Early Entrance Coproduction Plant
Phase I - Quarterly Report No. 4

Reporting period: July 1, 2000 – September 30, 2000

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Date Issued: December 18, 2000 (Preliminary)
February 15, 2001 (Final)

DOE Cooperative Agreement No. DE-FC26-99FT40658

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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 objective of Phase I is to determine the feasibility and define the concept for the EECP located at a specific site and to develop a Research, Development, and Testing Plan (RD&T) for implementation in Phase II.

The objective of Phase II is to implement the RD&T 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 plan for an EECP located at a specific site.

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.

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I. List of Figures

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II. List of Acronyms

The following acronyms were used in this report:

AGR	Acid gas removal
ASU	Air Separation Unit
BACT	Best Available Control Technology
BFW	Boiler feedwater
bpd	barrels per day
CO_2	Carbon dioxide
DCU	Delayed Coking Unit
DOE	United States Department of Energy
EECP	Early Entrance Coproduction Plant
F-T	Fischer-Tropsch
GE	General Electric Power Systems
GT	Gas turbine
H_2S	Hydrogen sulfide
H_2SO_4	Sulfuric Acid
HCU	Hydrocracking Unit
HP	High pressure
HRSG	Heat Recovery Steam Generator
IP	Intermediate pressure
KBR	Kellogg Brown & Root, Inc.
LP	Low pressure
MDEA	Methyldiethanolamine
NOx	Nitrogen oxides
NPV	Net Present Value
PAR	Motiva's Port Arthur, Texas Refinery
PARFW	Port Arthur Refinery Finished Wax Case
PARHCU	Port Arthur Refinery Hydrocracking Case
RD&T	Research, Development & Testing
SO_2	Sulfur dioxide
SRU	Sulfur Recovery Unit
ST	Steam Turbine
STAG	Steam and gas
sTPD	Short tons per day
SWS	Sour water stripper
TECO	Tampa Electric Company
TGTU	Tail Gas Treating Unit
TSC	Tampa Syncrude Case
THCU	Tampa Hydrocracking Case
WGS	Water gas shift

III. Executive Summary

This is the fourth of five quarterly reports which summarize the progress of Phase I of the development of the Early Entrance Coproduction Plant (EECP) concept covered by DOE Cooperative Agreement No. DE-FC26-99FT40658. The Phase I objective is to determine the feasibility and define the concept for the EECP located at a specific site and to develop a Research, Development, and Testing (RD&T) Plan. Phase I is scheduled for completion by the end of the year 2000, except for activities resulting from DOE comments on Phase I reporting. Phase II is to conduct the research as outlined in Phase I and is scheduled for two calendar years (2001 through 2002). Phase III is a one year effort scheduled for the calendar year 2003 and is to develop an engineering design package and financing plan for the EECP. 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.

As reported in the previous quarterly report, the Port Arthur Refinery was selected as the EECP host site and the Finished Wax case as the facility configuration. During this reporting period, development of the basis of design and technical assessment of subsystems for this case progressed. Capital and operating cost estimating activities began as well as risk assessment of the facility's integrated subsystems. Updating of the marketing, environmental, and economic assessments for the Port Arthur site also began. Preparation of the Research, Development, and Testing Plan, which outlines work to be conducted in Phase II, also began. In addition, preparation of the Phase I Concept Report started.

4Q2000 work will include completion of all conceptual process design, cost estimates, risk assessment, and marketing, environmental, and economic assessments. The Research, Development, and Testing Plan, the Phase I Concept Report, and the Preliminary Project Financing Plan will be submitted to the DOE for comments.

IV. Results, Discussion, and Preliminary Conclusions

In the previous quarter, four cases (Port Arthur Finished Wax, Port Arthur Hydrocracker, Tampa Electric Hydrocracker, and Tampa Electric Syncrude) were studied. After performing preliminary technical, marketing, environmental, economic, and site evaluations, the Port Arthur Refinery (PAR) location and the Finished Wax case were selected for further development of the EECP concept. During this quarter, more detailed refinery site specific-technical, marketing, environmental, and economic assessments were begun.

The EECP in this configuration will convert approximately 1,235 sTPD of petroleum coke into electric power, steam, and finished Fischer-Tropsch (F-T) liquids. Estimated quantities of saleable products are as follows: 55MW of net electrical power; 130,000 kg/hr of 4,272 kPa (286,588 lb/hr of 620 psia) steam; 104,000 kg/hr of 1,171 kPa (229,209 lb/hr of 170 psia) steam; 2,025 kg/hr (360 bpd) of finished high-melt wax; 509 kg/hr (97 bpd) of finished low-melt wax; 125 bpd of F-T diesel; 35 bpd of F-T naphtha; and 89 sTPD of sulfur. Additional quantities of power and steam will be produced and consumed internally.

Feedstock Considerations

While the original solicitation requested that coal be used as a feedstock, the analysis of the current available feedstocks resulted in our proposal premise that a petcoke feedstock would be the best feedstock to enable the EECP concept to become an actual project. The analysis results were that petcoke would be the lowest cost source of hydrogen and carbon for the future. The highest probable application of the EECP concept would be based on petcoke and most probable at a refinery location due to the high cost of handling and transporting petcoke to another location. Therefore our proposal premise was that the project would be coal capable and must demonstrate the design would be capable of converting coal to F-T fuel products. This decision was based on gasification pilot plant research and development results for over fifty years of using different feedstocks and their performance in the gasification process. Feedstocks have included petroleum products ranging from natural gas to the heaviest petroleum fractions, petroleum coke, and coal ranging from anthracite to lignite and many types of waste materials. All of these materials have been gasified successfully. Because of the severe operation conditions used in the gasification process, very high temperature and pressure, it has been shown that there are only minor, in many cases negligible, differences in the reactivities of the various feedstocks.

This universality of performance has been further demonstrated in the more than 130 commercial plants that have been built and run using the Texaco Gasification Process. These plants use the complete range of feedstocks, natural gas, all petroleum fractions, asphalt, petroleum coke, coal and several waste materials. Any differences in the results, such as variations in the composition of the product syngas or thermal efficiency, can be accounted for by the differences in atomic composition of the feedstocks. Currently, new plants are designed based only on the chemical composition of the feeds.

While this vast store of experience should demonstrate the validity of generalizing gasification performance across feedstocks, some interesting observations have been developed in the cases of petroleum coke and coal. In many other process uses, where operating conditions are less severe, there are significant performance differences. In these cases, coal is generally more reactive than coke because of the differences in the molecular structures. Higher volatility of coal, due to the relative ease of its thermal cracking, is perhaps the most obvious difference and is the source of many of the process differences seen. These processes are generally reaction rate limited at the lower temperatures and pressures used, and the volatiles generated in heating the coal react more rapidly than the solid portions of the material. But in gasification, reaction rates are extremely high, and primarily physical processes, heat, mass transfer and fluid mechanics determine the performance. When these processes are considered, coal and coke are quite similar and hence they perform the same in the Texaco Gasification Process.

