



Generation Interconnection Facilities Study Report Request # GI-2004-2 Restudy

75MW Expansion of the Existing Wind Generation
Lamar 230kV Substation, Colorado

Transmission Planning West - Xcel Energy

September 28, 2016



I. Executive Summary

This Interconnection Facilities Study Report summarizes the construction schedule and cost of siting, engineering, equipment procurement and construction needed to expand the existing wind generation at the Lamar 230kV Substation by 75MW.

The study request for GI-2004-2 was originally received in 2004. The initial request received by Public Service Company of Colorado (PSCo – Xcel Energy Transmission Planning West) in 2004 was for the interconnection of a 238MW wind generating facility at PSCo's Lamar 230kV Substation. The Feasibility Study completed in May 2004 and the System Impact Study completed in December 2004 had evaluated the 238MW capacity for Network Resource Interconnection Service (NRIS) as well as Energy Resource Interconnection Service (ERIS). Subsequently, the LGIA executed in 2005 was for a reduced 150MW capacity as ERIS only. However, only 75MW was constructed by the Interconnection Customer by installing fifty (50) GE-1.5MW Type-3 wind turbine generators, which were consistent with the wind turbine generators studied for the original GI-2004-02 request. The resulting 75MW generating facility has been in commercial operation since 2005.

In 2015, the Interconnection Customer approached PSCo to avail the remaining 75MW capacity under the purview of the existing LGIA by installing thirty-six (36) Gamesa-G9x 2.0/2.1MW wind turbine generators. PSCo as a Transmission Provider determined that a combined Feasibility & System Impact Restudy was needed to evaluate the proposed 75MW capacity addition for ERIS. The proposed in-service date of the 75MW expansion was November 1, 2016, which was later revised to November 1, 2017.

PSCo posted a draft Feasibility and System Impact Restudy report on September 22, 2015, and a final Feasibility and System Impact Restudy report on June 27, 2016. Since the proposed 75MW capacity addition is for ERIS only, the study did not determine any Network Upgrades attributable to the 75MW expansion. However, the existing Lamar 230/115kV, 100MVA #T1 transformer was identified as a network facility which limits the maximum allowable injection at the Lamar 230kV POI to 237MW. Therefore, the study determined that the ERIS for the 75MW expansion is 0MW without upgrading the Lamar 100MVA #T1.

TSGT as Transmission Owner and Operator has the responsibility for engineering and constructing the project to replace the Lamar 230/115kV, 100MVA#T1 transformer with a 150MVA transformer, this report does not address the engineering design and cost estimates for it.

The total estimated cost for the Transmission Provider's facilities required for the proposed 75 MW expansion of GI-2004-2 as ERIS is **\$0.36M¹**

¹ Appropriation estimates are considered to have an accuracy of +/- 20%.

- \$0.36 million for PSCo-Owned, Customer-Funded Interconnection Facilities
- \$0 for PSCo-Owned, PSCo-Funded Interconnection Facilities
- \$0 for PSCo Network Upgrades for Delivery

The estimated time required to design, engineer, procure and construct the facilities described is 12 months from the date the Customer meets all applicable milestones as agreed to in any future LGIA. An Engineering & Procurement Agreement can be executed to facilitate completion of the Interconnection Facilities.

