

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

## **Quarterly Technical Progress Report No. 15**

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and

Subcontractors: Air Products and Chemicals Inc., The Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation

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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), and supported by Air Products and Chemicals, Inc., Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation. Two project phases are planned for execution, including:

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

The WREL facility is a project selected and co-funded under the 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., parent company of GEC and WREL, 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.

The objectives of this effort are 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, economic, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

During the reporting period, DOE approved the RD&T Plan submitted in the previous quarter. The RD&T Plan forms the basis for the Continuation Application to initiate the transition of the project from Phase I to Phase II. Potential technologies for removing contaminants from synthesis gas to the level required by methanol synthesis will be tested in slipstream units at the WREL facility during Phase II. A supplemental information package consisting of a revised Work Breakdown Structure and Budget Plan for Phase II and other necessary forms was also submitted. Agreement is being reached with DOE's patent attorney on the scope of the limited rights data to be provided under the Cooperative Agreement.

Preparation of a comprehensive Final Report for Phase I of the project, which will consolidate the remaining deliverables including the Initial Feasibility Report, Concept Report, Site Analysis Report, Economic Analysis, and Preliminary Project Financing Plan, continued during the reporting period. Significant progress was made in the Subsystem Design Specification section of the report.

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## ACRONYMS AND DEFINITIONS

Acronym	Description
ASU	Air Separation Unit
BFW	Boiler Feed-Water
CC	Combined Cycle (plant including only HRSG, CT & ST)
CEP	Commercial Embodiment Plant
CT	Combustion Turbine
CCT	Clean Coal Technologies
DOE	Department of Energy
EECP	Early Entrance Coproduction Plant
E-GAS™	Title of Global Energy, Inc.'s Gasification Process
GEC	Gasification Engineering Corporation
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
LGTI	Louisiana Gasification Technology Incorporated
LOX	Liquid Oxygen
LPMEOH™	Liquid Phase Methanol (process)
MAC	Main Air Compressor
MDEA	Methyl-Di-Ethanol Amine (solvent)
MeOH	Methanol
MMBtu	Million British Thermal Units
Mt	Metric Ton
MTPD	Metric Ton Per Day
MW	Mega Watt

<b>Acronym</b>	<b>Description</b>
NETL	National Energy Testing Laboratory
NO <sub>x</sub>	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)
SCF	Standard Cubic Foot
SFC	Synthetic Fuels Corporation
ST	Steam Turbine
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. Both GEC and WREL are wholly owned subsidiaries of Global Energy, Inc., headquartered in Cincinnati Ohio.

The E-GAS™ process features an oxygen-blown, continuous-slugging, 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 approximately 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 the 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 to remove the chloride, 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 NO<sub>x</sub> 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

