U.S. Department of Energy

National Energy Technology Laboratory

Early Entrance Co-Production Plant – Decentralized Gasification Cogeneration Transportation Fuels and Steam From Available Feedstocks

DOE Cooperative Agreement DE-FC26-00NT40693

Quarterly Technical Progress Report April to June 2002

WMPI PTY., LLC

July 2002

DISCLAIMER

ABSTRACT

Waste Processors Management, Inc. (WMPI), along with its subcontractors Texaco Power & Gasification (now ChevronTexaco), SASOL Technology Ltd., and Nexant Inc. entered into a Cooperative Agreement DE-FC26-00NT40693 with the U. S. Department of Energy (DOE), National Energy Technology Laboratory (NETL) to assess the techno-economic viability of building an Early Entrance Co-Production Plant (EECP) in the United States to produce ultra clean Fischer-Tropsch (FT) transportation fuels with either power or steam as the major co-product. The EECP design includes recovery and gasification of low-cost coal waste (culm) from physical coal cleaning operations and will assess blends of the culm with coal or petroleum coke.

The project has three phases. Phase I is the concept definition and engineering feasibility study to identify areas of technical, environmental and financial risk. Phase II is an experimental testing program designed to validate the coal waste mixture gasification performance. Phase III updates the original EECP design based on results from Phase II, to prepare a preliminary engineering design package and financial plan for obtaining private funding to build a 5,000 barrel per day (BPD) coal gasification/liquefaction plant next to an existing co-generation plant in Gilberton, Schuylkill County, Pennsylvania.

The current report covers the period performance from April 1, 2002 through June 30, 2002.

TABLE OF CONTENTS

List of Figures

Table of Contents

List of Tables

Section 1 Introduction and Summary

1.1 INTRODUCTION

WMPI, along with its subcontractors Texaco (now ChevronTexaco), Sasol, and Nexant entered into a Cooperative Agreement DE-FC26-00NT40693 with the U. S. Department of Energy (DOE), National Energy Technology Laboratory (NETL), to assess the technical and economic viability of building an Early Entrance Co-Production Plant (EECP) in the U. S. to produce ultra clean Fischer-Tropsch (FT) transportation fuels with either power or steam as the major co-product. The EECP design emphasizes on recovery and gasification of low-cost coal wastes (culm) from coal cleaning operations, and will assess blends of the culm with coal or petroleum coke as feedstocks. The project has three phases.

1.1.1 Phase I – Concept Definition and RD&T Planning

Phase I objectives include concept development, technology assessment, conceptual designs and economic evaluations of a greenfield commercial co-production plant and of a site specific demonstration EECP to be located adjacent to the existing Gilberton Power Station. There are very few expected design differences between the greenfield commercial co-production plant versus the EECP plant other than:

- The greenfield commercial plant will be a stand-alone FT/power co-production plant, potentially with larger capacity than the EECP to take full advantage of economies of scale.
- The EECP plant, on the other hand, will be a nominal 5,000 bpd plant, fully integrated into the Gilberton Power Company's Cogeneration Plant's existing infrastructure to reduce cost and minimize project risks. The Gilberton EECP plant will be designed to use eastern Pennsylvania anthracite coal waste and/or a mixture of culm and other fuels as feedstock.

Phase I includes 11 tasks and the following major deliverables.

- A project management plan.
- A process feasibility design package with sufficient details to determine order-of-magnitude cost estimates for preliminary economic and market analyses.
- A preliminary environmental and site analysis.
- A Research, Development and Testing (RD&T) plan for Phase II tasks.
- A preliminary project financing plan.

1.1.2 Phase II – R&D and Testing

The Phase II objective is to perform research, development and process performance verification testing of any design deficiencies identified in Phase I. Due to the relative maturity of the two key technologies (Texaco's coal gasification and SASOL's FT) proposed for the EECP designs, Phase II activities will focus on feedstock characterization and gasification process performance testing rather than research and development. Specific Phase II goals include:

- Characterization of anthracite culm and its mixture with other fuels as feedstocks for the Texaco gasifier.
- Gasification performance (pilot plant) testing of design anthracite culm feedstocks at an existing Texaco facility to verify its performance.

1.1.3 Phase III – Preliminary Engineering Design

The objective in Phase III is to upgrade the accuracy of the Phase I site-specific Gilberton EECP capital cost from plus or minus 35% to plus or minus 20%. The increased cost estimation accuracy is achieved by updating the Phase I inside battery limits (ISBL) processing plant design packages to incorporate Phase II findings, by refining the outside battery limits (OSBL) utility and offsite support facility design packages to include final and updated ISBL unit demands, by obtaining actual budgetary quotes for all major equipment, and by further engineering to define the actual bulk commodities requirements.

The upgraded Phase III capital cost estimate, together with the updated operating and maintenance cost estimate, are crucial elements to finalize the EECP Project Financing Plan needed to proceed with detailed engineering, procurement and construction of the EECP.

The Phase III goals and deliverables include the development of:

- Preliminary Engineering Design package of the EECP.
- A Project Financing Plan.
- An EECP Test Plan.

The project scope of work consists of sixteen tasks organized into the three phases as shown in Table 1.1. The table also shows the project team members responsible for the leading role for each task. The specific task description details were discussed in the Project Management Plan.

1.2 SUMMARY

The main technical activities performed during the current reporting period include work in the following tasks.

- Phase I Task 4 – Feasibility Design Package Development
    - Balance of Plant (BOP)
    - Offsites

Table 1-1

Scope of Work Task Summary

Phase/Task	Description	Task Leaders
Phase I	**Concept Definition and RD&T Planning**	
Task 1	Project Plan	Nexant
Task 2	Concept Definition, Design Basis & EECP Process Configuration Development	Nexant
Task 3	System Technical Assessment (Trade-off Analysis)	Nexant
Task 4	Feasibility Study Design Package Development	Nexant (w/individual Process Design package from Texaco and Sasol)
Task 5	Market Assessment	Texaco
Task 6	Preliminary Site Analysis	WMPI and Consultants
Task 7	Preliminary Environmental Assessment	WMPI and Consultants
Task 8	Economic Assessment	WMPI and Consultants
Task 9	Research Development and Test Plan	Texaco
Task 10	Preliminary Project Financing Plan	WMPI and Consultants
Task 11	Phase I - Concept Report	Nexant
Phase II	**R&D and Testing**	
Task 1	Feedstock Mix Characterization and Gasification Performance Verification	Texaco (w/ support from Nexant and WMPI)
Task 2	Update RD&T Plan	Texaco
Phase III	**EECP Engineering Design**	
Task 1	Preliminary Engineering Design Package Development	Nexant – with a) Texaco – Gasification Design Package b) Sasol – FT Design Package c) Nexant – BOP and cost estimate
Task 2	Project Financing Plan	WMPI and Consultants
Task 3	EECP Test Plan	Nexant

Section 2 Phase I Task 1 – Project Plan

TASK COMPLETED.

A Project Management Plan was prepared, issued and approved by DOE. A copy was submitted to the AAD Document Control Office of DOE/NETL on May 15, 2001.

This plan provides a road map for the overall project execution delineating the project:

- Objectives.
- Detailed work breakdown structure and obligated deliverables.
- Technical and management approach.
- Control plan – scheduling, budget and reporting.
- Administration details.

Section 3 Phase I Task 2 – Concept Definition, Design Basis & EECP Process Configuration

TASK COMPLETED.

3.1 EECP concept and process configuration defined, giving full considerations of:

- WMPI's feedstock availability and quality (e.g., ash content, composition and anticipated fusion temperature.)
- Desired mode of operation for Texaco's gasification process in handling the design project feed mix.
- Design consideration of Sasol's Low-Temperature FT (LTFT) process giving the estimated design syngas feed.
- System integration and site-related issues (e.g., syngas clean up, utility availability.)

