U.S. DEPARTMENT OF ENERGY
PITTSBURGH ENERGY TECHNOLOGY CENTER

DIRECT COAL LIQUEFACTION BASELINE DESIGN AND SYSTEM ANALYSIS

CONTRACT NO. DEAC22 90PC89857

FINAL REPORT ON BASELINE AND IMPROVED BASELINE

VOLUME II B
BASELINE DESIGN CONTINUED

AMOCO

BECHTEL

MARCH 1993

PITTSBURGH, PENNSYLVANIA

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March 5, 1993

U. S. Department of Energy
Pittsburgh Energy Technology Center
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Attention: Mr. Swenam Lee
Project Manager

Subject: D.O.E. Coal Liquefaction
Base Line Design and System Analysis
Contract No. DE-AC22 90PC89857
Bechtel Job No. 20952
Final Report on Study
Letter No. BLD-132

Dear Mr. Lee:

Enclosed are two copies of Volume II-B of the subject multi-volume final report. The final report is published in nine volumes plus an executive summary. As requested, the remaining third copy of this nine volume report will be sent to you in 3-ring binders for your desk use. Copies to the other members of DOE, as requested by the contract, are sent directly to each of them.

Sincerely yours,

Syamal K. Poddar
Project Manger

SKP:tr
Enclosure

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The information and data contained in this report are the result of an ecomonic evaluation and a preliminary design effort and because of the nature of this work no guarantees or warranties of performance, workmanship, or otherwise are made, either expressed or by implication.

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18. PLANT 21

18. Plant 21 (Interconnecting Piping Systems)

18.0 Design Basis, Criteria and Considerations

Plant 21 includes the fuel gas blending and distribution system and the interconnecting process and utility piping between process plants and offsites. All above ground and underground piping systems are included except fire water piping which is included in Fire Systems (Plant 33) and plant flare headers which are included in the Flare System (Plant 19). In general, water distribution piping is underground and all other piping is located above ground on pipe racks.

Fuel gas users in the complex include process fired heaters and combustion turbine generators (CTG), the coal drying heaters. Fuel for these users must be clean gas with virtually no sulfur content so that no treatment of stack gases for sulfur removal is needed.

Two types of fuel gas are produced within the complex. One is classified as high BTU gas and the other as medium BTU gas. The high and medium BTU gases have been segregated in two separate distribution systems. Natural gas can be added to either system to meet the fuel gas requirements and to maintain consistency within each system. The gas fired equipment will burn the high BTU gas while the medium BTU gas system goes to Plant 31 to produce steam and power.

Fuel Gas System

The rates and specifications of the plant fuel gas available from two sources within the facility and natural gas are summarized in Table 18.1. The rates and compositions of the first two sources in the table are from the material balances included on the process flow diagrams for the Gas Plant (Plant 3) and Hydrogen Production by gasification (Plant 9). Natural gas composition is based on the analysis used in this complex.

The material balance and equipment design for Plant 3 and Plant 9 were developed based upon a preliminary design basis.

Interconnecting Piping

The interconnecting piping consists of all the process lines and racks connecting one process plant to another, the utility headers and the branches to each process. Pipes are sized based on pressure drop and fluid velocity considerations.

The cooling water system is routed underground and process lines and other utilities are routed on the pipe racks. All the steam, condensate and boiler feedwater lines are insulated. The headers, one for each utility service, include the following:

- 600 psig steam (superheated)
- 150 psig steam (saturated)
- 50 psig steam (saturated)
- Instrument air
- Utility air
- Utility water
- Cooling water supply
- Cooling water return
- 600 psig boiler feedwater
- Potable water
- High BTU fuel gas
- Medium BTU fuel gas
- Natural gas
- Nitrogen Gas

Storm sewer, sanitary sewer, and process wastewater lines are included in the scope of Sewers and Wastewater Treating (Plant 34).

