

# **Early Entrance Coproduction Plant**

## **Phase II - Quarterly Report No. 15**

Reporting period: April 1, 2003 – June 30, 2003

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## **DOE Cooperative Agreement No. DE-FC26-99FT40658**

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Houston, Texas 77042

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**Abstract:**

The overall objective of this project is the three phase development of an Early Entrance Coproduction Plant (EECP) which uses petroleum coke to produce at least one product from at least two of the following three categories: (1) electric power (or heat), (2) fuels, and (3) chemicals. The objective is to have these products produced by technologies capable of using synthesis gas derived from coal and/or other carbonaceous feedstocks.

The objectives of Phase I were to determine the feasibility and define the concept for the EECP located at a specific site; develop a Research, Development, and Testing (RD&T) Plan for implementation in Phase II; and prepare a Preliminary Project Financing Plan.

The objective of Phase II is to implement the work as outlined in the Phase I RD&T Plan to enhance the development and commercial acceptance of coproduction technology that produces high-value products, particularly those that are critical to our domestic 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 chemicals from coal and/or other carbonaceous feedstocks.

The objective of Phase III is to develop an engineering design package and a financing and testing plan for an EECP located at a specific site.

The project's intended result is to provide the necessary technical, economic, and environmental information needed by industry to move the EECP forward to detailed design, construction, and operation.

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The Contractor can not confirm the authenticity of the information contained herein since this report is being submitted under the U.S. Department of Energy requirement that the electronic files must be submitted without being write-protected.

Note: Unless specified otherwise, all quarters/years are calendar quarters/years.

**I. List of Figures**

The following figures were used in this report:

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## II. List of Acronyms

AFDU	Alternative Fuels Development Unit
ASU	Air Separation Unit
Btu	British thermal unit
CO <sub>2</sub>	carbon dioxide
DOE	U.S. Department of Energy
EECP	Early Entrance Coproduction Plant
F-T	Fischer-Tropsch
GE	General Electric
KBR	Kellogg Brown & Root
MDEA	methyldiethanolamine
ORNL	Oak Ridge National Laboratory
RD&T	Research, Development, and Testing
stpd	short tons per day
TES	Texaco Energy Systems LLC

### **III. Executive Summary**

This is the tenth quarterly report which summarizes the progress of Phase II of the development of the Early Entrance Coproduction Plant (EECP) being performed under U.S. Department of Energy (DOE) Cooperative Agreement No. DE-FC26-99FT40658. The EECP will integrate advanced, high-efficiency, fuel-flexible electrical power generation, from coal and/or other carbonaceous materials, with a facility capable of producing clean transportation fuels and/or chemicals. An industrial consortium consisting of Texaco Energy Systems LLC (TES), Kellogg Brown & Root (KBR), General Electric (GE), Praxair, and Rentech Inc. developing this project.

In the proposed EECP, approximately 1,235 short tons per day (stpd) petroleum coke is used to produce 55 megawatts of net electric power for export, approximately 617 barrels per day of Fischer-Tropsch (F-T) products (finished high-melt wax, finished low-melt wax, hydrotreated F-T diesel, and hydrotreated F-T naphtha), steam, and approximately 89 stpd of sulfur. Additionally, the Air Separation Unit (ASU) will produce excess nitrogen and oxygen that will be exported.

The Phase I objective was to determine the feasibility and define the concept for the EECP located at a specific site, develop a Research, Development, and Testing (RD&T) Plan, and prepare a Preliminary Project Financing Plan. Phase I was completed in December 2000 and the final Phase I Concept Report was issued in May 2001. In Phase I, a typical refinery site, Motiva Port Arthur, was identified as the potential EECP site. As a result of the merger between Texaco and Chevron, Texaco was required to sell its interest in the Motiva Enterprises LLC joint venture to Shell Oil Company and Saudi Refining Inc. For Phase III of the EECP project, at the present time, TES has recommended to DOE that the EECP Cooperative Agreement be ended at the end of Phase II unless another project opportunity can be identified.

The Phase II objective is to conduct the research as outlined in the Phase I RD&T Plan and was originally scheduled for two calendar years (2001 through 2002). The revised target for Phase II completion is the fourth (4<sup>th</sup>) calendar quarter of 2003.