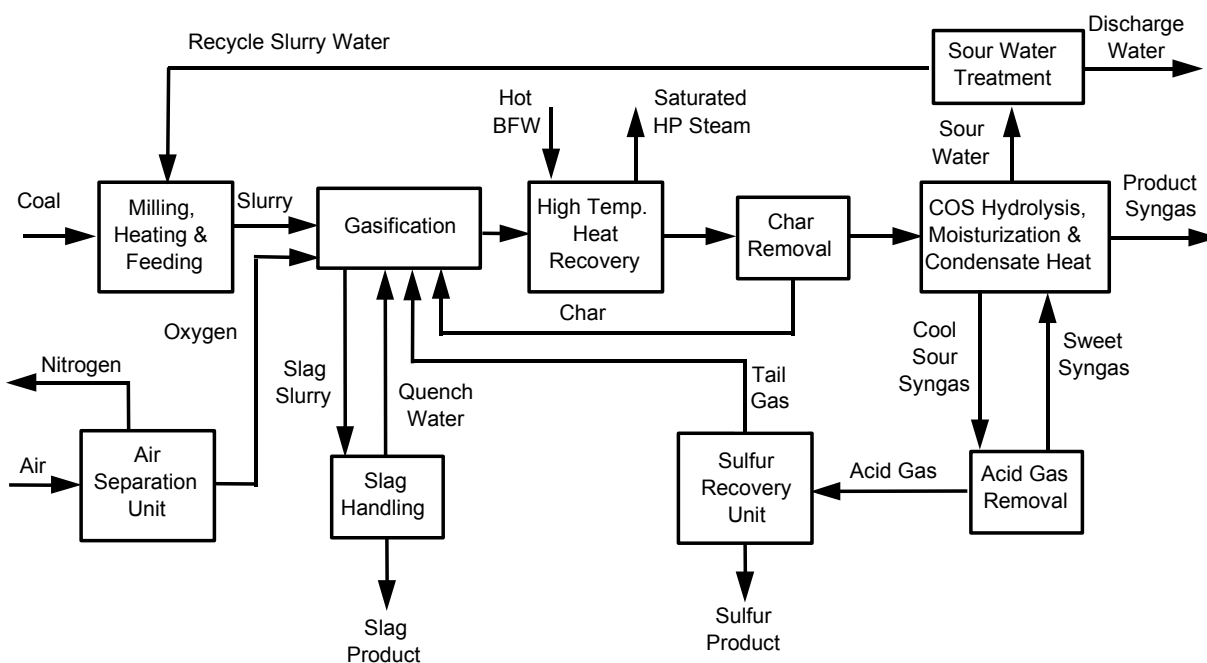
such as cooling water and steam from the gasification facilities and is operated from the gasification plant control room.

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 <sup>†</sup>	1690 <sup>†</sup>
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

<sup>†</sup> 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 EECF 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 EECF 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 testing (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. Updating the preliminary economic analysis.

Efforts under Solicitation No. DE-SC26-99FT40040 must support an EECP 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 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<sup>TM</sup> Gasification Process utilizing coal and other feedstocks. In a planned two-phase project, this team plans to review and 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 to power and 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 economics 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 to power and methanol coproduction 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 implementation of the RD&T Plan and commercially verified by an economic model.

### **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 and Gasification Engineering Corporation (GEC), as the E-GAS™ technology.

The demonstration project 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 Wabash Repowering Project successfully demonstrated commercial application of the E-GAS™ coal gasification technology in conjunction with power generation. The combustion turbine generates 192 MW while 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. By the end of the demonstration period of the Clean Coal Technology Program, operating time had exceeded 18,000 hours, with over 5 million MW of power produced. The WREL Plant operates successfully on baseload dispatch in the Cinergy power grid, and continues to operate as a privately owned facility after the demonstration period to supply synthesis gas 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 successfully tested at WREL as early as November 1997. Since August 2000, the facility has been

operating on 100% petroleum coke feed. As of January 2003, over 800,000 tons of fuel grade petroleum coke has been processed, demonstrating the commercial viability of petroleum coke as the principle fuel for gasification.

Sulfur removal from the gasifier's solid feed is recovered and sold, as is the slag byproduct. Sulfur removal exceeds 97% resulting in sulfur oxides 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 nitrogen oxides emissions are 0.15 lb/million Btu, which meets the current target for coal-fired power generation plants. The WREL facility is the cleanest solid fuel-based power plants in the world.

In a joint effort with DOE, a Cooperative Agreement titled "Integrated Methanol and Power Production from Clean Coal Technologies" (IMPPCCT), was awarded under the Early Entrance Coproduction Plant (EECP). An Industrial Consortium led by GEC and supported by Air Products, Dow Chemical, Dow Corning, Methanex, and Siemens Westinghouse 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 sites chosen are the existing WREL facility and greenfield locations within the Dow Chemical and Dow Corning manufacturing complexes. 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 the reporting period, DOE approved the RD&T Plan submitted in the previous quarter. The RD&T Plan forms the basis for the Continuation Application to initiate the transition of the project from Phase I to Phase II. Potential technologies for removing

contaminants from synthesis gas to the level required by methanol synthesis will be tested in slipstream units at the WREL Plant during Phase II. A supplemental information package consisting of a revised Work Breakdown Structure and Budget Plan for Phase II and other necessary forms was also submitted to DOE. Agreement is being reached with DOE's patent attorney on the scope of the limited rights data to be provided under the Cooperative Agreement.

