Generation Interconnection Feasibility Study Report
Request # GI-2008-5

500 MW Wind Generation Facility, near Lamar, Colorado

PSCo Transmission Planning
February 23, 2009

Executive Summary

On July 24, 2008, Public Service Company of Colorado (PSCo) and the Customer signed a Generation Interconnection Feasibility Study Agreement to evaluate the feasibility of interconnecting a 500 MW wind powered generation plant at the PSCo Lamar 230 kV bus. The 500 MW wind farm consists of three hundred and thirty four (334) General Electric 1.5 MW wind turbines, interconnecting to a 34.5 kV collector bus with two (2) dedicated 34.5/230 kV step-up transformers. The Customer's wind collector system is approximately 30 miles northeast of Lamar substation, in Kiowa County..

.The Customer requested the primary point of interconnection to be on the PSCo Lamar 230 kV bus. During the feasibility study, the Customer's request has proven to be not feasible. PSCo proceeded on a feasibility study with a 345 kV interconnection at Lamar. The Lamar 345 kV switchyard is assumed to be adjacent to the existing Lamar 230 kV substation. There will be a single 560 MVA, 230/345 kV autotransformer connecting the two substations. This is consistent with the Senate Bill 100 (SB100) Plans that PSCo has developed and discussed with stakeholders.

One of the assumptions made was the wind turbine generators are capable of operating between the +/- 0.95 power factor. The generators were modeled as two (2) lumped equivalent units at 250 MW each with no additional reactive capability to compensate for the rise in voltage at the point of interconnection due to the charging current on the line. Additional reactors will be required to compensate for the line charging current when the wind turbines are offline.

The Customer's proposed commercial operation in-service date is January 5, 2011 with an assumed back feed date of July 5, 2010. The Customer was notified in the Scoping Meeting that the schedule was very aggressive. Upon completion of the Feasibility Study, PSCo has determined that it is not feasible to interconnect at Lamar substation and deliver the full 500 MW of firm power by the requested in-service date. See cost and schedule for an approximate in service date in Table 5. The Customer will be able to interconnect to PSCo system once the Lamar 345 kV switchyard is built and may be able deliver power on a non-firm basis if available. Major network upgrades to the current transmission system will need to be in place prior to transfer any firm power to the customer. The list of network upgrades is listed under Network Resource section of this report.

This request was studied as both a Network Resource (NR)[1], and as an Energy Resource (ER)[2]. This investigation included steady-state power flow study and preliminary short circuit analysis. The request was studied as a stand-alone project, with no evaluations made of other potential new generation requests that may exist in the LGIP queue, other than the generation projects that are already approved and planned to be in service by the summer of 2011.

Energy Resource

The ER portion of this study determined that the Customer could provide 0 MW without the construction of the new Lamar 345 kV substation. The Lamar 345 kV switchyard will need to be built prior to the requested interconnection. Once the interconnection is made, non-firm transmission capability may be available depending on marketing activities, dispatch patterns, generation levels, demand levels, TOT 3 levels, and the status of transmission facilities.

Network Resource

As an NR request, PSCo evaluated the network to determine the upgrades required to deliver the full 500 MW of the wind facility to PSCo native load customers. The estimated cost of the recommended system upgrades to accommodate the project is approximately **$218.0 million** and includes:

- $326,000 for Customer Funded PSCo Interconnection Facilities at Lamar 345 kV substation. Refer to Figure 1 for the interconnection diagram at Lamar.

- $9,472,000 for PSCo Funded PSCo Interconnection Facilities at Lamar 345 kV substation. Refer to Figure 2 for the interconnection diagram at Lamar.

- $208.2 million for PSCo Network Upgrades for Delivery. Refer to Figure 2 for the system upgrades diagram necessary for delivery. This project has been submitted to the CPUC as part of the SB100 filing for Zone 3.

The generator interconnection at the new Lamar 345 kV substation would require the construction of interconnection facilities from the Customer facilities to the PSCo bulk transmission system. The works required include:

- Constructing the Lamar 345 kV substation with 4-breaker ring layout. See Figure 1 for conceptual interconnection diagram.

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[1] **Network Resource Interconnection Service** shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as all other Network Resources. Network Resource Interconnection Service in and of itself does not convey transmission service.