During this reporting period, final reports were received from Bechtel and ChevronTexaco Integrated Laboratories (Task 2.5), Southwest Research Institute (Task 2.6), Oak Ridge National Laboratory (Task 2.10), and LCI (Task 3.0). Topical reports for Catalyst/Wax Separation (Task 2.3) and Update and Implement Essential RD&T (Task 3.0) were submitted to the DOE for review. Final topical reports for Fischer-Tropsch Mathematical Model and Reactor Scale-Up Confirmation (Task 2.2), Low British Thermal Unit (Btu) Gas Combustion Test (Task 2.4), Petroleum Coke Analysis (Task 2.7), and Integration (Task 2.9) were approved by the DOE.

Phase III was envisioned to be a one-year effort scheduled to begin at the conclusion of Phase II. An engineering design package, testing plan, and financing plan for the EECP was to be developed in Phase III. The overall project's intended result is to provide the necessary technical, economic, and environmental information needed by industry to move the EECP forward to detailed design, construction, and operation.

### **III. Results, Discussion, and Preliminary Conclusions**

#### Task 1 Project Management

Task completed.

#### Task 2.1 Fischer-Tropsch Pilot Plant Confirmation

The Task 2.1 Topical Report was developed by TES. The topical report will be submitted to DOE for review in the third (3<sup>rd</sup>) calendar quarter of 2003.

#### Task 2.2 Fischer-Tropsch Mathematical Model and Reactor Scale-Up Confirmation

Task completed. The final Task 2.2 Topical Report was submitted to and approved by the DOE in the second (2<sup>nd</sup>) calendar quarter of 2003.

#### Task 2.3 Catalyst/Wax Separation

The Task 2.3 Topical Report was submitted to DOE for review in the second (2<sup>nd</sup>) calendar quarter of 2003.

#### Task 2.4 Low British Thermal Unit (Btu) Gas Combustion Test

Task completed. The final Task 2.4 Topical Report was submitted to and approved by the DOE in the second (2<sup>nd</sup>) calendar quarter of 2003.

#### Task 2.5 F-T Product Upgrading

Final product upgrading testing reports were completed and delivered to TES in the second (2<sup>nd</sup>) calendar quarter of 2003. TES began developing the Task 2.5 Topical Report. The topical report will be submitted to DOE for review in the third (3<sup>rd</sup>) calendar quarter of 2003.

#### Task 2.6 Fuel/Engine Performance and Emissions

The Task 2.6 Topical Report was developed by TES. The topical report will be submitted to DOE for review in the third (3<sup>rd</sup>) calendar quarter of 2003.

#### Task 2.7 Petroleum Coke Analysis

Task completed. The final Task 2.7 Topical Report was submitted to and approved by the DOE in the second (2<sup>nd</sup>) calendar quarter of 2003.

Task 2.8 Carbon Dioxide (CO<sub>2</sub>) Stripping from Methyldiethanolamine (MDEA) at Medium Pressure

Task completed. The task 2.8 Topical Report was issued in December 2002.

Task 2.9 Integration

Task completed. The final Task 2.9 Topical Report was submitted to and approved by the DOE for review in the second (2<sup>nd</sup>) calendar quarter of 2003.

Task 2.10 Environmental

The final report was received from Oak Ridge National Laboratory (ORNL) for Carbon Dioxide Recovery from the Gas Turbine Exhaust (2.10.4). The Task 2.10 Topical Report was developed by TES. The topical report will be submitted to DOE in the third (3<sup>rd</sup>) calendar quarter of 2003.

Task 3.0 Update and Implement Essential RD&T

The Task 3.0 Topical Report was developed by TES and submitted to DOE for review in the second (2<sup>nd</sup>) calendar quarter of 2003.

