Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT)

Quarterly Technical Progress Report No. 11

For the Period

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ABSTRACT

The Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT) project is evaluating integrated electrical power generation and methanol production through clean coal technologies. The project is conducted by a multi-industry team lead by Gasification Engineering Corporation (GEC), a company of Global Energy Inc., and supported by Air Products and Chemicals, Inc., Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation. Three project phases are planned for execution over a three year period, including:

I. Feasibility study and conceptual design for an integrated demonstration facility, and for fence-line commercial embodiment plants (CEP) operated at Dow Chemical or Dow Corning chemical plant locations
II. Research, development, and testing to define any technology gaps or critical design and integration issues
III. Engineering design and financing plan to install an integrated commercial demonstration facility at the existing Wabash River Energy Limited (WREL) plant in West Terre Haute, Indiana.

The WREL facility is a project selected and co-funded under the Round IV of the U.S. Department of Energy's (DOE's) Clean Coal Technology Program. In this project, coal and/or other solid fuel feedstocks are gasified in an oxygen-blown, entrained-flow gasifier with continuous slag removal and a dry particulate removal system. The resulting product synthesis gas is used to fuel a combustion turbine generator whose exhaust is integrated with a heat recovery steam generator to drive a refurbished steam turbine generator. The gasifier uses technology initially developed by The Dow Chemical Company (the Destec Gasification Process), and now offered commercially by Global Energy, Inc., as the E-GAS™ technology.

In a joint effort with the DOE, a Cooperative Agreement was awarded under the Early Entrance Coproduction Plant (EECP) solicitation. GEC and an Industrial Consortium

are investigating the use of synthesis gas produced by the E-GAS™ technology in a coproduction environment to enhance the efficiency and productivity of solid fuel gasification combined cycle power plants.

During the reporting period, various methods to remove low-level contaminants for the synthesis gas were reviewed. In addition, there was a transition of the project personnel for GEC which has slowed the production of the outstanding project reports.

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ACRONYMS AND DEFINITIONS

Acronym	Description
ASU	Air Separation Unit
BFW	Boiler Feed-Water
BGL	British Gas Lurgi
CC	Combined Cycle (plant including only HRSG, CT & ST)
CEP	Commercial Embodiment Plant
CT	Combustion Turbine
CCT	Clean Coal Technologies
DCAA	Defense Contract Audit Agency
DOE	Department of Energy
EECP	Early Entrance Coproduction Plant
E-GAS™	Title of Global Energy, Inc.'s Gasification Process
EVA	Energy Ventures Analysis Inc.
GEC	Gasification Engineering Corporation
GJ	Giga Joule
GPMEOH	Gas Phase Methanol
GTW	Gas Turbine World
HHV	Higher Heating Value in Btu/SCF
HRSG	Heat Recovery Steam Generator
HTHRU	High Temperature Heat Recovery Unit
IGCC	Integrated Gasification Combined Cycle
IMPPCCT	Integrated Methanol and Power Production from Clean Coal Technologies
KPaa	Kilo Pascals Atmospheric (pressure)
KPag	Kilo Pascals Gauge (pressure)
LGTI	Louisiana Gasification Technology Incorporated
LOX	Liquid Oxygen

Acronym	Description
LPMEOH™	Liquid Phase Methanol (process)
MAC	Main Air Compressor
MDEA	Methyl-Di-Ethanol Amine (solvent)
MeOH	Methanol
MMBtu	Million British Thermal Units
MP	Medium Pressure
Mt	Metric Ton
MTPD	Metric Ton Per Day
MW	Mega Watt
NETL	National Energy Testing Laboratory
NOAA	National Oceanic and Atmospheric Administration
NOx	Oxides of Nitrogen (symbol)
NPV	Net Present Value
O&M	Operating & Maintenance
PPMV	Parts Per Million Volume
PSE	Power Systems Engineering
RD&T	Research, Development & Test (plan)
Q	Heat Flow in MMBtu/Hour
SCF	Standard Cubic Foot
SFC	Synthetic Fuels Corporation
SRC	Steam Raising Converter
ST	Steam Turbine
SWPC	Siemens Westinghouse Power Corporation
Syngas	Synthesis Gas
TPD	Tons Per Day
WBS	Work Breakdown Structure (activities)
WREL	Wabash River Energy Ltd.

1.0 BACKGROUND

1.1 E-GAS™ Process Background

The Gasification Engineering Corporation (GEC) headquartered in Houston Texas, develops and markets the E-GAS™ coal gasification process. The E-GAS™ technology is utilized at the Wabash River Energy Ltd., (WREL) facility, which is located at Cinergy's Wabash River Generating Station in West Terre Haute, Indiana. GEC and WREL are wholly owned subsidiaries of Global Energy, Inc., headquartered in Cincinnati Ohio.

The E-GAS™ process features an oxygen-blown, continuous-slagging, two-stage, entrained-flow gasifier, which uses natural gas for start-up. Coal or petroleum coke is milled with water in a rod-mill to form slurry. The slurry is combined with oxygen in mixer nozzles and injected into the first stage of the gasifier, which operates at 2600°F and 400 psi. A turnkey, Air Liquide, 2,060-ton/day low-pressure cryogenic distillation facility that WREL owns and operates, supplies oxygen of 95% purity.