[2] **Energy Resource Interconnection Service (ER Interconnection Service)** shall mean an Interconnection Service that allows the Interconnection Customer to connect its Generating Facility to the Transmission Provider's Transmission System to be eligible to deliver the Generating Facility's electric output using the existing firm or non-firm capacity of the Transmission Provider's Transmission System on an as available basis. Energy Resource Interconnection Service in and of itself does not convey transmission service

  - Add an additional bay at the Lamar 230 kV to accommodate a new 230/345 kV autotransformer.
  - Add a new 230/345 kV autotransformer.

- Constructing a new 345 kV circuit from Lamar 345 kV to Comanche 345 kV.
- Constructing a new 345 kV circuit from Lamar 345 kV to the future Missile Site 345 kV.

- Revenue metering equipment (CT/VT metering instrument transformers, meters, recorder) and line termination equipment at the Lamar 345 kV substation.

- No additional transmission infrastructure upgrades required for delivery were identified. Criteria violations will be resolved through the PSCo Capital Construction Budget Process for FAC-009 projects.

- Adding a new 345 kV termination at Comanche 345 kV substation.

PSCo Engineering and Siting and Land Rights conducted studies and determined that the time required to site, engineer, procure and construct the Lamar 345 kV substation would be approximately 24-60 months from the Authorization to Proceed to the completion of the project. Refer to the schedule in the cost estimate section for more details. Based on this information, the required Lamar 345 kV switch yard and transmission upgrades would not be achievable by July 5, 2010, consistent with providing back-feed service prior to the requested commercial operation in-service date of January 5, 2011. PSCo Engineering and Siting and Land Rights indicated that a CPCN will be required for this project.

Additional details of the study can be found in the Appendix A. Any Interconnection Agreement (IA) requires that certain conditions be met, as follow:

1. The conditions of the Interconnection Guidelines[2] are met.

2. A single point of contact is given to Operations to manage the Transmission System reliably for all wind projects (GI-2008-5) as found in the Interconnection Guidelines.

3. Customer must show the ability to operate the wind generation within the required +/- 0.95 power factor range during all operating conditions (0 MW to 500 MW) as measured at the Point of Interconnection (POI).

The study indicates that the Customer's transmission line design at full wind output of 500 MW does not meet the voltage requirement without installing additional static and/or dynamic VAR support equipment at either the Customer's site or near the Lamar 345 kV switch yard. According to the Rocky Mountain Area Voltage Coordination Guideline, the ideal voltage on the Lamar 230 kV bus is 1.03 p.u. Although the study shows that the Customer's wind facility is able to operate within the +/- 0.95 power factor requirement as measured at the POI, the 30-mile of 345 kV transmission line connecting the wind facility to the POI is outputting approximately 55 MVAR of reactive power when the wind is not blowing causing an increase in the voltage level at the POI.

[2] Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater than 20 MW, version 3.0 12/31/06.

Therefore, the Customer will need to install reactors to keep the voltage at the POI at an ideal level per the guideline. More detailed studies will need to be performed during the system impact study to determine the exact amount of reactors needed.

Additional details of the studies can be found under the Power Flow Study Results section.

