INTERCONNECTION FACILITIES STUDY REPORT

Wires-to-Wires Interconnection Request For Mora Line Transmission Project

Springer, New Mexico

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1. EXECUTIVE SUMMARY

This Wires-to-Wires Interconnection Facilities Study ("FacS") report sets forth the scope of work, +/- 20% cost estimate, and schedule for Tri-State Generation & Transmission, Inc. ("Tri-State") and Lucky Corridor ("Interconnection Customer") to interconnect the Mora Line Transmission Project ("MLTP") to Tri-State's existing 115kV Springer substation. The MLTP includes a 38.9 mile 230kV line, new 230/115kV Mora substation, and a new Don Carlos 230kV Switching Station. The MLTP costs are not included in this study and will be completed by others. This Facilities Study is based on Alternative 5 (Bypass Gladstone with a 230kV connection to Springer) and Figure 1 of the Don Carlos Wind Farm System Impact Study (Version 3.5, dated March 27, 2019).

The MLTP has a completed Wires to Wires Facilities Study with PNM finalized on 11/16/2017, and a Transmission Construction and Interconnection Agreement ("TCIA") with PNM fully executed on 1/29/2018 and FERC approved on 3/27/2018.

The Don Carlos Wind Farm ("DCWF") project has requested to interconnect 181.44 MW gross to the MLTP originally planned for October 31, 2018. The DCWF project submitted a Large Generator Interconnection request to Lucky Corridor on July 15, 2016.

The MLTP design has been changed as it relates to the connections to Tri-State due to high voltage concerns raised during the course of this DCWF System Impact Study ("SIS") (Version 2 studies). The previous MLTP design consisted of only 115 kV with connections to both Tri-State's Gladstone and Springer 115 kV substations before ultimately connecting to PNM's Arriba 115 kV substation. Study results showed that simultaneous loss of both Tri-State's Gladstone-Springer and MLTP's Gladstone-Springer 115 kV lines resulted in a high instantaneous voltage in and around the Springer 115 kV system. The high voltage is due to the area shunt capacitors being switched in-service to accommodate the high transfer of flow from both the Gladstone Phase Shifting Transformer ("PST") and the DCWF followed by a contingency that eliminates both sources of the flow transfer. Per the DCWF SIS, numerous mitigation measures were explored including siting SVC or STATCOM in the area. After much investigation, Tri-State and Lucky agreed that the preferred mitigation alternative is to redesign the MLTP to bypass Gladstone and significantly reduce the potential for the simultaneous loss of both resources. This study shows that in the unlikely event that both resources be lost under the new MLTP design, the post-transient voltage performance is significantly improved.

The new MLTP design includes an initial 230 kV portion that bypasses Gladstone substation. The line will now step the voltage down from 230 kV to 115 kV at a new substation called Mora in the vicinity of Springer. The MLTP will connect to Springer through a single 115 kV tie and continue to Arriba as originally planned. The conductor size also increased from 954 ACSR to 1272 ACSR (a more typical 230 kV conductor).

<u>SIS Overview</u>

The technical analysis conducted as part of the SIS included power factor, power flow, post-transient, transient stability, and short circuit analysis. Several scenarios were evaluated and studied. The following are items to note of as part of the study:

- The DCWF will connect to the MLTP at the Don Carlos 230 kV Switching Station by installing one circuit breaker. The associated terminating equipment have been identified as the customer's Interconnection Facilities. The circuit breaker will be part of Mora's Don Carlos 230 kV switching station.

- The DCWF will be required to install a Remedial Action Scheme (RAS) that ensures reliable system performance when the DCWF is at maximum output. The specific parameters of the RAS are discussed in the SIS study.

- It is estimated that the DCWF will be limited to 175 MW gross (172 MW net) in the heavy winter and 157 MW gross (155 MW net) in the light spring conditions when the Gladstone PST is importing 190 MW. The actual limitation will be dictated by the Arriba Tap-Valencia 115 kV Line loading. The DCWF RAS will trip the project back to 100 MW if the line loading exceeds the rating.