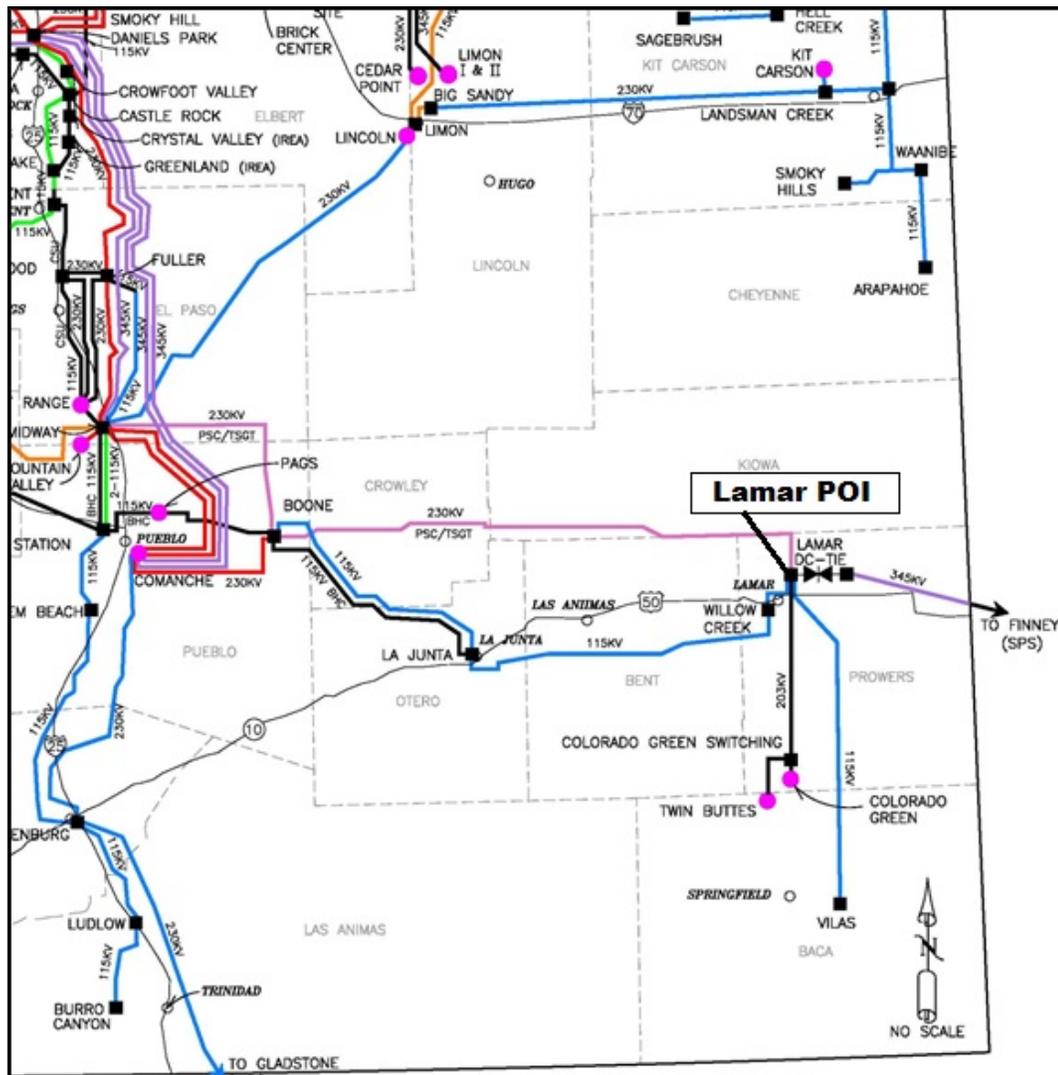


Figure 1 Lamar Substation and Surrounding Transmission System

II. Introduction

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In 2015, the Interconnection Customer approached PSCo to avail the remaining 75MW capacity under the purview of the existing LGIA by installing thirty-six (36) Gamesa-G9x 2.0/2.1 wind turbine generators. PSCo as Transmission Provider determined that a combined Feasibility & System Impact Restudy is needed to evaluate the proposed 75MW capacity addition for ERIS. The proposed in-service date of the 75MW expansion was November 1, 2016, which was later revised to November 1, 2017.

The 75MW expansion will be located adjacent to the existing Twin Buttes wind generating facility and interconnect to the Interconnection Customer's existing 230kV tie-line at approximately eight (8) miles from the existing Colorado Green Substation. Since this is a 75MW expansion for GI-2004-2, the existing POI at Lamar 230kV station remains unchanged.

PSCo (Xcel Energy - Transmission Planning West) posted a draft Feasibility and System Impact Restudy report on September 22, 2015, and a final Feasibility and System Impact Restudy report on June 27, 2016. Since the proposed 75MW capacity addition is for ERIS only, the studies did not find any Network upgrades attributable to the 75MW expansion. However, the existing Lamar 230/115kV, 100MVA #T1 transformer limits the maximum allowable injection at the Lamar 230kV POI to 237MW. Therefore the study determined that the ERIS for the 75MW expansion is 0MW without upgrading the Lamar 230/115kV, 100MVA #T1 transformer.

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An agreement for a Facility Study was executed on July 19, 2016.

This request was studied as a stand-alone project, with no evaluations made of other potential new generation requests that may exist in the Generator Interconnection Request queue, other than the resource acquisitions for which Power Purchase Agreements have been signed.

III. General Interconnection Facilities Description

A. Project Purpose & Scope

The capacity of the existing GI-2004-2 wind generation facility interconnected at the Lamar 230kV POI is being increased by 75MW. The relaying and communication on the existing generator tie-line will need to be upgraded.

