Interconnection Feasibility Study Report
Request # GI-2007-10

201 MW Wind Farm, Near Simla, Colorado

PSCo Transmission Planning
May 2008

Executive Summary

On September 14, 2007 Public Service Company of Colorado (PSCo) Transmission Planning received a generation interconnection request to determine the feasibility of injecting power from a 201 MW wind turbine generation farm into the bulk transmission system at the Jackson Fuller Substation near Colorado Springs. The proposed commercial operation date is December 1, 2010. The proposed back feed date is June 1, 2010.

This request was studied as both a Network Resource (NR)[1], and as an Energy Resource (ER)[2]. These investigations included steady-state power flow and short-circuit studies only, and did not include transient dynamic stability analysis. The request was studied as a stand-alone project only, with no evaluations made of other potential new generation requests that may exist in the Large Generator Interconnection Request (LGIR) queue, other than the generation projects that are already approved and planned to be in service by the summer of 2010. The main purpose of this Feasibility Study was to evaluate the potential impact on the PSCo transmission infrastructure as well as that of neighboring utilities, when injecting the new 201 MW of generation into the Jackson Fuller 230 kV bus, and delivering the additional generation to native PSCo loads. The costs to interconnect the project with the transmission system at Jackson Fuller Substation have been evaluated by Engineering.

[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

Energy Resource

The results of the ER analysis indicate that the Customer could not provide power as an energy resource without the construction of network reinforcements. Transmission upgrades will be required on PSCo's system and the Intermountain Rural Electric Association (IREA) system. If the Monument-Palmer 115 kV line must be placed back in service, transmission upgrades will be required on the Colorado Springs Utilities (CSU) system. Non-firm transmission capability may be available depending upon demand levels, generation levels, dispatch patterns, marketing activities and the status of transmission facilities.

Network Resource

The results of the NR analysis indicate that the Customer could provide 201 MW if the following is completed:

- Place the Monument-Palmer Lake 115 kV transmission line out-of-service for an indefinite period of time. Studies demonstrate that this would mitigate potential overloads on the CSU system. CSU made this recommendation to PSCo and Tri-State G&T after studies demonstrated that this action would alleviate many potential overloads during outage conditions. Under an interim understanding with PSCo and Tri-State G&T, the line will be operated open for one year, after which the open or closed status of the line would be reevaluated.
- Upgrade substation facilities in the PSCo area that presently limit the ratings of certain lines in the study area below their thermal ratings. These facility enhancements are being evaluated as part of PSCo's Transmission Facility Equipment Ratings Project and would be funded through PSCo's Five Year Capital Construction Budget.
- Upgrade the two 100 MVA Waterton 230-115 kV transformers and the 150 MVA Daniels Park 230-115 kV transformer. PSCo plans to upgrade these transformers through its Five Year Capital Budget process.
- Upgrades on the IREA system are planned for 2008 (to reconductor the Parker-Bayou 115 kV line with 795 kcmil ACSS[2] conductor) and 2012 (the Brick Center-Spring Valley-Kiowa 115 kV line addition)

[2] Aluminum Conductor Steel Supported (ACSS) conductor operates continuously at high temperatures and carries substantially more current than standard Aluminum Conductor Steal Reinforced (ACSR) conductor.

- If the Monument-Palmer 115 kV line cannot be left open indefinitely, transmission upgrades will be needed to allow the Customer to provide 201 MW to PSCo. Studies identified two contingency overloads that could occur on the CSU system - a contingency overload of the Cottonwood N-Kettle Creek 115 kV line and a contingency overload of the Fuller 230-115 kV transformer. These criteria violations may be mitigated through facility additions or upgrades. For example, the Cottonwood N-Kettle Creek 115 kV line could be surveyed and a determination made which transmission structures could be raised or replaced to increase the rating of the line. Because the final status of the Monument-Palmer Lake 115 kV line was unknown at the time of this study process, the study considered opening the Monument-Palmer Lake 115 kV line for an indefinite period of time. If this study continues into the System Impact Study phase, this assumption (opening the Monument-Palmer Lake 115 kV line indefinitely) will need to be re-evaluated.
- Approximately 30 MVAR of reactive power will be needed to meet the power factor requirements for the interconnection. Additional studies would be needed in the system impact study to define the reactive power requirements.