<u>Description of the Proposed EECP Facility</u>

Please refer to Figure 1 (page 17) for a block flow diagram of the proposed facility.

Petroleum coke from the Port Arthur Refinery (PAR) Delayed Coking Unit (DCU) is crushed, mixed with water, and pumped to the gasification section. This coke slurry is mixed with high-pressure oxygen from the Praxair air separation unit (ASU) and a small quantity of high-pressure steam in a specially designed feed injector mounted on the gasifier. The resulting reactions take place very rapidly to produce synthesis gas, also known as syngas, that is composed primarily of hydrogen, carbon monoxide, water vapor, and carbon dioxide (CO_2) with small amounts of hydrogen sulfide, methane, argon, nitrogen, and carbonyl sulfide. The raw syngas is scrubbed with water to remove solids, cooled, then forwarded to the Acid Gas Removal Unit (AGR), where the stream is split. One portion of the stream is treated in the AGR to remove CO_2 and H_2S and then forwarded to the F-T synthesis unit. The other portion is treated in the AGR to remove the bulk of H_2S with minimal CO_2 removal and then forwarded as fuel to the General Electric frame 6FA gas turbine. In the AGR solvent regeneration step, nitrogen from the ASU is used as a stripping agent to release CO_2. The resulting CO_2 and nitrogen mixture is also sent to the gas turbine, which results in increased power production and reduced nitrogen oxides emissions. The bulk of the nitrogen is also sent to the gas turbine as a separate stream, where its mass flow also helps increase power production and reduce nitrogen oxides emissions.

Overall, approximately 75% of the sweetened syngas is sent to the gas turbine as fuel. The remaining 25% is first passed through a zinc oxide bed arrangement to remove the remaining traces of sulfur and then forwarded to the F-T synthesis unit. In the F-T reactor, carbon monoxide and hydrogen react aided by an iron-based catalyst, to form mainly heavy straight-chain hydrocarbons. Since the reactions are highly exothermic, cooling coils are placed inside the reactor to remove the heat released by the reactions. Three hydrocarbon product streams; heavy F-T liquid, medium F-T liquid, and light F-T liquid are sent to the F-T product upgrading unit while F-T water, a reaction byproduct, is returned to the gasification unit and injected into the gasifier. The F-T tail gas and AGR offgas is sent to the gas turbine as fuel for additional power production.

In the product upgrading section, the three F-T liquids are combined and processed as a single feed. The unit consists of a Bechtel Hy-Finishing™ reactor, product separators, an atmospheric fractionator, naphtha stabilizer, a vacuum distillation tower, feed preheaters, hydrogen compression facilities, and product coolers. The reaction is carried out at elevated pressure and temperature. A mixture of feed hydrocarbons and hydrogen-rich gas is fed to the top of the fixed bed reactor. In the presence of a hydrotreating catalyst, hydrogen reacts slightly exothermally with the feed to produce saturated hydrocarbons, water, and some hydrocracked light ends. The resulting four liquid product streams are naphtha, diesel, low melt wax, and high melt wax. Each of these streams is sent to segregated product storage tanks. The wax tanks are insulated and equipped with steam coils to maintain the storage temperature above the wax melting point. All of the products leave the EECP facility via tank truck. Transfer pumps and truck loading facilities are provided adjacent to the storage tanks.

The power block consists of a GE frame 6FA 60 hz heavy-duty gas turbine generator and is integrated to a two-pressure level heat recovery steam generator and a non-condensing steam turbine generator. The system is designed to supply a portion of the compressed air feed to the ASU, process steam to the refinery, and electrical power for export and use within the EECP facility. The gas turbine has a dual fuel supply system with natural gas as startup and backup fuel, and primary fuel as a mixture of syngas from the gasifier, off gas from the AGR unit, and tail gas from the F-T synthesis unit. Nitrogen gas for injection is supplied by the ASU for NO_x abatement, power augmentation, and the fuel purge system. The combustion system design, including appropriate fuel nozzles, will require new design testing and validation. The heat recovery steam generator is a two-pressure, non-reheat, natural circulation type with horizontal gas flow and vertical fin tubes in all sections. It will be arranged with a high-pressure (HP) superheater, HP drum and evaporator, HP economizer, intermediate pressure (IP) superheater, IP drum and evaporator, and IP economizer. High pressure steam will be produced at 6,890 kPa (1,000 psia) and intermediate pressure steam at 1,275 kPa (185 psia).

The Praxair ASU is designed as a single train elevated pressure unit. Its primary duty is to provide oxygen to the gasifier and Sulfur Recovery Unit (SRU), and all of the EECP's requirements for nitrogen and instrument and compressed air. However, it can also export surplus oxygen and nitrogen, when available, to PAR. As mentioned above, ASU nitrogen product applications within EECP include its use as a stripping agent in the AGR, as a diluent in the gas turbine where its mass flow helps increase power production and reduce nitrogen oxides emissions, and as an inert gas for purging and inerting. The gas turbine, in return for diluent nitrogen supplies approximately 25% of the air feed to the ASU, which helps reduce the size of the ASU's compressor, hence oxygen supply cost.

Acid gases from the AGR, as well as sour water stripper (SWS) offgas from the gasification unit, are first routed to knockout drums as they enter the Claus SRU. After entrained liquid is removed in these drums, the acid gas is preheated and fed along with the SWS gas, oxygen, and air to a burner. H_2S in the thermal reactor, a portion of which has been combusted to SO_2, starts to recombine with the SO_2 to form elemental sulfur. The reaction mixture then passes through a boiler to remove heat while generating steam. The sulfur-laden gas is sent to the first pass of the primary sulfur condenser in which all sulfur is condensed. The gas is next preheated before entering the first catalytic bed in which more H_2S and SO_2 are converted to sulfur. The sulfur is removed in the second pass of the primary sulfur condenser, and the gas goes through a reheat, catalytic reaction, and condensing stage two more times before leaving the SRU as a tail gas. The molten sulfur from all four condensing stages is sent to the sulfur pit, from which product is transported offsite by tank truck.

The tail gas from the SRU is preheated and reacted with hydrogen in a catalytic reactor to convert unreacted SO_2 back to H_2S. The reactor effluent is cooled while generating steam before entering a quench tower for further cooling. A slip stream of the quench tower bottoms is filtered and sent along with the condensate from the SRU knockout drums to the SWS. H_2S is removed from the quenched tail gas in an absorber by lean methyldiethanolamine (MDEA) solvent from the AGR unit, and the tail gas from the absorber is thermally oxidized and vented to atmosphere. The rich MDEA solvent returns to the AGR unit to be regenerated in the stripper.