3.2 Gilberton EECP Design Basis established, and a Basic Engineering Design Data (BEDD) package was developed to guide the overall process design development regarding:

- Plant capacity
- Site data
- Feedstock properties
- Product specifications
- Battery limits and offsite utility specifications

3.3 Project Instruction of Equipment Code of Accounts established.

Details of the above were reported in the April to June 2001 Quarterly Technical Progress Report.

EECP process configurations will be discussed in more details as part of the Phase 1 Task 4 activity.

Section 4 Phase I Task 3 – System Technical Assessment

Under this task 1) technical design issues/systems (e.g., ash fusion characteristics of EECP feed mix) identified in Phase 1 Task 2 were assessed in more detail, and 2) preliminary heat, material and utility balance sensitivity analyses were carried out, based on process performance estimates and utility demands from Texaco and Sasol for the gasification and FT synthesis section respectively, to continuously optimize the overall EECP process plant design and preliminary economics, and to provide preliminary emission and cost data needed for Phase I Tasks 7 and 8 planning.

Current sensitivity analysis activities included assessment of:

- The Base Case, stand-alone 5000 bpd Greenfield EECP plant with 2 separate gasification trains, in comparison with a reduced capacity design with only a single gasification train operating at a higher tail gas recycling ratio for FT synthesis.

- An integrated design with sending portion of the unconverted FT tail gas to the existing Gilberton cogen plant circulating fluidized bed boiler (CFB) as auxiliary feed.

Under this task, feasibility study process design packages are to be developed for the EECP gasification island, FT synthesis and offsite utility plants by Texaco, Sasol and Nexant respectively. With most of the major EECP processing plants already identified, Texaco has developed a gasification island Type C Feasibility Study package, and Sasol, the Slurry-Phase Distillate Process Feasibility Study package. Balance of Plant (BOP) and offsite facility designs are the major activities performed during this reporting period by Nexant.

Both the Texaco Type C Feasibility Study and Sasol Slurry-Phase Distillate Process Feasibility Study design packages have been discussed in the last quarterly report (4^{th} quarter, 2001) and are considered CONFIDENTIAL. These two processes will be reviewed briefly in this quarterly report.

5.1 Overall EECP Configuration

Figure 5-1 shows the overall WMPI EECP block flow configuration.

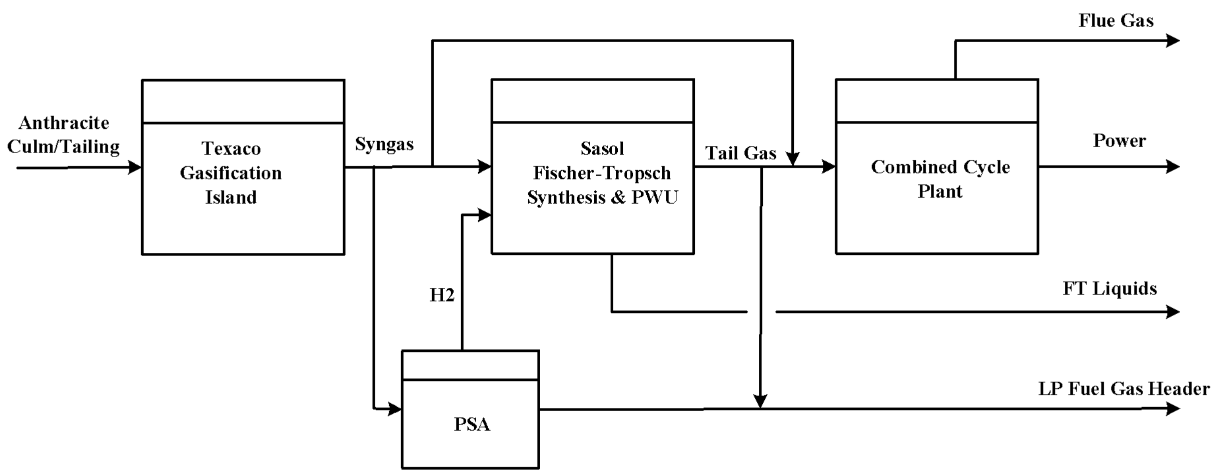


Figure 5-1 Overall EECP Process Configuration

The EECP plant consists of two main process sections: Texaco Gasification, and Sasol FT Synthesis and product work up (PWU). It is designed to use anthracite culm of 20% ash as the primary feed. The design has the operation flexibility of feeding in 25% petroleum coke as feed.

5.2 Texaco Gasification Feasibility Design

Texaco provided a Type C Feasibility Study Package as their input to Phase I EECP process design. The detailed feasibility study contains material confidential to Texaco, and if desired the DOE can inspect the report separately from the Quarterly Report.

The overall EECP gasification island block diagram is shown below, Figure 5-2.

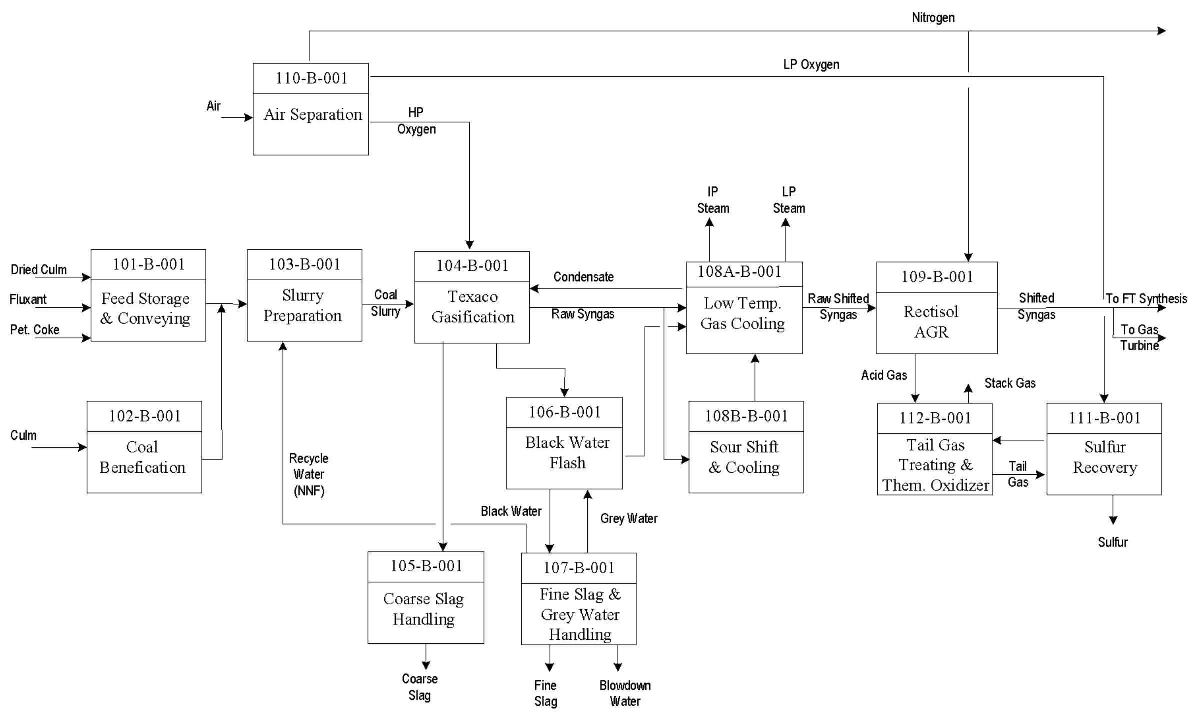


Figure 5-2 EECP Block Flow Diagram – Gasification Section

It consists a total of eleven major processing plants of which Coal Beneficiation (Plant 102B-001) design is the responsibility of WMPI. Other processing plants within the gasification island include:

- Feed Storage and Conveying
- Slurry Preparation, Gasification
- Slag Handling
- Black Water Flash
- Black Water Filtration
- Sour Shift and Low Temperature Gas Cooling
- Rectisol Acid Gas Removal
- Air Separation Unit
- Sulfur Recovery
- Tail Gas Treating

Individual process plant description, design criteria, stream flow characteristics and estimated plant emissions were presented in the last quarterly technical report

5.2 Sasol Slurry-Phase Distillate Process Feasibility Study

Sasol has prepared a Feasibility Design Package for the Fischer-Tropsch unit and the associated product work-up processing plant. The overall block flow diagram is shown below, Figure 5-3.

