The Pittsburg & Midway Coal Mining Co.

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MASTER

Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37830

ATTENTION: Mr. John F. Pearson, Jr.
Assistant Manager for Solvent
Refined Coal Projects

SUBJECT: Phase Zero Deliverables

Gentlemen:

The Pittsburg & Midway Coal Mining Co. ("P&M") is pleased to transmit with this letter the results of the Phase Zero Tasks in accordance with Article XI of the SRC-II Demonstration Project Contract (No. DE-AC05-780R03055) between P&M and the Department of Energy ("DOE"). Several important aspects of this Project are set forth in this letter.

The purpose of the Project is to demonstrate the technical and economic feasibility of the SRC-II Process. The SRC-II demonstration plant to be located at Morgantown, West Virginia, will utilize a combination of new and existing technologies, processes, and equipment. The Plant is very complex and therefore at this point must be regarded as one involving high technical risk. P&M will seek to reduce the risk during the current engineering tasks without compromising the overall purpose of the Demonstration Project.

The most important criterion for the success of the Project is to achieve satisfactory operability in the Demonstration Plant, thereby obtaining the products and information needed to evaluate commercial feasibility. Phase Zero activities have shown that to build and operate this Demonstration Plant with satisfactory operability will require modification of the present "conceptual" design in order to reduce the high degree of interdependence of the plant's various units. In support of these modifications it is essential that the Fort Lewis pilot plant be dedicated to the SRC-II efforts and that changes be made to it which will provide necessary design information.

Most of the current effort on the Project is directed to the selection of the best design basis for the Demonstration Plant. Design changes are expected to affect the estimated costs and may affect the schedule. Also, factors beyond the control of P&M or DOE could result in delays and increased costs.

As instructed by DOE, the date of December 1, 1983, was used during Phase Zero as the target for mechanical completion of the Demonstration Plant. It does not appear likely that the target date can be achieved even if substantial additional costs are incurred in the effort. An industrial-type project management approach in contracting should avoid these additional costs and allow mechanical completion in the first half of 1984.

During Phase Zero, P&M identified certain problems in the conceptual design which led to the concerns mentioned above. In spite of these potential problems, P&M believes that the Demonstration Project can be conducted successfully. Establishing an improved design, cost and schedule basis for the Project will be primary goals of Phase I. Once established, these will form the basis for the mutual decisions of DOE and P&M regarding the future course of the Project.

Delivery is in accordance with instructions in your Telex of July 27, 1979, to P&M. Any requests for revisions or for added information should be made by DOE's Assistant Project Manager for Solvent and Refined Coal Projects to P&M's SRC-II Project Manager. To maintain control of such requests, P&M asks that they be made in writing.

This letter and the Executive Summary (Deliverable No. 5, a copy of which is attached hereto and made a part hereof) constitute P&M's position with respect to the results of the Phase Zero Tasks, and therefore control in the event of inconsistencies, ambiguities, or differing statements or implications in the Phase Zero documents.