In the first stage, slurry fuel undergoes a partial oxidation reaction at temperatures high enough to bring the coal's ash above its melting point. The fluid ash falls through a taphole at the bottom of the first stage into a water quench, forming an inert vitreous slag. The synthesis gas produced by this reaction then flows to the second stage, where additional coal slurry is injected. This coal is pyrolyzed in an endothermic reaction with the hot synthesis gas to enhance the heating value of the synthesis gas and to improve overall efficiency of the process.

The synthesis gas then flows to the high-temperature heat-recovery unit (HTHRU), essentially a fire tube steam generator, to produce high-pressure saturated steam. After cooling in the HTHRU, particulates in the synthesis gas called char are removed in a hot/dry filter and recycled to the gasifier where the carbon content in the char is converted into synthesis gas. The synthesis gas is further cooled in a series of heat exchangers, is water scrubbed for chloride removal, and is passed through a catalyst,

which hydrolyzes carbonyl sulfide into hydrogen sulfide. Hydrogen sulfide is removed from the synthesis gas using a methyl-di-ethanol-based amine solvent in an absorber/stripper column process. The “sweet” synthesis gas is then moisturized, preheated, and piped over to the power block.

The key elements of the power block are the General Electric MS 7001 FA (GE 7 FA) high-temperature combustion turbine/generator, the heat recovery steam generator (HRSG), and the repowered steam turbine. The GE 7 FA is a dual-fuel turbine (synthesis gas for operations and No. 2 fuel oil for startup) that is capable of generating a nominal 192 MW when firing synthesis gas, about seven percent (7%) higher power production than the same turbine fired on natural gas. The enhanced power production is attributed to the increased mass flows associated with synthesis gas. Steam injection is used for control of nitrogen oxides called NOx within the combustion turbine. The required steam flow is minimal compared to that of conventional systems as the synthesis gas is moisturized at the gasification facility, by recovery of low-level heat in the process. The water consumed in this process is continuously made up at the power block by water treatment systems, which clarify and further treat river water.

The HRSG for this project is a single-drum design capable of superheating 754,000 lb/hr of high-pressure steam at 1010°F, and 600,820 lb/hr of reheat steam at 1010°F when operating on design-basis synthesis gas. The HRSG configuration was specifically optimized to utilize both the gas-turbine exhaust energy and the heat energy made available in the gasification process. The nature of the gasification process in combination with the need for strict temperature and pressure control of the steam turbine led to a great deal of creative integration between the HRSG and the gasification facility. The repowered steam turbine produces 104 MW, which combines with the combustion turbine generator’s 192 MW and the system’s auxiliary load of approximately 34 MW to yield 262 MW (net) to the Cinergy grid.

The Air Separation Unit (ASU) provides oxygen and nitrogen for use in the gasification process but is not an integral part of the plant thermal balance. The ASU uses services

such as cooling water and steam from the gasification facilities and is operated from the gasification plant control room.

The gasification facility produces two commercial by-products during operation. Sulfur, which is ultimately removed as 99.99 percent pure elemental sulfur, is marketed to sulfur users. Slag is targeted as an aggregate in asphalt roads and as structural fill in various types of construction applications. In fact, the roads at the WREL Facility have been top-coated with asphalt incorporating slag as the aggregate. Furthermore, at least two surrounding area sites have been audited, approved, and have used WREL generated slag as structural fill under the Solid Waste Management Rules of Indiana. Another beneficial use of the slag by-product is as a fluxing agent during petroleum coke operation as this feed is typically deficient in mineral content required for proper slag fusion and flow. For this use, WREL has retained a reserve supply of slag generated from coal gasification.

The E-GAS™ process flow diagram presented in Figure 1.1.1 illustrates the features and components described in the above text. In Table 1.1.1, the WREL production statistics during the demonstration period of the Clean Coal Technology Program are presented in both English and Metric units. In Table 1.1.2, the WREL thermal performance variables are compared to the process design basis for both coal and petroleum coke feedstocks.

Please refer to the listing in Section 8.1 of this report for additional information on the Wabash River Coal Gasification Plant.