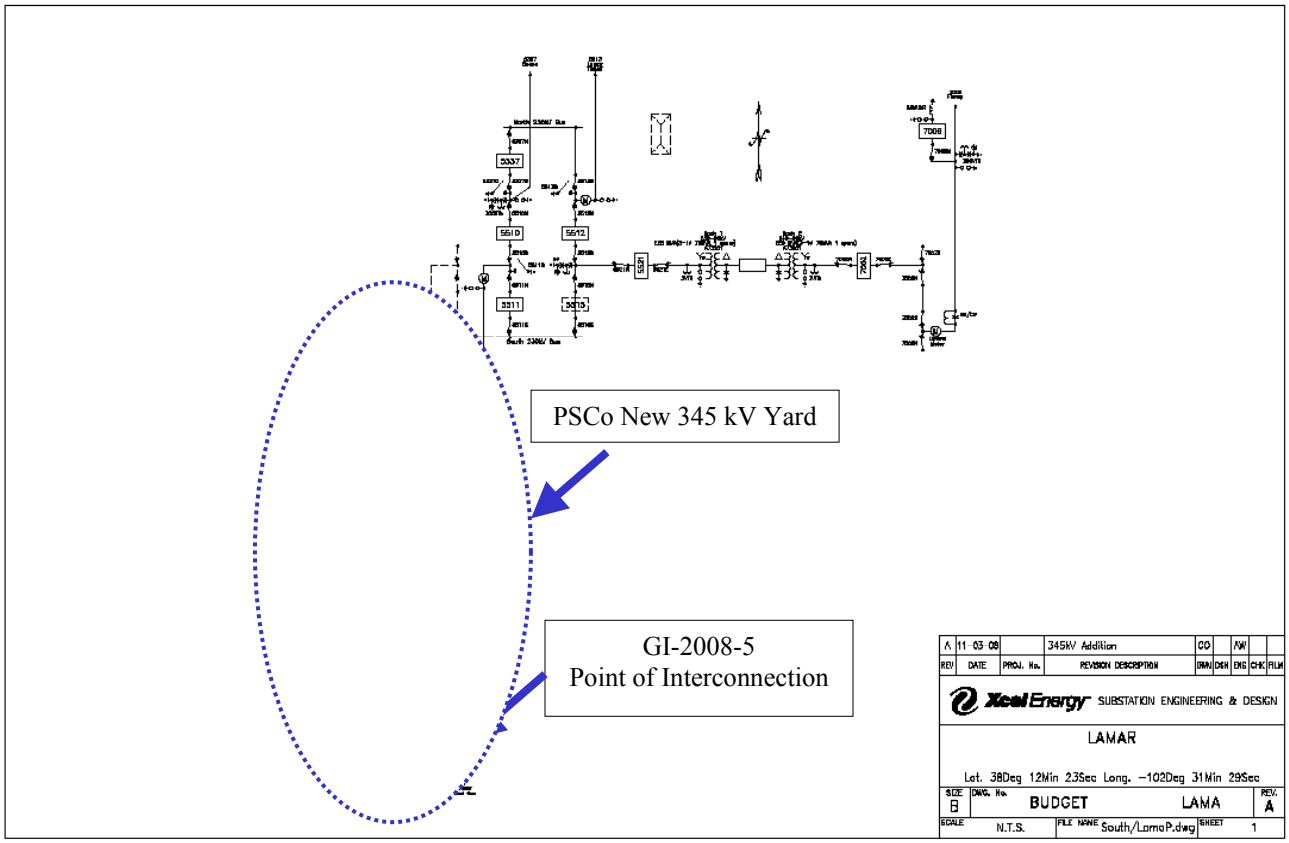

Figure 1: GI-2008-5 interconnection portion of the Feasibility Study.