The steam system of the EECP serves two main functions: (1) it serves as a medium for exporting a large amount of surplus heat from the EECP to PAR and (2) integrates the heat balances between the individual process blocks within the EECP. The system is designed to recover the maximum amount of heat from the EECP and to export it in the form of 4,272kPa (620 psia) and 1,171 kPa (170 psia) superheated steam to the refinery. PAR will provide zeolite treated water which will be passed through a mixed-bed polishing unit to remove final traces of contaminants and produce high-quality deaerator feed water. This water is first preheated by exchange with waste heat streams available from the air separation unit and gasifier, then pumped to the deaerator. Two low-pressure (LP) boiler feed water (BFW) pumps are used to deliver deaerated water to the gasification section where low-grade heat is used to generate 482 kPa (70 psia) saturated steam, which is used within the EECP facility. Other portions of the low-pressure water are sent to the gasification unit and heat recovery steam generator (HRSG) for production of 1,275 kPa (185 psia) saturated steam. A significant portion of this steam is consumed internally within the EECP facility, however approximately 103,997 kg/hr (229,209 lbs/hr) is superheated in the HRSG and exported to the refinery. The remaining portion of the low-pressure water is passed through high-pressure boiler feedwater pumps and sent to the HRSG for production of 6,890 kPa (1,000 psia) saturated steam. A small portion of that steam is used in the gasifier and SRU, while the remainder is superheated in a HRSG coil before being let down to 4,272 kPa (620 psia) through a steam turbine. The steam turbine is used to drive a generator which recovers 2,827 kW (3,790 horsepower) from the letdown steam. Two intermediate-pressure (IP) BFW pumps are used to feed deaerated water to both the 2,963 kPa (430 psia) and 4,272 kPa (620 psia) headers after heat exchange with a stream from the gasifier. A portion of the water also picks up heat from the F-T synthesis unit to produce 2,963 kPa (430 psia) saturated steam for use within the EECP. The remainder is let down to the 1,275 kPa (185 psia) header. The remainder of the IP BFW is used to generate 4,272 kPa (620 psia) saturated steam which combines with the letdown from the steam turbine and is exported to PAR. Provisions are included for letting down steam from one header to the next to facilitate control during start-ups or upset conditions.

A cooling water system is included in the EECP facility. The system consists of a freshwater cooling tower and basin. Motor driven cooling water pumps serve to circulate cooling water between the cooling tower and various cooling water exchangers within the EECP. A vendor maintained cooling water treatment unit is also provided. Make-up water to the cooling tower is taken from PAR and cooling tower blowdown is sent to PAR for treatment.

A flare and associated piping and knockout drum are also provided to handle the full flow of the gasifier in the event that a unit downstream of it should trip.

Firewater and service water systems are provided and connect to the much larger PAR facilities. Services such as sewer, potable water, and oily water systems are also connected to the PAR facilities. In addition, costs for a control room, offices, laboratory, and maintenance shops have been included in the EECP capital cost estimate.

The EECP is capable of operation without the F-T synthesis unit and F-T upgrading section. In that case, all of the syngas will be used as fuel to the gas turbine. The gasifier and ASU would then be operating at slightly reduced capacity, however power and steam export to the refinery would be maintained.

Proposed EECP Facility Energy Audit

An overall energy assessment study was performed for the EECP facility. Pinch analysis, a systematic approach based on thermodynamics, was used to determine the minimum energy requirements for the process subject to imposed constraints. Composite heating and cooling curves were developed and combined into a composite curve by plotting the temperature with the enthalpy difference between the hot and cold composite curves. After the steam export was fixed, the opportunities for recovering additional heat from the process were identified and the final heat exchange design was completed. The main objective of this study was to carry out an energy audit of the process and identify opportunities to improve energy recovery of the proposed design. The analysis indicated the proposed process configuration exhibited a high degree of recoverable energy efficiency of about 92%. This efficiency value is considered high at this point in design. The detailed results of the study will be included in the Concept Report.

Proposed EECP Facility Thermal Efficiency

On a gross heating value basis, the proposed EECP thermal efficiency has been estimated at 66.5%. This calculation is based on processing 1,235 short tons per day of petroleum coke to produce saleable products of: 55MW of net electrical power;

130,000 kg/hr of 4,272 kPa (286,588 lb/hr of 620 psia) steam; 104,000 kg/hr of 1,171 kPa (229,209 lb/hr of 170 psia) steam; 2,025 kg/hr (360 bpd) of finished high-melt wax; 509 kg/hr (97 bpd) of finished low-melt wax; 125 bpd of F-T diesel; 35 bpd of F-T naphtha; and 89 short tons per day of sulfur.

Technical Barriers

Work also began this period to identify and assess the technical barriers that require additional research, development, and testing before the process can be commercialized. Several technical barriers have been identified within the F-T Synthesis Unit, Power Block, F-T Product Upgrading section, and AGR.

The barriers within the F-T Synthesis Unit have been categorized into four main areas: reactor design; catalyst/wax separation; equipment design; and environmental concerns. Reactor design is critical to ensure that the synthesis reaction will produce the desired yields, offgas, and product liquid composition for the syngas provided. The main technical barriers within this area are the confirmation of the catalyst performance, hydrodynamics, reactor scale-up, and the design of reactor internals. Catalyst performance has been included under reactor design because it is one of the most important considerations when designing a reactor. An acceptable reactor design will provide good distribution of the syngas within the reactor, manage the chemical energy that is released from the reaction, allow for the products to be removed from the reactor in a controlled fashion, and produce the maximum amount of desired products. The reactor should be the smallest that will maintain the desired reactor yield and selectivity. Proper instrumentation must be provided in the reactor to measure slurry concentration, bed expansion, temperature gradients, gas holdup, etc.

Catalyst/wax separation is a critical issue that must be resolved. Currently, various separation methods are being evaluated outside of DOE EECP funding. For example, Texaco will demonstrate the effectiveness of the separation on a stand-alone system and a small slurry bubble column reactor (SBCR). Texaco will also privately fund construction and testing of a Demonstration Separator at the DOE Alternative Fuels Development Unit at LaPorte, Texas. Catalyst/wax separation involves the separation of the liquid products of the reaction from the catalyst. The purpose is to remove clean liquid products from the reactor while keeping the catalyst inventory within the reactor. The separation may occur within the reactor or may occur outside of the reactor. In the current design, the catalyst/wax separation is accomplished in two stages. The first stage removes the liquid products as filtrate while maintaining reactor catalyst inventory. The second stage removes the remaining catalyst solids from the liquid products being sent to the F-T Product Upgrading Unit. The design of the catalyst/wax separation system must be tested and optimized before the F-T Synthesis Unit can be commercialized.

