Interim Feasibility Study Report
Request # GI-2007-2 Scenario B[1]

675 MW Integrated Gasification Combined Cycle (IGCC) Facility
Near Las Animas, Colorado

PSCo Transmission Planning
May 31, 2007

Executive Summary

PSCo Transmission received a generation request to determine the feasibility of interconnecting a 675 MW IGCC Plant at a new 345 kV Las Animas Switching Station. The Customer proposed commercial operation date is May 2014 with an assumed back feed date of September 2012. This request was studied as a Network Resource (NR)[2] and as stand-alone project. ***To meet the Customer proposed In-Service Dates, the Large Generator Interconnection Agreement (LGIA) or an Engineer and Procure (E&P) Agreement must be fully executed by January 2008.***

Stand Alone Results

Network Resource:
PSCo evaluated the network to determine the upgrades required to deliver the full 675 MW of the IGCC to PSCo native load customers.

The total estimated cost of the recommended system upgrades to accommodate the project is approximately **$287.83** million and includes:

- $0.94 million for Transmission Provider Owned, Customer Funded Interconnection Facilities
- $74.66 million for Transmission Provider Network Upgrades for Interconnection
- $212.23 million for Transmission Provider Network Upgrades for Delivery

These basic upgrades including interconnection as shown in Figure 1 would consist of:

[1] This study is Scenario B is the stand alone without the East Plains Transmission Projects (EPTP) where Scenarios A is the stand alone with the East Plains Transmission Project that will be published in June 2007

[2] **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.

- Constructing a new 345 kV Station at Las Animas just outside the proposed IGCC for both Interconnection and Delivery
- Construct a new 82-mile 345 kV line from Boone Substation to Las Animas
- Substation expansion at Boone for the 345 kV Interconnection and Delivery
- Construct a new 345 kV line from Las Animas to the Southeast Tap (S.E. Tap) location.
- Construct a new 50-mile 345 kV line from Boone to a S.E. Tap location. (S.E. Tap is the location where the Boone and Las Animas Line Converge).
- Construct a new 135-mile double circuit 345 kV line from the S.E. Tap location to Brick Center.
- Substation expansion at Brick Center for a new 345 kV yard and 230 kV yard expansion.
- Rebuild the existing 16-mile Brick Center to Quincy to Smoky Hill 230 kV line to a double circuit 345 kV capable line operated at 230 kV.

A partial one-line of the Las Animas Switching Station detailing the Interconnection is shown in Figure 2.