THE PITTSBURG & MIDWAY COAL MINING COMPANY

By /ORIGINAL SIGNED BY S. A. ZAGNOLI/
S. A. Zagnoli
Executive Vice President

SAZ:jr

COPY NO. 106

SRC-II DEMONSTRATION PROJECT
PHASE ZERO
TASK NUMBER 1

DELIVERABLE NUMBER 5

EXECUTIVE SUMMARY

JULY 31, 1979

THE PITTSBURG & MIDWAY COAL MINING CO.
DENVER, COLORADO

PREPARED FOR

UNITED STATES DEPARTMENT OF ENERGY
UNDER CONTRACT
DE-AC05-780R03055

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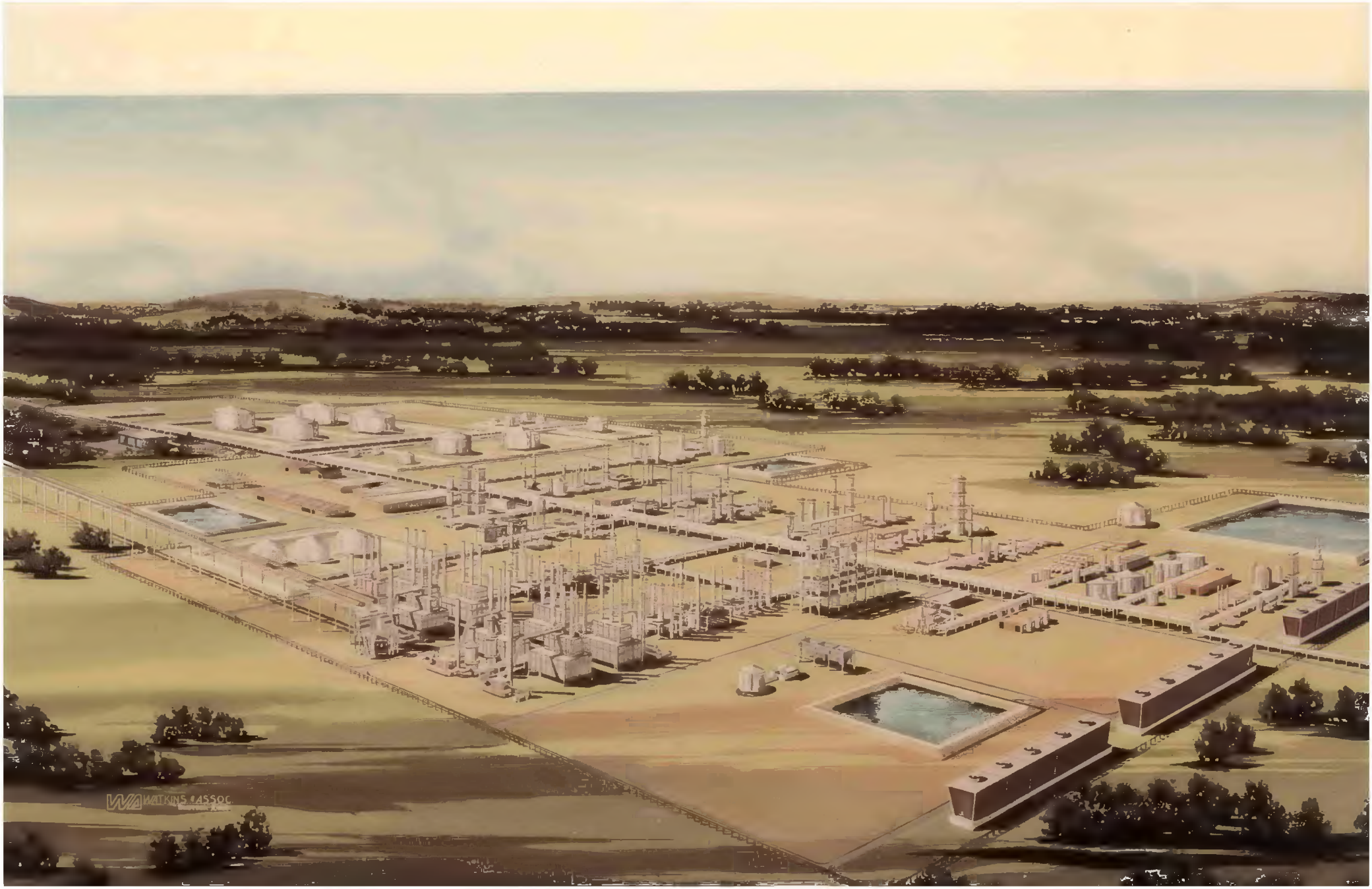
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SRC-II DEMONSTRATION PROJECT
PHASE ZERO EXECUTIVE SUMMARY

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1.0 OBJECTIVES

The SRC-II Demonstration Project is being carried out to demonstrate the economic and technical feasibility of the SRC-II coal liquefaction technology in a full-scale demonstration facility. The conversion of coal to oil provides one of the important alternatives to petroleum. By demonstrating successfully in a well-designed and operating plant that SRC-II works on a large scale and thereby establishing the cost of producing oil from coal, it should be possible to accelerate the widespread use of this technology to aid in achieving the national energy goals.

