

PEC

Power Engineers Collaborative, L.L.C.

**Chicago Clean Energy, LLC
SNG Plant Facility Range of Costs
CDB RFP# 651-000-025**



Prepared by Power Engineers Collaborative, LLC
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I. Introduction

This report presents the results of Power Engineers Collaborative LLC's (PEC) cost analysis of the Chicago Clean Energy LLC's (CCE) proposed Clean Coal Substitute Natural Gas (SNG) plant at the Calumet site in Chicago. MFH Associates Architects/Engineers and Terra Engineering Ltd acted as subcontractors to PEC in this cost analysis.

This work was commissioned by the Capital Development Board of the State of Illinois in accordance with Public Act 097-0096 SB 1533 Enrolled LRB097 09938 ASK 50103 b, and in response to CDB RFP#651-000-025 SNG Plant Facility Range of Cost.

The work has two objectives:

- Determine the reasonable range of capital costs for the Core Facility.
- Determine the reasonable range of operating and maintenance costs, exclusive of the feedstock coal and petroleum coke costs.

The source document for this work is the Facility Cost Report April 28, 2010 prepared by Chicago Clean Energy, LLC in accordance with SB 658 and SB 52.

PEC's contract for this work was awarded August 31, 2011 with a fixed end date of October 31, 2011 for submittal of the report.

II. Executive Summary

The Chicago Clean Energy LLC's proposed Clean Coal SNG Facility was based on the Front End Engineering Design (FEED) and estimate prepared by Black & Veatch (B&V) and Turner Construction (Turner). PEC considered that estimate and its supporting documents, together with three CCE interview meetings (minutes contained in Appendix 1), reports, studies, standards and economic indices in the public domain, and PEC's own proprietary resources to develop a range of reasonable Core Facility capital costs:

\$ 1,710,000,000 to \$ 2,335,000,000 in June 2011 dollars.

The B&V Core Facility capital cost estimate in 2010 dollars is \$1,735,328,124 which adjusted to June 2011 dollars is \$1,836,690,748.

basic cost record used within the petrochemical industry, and the clean coal SNG plant is a petrochemical plant.

The Front End Engineering Design (FEED) and estimate for the Clean Coal SNG plant is very preliminary, so there will be uncertainty relative to the final core facility capital cost.

To deal with this uncertainty, recognized practice is to provide plus and minus percentages around facility estimates at different stages of engineering and purchasing completion. A recognized procedure for doing this is codified in an American Association of Cost Estimators (AACE) standard classification system, an excerpt of which appears as Figure 2.

DOE Estimating Guide (413.3-21)



- AACE Estimate Classification System (1998 version included as Appendix J)

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic			
	LEVEL OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Reprinted from AACE RP No. 18R-97, *Cost Estimate Classification System – As Applied in Engineering, Procurement and Construction for the Process Industries*

Figure 2

We judged the FEED work to be at 10 to 15% complete, and therefore consider this a Class 4 estimate. As indicated in Figure 2, if 15% of engineering is performed on a project, the cost of that project cannot be estimated in a range much less than 35% (-15% to +20%).

The technology utilized in the Core Facility is proven and not prototypical; it has been in existence for over 40 years and all the equipment in the design is commercially proven. There is nothing in this plant that is pioneering or not commercially-developed, with the exception of the larger scale of the GE quench gasifiers. The CCE gasifiers are twice the size of the largest existing unit in the US, but according to CCE several are running in China. Therefore, the maturity of the technology leads to substantial confidence in estimating the range of costs, and accordingly any adders for technology uncertainty are not included.

III. Project Scope

The CCE project is composed of systems classified as being “Inside the Core Facility” and “Outside the Core Facility”. In this assignment, PEC is responsible for developing a range of capital costs for installed equipment Inside the Core Facilities, specifically being responsible for developing a capital cost range for the following item, described in Section 6.0 of the Facility Cost Report:

- Construction Direct Costs including constructor’s indirect costs (for systems indicated in Figure 1)

PEC is also responsible for developing a range of operating and maintenance costs for equipment Inside the Core Facilities, specifically being responsible for developing a non-fuel operating and maintenance cost range for the following items, described in Section 4.0 of the Facility Cost Report:

- Plant operating and maintenance labor and supervision
- Maintenance repairs and materials
- Contract labor (full time)
- Catalyst and chemicals
- Environmental, health safety, security
- Operating expenses
- Outside services

PEC is not responsible for developing a range of costs for the following “Inside the Core Facility” items, described in Section 6.0 of the Facility Cost Report:

- Indirect Costs (not constructor’s), Engineering and Management
- Contingency including escalation prior to construction financing

- Additional Contingency
- Owner's Costs (listed in Section 3.13 of the Facility Cost Report)
 - Environmental permits/offsets
 - Site remediation & disposal
 - Geotechnical investigation & report
 - Land survey
 - Plant site prep – fill
 - Plant site prep – removal of existing underground
 - Plant site prep – removal of existing above ground
 - Intake structure (modifications/refurbishment)
 - Process licenses
 - Administrative building
 - Shop & laboratory equipment
 - Permanent plant mobile equipment
 - Tie-in to City sanitary sewer & potable water
 - Road modifications/upgrade (offsite), parking
 - Tie-in to gas supply for Admin building
 - Startup & commissioning (incl operator & maintenance staff training)
 - Builders All-Risk insurance, including marine riders
 - Taxes for startup & commissioning items
 - Land cost (options, purchase)
 - Public relations
 - Legal costs
 - Front-end Engineering and Design
 - Further site investigation and environmental insurance
- Financing Costs
- Consumer Protection Reserve Account
- Fuels and Feedstocks
- Electricity and other Utilities
- By-product Sales

“Outside the Core Facility” is not part of the PEC scope, but its composition is described in Section 3.0 of the Facility Cost Report and listed here for the sake of clarification:

- Preliminary Site Plan with Evaluations
- Gas Pipeline Interconnection Options for CCE Calumet Facility by ICF
- CCE SNG and CO₂ Pipelines Report by EN Engineering
- Pipeline Cost Summary by EN Engineering
- CO₂ Sequestration Potential in Northeastern Illinois by ISGS
- Carbon Storage Feasibility Study by Schlumberger Carbon Services
- CO₂ Sequestration Cost by Schlumberger Carbon Services

- Interconnection Assessment for Proposed CCE Facility by ICF International
- Preliminary Report for Process and Fire Water Intake System by Valdes
- Preliminary Report for Natural Gas and Potable Water Supply and for Sewer Discharge by Valdes Engineering Co.
- Probable Construction Costs for Burley Avenue Improvements by Martin Engineering, Inc.
- Preliminary Engineering Report for Facility Main Office & Parking by Valdes Engineering Co.

IV. PEC Team Methodology

PEC assembled a project team consisting of professionals with professional engineering certifications and or advanced degrees in the petrochemical, power, structural and civil engineering fields. This team in aggregate has over 400 man-years of professional experience. PEC team members and their certifications are listed in Appendix 2.

The source document for this cost analysis is the Facility Cost Report April 28, 2010 prepared by Chicago Clean Energy, LLC

The Facility Cost Report prepared by Chicago Clean Energy, LLC utilized the services of Black & Veatch (B&V) to prepare the cost estimates for the Core Facility. B&V built their estimates from their work doing the Front End Engineering Design (FEED). FEED consists of physical site plans, process flow diagrams, preliminary process and instrument diagrams (P&ID's), equipment lists, motor lists, and electrical one line diagrams, all of which are the basic communication tools of power and process engineering. B&V did not provide limits on the accuracy of their capital estimate. Usually, a FEED is required to establish the identity of the total capital costs required in a project – especially if it is to be “project financed” (financing costs are recovered by project-generated revenue). Therefore, a FEED is simply an up-front, basic design that suffices only to identify the required resources within an accepted level of accuracy. Inherently then, a FEED is not sufficient to specify, purchase, install, start up, or operate a major process.

B&V took the FEED documents and created equipment requisition specifications that were then sent to vendors of the various types of equipment to obtain engineering information and pricing quotes in current dollars (These were in 2009 and 2010 dollars which they adjusted to May 2010 dollars for the final report). The information so obtained is used to develop the arrangement of the equipment on the site and drives the site piping, structural and electrical infrastructure design. These last items at this stage of engineering completion

are normally estimated by a factored methodology which is based on experience with other similar facilities.

The B&V documents supporting their core facility estimate in hard copy format were contained in sixteen standard file boxes. Fortunately this information was available electronically. After some effort the information was extracted from the files on a secure B&V website. To facilitate the flow of information, confidentiality agreements between Power Engineers Collaborative, LLC (PEC) and CCE and specific Licensor process/equipment vendors, Haldor Topsoe – methanation process, General Electric – gasification process, and Lurgi – acid gas cleanup process were executed.

The files were downloaded to a PEC secure website where full control of access is possible, and a record of those accessing exists. This project could not have been accomplished in the required time frame without this arrangement.

Copies of PEC's weekly progress reports to the CDB through the course of the analysis are contained in Appendix 3.

IV. A. Capital Costs

The B&V estimate was broken into 3 main sections:

1. CCE area (technology vendor quotes for methanation and the oxygen plant)
2. Material Take Off area (based on major equipment cost and definitive materials and labor for installation)
3. Factored areas (major equipment costs multiplied by an installation factor to obtain an estimate of the installed cost)

PEC methodology for examining the total capital cost range varied, depending on the Area. The B&V assigned Areas appear in Table 1 below.