The required transmission upgrades are not all achievable by the summer of 2010 and the status of the Monument-Palmer Lake 115 kV line as operated open indefinitely has not been decided. The work required in PSCo's system would be accomplished through PSCo's Transmission Facility Equipment Ratings Project and would be funded through PSCo's Five Year Capital Construction Budget. While opening the Monument-Palmer 115 kV circuit will eliminate the loop flow through the Jackson Fuller 230/115 kV transformer and the Cottonwood-Kettle Creek 115 kV circuit, if it is found to be a temporary solution, then the affected utility (CSU) would need to fully develop system reinforcements to meet their own internal transmission needs. Please refer to Figure 1 for a diagram of the system upgrades necessary for delivery.

The cost for the transmission interconnection (in 2008 dollars):

Transmission Proposal
The total estimated cost of the recommended system upgrades to interconnect the project is approximately **$1.705** million and includes:

- $ 0.305 million for PSCo-Owned, Customer-Funded Interconnection Facilities
- $1.400 million for PSCo-Owned, PSCo-Funded Network Upgrades for Interconnection
- $ 0.000 million[3] for PSCo Network Upgrades for Delivery

[3] Assumes the Monument-Palmer Lake 115 kV line can be operated open indefinitely. If the status of the line is changed to be operated closed indefinitely, transmission system upgrades on the CSU system will

The transmission study shows that the addition of 201 MW of new wind generation connected to Jackson Fuller may not supply the full reactive power support necessary at the Point of Interconnection (POI) to control the power factor to between +/-0.95 across the full output range of the wind generation. Based upon supplied generator data concerning reactive power capabilities, the Customer may need to supply approximately 30 MVAR of reactive power on the Customer's facilities in order to meet the interconnection guidelines at the POI. This would make up for the reactive power losses at the Customer's 230/34.5 kV main transformer and the Customer's 34.5 kV collector system facilities. The Customer's facility as studied can be VAR neutral at the POI with full output. More detailed studies will have to be performed by the Customer to determine the specific reactive (capacitive and inductive) dynamic or static equipment that may be necessary to meet the requirements. The project costs do not reflect the addition of the reactive power requirements for interconnection.

The Interconnection Agreement (IA) requires that certain conditions be met, as follows:

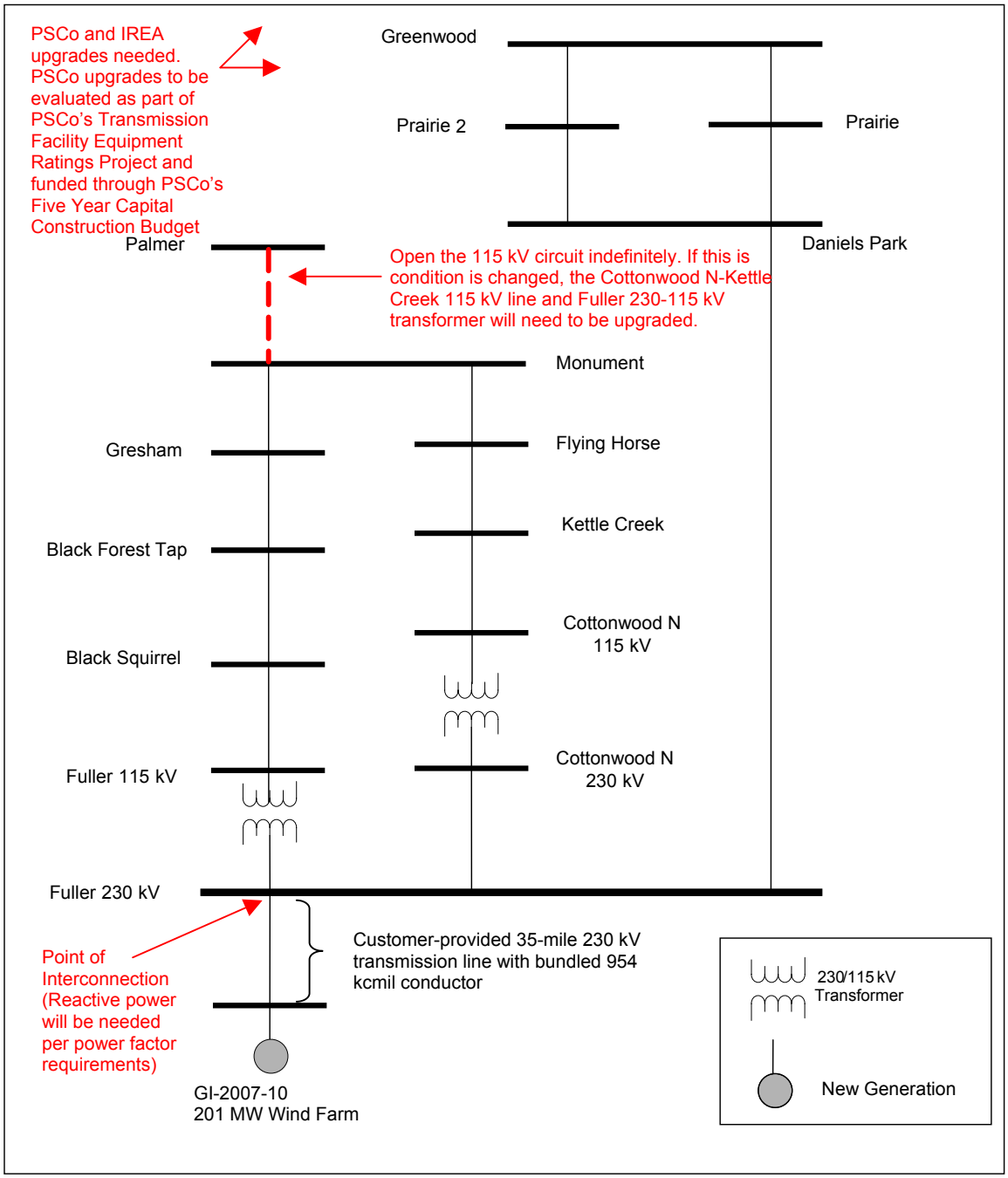
1 The conditions of the Large Generator Interconnection Guidelines (LGIG) are met.