Notable Items

The existing terminal equipment is rated adequately to accommodate the 75MW expansion. This includes the metering units.

Future Considerations

There is currently a study underway looking at upgrading the power controls between the Lamar Substation and the Colorado Green Wind Farm and Twin Buttes II. Depending on the outcome of the study, the power controls may need to be modified, which will affect the cost estimates and construction schedule.

The Interconnection Customer must perform a study to identify the wind farm voltage controller settings. The wind farm voltage control settings should be coordinated with the existing wind generation facilities to meet the requirements stated in section 4.0 of the Feasibility and System Impact study report posted on June 27, 2016.

These studies must be performed before the new 75MW wind generation expansion facility can become commercially operational.

Distribution vs. Transmission Asset Ownership and Cost Responsibility

The substation primary function is presently defined as Transmission. This project will not change the primary function of the substation when complete assuming no other changes.

Interconnection / Customer Cost Responsibility

The project cost will be reimbursable by the customer as per the LGIA.

B. FERC and/or NERC Compliance Requirements

Critical Infrastructure Protection (CIP) Asset

The CIP status of this substation will be confirmed at a later date.

Facility Ratings and Smart One-Lines

This substation has Bulk Electric System facilities.

A smart one-line diagram does not yet exist for this substation. A smart one-line diagram will not be created as part of this project for the following reasons: Facility rating changes will be managed via existing pre-GIST2 facility rating processes.

C. Right of Way/Permitting

There is no need for right of way or permitting for this project.

D. Electrical Features

Transmission Lines: Current Carrying Capacity of Affected/Tapped/New

The existing capacity of the line terminal equipment will be adequate to accommodate the 75MW expansion wind generation facility.

Fault Current

The Three phase fault current level contributions from the 75MW expansion wind generation facility are expected to be minimal. The Single Line to Ground fault current level contributions from the 75MW expansion wind generation facility are also expected to be minimal, but the exact value is not known at the time of writing this report. The three phase fault current levels at Lamar 230kV bus for the existing system and with the 75MW expansion are given below. The breaker duty study indicated that all circuit breakers at the Lamar 230kV substation and the surrounding system are adequately rated.

Location \ Type of Fault	Three Phase (A) Existing System	Three Phase (A) With 75MW expansion
230kV Bus (Existing)	1781	1781

Electrical Removals & Relocations

There are no removals associated with this project.

Electrical Installations (Major Equipment)

Two (2) new panels will be installed and one (1) removed from the existing EEE.

Electrical Equipment Enclosure (EEE)

This project will not require a new EEE.

AC System

The AC system is adequate for the proposed additions.

DC System

The existing DC system is adequate for this project. The new relays (SEL-351S, SEL-411L, SEL-311C) will have comparable DC draws to the previous equipment (SEL-311, SEL-321, SEL-501). We do not anticipate that the new SEL-735 Power Quality meter will necessitate an increase in battery size.

Grounding

The existing ground grid is adequate to accommodate the 75MW wind generation facility expansion.

Lightning Protection

The existing lightning protection will not be modified for this project.

Trenching & Cable

Existing cable and conduit will be adequate for this project.

Wave/Line Traps

Wave Traps will not be required for this project.

E. Civil Features

Grading & Fencing

The existing grading and fencing will be adequate for this project

Storm Water Permit

A storm water permit will not be required for this project.

SPCC (Oil Containment)

Oil containment will not be required for this project.

Civil Removals & Relocations

There are no civil removals or relocations required.

Foundations & Structures

There are no foundations or structures being installed for this project.

F. Protection Features

Transmission Line Protection (230kV)

The existing primary relay and the secondary relay will be removed. The line protection will be upgraded to the new standard line differential with a POTT backup scheme. The existing Transfer Trip scheme will remain and an additional Transfer Trip will be added to the new wind generation facility site.

Transmission Breaker Protection (230kV)

The existing breaker failure relay will be removed. A SEL-351S will be installed for breaker failure/synchronizing.

G. Control Features

General

The existing line and breaker relaying will be replaced with the new harmonized design relays.

Digital Fault Recorder

The existing Digital Fault Recorder will be adequate

Control Panel Locations

The new control panel locations will be determined during detailed design.

Power Metering

The existing telemetry and RTU are adequate for this project, but will need a new SEL-735 power quality meter.

