



## **INTERCONNECTION FACILITIES STUDY REPORT**

Interconnection Request No. TI-04-1123  
120 MW Wind Energy Generating Facility  
Point of Interconnection at Big Sandy Substation 230 kV Bus  
Lincoln County, Colorado

FINAL - January 3, 2012

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## TABLE OF CONTENTS

1. INTRODUCTION
2. INTERCONNECTION OF THE GENERATING FACILITY
  - 2.1.1. Scope of Work
  - 2.1.2. Cost Estimates and Assumptions
3. GENERATING FACILITY PERFORMANCE VERIFICATION
4. SCHEDULE
5. LIST OF APPENDICES – *TO BE SUPPLIED TO IC ONLY (NOT FOR OASIS POSTING)*

### Drawings:

- Appendix A-1: Big Sandy 230kV SW Key Plan View (With 230kV IC Line Monopole)
- Appendix A-2: Big Sandy 230kV SW Plan View
- Appendix A-3: Big Sandy 230kV SW Section B-B View
- Appendix B-1: Big Sandy 230kV West One-Line Diagram
- Appendix B-2: Big Sandy 230kV East One-Line Diagram

### Cost Estimates:

- Appendix C: TP Interconnection Facilities Cost Est. Summary
- Appendix D: Interconnection Facilities Network Upgrades Cost Est. Summary

### Schedule:

- Appendix E: Construction Schedule (MS Project Gantt Chart)

## 1. EXECUTIVE SUMMARY

This Interconnection Facilities Study report sets forth the scope of work, +/- 20% cost estimate, and schedule for the Transmission Provider (TP) and the Interconnection Customer (IC) to interconnect a proposed 120 MW wind energy generating facility (GF) per Interconnection Request No. TI-04-1123 (the Project) to the Transmission System with a Point of Interconnection (POI) on the Big Sandy substation 230 kV bus in Lincoln County, Colorado.

Based on the System Impact Re-Study (SIRS) Final Report dated February 25, 2011, the IC will construct a GF that consists of 80 GE 1.6 MW wind turbine generators, located on a collector system that will be connected to a 230-34.5 kV step-up transformer and an 11.3-mile, 795kcmil ACSR overhead transmission line to the POI.

As discussed herein, Tri-State requires that in order to interconnect the IC's proposed new 120 MW GF at the Big Sandy Substation 230kV bus, a second 230-115 kV, 60/80/100 MVA autotransformer will need to be installed to mitigate potential contingency overloads on Tri-State's existing 230-115 kV, 60/80/100 MVA autotransformer (refer to Tables 1 and 2 later in this report). This installation is estimated to cost **\$1.08 million** (+/-20%) to be paid for by the IC, with **18 to 24 months** required to complete the work, after obtaining authorization to proceed, and including the completion of the TP's planned new Burlington to Wray 230kV line project. However, under an accelerated schedule and based upon resource availability, a 10 to 12 month schedule may be feasible.

The TP will provide a new line position and all associated engineering and construction after authorization to proceed under a signed Generator Interconnection Agreement (GIA) or an Engineering and Procurement (E&P) Agreement. The IC's requested In-Service Date (ISD) of October 1, 2012, as requested in Attachment B to the Facilities Study Agreement dated March 25, 2011 is not attainable, as this FacS report has identified that it will take an estimated 18 to 24 months to complete the work. Furthermore, until the TP's planned Burlington to Wray 230 kV line is in service (scheduled for completion by the end of 2015), 0 MW of new generation is available to be interconnected at this location, due to thermal overloads associated with the N-1 contingency of loss of the Lincoln to Midway 230 kV line. **Therefore, the earliest ISD for this interconnection would be December 31, 2015.**

Note that per section 2.4 of the GIP, nothing in this GIP 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.

In the SIRS, the TP recommended that, to interconnect 120 MW for Network Resource (NR) or non-NR service with an ISD before the end of 2015, an automatic curtailment to 0 MW could be implemented on an interim basis for the N-1 contingency of loss of the Lincoln to Midway 230 kV line. However, since that time, the TP has determined that temporary interim project generation curtailment procedures would not be an acceptable option for allowing any of this proposed project's generation to interconnect into the TP's transmission system prior to the completion of all identified Network Upgrades (end of 2015). This decision was arrived at

after consideration of the existence of present operating restrictions for the existing TP's Network Resource generation in the Burlington region, and the potential for significant negative impacts on the 115kV transmission system, notably excessive overloads and resultant cascading and system instability under a contingency outage (N-1) of the Lincoln to Midway 230kV line. This restriction is under the assumption that the generation is not a Network Resource (NR) for an existing Network customer on the Tri-State system. If designated as a NR by a Network customer, the generation project may be operated with all other network resources in the constrained area. This could result in the generating project obtaining some level of operation prior to the completion of the Burlington -Wray 230kV transmission project. Details of the possible reduced level of generator operation would need to be discussed with the Network customer who is responsible for designating resources for network load.