2 PSCO will require testing of the full range of 0 MW to 201 MW operational capability of the facility. These tests will include, but not be limited to, power factor control, and VAR control as measured at the Jackson Fuller 230 kV bus POI for various generation output levels (0 to 201 MW) of the Customer's wind generation facility.

3 A single point of contact needs to be provided to PSCo Operations to manage the transmission system reliably for all wind projects on the proposed line.

be required. Does not include the cost for PSCo to upgrade facilities on its system or the upgrades IREA is planning for its system.

Figure 1 Proposed Jackson Fuller One-Line Diagram (Upgrades Marked in Red)



Introduction

PSCo Transmission received a large generator interconnection request (GI-2007-10) to interconnect 67 Vestas V90 3.0 MW wind turbines, a total generation capability of 201 MW, with a commercial operation date of December 1, 2010, and a back feed date of June 1, 2010. The proposed wind farm would be located near Simla, Colorado and would interconnect with the transmission system via the Customer's planned 35-mile radial 230 kV line terminating at the jointly-owned Jackson Fuller substation. PSCo owns three 230 kV power circuit breakers and six disconnect switches that are used to terminate the Daniels Park-Jackson Fuller 230 kV and the Jackson Fuller-Comanche 230 kV lines. Colorado Springs Utilities (CSU) owns three 230 kV power circuit breakers and six disconnect switches that are used to terminate the CSU Nixon-Jackson Fuller 230 kV and the Jackson Fuller-Cottonwood 230 kV lines. PSCo owns approximately 0.31 miles of new double circuit transmission line that taps the PSCo Daniels-Comanche 230 kV line into and out of the Jackson Fuller Substation. Tri-State Generation and Transmission Association (Tri-State) also has an interest in this substation as it presently has terminated two 115 kV transmission lines at Jackson Fuller Substation - the Jackson Fuller-Falcon 115 kV line and the Jackson Fuller-Black Squirrel 115 kV line.

The Customer has requested that this project be evaluated as a Network Resource (NR) and an Energy Resource (ER), with the energy delivered to PSCO customers.

Study Scope and Analysis

The Interconnection Feasibility Study evaluated the transmission impacts associated with the proposed interconnection of 201 MW of new wind generation at Jackson Fuller Substation. It consisted of steady-state power flow and short-circuit analyses only. The power flow analysis provided a preliminary identification of any thermal or voltage limit violations resulting from 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 that would be exceeded as a result of the interconnection and, for a NR request, the delivery of the output of the proposed generator 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, potential affected parties include the Intermountain Rural Electric Association (IREA) transmission system in the regions south of the Denver area, Tri-State G&T (Mountain View EA), and CSU. PSCo has contacted affected utilities during the course of this study.

Power Flow Study Models

The power flow studies were based on a PSCo-developed 2010 heavy summer base case that originated from the study model developed in early 2008 as part of PSCo's normal annual Five Year Transmission Capital Budget project identification process. These budget case models are developed from Western Electricity Coordinating Council (WECC) approved models, modified as appropriate for PSCo planned and approved projects and associated topology. Load levels reflect 2010 heavy summer peak system conditions. The case reflects the addition of the Comanche Project. The Comanche Project includes the addition of the 750 MW Comanche #3 unit, two Comanche-Daniels Park 345 kV lines, two Comanche-MidwayPS 230 kV lines, the Midway-Fuller-Daniels Park 230 kV line and the MidwayPS-Waterton 345 kV transmission line (with a 560 MVA MidwayPS 345-230 kV transformer). The Waterton substation includes a 560 MVA 345-230 kV transformer and two 100 MVA 230-115 kV transformers.