Figure 1.1.1: E-GAS™ Process Flow Diagram

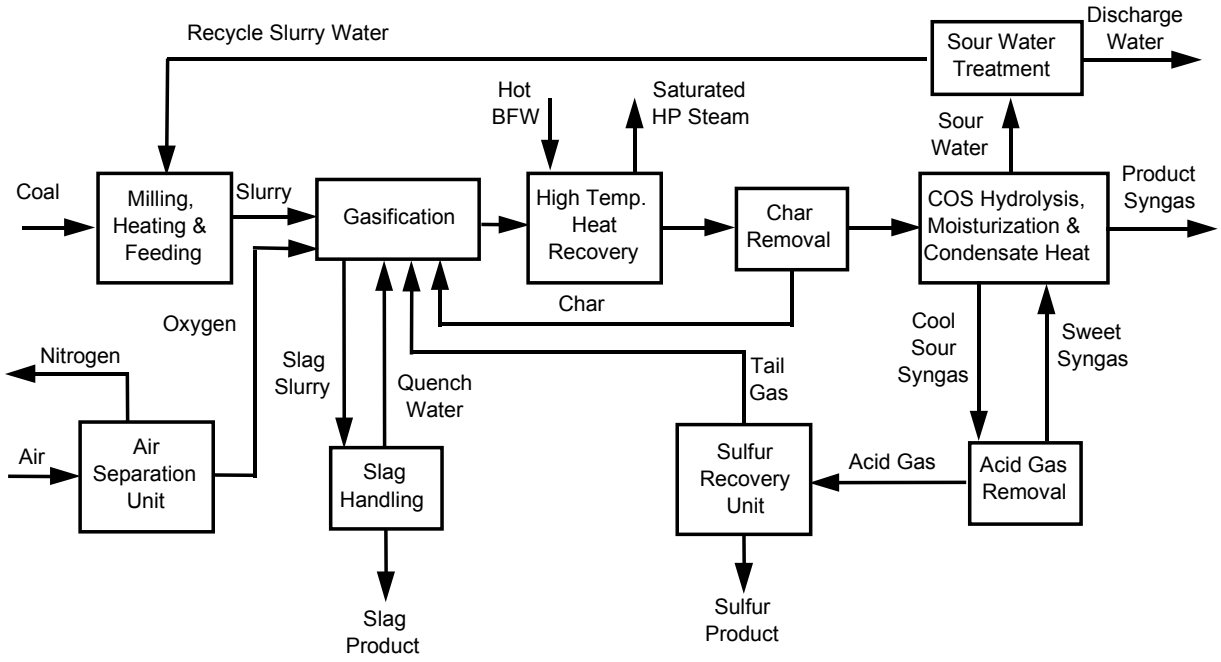

Table 1.1.1 - WREL Gasification Production Statistics during the Demonstration Period of the Clean Coal Technology Program

Production Variable	Production Year				
	1996	1997	1998	1999	2000
Gasifier Operation, Hrs	1,902	3,885	5,279	3,496*	3,406**
Dry Synthesis Gas Produced, GJ (MMBtu)	2,922,015 (2,769,683)	6,555,626 (6,213,864)	9,316,716 (8,831,011)	6,132,874 (5,813,151)	5,497,588 (5,210,984)
Coal Processed, Mt (Tons)	167,270 (184,381)	356,368 (392,822)	500,316 (551,495)	335,538 (369,862)	290,034 (319,703)
Longest Operating Campaign, (days)	19	46	82	60	104

***** Three months of production were lost to the GE 7FA compressor failure & repair.
** Three months of production were lost during commercial negotiations required when the WREL Facility transitioned to market-based operation.

Table 1.1.2: Overall Thermal Performance of Gasification at WREL

Performance Feature	Design	Actual Performance	
		Coal	Coke
Nominal Throughput, TPD	2550	2450	2000
Synthesis gas Capacity, MMBtu/hr	1780	1690†	1690†
Combustion Turbine, MW	192	192	192
Steam Turbine, MW	105	96	96
Aux. Power, MW	35	36	36
Net Generation, MW	262	261	261
Plant Efficiency, % (HHV)	37.8	39.7	40.2
Sulfur Removal Efficiency, %	>98	>99	>99

† Synthesis gas capacity referenced for coal and petroleum coke are the actual quantities fed to the combustion turbine when 192 MW (100%) of power generation occurs.

1.2 EECP Background Information

The request for Cooperative Agreement Proposals under the "Early Entrance Coproduction Plant (EECP)," Solicitation Number DE-SC26-99FT40040 was issued on February 17, 1999, by the United States Department of Energy.

The objective of this effort is to determine the feasibility of an EECP located at a specific site which produces some combination of electric power (or heat), fuels, and/or chemicals from synthesis gas derived from coal, or, coal in combination with some other carbonaceous feedstock. The scope of this effort includes:

a. Market analysis to define site-specific product requirements (i.e. products needed by market, market size, and price), process financials, feedstock availability, and feedstock cost;

b. System analysis to define feedstocks, feedstock preparation, conversion to synthesis gas, synthesis gas cleanup, and conversion of synthesis gas to market-identified products;
c. Preliminary engineering design of the EECP facility;
d. Preparation of a research, development, and test (RD&T) plan that addresses the technical uncertainties associated with eventual design, construction, and operation of the EECP;
e. Implementation of RD&T Plan;
f. Revision of the preliminary engineering design; and
g. Preparation of a project financing prospectus for obtaining private sector funding to perform the detailed design, construction, and operation of the EECP.

Efforts under Solicitation No. DE-SC26-99FT40040, must support an Early Entrance Coproduction Plant that at a minimum:

1. Is a single-train facility of sufficient size to permit scaling to commercial size with minimal technical risk;
2. Provides the capability of processing multiple feedstocks (must be capable of processing coal) and producing more than one product;
3. Is undertaken by an industrial consortium;
4. Reduces risk such that future coproduction plants may be deployed with no government assistance; and
5. Meets or exceeds environmental requirements and discusses the issue of carbon dioxide reduction by one or more routes, which include mitigation, utilization, and sequestration.

Using a focused RD&T Plan, the EECP Project will enhance the development and commercial acceptance of coproduction technology that produces high-value products, particularly those that are critical to our domestic chemical, fuel, and power requirements. The proposed project will resolve critical knowledge and technology gaps on the integration of gasification and downstream processing to coproduce some combination of power, fuels and/or chemicals from coal or coal in combination with

other carbonaceous feedstocks. The project's intended result is to provide the necessary technical, financial, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

2.0 INTRODUCTION

The Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT) project is a $4.92 million cooperative agreement between the United States Department of Energy (DOE) and the Gasification Engineering Corporation (GEC) to evaluate the integration of gasification-based electrical generation and methanol production processes to determine the economic and technical feasibility of power/chemicals coproduction. A multi-industry team led by GEC and consisting of Air Products & Chemicals, Inc., Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation will perform the IMPPCCT study.