Preparation of a comprehensive Final Report for Phase I of the project, which will consolidate the remaining deliverables including the Initial Feasibility Report, Concept Report, Site Analysis Report, Economic Analysis, and Preliminary Project Financing Plan, continued during the reporting period. Significant progress was made in the Subsystem Design Specification section of the report.

For the period of reporting, actual expenditure was \$45,492, with cumulative actual expenditure for the project to be \$918,540. The amounts include funding from DOE that is at 80% of the total, and cost share provided by the consortium members. Total budget for the project is \$1,933,628, with DOE providing \$1,546,902. The initial project tasks in Phase I had been mostly completed under budget. The scope of the remaining tasks was reduced, reflecting the results of the initial work. This has resulted in a significant amount of remaining funds in Budget Period I. The Continuation Application submitted proposes to utilize the remaining funds to conduct the RD&T testing during Budget Period II.

## **4.0 ACTIVITIES**

### **4.1 Planning for Phase II RD&T**

GEC continued discussions with partner companies to make preparations for starting the RD&T activities during Phase II of the project. The main area being pursued is in synthesis gas contaminant removal. Both laboratory and slipstream testing at WREL were incorporated. Potential technologies to be evaluated include a regenerable activated carbon and a direct sulfur oxidation process to remove hydrogen sulfide and other sulfur species.

### **4.2 Reporting and Deliverables**

During this reporting period, a supplemental information package to the Continuation Application to initiate the transition of the project from Phase I to Phase II was submitted to DOE. Also, efforts continued on preparing the Phase I Final Report.

## **5.0 RESULTS AND DISCUSSION**

The consortium for the Wabash River IMPPCCT Project, led by GEC, and including Dow Corning, Dow Chemical, Air Products, Methanex, and Siemens Westinghouse, continued to analyze and develop a concept of methanol and power production based on GEC's E-GAS<sup>TM</sup> Gasification Process utilizing coal and petroleum coke feedstocks. The team furthered efforts to analyze the domestic methanol market and examined other criteria needed to develop an economic model for full-scale implementation of this gasification to power and methanol coproduction concept. Feasibility studies, testing and engineering, and economic studies of an IMPPCCT facility based on addition of methanol production capabilities at the WREL gasification plant in West Terre Haute, Indiana will be developed to enable the commercialization of the gasification-based concept to coproduce power and methanol.

### **5.1 Planning for Phase II RD&T**

GEC continued discussions with partner companies to make preparations for starting the RD&T activities during Phase II of the project. The main area being pursued is in synthesis gas contaminant removal. Both laboratory and slipstream testing at WREL were incorporated. Potential technologies to be evaluated include a regenerable activated carbon and a direct sulfur oxidation process to remove hydrogen sulfide and other sulfur species.

Small-scale slipstream testing at WREL, using actual synthesis gas being produced, is the preferred mode of testing. Laboratory testing will be conducted prior to the on-site slipstream testing to determine the optimum operating condition for the slipstream unit. The technology suppliers have agreed to provide the 35% cost-sharing required in Phase II.

GEC updated the partner companies on the delay and status of getting the final modification to the cooperative agreement issued. The originally proposed schedule will need to be revised once the final modification is issued and the slipstream testing of the technologies is started.

## **5.2 Reporting and Deliverables**

During the reporting period, DOE approved the RD&T Plan submitted in the previous quarter. The RD&T Plan forms the basis for the Continuation Application to initiate the transition of the project from Phase I to Phase II. A supplemental information package consisting of a revised Work Breakdown Structure and Budget Plan for Phase II and other necessary forms was also submitted. Agreement is being reached with DOE's patent attorney on the scope of the limited rights data to be provided under the Cooperative Agreement.

Preparation of a comprehensive Final Report for Phase I of the project, which will consolidate the remaining deliverables including the Initial Feasibility Report, Concept Report, Site Analysis Report, Economic Analysis, and Preliminary Project Financing Plan, continued during the reporting period. Significant progress was made in the Subsystem Design Specification section, which provides the design basis, flow diagram, and major equipment list for the WREL IMPPCCT and CEP facilities.