Table 1
SNG Facility Area Designations

AREA	TITLE
Vendor Quotes	
Area 01	Coke Handling
Area 10	Methanation
Area 19	Air Separation Unit
Material Take Offs	
Area 02	Coke Grinding & Slurry
Area 03	Gasification
Area 04	Slag & Fines Handling (incl. SWS)
Area 05	Shift Conversion
Area 06	Rectisol
Area 07	Sulfur Recovery Unit (SRU)
Area 08	Tail Gas Unit (TGU)
Area 80	Interconnections/OSBL
Area 81	Switchyard & Transmission Line
Area 90	Buildings
Factored	
Area 10	Methanation
Area 14	Glycol Dehydration
Area 16	CO ₂ Thermal Oxidizer
Area 18	CO ₂ Compression
Area 20	Raw Water Treatment
Area 21	Demineralized Water System
Area 22	Process Wastewater Treatment
Area 23	Condensate & BFW System
Area 24	Oily Water System
Area 25	Firewater System
Area 26	Cooling Tower
Area 27	Stormwater System
Area 30	Plant Instrument Air System
Area 40	Flare System
Area 50	Power Generation
Area 60	Diesel & Gasoline Storage
	Modularization

For all Areas, PEC attempted to confirm the CCE total installed cost and determine a low and high installed cost for each area. In doing so, PEC personnel became familiar with the project as it is currently defined. This

experience is also the basis PEC used for estimating the AACE class of the project.

The capital and operating and maintenance ranges were determined based on the following:

1. Low and high differences for each area and category in the CCE estimated capital and operating labor and maintenance requirements
2. Variability in the scale factor for scaling to the CCE size plant.
3. Variability in the market price of key chemical and catalysts components over the last 5 years.
4. Engineering judgment

PEC has a proprietary historical cost database for many of the process packages used in the Clean Coal SNG plant design - GE quench gasification of coal/petroleum coke, air separation units (ASU), sour gas shift, Rectisol, sulfur recovery and tail gas clean up. For the methanation step, we consulted the literature (An Engineering-Economic Analysis of Syngas Storage, DOE/NETL-2008/1331, July 31, 2008, Jay Apt et al. Contract DE-AC26-04NT 41817.404.01.02). Installed capital projections in our database and literature were adjusted for size and for time. A proprietary scaling factor was used in the adjustments for size. The costs were timing-adjusted to June 2011 dollars using Chemical Engineering's Plant Cost Index (CEPCI). The May 2010 CEPCI is 556.4 and the June 2011 CEPCI is 588.8. These methods of adjusting cost are standard practice in the petrochemical industry.

As a primary review of equipment cost, PEC used the vendor quotes obtained by B&V. When quotes were not available, CAPCOST was used to develop the equipment cost. CAPCOST is a software package developed by Turton et al (Analysis, Synthesis and Design of Chemical Processes, R. Turton et al, 3rd Edition, Prentice Hall, 2009). CAPCOST software is based on the methods developed by K. M. Guthrie (Process Plant Estimating Evaluation and Control, Craftsman Book Co, 1974) and modified by G. D. Ulrich (A Guide to Chemical Engineering Process Design and Economics, Wiley, 1984). Projections of installed cost for the factored areas, were done also using CAPCOST.

For each area, the process flow diagram was obtained from the B&V database. Key process information (vessel dimensions, pump and compressor horse power, etc.) for each piece of equipment was also obtained from the database. These key data were entered into CAPCOST and the installed total cost for the area was determined. In some cases, such as the flare system, vendor quotes for unique pieces of equipment (such as the flare derrick and stack) were used in conjunction with the CAPCOST results to develop a complete installed cost for the area. Matche.com/EquipCost.com was also used to obtain unique equipment

costs not contained in CAPCOST. These equipment costs were then adjusted by an installation factor to obtain the installed cost.

IV. B. Operating and Maintenance Costs

PEC also developed ranges for some of the operating and maintenance costs. These cost areas and the method of estimating ranges are as follows:

1. The number of operators was estimated by using literature data and Turton et al.
 - a. The number of operators for the gasification and power generation sections was estimated from the Integrated Gasification Combined Cycle (IGCC) experience at Polk #1 Unit near Tampa, FL (Tampa Electric Integrated Gasification Combined-Cycle Project, A DOE Assessment, August 2004, U. S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory)
 - b. The number of operators for the remainder of the plant (shift reactor through products, SNG, CO₂, sulfur) was estimated using the method suggested by Turton et al (equation 8.3).
2. Catalyst and Chemical cost ranges were developed by indentifying key catalyst components (such as nickel for the methanation catalyst) and key chemical components (such as methanol in the Rectisol unit) and then using the historical market price variability data to develop a cost range.
3. Maintenance costs were estimated as a percentage of installed capital cost. Turton et al indicated that maintenance material/labor costs can range from 2 to 10% of installed cost. Turton et al recommend using 6%. Historically, PEC personnel have used 3% of installed capital to estimate maintenance material/labor cost. The maintenance material cost component was escalated to June 2011 dollars using Chemical Engineering's Plant Cost Index (CEPCI). The May 2010 CEPCI is 556.4 and the June 2011 CEPCI is 588.8. The maintenance labor cost component was escalated to June 2011 dollars using Illinois Department of Labor average prevailing construction trade wage rates for Cook County. The May 2010 average wage is 66.18 and the June 2011 average wage is 69.52. The maintenance material component is 68% and the maintenance labor component is 32%.

V. Results and Discussion

V. A. Capital Costs

PEC's analysis of the potential variability in the required installed capital investment and operating/maintenance cost for the CCE project has been completed. PEC concludes that the project is at an ACE Class 4 stage of development with about 10 to 15% of the project defined. In PEC's opinion, B&V/Turner have developed a reasonable installed capital estimate for the project given the level of project definition. Their estimate is \$1,735,328,124 (2010\$). However, at this level of development, there is considerable uncertainty in the installed capital requirements. Based on the sum of low and high cost values determined for the Project Areas we developed a range from low to high of:

\$ 1,710,000,000 to \$ 2,335,000,000 in June 2011 dollars

B&V's 2010 estimate includes a \$76 million deduction assigned for "modularization", which is a technique to reduce the installation cost by factory-assembling major pieces of equipment into large shipping units, transporting them on barges, and setting them into place on site, effectively substituting field labor with less costly shop labor. The term "Modularization" can have a wide range of definitions, typical modularization of equipment shipped in standard size and weight skids are considered normal and should be accounted for in the base estimate. In our opinion, in this context it means modularization so extensive, that extraordinary special shipping and equipment handling rigs are required. We took this position, because it is a special line item in B&V's estimate below the standard lines of normal estimate activities. This type special Modularization usually requires a detailed analysis to assure there is a true savings beyond the difference between shop and field labor. There are additional costs and risks which offset at least part of the theoretical savings.

- There is more engineering (and it must be done earlier than normal), involved to:
 1. Detail the module configuration for shop assembly
 2. Assure the module is shippable and constructible in the field
 3. Optimize the design for modularization, which may necessitate some trade-off with optimal design for plant operation and reliability, for example, maintenance space may become less than ideal.
- There is additional cost for the extra support of the equipment in the module to withstand the loads during construction and installation.

- There is the additional cost for the special rigging and transport vehicles used.
- There is a higher risk of damage to the equipment during shipping and during installation. If there is rework required, it becomes significantly more expensive since there is demolition plus rework involved.

PEC was not provided any information on how this savings was analyzed, however we have included the full savings by reducing the low range cost by \$76 million dollars. In PEC's opinion, it is questionable whether this full savings can be realized.

Following are some of our observations as we reviewed B&V's estimate, which influenced our judgment on the completeness of their effort. In general, their estimate appeared to be accurate for a Class 4 level of completion.

There are many reasons driving the installed equipment cost uncertainty, including:

V. A. 1. Process

- Construction labor – labor efficiency, productivity, and cooperation.
- Competence and effectiveness of the eventual Engineering / Procurement / Construction contractor.
- Vendor quotes for major equipment and process steps have not been guaranteed. There can be considerable material and equipment cost escalations if the economies in China and India heat up as occurred several years ago.
- All equipment has not been specified and fully estimated.
- Materials of construction could change to require the use of more expensive alloys as the detail design is fully developed.
- Non-process Balance of Plant systems are not completely defined, and detailed cost estimates have not been developed.
- Plant utilities have not been completely designed and detail estimated.
- Site layout is not complete.
- An overall plant thermal balance has not been optimized

V. A. 2. Mechanical and Piping

- Cooling towers and circulating water system show discrepancies in quantity of circulating water pumps.
- The uncertainty of the circulating water system design. The proposed circulating water piping configuration has both condensers supplied with

- cooling water from the same common pipe between condenser and cooling tower. This arrangement would not allow independent shutdown of an individual condenser. Designing the system to allow one condenser to remain in service while the other one operates will add cost.
- Conflicting information on whether the steam turbine has axial or bottom discharge will impact the cost.
 - Freight was not included in the B&V Turbine Generator cost estimate.
 - Cooling Tower drawings show 3 pumps but the quotes are for 4. This conflict would also impact electrical equipment and labor.
 - Auxiliary boiler emission limits are shown as meeting a less restrictive emissions standard than we believe would apply within the Chicago city limits. Compliance would impact the cost estimate.
 - Auxiliary boiler is not shown on the site general arrangement drawing.

