TI-04-1214

INTERCONNECTION FACILITY STUDY REPORT

Prepared by

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Facility Study Report
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1. EXECUTIVE SUMMARY

This report presents the Interconnection Facility Study for connecting the proposed TI-04-1214 Project to the Tri-State Generation and Transmission Association's (Tri-State's) 115 kV transmission system in northeastern New Mexico. Previous engineer studies were conducted to investigate facility impacts identified in the system impact studies but the actual interconnection of the generation plant was not included. The TI-04-1214 interconnection to Tri-State's 115 kV transmission system is proposed to be located approximately midpoint between the existing Rosebud and Clapham Substations in northeastern New Mexico at a new substation facility. This report provides detailed one-line diagrams, general arrangements, cost estimates and a schedule for providing the 115 kV tap interconnection facility.

An initial System Impact Study (SIS) report [1] examined power flow, dynamic and short circuit impacts with the TI-04-1214 Project generation rated at 40 MW without provisions for a proposed future Tri-State 230 kV transmission line from Gladstone to Walsenburg. A second SIS report [2] included the Gladstone to Walsenburg 230 kV Line and investigated the TI-04-1214 Project interconnected at the same location as report [1], but with larger blocks of power (80 MW and 120 MW) being injected into the power system from the TI-04-1214 Project as well as the original 40 MW output level.

It will be necessary that the new substation interconnecting the TI-04-1214 to the Clapham-Rosebud 115 kV Transmission Line be arranged in a single-breaker tap configuration (Alternative No. 1) so that faults within the generation facility will be contained within the wind ranch and not affect operation of Tri-State's 115 kV line. Customer may also want to consider the benefits of adding a second 115 kV breaker on the line to Rosebud (Bravo Dome). This is Alternative No. 2 in this report. This would allow 115 kV faults between the proposed Customer 115 kV Tap and Bravo Dome to be cleared without impacting the TI-04-1214 Project generation. Without this additional protection, faults on the line between Customer and Bravo Dome will be cleared by breakers at Gladstone Substation. The actual tap breaker would be part of the Customer Substation [5] and is not included in the scope of the interconnection facilities.

Estimated Costs

Alternative No. 1 - Simple Tap	$1,538,000
Alternative No. 2 - Bravo Dome Line Breaker	$2,030,000
Telecommunication System Additions	$ 115,000
Temporary 115 kV By-Pass	$ 189,500

Schedule

Based on current lead times for 115 kV electrical equipment, it would require approximately 14 months after execution of the LGIA to complete the interconnection. The schedule would not be dependent on which alternative for the interconnection is chosen by Customer.

2. INTRODUCTION

2.1 Objective

The objective of this report is to document the results of an interconnection facility study for the proposed TI-04-1214 Wind Ranch Project in northeastern New Mexico. The project is proposed by TI-04-1214 customer.

The previous Facility Study Report [4] included a general description of the Customer substation configuration but did not include a detailed scope, estimate or schedule for providing the 115 kV interconnection of this facility. This facility report will provide detailed electrical configuration one-line diagrams, equipment plans, cost estimates and a schedule for the 115 kV line tap interconnection for the proposed Customer Substation.

2.2 Background

A previous SIS Report [1] examined power flow, dynamic and short circuit studies for the TI-04-1214 Project rated at 40 MW without a future Gladstone to Walsenburg 230 kV Transmission Line. This was the case because the proposed generation addition was scheduled to be in-service prior to the proposed Gladstone to Walsenburg 230 kV Transmission Line. A second SIS Report [2] investigated the TI-04-1214 Project at the same interconnection point considering the Gladstone to Walsenburg Line in-service with 80 MW and 120 MW outputs as well as the original 40 MW output from the TI-04-1214 Project. The second SIS differed in its representation of the proposed Gladstone to Walsenburg 230 kV Line from the first SIS in order to compare the ability to support the proposed generation in the two system scenarios.

A previous Facility Study Report [4] dated November 17, 2004 included an evaluation of facilities impacted by the proposed interconnection to a wind generator resource identified in previous system studies [1] [2]. This Facilities study included discussion of the TI-04-1214 Project impacts at the Rosebud, Clapham, Springer, Black Lake and Taos Substations along with estimates of the cost to mitigate the facility impacts.