Aside from the F-T Synthesis reactor and the catalyst/wax separation system, there are other equipment items within the F-T Synthesis Unit with unproven design. These items include the activation vessel, the catalyst dump tank, and the catalyst withdrawal and replacement equipment.

In addition to the equipment design issues, there are some process design and environmental issues that need resolution. These include the disposal of F-T synthesis catalyst and the use of F-T water in the gasification section. Testing will be required to confirm that the assumed methods are technically feasible.

The GE multi-shaft combined cycle STAG (steam and gas) 106FA system configuration designed for the EECP plant uses commercially available equipment except for the gas turbine combustion system. The GE 6FA gas turbine has been successfully tested for operation on syngas produced in Texaco gasifiers from a variety of feedstocks such as coal, coke, vacuum residue, etc. For the EECP proposed, part of the syngas from the Texaco gasification unit, after getting treated in the AGR, will be sent to the F-T Synthesis Unit for conversion into liquid products. The tail gas from the F-T Synthesis Unit consists of uncondensed reactor products along with unreacted F-T feed gas. The thermal energy content of the F-T tail gas is lower than the syngas. There is no operating experience with the burning of this tail gas in the commercial combustion turbine. The percentage of F-T tail gas that can be burned along with the mixture of Texaco gasifier syngas and offgas from the AGR is not known. Moreover, the gas turbine combustor required in this design will also have air extraction for the ASU and nitrogen injection near the reaction zone for NO_x emission control. The gas turbine combustion system will need to be designed and tested before it can be offered for commercial operation.

With regard to technical barriers for F-T Product Upgrading, the Bechtel Wax Hy-Finishing™ technology has not yet been applied specifically to the hydrogenation of F-T liquids, although the concept of processing feeds of this composition is commercially proven. Summarily, the barriers to full confidence in the process technology to produce finished wax include: operating conditions of temperature, pressure, hydrogen to hydrocarbon ratio; deactivation rate of the process catalyst; separation of light hydrocarbon byproducts produced during the process; and separation of the finished wax into narrow boiling and viscosity ranges without thermal degradation.

The primary technical risk with the AGR is the uncertainty of commercial tray efficiencies at medium pressure in stripping a rich amine with nitrogen at medium pressures. Error in this regard has a potential double negative impact that could result in less CO_2 to the gas turbine and more CO_2 to the SRU. Other potential risks include trace or acidic contaminants in the syngas that may cause amine degradation and/or corrosion problems and trace oxygen in the stripping nitrogen that may cause formation of heat stable salts and other degradation problems. These risks are judged relatively minimal since they could be addressed by design issues and/or available technologies that would mitigate or eliminate them.

In Phase I, solutions have been assumed for all of the above technical barriers. During Phase II, research, development, and testing will be performed to confirm and to develop solutions to the technical barriers that have been identified. Some of the work will be done within the scope of Phase II of the EECP and some will be performed outside the scope of the EECP.

Risk Assessment

A risk assessment of the EECP facility was begun during this quarter. The purpose of this effort was to test the interdependencies between units and the effect of individual and collective dependencies on the overall availability of the facility. The facility was modeled as a single train plant (to comply with the original basis of the DOE's solicitation), with no spare equipment unless specifically indicated in the equipment list. Planned and unplanned failure data were solicited from team members for each of the elements modeled. Where data did not exist, industry sources were consulted to provide the reliability model with a reasonable basis. Overall planned downtime was not calculated on a process block by block basis, as any major outage in one block would have a direct affect on the availability of others. Instead, planned downtime was calculated by identifying the longest planned outage for a given 6-month interval and identifying other planned events that could be performed during that outage, so that no additional downtime would be incurred for these shorter events. Those planned maintenance activities that did not fall into one of the 6-month turnaround intervals were counted as additional outages.

In the event of a shutdown of the F-T synthesis unit, all of the syngas would be diverted to the gas turbine resulting in additional electricity and steam production.

Reliability prediction software was utilized to define the initial basis and generate reliability block flow diagrams. Data was input into this software for initial analysis and review, then loaded into Microsoft Excel for additional calculations, case comparisons, and development of charts and tables. The initial results indicate an overall EECP facility availability of 78% with an increase to 80.8% by sparing the Make-up Hydrogen Compressor and Hydrogen Recycle Compressor in the F-T Product Upgrading Unit. Further improvements in overall availability may be obtained by selective sparing and/or parallel operation of some equipment. Additional work in this area will be conducted in Phase III. Sparing of major equipment such as the GE gas turbine is not planned in keeping with the single train philosophy.

Marketing, Environmental, Economic Assessments

Products considered for manufacture by the EECP include F-T diesel, F-T naphtha, finished wax, syncrude, sulfur, power, and steam. For each of these products, the Product Valuation Team considered valuation methodologies, current market size and growth rate, projected new markets, and niche opportunities. The team established a price basis and forecast for future prices to be used in the project's proforma calculations. A summary of the team's assessment for each product will be included in the Phase I Concept Report.

A preliminary assessment of environmental issues associated with the proposed siting of the EECP was undertaken as part of the site selection process in Tasks 2 and 6. The intent of this first assessment was to identify significant differences between the environmental issues at each site so that their impact upon technical and economic feasibility of an EECP at a site could be properly quantified and factored into the site selection process.

After selection of the Port Arthur Refinery site and more improvement of the integration of the EECP with the host site, the environmental issues will be reassessed during the next quarter and will be reported under Task 7 of the Concept Report. The work in this task consists of identifying the relevant environmental requirements that would be imposed on an EECP implementation at Port Arthur, and of quantifying the expected emissions from an EECP. Several opportunities for integration of the environmental control technologies with the host site exist. This integration will result in lower costs without compromising environmental concerns. The overall work accomplished in Task 7 will provide a strong basis for further environmental evaluations as part of Phase III of the project and will be documented in the Concept Report.

The economics of the EECP will be evaluated at two points during Phase I: first during the site selection process (Tasks 2 and 6) and second after the facility configuration and capital and operating costs estimates are completed for the Port Arthur Refinery site. The cost estimates will be completed in the fourth quarter, 2000 and then the economics determined by use of an in-house developed economic model. This model provides the ability to change various input parameters and note their affect on several financial return calculations. Details of the various runs, including capital and operating cost estimates, along with explanations of their basis, will be included in the Concept Report.