The SRC-II Demonstration Plant is designed to produce synthetic fuels and by-products. By using these products in engines and boilers, and testing their potential use in refineries and chemical plants, it should be possible during demonstration to establish that coal liquefaction can yield oil that could displace petroleum in most of its major uses.

Operation of the Demonstration Plant and the use of its products under controlled conditions will confirm and establish suitable environmental, safety, and health criteria to be applied as commercialization of SRC-II and related technologies occurs.

Phase Zero of the Demonstration Project has been carried out to evaluate the current status of the SRC-II Demonstration Plant design and the market and economic prospects for the products of SRC-II. In addition, the initial environmental, geotechnical, and socioeconomic work for the proposed plant site has been undertaken during Phase Zero and management plans have been made for the next phase of the Project. Preliminary cost estimates for the Plant and the Project have been produced and The Pittsburg & Midway Coal Mining Co. (P&M) has submitted a plan to DOE to share in the costs.

An artist's sketch of the proposed Demonstration Plant is shown on the next page.

2.0 PROJECT STATUS

2.1 PLANT DESIGN

The key to success in the SRC-II Demonstration Project is to build a plant that will operate in such a manner that the SRC-II Process and its products can be tested, measured, and improved. The preliminary Demonstration Plant design evaluated in the Phase Zero effort is a fully integrated "Conceptual Design". It was conceived to achieve commercial efficiency and operating economies and therefore involves a high degree of interdependence among the plant processes.

In order to increase the probability of successful operations in this demonstration plant, some of the integration among processes that exists in this conceptual design should be modified. Suggested changes are described in the body of the technical reports submitted with this Executive Summary. Among the more important design changes presently being studied in the interest of improving the probability of success through better plant operability are:

- The number of hydrogen-producing gasifiers may be increased and their individual sizes decreased;
- The large cryogenic unit which purifies the recycle hydrogen by rejecting methane and heavier hydrocarbons may be replaced with two smaller units;
- The large oxygen plant may be replaced with two smaller plants;
- Excess gas made in the gasifier may be used as plant fuel, simplifying subsequent gas processing and making the gasoline-range materials available.
- The coal slurry preparation system may be modified.
- The dissolver effluent let-down system may be modified.

Numerous other design improvements are being considered for incorporation in the Final Design, but it is expected that most of them will have less effect on the cost and schedule of the Project than those enumerated above. In this regard, pilot testing of several key plant components at the Fort Lewis pilot plant is necessary.

In addition to the Demonstration Plant design effort, Phase Zero has included studies of the design and cost of a conceptual commercial

plant as well as the design and cost of an expansion of the Demonstration Plant to a full-scale commercial facility. These designs are each conceptual in the same sense as the current Demonstration Plant design is and, further, they are based upon the assumption that the Demonstration Project is successful as planned. Accordingly, all projections based upon these two commercial-size plants depend upon a successful Demonstration Plant Project.

2.2 SCHEDULE

At DOE's direction the schedule for the Project calls for mechanical completion of the Demonstration Plant in December, 1983. On the basis of the Phase Zero work which has been completed, this schedule was found to be possible only if there were no major design changes after the first quarter of 1980. Other factors that P&M believes could lead to delay include environmental certification and failure to agree upon the use of an industrial-type project management approach.

Existing schedules must be viewed as preliminary. During Phase I, a Definitive Schedule is to be produced and agreed upon by P&M and DOE. Until this Definitive Schedule is determined, an accurate portrayal of the overall Project timing will not be available.

2.3 COST

The current estimate of cost to engineer and build the Demonstration Plant based upon the conceptual design is $755 million (in fourth quarter 1979 dollars). It is assumed in arriving at this cost estimate that DOE will agree to the use of an engineering-procurement-construction management procedure that is normal for industrial projects of this type. This estimate is greater than previous cost estimates, due primarily to inflation and to additions and modifications to improve operability. No costs for start-up operations or modifications during start-up are included in the $755 million.