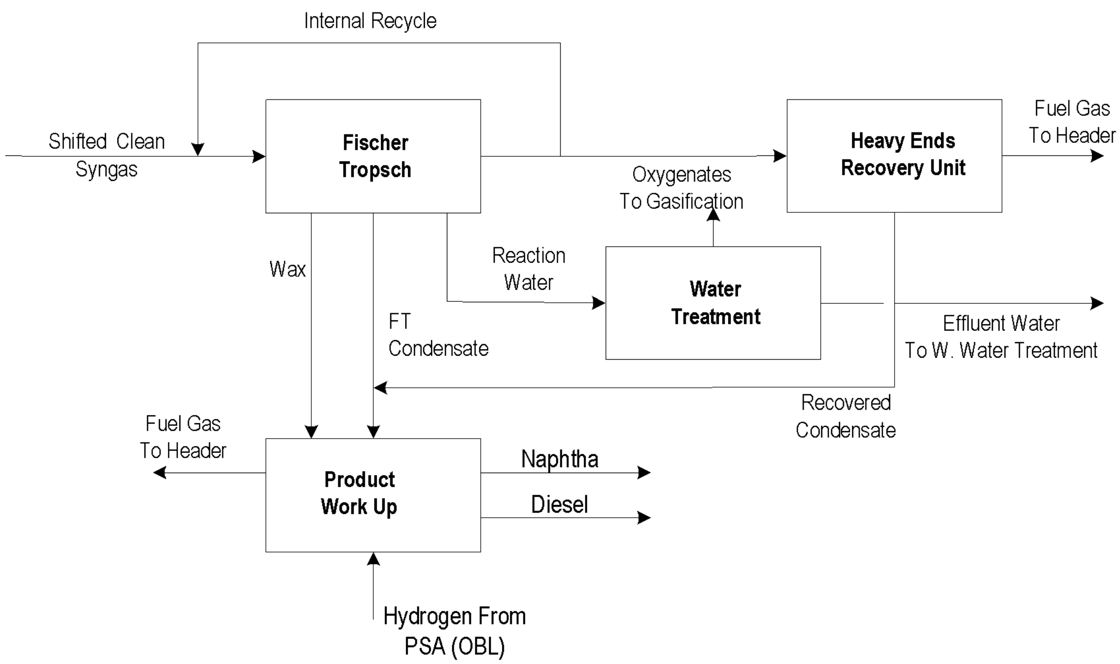


Figure 5-3 EECP Block Flow Diagram – FT and PWU Section

The Sasol EECP feasibility study scope includes the following process units:

- Plant 201 Fischer-Tropsch Synthesis Unit (including the Catalyst Reduction and Heavy Ends Recovery)
- Plant 202 Product Work-Up Unit
- Plant 203 Effluent Water Primary Treatment Unit

Individual process plant description, design criteria, stream flow characteristics and estimated plant emissions were presented in the last quarterly technical report

5.3 Balance of Plant / Offsites Feasibility Design

Nexant has prepared a Feasibility Design Package for the Balance of Plant and Offsite facilities. It consists of the following major offsite facilities:

Offsite Facilities:

- Plant 301 - Fuel Gas Collection and Distribution System
- Plant 302 - Relief and Blowdown
- Plant 303 - Steam and Condensate Collection and Distribution
- Plant 304 - Interconnecting Piping
- Plant 305 - Plant Air/Instrument Air System
- Plant 306 - Tankage
- Plant 307 - Tank Car/Truck Loading
- Plant 308 - Catalysts and Chemical Handling
- Plant 309 - Combined Cycle Plant
- Plant 310 - Electric Power Distribution
- Plant 311 - Raw/Potable/Process Water System
- Plant 312 - Cooling Water System
- Plant 313 - Waste Water Treatment
- Plant 314 - Sewage/Effluent Treating
- Plant 315 - Solid Waste Storage and Handling
- Plant 316 - Fire Protection
- Plant 317 – Buildings
- Plant 318 - DCS, Communication, and General Services

- Plant 319 - Site Preparation

In addition, facilities that are outside the EECP plant boundary but are necessary for its operation are included in the scope of Area 400, the Outside-Fence-Facilities. These include:

- Facilities for coal/coke and solid wastes conveying from/to the rail cars
- Equipment for pumping mine pool water to EECP and treated mine pool water back to an outside-fence percolation pond
- Coal slurry lines to EECP
- Natural gas tie-ins to the gas main
- Electrical tie-ins to the main grid
- Well water pumps

Design and specifications for Plants 301 to 312 were completed and described previously in the DOE report for the first quarter of 2002. The current report will describe the work completed for Plants 313 to 319 and Area 400.

5.3.1 Process Flow Diagrams

The BOP/Offsites Feasibility Study Design Package includes simplified process flow diagrams listed below. These drawings are available in the final design package.

Drawing No.	Description
• 301-B-001	Fuel Gas Collection and Distribution System
• 303-B-001	Steam and Condensate Collection and Distribution System, Boiler Blowdown Collection and Flash
• 303-B-002	Steam and Condensate Collection and Distribution System, Condensate Collection
• 303-B-003	Steam and Condensate Collection and Distribution System, Condensate Collection
• 303-B-004	Steam and Condensate Collection and Distribution System, Gasification Steam and Condensate Collection
• 303-B-005	Steam and Condensate Collection and Distribution System, Fischer Tropsch Steam and Condensate Collection
• 305-B-001	Plant Air/Instrument Air System
• 309-B-001	Combined Cycle Plant
• 312-B-001	Cooling Tower Water System
• 313A-B-001	Sour Water Stripper
• 315-B-001	Solid Waste Storage & Handling

5.3.2 Process Description

The BOP/Offsites Facilities for the EECP completed for this quarterly report period are described in this section.

Plant 313 Waste Water Treatment

Nearly all the water within the plant is classified as wastewater, which will require some treatment or control prior to discharge. This includes process wastewater and contaminated and uncontaminated rainwater but excludes sewage treatment. Sewage treatment is discussed in Plant 314.