## **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 the WREL facility for the IMPPCCT demonstration. GEC has utilized the analysis of potential IMPPCCT feedstocks to the gasification section, developed a preliminary site layout, determined synthesis gas quantities available to IMPPCCT, assessed final synthesis gas cleanup needs, provided the preliminary environmental assessment, reviewed modifications and tie-ins to the existing infrastructure at the WREL site, and worked 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. Air Products has completed the review and application of the LPMEOH™ Process with methanol purification systems resulting in development of the methanol unit process package.

### **6.1 Planning for Phase II RD&T**

GEC continued discussions with partner companies to make preparation for starting the RD&T activities during Phase II of the project. The main area being pursued is in synthesis gas contaminant removal. Both laboratory and slipstream testing at WREL were incorporated. Potential technologies to be evaluated include a regenerable activated carbon and a direct sulfur oxidation process for the removal of hydrogen sulfide and other sulfur species.

GEC updated the partners on the delay and status of getting the final modification to the Cooperative Agreement issued. The originally proposed schedule will need to be revised once the final modification is issued and the slipstream testing of the technologies is started.



## **6.2 Reporting and Deliverables**

During the reporting period, DOE approved the RD&T Plan submitted in the previous quarter. The RD&T Plan forms the basis for the Continuation Application to initiate the transition of the project from Phase I to Phase II. A supplemental information package consisting of a revised Work Breakdown Structure and Budget Plan for Phase II and other necessary forms was also submitted. Agreement is being reached with DOE's patent attorney on the scope of the limited rights data to be provided under the Cooperative Agreement.

Preparation of a comprehensive Final Report for Phase I of the project, which will consolidate the remaining deliverables including the Initial Feasibility Report, Concept Report, Site Analysis Report, Economic Analysis, and Preliminary Project Financing Plan, continued. Significant progress was made in the Subsystem Design Specification section of the report.

## **7.0 MILESTONES & PLANS**

### **7.1 Plans for Completing Phase I**

Efforts are expected to primarily concentrate on completing the consolidated Phase I Final Report, and providing the necessary input and information to finalize the Phase II Continuation Application to transition the project from Phase I to Phase II.

### **7.2 Project Schedule and Milestones**

Figure 7.2.1 illustrates a revised Phase I project milestone map. 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. Progress on the project was hindered for most of 2002 due to loss and turnover of critical personnel. This schedule was granted several extensions by DOE.

During the reporting period, an RD&T Plan has been completed and preparation of a consolidated Final Report is in progress. Phase I of the project is being brought to a close.