It is not expected that a final design configuration will be established until early 1980 so further cost changes may occur. Although changes which could increase or decrease costs are under consideration, experience has shown that increases usually are greater than decreases.

The Demonstration Project concept includes a production period, following construction and start-up during which salable products are to be made. Based on the "mid-range operating case, up to 26 million barrels of fuel could be produced during the five years of operation described in the Phase Zero plans. At the $22.50 per barrel price, plus a $2 per barrel premium the participating utilities are expected to pay, this production of salable product could produce up to $600 million (in fourth quarter 1978 dollars) to help pay Project costs.

2.4 COST SHARING

P&M has submitted a plan to DOE to share in the costs of the Project. The proposal includes the contribution to DOE of technology developed by Gulf and P&M at a cost of more than $25 million prior to the mid-1978 start of the Demonstration Project and also includes another $25 million in contributions to be made during the Project. An additional $50 million was proposed in contributions to be made by P&M if the Plant proves to be more costly to build or of lower capacity.

There is the possibility of foreign nations joining DOE in the financing of this Project, and firms from those same nations are considering joining the Project as industrial participants. P&M is engaged in discussions with Ruhrkohle A.G. and Steag A.G. from The Federal Republic of Germany and Mitsui's SRC Research Consortium from Japan concerning their possible participation in the Project. In addition, the Federal Republic of Germany and Japan have indicated to DOE that they may each pay 25 percent of the Project cost in return for technology rights and access to coal-derived oil in the future.

3.0 PROJECT MANAGEMENT

3.1 PROJECT MANAGEMENT

P&M will establish a Project organization which will be responsible for managing all technical, schedule and cost aspects of the Project. This Project organization will coordinate the planning, work, and reporting of all Project participants. It will also direct the integration of cost, schedule and technical goals into a unified P&M Project management system.

P&M will employ sound management practices to direct the Project in an efficient and cost-effective manner. Accurate, timely and useful information will be provided to both internal management and DOE. These concepts will guide the implementation of a management system which maximizes decision-making capabilities.

Project visibility will be achieved by the use of integrated management control systems which provide information on cost, schedule, and technical data to all managers. Reporting will be consolidated and simplified. Managers at each level in the Project will receive information in sufficient detail to meet their management and planning needs.

Earned-value methods of P&M's own design will be used. The system provides a way of comparing the actual costs incurred with the planned schedule and costs for that task. Tolerance levels will be established for variances to accommodate errors in planning. Variances will be examined and corrective actions taken only when they exceed the tolerance thresholds.

These management systems include procedures for the following:

- o Baseline Planning
  - Including work definition, schedule definition, budgeting, and their integration.
- o Operating
  - Including work authorization, progress assessment, reporting, variance analysis, corrective action planning, and estimates-at-completion.
- o Configuration Management
  - Including design control, change control, and document control.

3.2 PROJECT WORK BREAKDOWN STRUCTURE

The tool for integrating the work to be done within the budget and schedule constraints will be the Work Breakdown Structure (WBS), which divides the Project into manageable components organized into a tiered set of related functions and services. The Project Work Breakdown Structure identifies eight areas into which Project work is subdivided. This furnishes a common framework for the accumulation and reporting of cost and performance information. Each one of the eight areas is subdivided into its logical work elements so that schedules and cost can be further broken down and performance analyzed at controllable levels.

3.3 PROJECT MANAGEMENT APPROACH

P&M plans to proceed with the EPC management approach for design and construction as follows:

- P&M plans to retain an architect-engineer supported by a process design subcontractor to perform the detailed design, procurement of major long lead equipment items, and inspection of major equipment fabrication and manufacture as appropriate.
- P&M plans to retain a construction manager/constructor to manage all construction efforts including the scheduling of all construction activities, procurement of construction materials and equipment, inspection of construction (P&M to perform QA/QC audit), awarding and control of all construction subcontracts and management of other appropriate construction activities.

