

Early Entrance Coproduction Plant

Phase II - Quarterly Report No. 14

Reporting period: January 1, 2003 – March 31, 2003

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Abstract:

The overall objective of this project is the three phase development of an Early Entrance Coproduction Plant (EECP) which produces 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.

Table of Contents

I. List of Figures	5
II. List of Acronyms.....	6
III. Executive Summary	7
IV. Results, Discussion and Preliminary Conclusions	9
V. List of Major Activities Accomplished in First (1 st) Calendar Quarter 2003	13
VI. List of Major Activities Planned for Second (2 nd) Calendar Quarter 2003	14
VII. Financial Status:	15
A. Phase II Total Expenditures	16
B. Phase II DOE Expenditures.....	17
C. Phase II Total Percent Complete.....	18
VIII. Schedule – MS Project Schedule updated through March 31, 2003.....	19

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:

Graph – Phase II Total Expenditures	16
Graph – Phase II DOE Expenditures	17
Graph – Phase II Total Percent Complete.....	18
Phase II Project Schedule.....	20

II. List of Acronyms

AFDU	Alternative Fuels Development Unit
ASTM	American Society for Testing and Materials
ASU	Air Separation Unit
BCR	bubble column reactor
Btu	British thermal unit
CARB	California Air Resource Board
CFCMS	carbon fiber composite molecular sieve
CO ₂	carbon dioxide
DOE	U.S. Department of Energy
EECP	Early Entrance Coproduction Plant
EPA	U.S. Environmental Protection Agency
F-T	Fischer-Tropsch
GE	General Electric
HFRR	High Frequency Reciprocating Rig
ILT	Integrated Laboratory Technologies
KBR	Kellogg Brown & Root
MDEA	methyldiethanolamine
N ₂	nitrogen
ppmw	parts per million-weight
ORNL	Oak Ridge National Laboratory
RD&T	Research, Development, and Testing
STLC	soluble threshold limit concentrations
stpd	short tons per day
TCLP	Toxic Characteristic Leaching Procedure
TEMA	Technology Marketing
TES	Texaco Energy Systems LLC

III. Executive Summary

This is the ninth 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 coproduction 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 is 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 Phase I and was originally scheduled for two calendar years (2001 through 2002). The revised target for Phase II completion is the fourth (4th) calendar quarter of 2003.

During this reporting period, Wax Hydrocracking (Task 2.5.3), Naphtha Hydrotreating (Task 2.5.7.2), and Diesel Hydrotreating (Task 2.5.7.5) were completed at ChevronTexaco's Integrated Laboratory Technologies (ILT) facilities. Bechtel completed catalyst screening tests (outside the scope of the EECP) for Wax Finishing (Task 2.5.4). LCI completed a secondary F-T catalyst/wax separation parametric test for Task 3.0: Essential RD&T. Four (4) diesel candidate samples were delivered to Southwest Research Institute (SwRI) for blending (Task 2.5.6), lubricity (Task 2.6.1), and engine (Task 2.6.2) testing. The candidates included a California Air Resources Board (CARB) reference fuel, neat F-T diesel from Task 2.5.2: Lab Batch Fractionation and Task 2.5.7.1:

Naphtha Fractionation, hydrocracked F-T diesel from Task 2.5.3: Wax Hydrocracking, and a hydrocracked-hydrotreated F-T diesel blend from Tasks 2.5.3: Wax Hydrocracking and Task 2.5.7.2: Diesel Hydrotreating. SwRI completed lubricity testing on the four (4) diesel candidates. The neat F-T diesel does not require a lubricity additive to meet engine lubricity limits.

Phase III is a one-year effort scheduled to begin at the conclusion of Phase II. An engineering design package, testing plan, and financing plan for the EECF will 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 EECF forward to detailed design, construction, and operation.

III. Results, Discussion, and Preliminary Conclusions

Task 1 Project Management

Task completed.

Task 2.1 Pilot Plant Confirmation

Catalyst regeneration/rejuvenation testing (Task 2.1.1) had been split between Rentech's Denver, Colorado laboratory and ChevronTexaco's Bellaire, Texas laboratory. Four (4) F-T catalyst samples, identified as RI56, RI59, LP18, and LP19, were selected for catalyst regeneration/rejuvenation testing at both facilities. TES completed testing on the four (4) catalyst samples during 3rd calendar quarter of 2002.