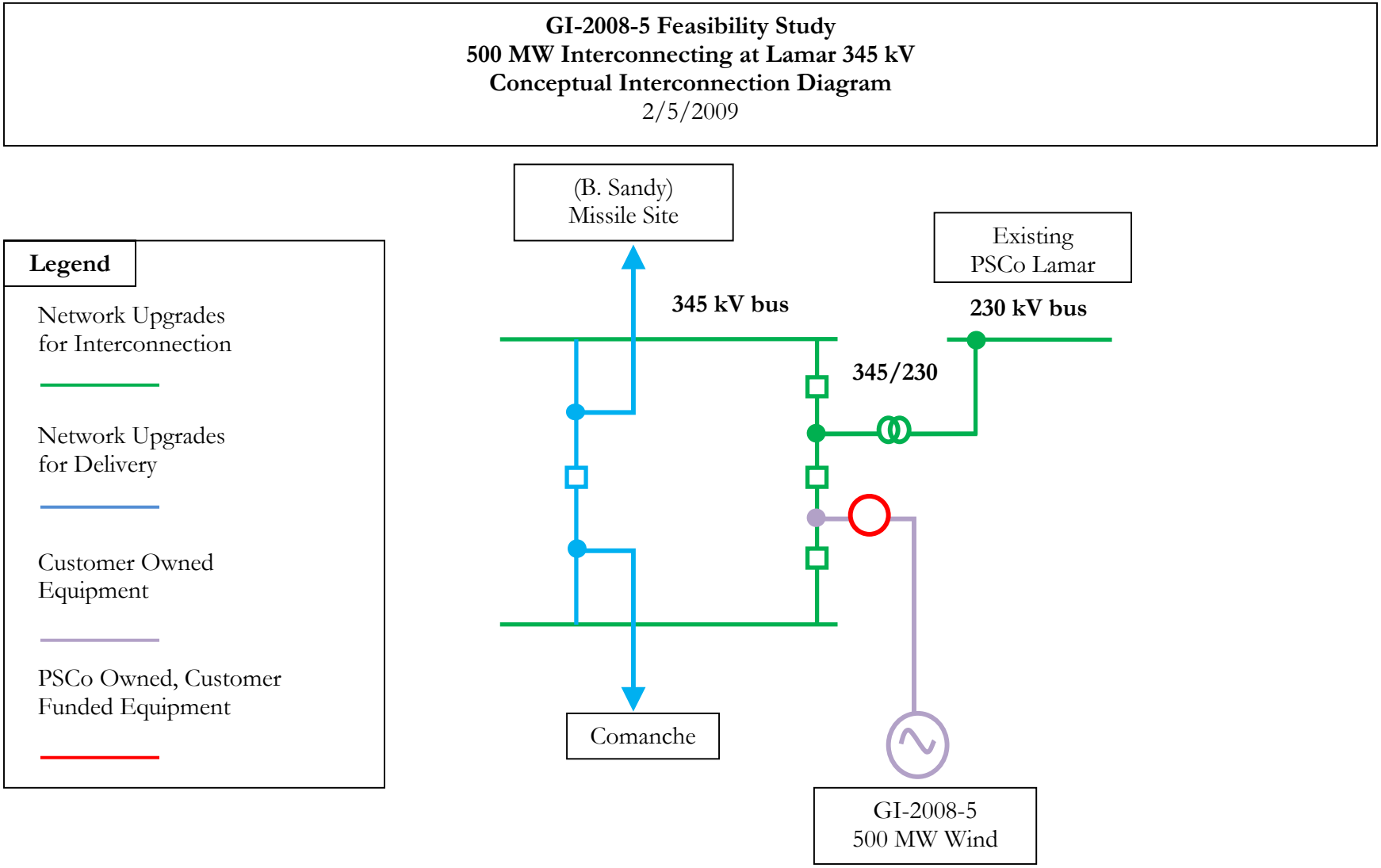

Figure 2: GI-2008-5 delivery portion of the Feasibility Study

Introduction

PSCo Transmission received a large generator interconnection request (GI-2008-5) to interconnect three hundred and thirty-four (334) General Electric (GE) 1.5 MW wind turbine generators, for a total of 500 MW of generation, with a commercial operation date of January 5, 2011 and a back feed date of July 5, 2010. The proposed wind facility will be located in Kiowa County, Colorado and will be interconnected into the PSCo transmission system via the planned Customer 30-mile radial 345 kV line terminating at the new PSCo Lamar 345 kV substation. The Customer has requested that this Project be evaluated as a Network Resource (NR) and an Energy Resource (ER) with the energy going to PSCo customers.

Study Scope and Analysis

The Interconnection Feasibility Study evaluated the transmission requirements associated with the proposed interconnection to the PSCo Transmission System. It consisted of power flow and short circuit analyses. The power flow analysis provided a preliminary identification of any thermal or voltage limit violations resulting for the interconnection, and for a NR request, a preliminary identification of network upgrades required to deliver the proposed generation to PSCo loads. The short circuit analysis identified any circuit breaker short circuit capability limits exceeded as a result of the Interconnection and for a NR request, the delivery of the proposed generation to PSCo loads.

PSCo adheres to NERC / WECC Reliability Criteria, as well as internal Company criteria for planning studies. During system intact conditions, criteria are to maintain transmission system bus voltages between 0.95 and 1.05 per-unit of system nominal / normal conditions, and steady state power flows within 1.0 per-unit of all elements' thermal (continuous current or MVA) ratings. Operationally, PSCo tries to maintain a transmission system voltage profile ranging from 1.02 per-unit or higher at generation buses, to 1.0 per-unit or higher at transmission load buses. Following a single contingency element outage, transmission system steady state bus voltages must remain within 0.90 per-unit to 1.10 per-unit, and power flows within 1.0 per-unit of the elements continuous thermal ratings.

For this project, affected party is Tri-State Generation and Transmission (TSGT). PSCo will notify and work with the affected party during the system impact study (SIS) phase.

Power Flow Study Models

The power flow studies were based on the Western Electricity Coordinating Council (WECC) approved 2015 heavy summer base case. Generation was dispatched for relatively high south-to-north stressing, with further regional stressing created by modeling the Colorado Green at full output (162 MW), Twin Buttes at full output (75 MW), and the Lamar DC Tie at full output (210 MW importing from East to West). Other wind farm generation facilities are modeled at 12.5% output level, consistent with other study procedures.