The consortium for the Wabash River IMPPCCT plans to analyze and develop a concept of methanol and power production based on GEC's E-GAS^{TM} Gasification Process utilizing coal and other feedstocks. In a planned three-Phase project, this team plans to review and fully analyze the domestic methanol market, examine the criteria needed and develop a robust financial model to study the economics of full-scale implementation of this gasification-methanol coproduction concept. Potential Dow Chemical and Dow Corning sites for the Commercial Embodiment Plant (CEP) will be examined. Feasibility studies, testing and engineering, and financing of IMPPCCT based on addition of methanol production facilities at the Wabash River Energy Limited (WREL) Gasification Plant in West Terre Haute, Indiana will be developed to enable the commercialization of the gasification-methanol production concept.

The vision of this project is to demonstrate the commercial viability of producing electric power, process energy (steam), and chemicals (methanol) from coal and other hydrocarbon feedstocks to satisfy the demands of at least two types and corresponding sizes of host chemical complexes. An efficient, low capital, integrated facility will convert the feedstock initially to synthesis gas and ultimately to electric power, process energy, and methanol with a series of reliable, commercially proven, and environmentally sound unit operations. The chemical products, required process energy, and at least a portion of the electric power will be delivered to the host chemical

complex for further conversion to higher value products. Any products in excess of the requirements of the host chemical complex will be sold through readily accessible distribution networks. The CEP will be technically verified from the IMPPCCT demonstration and commercially verified by an economic model and a project financing prospectus.

3.0 EXECUTIVE SUMMARY

The Wabash River Repowering project, a joint effort between Wabash River Energy Limited (WREL) and Cinergy, was selected and co-funded under Round IV of the United States Department of Energy's (DOE's) Clean Coal Technology Program. In this project, coal and/or other solid fuel feedstocks are gasified in an oxygen-blown, entrained-flow gasifier with continuous slag removal and a dry particulate removal system. The resulting product synthesis gas is used to fuel a combustion turbine generator whose exhaust is integrated with a heat recovery steam generator to drive a refurbished steam turbine generator. The gasifier uses technology initially developed by The Dow Chemical Company (the Destec Gasification Process), and now offered commercially by Global Energy, Inc., the parent company of WREL, as the E-GAS™ technology.

The Clean Coal Technology project demonstration was completed in December 1999, having achieved all of its objectives. The facility built for this project is located at Cinergy Corporation's Wabash River Generating Station near West Terre Haute, Indiana.

The WREL project successfully demonstrated commercial application of the E-GAS™ coal gasification technology in conjunction with power generation. Operating time exceeds 18,000 hours, with over 5 million MWh of power produced. The combustion turbine generates 192 MW and the repowered steam turbine generates 104 MW. With the system's parasitic load of 34 MW, net power production is 262 MW, which meets the target goal. The plant operates successfully on baseload dispatch in the Cinergy power grid, and continues to operate as a privately owned facility providing power to Cinergy.

Gasification is an environmentally superior means of utilizing domestic coal resources for power production. It also offers the opportunity to use lower quality, less expensive feedstocks such as petroleum coke. Petroleum coke operation was tested and has

been commercially demonstrated at the WREL Facility since August of 2000, resulting in over 3300 hours of operational experience.

Sulfur removed from the gasifier's solid feed is recovered and sold, as is the slag byproduct. Sulfur removal exceeds 97% resulting in SO_X emissions of 0.1 lb/million Btu, which is far below regulatory requirements of 1.2 lb/million Btu. Particulate emissions are less than the detectible limit and NOx emissions are 0.15 lb/million Btu, which meets the current target for coal-fired power generation plants. The WREL Facility is one of the cleanest if not the cleanest solid fuel based power plants in the world.

In a joint effort with the U.S. Department of Energy (DOE), a Cooperative Agreement titled "Integrated Methanol and Power Production from Clean Coal Technologies" (IMPPCCT), was awarded under the Early Entrance Coproduction Plant (EECP) solicitation to Gasification Engineering Corporation (GEC). An Industrial Consortium led by GEC is investigating the use of synthesis gas produced by the E-GAS™ technology in a coproduction environment to enhance the efficiency and productivity of solid fuel gasification combined cycle plants.

The objective of this effort is to determine the feasibility of an EECP located at a specific site which produces some combination of electric power (or heat), fuels, and/or chemicals from synthesis gas derived from coal, or, coal in combination with some other carbonaceous feedstock. The project's intended result is to provide the necessary technical, financial, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

During this period, various methods to remove low-level contaminants for the synthesis gas were reviewed. Several processes were identified that had the potential to clean the synthesis gas of trace contaminants that would foul or poison the methanol synthesis catalysts. Unfortunately most of these processes are currently in the laboratory testing phase of development and will require more testing both in the

laboratory and in an industrial environment. Even with the additional testing requirements, several of the identified technologies should be available for use in the next few years.

In addition, a transition of the project personnel for the GEC team has hampered the production of project reports.

For the period of reporting, actual expenditure for the reporting period was $20,849. The amounts include funding from DOE that is at 80% of the total, and cost share provided by the consortium members. The figures are a reflection of actual invoice totals to the DOE and are current for the period of report issue. Total budget for the project is $1,933,628, with DOE providing $1,546,902. Total project spending to-date is about 40.6% of Phase I budget.

4.0 ACTIVITIES

4.1 Reporting/Personnel Transition Activity

The overriding activity this reporting period has been the familiarization of the new team members with the project, procedures, and with the reporting requirements.