V. A. 3. Electrical and Controls

- In reviewing the electrical and controls costs for the project, both major materials and installation, the costs were based on responses to Requests for Quotes (RFQ). The RFQ's were supported by drawings, specifications, and bid instructions.
- Multiple proposals were received for most of the major electrical items, for materials but not installation.
- There was one exception to the materials-only quotes, and that was the 138 kV switchyard which was bid as a turnkey (materials and installation) installation. The lone quote was for \$6.2 million.
- The DC system and the uninterruptible power supply system were quoted together, with prices from two bidders of \$620 thousand and \$673 thousand.
- Only one quote was presented for chargers and inverters, and this was for \$327 thousand.
- The low voltage switchgear, motor control center, and enclosure were quoted by two bidders, with prices of \$4.3 million and \$4.7 million. The

- B&V tabulation did not carry forward the cost of the low voltage switchgear.
- The medium voltage switchgear was also quoted by two bidders, with prices of \$6.4 million and \$6.7 million.
 - The base quotes for power transformers came from three bidders and ranged between \$5.2 million and \$7.5 million. Alternative quotes from the same bidders ranged between \$6.2 million and \$7.8 million
 - Two quotes were available for the eight diesel generators, with prices of \$8.3 million and \$8.2 million.
 - Three quotes were available for the generator terminal equipment and bus, with process ranging between \$1.1 million and \$1.8 million.
 - The Distributed Control System (DCS) was quoted by two bidders, with prices of \$4.6 million and \$9.3 million. These quotes are not sufficiently detailed to identify the reasons for the 2 to 1 cost differences.
 - Installation of the major equipment was covered by quotes received from electrical contractors. These quotes were inclusive of all materials and labor for installation of the equipment. Also included was the cost for general electrical items such as lighting and receptacles. The B&V information includes quotes from three electrical contractors, ranging from \$21.7 million to \$28.8 million, exclusive of 5/15 kV cable. One bidder included an incremental amount of \$7.8 million for the 5/15 kV cable. These electrical contractor quotes do not include any field costs for the general contractor.
 - All of the submitted bids/quotes included statements covering future cost increases due to raw material price increases, receipt of definitive design documents, or possible labor cost increases.
 - Based on our review of the bid documents, the electrical costs appear to be reasonable.

V. A. 4. Structural

- 90 – 02-Buildings
No breakdown of Pre-Engineered structures was found in B&V's backup. We examined the drawings and determined a total 244,563 square feet of Pre-Engineered Buildings. When this figure is divided into the listed figure of \$23,084,135, the unit cost comes to \$95 per sq ft without foundation

work. In our opinion this is a very low figure. For reference, the Admin Building was priced out by Valdes Construction at \$310 per sq ft (\$3,292,747 and 10,620 sq ft). That figure included furniture and appurtenances, but we still believe a figure of \$125 per sq ft for superstructure is more appropriate.

- 90 - 04 Concrete Work

We have been able to track the foundation component of the building cost, and these cost figures are worked out in an acceptable fashion. However, no cost figures were included for Grouted Piles for building foundations. All other structures follow the recommendations of the Geotechnical report that calls for all foundations to have grout piles. A quote for grout piles is included in the backup, though it is utilized for all structures other than 90 – Buildings. We therefore are adding an additional cost for grout piles to the Turner derived cost figures for building foundations. We also noted that the foundation summary figures did not include foundations for all the structures listed in the Pre-Engineered section for 90 – Buildings, and we added costs for those buildings on a \$ per sq ft basis.

- Other Areas - 10 Methanation; 19 Air Separation Units; 02, 03, 04; 05 Shift; 07/08 Rectisol; 80 OSBL; and 81 Switchyard

We have factored the structural portion of the costs in these areas to reflect a -10%/+20% to be more consistent with the accuracy stated in the Turner Cost options.

V. A. 5. Civil

- The referenced cost estimate summary prepared by B&V has been reviewed in regards to the site and Civil Engineering capital cost scope. The following discusses the observations made for each segmented area of the reviewed cost estimate.

- Methanation [Area 10]

The B&V cost estimate summary outlines a total cost for the Methanation at a value of \$111,814,292. In review of the detailed associated cost estimate summary, a value of \$41,184 is noted to be associated with the “Plant Site” line item encompassing the Civil Engineering construction scope. Though this value of \$41,184 is denoted, no detailed description of quantities was found in the transmitted CCE Report. For this cost comparison evaluation, the unsupported \$41,184 value is found *de minimis* in comparison to the subject \$1.7 billion estimate.

- Interconnections/OSBL [Area 80]

The B&V cost estimate summary outlines a total cost for this construction item at a value of \$253,865,668 of which \$37,839,378 are accountable under the "Plant Site" line item encompassing the Civil Engineering construction scope.

In detailed review of the supporting Basis of Quantities [BOQ] for Area 80, no construction costs and quantities identify site landscape and topsoil. In further review, the tabulated values exceed the summarized value by approximately \$660,000. It is unclear in the CCE Report and the supporting BOQ where the discrepancy of in site construction is accounted for.

- Stormwater System [Area 27]

The B&V cost estimate summary outlines a total cost for the Stormwater System at a value of \$555,584. No construction cost backup is found in the CCE report associated with Area 27; there is however, a detailed BOQ outlining stormwater components in the "Plant Site" section associated with Area 80. Further clarification is advised to be made regarding this line item, as the subject cost estimate summary appears to have partially accounted for the stormwater system as part of Interconnections/OSBL line item.

In other review of the proposed stormwater related materials from the referenced site plan documents, we find that the segmented line item value of \$555,584 [Area 27] is significantly underestimated. A detailed review of the stormwater structures, pipe runs, and associated components was conducted to establish a projected quantity of stormwater items. This summary of quantities was used to determine a comparative probable construction cost projection. The projected construction cost value determined falls within a range of \$2.7 million to \$2.9 million (reflecting May 2010 US dollars). The construction cost projection range of \$2.7 million to \$2.9 million consists of furnishing and installing the structural stormwater components identified in the source documentation referenced.

- Hardscape

The planned concrete pavement surface is approximately 17 acres in size and the asphalt pavement surface is approximately 16.7 acres. The B&V cost estimate summary tabulates a pavement construction cost totaling roughly \$7.1 million (\$4.1 million and \$3.0 million, respectively for each surface type inclusive of base installation). We find that this pavement construction cost estimate is underestimated, in comparison with a comparable construction cost estimate ranging from \$9.3 million to \$9.8 million for the total site pavement costs.

- Greenscape
As mentioned above, no construction cost line items were found in supplement documentation BOQ data identifying site landscaping and topsoil installation. We project a construction cost range of \$1.7 million to \$2.3 million for the installation of landscape and topsoil surfaces as illustrated in the project renderings.
- General Fill (non-environmental)
In review of the BOQ, the unit cost for site fill used to populate the cost estimate is \$7.94 per cubic foot; this unit cost value results in a total construction cost of roughly \$13.5 million. Pending the type of fill material used, the unit cost of fill material may range from \$7.29 to \$35 per cubic foot; utilizing this range of unit costs results in a projected construction cost range of \$12.4 million to \$59.5 million. As such we find that the B&V cost estimate falls within the lower extents of the comparative construction cost estimate range furnished in this report.

As CCE moves to construction, the level of plant definition will increase and the uncertainty in the installed capital estimate will decline.

V. B. Operating and Maintenance Costs

PEC has also examined CCE's operating and maintenance cost estimates. The 3 areas where PEC has focused its major efforts are:

1. Maintenance material cost
2. Operating and maintenance labor
3. Catalysts and Chemicals.

CCE's estimate for operating cost is \$70,372,000 per year in 2010 dollars. PEC considers the corresponding range of annual operating and maintenance cost to be:

\$ 64,200,000 to \$ 104,390,000 in May 2010 dollars, adjusted to

\$67,775,000 to \$110,270,000 in June 2011 dollars.

For the low end of the range we accepted CCE's operating and maintenance labor and maintenance materials cost because of the very clear and knowledgeable presentation of their O & M team. We used PEC's estimated chemical and catalyst cost because of the method we used to determine these values

At the high end PEC's estimate differs from CCE's estimate due to the basis of CCE's estimated labor hours and maintenance materials. CCE's estimate of maintenance cost and operator requirements is based on Farmland Industry's Coffeyville, Kansas, ammonia plant. The Coffeyville plant is very similar to CCE's plant in that it uses a GE quench gasifier, a shift reactor, a Rectisol unit, and a Sulfur Recovery Unit (SRU)/Tail Gas Unit (TGU). Coffeyville began production in the 1999-2000 timeframe so it has been running for 11 to 12 years. This time period is sufficient time to debug and debottleneck the plant and develop an experienced operating staff and make modifications to equipment of lower maintenance materials costs.