The Customer's 500 MW wind facility was modeled as two lumped equivalent (2) x 250 MW, 34.5 kV conventional generators, and operated at +/- 0.95 p.f. (without any additional VAR support). The two 250 MW generators were tied to two separate 34.5/345 kV, 250 MVA main step-up transformers, with a 30-mile, 345 kV Customer transmission line connecting the generating facility to the POI. As discussed later on, the studies show that additional MVAR of reactors support will

be required to maintain an ideal voltage at the POI. For dispatching to the PSCo native loads, the Customer's generation was scheduled (re-dispatched) to offset other PSCo generation in the northern PSCo system by reducing generation in that area.

Table 1: Pertinent modeling adjustments:

- Other generation at Lamar was modeled at full output.

Base Case	Generation Resources	Gross Output (MW)
2015 HS	Colo. Green	162
	Twinbuttes	75
	Lamar DC Tie	210 (East -> West)
	GI-2008-5	500
	Total Generation on-line at Lamar:	947

The Point of Interconnection (POI) between the Customer and PSCo is assumed to be the point at which the Customer's 30-mile, 345 kV transmission line connects to the Lamar substation bus. The 30-mile line was modeled per the Customer provided information:

- A single-circuit of 30-mile using bundled 954-kcmil ACSR (Cardinal) strung on a single 345 kV circuit steel pole.

Power Flow Study Results and Conclusions

Energy Resource (ER) Study Results

The ER portion of this study determined that the Customer could provide 0 MW without the construction of the new Lamar 345 kV substation. The Lamar 345 kV switch yard will need to be built prior to the requested interconnection. Once the interconnection is made, non-firm transmission capability may be available depending on marketing activities, dispatch patterns, generation levels, demand levels, TOT 3 levels, and the status of transmission facilities.

Network Resource (NR) Study Results

The NR study determined the network upgrades that would be required to accept the full 500 MW from the proposed generating plant for the conditions studied. The study was conducted primarily as a "stand-alone" project. With 500 MW of additional generation, the wind facility at full output, and the Lamar DC tie importing from East to West, there were numerous of overloaded elements. Appendix A shows the most significant contingencies and the associated overloads along with results from the benchmark case and with the Network Upgrades. All impacts to neighboring utilities as a result of this project will be assessed in a greater detail during the system impact study.

Voltage Control at the Point of Interconnection

Interconnecting to the PSCo bulk transmission system involves the Customer adhering to certain interconnection requirements. These requirements are contained in the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater than 20 MW (Guidelines). The Guidelines make reference to interconnection requirements from FERC Order 661A. FERC

Order 661A describes the interconnection requirements for wind generation plants. In addition, PSCo System Operations conducts commissioning tests prior to the commercial in-service date for a Customer's facilities. Some of the requirements that the Customer must complete include the following:

1. A wind generating plant shall maintain a power factor within the range of 0.95 leading to 0.95 lagging, measured at the POI, if the Transmission Provider's System Impact Study shows that such a requirement is necessary to ensure safety or reliability.
2. The System Impact Study will investigate pertinent demand, dispatch, and outage scenarios based on the defined study area that includes the proposed POI. The study will conform to the NERC Transmission System Planning Performance Requirements (TPL standards).
3. The results of the System Impact Study (mentioned in Item 1 and 2 above) do not absolve the Customer from its responsibility to demonstrate to the satisfaction of PSCo System Operations prior to the commercial in-service date that it can safely operate within the required power factor and voltage ranges.
4. Reactive Power Control at the POI is the responsibility of the Customer. Additional Customer studies should be conducted by Customer to ensure that the facilities can meet the power factor control test and the voltage controller test when the facility is undergoing commissioning testing.
5. PSCo System Operations will require the Customer to perform operational tests prior to commercial operation that would verify that the equipment installed by the Customer meets operational requirements.
6. It is the responsibility of the Customer to determine what type of equipment (DVAR, added switched capacitors, SVC, reactors, etc.), the ratings (MVAR, voltage - 34.5 kV or 345 kV), and the locations of those facilities that may be needed for acceptable performance during the commissioning testing.
7. PSCo requires the Customer to provide a single point of contact to coordinate compliance with the power factor and voltage regulation at the POI. The reactive flow at the end of 345 kV line near the POI will need to be controlled according to the Interconnection Guidelines

Item 1 makes reference to the wind generating plant maintaining a power factor within the range of 0.95 leading to 0.95 lagging, measured at the POI, if the Transmission Provider's System Impact Study shows that such a requirement is necessary to ensure safety or reliability.