- The Gladstone PST is manually adjusted by Tri-State to maintain power schedules or to mitigate unscheduled flow. Post-contingency, the Gladstone PST may not be immediately adjusted. However, Tri-State operations or the reliability coordinator may initiate a manual adjustment post-contingency after 30 minutes to mitigate unscheduled flow. In the event Tri-State needs to make a Gladstone PST adjustment, coordination will need to be made with the DCWF to ensure an appropriate generation curtailment is made to maintain acceptable loading on PNM's Arriba Tap-Valencia 115 kV Line. An operating procedure is recommended in order to facilitate such coordination

- It is recommended that transient stability analysis be performed after the PSCAD results to ensure that the final Springer substation design and any dynamic model parameter setting changes sufficiently address these transient stability concerns.

- The overall system performance will need to be re-evaluated in a PSCAD study.

- A ringing is observed at the DCWF and propagates to nearby Cimarron Solar project. The ringing may be resolved by a dynamic model parameter setting change or may be due to the weak nature of the NENM system coupled with the radial MTLP connection to Springer. In either case, the dynamic performance will need to be re-evaluated in a PSCAD analysis.

- The MLTP will install a 20 MVAr shunt reactor at the Don Carlos 230 kV Switching Station used to control high voltage at the Don Carlos 230 kV Switching Station and minimize reactive power flow through the Mora 230/115 kV transformer when the DCWF is offline and the MLTP facilities are energized.

2. INTERCONNECTION OF THE TRANSMISSION PROJECT

2.1 Scope of Work

The documents in support of a TCIA 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 Interconnection Customer only (not to be posted on the OASIS for Public use).

The proposed installation includes high-side bi-directional metering, 115 kV line protection, and Supervisory Control and Data Acquisition ("SCADA") system. Primary and secondary line relaying will be required between the IC facilities and Springer substation. Primary and secondary relay protection and the interrupting device for the Interconnection Customer's step-down transformer will be provided by the Interconnection Customer in its substation yard. To facilitate protective relaying, SCADA, and metering between the Springer substation and the IC substation, an OPGW with 48-strand single-mode fiber will be installed with the Interconnection Customer's transmission line. The IC must also provide access to analog and status circuits as required to integrate the MLTP into the design and operation of the Tri-State system.

The Transmission Owner's (Tri-State's) Interconnection Facilities are located 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 Vertically configured Full Tension Monopole dead-end). The estimate includes all site work and necessary substation equipment including but not limited to grounding, conduit, cable, insulators, foundations, support steel, tubular and cable bus, trench, site preparation, yard work, fencing, etc. inside the Springer substation. The estimate does not include access roads or any site work outside the Springer substation. The estimate does not include the purchase of any land, and assumes that all county and environmental permits will be obtained by the Interconnection Customer.

The Network Upgrades are located on the Tri-State's side of the POI and involves construction upgrades associated with adding a new leg and expanding the yard at the Springer substation to accommodate the Interconnection Customer's new line terminal. The estimate assumes that all work will be done by the Tri-State'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 MLTP and all Interconnection Facilities up to the PCO.

- Install one (1) 115 kV vertically configured full tension monopole deadend structure located outside of Springer substation fence at a mutually agreed location inside the Transmission Provider's property line for Interconnection Customer line termination ("IC's Monopole Dead-end Structure"). Structure shall be provisioned to ensure appropriate electrical phasing as required by TP.
- Install an interrupting device, associated isolation switch and relaying for line protection.
- Land costs, access roads and any costs associated with obtaining state or local permits for the Project.
- Provide access to analog, indicating, and data circuits, as required to integrate into the design and operation of Tri-State's control system.