V. B. 1. Maintenance Costs

CCE's estimate of annual maintenance material/maintenance labor cost is \$31,000,000 (\$24,756,000 for materials and \$6,244,000 for maintenance and outside service labor) or approximately 1.8 % of installed CCE's capital cost estimate. PEC's experience and that of the petrochemical industry would suggest that this cost should be higher. PEC recommends 3% of installed capital or approximately \$52,000,000/year based on CCE's capital cost estimate. PEC used standard union wage rates to estimate maintenance labor. The difference between PEC and CCE is significant. PEC believes that CCE's estimate is based on a mature (Coffeyville) plant that has been running for over a decade. In the first 5 years of operation, the operating and maintenance costs are much

higher due to debugging. Perhaps the CCE plant can achieve the 1.8 % level, but only after staff has developed operating experience and the plant has been debugged and debottlenecked. In general, maintenance costs should allow for ample preventive maintenance with a corresponding increase in on-stream time.

V. B. 2. Operating Labor

CCE's estimate for operating labor is 140 operators plus supervisors (203 total minus 63 maintenance personnel). This estimate rightly does not include the personnel required to run the coal/coke pile or feed the fuel holding bins that feed the rod mills, since the fuel will be purchased "Delivered to the fuel bins". PEC developed an estimate for the required operators based on experience at the Polk Integrated Gasification Combined Cycle (IGCC) plant run by Tampa Electric for the gasification and power sections, and the method suggested by Turton et al for the remainder of the plant (shift reactor through all products). In adjusting the number of Polk operators, we assumed that 58 of the 78 Polk operators would be required to operate the Polk plant from rod mills to power. PEC's estimate of operation plus supervisory staff is 197 which are 57 more than the CCE's estimate. PEC estimates that total staffing requirements for the CCE plant, including maintenance and contract labor, will be 260 versus the 203 total estimated by CCE.

The PEC estimate could possibly increase by as many as 20 operators depending on how restrictive the work rules are at the CCE plant. PEC used standard union wage rates to estimate operating labor. Once again, PEC believes that CCE's estimate is based on a mature plant that does not require the same number of operators as a brown field startup plant which has not been debugged or debottlenecked. As an example, the Great Plains SNG plant started with 1000 staff, but today employs only 700. A decline in operating personnel as the plant matures is common in the petrochemical/power industries. Perhaps after 4 to 5 years of operation, CCE can achieve their current estimate of operators.

V. B. 3. Catalyst and Chemicals

The final operating cost range that PEC developed was for catalysts/chemicals. The CCE estimate is based on 2010 market prices for these commodities. However, commodity prices can fluctuate markedly with time. In order to estimate the cost range for catalysts/chemicals, market prices of key catalysts components and methanol were evaluated over the last 5 years. The key catalysts components focused on the metals needed to make the catalysts for the process:

1. Nickel for methanation
2. Cobalt and Molybdenum for the dirty gas shift.

Methanol solvent is required for Rectisol process to remove the acid gases, hydrogen sulfide and carbon dioxide. As an example of how much market prices can fluctuate, in the past 5 years, methanol price has ranged between \$0.60 and \$2.50 per gallon. CCE's estimate for catalysts/chemicals is \$16,500,000 per year. PEC estimates lower and upper ranges for chemicals/catalyst cost to be \$10,400,000 to \$22,500,000/year.

PEC's estimates for maintenance, number of operators and the catalysts/chemical requirements form the basis for the range of operating and maintenance listed above.

VI. APPENDIX

APPENDIX 1

CCE INTERVIEW MEETING NOTES

September 8, 2011

September 12, 2011

October 4, 2011

September 8, 2011 Meeting

State of Illinois
CAPITAL DEVELOPMENT BOARD

ATTENDANCE RECORD

Project No.: 651-000-025
Project: SNG Plant Facility Range of Costs
Chicago, Cook County, Illinois

Meeting Description: Owner/Developer Meeting
Date: 09-08-11
Time: 09:00 AM
Place: Power Engineers Collaborative Office, Chicago, Illinois

Attendant

	<u>Name & Title</u>	<u>Representing</u>	<u>E-mail</u>	<u>Phone & Fax Numbers</u>
1.	Karen Fredrickson	CDB	Karen.Fredrickson@illinois.gov	312-814-6046 312-814-2041
2.	Emily Zgonjanin	CDB	Emilija.Zgonjanin@illinois.gov	312-814-6307 312-814-2041
3.	Hoyt Hudson	Chicago Clean Energy	hhudson@EIDsite.com	312-642-2427 312-896-1515
4.	Dave Hagen	Leucadia	dhagen@EIDsite.com	312-698-9861 Fax 312-896-1515
5.	Chris Townsend	DLA Piper	christopher.townsend@dlapiper.com	312-368-4039 Fax 312-630-6300
6.	Marshall Hjertstedt	MFH Associates	marshallh@mfhassociates.com	312-258-0530
7.	Arvin Villanueva	Terra	avillanueva@terraengineering.com	312-467-0123 Fax 312-467-0220
8.	Jamil Bou-Saab	Terra	jbousaab@terraengineering.com	312-467-0123
9.	George Shibayama	PEC	gshibajama@pecllc.com	312-466-1540 Fax 312-466-1546
10.	Matt Brown	PEC	mbrown@pecllc.com	312-953-5819 Fax 312-466-1546
11.	Dave Tatterson	PEC	tatter@corecom.net	630-841-8395
12.	Scott Gloss	PEC	sgloss@pecllc.com	312-735-5348
13.	Don Pacer	PEC	dwpacer@pecllc.com	312-466-1540 ext 102 Fax 312-466-1546
14.				
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E-MAIL THIS FORM

This form may be submitted to CDB electronically as an attachment to meeting minutes. Attach the completed form to an e-mail addressed to the CDB Project Manager. All CDB e-mail addresses are available on our website: www.cdb.state.il.us.

Donald Pacer

From: Donald Pacer
Sent: Thursday, September 08, 2011 11:01 AM
To: 'Emilija.Zgonjanin@Illinois.gov'
Subject: FW: CCE - PEC Confidentiality Agreement
Attachments: CCE Confidentiality - PEC.DOC

Emily,

Attached is a copy of Leucadia's Confidentiality Agreement for you to review with the CDB Legal Dept.

Don

From: Hoyt Hudson [mailto:hhudson@eidsite.com]
Sent: Wednesday, September 07, 2011 3:02 PM
To: Donald Pacer
Cc: David Hagen; Christopher Townsend (christopher.townsend@dlapiper.com)
Subject: CCE - PEC Confidentiality Agreement

Don,

Attached is our suggested confidentiality agreement between PEC and CCE. Please let us know if you have any comments, otherwise go ahead and execute via PDF or fax (312.896.1515), and we will do the same.

Thanks,

Hoyt

312.642.2427

Donald Pacer

From: Donald Pacer
Sent: Thursday, September 08, 2011 3:13 PM
To: 'Emilija.Zgonjanin@Illinois.gov'
Subject: FW: GDS report & email
Attachments: SNG Project-Report 5-24-10.pdf; SNG Project Emails.docx

Emily,
Attached are the GDS report and some reference emails that were forwarded to us this morning. These originated with Illinois Power Agency.
Don

-----Original Message-----

From: David Hagen [mailto:dhagen@eidsite.com]
Sent: Thursday, September 08, 2011 10:26 AM
To: Donald Pacer
Cc: Hoyt Hudson; Christopher Townsend (christopher.townsend@dlapiper.com)
Subject: FW: GDS report & email

GDS report and the lead for GDS, Michael Chimack, contact info.

Dave Hagen

-----Original Message-----

From: Pruitt, Mark [mailto:Mark.Pruitt@Illinois.gov]
Sent: Thursday, September 08, 2011 9:36 AM
To: David Hagen
Subject: RE: GDS report

Here you go. Emails as well if you need them.

Mark Pruitt
Director
Illinois Power Agency
312/814-8106

From: David Hagen [dhagen@eidsite.com]
Sent: Thursday, September 08, 2011 9:30 AM
To: Pruitt, Mark
Subject: GDS report

Mark,

PEC has just asked if the report that GDS prepared is available to them?

Thanks

Donald Pacer

From: Donald Pacer
Sent: Thursday, September 08, 2011 3:20 PM
To: 'Emilija.Zgonjanin@Illinois.gov'; 'Karen.Fredrickson@illinois.gov'; George Shibayama; Matthew Brown; 'Marshall Hjertstedt'; 'Arvin Villanueva'; 'Dave Tatterson'; Bryan Eskra
Subject: FW: Shaw Final Report for IFA 2-14-2011
Attachments: Shaw Final Report for IFA 2-14-2011.pdf

Attached is a copy of the Indiana Project report referred to in today's meeting. This was indicated as a "public" document.

Don

-----Original Message-----

From: Hoyt Hudson [mailto:hudson@eidsite.com]
Sent: Thursday, September 08, 2011 1:56 PM
To: Donald Pacer
Cc: David Hagen
Subject: Shaw Final Report for IFA 2-14-2011

Don,

Great to meet in person today. Attached is the Shaw report on Indiana Gasification, presented to the Indiana Finance Authority, that Don Maley referenced on the call.

Regards,
Hoyt

September 12, 2011 Meeting

**Black & Veatch and Owner/Developer Meeting
10:00 AM Monday, September 12, 2011
DLA Piper Chicago Office**

Chris Townsend
Hoyt Hudson
David Hagen
Greg Wayne

Dave Tatterson
Matt Brown
Don Pacer

Sourcing Agreement – still work in progress.

Confidentiality Agreement with PEC is OK. There will still be other C/As with licensors.
Have the two PEC subs sign off now.

Leucadia person would come here from Grand Rapids Friday if PEC wants. Hold off for now.