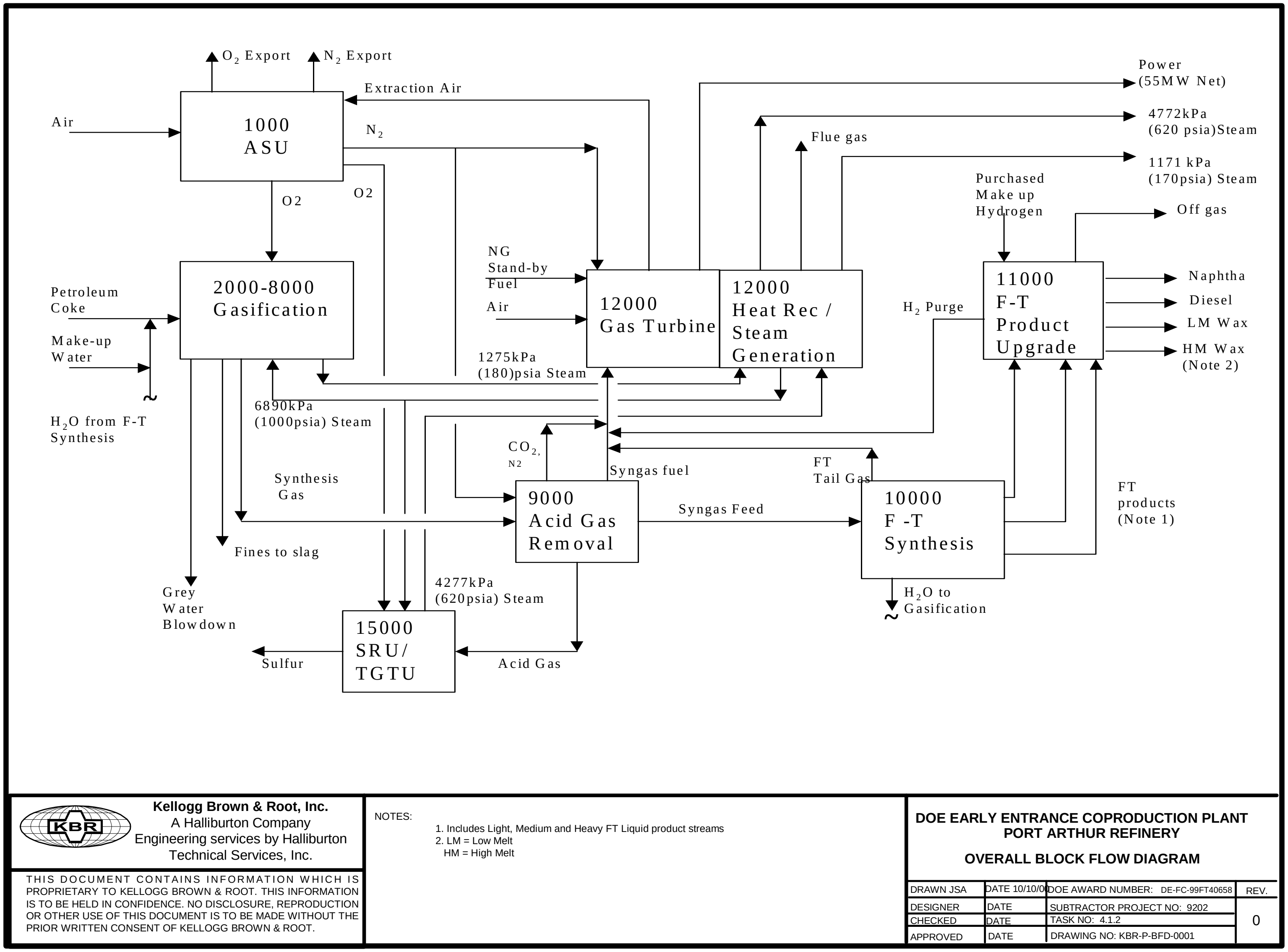


Figure 1
Overall Block Flow Diagram

V. List of Major Activities Accomplished in 3Q2000

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

- Completed process basis of design for Port Arthur Refinery Finished Wax (PARFW) case
- Contracted with Bechtel for F-T Product Upgrading work
- Completed technical assessment of subsystems
- Continued preparation of subsystem design basis
- Began risk assessment of subsystems
- Began cost estimating activities for PARFW case
- Began updating market, environmental, and economic assessments for PARFW case
- Began RD&T planning and preparation of the RD&T Report
- Began preparation of the Phase I Concept Report
- Issued 2Q2000 quarterly report for comments

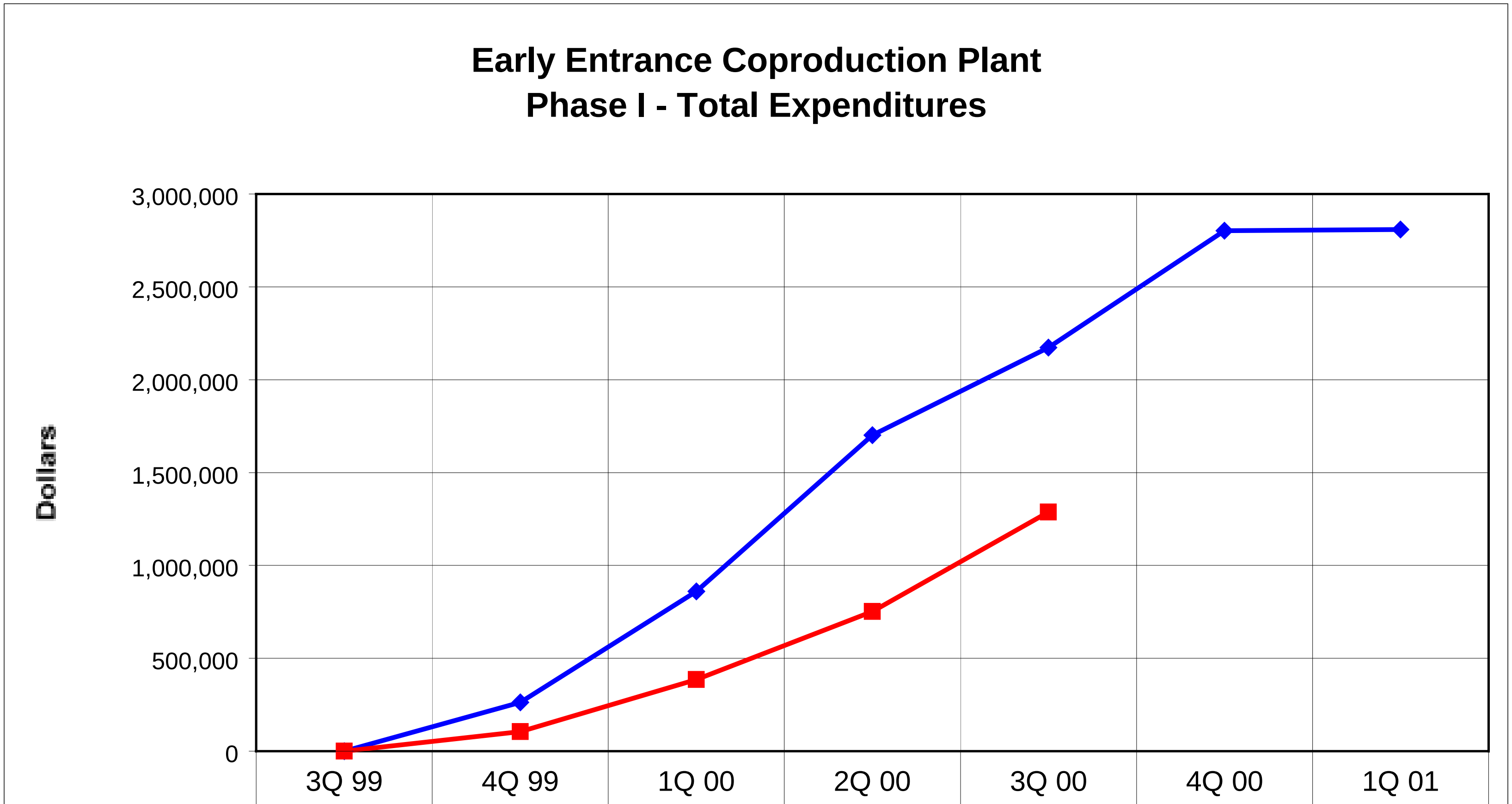
VI. List of Planned Activities for 4Q2000