Removals

The existing panel and relays for the existing 230kV tie-line will be removed.

H. Communication Features

Remote Terminal Unit (RTU)

The existing RTU is adequate.

Local Annunciation

The existing local annunciation will be adequate for this project.

Relay Remote Access

The existing relay remote access will be adequate to accommodate the 75MW expansion

Fiber Optic Cable

Fiber will be utilized for transfer trip on the generator tie-line to the new 75MW wind interconnection point. Six (6) strands of dark fiber will be required by the new line protection scheme, a new fiber distribution unit will be installed to terminate the additional fibers.

Removals

There are no communication removals needed

I. Project Operating Concerns and Outages

Outages/Temporary Configurations

There will be an outage for connecting the new generation on the tie line and for testing the relays at the Lamar Substation. Since new panels and new relays will be installed, they can go through STAC process to limit the outage length necessary. The outage will be approximately two (2) weeks.

Mobile Substation or Transformer

There will not be a need for a mobile transformer or substation

Environmental

There are no environmental concerns at this time

J. Material Staging Plan

It is preferred to have major material shipped directly to the job site rather than to a warehouse location. Stock materials will be ordered and staged through PSCo Supply Chain.

K. Related Projects

There are no related Work Orders at this time.

L. Estimate Discussion

The standard contingency factors for estimates are as follows:

- Scoping Estimate Contingency Factors: Material:20%, Labor and Equipment:10%
- The estimate for this project utilizes the standard contingency levels

M. Risk Check List

Risk factors identified at the time the Design Guide Package was prepared are indicated below. Explanations indicate the action taken, if any, in the estimate as a result, such as additional contingencies or multipliers that were applied.

- Survey information is not available. Explain:
- Soil boring results are not available. Explain:
- Unusual soils or environmental conditions exist. Explain:
- Key materials or items need decisions or approvals. Explain:
- Potential permitting delays or unusual requirements exist. Explain:
- There are difficult or seasonal outage requirements. Explain:
- There are conflicting outage requirements. Explain:
- There are risks due to who will construct the project and their availability. Explain:
- Unusual construction techniques will be required. Explain:
- There are risks associated with plans to reuse existing material. Explain:
- There are potential alternatives still under consideration. Explain:
- Material prices are likely to change or volatile. Explain:
- Material lead times are likely to be longer than estimated. Explain:
- Labor prices are likely to change. Explain:

- There are existing erosion problems. Explain:
- The existing oil containment may not be adequate. Explain:
- The existing lightning protection may not be adequate. Explain:
- The existing bus and equipment ampacity may not be adequate. Explain:
- The existing drawings are incomplete and inaccurate. Explain:

Notes and Comments:

IV. Cost Estimates and Assumptions

Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 20% accuracy) were developed by Public Service Company of Colorado (PSCo) / Xcel Energy (Xcel) Engineering. The cost estimates are in 2016 dollars with escalation and contingency included. AFUDC is not included. Estimates are developed assuming typical construction costs for previous completed projects. These estimates include all applicable labor and overheads associated with the siting support, engineering, design, material/equipment procurement, construction, testing and commissioning of these new substation and transmission line facilities. This estimate does not include the cost for any other Customer owned equipment and associated design and engineering.

The estimated total cost for the required upgrades is **\$358,969**. The project one-line in Appendix A below represents the Lamar Substation and the existing 230kV Point of Interconnection for GI-2004-2. These estimates do not include costs for any other Customer owned equipment, associated design and engineering. The following tables list the improvements required to accommodate the interconnection and the delivery of the 75MW generation output. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines. System improvements are subject to change upon a more detailed and refined design.

- Labor is estimated for straight time only – no overtime included.
- Lead times for materials were considered for the schedule.

- The Wind Generation Facility is not in PSCo’s retail service territory. Therefore, no costs for retail load (distribution) facilities and metering required for station service are included in these estimates.
- PSCo / Xcel (or our Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.
- The estimated time to site, design, procure and construct the interconnection and network delivery facilities is approximately 12 months after authorization to proceed has been obtained.
- A CPCN will not be required for the interconnection and network delivery facilities construction.
- The Customer will be required to design, procure and install a Load Frequency/Automated Generation Control (LF/AGC) RTU at their Customer Substation.
- Customer will string OPGW fiber into substation as part of the transmission line construction scope.
- No new substation land will need to be acquired.