How is the website arranged?

18 boxes, all titled. But we prefer the efiles.

Greg Wayne discusses the information.
Using the website
See table of contents

A 16 volume set with 20 units
B&V had 7 months to do the estimate including licensors and MTOs, etc. Normally would be at least 12 months.

The MTOs are not FULL MTOs, key areas only.

GE and Holder Topsoe and Lurgi are the licensors.

TOC section 2.4 is the Estimate basis.

Demo is ongoing at site now. This is 90% complete.

There will be a Single Overall Control System for the Project with one (1) Control Room.

B&V's scope is Feedstock In to Gas Out.

Outside core facility – by local third party companies
Core is ISBL (inside battery limits) and OSBL (outside battery limits).
B&V does core.

TOC section 4.0 is O&M

Zero Liquid Discharge – mostly zero.
Then an oil/water separator.
Rain runoff is not included.

Turndown of 25% with the gasifier trains.

Fuel analyses are in the design basis.

Estimate aimed for overall $\pm 20\%$ accuracy did not always meet this.

Assumed April, 2010 data date for money.

Site demolition is not in the B&V estimate, and it is not supposed to be.

\$20 million remediation is not in B&V's estimate.

DTE blends – B&V has only 1 set of fuel silos.

B&V does the final fuel crushing and sizing.

B&V has 8-hours fuel storage onsite, dual conveyors.

40,000 HP for each ASU compressor – verify this figure.

The ASU island has its own cooling tower.

Liquid sulfur – a product that will be shipped out.

2 x 50% trains throughout the plant, except for 2 x 55% for ASU.

All drives are electric, no steam turbines.

Won't use or export >50 MW, so adjacent transmission systems are OK.

There will be no metals recovery from the slag or ash. No recovery of vanadium or nickel.

Greg Wayne will respond to any questions.

Also get a copy of the 9/8 PowerPoint presentation.

October 4, 2011 Meeting

Minutes of Meeting

Description: CDB Project No. 651-000-025
SNG Plant Facility Range of Costs
Chicago, Cook County, Illinois
Operations and Maintenance Meeting

Date: October 4, 2011

Location: PEC Chicago Office

Attendees: See Attachment 1

The purpose of this meeting was to conduct the CCE Operations and Maintenance (O&M) Presentation Meeting, for the SNG Plant Facility Range of Costs Project.

Background

CCE/Leucadia retained a gasification and operations consultant team to participate with Black & Veatch on O&M issues of the Front End Engineering and Design (FEED) phase. Following PEC's initial review of the FEED capital cost documentation, it was appropriate for a meeting on the O&M cost estimates. Gasification and operations consultant representatives, Scott Pierce and Robby Collums presented the latest O&M budget estimate including the redacted slides contained in Attachment 2. These individuals have extensive experience with O&M at the Coffeyville Nitrogen Facility, which uses GE quench gasifier technology as is proposed for the CCE Facility. Coffeyville is reportedly the lowest-cost producer of anhydrous ammonia in the USA. They have also worked at four other ammonia plants, and now work exclusively for Leucadia.

Project Issues

In the CCE Report to the State of Illinois, Section 4.0 discusses O&M issues. Section 4.0 and today's presentation reviewed the following O&M Categories:

- Budget Overview
- Labor Cost and Staffing Plan
- Maintenance and Repair Budget
- Gasifier Overview
- Major Gasifier Repair Components
- Maintenance Planned Outage Schedule
- Plant Availability
- Catalyst and Chemicals Budget
- Remainder of Yearly Budget Items

Meeting Minutes

Budget Overview

The Section 4.0 costs are not factored, for example using an index such as a percentage of the installed capital cost (TIC). The O&M costs were developed bottom up, and there is no contingency in the method used.

PEC, in preliminary review of O&M costs, had observed about 3% of the Gasification TIC for Gasification O&M and about 0.5% of the Methanation TIC for Methanation O&M.

Labor Cost and Staffing Plan

The Section 4.0 staffing estimate shows 203 regular employees. In addition, CCE expects to use 16 regularly-employed outside contractors and a team of 12 subcontracted specialist technicians for ongoing Gasifier refractory repairs. There was extended discussion on the estimated size of the facility O&M staff.

There is no need for a staffing category covering fuel receiving, storage, handling, stack out, reclaim, since fuel will be purchased as a delivered commodity. CCE will take possession of sized fuel at the outlet of the CCE silos within the Fence, then perform the final sizing in rod mills and produce the slurry for feed to the Gasifiers.

Although not shown on the chart presented, the Environmental Technician function will fall under the Technical Manager Group.

Labor rates presented in the CCE O&M estimate assume union scale. CCE has not yet finalized the labor posture at the SNG facility. It was noted that the Coffeyville facility used as an example is a non-union site. (Separately, construction labor is based on union rates.)

The staff position titles have separate pay grades. CCE is anticipating the ability of staff to readily cross over to other position titles, as this arrangement has worked well at other Gasification facilities.

Maintenance and Repair Budget

The category of maintenance material and repairs was developed from information provided by the three Licensors, Lurgi-Rectisol, Haldor Topsoe-Methanation, and GE-Gasifier.

The Gasifier is the largest component of maintenance, and refractory/brickwork repair is the largest Gasifier maintenance item.

Aside from gasification, the remainder of the facility plant is in many ways similar to an ammonia plant, on which there is a good experience base.

Gasifier Overview

Of the five Gasifiers, the projected operating schedule calls for any four to be in operation while one is shut down for maintenance.

Meeting Minutes

One CCE Gasifier section has a volume of about 900 cu ft and dimensions of about 11 ft outside diameter x 19 ft tall. The inside of the Gasifier is lined with refractory and brickwork. The quench chamber section of the Gasifier is about twice the size of the main Gasifier section. The Gasifiers will be located outdoors at the site.

The CCE Gasification will use a blend of coal and petroleum coke as a feedstock. As a reference, the Coffeyville facility uses only petroleum coke which is considered to be a more maintenance cost-intensive fuel than a blend.

Major Gasifier Repair Components

The Gasifier is the highest maintenance component in the facility. A Gasifier typically runs for 120 days then is shut down for brick and refractory repairs. The throat region of the Gasifier is expected to require the most maintenance. A gasifier typically takes about 10 days of outage time to cool and repair the brick/refractory at the throat. Should the wall region brick and refractory require repairs, the outage will take longer than 10 days. The proposed schedule allows for 30 days of Gasifier outage time. Following repairs, that Gasifier is kept in a hot standby condition ready to be brought back into the system if needed.

The plan is to use continuous thermal image monitoring of the Gasifier outside walls to detect brick and refractory deterioration/failures. The brick and refractory repair will be performed by a specialized outside subcontractor, which is not part of the CCE employee staff count.

Maintenance Planned Outage Schedule

The plan is for a major facility turnaround every six years, but even during such a turnaround, one-half the facility will remain in operation. All operating schedules appear to be built around the 120 day cycle needed for Gasifier refractory/brick repair. The Power Generation Plan is to have a major overhaul every six years, the expense being annualized for the budget. This six year time frame came from specific equipment vendors and B&V. The Air Separation Units are scheduled for shutdown every three years.

Plant Availability

Plant availability was discussed in conjunction with outage time. The projection is for a 90.8% weighted average availability.

Two steam turbine generators are in the scope, one per train.

In a discussion on operating upsets, it was stated that the Gasifier quantities and trains are redundant, while the Air Separation Units (ASU) typically perform at +99% reliability. The CCE facility will have 8 hours worth of liquid oxygen storage onsite, which is expected to provide sufficient coverage for unplanned ASU shutdowns.

Catalyst and Chemicals Budget

The category of Catalyst and Chemicals dollars come from the three Licensors, Lurgi-Rectisol, Haldor Topsoe-Methanation, and GE-Gasifier, and also B&V for the Shift Conversion.

The CCE Gasifier feedstock throughput was compared with that at Coffeyville and is much greater. CCE will flux the Gasifier with silica and calcium compounds for any cases of 100% petroleum coke feed.

Meeting Minutes

Different types of brick will be considered in order to arrive at an overall best use. A 90% chrome brick has good wear characteristics but has a greater tendency to degradation; less chrome content is less wear-resistant but withstands degradation better. Chrome content of the slag stream leaving the Gasifier will be measured to detect brick wear. There is an expected 120 to 140 days life on the Gasifier throat brick/refractory and 2 years on the wall brick and refractory. A budgeted amount of about \$1 million has been allocated for Gasifier wall rebuild with a projected one such wall rebuild per year. Two years life are expected on the Gasifier drift tube and draft tube and one spare has been included within the budget.

The Methanation Catalyst and Chemicals budget was presented as \$5M per year vs. \$1.5M in Section 4.0 of the Report.

Remainder of Yearly Budget Items

Other operating expenses, environmental health and safety (EHS) expenses, and outside services expenses were reviewed.