Figure 1 - Transmission Network with Recommended Upgrades for Delivery

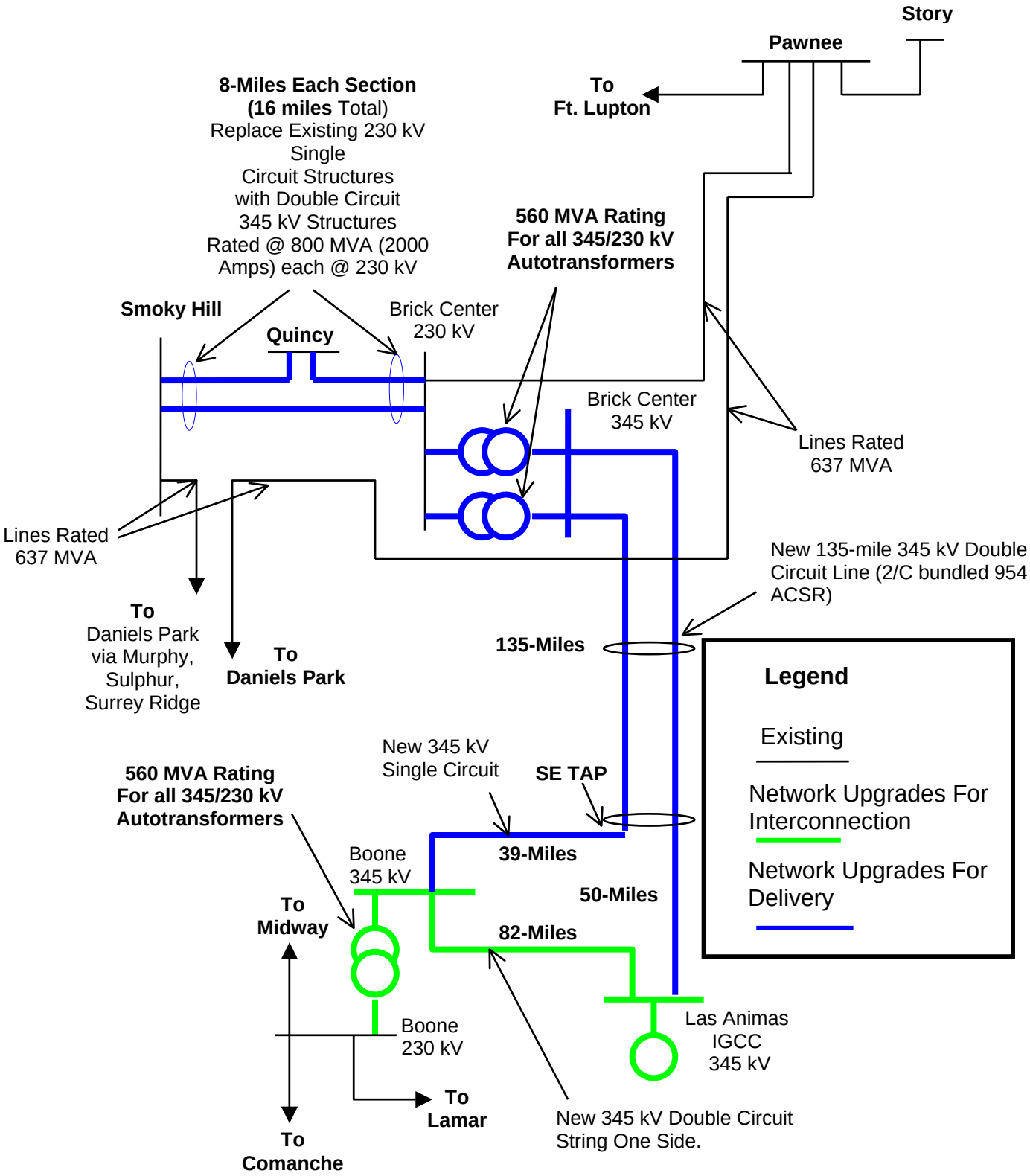
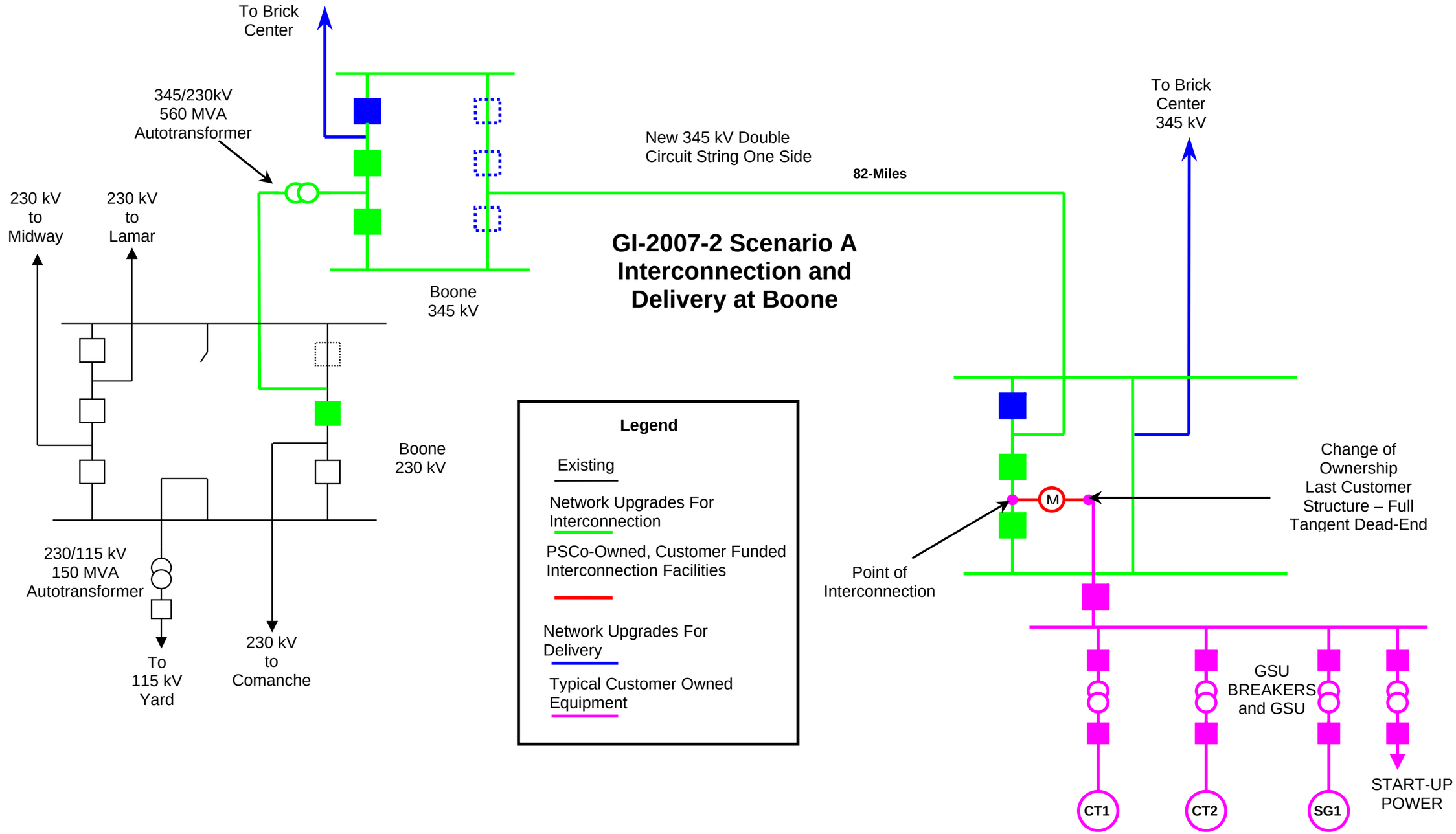