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

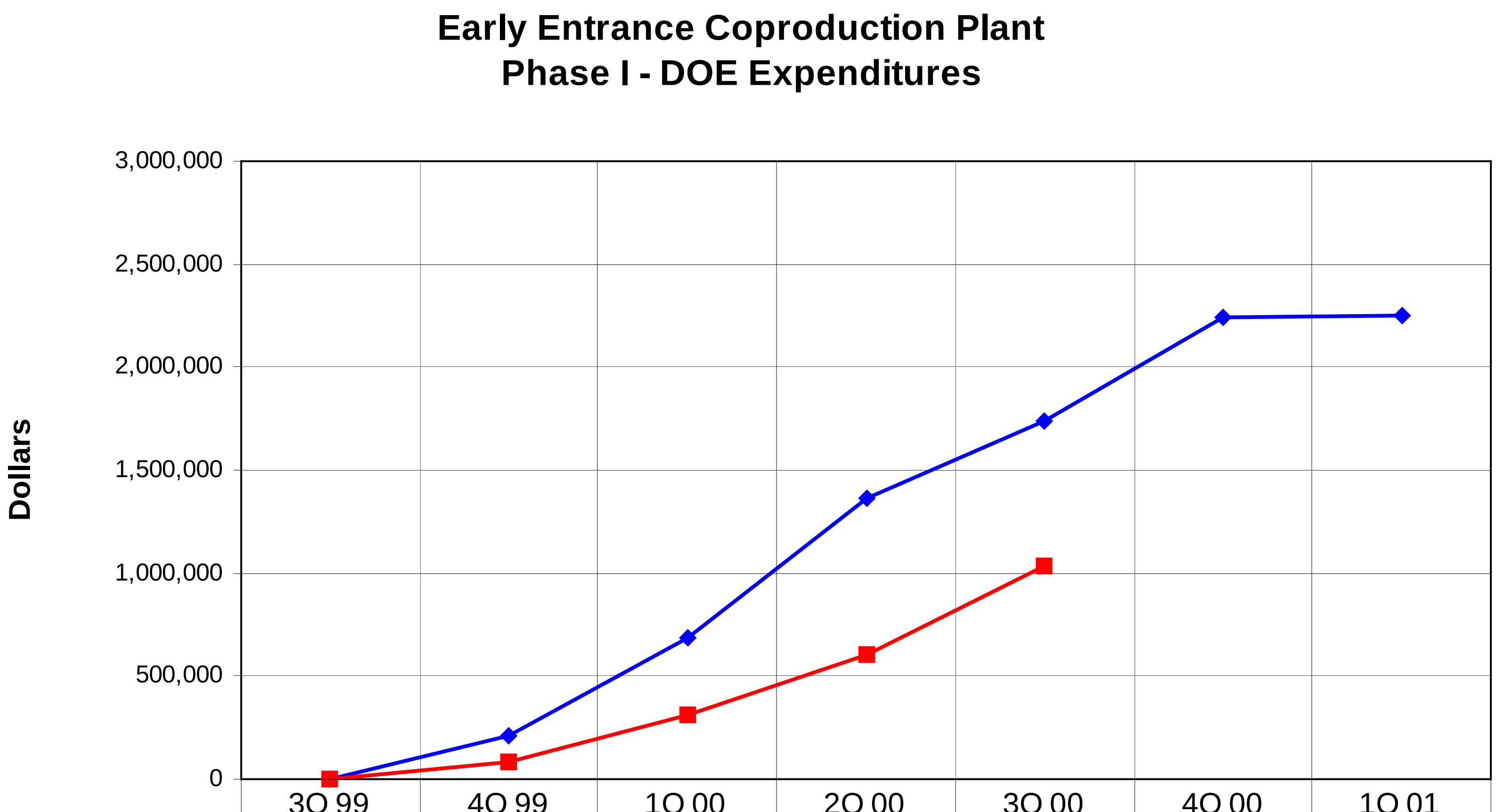
- Complete all process design for PARFW case
- Complete risk assessment of subsystems
- Complete cost estimating activities for PARFW case
- Complete marketing, environmental, and economic assessments for PARFW case
- Issue 2Q2000 Final Quarterly Report
- Issue 3Q2000 Quarterly Report for comments
- Complete and submit RD&T Plan to DOE for comments
- Complete and submit Phase I Concept Report to DOE for comments
- Complete and submit Preliminary Financing Plan to DOE for comments