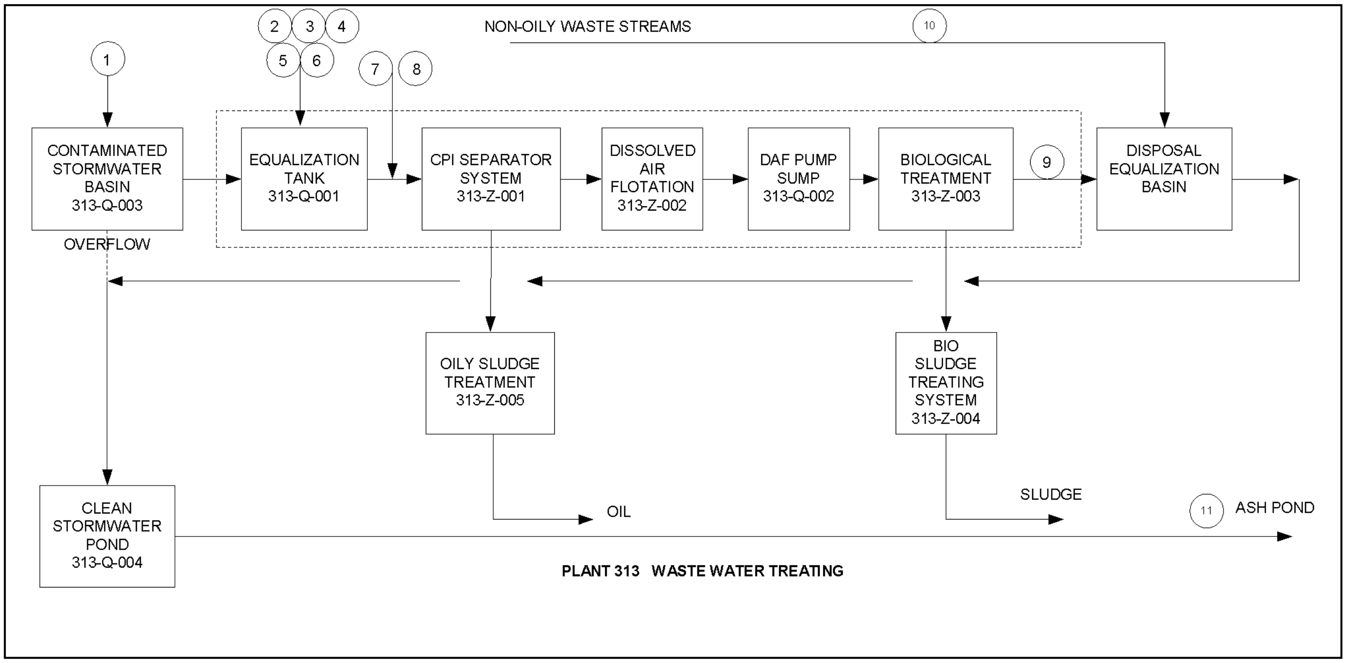
Pennsylvania has established regulation for industrial wastewater management, which needs to be met to permit the discharges from this plant. At this time, the discharge limits are not established. Therefore it will be assumed the same discharge as used by Gilberton Power Plant is acceptable. The Power Plant recycles their cooling tower blowdown and ion exchange waste stream to the ash pond. The EECP liquid waste streams are, in some cases, different than the power plant and will contain organics and, potentially, heavy metal and other regulated compounds. In addition, much of the process area is uncovered so that this area rainwater runoff may require some treatment before discharge.

The wastewater treatment plant is divided into five sections:

- Contaminated storm water retention
- Wastewater treating
- Oil recovery
- Biological treatment and solids removal
- Mixing and Disposal

This is illustrated in Figure 5-4. The contaminated storm water retention pond retains storm water so that it can be controlled and then combined in an equalization basin with the EECP waste streams for treatment. This combined water enters an API type separator for oil removal and recovery. The treated stream then enters a dissolved air flotation (DAF) type unit for further oil removal before biological treatment. The biological treatment greatly reduces the organics and other constituents before discharge. The discharged water is then mixed and returned to the ash pond.

Figure 5-4
Waste Water Treatment



Waste Water Streams

1-storm water
2-plant water return
3-FT reaction water
4-gasification grey water blowdown
5-LTGC blowdown
6-Retisol purge water
7,8 -combined waste water
9-treated wastewater
10-non oily waste water
11-combined discharge

Contaminated Storm water

The storm water collection system will consist of one splitter junction box and two storm water ponds. One pond will be designated as contaminated storm water retention pond and the other clean storm water retention pond. Both of these ponds will be lined with synthetic membrane.

The contaminated storm water will normally flow by gravity to the contaminated storm water retention pond. A plot area of 150 ft by 150 ft will be required with an overall depth of 12 ft. to provide 2 million gallons storage.

The contents in the contaminated storm water retention pond will be pumped to the wastewater treatment plant for treatment. Rainfall in excess of this rate will over flow to the clean storm water pond since it is considered to be non-contaminated.

Wastewater Treatment

The mixed wastewater will be pumped into a two-cell oil separator (313-Z-001). For the project cost estimate, an EIMCO™ equivalent to an API separator was selected. The WEMCO Pacesetter Gravity Oil/Water Separator is a CPI (coalescing plate interceptor) Separator. It uses internal, inclined perforated and corrugated plates to greatly improve separation efficiency and increase sludge settling area, much like any inclined plate settler. A typical API separator can remove droplets of oil greater than 140 microns while a WEMCO Pacesetter Gravity Oil/Water Separator can typically remove droplets greater than only 40-60 microns.

Surface skimming and bottom sludge removal mechanisms will be provided. The CPI unit will also be totally enclosed. The unit may include nitrogen blanket to minimize potential for explosion.

The dissolved air flotation (DAF) units (313-Z-002) consist of two 35' diameter circular steel tanks. The system also includes the collections mechanisms and the pressurization equipment skids. Each unit will be designed for 2-hour hydraulic retention time based on 50% of the design flow, excluding the recycle flow. Compressed air will be used as the media to carry the floc to the surface of the unit where a skimmer will remove the accumulated float to a storage pit. The accumulated float from this unit will be pumped to the sludge dewater system for further treatment and disposal. Bottom sludge will be pumped back to the CPI Separator. Effluent from the DAF units will be routed into a flow equalization pond (313-Q-002).

Oil Recovery System

Skimmed oil from the CPI units will be collected in a skimmed oil retention tank. Oily sludge's from the CPI separators, the DAF units and other source in the EECP will be stored in sludge receiving tanks. Oily sludge stored in the receiving tanks will be pumped to the oily sludge mixing and retention tank. The tank will also be provided with a side-mounted mixer. Stored oily sludge will be fed into a centrifuge thickener for dewatering. De-watered sludge will be collected in a dewatered sludge retention bin. The bin will have three-day storage capacity for sludge's from all sludge thickeners. Clear liquid from the centrifuge will be collected in the clear liquid tank and pumped back to the CPI inlet. The oily sludge's will either be removed from the site or utilized in the process. This decision is to be made for the final design.

Biological Treatment and Solids Removal

The treated wastewater will be pumped to a 2-pond aeration tank for biological treatment. The pond will be provided with submerged air diffusers for aeration and mixing. The biological treatment system sizing is strongly dependent upon the BOD and COD loading.

For the estimate, an EIMCO™ Advent Integral System (AIS) Biological Reactor was selected. It is specifically designed to handle a high strength, low flow wastewater stream. It is an integrated system of aeration pond and clarifier.

Waste biological sludge from secondary clarifier units will be routed to a Bio-Sludge Flotation Thickener where it will be thickened to a solids concentration of about 4%. A polymer feed system will be provided to enhance the dewatering characteristics of the bio-sludge. Aerobic digestion of the bio-sludge needs to be considered for inclusion in the final design to stabilize the sludge for land farming.

De-watering of the Bio-sludges will be done as follows: Thickened bio-sludge will be stored in the bio-sludge retention and feed tank. The tank will be provided with a side-mounted mixer. The daily solids production will be dewatered on one (1) 3.0-m EIMCO™ Mode13DP Belt Filter Press. This assumes a one-shift-per-day operation and production rates of 500 lbs/hr/m for activated sludge with a polymer system.