Figure 2: Las Animas IGCC Interconnection One-line



The estimated time required to engineer, permit, and construct all the required PSCo facilities for interconnection is estimated to be at 57 months. Therefore, the requested back feed date of September 2012 is achievable providing the project is started in January 2008. The estimated time required to engineer, permit, and construct the Network Upgrade facilities for delivery is 77 months once the project has started.

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 1.03 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.

Study Models

The power flow studies were based on a 2014 power flow case that was developed from the approved Western Electricity Coordinating Council (WECC) 2011 heavy summer base model. The loads were adjusted in the Rocky Mountain Region for the 2014 summer time frame. The Customer's 675 MW IGCC was modeled with Customer provided details and a +/-0.95 per unit (p.u.) power factor capability to simulate required VAR output. The project generation was dispatched to replace northern PSCo generation.

The Point of Interconnection (POI) between the Customer and PSCo is assumed to be the point at which the Customer connects to the proposed Las Animas Switching Station 345 kV bus. For this 345 kV interconnection, typical GSU transformer impedances were used for the Customer's equipment.

Efforts were made to include in the models all transmission projects expected to be in service for the 2014 heavy summer season. The studies assumed 2014 peak summer demand conditions in the PSCo system and in other utility systems.

Power Flow Study Results and Conclusions

Network Resource (NR) Study Results

The NR study determined the network upgrades that would be required to accept the full 675 MW from the proposed generating plant for the conditions studied. At 675 MW of generation from the Customer, there were a number of contingency overloads. Appendix A shows the most significant contingencies and the associated overloads along with results from the benchmark case and with the Network Upgrades.

Studies indicated that if the proposed Network Upgrades for Delivery are implemented for this project, there are no significant impacts to the neighboring utilities. However, studies show that there exists the potential for impacts on the neighboring transmission system between Daniels Park and Brick Center. Additional transmission may be needed to address these impacts. These issues will be evaluated during the System Impact Study in coordination with the Affected Utilities

Short Circuit Study Results

The study results are not yet complete. Once the fault study is completed, this report will be revised to reflect the fault study results.

The fault study will examine faults at Las Animas, Boone, Brick Center, Midway, and Comanche.

Costs Estimates and Assumptions

The estimated total cost for the required upgrades is **$287,830,000.**

The estimated costs shown are “scoping” (+/-30%) estimates in 2007 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, and construction of these new PSCo facilities. This estimate does not include any costs for any Customer-owned, supplied, and installed equipment and associated design and engineering. This estimate also does not include any costs that may be required for other entities’ systems. 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.

The estimated costs for interconnection are detailed in Table 1 and Table 2. Table 3 shows the detailed costs for Network Upgrades required for Firm Delivery.