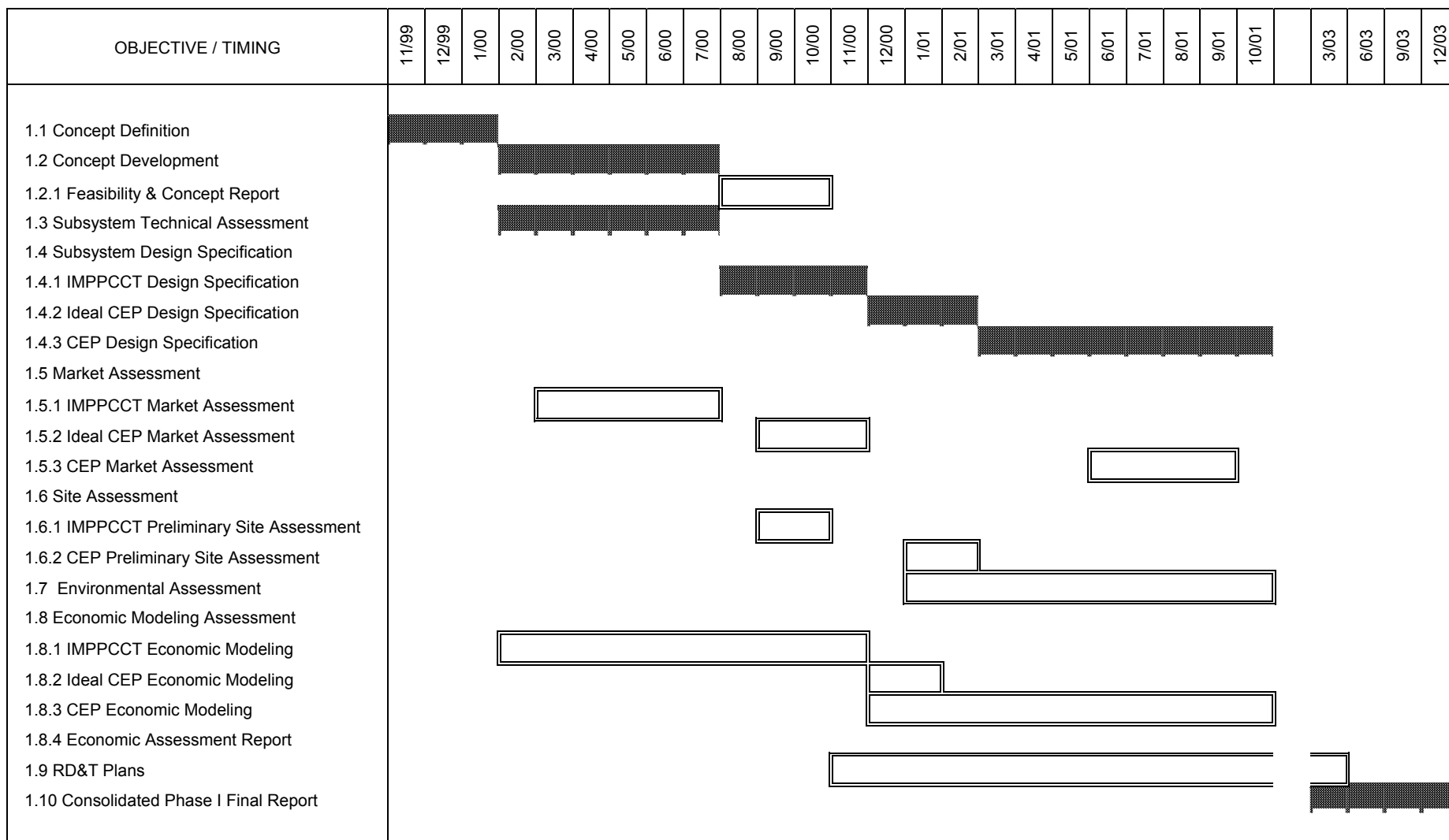
### **7.3 Project Spending -- Plan and Actuals**

As shown in Figure 7.3.1, actual expenditure for the reporting period was \$45,492, which includes an invoice of \$9,998 from Dow Corning for labor rate adjustment for 1999 and 2000. The cumulative actual expenditure for the project was \$918,540. The amounts shown over the periods of the graphs are based on actual invoice figures to the DOE. The figures include funding from DOE that is at 80% of the total, and cost share provided by the consortium members. Total budget for the project is \$1,933,628, with DOE providing \$1,546,902.

Figure 7.3.1 and Figure 7.3.2 present the actual total spending and spending of DOE cost share respectively for the Phase I effort. Total expenditure to-date is \$734,844. Spending is far below original plan. The initial project tasks in Phase I had been mostly completed under budget. The scope of the remaining tasks was reduced, reflecting the results of the initial work (e.g. little work is needed on a Preliminary Finance Plan for a

project that is not slated to go forward in the near future). This has resulted in a significant amount of remaining funds in Budget Period I. The Continuation Application submitted proposes to utilize the remaining funds to conduct RD&T testing during Phase II.