Attachment 1

State of Illinois
CAPITAL DEVELOPMENT BOARD

ATTENDANCE RECORD

Project No.: 651-000-025
Project: SNG Plant Facility Range of Costs
Chicago, Cook County, Illinois

Meeting Description: CCE Operations & Maintenance Meeting
Date: 10-04-11
Time: 09:00 AM
Place: PEC Chicago Office

Attendant

	<u>Name & Title</u>	<u>Representing</u>	<u>E-mail</u>	<u>Phone & Fax Numbers</u>
1.	Dave Hagen	CCE	dhagen@eidsite.com	312-519-1080
2.	Robby Collums	CCE	Collums@sbcglobal.com	918-766-6851
3.	Scott Pierce	CCE	spierce@leucadiaenergy.com	918-534-6877
4.	Ken Robinson	PEC	krobinson@pecllc.com	630-987-0018
5.	Dave Tatterson	PEC	dtatterson@pecllc.com	630-841-8395
6.	Bryan Eskra	PEC	bjeskra@pecllc.com	262-786-1700 ext 201
7.	Steve Coons	PEC	jscoons@pecllc.com	312-466-1540 ext 103
8.	George Shibayama	PEC	gshibayama@pecllc.com	312-466-1540
9.	Matt Brown (by phone)	PEC	mwbrown@pecllc.com	312-953-5819
10.	Don Pacer	PEC	dwpacer@pecllc.com	312-466-1540 ext 102 312-466-1546 fax
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E-MAIL THIS FORM

This form may be submitted to CDB electronically as an attachment to meeting minutes. Attach the completed form to an e-mail addressed to the CDB Project Manager. All CDB e-mail addresses are available on our website: www.cdb.state.il.us.

APPENDIX 2
PEC PROJECT TEAM

PEC Professional Project Team

Matthew West Brown, P.E., BS, Member ASME, ASHRAE, NSPE, ISPE

John S. Coons, P.E., MSME, BSME, Life Member ASME

Bryan J. Eskra, P.E., BSE, Member ASME

William F. Geisheker, P.E., BSEE, Senior Member ISA

Daniel Gunderson, BSEE, Senior Member IEEE

Marshall Hjertstedt, AIA, SE, PE, LEED-AP

Thomas McCauley, P.E., MSEE, BSEE, Life Senior Member IEEE

Donald W. Pacer, P.E., BSME, Life Member ASME

Kenneth Robinson, Ph.D. ChE, MSChE, BSChE, Member ACS

George Shibayama, P.E., BSME, Member ASME

David Tatterson, Ph.D. ChE, MSChE, BSChE, Member AIChE, SAE

Arvin Villanueva, BSCE, Member ASCE, NSPE, PESO

APPENDIX 3

CDB/PEC MEETING MINUTES

AND

PEC WEEKLY REPORTS TO CDB

Minutes of Meeting

Description: CDB Project No. 651-000-025
SNG Plant Facility Range of Costs
Chicago, Cook County, Illinois
Kickoff/Orientation Meeting

Date: September 1, 2011

Location: 14th Floor, James R. Thompson Center

Attendees: See Attachment 1

The purpose of this meeting was to conduct the Kickoff/Orientation Meeting for the SNG Plant Facility Range of Costs Project.

Background

The CDB must calculate a range of capital and operations and maintenance costs that would be reasonable for a Clean Coal Brownfield facility to recover under a Sourcing Agreement. The CDB is authorized to retain an engineering firm to assist in calculating these costs. The Clean Coal Brownfield facility is being developed by Owner/Developer, Leucadia Corp, on the southeast side of Chicago. This project to calculate the range of costs, was initiated relatively quickly because the corresponding legislation was specifically written with an immediate requirement.

On August 29, 2011, PEC was advised of selection to assist the CDB in this effort. PEC received the executed contract and award letter on August 31, 2011.

Schedule

Per specification, PEC will target October 31, 2011 to submit the final report. PEC's support of CDB in presentations to the General Assembly will potentially extend the project duration to December 31, 2012.

Administrative

PEC will prepare a project directory and will include it with submittal of these meeting minutes, see Attachment 2.

Emily Zgonjanin will be CDB's Project Manager and primary contact. Karen Fredrickson of CDB Chicago and Lisa Mattingly of CDB Springfield will also participate in this project. Don Pacer will be PEC's primary contact.

Project communication can be by telephone and emails. Emily Zgonjanin to be copied on all emails and other project correspondence. PEC will provide weekly telecon project status summaries and written

Meeting Minutes

project status reports every 2 weeks to Emily Zgonjanin. The project status reports will contain a summary of work accomplished the past reporting period and what work is expected to be accomplished in the coming reporting period.

All correspondence and documents must contain the CDB project number, 651-000-025, the project title, “SNG Plant Facility Range of Costs”.

PEC will update the project schedule upon meeting with the Owner/Developer, and submit to CDB.

Project Issues

CDB advised that their objective is to compare the range of costs developed by PEC to the project costs from Leucadia, to determine if it is reasonable.

PEC advised that capital cost estimates for large projects often create misunderstandings between parties regarding the level of detail and level of accuracy that can be expected in the estimate. The estimate accuracy depends on how much information detail is available and how much time is allowed to develop the estimate. Mr. Shibayama stated that for the magnitude of the project, the time allowed for this task is inadequate to develop a $\pm 10\%$ estimate so that should not be expected. Ms. Zgonjanin agreed and advised that a range of costs is desired and expected, with the ultimate goal being to assure the Leucadia cost is reasonable. PEC’s scope is to prepare a budgetary-level estimate range of capital cost and operating and maintenance costs, with a level of detail commensurate with the plant information provided and the time allotted. PEC expects the estimate will be conservative to account for the uncertainty caused by the time and information constraints. PEC will then apply a contingency to satisfy the scope requirement for a range of costs.

PEC’s scope is to prepare a budget-level estimate based on the information in the documents provided by CDB or Leucadia. PEC’s scope does not include process or design validations, engineering checks, conceptual engineering, or detailed design engineering. The estimate will be budgetary to the extent that the information provided is conceptual in nature.

The project schedule proposed shows major headings, and detailed activities will be added as information is obtained from the Owner/Developer.

PEC requested, as stated in the proposal, that there be a meeting early next week with Owner/Developer Leucadia. PEC will have all the key senior staff and consultants in attendance at this meeting.

CDB stated that Leucadia has a Chicago presence through their (unnamed) consultant, who is based in the Chicago area. A Leucadia vice president-level officer is reportedly often at the consultant’s Chicago office. PEC does not know how much work Leucadia has done on this project. CDB reported that Leucadia has prepared a Front End Engineering and Design (FEED) document, and PEC requested a copy as soon as possible.

PEC emphasized that meeting the October 31 target is dependent on PEC receiving information in a timely manner, and recommended that CDB direct Leucadia to make direct contact with PEC and provide the necessary documents for PEC’s use. The information request made in PEC’s proposal, an excerpt from Section 6, Article 3.1.1.1 was reviewed.

Meeting Minutes

By September 9th, 2011, the Owner shall make available the following project documents on an FTP site to both the Illinois CDB and PEC. In order for PEC to be able to provide a meaningful Range of Costs for either Capital and Operating and Maintenance for the project by the October 31, 2011 deadline date, PEC requires the full set of these documents to be made available by September 15th.

1. *Site and building general arrangement drawings*
2. *Process flow diagrams (indicating range of mass flows, mass state, range of temperatures and pressures and number and size of processing equipment.)*
3. *Piping and instrument diagrams (can be preliminary)*
4. *Electrical single line diagram (can be preliminary)*
5. *Major equipment list*
6. *Driven Equipment list (can be preliminary)*
7. *Written project description covering all facility systems*
8. *Sourcing Agreement*
9. *Facility cost report*
10. *Assurance of cooperation from the facility Owner and the Illinois Power Agency in investigating the costs involved in the project*
11. *Owner's cost of individual major pieces of equipment.*

The accuracy of PEC's estimate will depend on the amount and quality of information that CDB provides to PEC. The better the information that PEC receives, the better the estimate that PEC can prepare. Considering the scheduled time frame, this project must be performed using extraordinary procedures, not always structured, in order to complete on time. PEC will accept Owner/Developer information piecemeal rather than waiting for a major information download. CDB should ask Leucadia to provide any quotes they may have for major equipment, and provide this information to PEC. Also, it should be understood that due to the compressed schedule duration, some tasks will be performed concurrently and/or out of the normal sequence, resulting in some inefficiency.

PEC provided clarification on their project scope after the final report submittal. PEC is to provide support for presentation to the General Assembly, and included an allotment of time in their proposal. CDB explained that the expectation would be 2 or 3 hearings maximum, as follows:

- 1 for Illinois Commerce Commission
- 1 for House committee
- 1 for Senate committee

Each hearing would be about 1-2 hrs plus preparation time beforehand, with probably the same presentation to each body. This was acceptable to PEC, with the understanding that PEC appearing as Expert Witness in any litigation is not in PEC's scope or budget.

CDB will meet internally on next Tuesday. CDB will arrange a meeting with Leucadia but it might not be until on Sep 9.

Emily Zgonjanin will try to contact Leucadia today, and communicate the above information request list to the Leucadia contact. CDB will also provide the Leucadia contact name so PEC can communicate and work directly.

Next 30 Days

Meeting Minutes

Prepare a work plan, meet with Owner/Developer, obtain Owner/Developer information, analyze the information, work on estimate, reach 50% complete.

Next Meeting

Meeting with Owner/Developer planned for next week.

Progress report to CDB next week.

Security

Not discussed.

Final Acceptance and Project Close Out

Not discussed.

Pay Progress

Not discussed.