Testing at Rentech has focused on solvent extraction of the F-T wax from the catalyst, reoxidation of the extracted F-T catalyst, followed by reactivation with synthesis gas and testing at standard Rentech proprietary F-T reaction conditions.

Rentech completed solvent extraction using hexane on all four (4) of the catalyst samples in the fourth (4th) calendar quarter of 2002. In the first (1st) calendar quarter of 2003, Rentech completed the oxidation, reactivation with synthesis gas, and testing of the four samples under standard Rentech proprietary F-T reaction conditions.

Rentech developed the preliminary confidential Task 2.1.1 test report. The report will be consolidated with the confidential TES test results to form a consolidated Task 2.1.1 test report. The consolidated Task 2.1.1 test report will be combined with the already completed Task 2.1.2: Catalyst Addition/Withdrawal and Task 2.1.3: F-T Confirmation Test confidential reports to form the basis for the Task 2.1 Topical Report. The Task 2.1 Topical Report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

Task 2.2 Mathematical Model and Reactor Scale-Up Confirmation

The preliminary topical report for Task 2.2 was submitted to DOE for review in February 2003. DOE comments were received and incorporated into the final topical report. The final topical report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

Task 2.3 Catalyst/Wax Separation

Gulftronics, San Diego, California, and ChevronTexaco continued discussions on the content of the preliminary Secondary Catalyst/Wax Separation (Task 2.3.2) confidential report Gulftronics submitted to ChevronTexaco. The Gulftronics report represents the third (3rd) and final report for Secondary Catalyst/Wax

Separation. The other reports were on magnetic separation tests with S.G. Frantz, Lawrenceville, New Jersey, and on filtration with LCI Corporation, Charlotte, North Carolina. The Task 2.3 Topical Report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

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

The preliminary topical report for Task 2.4 was submitted to DOE for review in January 2003. DOE comments were received and incorporated into the final topical report. The final topical report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

Task 2.5 F-T Product Upgrading

The F-T naphtha and the F-T diesel collected by ChevronTexaco ILT during Task 2.5.2: Lab Batch Fractionation in the fourth (4th) calendar quarter of 2002 were blended with neat F-T naphtha and neat F-T diesel cuts obtained from task 2.5.7.1.a, b, and c and blend was hydrotreated in the first (1st) calendar quarter of 2003. ChevronTexaco ILT and ChevronTexaco Technology Marketing (TEMA) in Richmond, California completed the Naphtha Hydrotreating (Task 2.5.6.2) and Diesel Hydrotreating (Task 2.5.7.5). The hydrotreated naphtha will be used in Task 2.5.7.3: Ethylene Cracker Yield Confirmation Tests with KBR and Task 2.5.7.4: Fuel Cell Reformer Tests with ChevronTexaco Technology Ventures. The scope of work and contract with KBR for Task 2.5.7.3 was executed in the first (1st) calendar quarter of 2003. Tasks 2.5.7.3 and 2.5.7.4 are scheduled to start in the second (2nd) calendar quarter of 2003.

ChevronTexaco TEMA completed Wax Hydrocracking (Task 2.5.3) in the first (1st) calendar quarter of 2003. The task produced the hydrocracked F-T diesel required for Task 2.5.6: Diesel Blending Testing and Diesel Engine Testing (Task 2.6). Product characterization and the confidential task report will be completed in the second (2nd) calendar quarter of 2003.

Bechtel completed catalyst screening (outside the scope of the EECF Project) in preparation for Wax Finishing (Task 2.5.4). The design basis confirmation run is scheduled to start in the second (2nd) calendar quarter of 2003. ChevronTexaco notified Bechtel that the production test to produce fifty (50) gallons of F-T wax was not required for Phase II RD&T. ChevronTexaco believes the elimination of this test from Bechtel's scope of work will reduce the EECF project expenditures by approximately \$200,000. ChevronTexaco recommended that the production test and Task 2.5.8: UIC Wax Fractionation be dropped from Phase II of the EECF project since the future location of the EECF would most likely not produce food-grade wax as a product.