As of the date of this report, TI-04-1123 is not a designated NR, nor has the IC submitted a Transmission Service Request to deliver power as a non-NR. 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 GIA include: electrical one-line diagram, general arrangement drawings, major material lists with cost estimates, and project schedule. These are located in Appendices A through E, which are available to the IC only (not to be posted on the OASIS for Public use).

The IC's substation is expected to be remote from the Big Sandy substation. Based upon discussions with the IC, it is assumed that the IC's 230kV transmission line will enter into the Big Sandy substation area from the south. A self supporting deadend monopole will be installed to transition (turn the line from south to east). A slack span from the monopole will enter the existing substation deadend structure from the west. There are no outages anticipated at the Big Sandy Substation to terminate the new wind farm transmission line.

The proposed installation includes high-side bi-directional metering, 230 kV line protection, 230 kV bus differential protection, and modifications relating to the control building, SCADA system, and RTU. 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 Big Sandy substation yard will only provide backup protection for the transformer in the event of equipment failure or malfunction in the IC's facility. To facilitate protective relaying and data acquisition between the Big Sandy and IC substations, the following will be provided: fiber optic cables for data communication and breaker failure relaying; circuits for differential tripping.

The Transmission Provider's Interconnection Facilities are located between the Point of Interconnect (POI) (tap point into the main bus) and the Point of Change of Ownership (PCO) (line monopole structure outside the substation fence line). The estimate includes all site work such as grounding and conduit installation inside the TP's switchyard. The

estimate does not include access roads or any site work outside the TP's 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.

The Network Upgrades are located on the TP's side of the POI. These include modifications to the existing bus with the installation of new electrical equipment, structures, and modification of existing protection schemes. The estimate assumes that there are no other protective relay or control replacements, and that all work will be done by the TP's personnel.

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

The layout of the proposed line termination is shown on the attached One-Line Diagram and General Arrangement.

### **2.2.1 Work to be completed and paid for by the Interconnection Customer**

- Engineer, purchase, construct and own equipment associated with the generating plant and all Interconnection Facilities up to the POC, as indicated on the attached one-line diagram.
- Install an interrupting device, associated isolation switch and relaying for transformer protection.
- 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.

### **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 GIP)**

- Install one 230kV monopole dead-end structure.
- One 230kV slack span from monopole to existing A-frame dead-end structure inside Big Sandy substation.
- Install three (3) 230kV surge arresters on existing dead-end structure.
- Install one 230 kV line disconnect switch.
- Install three 230 kV potential transformers and three 230 kV current transformers for bi-directional metering.
- Install one meter panel and one line relaying panel including testing/checkout/commissioning.
- Install all other necessary substation equipment including but not limited to grounding, conduit and cable, foundations, support steel, static protection and cable bus.
- Install new Focus equipment at Big Sandy and Lincoln.

The estimated cost for the **Transmission Provider's Interconnection Facilities is \$712,660**; 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 GIP)**

- Engineer, purchase, and construct all Network Upgrades starting from the POI.
- Install two (2) 230 kV circuit breaker isolation switches.
- Install one (1) 230 kV circuit breaker.
- Install one (1) 230 kV PCB control panel including testing / checkout / commissioning.
- Modify as required line/bus differential relaying and SCADA equipment.
- Expand or modify as required all other necessary substation equipment including but not limited to grounding conductor, conduit and cable, foundations, support steel and tubular and cable bus.

The estimated cost of the **Network Upgrades construction is \$366,396**; a copy of the estimate is attached is attached as Appendix D.

### **3. GENERATING FACILITY PERFORMANCE VERIFICATION**

The SIS Re-Study stated that the IC will need to install additional equipment to provide the voltage regulation and reactive support capabilities required. Verification of these capabilities as measured at the POI bus will be required when the facility is ready for commercial operation.

### **4. SCHEDULE**

A Gantt chart schedule is attached (Appendix E) for the engineering and construction of the Big Sandy substation 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 GIA, or with the receipt of funds and execution of a GIA. **The estimated duration from the receipt of authorization to proceed is 18 to 24 months.** However, under an accelerated schedule and based upon resource availability, a 10 to 12 month schedule may be feasible. Until the TP's planned Burlington to Wray 230 kV line is in service (scheduled for completion by the end of 2015), \*0 MW of new generation is available to be interconnected at this location, due to thermal overloads associated with the N-1 contingency of loss of the Lincoln to Midway 230 kV line. **Therefore, the earliest ISD for this interconnection would be December 31, 2015.**

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Details of the possible reduced level of generator operation would need to be discussed with the Network customer who is responsible for designating resources for network load.

## **5. LIST OF APPENDICES**

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