4.2 Synthesis Gas Contaminant Removal Activity

During this period, the review of methods for the removal of contaminants from the product synthesis gas continued. The technologies reviewed include regenerable and non-regenerable systems for removing trace levels of contaminants in synthesis gas. Most of these technologies were under development. These contaminants are known poisons for methanol synthesis catalysts. Information was provided under certain confidential arrangement with Global Energy, which can be disclosed to DOE with the agreement from the provider. The contaminants to be removed include lead, mercury, arsenic, sulfur, and other catalyst poisons. The processes reviewed included current technology and technologies currently under investigation that should be commercially available in the timeframe need for the CEP.

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5.0 RESULTS AND DISCUSSION

The consortium for the WREL IMPPCCT project, led by Gasification Engineering Corporation, and including Dow Corning Corporation, The Dow Chemical Company, Air Products and Chemicals Inc., Methanex Corporation, and Siemens Westinghouse Power Corporation, continued to analyze and develop a concept of methanol and power production based on Gasification Engineering Corporation's E-GAS™ Gasification Process utilizing coal and petroleum coke feedstocks. Feasibility studies, testing and engineering, and financing of an integrated methanol and electric power coproduction facility using clean coal technologies based on the addition of methanol production facilities at the WREL gasification plant in West Terre Haute, Indiana, will be developed to enable the commercialization of the gasification to methanol and power coproduction concept.

5.1 Reporting/Personnel Transition Results

During this period the team familiarized themselves with the project and all of the requirements that must be met in order to successfully complete Phase 1 of the project.

5.2 Synthesis Gas Contaminant Removal Results

Two regenerable systems for removing trace levels of sulfur species were reviewed. One uses a combination of molecular sieves to remove hydrogen sulfide (H_2S) and carbonyl sulfide (COS). Because of the low capacity of the molecular sieves, the capital and operating costs for such a system could be high. The other system uses a modified activated carbon. The technology is still under development. Limited laboratory testing has been conducted by the developer with technical input from GEC, on removing low levels of H_2S and COS. The ability to remove COS and then to successfully regenerate the sorbent is the critical challenge. Early results from the testing are encouraging.

A regenerable system for removing trace levels of mercury in synthesis gas was reviewed. The system employs the pressure swing absorption concept using a modified silicate sorbent. The concept is in the early laboratory stage of evaluation.

Three non-regenerable sorbents for removing trace levels of mercury, arsenic, carbonyls, and other trace metals were reviewed. One of these approaches has completed its laboratory stage of evaluation, and is proceeding to the pilot stage of development. The other two systems are just beginning early laboratory stage evaluation. The ability of the sorbent to demonstrate a high enough removal capacity and life to reduce its cost to attain favorable economics is critical for these non-regenerable systems.

6.0 CONCLUSIONS

Under the guidance of the Project Management Plan, Phase I is being performed by all team members, GEC, Air Products, Methanex, Dow Corning, Siemens Westinghouse, and Dow Chemical. The Phase I focus is on development of the advanced economic model, analysis of the commercialization potential for the gasification to methanol and power coproduction concept for future CEP, and preliminary engineering and environmental work for implementation of the methanol production addition at Wabash River for the IMPPCCT demonstration. GEC will utilize the analysis of potential IMPPCCT feedstocks to the gasification section, develop a preliminary site layout, determine synthesis gas quantities available to IMPPCCT, assess final synthesis gas cleanup needs, provide the preliminary environmental assessment, review modifications and tie-ins to the existing infrastructure at the WREL site, and work jointly with Air Products and Methanex to develop the most advantageous economics for IMPPCCT based on either the liquid or gas phase methanol processing units.

6.1 Synthesis Gas Contaminant Removal Conclusions

After reviewing the current state of trace contaminant removal processes, several process were identified that had the potential to clean the synthesis gas of trace contaminants that would foul or poison methanol synthesis catalysts. Unfortunately most of these processes are currently in the laboratory testing phase of development and will require more testing both in the laboratory and in an industrial environment. However, even with the additional testing requirements, several of the identified technologies should be available for use in the next four to six years allowing them to be used in plants with a 2006 to 2008 startup.

6.2 Reporting Conclusions

Activity on completing the reporting requirements should increase during the next period as the new team members gain familiarity with the project.

7.0 MILESTONES & PLANS

7.1 Plans for Next Reporting Period

Efforts for the team during the next reporting period are expected to primarily concentrate on reporting requirements and delivery of items found within Table 7.2.1.

7.2 Project Schedule and Milestones

Figure 7.2.1 illustrates the Phase I project milestone map. Note the blocks shown in full shading are those associated with the critical path to completion of Phase I. Hollow blocks are tasks which support the overall time table and or result in deliverable items to the DOE.

During the reporting period, the project achieved only minor progress on reporting efforts for the Phase I study of the CEP. The remaining marketing milestones associated with ideal and specific CEP case studies are with only minor exception complete. Most of the continuing efforts dedicated to Phase I of this study will be devoted to CEP analysis and generation of outstanding deliverable items to DOE.