The Customer Substation was discussed in the Facilities Study [4] but cost estimates for the 115 kV tap and interconnection were not included.

2.3 Scope

This Interconnection Facility Study Report includes details of the two alternative tap configurations for the interconnection of the Customer Substation as outlined in the previous Facility Study [4]. Electrical one-line diagrams, general arrangement drawings and cost estimates for the two alternatives are included. Since the TI-04-1214 Project will be connected to a radial line, a temporary 115 kV by-pass will have to be constructed to maintain service to Bravo Dome. An estimate of the cost of the by-pass (shoo-fly) is also included.

The interconnection facility will require a telecommunications system that would be common to either tap alternative. An estimate of the Digital Microwave System is included as a separate item.

All estimates include a listing of major equipment and materials.

3. INTERCONNECTION OF FORESIGHT SUBSTATION

3.1 General Discussion

Since the TI-04-1214 Project will be connected to a radial system, full line sectionalizing at the tap of Tri-State's Gladstone-Clapham-Rosebud 115 kV line will not be required. However, provision for future sectionalizing is required in the physical layout and initial construction at the tap. This will allow sectionalizing to be added in the future should the radial 115 kV circuit become part of a looped system. Potential for a four breaker ring-bus is assumed for the layout of both configuration alternatives. As outlined in the FS [4], there are two alternatives for connecting the Customer Substation. The minimum requirement would be single-breaker tap configuration using two motor-operated line-break switches and a tap disconnect switch. The 115 kV tap breaker is not included in the scope of this interconnection study, but is part of the TI-04-1214 project substation as depicted on the Single Line Diagram SE-1 for the TI-04-1214 Wind Ranch as provided by the Interconnection customer [5]. The alternative configuration would be to add a 115 kV line breaker on the Rosebud (Bravo Dome) circuit. The line breaker would isolate faults on the line between the Customer Tap and Rosebud (Bravo Dome). The simple tap breaker configuration would allow isolation of the Customer facility by using the motor-operated switches but not without an interruption to the Customer interconnection. The choice of configuration is Customer's decision to make. There would be cost differences in the two alternatives but little or no impact on schedule. Both alternatives include Tri-State installing 115 kV bi-directional metering, high-side protection, SCADA system and telecommunications.

All estimates included in this study do not include land costs, access roads, or any costs associated with obtaining state or local permits for this project.

3.2 Alternative No. 1 - Simple Tap

This alternative is depicted on the attached One-line Diagram and Equipment Plan. This alternative will require two motor operated switches (one with load-break capabilities), a transformer disconnect switch, transmission line A-Frame strain structures and the 115kV bi-directional metering. The physical layout will provide for a future expansion of the bus arrangement into a possible four-breaker ring bus. It will also allow for the efficient addition of a second transformer at this tap. The control building would provide space for switch controls, meter panel, battery system, and telecommunication and SCADA equipment. A 115 kV tap breaker would be required and would be installed by the customer. An estimate of $1,537,981 for the construction cost of Alternative No. 1 is attached. The cost of the 115 kV tap breaker and associated switch and transformer protection are not included in the Alternative No. 1 estimate. The tap breaker, transformer protection and control system as provided by the customer would have to be integrated into the design and operation of the Tri-State control system at the tap.

3.3 Alternative No. 2 - Bravo Dome Line Breaker

This alternative is depicted on the attached One-line Diagram and Equipment Plan. This alternative will require line switches, a transformer disconnect switch, transmission line A-Frame strain structures and the 115 kV bi-directional metering. It would add a 115 kV line breaker and associated switches on the radial line that continues on to Bravo Dome. Motor operation of the line disconnect switches would not be required for this alternative. The physical layout will provide for a future expansion of the bus arrangement into a possible four-breaker ring bus. The

ring-bus configuration would be included in the initial construction so as to provide for a breaker by-pass. This will allow maintenance of the Bravo Dome breaker without interruption of the radial line. It will also allow for the efficient addition of a second transformer at this tap. The control building would provide space for breaker controls, meter panel, battery system, and telecommunication and SCADA equipment. The 115 kV tap breaker would be required and would be installed by the customer. An estimate of $2,029,742 for the construction cost of Alternative No. 2 is attached. The cost of the 115kV tap breaker and associated switch and transformer protection are not included in the Alternative No. 2 estimate. The tap breaker, transformer protection and control system as provided by the customer would have to be integrated into the design and operation of the Tri-State control system at the tap.