TABLE 18.1

FUEL GAS AVAILABILITY

(All Rates are TPSD)

Stream Component	High BTU Gas From Plant 3	Medium BTU Gas from Plant 9	Natural Gas
Hydrogen	27.0	210.6	--
Carbon Dioxide	0.0	126.6	--
Carbon Monoxide	9.1	240.7	--
Methane	389.7	8.8	1819.5
Ethane	311.3	0.0	108.3
Propane	77.9	0.0	38.4
Water	36.4	0.0	--
N_2	15.3	149.6	33.4
Argon	0.0	29.1	--
O_2	0.0		207.8
TOTAL	866.7	765.4	2207.4
LHV, BTU/SCF (1)	886	259	884
MM BTU/hr (LHV)	1473	1007	3510

(1) Heating values are BTU per scf based on 379 ft^3 per pound-mole. Maximum operating pressure for high BTU gas is 75 psig and minimum pressure 50 psig at the battery limits of any user. Medium BTU gas will have an operating pressure of 300-400 psig as it exits Plant 9.

18.1 Plant Description

Fuel Gas System

There are two fuel gas systems in order to segregate high and medium BTU gases.

Medium BTU Gas

The source of the medium BTU gas is:

- o Desulfurized raw syngas from Gasification and Purification (Plant 9)

Medium BTU gas must be burned within the facility as there is no other use for it in the present concept. It is supplied to the power plant (Plant 31) to produce steam and power. Natural gas may be injected into this stream to satisfy the needs of the gas turbines in the power plant.

High BTU Gas

High BTU gas comes from the following sources:

- o Outside purchased gas (Natural Gas)
- o Desulfurized deethanizer overhead gas from the Gas Plant (Plant 3)

Outside pipeline gas is purchased only to supplement the internally produced gas or for start-up use. The deethanizer overhead gas is burned within the facility. Natural gas can be burned within the facility as needed to balance fuel usage. The high BTU gas distribution system is designed to accommodate all of these requirements.

All of the streams first pass into a mixing drum to smooth out variations in calorific value that would result from fluctu- ations in flow rate of any of the gases. High BTU gas is to be piped to all in-plant users, with the piping designed so that all users operate entirely on high BTU gas.

Fuel Gas Blending

Two 10' x 5' vertical drums (21-C101 and 102) are provided for mixing natural gas with the medium and high BTU gases, respectively.

Interconnecting Piping

Interconnecting pipings consists of all process lines connecting the plants, the utility headers, and the branches to each plant.

The process and utility line sizes are summarized in the major line list section below.

18.2 Major Lines Summary

Process Lines

Line Contents	From	To	Size (in)
Naphtha Product	Plant 4	Plant 20 Tank	6
Light Distillate Product	Plant 5	Plant 20 Tank	4
Heavy Distillate Product	Plant 5	Plant 20 Tank	6
Gas Oil Product	Plant 5	Plant 20 Tank	6
Propane Product	Plant 3	Plant 20 Tank	2
Mixed Butanes Product	Plant 3	Plant 20 Tank	2
Sulfur Product	Plant 11	Plant 20 Tank	3
Ammonia Product	Plant 38	Plant 20 Tank	2
Phenol Product	Plant 39	Plant 20 Tank	1
Naphtha Product	Plant 20 Tank	Plant 20 Pump	22
Light Distillate Product	Plant 20 Tank	Plant 20 Pump	22

Line Contents	From	To	Size (in)
Heavy Distillate Product	Plant 20 Tank	Plant 20 Pump	22
Gas Oil Product	Plant 20 Tank	Plant 20 Pump	22
Naphtha Product	Plant 20 Pump	Plant 22 Pipeline	14
Light Distillate Product	Plant 20 Pump	Plant 22 Pipeline	14
Heavy Distillate Product	Plant 20 Pump	Plant 22 Pipeline	14
Gas Oil Product	Plant 20 Pump	Plant 22 Pipeline	14
Propane Product	Plant 20 Pump	Plant 23 Tank Car/Truck	8
Mixed Butanes Product	Plant 20 Pump	Plant 23 Tank Car/Truck	8
Sulfur Product	Plant 20 Pump	Plant 23 Tank Car/Truck	10
Ammonia Product	Plant 20 Pump	Plant 23 Tank Car/Truck	8
Phenol Product	Plant 20 Pump	Plant 23 Tank Car/Truck	6
Naphtha Intermediate	Plant 2	Plant 20 Tank	6
Light Gas Oil Intermediate	Plant 2	Plant 20 Tank	6
Heavy Gas Oil Intermediate	Plant 2	Plant 20 Tank	6
Sour Water Header	Plants 2, 3, 4, 5, 9, 11	Plant 20 Tank	12