In March 2003, Southwest Research Institute (SwRI), San Antonio, Texas, issued the preliminary Task 2.5.5b: Oxygenate Testing report to ChevronTexaco. SwRI

used multiple methods to measure the total concentration of oxygen in various upgraded samples of F-T naphtha.

Task 2.6 Fuel/Engine Performance and Emissions

SwRI acquired a California Air Resource Board (CARB) reference diesel for testing in Task 2.5.6: Diesel Blending Testing and Task 2.6.2: Hot-Start Cycle Transient Diesel Engine Test. Three (3) F-T diesel samples were sent to SwRI in sufficient quantity for Task 2.5.6: Diesel Blending Testing, Task 2.6.1: Lubricity Testing, and Task 2.6.2: Hot-Start Cycle Transient Diesel Engine Test. The three (3) F-T diesel candidates sent to SwRI include: neat F-T diesel from Task 2.5.2: Lab Batch Fractionation and from Task 2.5.7.1: Naphtha Fractionation, hydrocracked diesel from Task 2.5.3: Diesel Hydrocracking, and a blend of hydrotreated diesel from Task 2.5.7.6: Diesel Hydrotreating and hydrocracked diesel from Task 2.5.3.

Lubricity Testing (Task 2.6.1) was completed on the three (3) F-T diesel fuels by SwRI in the first (1st) calendar quarter of 2003. The purpose of the test was to ensure the F-T diesel samples would not damage the SwRI diesel engine in Task 2.6.2: Hot-Start Cycle Transient Diesel Engine Test. Two commercially available lubricity additives were added in various concentrations and the wear scar dimension with a standard hardened steel plate, as measured by the American Society for Testing and Materials (ASTM) D-6079, High Frequency Reciprocating Rig (HFRR) test, was recorded for each concentration of additive.

Preliminary results from the HFRR testing shows that each of the F-T fuels exceeds the U.S. limit of fewer than 450 micrometers. The neat F-T diesel exceeded the U.S. limit without any lubricity additive. For the diesel engine test (Task 2.6.2), appropriate amounts of lubricity additive will be added to each of the F-T diesel fuels with the possible exception of the neat F-T diesel. ChevronTexaco and SwRI will meet prior to the engine test, second (2nd) calendar quarter of 2003, and decide on the amount of lubricity additive to be added to each fuel.

Task 2.7 Petroleum Coke Analysis

The preliminary topical report for Task 2.7 was submitted to DOE for review in January 2003. DOE comments were received and incorporated into the final topical report. The final topical report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

Task 2.8 Carbon Dioxide (CO₂) Stripping from Methyldiethanolamine (MDEA) at Medium Pressure

Task completed.

Task 2.9 Integration

The preliminary topical report for Task 2.7 was submitted to DOE for review in January 2003. DOE comments were received and incorporated into the final topical report. The final topical report will be submitted to DOE in the second (2nd) calendar quarter of 2003.

Task 2.10 Environmental

CO₂ Recovery from Gas Turbine Exhaust Gas (Task 2.10.4):

Originally, Oak Ridge National Laboratory (ORNL) proposed building a three-cell demonstration unit using a Carbon Fiber Composite Molecular Sieve (CFCMS) to remove CO₂ from the combustion flue gas. Experimental work showed that more design needs to be done for the configuration.

A design study of how the CFCMS can be used to remove CO₂ from the gas stream is underway. Features to be considered in the design study include:

- a. Multi-bed plant
- b. Beds with high aspect ratio (diameter/length) resulting in high throughput and low pressure drop
- c. The use of the nitrogen (N₂) exhaust from one bed to purge another, after the heat and vacuum regeneration

The report on the ORNL testing is scheduled to be issued in May 2003. The Task 2.10 Topical report is scheduled to be issued to DOE for review in the 3rd calendar quarter of 2003.