Dewatered sludge from the sludge de-watering thickeners will be trucked to a land farm. The sludge land farm will be a biological treatment system, which uses natural microorganisms to decompose oil in soil.

Discharge

Treated effluent will be routed to an equalization basin where it will be mixed with all other non-oily liquid stream from the EECP facility. This will be blended with the clean storm water prior to discharge to the ash pond. Wastewater quality will need to be monitored to ensure full compliance with the appropriate environmental regulations

Plant 313A Sour Water Stripper

The Sour Water Stripping system is designed to handle sour water discharged from the Low Temperature Gas Cooling (LTGC) section of the gasification unit, sour water from the Sulfur Recovery Unit (SRU) and sour water from the FT Products Workup Unit. The sour water feed from these units is first degassed before it is sent to an atmospheric sour water storage tank. The SWS system is consisted of a single column, steam reboiled sour water stripper with an air fan overhead condenser (see figure 5-5).

The Texaco Basis of Design provided the following sour water composition:

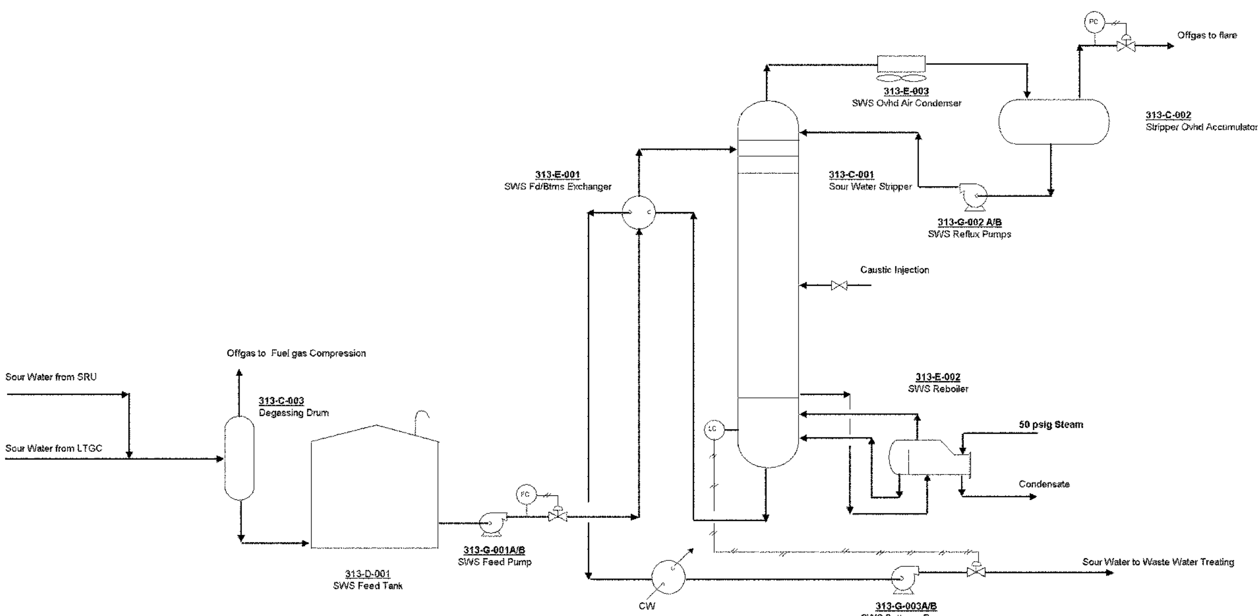
Component	Concentration (ppmw)

Formates	0
Chlorides	0
Ammonia	25,600
Cyanide	<50
Carbonate	<10
Sulfide	250
Total Dissolved Solids	25,600
BOD	0
COD	96,400

Pressure, psig	482
Temperature, °F	106

The total sour water flow is 17,500 lbs/hr. The high level of ammonia in the sour water makes it necessary to provide additional trays in the sour water stripper to meet the 50 ppmw ammonia specification of the stripper bottoms. A 40-tray sour water stripper is specified versus the more typical 30-tray stripper.

Figure 5-5
Sour Water Stripper System



Plant 314 Sewage/Effluent Treating

The Gilberton Power Plant uses a septic system for sewage treatment. This type of system will also be used for EECP. It will be designed for a rate of 4 gpm on a 24 hours per day basis.

The sewage/effluents will be collected in a separate drain and routed to the septic system. It is assumed a location can be selected that provides proper drainage. The final design will conform to the local regulations for a septic system. The final design can also consider whether it is appropriate to utilize a public owned treatment works for disposal.

Plant 315 Solid Waste Storage and Handling

Plant 315 is designed to transfer the coarse slag output from the Texaco Gasification Coarse Slag Handling Unit (Plant 105) via overland conveyor to a slag unloading facility outside the plant fence, and to store, reclaim and remove all slag received when the overland conveyor is under repair. It is designed to handle up to 2000 STPD (wet basis) or 1000 STPD (dry basis) of coarse slag from Plant 105. The expected coarse slag output from Plant 105 is 1600 STPD (wet basis) or 800 STPD (dry basis). The 20% over-capacity provides flexibility to handle variations in slag production.

One 100% train is provided. The plant is sized to transfer the combined coarse slag output from two 50% Plant 105 trains to offsite twenty four-hours each day, seven days a week. The overland conveyor length outside the fence, 5,700 ft., includes 30% contingency for routing uncertainty.

Final destination for the coarse slag has not been determined. For the Phase 1 estimate it is assumed that the coarse slag will be conveyed to the rail spur vicinity down in the valley (approximately 6000 ft. away) for stockpile and final disposal.

Coarse slag removal from the plant can be done with dump trucks or with fixed conveyors. The dump truck option is impractical because there is too much slag produced for a safe and economic hauling operation. The conveyor option is selected for safety, reliability, availability and low operating cost. Conveyors are assumed to be uncovered.

Provision for failure of the overland conveyor includes an emergency bypass conveyor and a 200-ton emergency reclaim hopper for temporary storage. A reclaim conveyor is included to return the slag to the overland conveyor.

Design Feed Characteristics

The characteristics of the coarse slag is listed below:

	Wt%	Specific gravity
Ash	48.2	2.12
Carbon	1.8	2.15
Water	50.0	1.00
Coarse Slag	100.0	1.23

Size	Nominal ¼"
Bulk Density, Dry	38.6 Lb/CF
Bulk Density, Wet	76.9 Lb/CF

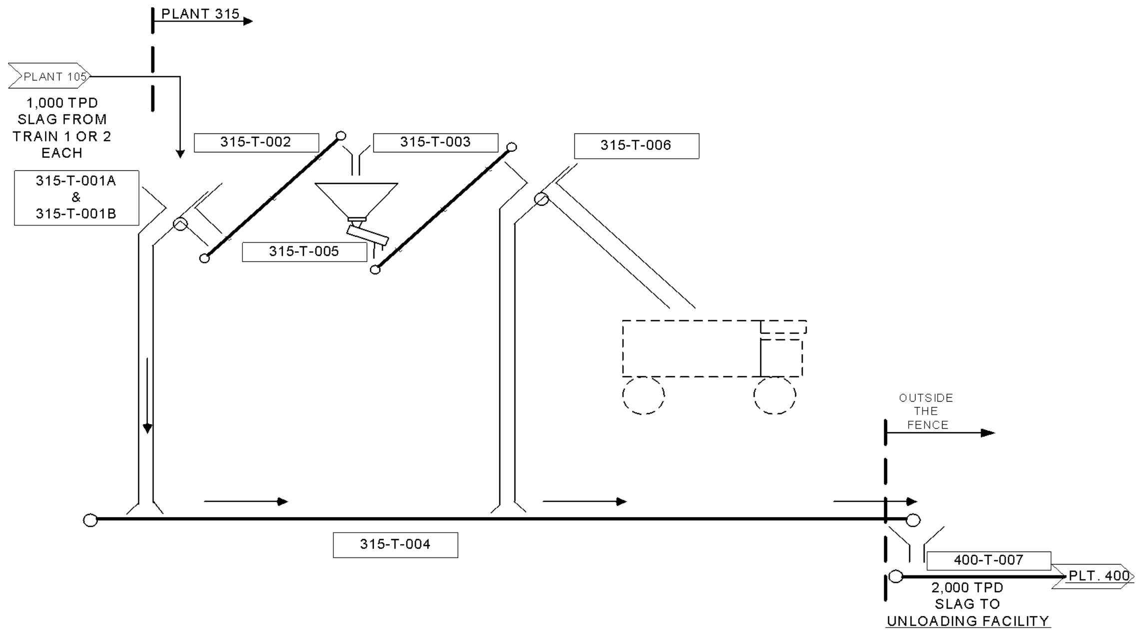
Figure 5-6 is a simplified flow schematic for Plant 315- Solid Waste Storage and Handling.