Attachment 1

State of Illinois
CAPITAL DEVELOPMENT BOARD

ATTENDANCE RECORD

Project No.: 651-000-025
Project: SNG Plant Facility Range of Costs
Chicago, Cook County, Illinois

Meeting Description: Orientation/Kickoff Meeting
Date: 09-01-11
Time: 09:30 AM
Place: James R. Thompson Center

Attendant

	<u>Name & Title</u>	<u>Representing</u>	<u>E-mail</u>	<u>Phone & Fax Numbers</u>
1.	Emily Zgonjanin	CDB	Emilija.Zgonjanin@illinois.gov	312-814-6307 Fax 312-814-2041
2.	Mike Wilson (by phone)	CDB	Mike.Wilson@illinois.gov	
3.	George Shibayama	PEC	gshibayama@pecllc.com	847-909-2469 Fax 312-466-1546
4.	Don Pacer	PEC	dwpacer@pecllc.com	312-466-1540 ext 102 Fax 312-466-1546
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E-MAIL THIS FORM

This form may be submitted to CDB electronically as an attachment to meeting minutes. Attach the completed form to an e-mail addressed to the CDB Project Manager. All CDB e-mail addresses are available on our website: www.cdb.state.il.us.

Attachment 2

State of Illinois
CAPITAL DEVELOPMENT BOARD

PROJECT DIRECTORY

PROJECT NUMBER: 651-000-025 Date: 09-01-2011
PROJECT NAME: SNG Plant Facility Range of Costs
PROJECT LOCATION: Chicago, Cook County, Illinois
PROJECT ADDRESS: _____

1. CAPITAL DEVELOPMENT BOARD

Project Manager: Emily Zgonjanin E-mail: Emilija.Zgonjanin@illinois.gov
State of Illinois Phone: 312-814-6307 Cell:
Capital Development Board Fax: 312-814-2041 Pager:
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4. COORDINATING CONTRACTOR: Power Engineers Collaborative (PEC)

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Weekly Report

Description: CDB Project No. 651-000-025
SNG PLANT FACILITY RANGE OF COSTS
PEC Activities for Week Ending September 16, 2011

Date: September 16, 2011

Weekly Progress

PEC and PEC consultants, MFH Associates and Terra Engineering, have executed the Confidentiality Agreement with CCE.

PEC met with CCE and Black & Veatch at the DLA Piper office to review the pre-Front End Engineering and Design document prepared by Black & Veatch for the State of Illinois. A table of contents showing the topics discussed is attached. In hard copy, this amounted to eighteen (18) legal boxes of backup documents.

PEC was given access to the B&V website containing the electronic files of B&V's study scope. We have archived these electronic files to a secure PEC FTP site for the PEC project team's use. Initial reviews show these electronic files to be very complete, to the extent of the B&V scope of the Facility.

We have been focusing on the capital cost estimates associated with the major process equipment and systems. cursory incidental review of the design from a technical point of view produced no unfavorable comments. We have a historical in house data base for coal and coke covering most of the technology units in the process design, including historical data for:

- Coke Grinding and Slurry
- Coke Feed
- Air Separation Units
- Gasification (Texaco Quench)
- Syngas Scrubbers,
- Shift Conversion,
- Rectisol (acid gas removal)
- Slag Removal Unit (SRU) and Tail Gas Unit (TGU)
- Slag and Fines Handling

We are adjusting our database numbers to the CCE scale and to 2010 funds, using the chemical equipment process cost index (CEPCI) an industry-accepted metric. In our preliminary independent review of individual process components, PEC's estimated equipment costs on the above processes are in line with those of the B&V estimate.

Upcoming

We are examining other SNG industry information for the Methanation area and will complete this review next week.

We are initiating our capital cost review of the following areas, and we expect preliminary results next week on:

Weekly Report

Piping
Electrical
Power Block
Switchyard
Transmission Line
Buildings
Site Work

We are also examining and developing the estimated operating and maintenance costs, to determine the extent of in house information vs. the outside-source data we will need.

Open Items

PEC has reviewed the Sourcing Agreement, and we are identifying specific elements of the Facility and their boundaries that are not part of the B&V scope, and we will request clarification from CBD on this matter.

Attachment 1



CCE Report to the State of Illinois
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2.0 Core Facility

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- Process Description
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- Project Design Basis
- Performance Summary – Refer to Appendix C

2.4 Design & Estimating Basis

2.4.1 General

- Basic Engineering Design Data

2.4.2 Process

- Utility Summary
- Catalyst and Chemical Summary
- Coal - Coke Handling Design Basis
- Equipment List
- Motor List
- PFDs - Refer to Appendix D

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- Drainage Design Basis
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- Foundation Scope Document
- Site-work Scope Document
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2.4.5 Piping / Fire Protection

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- Estimate Summary
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- Construction Estimate Backup

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- 3.2 Gas Pipeline Interconnection Options for CCE Calumet Facility - ICF 022510
- 3.3 Carbon Dioxide Sequestration Feasibility and Cost Analysis – CCE April 2010 and CCE SNG and CO2 Pipelines – EN Draft Report 040510
 - CCE SNG and CO2 Pipelines - Drawings - ENE 040510
 - CCE SNG and CO2 Pipelines - Maps - ENE 040510
- 3.4 Pipeline Cost Summary - ENE 031610
- 3.5 CO2 Sequestration Potential in Northeastern Illinois - ISGS 030810
- 3.6 CCE CO2 Draft Report - Schlumberger
- 3.7 Not Used
- 3.8 Interconnection Assessment for Proposed Chicago Clean Energy Facility - ICF 012910
- 3.9 Preliminary Engineering Report for Process & Fire Water Intake System-Valdes-040610
- 3.10 Preliminary Engineering Report for Natural Gas and Potable Water Supply and for Sewer Discharge-Valdes-040610
- 3.11 Probable Construction Costs for Burley Avenue Improvements - ME 032510
 - For Drawings see Appendix L
- 3.12 Preliminary Engineering Report for Facility Main Office & Parking-Valdes-040610
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4.0 Operation & Maintenance

- 4.1 O&M Plan and Estimate
 - Salary Schedule - CCE 040810
- 4.2 Scope & Estimating Basis
 - EIA Annual Energy Outlook 2010
 - CCE Petcoke Price Forecast - Jacobs – 042810
 - Sulfur Marketing Summary - 042910



- Non-Binding Proposal for CFT Terminal Services for Coal and Petcoke - DTE 031710
- Probable Costs for Slag Removal - ME 032510

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5.0 Environmental & Permitting

5.1 Land – Remediation

- Preliminary Subsurface Investigation Report - DAI 030110
- “Hot Spot” Remediation and NFR Cost Estimates - DAI - 040510
- CCE Construction Support Opinion Report - DAI - 040510
- Probable Construction Costs for "Bath-Tub" Site Preparation - ME 032510
- Probable Construction Costs for Existing Concrete Removal - ME 032510

5.2 Not Used

5.3 Technical Project Plan and Air Permitting Strategy URS-040510

5.4 Regulatory Analysis of Water Withdrawal and Use URS-040510

5.5 Estimate Summary

6.0 Facility Cost Estimate

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- A Block Flow Diagram
- B Plot Plan
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- D Process
- E Mechanical Equipment Data Sheets

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VOLUME 8

- L Roadway Drawings
- N **Engineering Company Qualifications - Black & Veatch**

**Black & Veatch and Owner/Developer Meeting
10:00 AM Monday, September 12, 2011
DLA Piper Chicago Office**

Chris Townsend
Hoyt Hudson
David Hagen
Greg Wayne

Dave Tatterson
Matt Brown
Don Pacer

Sourcing Agreement – still work in progress.

Confidentiality Agreement with PEC is OK. There will still be other C/As with licensors.
Have the two PEC subs sign off now.

Leucadia person would come here from Grand Rapids Friday if PEC wants. Hold off for now.

How is the website arranged?

18 boxes, all titled. But we prefer the efiles.

Greg Wayne discusses the information.
Using the website
See table of contents

A 16 volume set with 20 units
B&V had 7 months to do the estimate including licensors and MTOs, etc. Normally would be at least 12 months.

The MTOs are not FULL MTOs, key areas only.

GE and Holder Topsoe and Lurgi are the licensors.

TOC section 2.4 is the Estimate basis.

Demo is ongoing at site now. This is 90% complete.

There will be a Single Overall Control System for the Project with one (1) Control Room.

B&V's scope is Feedstock In to Gas Out.

Outside core facility – by local third party companies
Core is ISBL (inside battery limits) and OSBL (outside battery limits).
B&V does core.

TOC section 4.0 is O&M

Zero Liquid Discharge – mostly zero.
Then an oil/water separator.
Rain runoff is not included.

Turndown of 25% with the gasifier trains.

Fuel analyses are in the design basis.

Estimate aimed for overall $\pm 20\%$ accuracy did not always meet this.

Assumed April, 2010 data date for money.

Site demolition is not in the B&V estimate, and it is not supposed to be.

\$20 million remediation is not in B&V's estimate.

DTE blends – B&V has only 1 set of fuel silos.

B&V does the final fuel crushing and sizing.

B&V has 8-hours fuel storage onsite, dual conveyors.

40,000 HP for each ASU compressor – verify this figure.

The ASU island has its own cooling tower.

Liquid sulfur – a product that will be shipped out.

2 x 50% trains throughout the plant, except for 2 x 55% for ASU.

All drives are electric, no steam turbines.