## **V. List of Major Activities Accomplished in the Second (2<sup>nd</sup>) Calendar Quarter of 2003**

The following list is provided as a quick reference for the work performed during this reporting period:

- Submitted Quarterly Report No. 14 for DOE review and approval.
- Developing Task 2.1 Topical Report (Fischer-Tropsch Pilot Plant Confirmation Test).
- DOE approved Task 2.2 Topical Report (Fischer-Tropsch Mathematical Modeling and Reactor Scale-up).
- Submitted Task 2.3 Topical Report (Fischer-Tropsch Catalyst/Wax Separation) for DOE review.
- DOE approved Task 2.4 Topical Report (Low Btu Combustion Test).
- DOE approved Task 2.7 Topical Report (Petroleum Coke Analysis).
- DOE approved Task 2.9 Topical Report (Integration).
- Submitted Task 3.0 Topical Report (Update and Implement Additional Research, Development, and Testing) for DOE review.
- Began developing Update to Phase I Design Basis Topical Report (Task 4.0).
- Began developing end of Phase II Topical Report (Task 2.11)

## **VI. List of Major Activities Planned for the Third (3<sup>rd</sup>) Calendar Quarter of 2003**

The following list is provided as a quick reference for the work planned for the upcoming quarter:

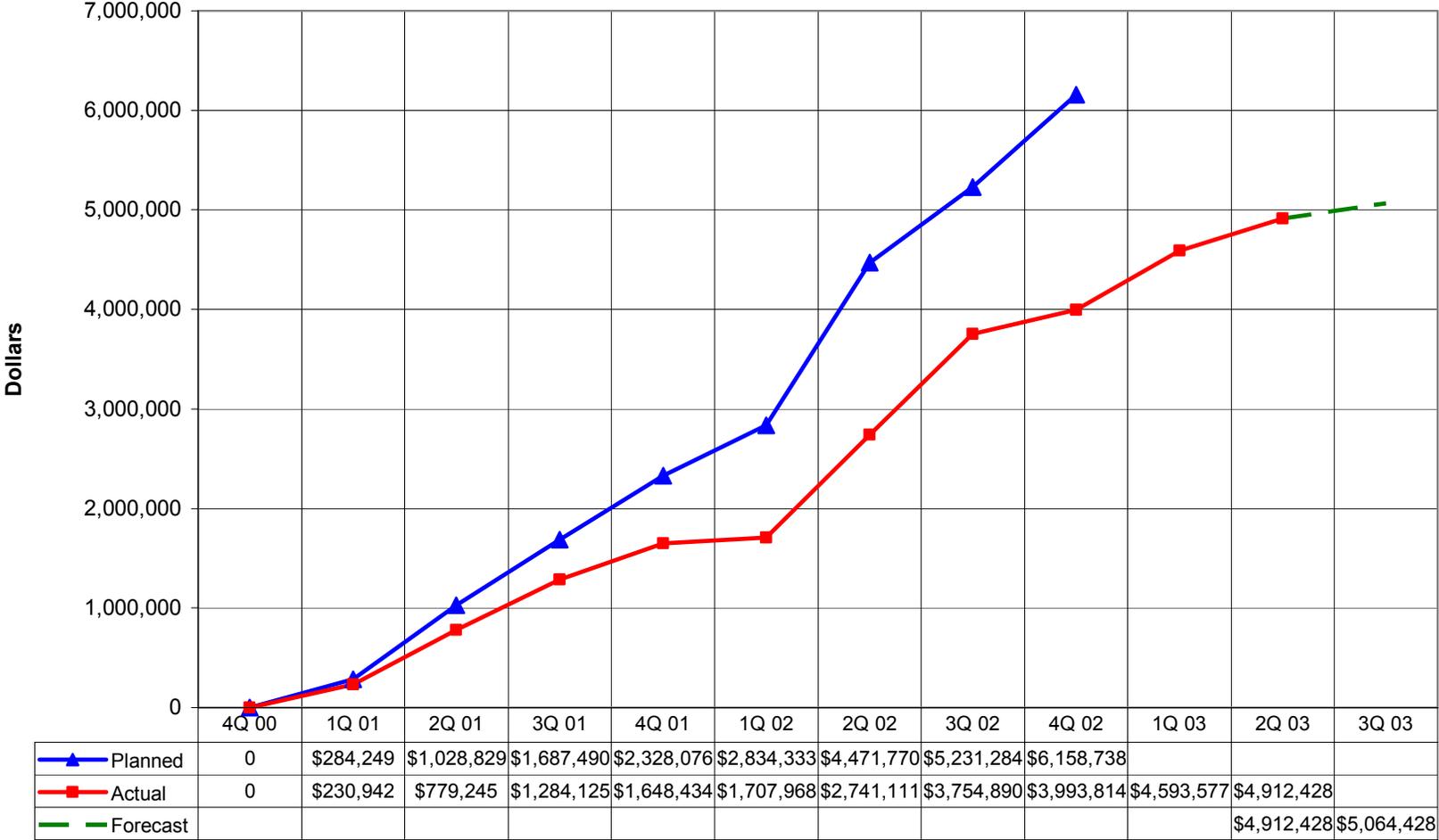
- Submit Quarterly Report No. 15 for DOE for review approval.
- Submit Task 2.1 Topical Report (F-T Pilot Plant Confirmation Run) to DOE for review.
- Submit final Task 2.3 Topical Report (F-T Catalyst/Wax Separation) to DOE for approval.
- Submit Task 2.5 Topical Report (F-T Product Upgrading) to DOE for review.
- Submit Task 2.6 (Topical Report (F-T Fuel/Engine Performance and Emissions) to DOE for review.
- Submit Task 2.10 Topical Report (Environmental) to DOE for review.
- Submit final Task 3.0 Topical Report (Update and Implement Additional Research, Development, and Testing) for DOE approval.
- Submit Task 4.0 Topical Report (Update to Phase I Design Basis) to DOE for review.
- Submit Task 2.11 end of Phase II Topical Report to DOE for review.