Task 3.0 Update and Implement Essential RD&T

In the first (1st) calendar quarter of 2003, LCI Corporation, Charlotte, North Carolina completed secondary catalyst/wax separation parametric tests using F-T wax collected at the LaPorte Alternative Fuels Development Unit (AFDU). The purpose of the parametric test was to provide scale-up data for an EECF-sized secondary catalyst/wax separation system. Over the time the LCI element showed a flux declines due to fouling. Preliminary system cleaning tests were also conducted by LCI. The LCI element must be periodically cleaned to remove solid particles from its pores to restore the flux. System cleaning tests examined a variety of materials to remove the solid particles. The filtrate from the parametric tests met the EECF F-T product upgrading technologies standard of less than ten (10) parts per million-weight (ppmw) of iron. LCI will issue the preliminary task confidential report to ChevronTexaco in the second (2nd) calendar quarter of 2003 once data analysis is complete. The Task 3.0 Topical report is scheduled to be issued to DOE for review in the 3rd calendar quarter of 2003.

V. List of Major Activities Accomplished in the First (1st) 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. 13 for DOE review.
- Completed F-T Catalyst Regeneration/Rejuvenation testing at Rentech (Task 2.1.1).
- Submitted preliminary Mathematical Modeling (Task 2.2) topical report for DOE review.
- Submitted preliminary Low Btu Combustion Test (Task 2.4) topical report for DOE review.
- Completed Wax Hydrocracking with ChevronTexaco TEMA (Task 2.5.3)
- Bechtel completed catalyst screening (outside EECF scope) for Wax Finishing (Task 2.5.4)
- SwRI issued preliminary Oxygenate Testing report (Task 2.5.5)
- Completed F-T naphtha hydrotreating at ChevronTexaco ILT (Task 2.5.7.2)
- Completed F-T diesel hydrotreating at ChevronTexaco ILT (Task 2.5.7.5)
- Completed F-T diesel lubricity testing at SwRI (Task 2.6.1)
- Submitted preliminary Petroleum Coke Analysis (Task 2.7) topical report for DOE review.
- Submitted preliminary Integration (Task 2.9) topical report for DOE review.