**Figure 7.2.1 : Phase I, IMPPCCT Milestones (rev.)**



(Solid blocks are critical paths)

Figure 7.3.1: Phase I Project Spending -- Overall

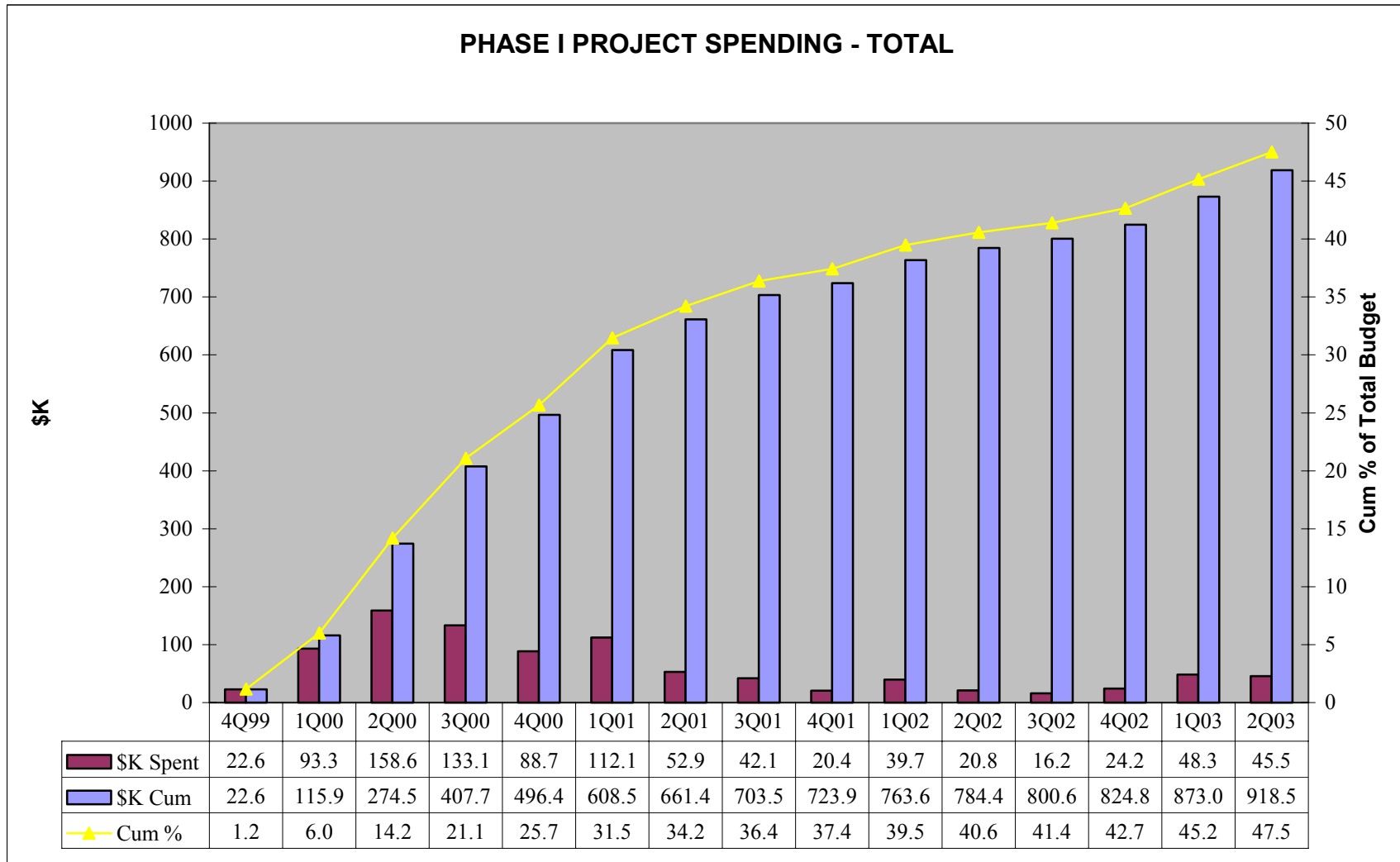
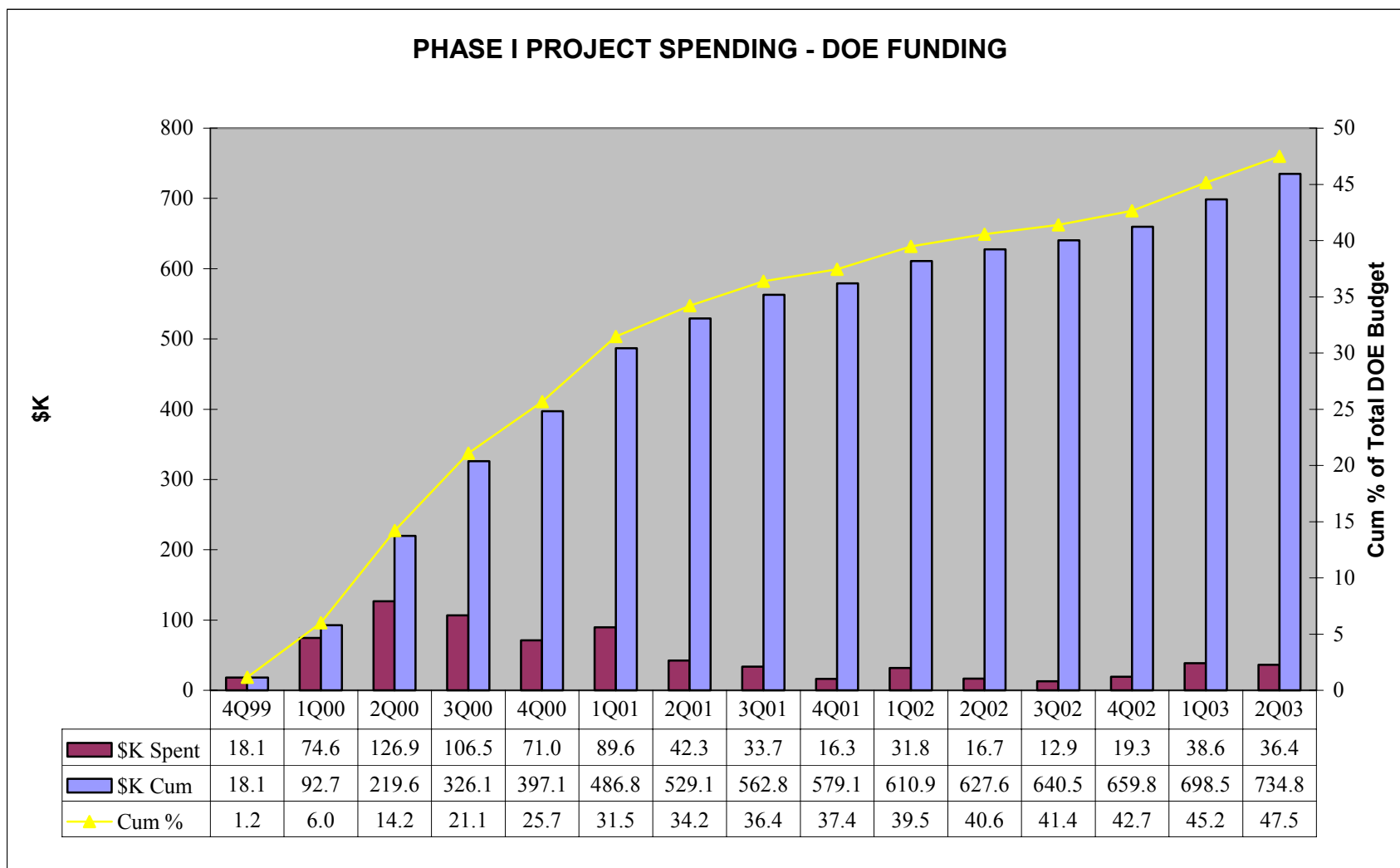


Figure 7.3.2: Phase I Project Spending -- DOE Funding



## 8.0 REFERENCES

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8. **The Gasification Technology Council** maintains a website ([www.gasification.org](http://www.gasification.org)) that includes a library of the papers presented at recent conferences. Papers presented by Global Energy in 2002 & 2001:
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[http://www.gasification.org/Presentations/2002\\_papers/GTC02010.pdf](http://www.gasification.org/Presentations/2002_papers/GTC02010.pdf)
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