The power flow studies show that the wind facility is does not meet the ideal voltage criteria given in the Rocky Mountain Voltage Coordination Guideline handbook (that were developed by the Voltage Coordination Guideline Subcommittee (VCGS) of the Colorado Coordinated Planning Group) when the generators are online and offline. The problem is more severe when the generators are offline. With the wind farm generating at 500 MW of output, the power factor is within the required 0.95 lagging/leading range, but the voltage at the POI is above the ideal voltage level. The Rocky Mountain Area Voltage Coordination Guidelines indicated that system should be operated in such a way that the voltage at the Lamar 230 kV bus should remain at 1.03 p.u. When the generators are offline, the voltage at the POI is even higher.

With the Customer wind units off-line, 55 MVAR of reactive power flow into the POI from Customer's 345 kV transmission line causing the voltage at the POI to be greater than the 1.03 p.u. It has been calculated that approximately 105 MVAR of reactors could be needed to bring the voltage down to the ideal level. The Lamar Substation is jointly owned by PSCo and TSGT,

therefore, the requirement to add additional 50 MVAR of reactors will need to be discussed with TSGT. More studies will be to be done to determine exact amount needed and who will be responsible for the cost.

The study did not investigate all possible operating conditions. Further study work may be required to study the impact of the proposed wind generating facility on the power factor and voltage at the POI.

NOTE - It is the responsibility of the Customer to determine what type of equipment is required (CVAR, added switched capacitors, SVC, reactors, etc.) and at what final ratings (MVAR, voltage 34.5 kV, 345 kV) and location (Lamar 345 kV POI) will be necessary to meet these reactive power controllability requirements. Furthermore, the actual voltage tap ratios used for the Customer's main 34.5/345 kV transformers will directly impact the operating voltages and related reactive capabilities for the Lamar wind generating facility. The Customer should review these issues in determining the final design requirements for this equipment (CVAR, transformer voltage tap ratios and MVA, etc.).

Short Circuit Study Results

A short circuit study was conducted to determine the fault currents (single-line-to-ground or three-phase) at the Lamar substation 345 kV bus. Table 3 summarizes the approximate fault currents at the Lamar 345 kV bus with the addition of the 500 MW wind facility.

Table 3: Short-Circuit Study Results

System Condition	3-Phase (amps)	Thevenin (R & X) (ohms)	SLG (amps)	Thevenin (R &X) (ohms)
System Intact	I1=7080 I2=I0=0 IA=IB=IC=7080	Z1(pos)= 2.55, 28.0 Z2(neg)= 2.56, 28.0 Z0(zero)= 2.68, 33.1	I1=I2=2226 3I0=6679 IA=6679 IB=IC=0	Z1(pos)= 2.55, 28.0 Z2(neg)= 2.56, 28.0 Z0(zero)= 2.68, 33.1

PSCo Substation Engineering indicated that the addition of the 500 MW wind farm is not expected to necessitate the replacement of circuit breakers, switches or other substation equipment due to the increased fault current levels at the Lamar 345 kV substation.

Costs Estimates and Assumptions

The estimated total cost for the required upgrades is **$218 million**

The estimated costs shown are (+/-30%) estimates in 2008 dollars and are based upon typical construction costs for previously performed similar construction. These estimated costs include all applicable labor and overheads associated with the engineering, design, procurement and construction of these new PSCo facilities. This estimate did not include the cost for any other Developer owned equipment and associated design and engineering.

The following tables list the improvements required to accommodate the interconnection and the delivery of the Project. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines. System improvements are subject to change upon more detailed analysis.

Table 4: Transmission Provider Interconnection Facilities (Customer Funded)

Element	Description	Cost Est. Millions
Lamar 345/230kV Substation	Interconnect Developer to tap the bus at Lamar 345/230kV Substation. The new equipment includes: • 345kV bidirectional metering • Three 345kV combination CT/PT instrument transformers • Associated foundations and structures • Associated transmission line communications, relaying and testing	**$0.211**
	Transmission Line Tap – string the last span of conductor and OPGW into Lamar Substation.	**$0.085**
	Developer Generator Communication to Lookout	**$0.010**
	Developer Load Frequency/Automated Generator Control and Generator Witness Testing	**$0.010**
	Siting and Land Rights for required easements, reports, permits and licenses.	**$0.010**
	Total Cost Estimate for Developer Interconnection Facilities	**$0.326**
Time Frame	**To site, engineer, procure and construct interconnection facilities**	**9 Months**

Table 5: Transmission Provider Interconnection Facilities (PSCo Funded)