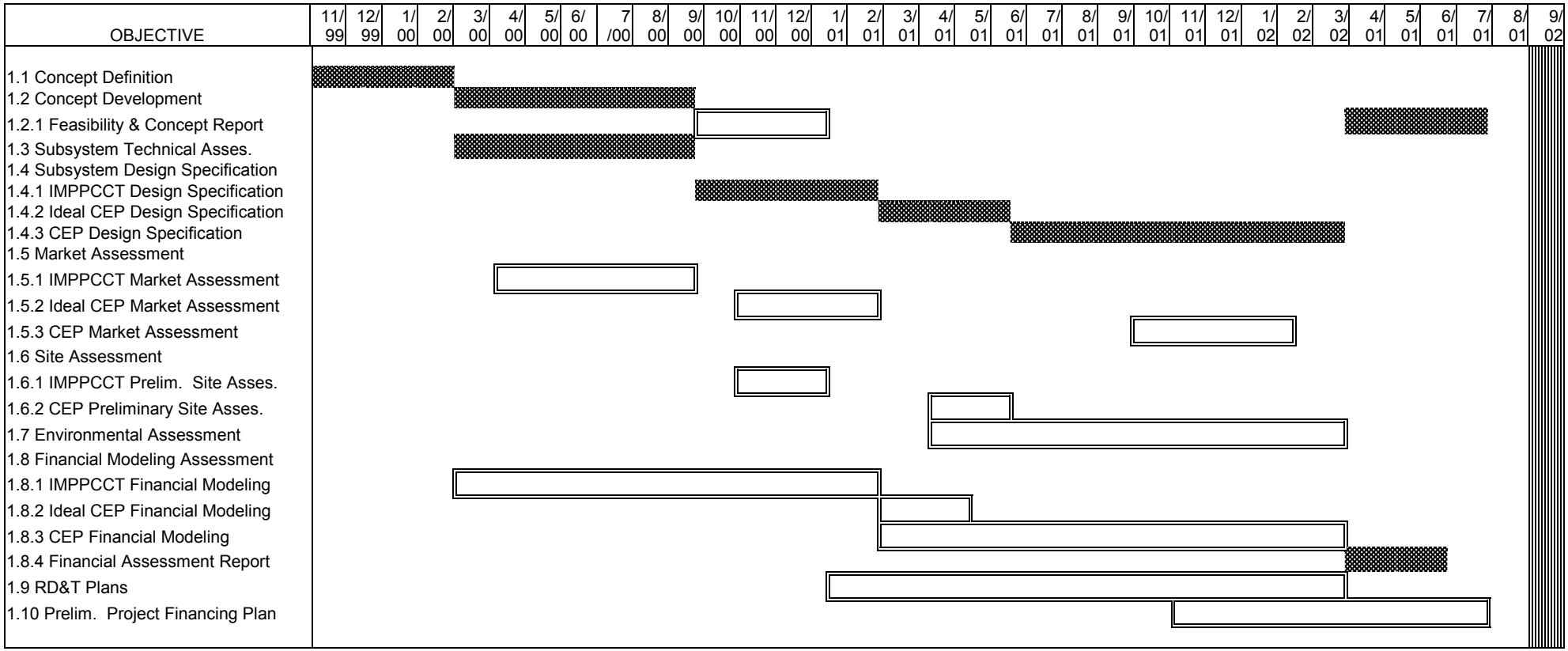
Resulting from the feasibility study work performed under Phase I within Tasks 1 through 10, deliverable reports are required periodically to finalize the obligations of certain tasks. Table 7.2.1 lists the specific deliverable requirements of Phase I.

Table 7.2.1: Phase I Deliverable Requirements by Task

Deliverable Report	Due Date
Project Management Plan*	60 days after executing a cooperative agreement with DOE, ending Task 1.1
Initial Feasibility Report	60 days after completing Task 1.2
Concept Report	60 days prior to the end of Phase I, including items from Task 1.2 through Task 1.8 of Phase I
Site Analysis Report	60 days after completing Task 1.6
Economic Analysis	60 days after completing Task 1.8
Research, Development and Test Plan	60 days prior to the end of Phase I
Preliminary Project Financing Plan	60 days prior to the end of Phase I