2.2.2 Interconnection Facilities to be completed and owned by Tri-State and paid for by the Interconnection Customer

- The estimate includes all site work and necessary substation equipment including but not limited to grounding, conduit, cable, insulators, foundations, support steel, tubular and cable bus, trench, site preparation, yard work, fencing, etc. inside Tri-State's Springer substation. The estimate does not include access roads or any site work outside the Tri-State substation. The estimate assumes that the purchase of additional land is not required, and includes $50,000 for county and environmental permits.
- One (1) 115 kV slack span from IC's Monopole Dead-end Structure to line A-frame in the station bus at the Springer substation.
- Springer substation:
    - Install one (1) 115 kV A-frame structure
    - Install one (1) 115 kV 3-phase gang operated line disconnect and associated structure.
    - Install three (3) 115 kV (76 kV MCOV) surge arresters.
    - Install three (3) 115 kV metering CTs/stand.
    - Install three (3) 115 kV metering VTs/stand.
    - Install power quality metering panel including SEL-735 REV/PQ meter, testing, checkout, and commissioning.
    - Install new line relaying control panel for the Interconnection Customer's radial 115 kV line protection including a SEL-411L primary relay, and a SEL-311L secondary relay.
    - Line termination SCADA and telemetry communication equipment upgrades to RTU.
    - Fiber splice boxes, terminations, and cable to accommodate the OPGW from the IC substation.
    - Install all other necessary substation equipment including but not limited to grounding, conduit, cable, insulators, foundations, support steel, tubular and cable bus, trench, site preparation, yard work, fencing, etc.

The estimated cost for the **Tri-State's Interconnection Facilities is $1,138,076**; a copy of the estimate is attached as Appendix C.

2.2.3 Network Upgrades to be completed and owned by Tri-State and initially paid for by Interconnection Customer

- The estimate includes all site work and necessary substation equipment including but not limited to grounding, conduit, cable, insulators, foundations, support steel, tubular and cable bus, trench, site preparation, yard work, fencing, etc. inside Tri-State's Springer substation. The estimate does not include access roads or any site work outside Tri-State's substation.
- Engineer, purchase, and construct all Network Upgrades starting from the POI to install a new leg to the existing Springer substation. The additional leg is to accommodate the new line terminal for the MLTP.
- Springer substation:
    - Remove and demo existing 12.5 MVAR Cap Bank/Cap Bank switch/Cap Bank Switcher.
    - Install new 115kV 15 MVAR Cap Bank and locate to new terminal on the new leg addition.
    - Install three (3) 115 kV circuit breakers as part of a new breaker and a half bay to the existing Springer substation ring bus.
    - SCADA and telemetry RTU communication equipment modifications.
    - Install new BF Relaying/sync check for new breakers to conform to existing protection conditions at station.
    - Install six (7) 115 kV 3-phase breaker disconnect switches / stands.
    - Install one (1) 3-phase low bus support stands.
    - Install four (4) 3-phase high bus support stands.
    - Install four (4) 1-phase low bus support stands.
    - Install (3) 115kV VT's/stand for new cap bank position.
    - Install all other necessary substation equipment including but not limited to grounding, conduit, cable, insulators, foundations, support steel, tubular and cable bus, trench, site preparation, yard work, fencing, etc.
    - Relay settings changes for new POI line termination protection at Springer substation.

The estimated cost of the **Network Upgrades construction is $2,451,742**; a copy of the estimate is attached as Appendix D.

3. SCHEDULE

A Gantt chart schedule is attached (Appendix E) for the engineering and construction of the upgrades at the existing 115 kV Springer substation associated with the MLTP interconnect. 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 TCIA, or with the receipt of funds and execution of a TCIA.

4. LIST OF APPENDICES

Appendix A-1: Springer Substation General Arrangement Plan
Appendix A-2: Springer Substation Elevations A-A, B-B, C-C
Appendix A-3: Springer Substation Elevations D-D, E-E, F-F, G-G, H-H, I-I
Appendix A-4: Springer Substation Elevations Q-Q, R-R, S-S
Appendix A-5: Springer Substation Elevations T-T
Appendix B-1: Springer Substation AC One-Line Diagram
Appendix C: TP Interconnection Facilities Cost Est. Summary
Appendix D: Network Upgrades Cost Est. Summary
Appendix E: Construction Schedule (Primavera Project Gantt Chart)