Slag from Plant 105 is fed to bypass feeders that are bifurcated chutes equipped with swing gates. Each feeder receives all the slag from the stackers from just one of the gasifier trains. Normally the feeder sends the slag to the overland conveyor for stockpiling and disposal outside the plant's fence.

During an overland conveyor outage the feeder routes the slag to an emergency bypass conveyor that feeds the emergency reclaim hopper.

The emergency hopper is equipped with a vibrating bin discharge and a vibratory feeder with a shut-off gate. When the hopper is full, the slag is discharged to a reclaim conveyor that empties through a bifurcated chute with swing gate onto the overland conveyor or optionally into a leased hauler truck through the other leg.

Figure 5-6
Solid Waste Storage and Handling



Plant 316 Fire Protection

Comprehensive fire water and other fire protection systems are provided for the general fire protection of the entire plant. Dust explosion prevention and inert gas fire suppression systems are provided for specific facilities and equipment. These systems cover:

- Fire water to process plants, co-generation, coal handling, water and waste treatment, and storage tankage.
- Fireproofing for vessel supports, pipe racks, etc.
- Water sprinkler systems for buildings. Foam spray system for tank truck filling racks.
- Portable extinguishers and mobile foam fire trucks

- Fixed water/foam system on tankage
- Gaseous clean-agent system for control building and laboratory
- Nitrogen system for sulfur storage tank

Fire water is supplied from treated mine pool water. The mine pool water treating system is capable of supplying 26,000 barrels, or 150% of the total requirements of the system for less than 8 hours. A fire water storage tank provides a dedicated supply (17,145 bbls) of fire water for 4 hours.

Two main fire water pumps, each rated for 3,000 GPM at 150 psig, deliver the water to the distribution system from the fire water tank. These are horizontal pumps with 100% capacity each and located in the fire water pump house. One is driven by electric motor. Diesel engine powers the second pump.

Two fire water pressurizing "jockey" pumps, each rated for 250 GPM at 150 psig discharge pressure, are also installed in the fire water pump house for maintaining the pressure in the fire water piping circuit. Only one pump is required to maintain the pressure in the fire water system. The second pump serves as an installed standby spare. Both pumps are powered by electric motors.

Fire water is supplied to fire hydrants and/or fixed monitors spaced at a maximum of 150 feet around each process units and a maximum of 300 feet around combined cycle plant and coal handling units.

The elevated water/foam monitors are 500 GPM units with adjustable fig/straight stream tips and locking devices for both horizontal and vertical adjustment. On-site alcohol-resistant foam storage containers with steam heating housing in winter for each monitor are provided. The monitors are mainly located at the gasification units and Fischer-Tropsch units.

Deluge systems are provided for pipe racks located within 25 feet of heaters, pump batteries, towers and major vessels containing flammable materials. The costs are included in the associate equipment costs.

Water sprinkler and fixed spray systems are provided for administration building, warehouse and coal belt conveyors. Dry- pipe sprinkler systems are installed. Four-inch standpipes and cabinets with 1½" diameter 50 feet hose and spray nozzle are also installed in the administration and warehouse buildings.

The fixed foam makers on the top of tank wall and pre-installed water pipes and foam pipes are provided for the internal floating roof tanks in Plant 306 (Tankage). Alcohol-resistant 3% foam solution is used for fire extinguishing. Fire water is also provided to cool the burning tank and adjacent tanks. Mobile foam truck will provide foam when a fire occurs.

The control building and laboratory building are protected by clean-agent FM200 fire extinguishing system. The systems are fully automatic, energized by thermal detectors, and have personnel alarms for evacuation.

A nitrogen fire extinguishing system is provided for a liquid sulfur tank in the sulfur recovery Plant 111. The system is fully automatic and energized by thermal detectors.

Low pressure snuffing (50 PSIG) steam is provided in the compressor buildings, exchanger rows, pump rows and accumulator decks as well as fire-boxes of heaters.

Detector units with alarms are utilized in the areas handling or processing flammable liquids or gasses, hydrogen sulfide and buildings where personnel are working.

Plant 317 Buildings

The following buildings are included in Plant 317's scope:

- Administration Building
- Central Control Building, including UPS equipment
- Laboratory Building
- Warehouse Building with Maintenance Shops
- Fire Station with First Aid Station
- Guard Houses #1 & 2
- Weigh Station
- Plant 309 HP Steam Turbine Building
- Plant 309A IP/LP Steam Turbine Building
- Fire Water Pump House
- Cooling Water Pump House
- Raw Water Treatment Building
- Waste Water Treatment Building

In addition to general good practices, the building designs shall include the requirements and recommendations of the following:

- Occupational Safety and Health Administration (OSHA)
- State of Pennsylvania Codes
- Uniform Building Codes (UBC)
- National Electrical Codes

A summary of the design basis is listed below:

- Control building to be blast-proof, cast-in-place reinforced concrete roof and walls designed for 3 psig over-pressure or 1 psig suction pressure. Structural parts are fireproofed with three-hour-rated materials. Buildings are pressurized to 0.1 to 0.2 inches of water during operation.
- Laboratory building and First Aid station to be steel framed with masonry walls. Bearing walls and steel columns support the roof framing of steel beams and decking. Structural members are fireproofed with three-hour-rated materials.
- Administration building to be steel framed with masonry walls. Bearing walls and steel columns support the roof framing of steel beams and decking. The building interior is finished with brick veneer masonry. Structural members are fireproofed with three-hour-rated materials.
- Warehouse, pump houses, water treatment buildings, steam turbine generator buildings, guard houses and weigh station to be steel framed structures sheathed and roofed with prefabricated metal panels. Metal sandwich panels are used for required building insulation for winterization. The building frame is designed for the support of cranes and monorails for warehouse and the buildings containing heavy equipment.
- Acoustic tile ceilings are installed for all rooms and administration building, control building and laboratory building. No ceilings to be installed on mechanical equipment areas. Carpets are only installed in the administration building. In general, interior walls are plasterboards.
- Buildings are provided with steam coils for winterization, fans for air circulation, lighting, glazing, hardware, electrical, and plumbing. Sanitary facilities are provided only in those buildings in which they are required.
- Air conditioning will be provided to all rooms, including locker rooms, showers and kitchens, and to administration building, control building and

laboratory. Chemical storage area and maintenance shops, etc. will have forced ventilation.

- All buildings are one-story buildings. Building costs include adequate allowance for internal furnishings, telephones, computers and emergency lighting, etc. utility equipments.