*Completed

Figure 7.2.1: Phase I, IMPPCCT Milestones



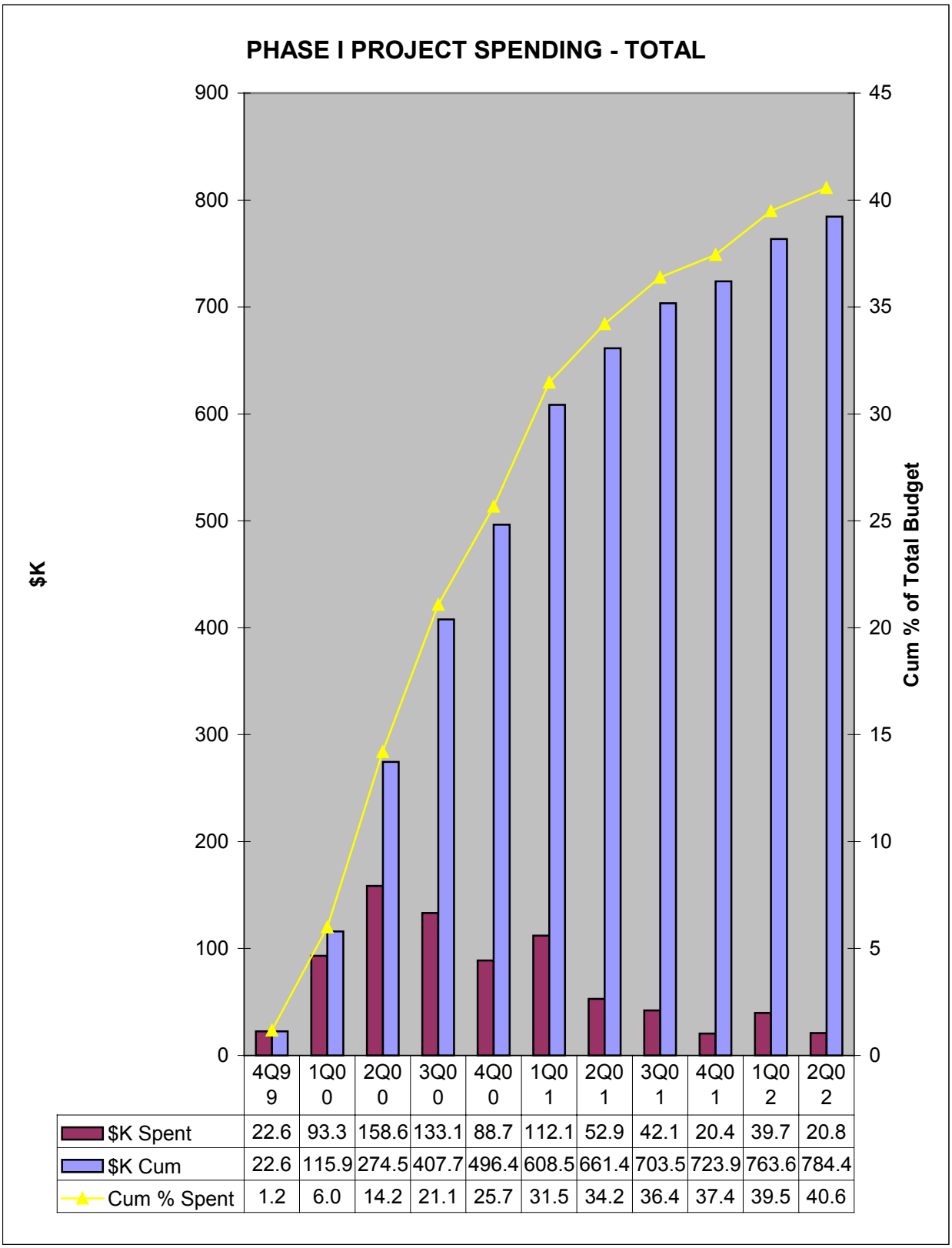
(Solid blocks indicate Critical Path)

7.3 Project Cost Plan Actuals

For the calendar year period of reporting, total project spending was $20,849. The DOE was invoiced for the cost share amount of $16,679. As a percentage, approximately 1.1% of the authorized Phase I funding was spent during the reporting period, while total project spending is about 40.6% of Phase I budget.

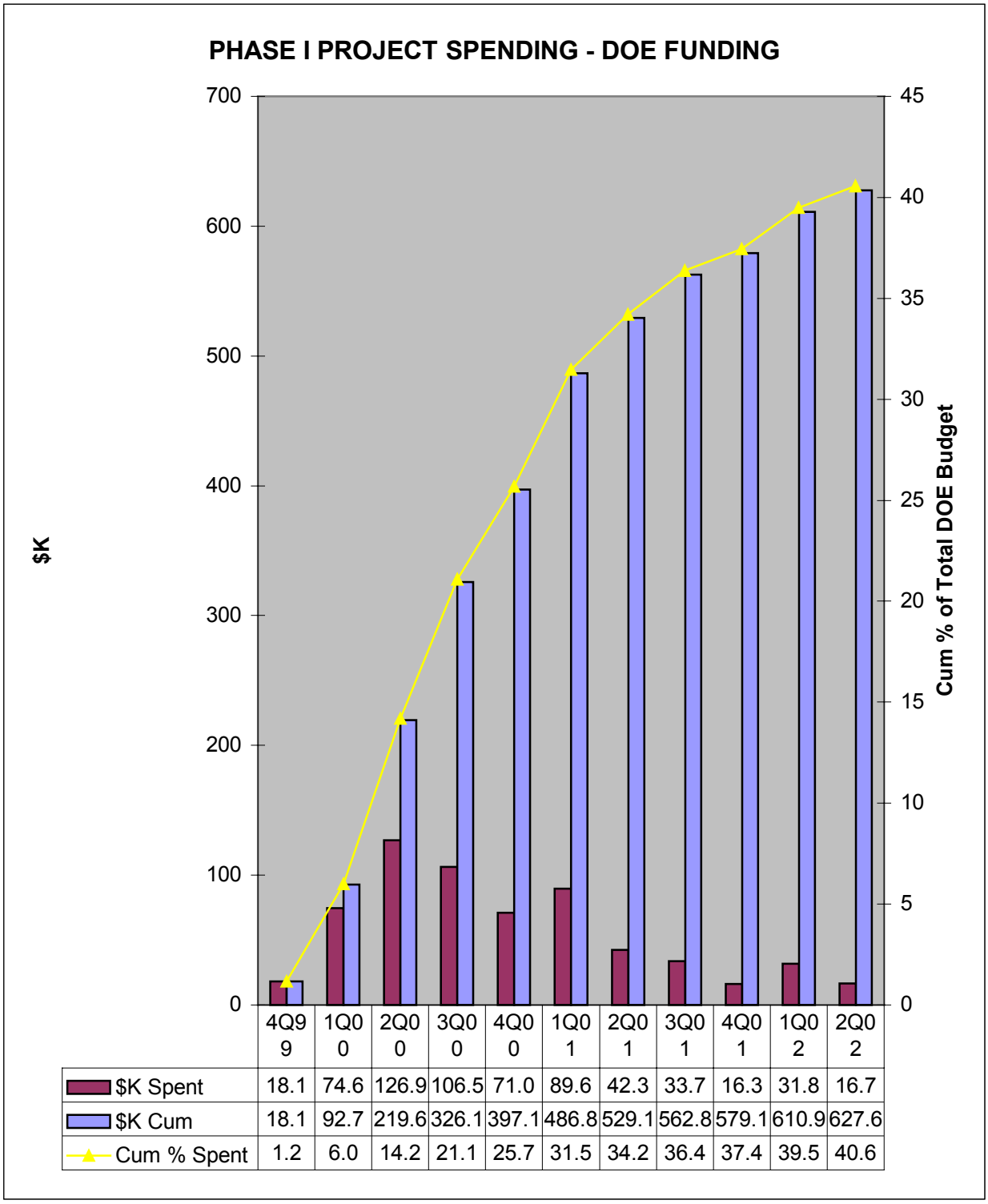
Figure 7.3.1 and Figure 7.3.2 present the actual total spending and spending of DOE cost share respectively for the IMPPCCT Phase I effort. Current spending pattern is far below plan.