Table 1 – PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Estimate
Lamar 230kV Transmission Substation	Transmission line communications, station controls, line relaying and testing upgrades	\$358,969
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	\$358,969
Time Frame	Site, design, procure and construct	12 Months

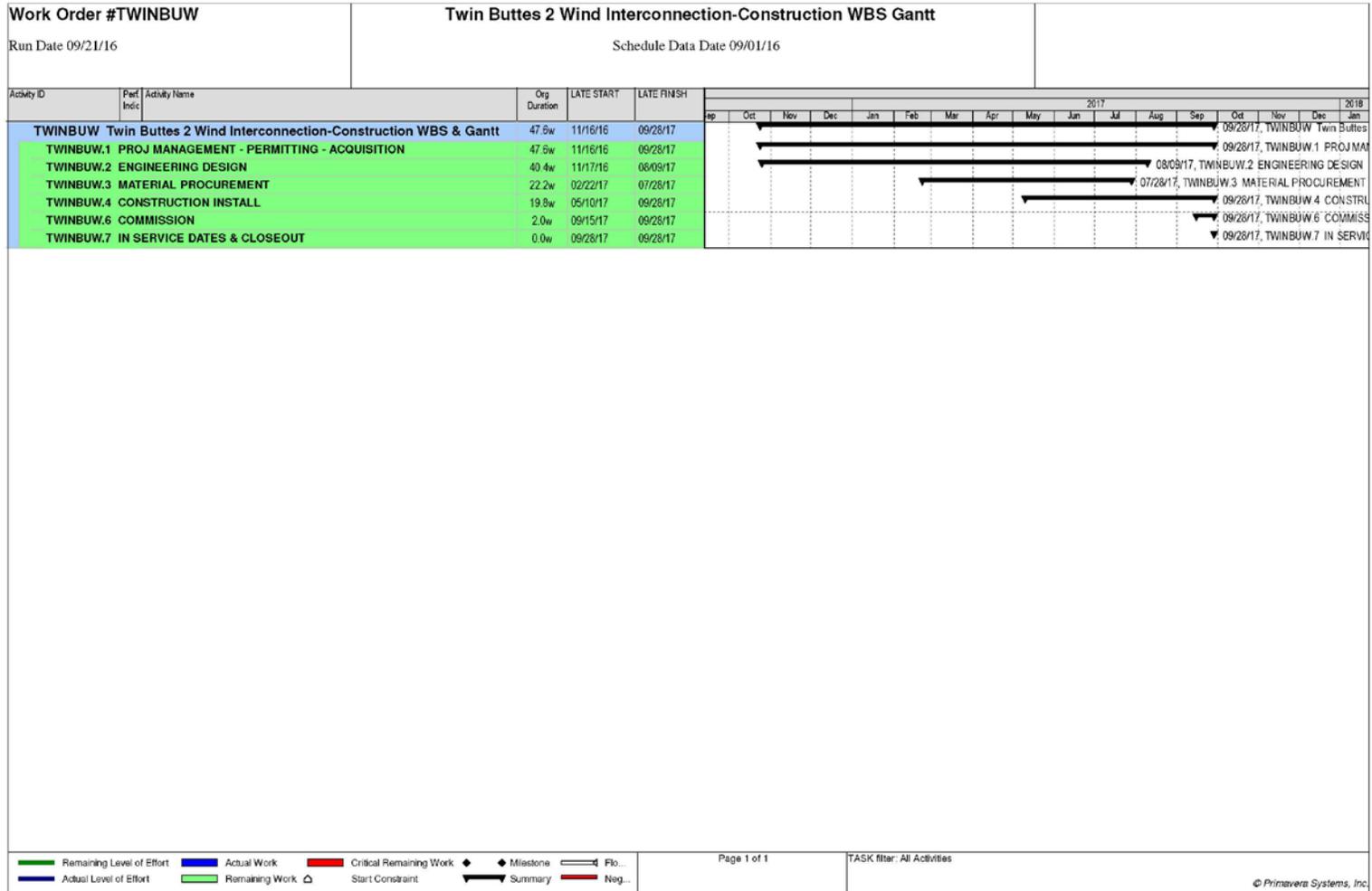
Table 2: PSCo Owned; PSCo Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Estimate
	None	0