3.4 Telecommunication System Addition

Operation and remote control of either tap alternative will require additions to the Tri-State digital microwave telecommunications system. This addition would be from the Customer Substation to the existing Clapham Substation, which has telecommunication links to the Tri-State System Operations Center in Denver, Colorado. This microwave addition will require at least a 30 ft. tower be erected at the Customer Substation. An estimate of $115,147 for the Clapham-TI-04-1214 Wind Ranch Digital NM system is attached.

3.5 Temporary 115 kV By-Pass

Since the Gladstone-Clapham-Rosebud (Bravo Dome) 115 kV line is a radial circuit, provision for continued service to the existing loads on this line during construction of the tap must be provided. A temporary by-pass will have to be constructed adjacent to the actual tap site. This by-pass will be constructed and removed by Tri-State. An estimate of $189,564 for the 'Shoo-fly' is attached.

4. SCHEDULE

A Gantt chart schedule is attached for the engineering and construction of the TI-04-1214 Wind Farm Substation tap facilities. The schedule starts with the preparation and execution of a LGIA for this interconnection. The estimated duration from the date of the LGIA execution to availability of the tap facilities is 14 months. The schedule would not vary significantly with choice of tap configuration.

5. REVISION OF THE FACILITY STUDY REPORT DATED 11/17/04

Significant escalation in the cost of constructing transmission facilities has occurred since the November 17, 2004 report was issued. All costs estimated within the Facility Study Report [4] dated 11/17/04 should be increased by at least 40% to account for these market increases.

6. REFERENCES

[1] Frank R. McElvain, P.E., "TI-04-1214 Wind Project - System Impact Study Report," prepared by Tri-State Generation and Transmission Association, Inc. for the customer, December 2002.
http://oatioasis.com/TSGT/TSGTdocs/TI-04-1214_Wind_Project1.pdf

[2] Dennis Woodford, Garth Irwin, Andrew Isaacs, "TI-04-1214 Wind Project - System Impact Study Final Report," prepared for Tri-State Generation and Transmission Association, Inc.
http://www.oatioasis.com/TSGT/TSGTdocs/04SystemImpactReport06.pdf

[3] McElvain, F.R., and Mulnix, S.S., "Statistically Determined Static Thermal Ratings of Overhead High Voltage Transmission Lines in the rocky Mountain Region, IEEE Transactions on Power Systems, May 2000, p.899.

[4] Duane Torgerson, Gerald Birney and Dennis Woodford, "TI-04-1214 Wind Ranch Project, Facility Study Final Report" dated Nov. 17, 2004 prepared for Tri-State Generation and Transmission Association, Inc.

[5] Customer, Single Line Diagram, SE-1, dated 1/27/04.

7. LIST OF ATTACHMENTS

Drawings
Customer Substation Tap for TI-04-1214 Wind Farm:
- One-Line Diagram Alternative No. 1, dated 2-05-07
- Equipment Plan Alternative No. 1, dated 2-05-07
- One-Line Diagram Alternative No. 2, dated 2-05-07
- Equipment Plan Alternative No. 2, dated 2-05-07

Cost Estimates
TI-04-1214 Wind Farm Substation Alternative No. 1, dated 1/22/07
TI-04-1214 Wind Farm Substation Alternative No. 2, dated 1/22/07
Clapham-TI-04-1214 Wind Ranch Digital MW, dated 5/22/06
Sho-Fly for Clapham to Bravo Dome 115 kV, dated 11/06/06

Schedule
TI-04-1214 Wind Farm MSProject Gantt Chart, dated 2/12/07