VII. Graphs

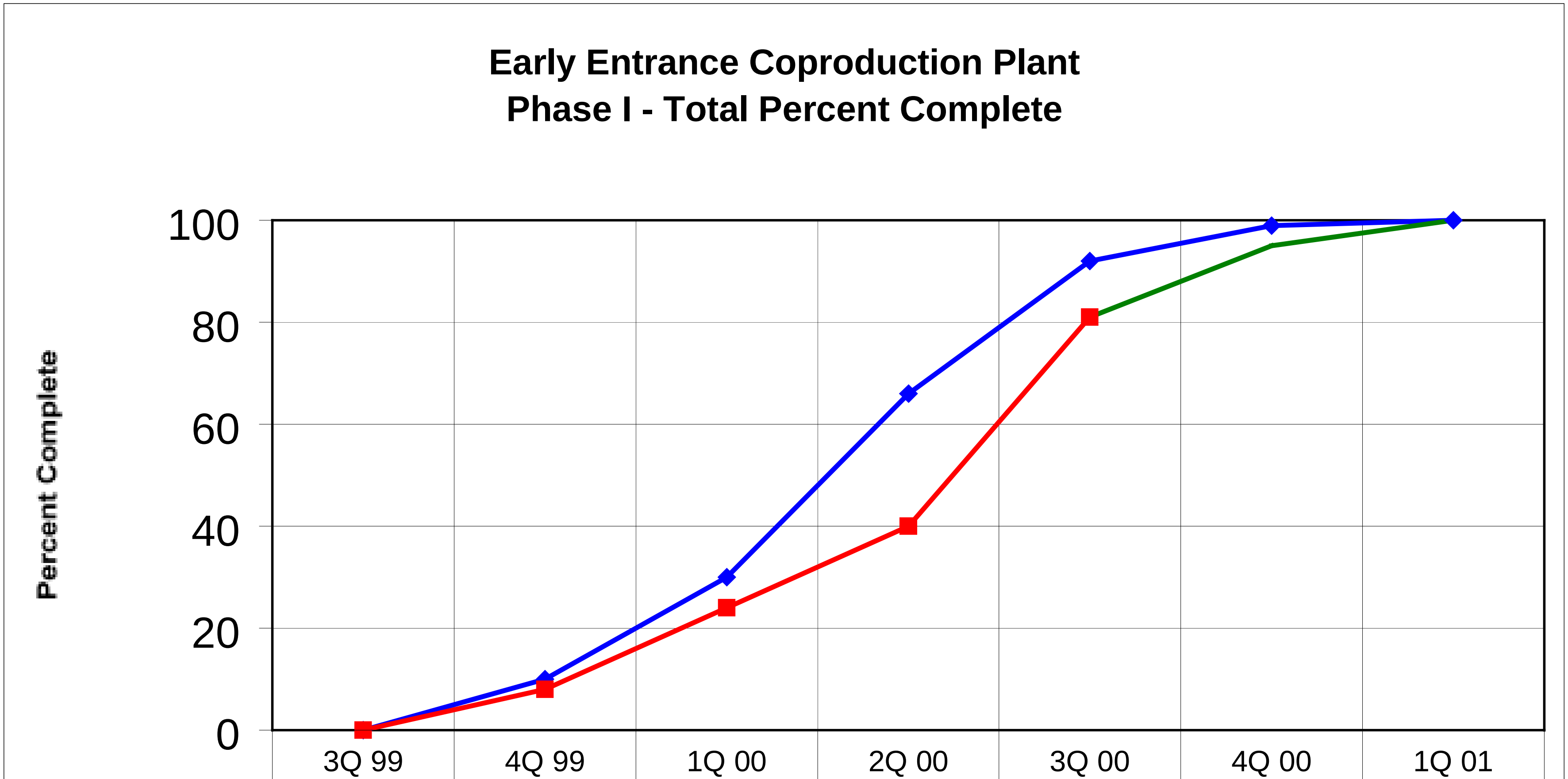
The following three graphs depict the financial status and progress of Phase I activities. The graphs are shown on the following three pages:



	3Q 99	4Q 99	1Q 00	2Q 00	3Q 00	4Q 00	1Q 01
Planned	0	262,896	859,687	1,701,482	2,173,750	2,802,782	2,808,813
Actual	0	105,434	384,911	752,706	1,287,786		



	3Q 99	4Q 99	1Q 00	2Q 00	3Q 00	4Q 00	1Q 01
Planned	0	210,316	687,750	1,361,185	1,739,000	2,242,225	2,247,050
Actual	0	84,347	307,928	602,165	1,030,229		



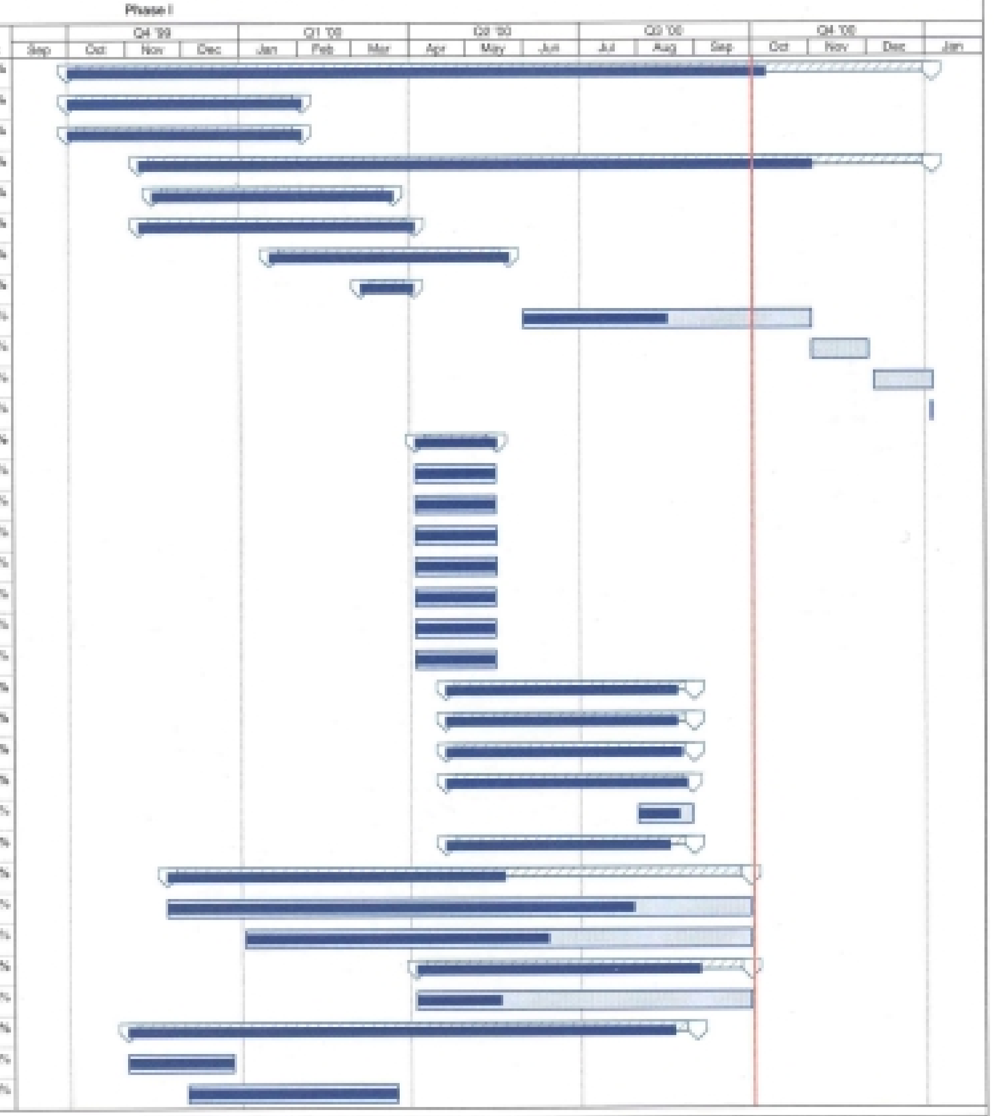
	3Q 99	4Q 99	1Q 00	2Q 00	3Q 00	4Q 00	1Q 01
Planned	0	10	30	66	92	99	100
Actual	0	8	24	40	81		
Forecast					81	95	100

VIII. Schedule

The following two pages depict the updated Phase I project schedule and show percent complete by task as of the end of 3Q2000. For a description of the work involved in each task, refer to the Cooperative Agreement. This schedule was prepared using MS Project 98 software.