Figure 7.3.1: Phase I Project Spending -- Total



	4Q99	1Q00	2Q00	3Q00	4Q00	1Q01	2Q01	3Q01	4Q01	1Q02	2Q02
$K Spent	22.6	93.3	158.6	133.1	88.7	112.1	52.9	42.1	20.4	39.7	20.8
$K Cum	22.6	115.9	274.5	407.7	496.4	608.5	661.4	703.5	723.9	763.6	784.4
Cum % Spent	1.2	6.0	14.2	21.1	25.7	31.5	34.2	36.4	37.4	39.5	40.6

Figure 7.3.2 : Phase I Project Spending – DOE Funding



	4Q99	1Q00	2Q00	3Q00	4Q00	1Q01	2Q01	3Q01	4Q01	1Q02	2Q02
$K Spent	18.1	74.6	126.9	106.5	71.0	89.6	42.3	33.7	16.3	31.8	16.7
$K Cum	18.1	92.7	219.6	326.1	397.1	486.8	529.1	562.8	579.1	610.9	627.6
Cum % Spent	1.2	6.0	14.2	21.1	25.7	31.5	34.2	36.4	37.4	39.5	40.6

8.0 REFERENCES

8.1 Selected References Available via the Internet

1. **"National Energy Policy", issued by the White House in May 2001.** The Wabash River facility and Global Energy received mention in a dedicated sidebar on page 3-6.
   http://www.whitehouse.gov/energy/Chapter3.pdf

2. **"Wabash River Coal Gasification Repowering Project, An Update**", Department of Energy Topical Report No. 20, September 2000, summarizes the history of the Wabash River facility and its construction and four year demonstration under the DOE's Clean Coal Technology program.
   http://www.lanl.gov/projects/cctc/topicalreports/documents/topical20.pdf

3. **"Wabash River Coal Gasification Repowering Project Final Technical Report",** August 2000, 358 pages. This is a very detailed look at the Wabash River facility and its operation 1995-1999.
   http://www.lanl.gov/projects/cctc/resources/pdfs/wabsh/Final%20_Report.pdf

4. **"Gasification Plant Performance and Cost Optimization",** May 2002, (23 MB). The final report of Task 1 of this comprehensive ($2.4 million) study performed by Global Energy, Nexant and Bechtel under subcontract to the DOE to identify cost savings in the next generation of integrated gasification and coproduction facilities utilizing the E-Gas Technology. Detailed cost estimating by Bechtel.
   http://www.netl.doe.gov/coalpower/gasification/projects/systems/docs/40342R01.PDF

5. **"Wabash River Coal Gasification Repowering Project, A DOE Assessment",** January 2002. This is the DOE's official post-project assessment of the Wabash River project.
   http://www.lanl.gov/projects/cctc/resources/pdfs/wabsh/netl1164.pdf

6. **"Environmental Benefits of Clean Coal Technologies"** Department of Energy Topical Report No. 18, April 2001. This report describes a variety of processes that are capable of meeting existing and emerging environmental regulations and competing economically in a deregulated electric power marketplace
   http://www.lanl.gov/projects/cctc/topicalreports/documents/topical18.pdf

7. **"Coproduction of Power, Fuel, and Chemicals"** Department of Energy Topical Report No. 21, September 2001. A description of the production of synthesis gas (syngas) from coal, the production of electricity from combusting a portion of the syngas and conversion of the remaining syngas to high-value fuels and chemicals.
   http://www.lanl.gov/projects/cctc/topicalreports/documents/topical21.pdf

8. **The Gasification Technology Council** maintains a website (www.gasification.org) that includes a library of the papers presented at recent conferences. Papers presented by Global Energy in 2002 & 2001:

   "Wabash River Repowering IGCC Operations and Performance Update Report", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02010.pdf

   "Comparative IGCC Cost & performance for Domestic Coals", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02018.pdf

   "NOx Control in IGCC Combustion Turbines: Steam vs. Nitrogen", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02022.pdf

   "Optimized Petroleum Coke IGCC Coproduction Plant", October 2001
   http://www.gasification.org/98GTC/GTC01018.pdf

   "Environmental Performance of IGCC Repowering for Conventional Coal Power Plants", October 2001
   http://www.gasification.org/98GTC/GTC01037.pdf