The Project's 67 Vestas wind turbine generators (three MW each) were modeled as a conventional 201 MW machine connected to a one kV bus. This voltage is raised to 34.5 kV through an equivalent 212 MVA step-up transformer and then raised to 230 kV through a 233 MVA transformer (9% reactance on a 140 MVA Base). The Project is connected to the Fuller Substation through a 35-mile 230 kV 2-conductor bundled 954-kcmil ACSR 794-MVA overhead transmission line. The generators' reactive capability chart was taken into account, and generator scheduled voltage was set-up so that the injected power at the POI is near a unity power factor. As discussed later in the report, the studies show that additional MVAR support will be required to enable the +/- 0.95 power factor capability with full rated output of 201 MW at the Customer's facility. The PSCo control area (Area 70) wind generation facilities, other than GI-2007-10, were dispatched to approximately 12% of facility ratings, consistent with other similar planning study models.

To evaluate the capabilities of the existing transmission system and the potential reinforcements that would be required for firm transfer levels, the power flow model was modified to simulate high flows from southeastern Colorado to the north. Specifically, generation from the Comanche units was near maximum capability and the generation at Fountain Valley was placed online at full capability, displacing generation at St. Vrain.

Two main power flow case model generation dispatch scenarios were evaluated: a reference model without the proposed wind farm; and a model with the new 201 MW (summer) of generation injected at the Jackson Fuller substation 230 kV bus. The GI-2007-10 case was re-dispatched to lower other PSCo control area generation by 201 MW, in the northern part of the PSCo system in order to maintain or maximize the south-to-north system stressing in the case. In particular, this was accomplished by decreasing the generation by 201 MW, split equally between the St. Vrain and Manchief power plants.

Power Flow Study Process

Automated contingency power flow studies were completed on all case models using the PSS™MUST program, switching out single elements one at a time for all of the elements (lines and transformers) in control areas 70 (PSCo) and 73 (WAPA RM). Upon switching each element out, the program re-solves with all voltage taps and switched shunt devices locked, and control area interchange adjustments disabled.

Stand Alone Power Flow Results

The stand-alone results assume that the new generation interconnecting at the Jackson Fuller 230 kV bus is modeled in the power flow case at full output, or approximately 201 MW, and the rest of the generation and loads in the power flow model reflect a heavy summer load 2010 case. The contingency studies were performed for both the "with GI-2007-10" generation model, and the reference model without the proposed wind farm, and the results listing the overloaded elements (power flows in excess of their continuous rating) were compared.

A list of the transmission facilities that either incur new single contingency (N-1) overloading, or that become significantly overloaded as a result of adding 201 MW of new generation at Jackson Fuller in the heavy summer 2010 power flow cases (i.e., 5% or more differential loading between the case with GI-2007-10 generation at 201 MW vs. 0 MW) can be found in Table 6 in the Appendix.

Two of the identified facilities that would become overloaded due to the addition of GI-2007-10 under contingency conditions are located in the CSU system due to increased flows on the nearby underlying 115 kV transmission facilities. For the short-term, the affected utilities, Tri-State and CSU, are willing to operate the area system with the Palmer – Monument 115 kV circuit open, thereby reducing the thru-flow. Near-term reinforcement plans for this area to meet growth and reliability issues have not been finalized. If a system impact study is performed for GI-2007-10, it is possible that the projects planned by the affected utilities may cause one or more other transmission facilities to be adversely impacted due to the addition of the proposed wind farm.

Contingency overloads were observed on PSCo's system. Under very high south-to-north stressed conditions, the 100 MVA Waterton transformers and 150 MVA Daniels

Park transformer may experience contingency overloads. PSCo has identified the need to upgrade these transformers and this will be accomplished through the Five Year Capital Budget process. Additional contingency overloads in the PSCo system system would be mitigated through PSCo's Transmission Facility Equipment Ratings Project and would be funded through PSCo's Five Year Capital Construction Budget. Contingency overloads on the IREA system could be mitigated by projects planned for completion in 2008 and 2012.

Network Resource (NR):

This Study has determined that any increase in the generation injected at the Jackson Fuller 230 kV bus directly increases the loading / overloading on the PSCo regional transmission system. Therefore, the 201 MW NR value requested will require interconnection and Transmission Network Upgrades.