Element	Description	Cost
Lamar 345/230kV Substation	Interconnect Developer to tap the bus at Lamar 345/230kV Substation. The new equipment includes: **345kV Line Termination** • One (1) 345kV, 3000 amp, dead tank breaker • Five (5) 345kV, 3000 amp gang switches • Three (3) transformers, CCVT, 345kV, 3000 amp • One (1) electric equipment enclosure (EEE) • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work • Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding **230kV Line Termination** • One 345/230kV, 560 MVA autotransformer • One (1) 230kV, 3000 amp, gas circuit breaker • Three (3) 230kV, 3000 amp gang switches • Three (3) transformers, CCVT, 230kV, 3000 amp • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work • Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding	**$3.246** **$6.226**
	Total Estimated Cost for PSCo Interconnection Facilities	**$9.472**
Time Frame	**To engineer, procure and construct interconnection facilities**	**24-30 Months**

Table 6: PSCo Network Upgrades for Delivery

Element	Description	Cost Est. Millions
Lamar 345/230kV Substation	Network infrastructure upgrades required for delivery. The new equipment includes: • Four (4) 345kV, 3000 amp, dead tank breakers • Two (2) 345kV, 3000 amp, live tank breakers • Two (2) reactors, 50 MVAR • Fourteen (14) 345kV, 3000 amp gang switches • Eight (8) transformers, CCVT, 345kV, 3000 amp • One (1) electric equipment enclosure (EEE) • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work • Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding	**$10.927**
Comanche 345kV Substation	Network infrastructure upgrades (new line termination) required for delivery. The new equipment includes: • One (1) 345kV, 3000 amp, dead tank breaker • One (1) 345kV, 3000 amp, live tank breaker • One (1) reactor, 50 MVAR • One (1) 345kV, 3000 amp gang switch • Two (2) transformers, CCVT, 345kV, 3000 amp • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work • Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding	**$3.840**
Missile Site 345kV Switching Station	Network infrastructure upgrades (new line termination) required for delivery. The new equipment includes: Network infrastructure upgrades (new line termination) required for delivery. The new equipment includes: • One (1) 345kV, 3000 amp, dead tank breaker • One (1) 345kV, 3000 amp, live tank breaker • One (1) reactor, 50 MVAR • One (1) 345kV, 3000 amp gang switch • Two (2) transformers, CCVT, 345kV, 3000 amp • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work	**$3.840**

Element	Description	Cost Est. Millions
	• Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding	
Lamar-Missile Site 345kV Line	Construct approximately 200 miles of 345 kV OH transmission line.	**$105.160**
Lamar-Missile Site 345kV Line	Siting and Land Rights for required easements, reports, permits and licenses.	**$7.430**
Lamar-Comanche 345kV Line	Construct approximately 120 miles of 345 kV OH transmission line.	**$72.560**
Lamar-Comanche 345kV Line	Siting and Land Rights for required easements, reports, permits and licenses.	**$4.450**
	Total Estimated Cost for PSCo Interconnection Facilities	**$208.207**
Time Frame	**To engineer, procure and construct interconnection facilities**	**60 Months**

Assumptions

- The cost estimates provided are "scoping estimates" with an accuracy of +/- 30%.
- Estimates are based on 2008 dollars.
- There is no contingency added to the estimates. AFUDC is not included.
- Labor is estimated for straight time only – no overtime included.
- The Generator is not in PSCo's retail service territory. Therefore no costs for retail load metering are included in these estimates.
- PSCo (or it's Contractor) crews will perform all construction and wiring associated with PSCo owned and maintained facilities.
- A CPCN will be required for network upgrades for delivery.
- No new substation land will be required.
- Developer will string OPGW fiber into substation as part of the transmission line construction scope.
- PSCo crews to perform checkout, relay panel construction and final commissioning.

Appendix A
Contingency Results

Table 7: Contingency Comparison Table of Most Significant Contingencies

2A Two 345 kV line from lamar to comanche and lamar to big sandy
2B Two 345 kV line from lamar to comanche and lamar to boone
2C Two 345 kV line from lamar to comanche and lamar to midway
2D Two 345 kV line from lamar to comanche and lamar to big sandy to corner pt
2E Two 345 kV line from lamar to boone and lamar to big sandy to corner
2F Two 345 kV line from lamar to comanche and lamar to big sandy to pawnee