VI. List of Major Activities Planned for the Second (2nd) Calendar Quarter of 2003

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

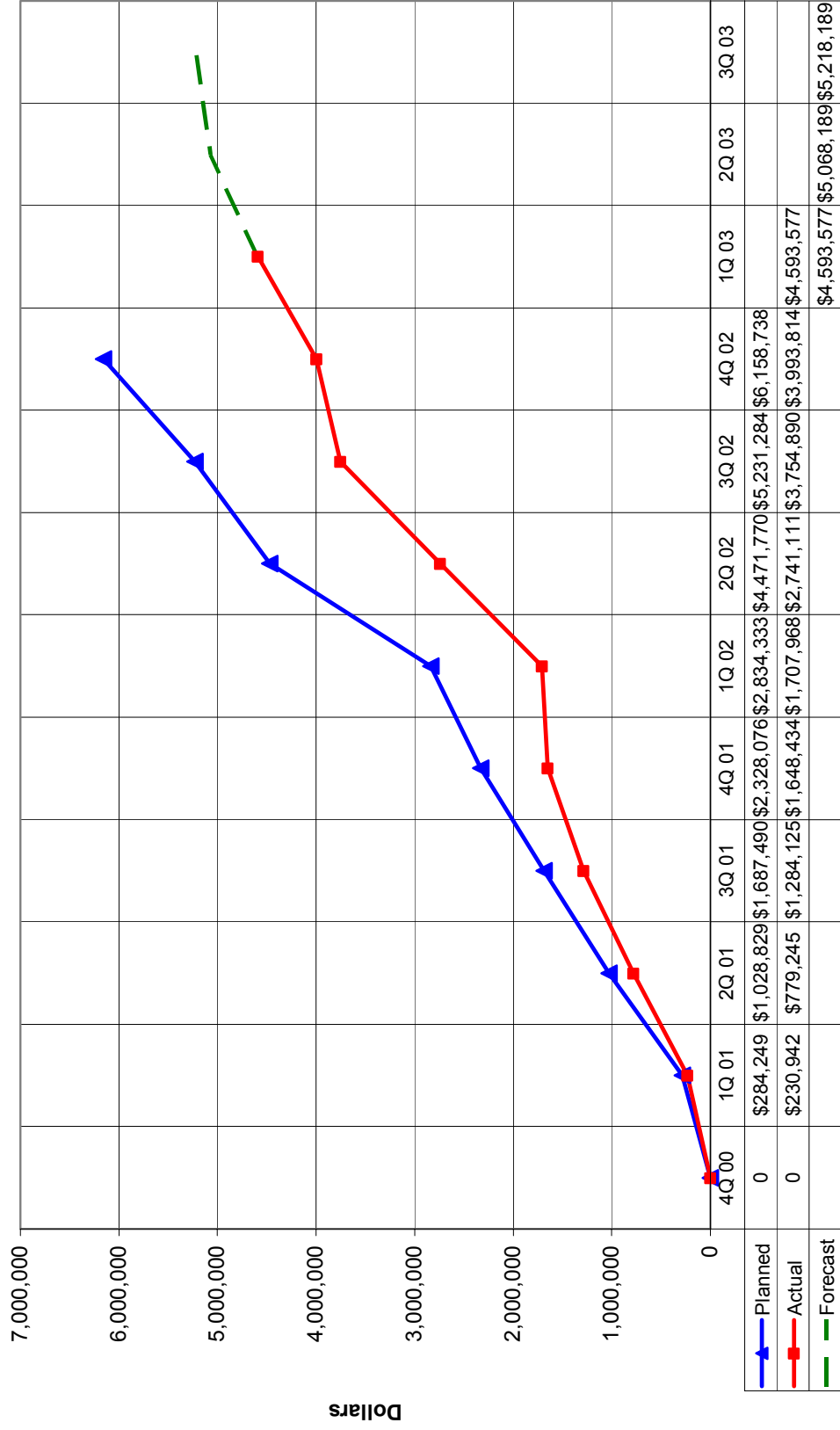
- Submit final Quarterly Report No. 13 for DOE approval.
- Submit F-T Pilot Plant Confirmation Run (Task 2.1) topical report to DOE for review.
- Submit final Mathematical Modeling (Task 2.2) topical report for DOE approval.
- Submit F-T Catalyst/Wax Separation (Task 2.3) topical report to DOE for review.
- Submit final Low Btu Combustion Test (Task 2.4) topical report for DOE approval.
- Complete design basis confirmation pilot plant test for Wax Finishing (Task 2.5.4) with Bechtel.
- Start Ethylene Cracker Yield Confirmation Tests (Task 2.5.7.3) with KBR.
- Complete Fuel Cell Reformer Tests (Task 2.5.7.4) with ChevronTexaco Technology Ventures.
- Complete Hot-Start Cycle Transient Diesel Engine Test (Task 2.6.2) and Solvent Extraction of Organic Fraction from the Diesel Particulate Matter (Task 2.6.3) at SwRI.
- Submit final Petroleum Coke Analysis (Task 2.7) topical report for DOE approval.
- Submit final Integration (Task 2.8) topical report for DOE approval.

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:

Phase II Total Expenditures	16
Phase II DOE Expenditures	17
Phase II Total Percent Complete.....	18