Table 1 – Transmission Provider Owned Customer Funded Interconnection Facilities

Element	Description	Cost Est. Millions
Las Animas Substation	PSCo's new 345 kV Las Animas Substation Metering and Communications and Witness Testing.	**$0.67**
	Transmission tie line into Las Animas IGCC Substation.	**$0.25**
	Siting and Land Rights for required easements, reports, permits and licenses.	**$0.02**
Total		**$0.94**

Table 2 – Transmission Provider Network Upgrades for Interconnection

Element	Description	Cost Est. Millions
Las Animas Substation	345 kV line into new 345 kV Yard. The new equipment required includes: Two new 345 kV 2000 A, 40 kA circuit breakers Ten 345 kV switches, 362kV, 3000A Transmission line relaying and testing Required steel supporting structures and foundations	**$5.04**
Boone Substation	Interconnect Customer's 345 kV line into new 345 kV Yard and existing 230kV Yard. The new equipment required includes: Two new 345 kV 2000 A, 40 kA circuit breakers One 345/230, 560MVA Autotransformer Twelve 345 kV switches, 362kV, 3000A One 230kV, 3000A Circuit Breaker Two 230kV Gang Switches Transmission line relaying and testing Required steel supporting structures and foundations	**$10.34**
Las Animas - Boone 345 kV Line	Single Circuit 82-mile 345 kV Line from Las Animas Substation to Boone Substation	**$55.95**
	Total Cost Estimate for PSCo Network Upgrades for Interconnection	**$71.33**
Time Frame		**57 Months**

Table 3 – PSCo Network Upgrades for Delivery

Element	Description	Cost Est. Millions
Boone 345kV Substation	New 345 kV Line terminals to Brick Center requiring the following equipment: One 345 kV, 2000 Amp, 40 kA circuit breakers Required steel and foundations Electrical bus work Control, relaying, and testing	**$1.03**
Las Animas 345kV Substation	New 345 kV line terminals to Brick Center. The following equipment will be required: One 345 kV, 2000 Amp, 40 kA circuit breakers Misc. supporting steel and foundations Electrical bus work Associated control, relaying, and testing	**$0.91**
Brick Center Substation	New 345 kV Yard with 230 kV yard expansion including onw 230 kV line terminal to Smoky Hill, and two 345 kV, one each to Boone and Las Animas. This includes the following equipment: Six 345 kV 2000 Amp 40 kA circuit breakers Two 345/230 kV 556 MVA autotransformers Fourteen 345 kV 2000 Amp, gang switches Six 230 kV 3000 Amp, 50 kA circuit breakers Eleven 230 kV gang switches Associated steel and foundations Associated control, relaying, and testing Electrical bus work	**$18.71**
Quincy 230kV Substation	Upgrade to Line Rupters to 2000A Three 230kV 2000A Line Rupters Associated Cable & Wiring	**$0.47**
Smoky Hill 230kV Substation	Upgrade Existing Line Terminal to Brick Center and Add a 2nd line Terminal to Brick Center. Equipment includes: Eight 230 kV 3000 Amp, gang switches Four 230 kV 3000 Amp, 50 kA circuit breakers Associated steel and foundations Associated control, relaying, and testing Electrical bus work	**$1.23**

Element	Description	Cost Est. Millions
Transmission	New 39-mile Boone - SE TAP Single Circuit 345 kV Line	**$22.79**
	New 50-mile Las Animas - SE TAP Single Circuit 345 kV	**$29.36**
	New 135-mile SE TAP - Brick Center Double Circuit 345 kV line.	**$104.05**
	Replace the 16-mile Brick Center - Quincy - Smoky Single Circuit 230 kV line with 345 kV Double Circuit Line operated at 230 kV.	**$15.97**
Siting and Permitting	Obtain necessary siting, permits, and ROW as required	**$17.71**
	Total Cost Estimate for PSCo Network Upgrades for Delivery	**$212.23**
	Total Cost of Project	**$287.83**
Time Frame		**77 Months**

Assumptions

- The estimates and time frames given are for reference only are subject to change with a more detailed system study.
- The cost estimates provided are “scoping estimates” with an accuracy of +/- 30%.
- Estimates are based on **2007** dollars.
- PSCo crews will perform all substation construction and wiring associated with PSCo owned and maintained facilities. Contractor Crews may perform transmission construction.
- The estimated time for design and construction of PSCo network upgrades for interconnection at the Las Animas Switching Station is 57 months, but could extend further if other queued projects also go forward.
- It is anticipated that in order to construct the PSCo network upgrades for Delivery and Interconnection, a Certificate of Public Convenience and Necessity (CPCN) will be required by the Colorado Public Utilities Commission (CPUC). The application for a CPCN will not be submitted until the Interconnection Agreement is fully executed. The estimated time frame for the CPCN process for the PSCo network upgrades is at least 14 months from the time the Interconnection Agreement is fully executed.