<--Chosen Option

overloaded line	Branch Rating	No gen Loading %	option 2A Loading %	option 2B Loading %	option 2C Loading %	option 2D Loading %	option 2E Loading %	option 2F Loading %	Contingency
70006 NYBERG 115 70159 DOT TAP 115 1	105.0	34.0							70061 BOONE 230 70649 BOONE 345 1 (1)
70060 BOONE 115 70061 BOONE 230 T2	150.0	40.0							70253 LAMAR CO 115 70472 WILOW CK 115 1
70060 BOONE 115 70159 DOT TAP 115 1	100.0	54.0		104.3			104.3		70061 BOONE 230 70122 COMANCHE 230 1 (2)
70060 BOONE 115 70249 LAJUNTAW 115 1	40.0	19.0							70061 BOONE 230 70649 BOONE 345 1 (3)
70061 BOONE 230 70254 LAMAR CO 230 1	620.0	50.0							70061 BOONE 230 70649 BOONE 345 1 (3)
70061 BOONE 230 70649 BOONE 345 1	560.0	#N/A		100.0			100.0		70061 BOONE 230 70254 LAMAR CO 230 1 (5)
70108 CHEROKEE 115 70175 FEDERHT2 115 2	149.0	113.6	124.4	124.7	124.5	125.0	125.1	124.1	70174 FEDERHT1 115 70382 SEMPER 115 1 (6)
70122 COMANCHE 230 70459 WALSENBG 230	159.0	121.7	132.8	138.5					70061 BOONE 230 70510 STEM BCH 230 1
70139 DANIELPK 230 70323 PRAIRIE2 230 1	319.0	110.6	144.8	149.4	148.1			131.5	70139 DANIELPK 230 70331 PRAIRIE 230 1
70139 DANIELPK 230 70331 PRAIRIE 230 1	319.0	119.1	153.3	157.8	156.6			140.1	70139 DANIELPK 230 70323 PRAIRIE2 230 1
70212 GREENWD 230 70323 PRAIRIE2 230 1	319.0	110.5	144.8	149.3	148.0			131.4	70139 DANIELPK 230 70331 PRAIRIE 230 1
70212 GREENWD 230 70331 PRAIRIE 230 1	319.0	77.5	112.1	116.8	115.2				70139 DANIELPK 230 70323 PRAIRIE2 230 1
70247 LAJUNTAT 115 70472 WILOW CK 115 1	109.0	68.0							70649 BOONE 345 70650 LAMAR 345 1 (4)
70254 LAMAR CO 230 70700 COLO GRN 230 1	239.0	97.0							70061 BOONE 230 70649 BOONE 345 1
70308 PALMER 115 73414 MONUMENT 115 1	149.0	93.2	123.0	113.2	117.9	101.2	106.1	108.2	70465 MIDWAYPS 345 70466 WATERTON 345 1 (7
70463 WATERTON 115 70484 MARTNTP 115 1	108.0	110.4	124.5	124.8	126.7				70018 SODALAKE 230 70400 SODALAKE 115 T2
73389 BRIARGAT 115 73393 CTTNWD S 115 1	157.0	90.6							73391 CTTNWD N 115 73410 KETTLECK 115 1
73391 CTTNWD N 115 73410 KETTLECK 115 1	132.0	111.3							73389 BRIARGAT 115 73393 CTTNWD S 115 1
73419 RD_NIXON 230 73559 FRTRANGE 230 1	500.0	106.0	109.0				109.0	109.0	70649 BOONE 345 70650 LAMAR 345 1 (4)
70002 BURNT MI 115 70456 W.STATON 115 1	100.0	84.1							70339 PUEBPLNT 115 70352 READER 115 1
70121 COMANCHE 115 70122 COMANCHE 230	176.0	111.3	120.4	121.0		121.0		120.3	70121 COMANCHE 115 70122 COMANCHE 230 T2
70121 COMANCHE 115 70122 COMANCHE 230	185.0	106.2	114.9	115.5		115.0		114.8	70121 COMANCHE 115 70122 COMANCHE 230 T1
70121 COMANCHE 115 70352 READER 115 1	180.0	127.7	139.6	140.1		139.0		139.1	70121 COMANCHE 115 70352 READER 115 2
70121 COMANCHE 115 70352 READER 115 2	180.0	127.7	139.6	140.1		139.0		139.0	70121 COMANCHE 115 70352 READER 115 1
70236 HYDEPARK 115 70339 PUEBPLNT 115 1	105.0	91.3		105.9					70002 BURNT MI 115 70456 W.STATON 115 1

Line MVA rating lower than actual value
overload due to choice of sink