NR = 201 MW (with required Network Upgrades)

Energy Resource (ER):

This Study has determined that any increase in the generation injected at the Jackson Fuller 230 kV bus directly increases the loading / overloading on the PSCo and CSU regional transmission system. Therefore, the ER value, i.e., the amount of generation injection that the transmission network can accommodate without requiring upgrades, is 0 MW.

ER = 0 MW (without any Network Upgrades)

Voltage Control at the Point of Interconnection:

Studies show that under certain conditions the Customer's wind turbine generators cannot meet the interconnection guidelines as mandated by PSCO in their Interconnection Guidelines for Transmission Interconnected-Producer Owned Generation Greater than 20 MW. One of the issues is with power factor control at the POI in the full range of +/- 0.95 p.f. While the facility as proposed can deliver 201 MW, less losses, at the POI at a unity power factor, the equipment proposed has a limited reactive power capability, and would not be able to provide sufficient reactive power at the POI to control voltage.

Additional Customer designed, specified and supplied reactive control equipment, which could include DVAR, SVC, switched capacitors, and switched reactors, will likely be required in order to meet the following reactive control requirements. Voltage-related issues will be addressed in dynamic studies as part of the system impact and facilities studies.

- The Customer needs to demonstrate that the proposed facility is designed to be capable of providing or absorbing reactive power at the POI sufficient to control to +/- 0.95 power factor across the full operating range. In addition, the Customer's facility needs to be VAR neutral at the POI and control to zero MVAR.

- 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 230 kV), and the locations of those facilities to meet these reactive power controllability standards.

Short Circuit Study Results

A breaker duty study was conducted to determine if the fault current (single-line-to ground or three-phase) exceeds the interrupt ratings of any circuit breakers on the PSCo transmission network. The duty study compared the short-circuit model with the proposed new generation injected at Jackson Fuller to a model without the generation, and identified which breakers are within 5% of their fault interruption rating as a result of the generation. Per PSCo policy, these breakers would require replacement and would be categorized as network upgrades. Table 1 summarizes the anticipated fault currents that could be expected after the addition of GI-2007-10.

Table 1 Short-circuit Study Results With and Without the Proposed 201 MW Wind Farm

System Condition	Three-phase (amps)	Thevenin System Equivalent Impedance (R,X) (ohms)	Single-line-to-ground (amps)	Thevenin System Equivalent Impedance (R,X) (ohms)
Jackson Fuller-Simla (customer site) o/s	I_1=12,359.7 I_2=I_0=0 I_A=I_B=I_C=12,359.7	Z1(pos)= 1.04584,10.6928 Z2(neg)= 1.04998,10.6972 Z0(zero)= 3.53994,17.0086	I_1=I_2=3,421.56 3I_0=10,264.7 I_A=10,264.7 I_B=I_C=0	Z1(pos)= 1.04584,10.6928 Z2(neg)= 1.04998,10.6972 Z0(zero)= 3.53994,17.00860
System Intact	I_1=14,322.0 I_2=I_0=0 I_A=I_B=I_C=14,322.0	Z1(pos)= 0.87945,9.22998 Z2(neg)= 0.88252,9.23323 Z0(zero) 3.53994,17.00860	I_1=I_2=3,702.4 3I_0=11,107.3 I_A=11,107.3 I_B=I_C=0	Z1(pos)= 0.87945,9.22998 Z2(neg)= 0.88252,9.23323 Z0(zero) 3.53994,17.00860

The results of the short-circuit analysis faulted at the Jackson Fuller 230 kV bus show that none of the circuit breaker's fault interruption ratings at the Jackson Fuller Substation would be exceeded as a result of the new generation.

Costs Estimates and Assumptions

The Customer has requested a 201 MW Wind Generation Project interconnecting on the 230 kV bus at Jackson Fuller Substation. A 230 kV radial transmission line will connect the Customer's collector site with the PSCo transmission system at the Point of Interconnection. The estimated total cost for the required upgrades for is **$1,705,000.**

The estimated costs shown are (+/-30%) scoping 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 Customer 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 2 – PSCo Owned; Customer Funded Interconnection Facilities

Element	Description	Cost Est. Millions
Jackson Fuller 230 kV Substation	Interconnect Customer to tap the bus at the Jackson Fuller 230 kV substation. The new equipment includes: • 230 kV bidirectional metering • Three 230 kV combination CT/PT instrument transformers • Associated foundations and structures • Associated transmission line communications, relaying and testing	**$0.210**
	Transmission – labor to install slack span into Jackson Fuller. Materials furnished by Customer.	**$0.070**
	Customer Generator Communication to Lookout	**$0.010**
	Customer LF/ACG and Generator Witness Testing	**$0.010**
	Siting and Land Rights for required easements, reports, permits and licenses	**$0.005**
	Total Cost Estimate for Customer Interconnection Facilities	**$0.305**