- A siting study will be required for network upgrades for interconnection and delivery. Extensive public involvement is anticipated. Permit applications and possible minor right-of-way acquisition will be required. Land use permits will be required from multiple local jurisdictions.

- This interconnection and delivery affects the following entities: Bent, Kiowa, Crowley, Pueblo Counties.

- 10 temporary staging areas for line construction at 5 acres per site will be needed and are included in this estimate.

- Any 345 kV line will require 200' width easements along the planned route.

- Implementation of the recommended infrastructure for Delivery and Interconnection will require that existing facilities be taken out of service for sustained periods. In most cases, these outages cannot be taken during peak load periods due to operational constraints. As a result, the estimated time frame for implementation could be increased.

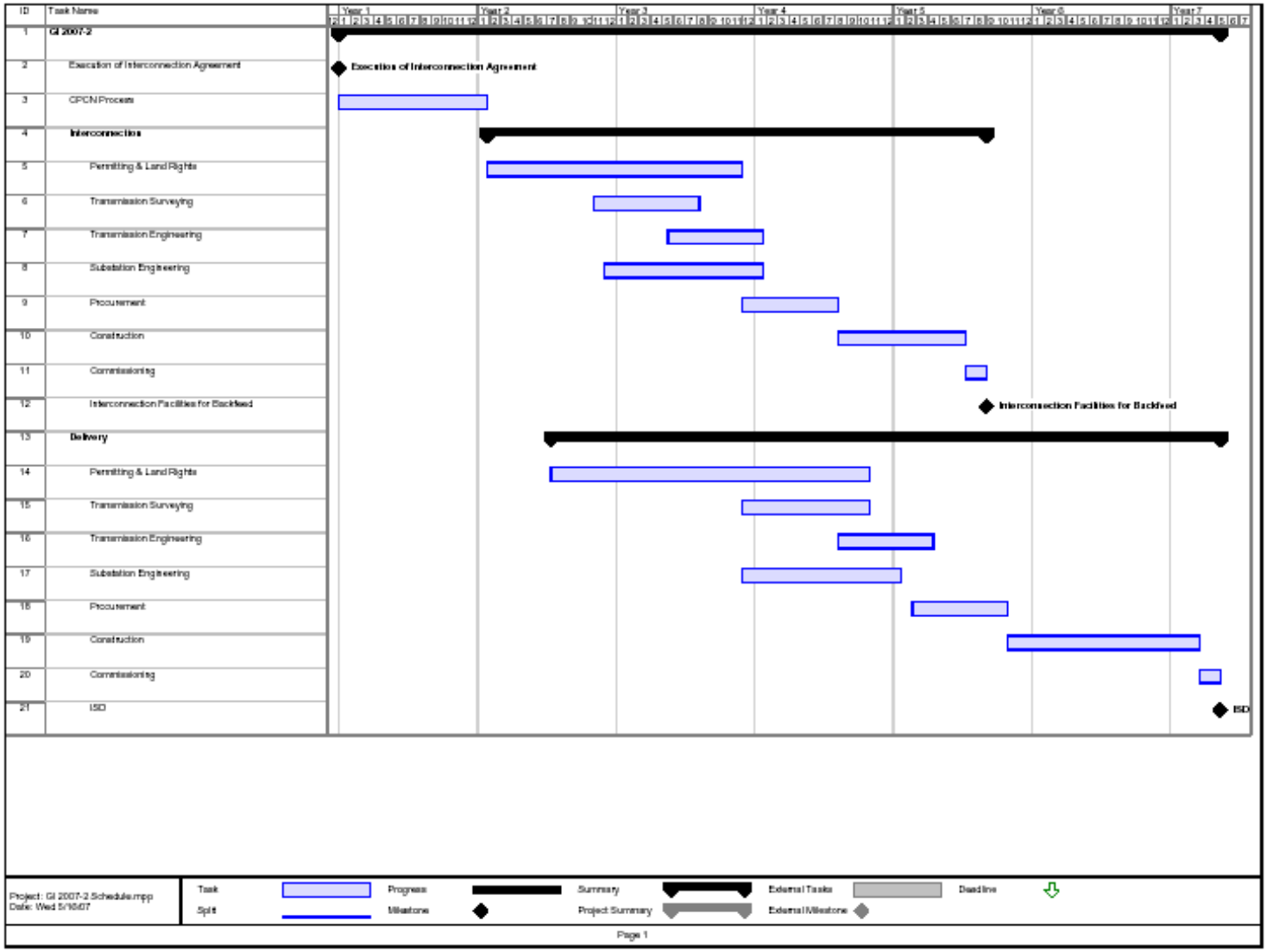
- The last span into Las Animas Switching Station from the Customer owned 345 kV yard will be a slack span between the Transmission Provider's substation dead-end and the Customer's last structure, which is assumed to be a dead-end tangent structure.