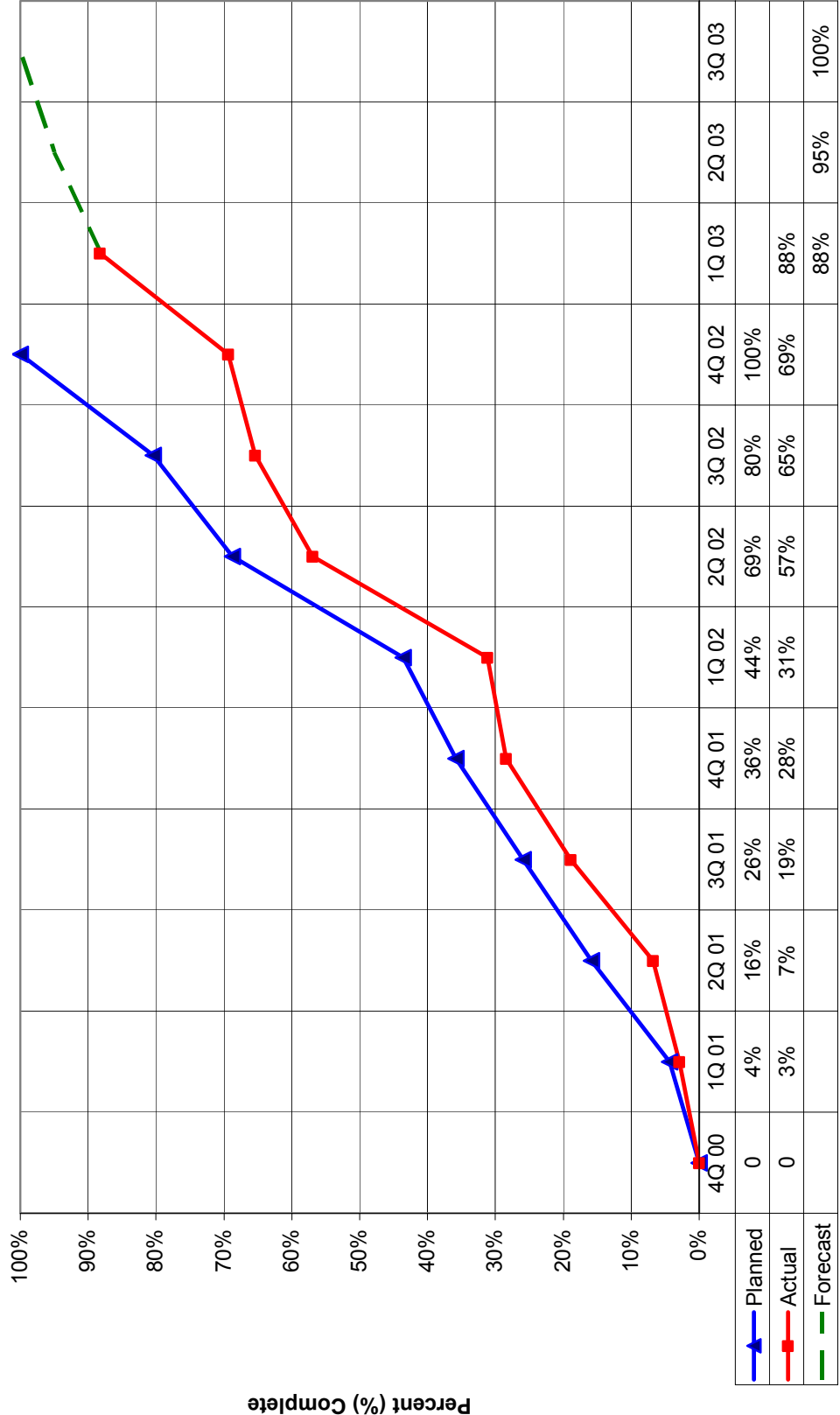
Early Entrance Coproduction Plant Phase II - Total Expenditures