Table 3: PSCo Owned; PSCo Funded Interconnection Facilities

Element	Description	Cost
Jackson Fuller 230 kV Substation	Interconnect Customer to tap the bus at the Jackson Fuller 230 kV substation. The new equipment includes: • Two 230 kV, 3000 amp, circuit breakers • Four 230 kV, 3000 amp gang switches • Associated communications and SCADA equipment • Line relaying and testing • Electrical bus work • Associated foundations and structures • Associated yard surfacing, landscaping, fencing and grounding	**$1.395**
Jackson Fuller 230 kV Substation	Siting and Land Rights for required easements, reports, permits and licenses	**$0.005**
	Total Estimated Cost for PSCo Interconnection Facilities	**$1.400**

Time Frame	**The estimated time to site, design, procure and construct the interconnection facilities.**	**18 Months**

Table 4 – PSCo Network Upgrades for Delivery **Not Applicable**

Element	Description	Cost Est. Millions

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.
- The estimated time to site, design, procure and construct the interconnection facilities is at least 18 months, and is completely independent of other queued projects and their respective ISD's.
- A CPCN will not be required for interconnection facility construction.
- Customer 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.
- No new substation land required. Substation work to be completed within existing property boundaries.

Appendix

A. Generation Dispatch

The power flow studies were based on a PSCo-developed 2010 heavy summer base case that originated from the study model developed in early 2008 as part of PSCo's normal annual 5-year transmission capital budget project identification process. Load levels reflect 2010 heavy summer peak system. In order to evaluate the capabilities of the existing transmission system and the potential reinforcements that would be required for firm transfer levels, the power flow model was modified to simulate high flows from southeastern Colorado to the north. Specifically, generation from the Comanche units was near maximum capability and the generation at Fountain Valley was placed on-line at full capability, displacing generation at Ft. St. Vrain. The Colorado Green and Twin Butte Wind Farms are modeled as generating at 12% of their respective maximum ratings. Table 5 below lists the generation levels assumed in the case.

Table 5 Generation Dispatch Assumed in the Study Benchmark Case

GI-2007-10 Feasibility Study				
Generation in Benchmark Case				
Bus	Name	ID	Status	Pgen
70119	COMAN 1 24.000	G1	1	300.3
70120	COMAN 2 24.000	G2	1	320.0
70560	LAMAR DC 230.00	1	1	-101.0
70577	FTNVL1-2 13.800	G1	1	38.0
70577	FTNVL1-2 13.800	G2	1	38.0
70578	FTNVL3-4 13.800	G3	1	38.0
70578	FTNVL3-4 13.800	G4	1	38.0
70579	FTNVL5-6 13.800	G5	1	38.0
70579	FTNVL5-6 13.800	G6	1	38.0
70701	CO GRN E 34.500	1	1	10.0
70702	CO GRN W 34.500	1	1	10.0
70703	TWNBUTTE 34.500	1	1	9.4
70777	COMAN 3 24.000	1	1	750.0
73507	FTRNG1CC 18.000	1	1	150.0
73508	FTRNG2CC 18.000	1	1	150.0
73509	FTRNG3CC 18.000	1	1	180.0
			(1=on)	

B. Generation Dispatch Sensitivity Case (Lamar DC Tie Importing)

The Lamar DC Tie is normally modeled as exporting in WECC power flow case. As a sensitivity, the Lamar DC Tie was represented as importing at 200 MW with generation units in northern Colorado reduced to accommodate that 301 MW change in the Lamar DC Tie schedule. This condition represents a very stressed south-to-north dispatch.

The study found that with the Monument-Palmer Laker 115 kV line open,the extreme dispatch case results in the contingency overload of the 100 MVA Waterton 230-115 kV transformers and 150 MVA Daniels Park 230-115 kV transformer. PSCo is planning to upgrade the Waterton 230-115 kV transformers through its Five Year Capital Budget process. In addition, other facilities in the PSCo system experience contingency overloads under this high stressed conditions. These criteria violations will also be mitigated through the Five Year Capital Budget Process. Contingency overloads on the IREA system could be mitigated with projects planned in 2008 and 2012.