## VII. Financial Status

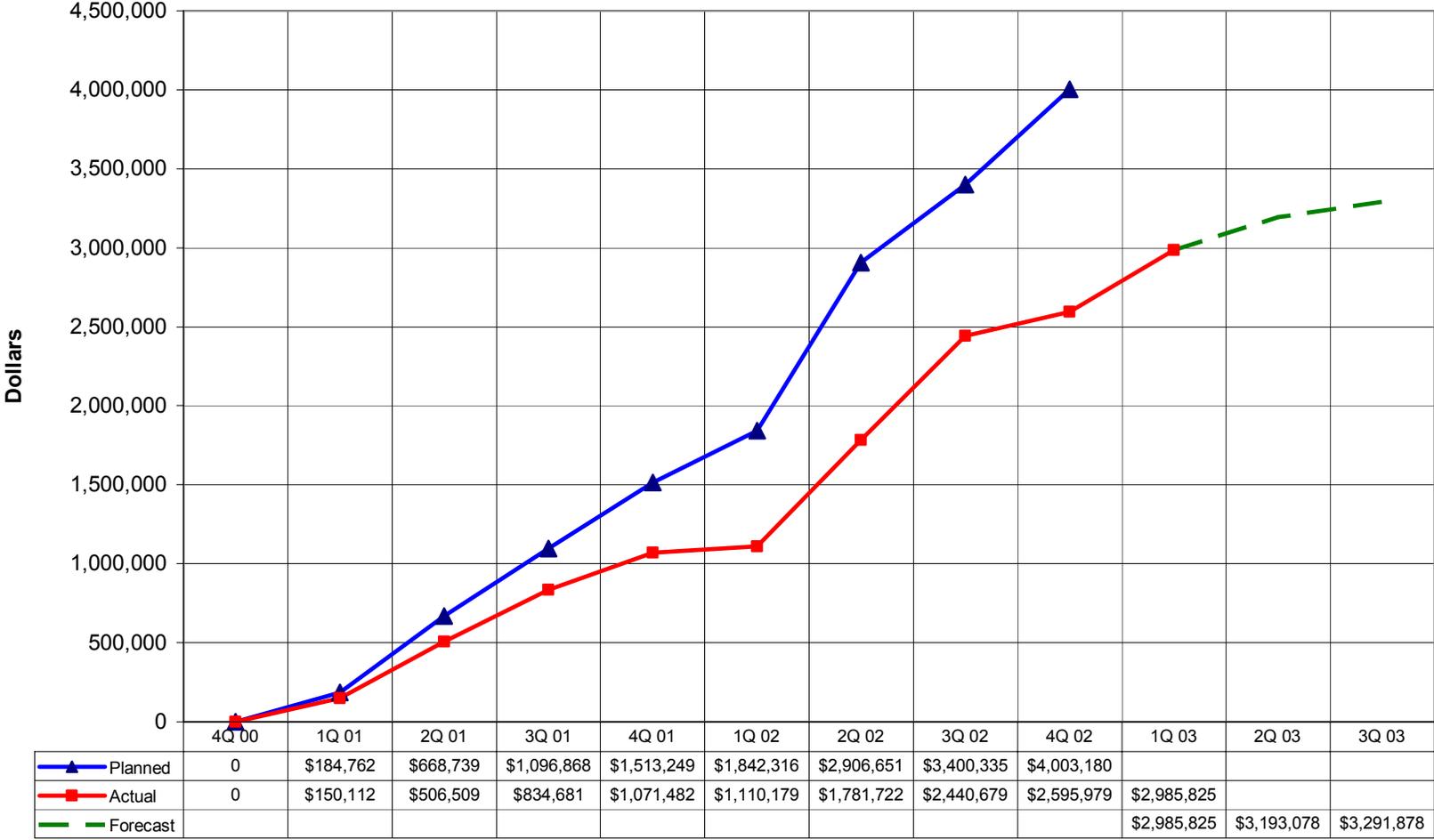
The following three graphs depict the financial status and progress of Phase II activities. The graphs are shown on the following three pages:

