SECTION 1

INTRODUCTION

This report presents the results of a conceptual design and economic evaluation for a commercial coal conversion complex that will mine coal and convert it into a product slate consisting of substitute natural gas (SNG), LPGs, unleaded gasoline, low sulfur distillate fuel oil, premium grade coke, and approximately 1,000 MW of electrical power for sale. The design was begun under the sponsorship of the Energy Research and Development Administration (ERDA), and completed under the Department of Energy (DOE). ERDA assigned the name Project POGO to the design; this is an acronym for Power-Oil-Gas-Other.

This is the sixth in the series of conceptual designs by Parsons.[1,2,3,4,5,6,7] Preceding conceptual design/economic analyses have included all major generic classifications of coal liquefaction; i.e., hydroliquefaction, donor solvent, pyrolysis, and indirect liquefaction. It also represents the third Parsons design using SRC-II technology. The first was published in 1973[2]; it produced a boiler fuel while consuming the fuel gases and light hydrocarbons generated during processing. A more recent version[7] developed the design and economics for a plant to convert 36,000 tons per day of feed coal to a product mix consisting of SNG, LPGs, naphtha, and a heavy fuel oil. Both of these earlier SRC-II designs used filtration to remove coal ash and unconverted solids from the fuel oil product. Predicted thermal efficiencies increased from 63.5% for the first design to approximately 77% for the second.

This third SRC-II design incorporates procedures for elimination of the troublesome filtration step, produces products that have been refined to be directly marketable, and also produces significant electrical power for sale. A primary objective was to design an improved configuration for the electrical power generation section using combined cycle facilities; also to maximize the effective use of energy potentials between the power plant, the coal mine, and the process section of the coal refinery. The intent is that such a system properly designed and operated would provide improved efficiency of the complex and its economics.

The design presented is conceptual. As such, it incorporates certain potentially attractive operations, such as pressurized flash pyrolysis and pressurized entrained slagging two-stage gasifiers, which have not yet been fully operated on a pilot plant scale. The design is intended to show the potential performances and economics for the configuration defined; also to define additional development work required to convert the conceptual design to commercial reality. These caveats become a part of the design report and its interpretation.

The design presented here is the result of a multiphased program. During the first phase, preliminary technical and economic analyses of existing processes and process combinations were made and a preferred design configuration recommended.[8] The configuration used for this design is therefore the result of Phase 1 analyses.

1.1 OBJECTIVES

The objectives of the work described in this report are to:

- Develop a conceptual design for a commercial grassroots complex including all operations required to mine coal, use multiple coal conversion processes in a preferred combination, and use an improved power plant system. This complex is to produce industrially marketable products at a price competitive with alternative sources.
- Define the product characteristics and marketability.
- Define probable project and financial parameters for design, engineering, procurement, construction, and startup of the complex.
- Estimate the economics for the complex.
- Present recommendations regarding additional development effort to encourage commercial exploitation of the technology.
- Develop conceptual designs for three separate U.S. locations:
  - The Eastern Region of the Interior Coal Province
  - The Southern Appalachian Region of the Eastern Coal Province
  - The Powder River Region of the Rocky Mountain Coal Province

1.2 REPORT ORGANIZATION

Sections 3 through 17 describe the design for The Eastern Region of the Interior Coal Province location in detail. The characteristics of the two alternate location designs are described in Sections 18 and 19.

A summary of key elements is presented in Section 2 to aid in rapid assimilation of the report contents. Sections 3 through 6 present the main technical elements of the design. Design parameters/bases used are summarized in Section 3. Section 4 describes project scope and major units included in the complex. Here major plant units and material flows are depicted in the form of a block flow diagram. A plot plan of the plant complex is also presented. Section 5 contains detailed descriptions of the separate units that comprise the complex. The detailed process flow diagrams with material balances are presented in Section 6.

Sections 7 through 10 summarize product descriptions and energy utilization factors involved in the design. Section 7 presents the properties of the various products and marketability considerations. The material balance for the complex is depicted in Section 8. Overall energy balance is presented in Section 9. The utility summary, by units, is given in Section 10.

Important environmental factors are summarized in Section 11. Facilities that have been included to ensure that effluent flows are properly treated to meet environmental standards are described. Section 12 presents a summary of plant startup procedures.

The list of major equipment, sizes, and materials of construction are presented in Section 13. This equipment list, combined with design information previously summarized in the report, provides the basis for the fixed capital investment estimate. A parametric economic assessment is given in Section 14. This includes capital investment requirements, discounted cash flow (DCF) rate of return for three project financial structures, and key economic sensitivity factors.

Sections 15, 16, and 17 present supporting data, analyses, and recommendations for future development work to ensure that the plant will perform as projected.

Sections 18 and 19 present the characteristics and projected economics for the coal mine and process/power complex for the Alternates, the Southern Appalachian Region of the Eastern Coal Province and the Powder River Region of the Rocky Mountain Coal Province. These sections contain process block flow diagrams, material balances, and economics pertinent to these locations.