4.0 TECHNOLOGY

4.1 BACKGROUND

Development of the Solvent Refined Coal (SRC) process began in 1962 at P&M's research laboratories. After a decade of laboratory work, construction of a 50 ton-per-day pilot plant was started in 1972 and completed in 1974 at Ft. Lewis, Washington. This 17-year laboratory and pilot plant program has been developed substantially at Government expense, although Gulf and its associates have privately funded more than $25 million of related research, development, and engineering. As a result of these efforts, we believe that the most advanced direct coal liquefaction process available today is SRC-II.

4.2 ENGINEERING DESIGN

In 1975 Gulf and P&M developed the first conceptual design of an SRC-II Demonstration Plant. The plant was designed to convert 6700 tons of coal per stream day to liquid and gaseous fuels. The initial conceptual design for a 33,500 ton-per-stream-day commercial-scale plant was also being developed at that time. As more information became available, additional engineering studies were conducted on these conceptual designs in 1976, 1977, and 1978. These engineering studies by Gulf, P&M, and their associates provided the initial conceptual design basis for the current SRC-II Demonstration Project.

During Phase Zero the conceptual design has been examined in detail to determine which areas require modification. In addition, the prospective plant site has been examined from socioeconomic, geotechnical, and environmental viewpoints, and potential coal supplies have been investigated.

As a result of the examination of the conceptual design, several areas where changes should be made have been identified, as discussed earlier (Section 2.1). Geotechnical studies on the site near Morgantown, West Virginia indicate that the site is suitable for plant construction. Although the environmental baseline work will not be complete for some months, the data now available (70% complete) do not show any major environmental obstacles to construction of the Demonstration Plant on the proposed site. The socioeconomic studies

indicate, among other things, that an adequate labor supply exists in the area for both construction and operation of the Plant.

Coal supply studies indicate that even though there is considerable variation in the reactivity of the various West Virginia coals to SRC-II processing, there is a substantial supply of suitably reactive coal for both demonstration and commercialization of SRC-II.

4.3 TECHNOLOGY TRANSFER

The public nature of the SRC-II Demonstration Project will provide for dissemination of the technical results. Projects such as the SRC-II Demonstration Project funded by the U. S. Government require the Contractor to report the technical results of the Project to the Government, which in turn makes such results available to the public, subject to the usual protection accorded proprietary information.

With DOE approval, P&M will continue its current practice of discussing the Project and the SRC-II Process regularly at public technical meetings. In addition, through the written Project reports, reasonably open facilities, and participating subcontractors, the SRC-II technical know-how should become widely understood.

If the Project is successful in demonstrating the economic feasibility of SRC-II, many qualified firms will have information enabling them to engineer, build and operate SRC-II plants. Further, P&M and Gulf have agreed to license its proprietary data and background patents at reasonable terms and conditions to responsible third parties to aid the commercialization of this technology.

Because of its unique role in the ownership and understanding of SRC technology, P&M has proposed to act as the exclusive SRC-II licensing agent in the U. S. for the Government after demonstration which will aid in the commercialization of this technology.

5.0 MARKET AND ECONOMIC PROJECTIONS

To assess the future of SRC-II coal liquefaction, extensive market analyses have been carried out as part of Phase Zero. By working with industrial and utility firms who could use the fuels produced and also by analyzing the possibility of refining SRC-II products to produce chemicals or transportation fuels such as gasoline and turbine fuels, it has been established that SRC-II products could be used in many of the markets now satisfied by petroleum.

The abundance of bituminous coal in the United States suitable for use in SRC-II plants indicates that widespread use of the SRC-II technology is possible, once the Demonstration Project has been successful. As part of Phase Zero, coal reserves elsewhere in the world have been analyzed and there appear to be large coal resources outside the United States that could be converted to synthetic fuels by the SRC-II process.

The prospect of economic success for coal liquefaction cannot be verified until the Demonstration Project has produced results from a successfully operating plant. Capital and operating cost information must be based upon firm results from a functioning plant, rather than estimated results from a conceptual plant.