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Phase II Total Percent Complete.....	16

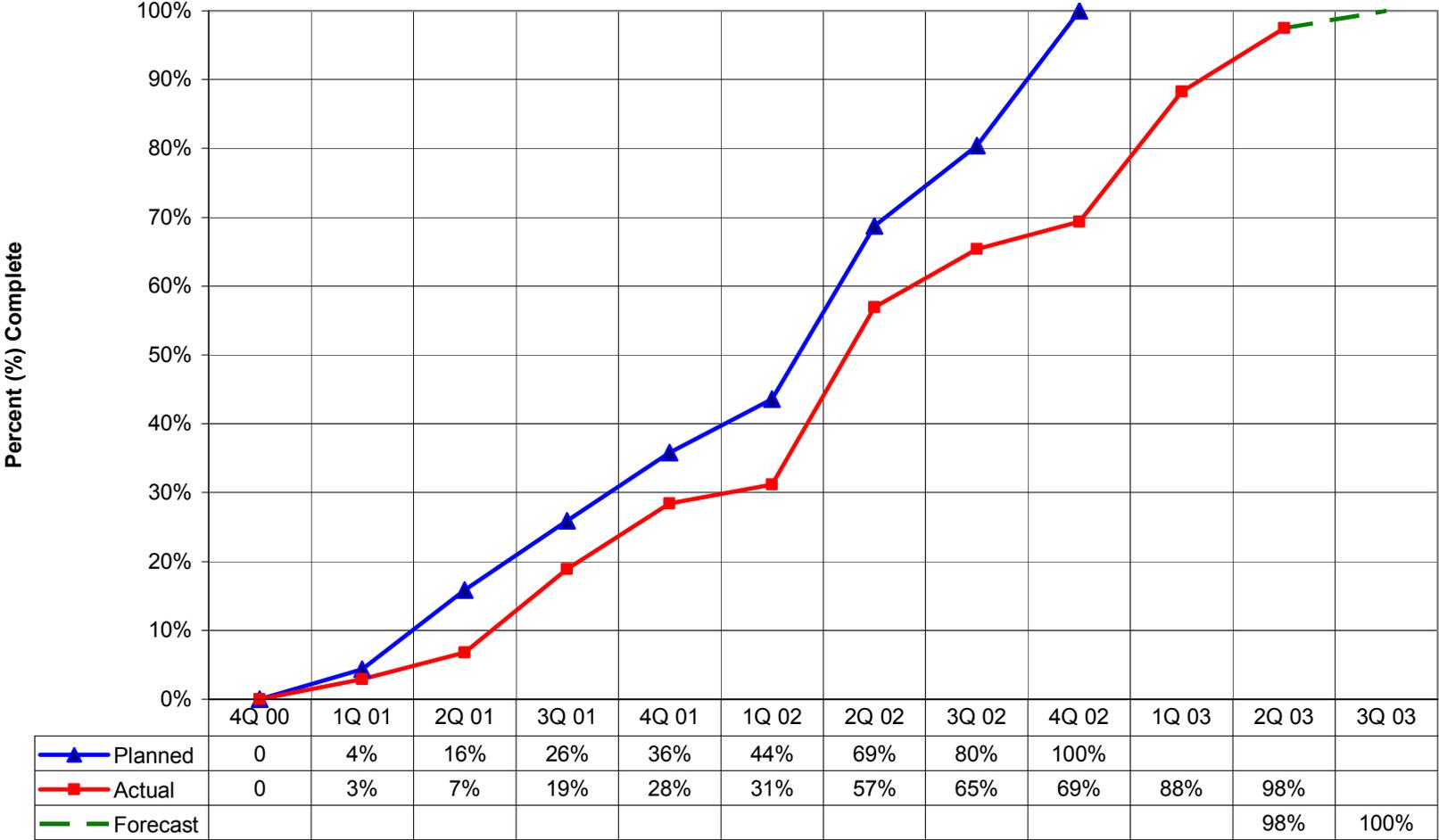
**Early Entrance Coproduction Plant  
Phase II - Total Expenditures**