Table 3 – PSCo Network Upgrades for Delivery

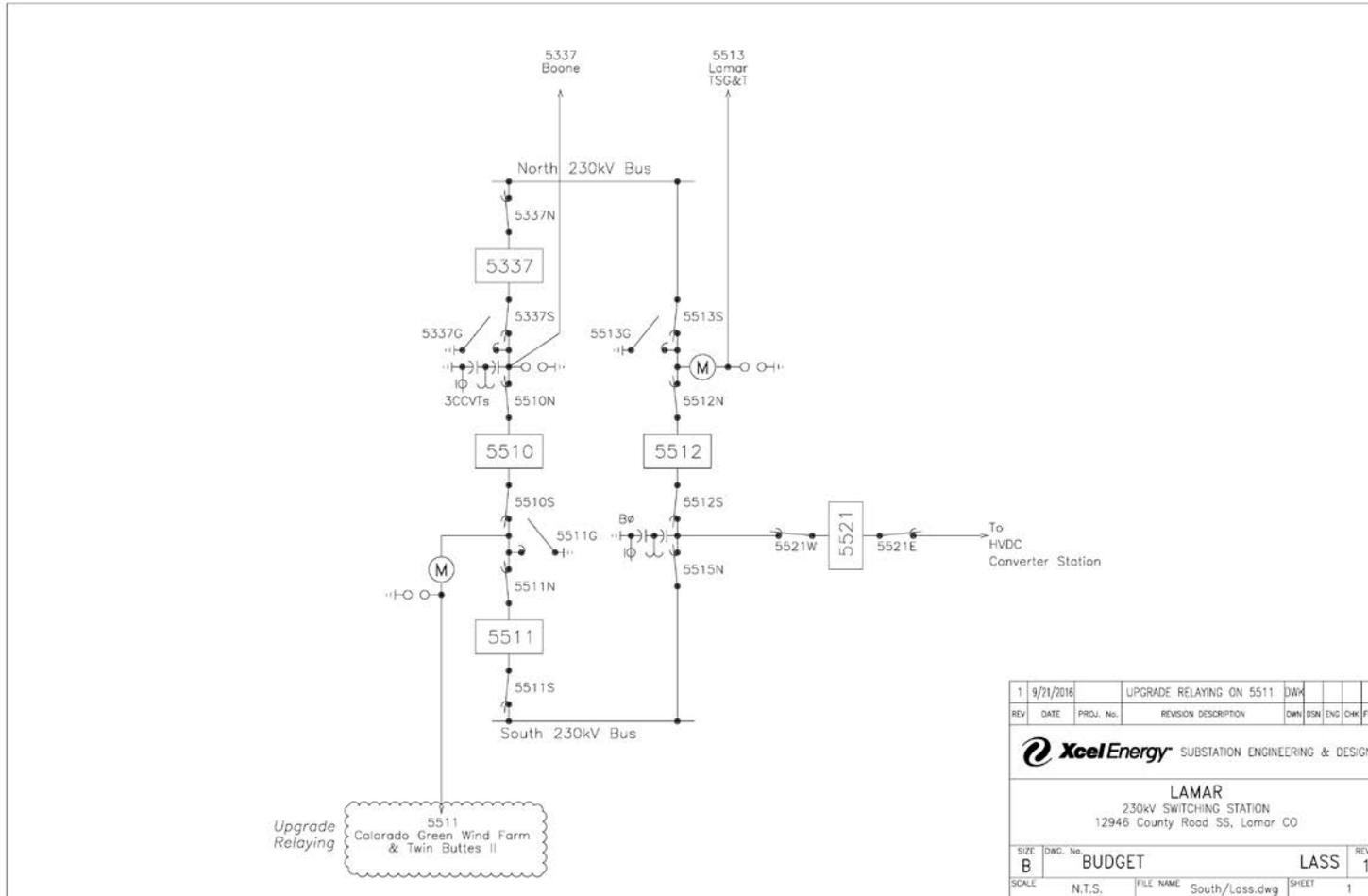
Element	Description	Cost Estimate
	None	0

V. Engineering, Procurement & Construction Schedule



Appendix - A

Project One-Line of the Lamar Substation and existing Lamar 230kV POI



1	9/21/2016		UPGRADE RELAYING ON 5511	DWY					
REV	DATE	PROJ. No.	REVISION DESCRIPTION	DWN	DSN	ENG	CHK	FLM	
SUBSTATION ENGINEERING & DESIGN									
LAMAR 230kV SWITCHING STATION 12946 County Road 55, Lamar, CO									
SIZE	DWG. No.						LASS	REV.	
B	BUDGET							1	
SCALE	N.T.S.	FILE NAME	South/Loss.dwg	SHEET	1				