- Number of offices inside buildings is based on the staffing plan for EEPC Gilberton Plant. Standard office sizes assume to be 150 sq. ft.

Plant 318 DCS, Communication, and General Services

Plant 318 includes the Distributed Control System (DCS) for linking onsite/offsite process monitors and controllers to the central control room, and the Overall Telecommunication System for linking plant-wide communications and data processing systems.

Plant 318 does not have an engineered scope since exact input/output (I/O) counts and communication requirement are not available for all onsite and offsite areas. Instead, a capital cost allowance, based on information provided by Texaco for the gasification area and historical cost from other recent IGCC plants, is provided for Plant 318.

Although facility and equipment descriptions are included here, they are generic for similar plants and are for information only.

Distributed Control System (DCS)

The overall concept for the DCS and operator interface is to have one central control system. The central control room has three operator consoles, one for each area:

Area 100	Gasification
Area 200	F-T Synthesis
Area 300	Offsite/Utility

There will also be a supervisory computer and a DCS engineering console. The central control room also contains the racks for the controllers and input/output (I/O) serving process equipment located near the central control building.

The DCS will be scoped to have a separate logic control network (LCN) highway system for each of the three areas.

Communication and General Services

The communication and general services system include the following facilities to support communication throughout the plant and to support overall plant operation:

- Interconnecting cables, standby emergency power and grounding
- Fire alarm
- Public address paging
- Medical emergency and life-signs telemetry
- Intra-plant party paging
- Land mobile radio
- Radio paging
- Security System
- Telephone System

Plant 319 Site Preparation

The site is located near Gilberton, in Schuylkill County, Pa., north of Interstate 81 and east of Pennsylvania State Highway 61. The 50-acre site is at the edge of the Gilberton Power Plant, designed and built by Bechtel about 15 years ago. The site is accessible via nearby surface roads. Nearest railroad spur is approximately a mile and half away and 400 feet down at the valley. The scope of the preliminary earthwork is based on pictures of the site taken on February 22, 2002. Aerial photo contour mapping and detailed site topography are not yet available.

Subsurface conditions at the plant site is assumed to have the same characteristic as Gilberton - 6 to 8 feet of soil overlaying solid bed rock. Based on Gilberton's experience, it is assumed that piling, site blasting and ripping are also not required for the EECP plant. It is also assumed that there are no contaminated soil or hazardous waste to be removed.

The scope of site preparation is consisted of:

- Leveling approximately 50 acre area;
- Clearing of trees, vegetation, brush, down timber, and rubbish;
- Adding basic improvements such as roads, fencing and drainage needed by the plant as a whole,

- Placing load-bearing concrete pier and spread footing foundations for the plant structures in accordance with individual needs.

Site leveling and clearing consist of clearing, grubbing, stripping, excavation and placement of fill to establish the rough grading elevations. All trees, stumps, roots, vegetation, logs, rubbish, and other unsuitable material will be removed to a assumed depth of at least 3 feet below existing grade or below final rough grade, whichever is greater.

Reusable topsoil and soil containing organic material will be stored in stockpiles and later be overlaid on finished grading areas that are not to be further improved.

Excavation are performed as required for footings, grade beams, pits, basements, retaining walls, manholes, catch basins, etc. Allowance is given for removing soft and compressible soil at footing grade and replacing with compacted fill or back fill in accordance with soil report recommendations.

Fill and back fill contain no rocks or stones large than 3" and will be free of frozen lumps, organic matter, or chunks of highly plastic clay, etc. material. Fill and backfill placed beneath footing, grade beams, mats, buildings, process areas, roads, and parking areas are compacted to the density as determined by ASTM standards.

Finish grading of the plant site provides the proper shape and contour to the final ground surface. Finish grading includes providing the correct amount of slope for surface drainage without causing erosion.

Upon completion of finish grading, all drainage ditches are constructed to proper size, shape and slope and all roads are brought to the proper elevation and made ready for paving.

Uncontaminated storm runoffs from building roofs, parking lots, outdoor storage areas and uncontaminated process plant areas are collected by catch basins and conveyed by buried pipes and open ditches to the treated water holding pond before disposal to the existing tailing percolating pond down in the valley.

Contaminated runoffs from process and off-plot area are collected by catch basins and conveyed by buried pipes and open ditches to the contaminated runoff/process effluent holding pond for treatment in the Waste Water Treatment Plant (Plant 313) before disposal to the existing tailing percolating pond down in the valley.

One contaminated runoff/process effluent retention pond and one clean/treated water retention pond are included to provide feed and product storage for Waste Water Treatment (Plant 313).

<u>Dikes for Tank Farm</u>

Containment dikes for the tank farm area are of earthen construction with 2 to 1 side slopes. They are constructed from ordinary compacted earth excavated and stored on the site. The tank farm will be designed to protect against groundwater contamination.

Foundations

Based on Gilberton Power Plant's construction experience, concrete pier foundations or spread footings over slightly weathered or fresh bedrock are used for heavy and settlement-sensitive structures and equipment.

Roads

Plant roads are constructed of asphalt concrete on a crushed limestone base, which is rested on a compacted sub-grade. Main plant roads are 24 feet wide with 3 feet wide shoulders. Secondary roads have similar cross sections with widths appropriate to their usage. Employee parking lots are of construction similar to that of plant roads.

Walks are provided to interconnect the parking lot, guard houses, administration building and process buildings, etc., to adjacent roads in order to provide safe pedestrian travel.

Fencing

Perimeter fencing and gates are provided to restrict access. Certain hazardous areas within the plant (such as the flare area) will also be fenced to restrict access.

Area 400 Outside-Fence-Facilities

Area 400 covers facilities that transfer coal/coke, water and slag to and from the EECP plant but are physically located outside the EECP perimeter fence. Since neither the locations nor the routings of these outside-fence facilities are defined at this time, capital costs of these equipments are grouped into a separate account to allow for easy changes.

The following equipments are included in the Area 400 scope:

- Coal slurry line from coal beneficiation plant (Plant 102) to Plant 101.
- Mine pool water pumps and mine pool water booster pumps with associated piping from the valley mine pool water pump-house to the mine pool water/fire water storage tank in Plant 311.
- Well water pumps and lines from the wells to the well water treatment facility in Plant 311.
- Treated effluent water line from Plant 313 to the existing percolation (tailings) pond in the valley.
- Coal/coke conveyor from the railroad spur in the valley to Plant 101.
- Slag conveyor from Plant 315 to the railroad spur in the valley.

Coal Slurry Feed Line:

A single 5,000 feet long pipeline carries coal slurry feed from Plant 102 (Coal Beneficiation) to Plant 101. Coal slurry feed from Plant 102 is assumed to contain 90% of the design anthracite culm feed. The remaining 10% of the solid culm feed will be conveyed to Plant 101 as makeup for final slurry concentration adjustment: The 100% Anthracite Culm feed operation will be the design case for the coal slurry feed pipeline.

		Flow, LB/Hr	
		100% culm	Mix feed
Slurry Feed from Plant 102	Culm	265,100	186,000
	Water	193,100	175,600
	Total	458,200	361,600
Dry Culm Feed from Plant 102 -	Culm	29,500 *	20,700**
Slurry Concentration, wt% solids		57.9	51.4

*Additional Flux will be added in Plant 101.
**Additional Petroleum Coke and Flux will be added.

Mine Pool Water Supply Facilities:

Three 50% (two operating plus one spare) motor driven submersible pumps are included to supply the normal mine pool water demand of 2,760 gpm (see Section 4.5 of this report). Each pump is encased in a 1,500' deep 24" diameter steel casing, and is designed to pump up to 1500 gpm of water to the valley surface.