EARLY ENTRANCE COPRODUCTION PLANT
DOE AWARD # DE-FC26-99FT40658
Phase I

ID	Task Name	% W/C
1	**Phase 1:Concept Definition**	81%
2	**Task 1 - Project Plan**	100%
3	**1.1 Project Management Plan**	100%
7	**Task 2 - Concept Definition, Development & Technical Assessment**	85%
8	**2.1 Overall concept definition & development**	100%
54	**2.2 Alternatives and options assessment and selection**	100%
64	**2.3 Preliminary Block Flow Diagrams with mass and energy balance**	100%
69	**2.4 Design considerations for advanced subsystems**	100%
73	2.5 Preliminary report	50%
74	2.6 DOE review	0%
75	2.7 Final report	0%
76	2.8 Milestone - Issue final report	0%
77	**Task 3 - Subsystem Technical Assessment**	100%
78	3.1 ASU	100%
79	3.2 Gasification	100%
80	3.3 H2:CO ratio adjustment	100%
81	3.4 Fischer-Tropsch Synthesis	100%
82	3.5 Gas Turbine	100%
83	3.6 Steam system	100%
84	3.7 Fischer-Tropsch product upgrading to market identifiable products	100%
85	**Task 4 - Subsystem Design Specifications**	90%
86	**4.1 Fischer-Tropsch synthesis**	90%
92	**4.2 Gas Turbine**	95%
99	**4.3 Fischer-Tropsch product upgrading to market identifiable products**	98%
106	**4.4 Risk assessment of integrated advanced subsystems**	75%
107	**4.5 Design specifications for proven technologies**	90%
115	**Task 5 - Market Assessment**	58%
116	5.1 Market analysis of products	80%
117	5.2 Market analysis of technology	60%
119	**5.3 Product slate and quantities**	85%
120	**5.4 Full scale commercial plant**	25%
121	**Task 6 - Preliminary Site Analysis**	98%
122	6.1 Site criteria	100%
123	6.2 Identify specific sites	100%



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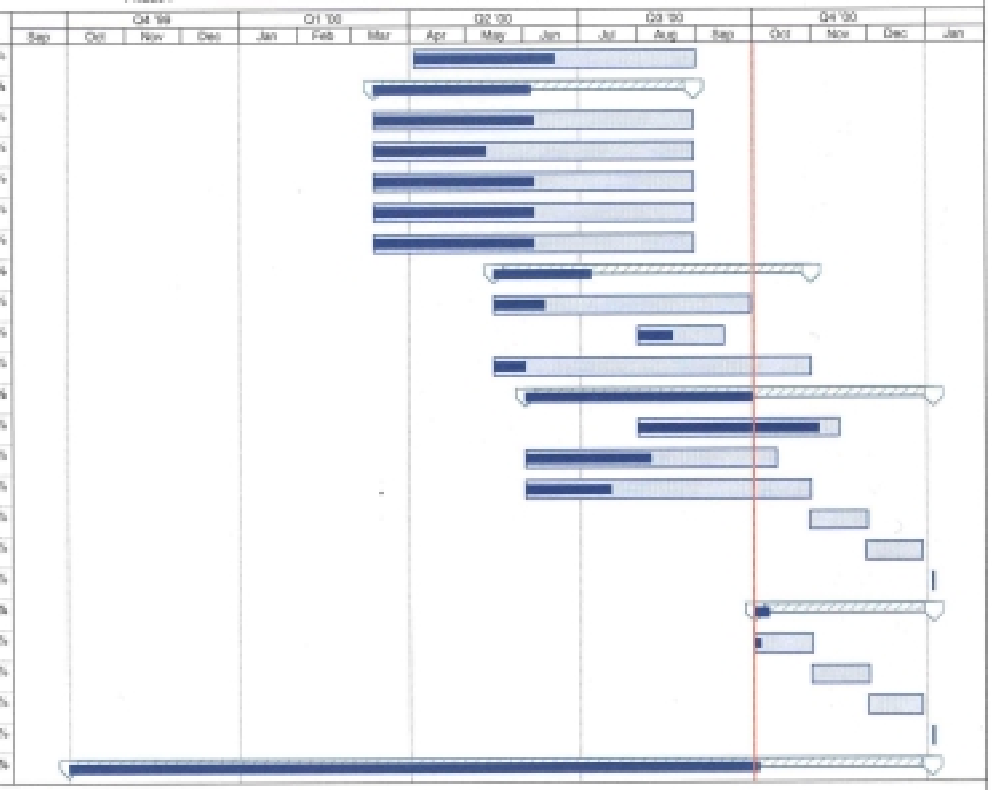
EARLY ENTRANCE COPRODUCTION PLANT
DOE AWARD # DE-FC26-99FT40658

Phase I

ID	Task Name	% W/C
124	6.3 Identify additional commitments/parties of EECP participation	60%
125	**Task 7 - Environmental Assessment**	**49%**
126	7.1 Emission levels	50%
127	7.2 Adaptability for CO2 sequestration	35%
128	7.3 Water use and remediation	50%
129	7.4 Waste by-products	50%
130	7.5 NEPA requirements	50%
131	**Task 8 - Economic Assessment**	**31%**
132	8.1 Feed, fuel and product cost/price evaluation	20%
133	8.2 Cost estimates	40%
134	8.3 Role of government incentives for commercial viability of EECP	10%
135	**Task 9 - Research, Development & Test Plans**	**58%**
136	9.1 Design deficiency analysis	90%
137	9.2 Proposed test plan	50%
138	9.3 Preliminary report	30%
139	9.4 DOE review	0%
140	9.5 Final report	0%
141	9.6 Milestone - Issue final report	0%
142	**Task 10 - Preliminary Project Financing Plan**	**8%**
143	10.1 Preliminary Financing Report	10%
144	10.2 DOE review	0%
145	10.3 Final report	0%
146	10.4 Milestone - Issue final report	0%
147	**Administration**	**80%**



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