Project Schedule

The following schedule, depicted in Figure 3, identifies the main milestones needed to complete the interconnection and the delivery portion of the proposed 675 MW IGCC generation facility.

The following schedule identifies project milestones for three separate phases of work needed to complete the proposed interconnection: Siting, Permitting & Land Acquisition, Substation Design & Construction and Transmission Line Design & Construction. The total estimated duration to complete all of the required activities and tasks is 77 months.

Figure 3 – Preliminary Schedule



Appendix A
Contingency Table

Table 4 – Contingency Results

Overloaded Element			Case				Contingency		
** From bus **	** CKT **	To bus **	Type	RATING (MVA)	Base % Overload	Base W/IGCC % Overload	IGCC W/NETWORK UPGRADES % Overload	** From bus **	** CKT **	To bus **
70004 FREEMARY	115	70352 READER	LN	99		107	n/a	70339 PUEBLO	115	70352 READER
70022 APT TAP2	115	70159 DOT TAP	LN	99		178		70061 BOONE	230	70122 COMANCHE
70022 APT TAP2	115	70549 APT MEM	LN	99		178		70061 BOONE	230	70122 COMANCHE
70061 BOONE	230	70122 COMANCHE	LN	435		132		70061 BOONE	230	70286 MIDWAYPS
70061 BOONE	230	70286 MIDWAYPS	LN	495		115		70061 BOONE	230	70122 COMANCHE
70091 CASTLRCK	115	70117 CROWFOOT	LN	135	106	110	110	70517 PARKERPS	115	70518 BAYOU
70108 CHEROKEE	115	70110 TODD CRE	LN	135	100	103	102	70191 FTLUPTON	115	70192 FTLUPTON
70115 HPCYN	115	70117 CROWFOOT	LN	135	112	116	116	70517 PARKERPS	115	70518 BAYOU
70115 HPCYN	115	70138 DANIELPK	LN	135	117	121	121	70517 PARKERPS	115	70518 BAYOU
70121 COMANCHE	115	70122 COMANCHE	TR	176	145	141	144	70121 COMANCHE	115	70122 COMANCHE
70121 COMANCHE	115	70122 COMANCHE	TR	184	139	135	138	70121 COMANCHE	115	70122 COMANCHE
70121 COMANCHE	115	70412 STEM BCH	LN	118	107	118	110	70122 COMANCHE	230	70459 WALSENBG
70236 HYDEPARK	115	70339 PUEBLO	LN	99	107	128	112	70004 FREEMARY	115	70352 READER
70236 HYDEPARK	115	70456 W.STATON	LN	99		116		70004 FREEMARY	115	70352 READER
70330 PORTLAND	115	70456 W.STATON	LN	80		110		73413 MIDWAYBR	230	73551 W CANON
70336 PUEB-TAP	115	70456 W.STATON	LN	100	103	106	104	70122 COMANCHE	230	70459 WALSENBG
70458 WALSENBG	115	70459 WALSENBG	TR	100	102	112	105	70122 COMANCHE	230	70459 WALSENBG
73384 BIRDSALE	115	73422 TEMPLTON	LN	79	104	114	105	73397 DRAKE N	115	73430 FAIRVWCS
73391 CTTNWD N	115	73410 KETTLECK	LN	132	102	123	104	73389 BRIARGAT	115	73393 CTTNWD S
73408 KELKER E	115	73496 ATMELSUB	LN	129	115	126	116	73398 DRAKE S	115	73409 KELKER W
73409 KELKER W	115	73420 ROCKISLD	LN	159	103	113	104	73408 KELKER E	115	73422 TEMPLTON
73412 MIDWAYBR	115	73413 MIDWAYBR	TR	100	103	122	106	73413 MIDWAYBR	230	73419 RD_NIXON
73412 MIDWAYBR	115	73416 RANCHO	LN	80	118	122	117	73477 FULLER	230	73481 FULLER
73412 MIDWAYBR	115	73417 RD_NIXON	LN	115		102		73413 MIDWAYBR	230	73419 RD_NIXON
73413 MIDWAYBR	230	73419 RD_NIXON	LN	482		106		73419 RD_NIXON	230	73559 FRTRANGE