profile:

- Appendix E: Twelve Month Hourly Max and Min Report for Ludlow Tap