Three 50% (two operating plus one spare) motor driven booster pumps are included to transfer each submersible pump's valley surface discharge through 8000' of common 12" header to the Mine Pool Water Storage Tank in plant 311.

Well Water Supply Facilities:

Eight wells are included to supply the normal well water demand of 700 gpm. Each well is equipped with one motor driven submersible pump encased in a 400' deep 8" diameter steel casing. No spare pumps are included.

In case of short-term pump failures (for up to three pumps), the normal well water demand can be supplied by 5 wells since each pump is capable of pumping up to 150 gpm of water.

With all pumps running, the system is capable supply up to 1,200 gpm of well water for short durations, as limited by the underground aquifer capacity.

Treated Wastewater Disposal:

Net plant treated water effluent will be piped, via gravity flow, from the Waste Water Treatment Plant (Plant 313) to the existing tailings pond in the valley, where the water will percolate through the anthracite tailings and be recovered in the underground mine pool. The wastewater discharge pipe is sized for 2,000 gpm to accommodate the estimated effluent rate of 1,960 gpm at EECP design throughput operation (see Section 4.5 of this report).

Coke/Coal Overland Conveyor:

A common overland conveyor will be used to transport the imported petroleum coke (for mixed feed operation) from the railroad spur to Plant 101, and the dry 10% makeup coal feed (for final slurry concentration control) from vicinity of Plant 102 to Plant 101. The coke and dry coal will be conveyed batch-wise on a weekly schedule assuming one batch every seven days. The estimated weekly solids consumptions are as follow:

	Mix Feed	100% Culm
Seven Days Consumption of Dry Culm, Tons	1,739	2,478
Seven Days Consumption of Pet Coke, Tons	5,788	0
Total Solids Consumed in Seven Days, Tons	7,527	2,478

The minimum conveyor capacity required would be 7,527 ÷ 7 = 1,075 STPD. Allowing 20% contingency for switching and other down times, the overland conveyor design capacity is 1,075 ÷ 0.8 = 1,350 STPD. The estimated weekly operation time breakdowns for the mix feed operation and the 100% culm feed operation are:

Weekly Operation Breakdown for Mix Feed:	Hours	% of Time
Conveying Coke	103	62
Conveying Culm	31	18
Switching & Stand-by Time	34	20
Total Time	168	100

Weekly Operation Breakdown for 100% Culm Feed:	Hours	% of Time
Conveying Coke	0	0
Conveying Culm	44	26
Switching & Stand-by Time	124	74
Total Time	168	100

The overland conveyor consists of three major sections:

- A coke reclaiming and conveying section transporting coke from the railroad spur to the feed conveying section at the vicinity of the Beneficiation Plant. This section only operates when conveying coke.
- A culm reclaiming section transporting anthracite culm from the Beneficiation Plant area to the feed conveyor. This section only operates when conveying culm.
- A feed conveying section which transports the coke or the culm from the Beneficiation Plant vicinity to Plant 101. This section operates when conveying either culm or coke.

Slag Disposal:

An overland conveyor is provided to receive 2,000 STPD (wet basis) or 1,000 STPD (dry basis) of slag from Plant 315 (Solid Waste Storage and Handling) at the EECP perimeter fence, and continue to transport the slag to the vicinity of the existing railroad spur for stockpile and export. The slag conveying is to be continuous, 24 hours a day and seven days a week.

No slag reclaim facilities for rail export are included at the stockpiling area. It is assumed that the slag will be exported via buyer's truck filled with rental front-end loaders.

TASK COMPLETED.

Purvin & Gertz, Inc. completed this task under a subcontract to Texaco. Final report was delivered to WMPI. The report contains sensitivity business information that WMPI would prefer not to report it in writing. Under an agreement, DOE can review the report and its findings with WMPI.

Section 7 Phase I Task 6 – Preliminary Site Analysis

Under this task, WMPI will assess the site-specific project requirements to include:

- Raw material availability
- Site transportation accessibility
- Supporting utility services
- Land availability and cost
- Construction and skilled labor availability

As part of this Task 6, Nexant, with support from Bechtel personnel, helped with examining alternative modes of transporting large process vessels to the EECP site near the existing Gilberton cogen plant. Results were discussed in the July/September 2001 Quarterly Technical Progress Report. Sasol's slurry phase FT reactor is expected to be over 18 feet in diameter. Its dimensions and weight are important parameters governing how the vessel should be most cost effectively fabricated and transported to site.

A topical report, summarizing all Phase I, Task 6 activities is being drafted.

Section 8 Project Management

8.1 BIWEEKLY PROJECT STATUS REPORT

Informal Biweekly Project Status Reports are transmitted to keep the DOE Project Manager updated of all work in progress.

8.2 PROJECT MILESTONE PLAN AND LOG

Project Milestone Plan and Milestone Log are submitted on time as prescribed by the contract to keep DOE management informed of work-in-progress and accomplishments against major project milestones planned.

Section 9 Experimental

EXECUTIVE SUMMARY

9.1 EXPERIMENTAL

9.2 RESULTS AND DISCUSSION

9.3 CONCLUSION

9.4 REFERENCE

NOT APPLICABLE - The current project is a design feasibility and economics study, leading to detailed engineering, construction and operation of an EECP plant. It's not a typical research and development (R&D) project where a topical report format described in this section applied. There was no experimental work performed. This section is included only to fulfill DOE's prescribed reporting format.

List of Acronyms and Abbreviations

AGR .... Acid Gas Removal
API .... American Petroleum Institute
ASTM.. American Standard Testing Methods
Bbls, bbls .... Barrels
BEDD.. Basic Engineering Design Data
BOC .... British Oxygen Company
BOD .... Biological Oxygen Demand
BOP .... Balance Of Plant
BPD .... Barrel Per Day
BFW .... Boiler Feed Water
CFB .... Circulating Fluidized Bed
COD .... Chemical Oxygen Demand
CPI .... Coalescing Plate Interceptor
DAF .... Dissolved Air Floatation
DCS .... Distributed Control System
DOE.. U.S. Department of Energy
EECP .... Early Entrance Co-Production Plant
ft .... Feet
FT .... Fischer-Tropsch
GPM .... Gallons per Minute
HER.. Heavy End Recovery
HHP.. High High Pressure
HP.. High Pressure, Horse Power
HRSG .... Heat Recovery Steam Generator
I/O .... Input/Output
IP .... Intermediate Pressure
ISBL .... Inside Battery Limits
KV .... Kilo Volts
Lb/CF .... Pounds per Cubic Feet
LCN.. Logic Control Network
LHV.. Lower-Heating Value
LP .... Low Pressure
LTFT .... Low-Temperature Fischer-Tropsch
LTGC .... Low-Temperature Gas Cooling
MMSCFD .... Million Standard Cubic Feet Per Day
MW .... Mega Watt
NETL.. National Energy Technology Laboratory
OSBL.. Outside Battery Limits
OSHA .... US Occupational Safety and Health Administration
PMCC.. Pensky-Martens Closed Cup
PPM.. Parts per Million
PSA .... Pressure Swing Absorption
PSIG, psig .... Pounds per Squared Inch, gauge
PWU .... Product Work Up

RD&T	Research, Development & Testing
RON	Research Octane Number
RVP	Reid Vapor Pressure
SCFM	Standard Cubic Feet per Minute
SCR	Selective Catalytic Reduction
SRU	Sulfur Recovery Unit
STPD	Short Tons Per Day
SWS	Sour Water Stripper
TGTU	Tail Gas Treating Unit
UBC	Uniform Building Code
WMPI	Waste Processors Management, Inc.
Wt%	Weight Percent