Early Entrance Coproduction Plant Phase II - DOE Expenditures



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

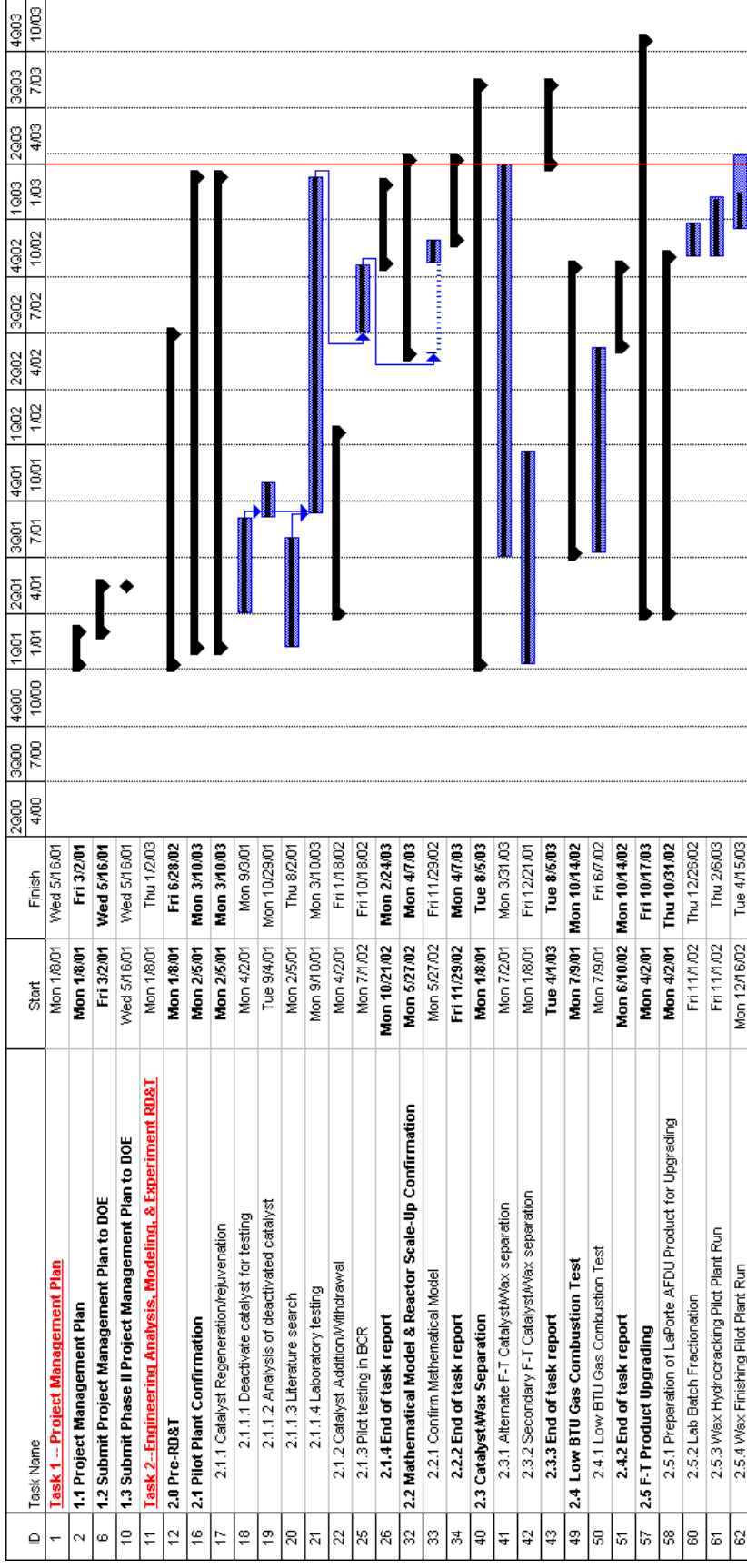


VIII. Schedule

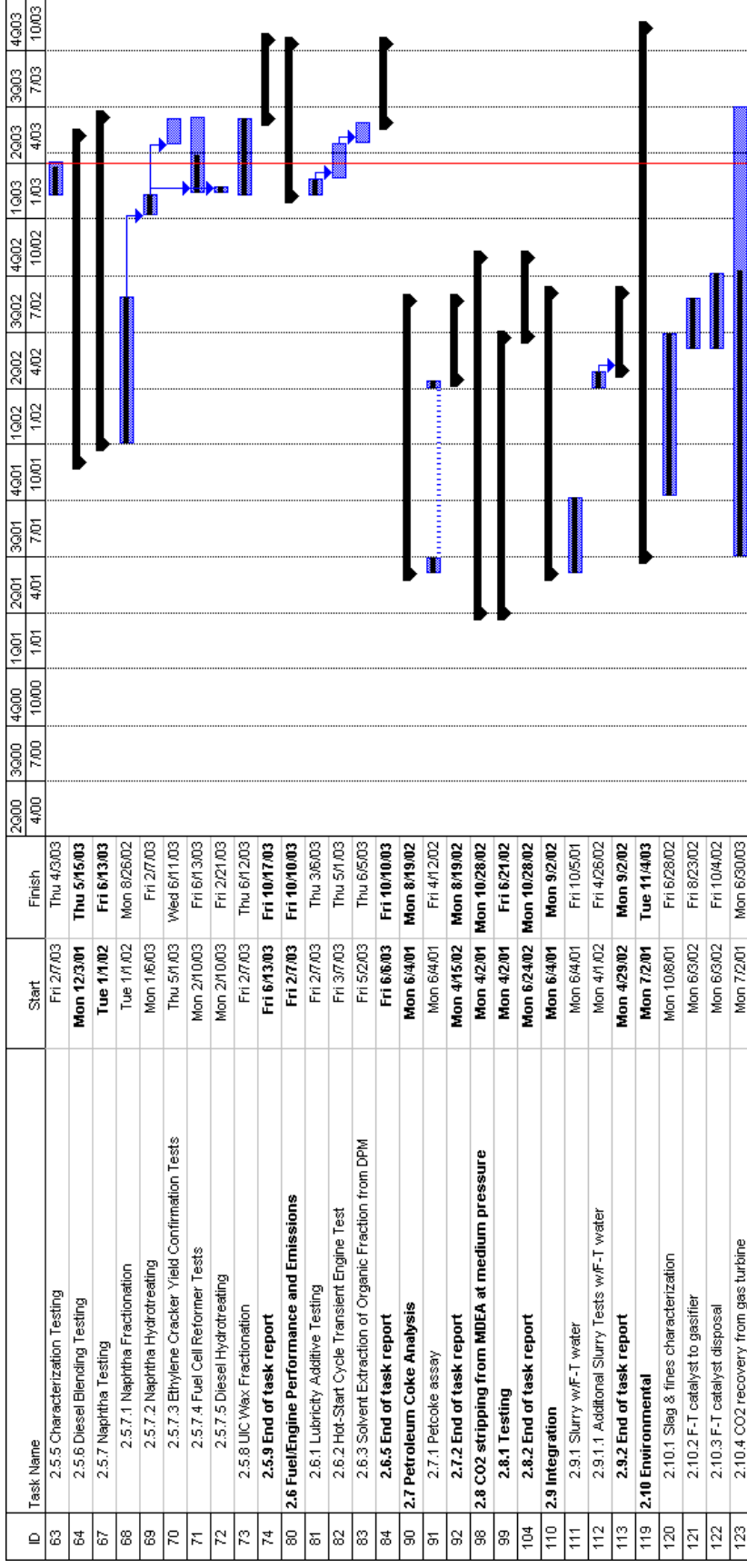
The following schedule depicts the updated Phase II project schedule and shows percent complete by task as of March 31, 2003. For a description of the work involved in each task, refer to the Cooperative Agreement and Research, Development, and Testing Plan. This schedule was prepared using Microsoft 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 (4th) calendar quarter of 2003. DOE has granted a no cost, time extension for the EECp project until November 30, 2003.

Early Entrance Coproduction Plant (EECP) – Phase II Schedule



Early Entrance Coproduction Plant (EECP) – Phase II Schedule



Early Entrance Coproduction Plant (EECP) – Phase II Schedule

ID	Task Name	Start	Finish	2Q00	3Q00	4Q00	1Q01	2Q01	3Q01	4Q01	1Q02	2Q02	3Q02	4Q02	1Q03	2Q03	3Q03	4Q03
124	2.10.5 End of task report	Tue 7/1/03	Tue 11/4/03															
130	2.11 End of Task 2 Summary Report	Tue 9/2/03	Tue 12/16/03															
136	Task 3--Updating & Implementing Essential RD&T	Mon 10/8/01	Tue 12/10/02															
137	3.0 Critical & Essential RD&T Plan	Mon 10/8/01	Mon 2/4/02															
144	3.1 Critical & Essential RD&T	Tue 2/5/02	Mon 11/11/02															
145	3.2 Preliminary Report	Tue 11/12/02	Thu 1/9/03															
152	3.3 Final Report	Fri 1/10/03	Tue 2/11/03															
155	Task 4--Update Concept Basis of Design	Mon 5/27/02	Wed 1/1/03															
156	4.1 Update the Concept Basis of Design	Mon 5/27/02	Wed 1/1/03															
162	4.2 Submit the Concept Basis of Design to DOE	Wed 10/30/02	Wed 1/1/03															
166	4.3 Submit the Updated Concept Basis of Design to DOE	Wed 1/1/03	Wed 1/1/03															
167	Administration	Mon 1/8/01	Wed 12/31/03															