**Early Entrance Coproduction Plant  
Phase II - DOE Expenditures**



**Early Entrance Coproduction Plant  
Phase II - Total Percent Complete**



## **VIII. Schedule**

The following schedule depicts the updated Phase II project schedule and shows percent complete by task as of March 31, 2003. For a description of the work involved in each task, refer to the Cooperative Agreement and Research, Development, and Testing Plan. This schedule was prepared using Microsoft Project 2000 software.

The delays caused by the wax conditioning in Task 2.5.1: Preparation of the LaPorte AFDU Product for Upgrading (outside the scope of the EECP) moved the start of several subtasks in Task 2.5: F-T Product Upgrading. The delays in Task 2.5 have moved the completion date of the EECP Phase II to the fourth (4<sup>th</sup>) calendar quarter of 2003. DOE has granted a no cost, time extension for Phase II of the EECP project until November 30, 2003.

# Early Entrance Coproduction Plant (EECP) – Phase II Schedule

ID	Task Name	Start	Finish	2Q01	3Q01	4Q01	1Q02	2Q02	3Q02	4Q02	1Q03	2Q03	3Q03	4Q03
				4/01	7/01	10/01	1/02	4/02	7/02	10/02	1/03	4/03	7/03	10/03
1	<b>Task 1 -- Project Management Plan</b>	Mon 1/8/01	Wed 5/16/01											
2	<b>1.1 Project Management Plan</b>	<b>Mon 1/8/01</b>	<b>Fri 3/2/01</b>											
6	<b>1.2 Submit Project Management Plan to DOE</b>	<b>Fri 3/2/01</b>	<b>Wed 5/16/01</b>	▶										
10	<b>1.3 Submit Phase II Project Management Plan to DOE</b>	Wed 5/16/01	Wed 5/16/01	◆										
11	<b>Task 2--Engineering Analysis, Modeling, &amp; Experiment RD&amp;T</b>	Mon 1/8/01	Thu 1/2/03											
12	<b>2.0 Pre-RD&amp;T</b>	<b>Mon 1/8/01</b>	<b>Fri 6/28/02</b>											
16	<b>2.1 Pilot Plant Confirmation</b>	<b>Mon 2/5/01</b>	<b>Mon 3/10/03</b>											
17	2.1.1 Catalyst Regeneration/rejuvenation	<b>Mon 2/5/01</b>	<b>Mon 3/10/03</b>											
18	2.1.1.1 Deactivate catalyst for testing	Mon 4/2/01	Mon 9/3/01											
19	2.1.1.2 Analysis of deactivated catalyst	Tue 9/4/01	Mon 10/29/01											
20	2.1.1.3 Literature search	Mon 2/5/01	Thu 8/2/01											
21	2.1.1.4 Laboratory testing	Mon 9/10/01	Mon 3/10/03											
22	2.1.2 Catalyst Addition/Withdrawal	Mon 4/2/01	Fri 1/18/02											
25	2.1.3 Pilot testing in BCR	Mon 7/1/02	Fri 10/18/02											
26	<b>2.1.4 End of task report</b>	<b>Mon 10/21/02</b>	<b>Mon 2/24/03</b>											
32	<b>2.2 Mathematical Model &amp; Reactor Scale-Up Confirmation</b>	<b>Mon 5/27/02</b>	<b>Mon 4/7/03</b>											
33	2.2.1 Confirm Mathematical Model	Mon 5/27/02	Fri 11/29/02											
34	<b>2.2.2 End of task report</b>	<b>Fri 11/29/02</b>	<b>Mon 4/7/03</b>											
40	<b>2.3 Catalyst/Wax Separation</b>	<b>Mon 1/8/01</b>	<b>Tue 8/5/03</b>											
41	2.3.1 Alternate F-T Catalyst/Wax separation	Mon 7/2/01	Mon 3/31/03											
42	2.3.2 Secondary F-T Catalyst/Wax separation	Mon 1/8/01	Fri 12/21/01											
43	<b>2.3.3 End of task report</b>	<b>Tue 4/1/03</b>	<b>Tue 8/5/03</b>											
49	<b>2.4 Low BTU Gas Combustion Test</b>	<b>Mon 7/9/01</b>	<b>Mon 10/14/02</b>											
50	2.4.1 Low BTU Gas Combustion Test	Mon 7/9/01	Fri 6/7/02											
51	<b>2.4.2 End of task report</b>	<b>Mon 6/10/02</b>	<b>Mon 10/14/02</b>											
57	<b>2.5 F-T Product Upgrading</b>	<b>Mon 4/2/01</b>	<b>Fri 10/17/03</b>											
58	2.5.1 Preparation of LaPorte AFDU Product for Upgrading	<b>Mon 4/2/01</b>	<b>Thu 10/31/02</b>											
60	2.5.2 Lab Batch Fractionation	Fri 11/1/02	Thu 12/26/02											
61	2.5.3 Wax Hydrocracking Pilot Plant Run	Fri 11/1/02	Thu 2/6/03											
62	2.5.4 Wax Finishing Pilot Plant Run	Mon 12/16/02	Tue 4/15/03											