C. Power Flow Contingency Results

The results of the power flow studies are summarized in Table 6 below. The elements identified in this study report as overloaded in these contingency runs, are limited to the new or significantly increased overloads, and do not address all of the elements that may have been indicated as overloaded in the contingency runs. The other elements that may be overloaded, independent of the new 201 MW generation injection at Jackson Fuller substation, will be addressed through other separate Transmission Planning project proposals or by other affected utilities.

Table 7 provides a list of elements that experience contingency overloads for the highly stressed south-to-north sensitivity scenario (Lamar DC Tie importing 200 MW along with the 201 MW wind farm at Jackson Fuller Substation). The table includes a column that describes the network upgrades required in PSCo's system that would be mitigated through PSCo's Five Year Capital Construction Budget. The table also includes contingency overloads on the IREA system. These overloads would be mitigated by upgrades planned by IREA on their system; however, these upgrades are intended to increase the realiability of IREA customers, not to mitigate overloads associated with GI-2007-10.

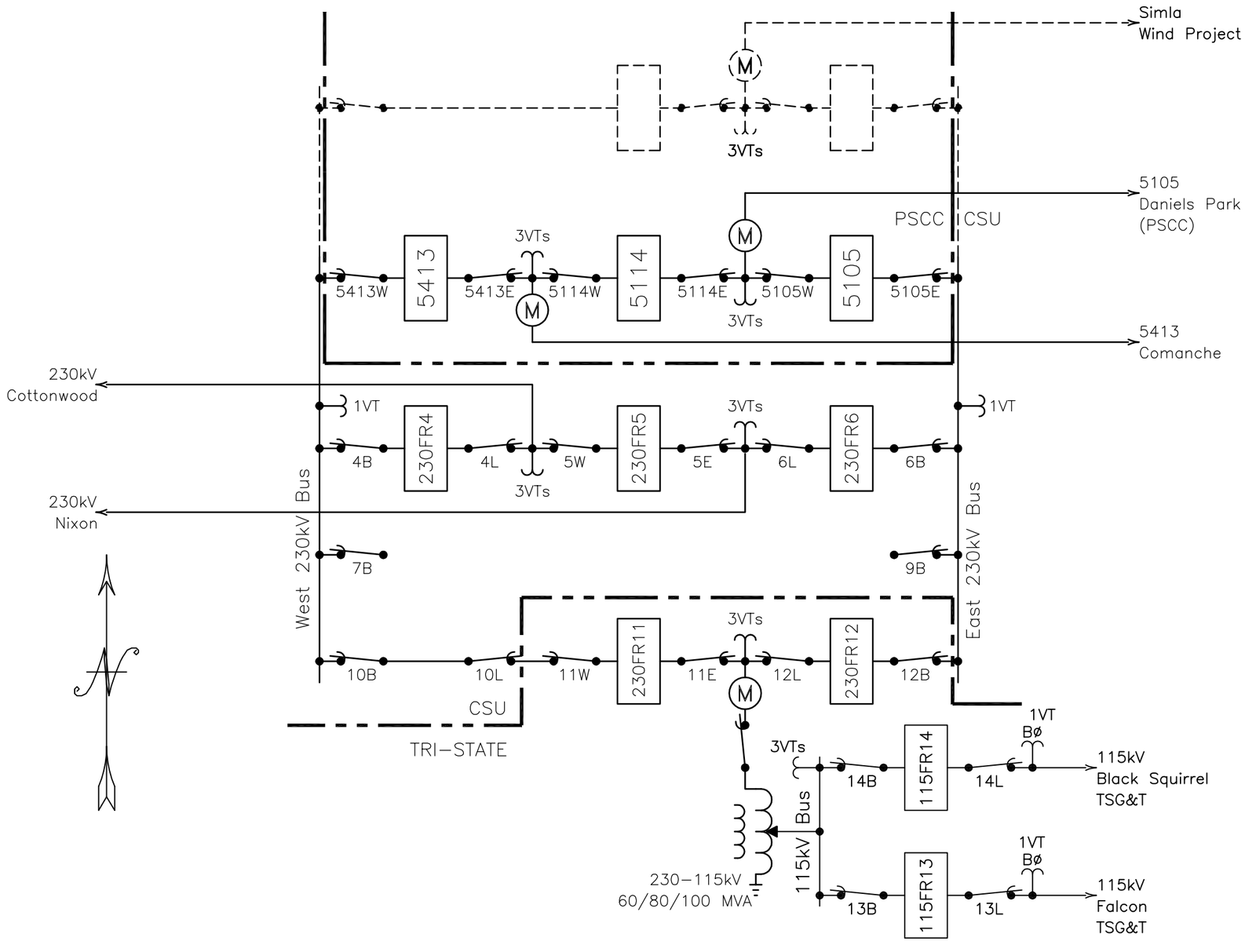
Table 6 Summary Listing of Differentially Overloaded Elements[4] on the Colorado Springs Utilities System