Won't use or export >50 MW, so adjacent transmission systems are OK.

There will be no metals recovery from the slag or ash. No recovery of vanadium or nickel.

Greg Wayne will respond to any questions.

Also get a copy of the 9/8 PowerPoint presentation.

Weekly Report

Description: CDB Project No. 651-000-025
SNG PLANT FACILITY RANGE OF COSTS
PEC Activities for Week Ending September 23, 2011

Date: September 23, 2011

Weekly Progress

We addressed CCE's concerns about proprietary information related to three specific Licensors of technology at the SNG Facility. PEC signed and returned the confidentiality agreement with Haldor Topsoe (Methanation) but have not heard back. We have heard nothing of substance from GE (Gasification Process) or Lurgi (Rectisol Acid Gas Removal Process). Thus far we have been able to use our own methods to review these licensed technologies, but if proprietary examination is required during the course of the analysis, the paperwork is not yet in place.

We continued our familiarization and review on the CCE files of documents, charts, and drawings. We submitted 5 inquiries to CCE and B&V regarding non-Licensor-sensitive processes and estimates. To date we have received one response and expect the remainder next week.

We have continued to focus on the Process design areas, and have extended our Capital Cost estimate review to the following Factored areas:

- Methanation
- Glycol Dehydration
- CO₂ Thermal Oxidizer
- CO₂ Compression
- Flare System

Most of these cost estimates will be based on Capcost, a software that produces estimated cost of common plant equipment, such as compressors, vessels and heat exchangers.

In the Material Take Off capital cost Areas, our estimates are based on historical data which we have in our files. These estimates are scaled for plant size and adjusted for inflation using the CEPCI index.

In the Balance of Plant Areas we have begun reviews of the Capital Cost estimates for the Site work, Buildings/Foundations/ and Structural Steel, Piping, and Power Block. In our preliminary review, the stormwater management system Capital Costs were found to be reasonable.

In the Process area we have begun working up the Operating and Maintenance expenses for the various sections of the plant. We reviewed the CCE estimates for operating labor, maintenance labor, and replacement costs. We will continue to examine these in greater detail, and compare with those of large facilities similar to the SNG project.

Per scope clarification from the CDB, our assignment will not include:

- Evaluation of systems outside the facility fence line, such as piping systems delivering compressed CO₂ to outlying facilities for sale or sequestration.

- Verification of selling price or potential revenue of facility byproducts such as CO₂, slag, Argon, Sulfur.

Weekly Report

Upcoming

We will continue expanding our capital cost review next week, and will move into analyzing the Electrical, Switchyard, and Transmission Line costs.

At this time, PEC is on schedule to provide the Draft Report to CDB by Oct 15.

Open Items

Nothing to report.

Weekly Report

Description: CDB Project No. 651-000-025
SNG PLANT FACILITY RANGE OF COSTS
PEC Activities for Week Ending September 30, 2011

Date: September 30, 2011

Weekly Progress

We received the executed confidentiality agreement from Methanation Licensor, Haldor Topsoe. We still have heard nothing from GE (Gasification Process) or Lurgi (Rectisol Acid Gas Removal Process). Thus far we have been able to use our own methods to review these licensed technologies, but if proprietary examination is required during the course of the analysis, the paperwork for two Licensors is not yet in place.

We continued our review on the CCE files of documents, charts, and drawings. We received responses from CCE on all previously submitted information requests, and have submitted an additional two inquiries.

This week we began analyzing the electrical capital cost scope in detail. We added electrical engineering consultants Tom McCauley of ConConCo and Dan Gunderson to the PEC team, to assist in the electrical area reviews and to prepare the electrical sections of the report. Copies of their resumes are attached.

We have completed most of the reviews on capital cost of the Process design areas, and have returned to the flare system and SNG compression for further analysis and refinement.

We have continued to review the reports and plans in regards to the site and civil scope. We noted that the site remediation and disposal scope is segmented to be an Owner's Cost, outside of the B&V estimate. We have not yet found a landscaping value in the report.

We are continuing to work through the Structure related costs, and in the areas we have checked through have shown no unusual findings. For major elements in the design/cost, like steel and foundation piles, the estimate includes actual quotes from potential suppliers. In the cases where there are multiple competitive bids we are finding very good budget figure ranges. The foundation report is agreeable and the foundation recommendations appear to have been followed through the design documents and cost estimates. Some of the building related costs are a little difficult to follow in how they are put together, the difficulty being searching through all the estimates to see if everything is accounted for in the summaries. Again, thus far there have been no building area findings out of the ordinary.

In the Piping and Power Block areas we developed spreadsheets to tabulate the equipment costs following the B&V format, and completed most of our equipment capital cost review for the following areas:

- Raw Water Treatment
- Demin Water System
- Process Wastewater Treatment
- Condensate and BFW System
- Oily Water System
- Cooling Tower
- Plant Instrument Air System

Weekly Report

Power Generation Diesel and Gasoline Storage

We have an inquiry in to CCE on the Firewater System regarding equipment cost data sheets, documentation, Drawings, on how the cost was obtained.

In addition to using the previously-reported Capcost software and the CEPCI index, we began reviewing the AACE cost classification system for the range and accuracy to assign to our assessments.

We have continued to examine operating and maintenance costs for the facility. We will continue to examine these in greater detail, and will meet with CCE representatives on this subject next week.

Upcoming

We expect to make significant progress on buildings and electrical areas in another week

In review of the stormwater management system, we understand that the system will primarily be a gravity system utilizing overland flow, swales (concrete/earthen), and pipes to convey the runoff into the ponds located east of the railroad. By next week, we expect to have preliminary progress value for this segment of construction prior to issuance of the Draft Report.

We will continue expanding our analysis of the O&M costs, including an O&M meeting Tuesday when CCE representatives will explain their O&M approach.

We expect to be approaching draft-level estimate completion by the end of next week, then to be followed by the text of the Draft Report the following week. At this time, PEC is on schedule to provide the Draft Report to CDB by Oct 15.

Open Items

Nothing to report.

Weekly Report

Description: CDB Project No. 651-000-025
SNG PLANT FACILITY RANGE OF COSTS
PEC Activities for Week Ending October 7, 2011

Date: October 7, 2011

Weekly Progress

No further activity on securing confidentiality agreements with GE (Gasification Process) or Lurgi (Rectisol Acid Gas Removal Process). Thus far we have been able to use our own methods to review these licensed technologies, but if proprietary examination is required during the course of the analysis, the paperwork for two Licensors is not yet in place.

We continued our review on the CCE files of documents, charts, and drawings. We received responses from CCE on two previously submitted information requests, and have submitted an additional three inquiries.

We returned to a more detailed review of the flare system and SNG compression, and have now essentially completed the capital cost reviews of the Process design areas. It was necessary to make engineering assumptions on SNG compression, in that we continue to await supplemental information from CCE. We developed the preliminary range and accuracy assessments for the installed cost estimates in the Process design areas.

Similarly in the Piping and Power Block areas we received clarification from CCE on the Firewater System equipment cost data sheets, and have completed the capital cost reviews in the Piping and Power Block areas. We have prepared the preliminary range and accuracy assessments of installed cost estimates for these areas, and have listed areas of assumptions and bases for our conclusions.

We have continued to further evaluate the quantity takeoffs for the Civil scope and are preparing our draft section of the report. It was determined that the Landscaping value is included in the Interconnections/OSBL area of the B&V report.

We are continuing to examine the Structure related costs, and do not find any unusual scope items or budget figures. We are proceeding with the range of installed capital costs for structures, foundations, and buildings. We are reconciling how our previously-checked individual structural costs are built into the overall budget figures, in order to increase our confidence in the range and accuracy conclusions.

We continued to analyze the Electrical capital cost scope in detail, and expect to have a preliminary range of results early next week.

Regarding the Operating and Maintenance estimates, this week we participated in a presentation meeting on this subject with CCE representatives. Minutes of this meeting have been submitted separately. We have completed our preliminary analysis of most O&M costs and developed the corresponding ranges.

Weekly Report

Upcoming

We have prepared the preliminary text of the Draft Report and estimates, and will continue with in-house review and revising throughout the next week. We plan to issue the Draft Report to CDB on Oct 14.

Open Items

There are two Request for Information communications pending with CCE, concerning catalyst materials and the treatment of system modularization.

Weekly Report

Description: CDB Project No. 651-000-025
SNG PLANT FACILITY RANGE OF COSTS
PEC Activities for Week Ending October 14, 2011

Date: October 14, 2011

Weekly Progress

No further activity on securing confidentiality agreements with GE (Gasification Process) or Lurgi (Rectisol Acid Gas Removal Process). Thus far we have been able to use our own methods to review these licensed technologies, but if proprietary examination is required during the course of the analysis, the paperwork for two Licensors is not yet in place.

We continued our review on the CCE files of documents, charts, and drawings. We received responses from CCE on two previously submitted information requests, and one additional inquiry remains open.

All disciplines completed their respective inputs on the range of capital costs and the range of operating and maintenance costs.

All disciplines completed their respective inputs to the Draft version of the Report, and participated in the in-house reviews and editing.

Upcoming

We have prepared the Draft Report and will issue it to CDB by end of business on Oct 14.

Open Items

There is one Request for Information communications pending with CCE, concerning the treatment of system modularization.

We will await CDB's review comments on the Draft Report.