# Early Entrance Coproduction Plant (EECP) – Phase II Schedule

ID	Task Name	Start	Finish	2Q01	3Q01	4Q01	1Q02	2Q02	3Q02	4Q02	1Q03	2Q03	3Q03	4Q03
				4/01	7/01	10/01	1/02	4/02	7/02	10/02	1/03	4/03	7/03	10/03
63	2.5.5 Characterization Testing	Fri 2/7/03	Thu 4/3/03											
64	2.5.6 Diesel Blending Testing	<b>Mon 12/3/01</b>	<b>Thu 5/15/03</b>											
67	2.5.7 Naphtha Testing	<b>Tue 1/1/02</b>	<b>Fri 6/13/03</b>											
68	2.5.7.1 Naphtha Fractionation	Tue 1/1/02	Mon 8/26/02											
69	2.5.7.2 Naphtha Hydrotreating	Mon 1/6/03	Fri 2/7/03											
70	2.5.7.3 Ethylene Cracker Yield Confirmation Tests	Thu 5/1/03	Wed 6/11/03											
71	2.5.7.4 Fuel Cell Reformer Tests	Mon 2/10/03	Fri 6/13/03											
72	2.5.7.6 Diesel Hydrotreating	Mon 2/10/03	Fri 2/21/03											
73	2.5.8 UIC Wax Fractionation	Fri 2/7/03	Thu 6/12/03											
74	<b>2.5.9 End of task report</b>	<b>Fri 6/13/03</b>	<b>Fri 10/17/03</b>											
80	<b>2.6 Fuel/Engine Performance and Emissions</b>	<b>Fri 2/7/03</b>	<b>Fri 10/10/03</b>											
81	2.6.1 Lubricity Additive Testing	Fri 2/7/03	Thu 3/6/03											
82	2.6.2 Hot-Start Cycle Transient Engine Test	Fri 3/7/03	Thu 5/1/03											
83	2.6.3 Solvent Extraction of Organic Fraction from DPM	Fri 5/2/03	Thu 6/5/03											
84	<b>2.6.5 End of task report</b>	<b>Fri 6/6/03</b>	<b>Fri 10/10/03</b>											
90	<b>2.7 Petroleum Coke Analysis</b>	<b>Mon 6/4/01</b>	<b>Mon 8/19/02</b>											
91	2.7.1 Petcoke assay	Mon 6/4/01	Fri 4/12/02											
92	<b>2.7.2 End of task report</b>	<b>Mon 4/15/02</b>	<b>Mon 8/19/02</b>											
98	<b>2.8 CO2 stripping from MDEA at medium pressure</b>	<b>Mon 4/2/01</b>	<b>Mon 10/28/02</b>											
99	<b>2.8.1 Testing</b>	<b>Mon 4/2/01</b>	<b>Fri 6/21/02</b>											
104	<b>2.8.2 End of task report</b>	<b>Mon 6/24/02</b>	<b>Mon 10/28/02</b>											
110	<b>2.9 Integration</b>	<b>Mon 6/4/01</b>	<b>Mon 9/2/02</b>											
111	2.9.1 Slurry w/F-T water	Mon 6/4/01	Fri 10/5/01											
112	2.9.1.1 Additional Slurry Tests w/F-T water	Mon 4/1/02	Fri 4/26/02											
113	<b>2.9.2 End of task report</b>	<b>Mon 4/29/02</b>	<b>Mon 9/2/02</b>											
119	<b>2.10 Environmental</b>	<b>Mon 7/2/01</b>	<b>Tue 11/4/03</b>											
120	2.10.1 Slag & fines characterization	Mon 10/8/01	Fri 6/28/02											
121	2.10.2 F-T catalyst to gasifier	Mon 6/3/02	Fri 8/23/02											
122	2.10.3 F-T catalyst disposal	Mon 6/3/02	Fri 10/4/02											
123	2.10.4 CO2 recovery from gas turbine	Mon 7/2/01	Mon 6/30/03											

Early Entrance Coproduction Plant (EECP) – Phase II Schedule

ID	Task Name	Start	Finish	2Q01	3Q01	4Q01	1Q02	2Q02	3Q02	4Q02	1Q03	2Q03	3Q03	4Q03
				4/01	7/01	10/01	1/02	4/02	7/02	10/02	1/03	4/03	7/03	10/03
124	<b>2.10.5 End of task report</b>	<b>Tue 7/1/03</b>	<b>Tue 11/4/03</b>											
130	<b>2.11 End of Task 2 Summary Report</b>	<b>Tue 9/2/03</b>	<b>Tue 12/16/03</b>											
136	<b>Task 3--Updating &amp; Implementing Essential RD&amp;T</b>	Mon 10/8/01	Tue 12/10/02											
137	<b>3.0 Critical &amp; Essential RD&amp;T Plan</b>	<b>Mon 10/8/01</b>	<b>Mon 2/4/02</b>											
144	<b>3.1 Critical &amp; Essential RD&amp;T</b>	Tue 2/5/02	Mon 11/11/02											
145	<b>3.2 Preliminary Report</b>	<b>Tue 11/12/02</b>	<b>Thu 1/9/03</b>											
152	<b>3.3 Final Report</b>	<b>Fri 1/10/03</b>	<b>Tue 2/11/03</b>											
155	<b>Task 4--Update Concept Basis of Design</b>	Mon 5/27/02	Wed 1/1/03											
156	<b>4.1 Update the Concept Basis of Design</b>	<b>Mon 5/27/02</b>	<b>Wed 10/30/02</b>											
162	<b>4.2 Submit the Concept Basis of Design to DOE</b>	<b>Wed 10/30/02</b>	<b>Wed 1/1/03</b>											
166	<b>4.3 Submit the Updated Concept Basis of Design to DOE</b>	Wed 1/1/03	Wed 1/1/03											
167	<b>Administration</b>	Mon 1/8/01	Wed 12/31/03											