								Branch N-1 Loading With GI-2007-10, 201 MW						
						Branch N-1 Loading Without GI-2007-10		Existing Configuration			Open Monument-Palmer 115 kV			
Monitored Element (Line or Transformer) From Bus To Bus	Type	Line Ckt #	FAC9 Limiting Element - Comments	Branch Rating MVA	Branch Rating Amps	N-1 Flow in % of Rating	Total # of Violations	N-1 Flow in MVA	N-1 Flow in % of Rating	Total # of Violations	N-1 Flow in MVA	N-1 Flow in % of Rating	Total # of Violations	N-1 Contingency Outage From Bus To Bus
73391 CTTNWD N 115 73410 KETTLECK 115 1	LN	CSU	-	132.0		97.1	0	139.4	105.6	2	<132	<100%	0	73389 BRIARGT 115 73393 CTTNWD S 115 1
73477 FULLER 230 73481 FULLER 115 1	TR	CSU	-	100.0		89.6	0	103.6	103.6	2	<100	<100%	0	73412 MIDWAY BR 115 73416 RANCHO 115 1

[4] **Newly overloaded elements, or delta overloads > 5% of rating, due to 201 MW wind farm generation injection at POI.**

Table 7 Dispatch Sensitivity Study – Lamar DC Tie Importing 200 MW (High South to North Stress) and Impact of GI-2007-10 201 MW Wind Farm

			Benchmark Sensitivity Lamar Import 200 MW		Added To Benchmark Sensitivity Lamar Import 200 MW			
Monitored Element	Type	Rating MVA	N-1 Flow in % of Rating	# of Violations	N-1 Flow in % of Rating	# of Violations	Contingency	Network Upgrades in PSCo's System to Mitigate the Criteria Violation
70115 HPCYN 115 70117 CRWFTVLY 115 1	LN	155.0	125.3	0	166.5	1	70517 PARKERPS 115 70518 BAYOU 115 1	The Brick Center-Spring Valley-Kiowa 115kV line addition (that is in IREA's Long Term Plan for completion in 2012) could mitigate the contingency overload of the Happy Canyon-Crowfoot Valley 115kV line; however, this project is being constructed to increase the reliability of IREA customers, and is not intended as a remedy to the overload associated with GI-2007-10.
70115 HPCYN 115 70138 DANIELPK 115 1	LN	155.0	134.3	0	175.7	1	70517 PARKERPS 115 70518 BAYOU 115 1	The Brick Center-Spring Valley-Kiowa 115kV line addition (that is in IREA's Long Term Plan for completion in 2012) could mitigate the contingency overload of the Daniels Park-Happy Canyon 115kV line; however, this project is being constructed to increase the reliability of IREA customers, and is not intended as a remedy to the overload associated with GI-2007-10.
70517 PARKERPS 115 70518 BAYOU 115 1	LN	186.6	83.3	0	192.3	1	70138 DANIELPK 115 70139 DANIELPK 230 T1	IREA plans to reconductor the Parker-Bayou 115kV line with 795 kcmil ACSS conductor (241.6 MVA) in 2008.
70138 DANIELPK 115 70139 DANIELPK 230 T1	TR	150.0	107.1	1	135.3	6	70517 PARKERPS 115 70518 BAYOU 115 1	PSCo to upgrade transformer to 280 MVA in 2010
70463 WATERTON 115 70464 WATERTON 230 T	TR	100.0	121.1	3	133.9	15	70463 WATERTON 115 70464 WATERTON 230 T	PSCo to upgrade transformer to 280 MVA in 2010
70463 WATERTON 115 70464 WATERTON 230 T	TR	100.0	122.2	4	135.1	22	70463 WATERTON 115 70464 WATERTON 230 T	PSCo to upgrade transformer to 280 MVA in 2010



REV	DATE	PROJ. No.	REVISION DESCRIPTION	DWN	DSN	ENG	CHK	FILM
A	02-20-08		New 230kV Bay Addition.	CO				

Xcel Energy SUBSTATION ENGINEERING & DESIGN

JACKSON FULLER

Lat. 38Deg 56Min 13Sec. Long. -104Deg 37Min 46Sec.

SIZE	DWG. No.	REV.
B	BUDGET JFUL	A

SCALE	FILE NAME	SHEET
N.T.S.	South/Budget/JfulC.dwg	1