The economic analyses included in these Phase Zero deliverables are based on conceptual SRC-II plants. As such, they are preliminary estimates that assume the plant will perform as planned. The predictions of the costs of building and operating a commercial SRC-II plant are not firm, consequently neither is the prediction of product costs resulting from them.

Recognizing these limitations, preliminary cost predictions support the prospect that fuels from SRC-II coal liquefaction would be strategically important and commercially competitive in the future. The results of more than a dozen industry studies conducted by potential users of coal liquids were integrated with an independent petroleum price forecast to predict possible demand for coal liquids by market segment. These studies indicate that:

a. Petroleum supply and availability are expected to continue to decline while costs increase, leading to higher prices - estimated as part of Phase Zero Deliverable 9 to be about $25

per barrel in 1985 and $30 per barrel in 1990 (in 1978 dollars). The economic analyses made during Phase Zero indicate that oils made from coal by SRC-II in a commercial plant could not be produced and sold for less than $25 per barrel (in 1978 dollars).

b. Fuel oil from SRC-II will be an environmentally acceptable replacement for the low-sulfur residual and distillate oils now used in utility boilers in the coastal metropolitan markets. A large-scale combustion test conducted by an eastern utility established the acceptability of SRC-II fuel oil for urban utility usage. Analysis of the east coast markets indicates that SRC-II oil in this utility usage could exceed a million barrels per day during the 1990's.

c. Fuel oil from SRC-II could be a replacement for the distillate oils and natural gas now used in industrial boilers throughout the east and midwest, where ninety percent of industrial boilers currently are petroleum or gas fired and which for logistical, economic, and environmental reasons cannot practically convert to use coal directly. SRC-II oil in this industrial usage could reach a half million barrels per day in the 1990's.

d. Lighter fractions from SRC-II could substitute for petroleum fuel oils and natural gas in stationary combustion turbines that are used now by utilities and that will be used in combined cycle power plants in the future.

Other studies of the prospective uses for the SRC-II products indicate that a significant portion of the SRC-II distillate and naphtha could be upgraded to jet fuel and high octane gasoline, with additional refining investment, providing a source of transportation fuels. In addition to the substantial amount of pipeline gas that an SRC-II coal liquefaction plant could produce, there would be enough gaseous hydrocarbons to feed a commercial-size ethylene plant, thus providing chemical intermediates to the plastics and synthetic fibers industries.

6.0 COMMERCIALIZATION

The New York harbor spot price for low sulfur fuel oil comparable to SRC-II oil was about $23 per barrel in July of 1979. The Phase Zero studies estimate the cost of SRC-II fuel oil in 1985 based upon a conceptual commercial plant design to be $25 per barrel (1978$). Although the current price of petroleum and the projected cost of SRC-II fuel oil appear to be reasonably close, it must be recognized that the estimate for SRC-II fuel oil is based upon very preliminary estimates of the costs to build and operate a conceptual commercial plant. Only through demonstration of the SRC-II technology at full-scale in this Project can the considerable uncertainties in this estimate be reduced.

Of the current eastern U. S. utility and industrial fuel oil consumption, one to two million barrels per day could be replaced with SRC-II products if the economics are favorable. These utilities and industries by-and-large cannot convert to direct coal usage. With further refining, substantial portions of the SRC-II liquid products could be converted to transportation fuels such as gasoline. Gaseous products from SRC-II could displace natural gas or petroleum feedstocks for chemical production.

The location chosen for a commercial SRC-II plant could anticipate substantial economic stimulus during construction of the plant and also following start-up and operation. Such a plant would generate additional economic activity by its own needs for supplies and services, and supply feedstocks which could lead to the construction of downstream and ancillary plants. The economic benefits for the area would be substantial.

P&M's plans for the expansion of the Demonstration Plant to a full-sized commercial plant and for the construction of other SRC-II plants are contingent upon the technical success of the Project, the economic analysis of the results, and upon world market and economic events affecting petroleum price and availability. P&M has asked for an option to purchase the Demonstration Plant from the Government after demonstration should such conditions favor commercialization of SRC-II.