Line Contents	From	To	Size (in)
Light Flush Oil Intermediate	Plant 2	Plant 20 Tank	3
Heavy Flush Oil Intermediate	Plant 2	Plant 20 Tank	4
Naphtha Intermediate	Plant 20 Tank	Plant 2	6
Light Gas Oil Intermediate	Plant 20 Tank	Plant 2	6
Heavy Gas Oil Intermediate	Plant 20 Tank	Plant 2	6
Sour Water Header	Plant 20 Tank	Plant 38	12
Light Flush Oil Intermediate	Plant 20 Tank	Plant 2	3
Heavy Flush Oil Intermediate	Plant 20 Tank	Plant 2	4
Make-up Water	Plant 32	Plant 9	8
Raw Water	Raw Water Source	Plant 32	14
50 psig Steam	50 psig Steam Header	Plant 31	24

Utility Lines

Utility Header	Size (in)
600 psig Superheated Steam (720°F)	10
600 psig Saturated Steam	10
150 psig Saturated Steam	24
50 psig Saturated Steam	36
Instrument Air	3

Utility Header	Size (in)
Utility Air	2
Utility Water	6
Cooling Water Supply	48
Cooling Water Return	48
600 psig Boiler Feedwater	6
Potable Water	3
High Btu Fuel Gas	8
Medium Btu Fuel Gas	10
Natural Gas	6
Nitrogen Gas	26

19. PLANT 22

19. Plant 22 (Product Shipping)

19.0 Design Basis, Criteria and Considerations

Plant 22 provides the pipeline and metering system for delivery of the final oil products from the hydrotreaters (Plants 4 and 5) to down stream customers.

The equipment for this plant includes the appropriate length of 20 in. schedule 40 pipe for product delivery to down stream customers and a meter for tracking the amount of product transfered for accounting and billing purposes. The meter is provided with a 16 in. proving loop for meter testing and calibration.

The pipeline is designed to carry 4375 gpm which allows 50,000 barrels of oil product to be delivered in 8 hour batches. The pressure drop should not exceed 500 psi for every 50 miles of pipe.

Dual meters are required to assure proper recording of product delivery quantities in case of single meter failure.

19.1 Plant Description

Pipeline

A 20 in. schedule 40 pipe is provided for product delivery to down stream customers. The pressure drop in the pipe is 0.15 psi per 100 ft. of pipe at the maximum flow rate of 4375 gpm.

Metering System

A dual metering system is provided for tracking the amount of product transfered for accounting and billing purposes. The meter consists of one active and one spare system. Product flow rates are measured by an in-line turbine element which transfers an electronic signal to a microprocessor. The microprocessor converts the electronic signal to digital data which is stored for future retrieval. The meter is provided with a 16 in. pipe diameter by 60 ft. long proving loop for meter testing and calibration.

Pig

A 20 in. pig is provided for periodic cleaning of residuals and debris in the pipeline.

19.2 Major Equipment List

Major Equipment List for the plant is shown in Table 19.1 below:

Table 19.1

Equipment No.	Type	Description
22-L101	Pipeline	20 in., schedule 40
22-V101	Metering System with Prover Loop	16 in. prover loop
22-V102	Pipe Cleaning Pig	For 20 in. pipe
22-V103	Pig Launcher	For launching pipe cleaning pig into the pipeline

19.3 Utility Summary

The electrical utility requirements for the product delivery pumps are included in Tankage (Plant 20).

20. PLANT 23

20. Plant 23 (Tank Car/Tank Truck Loading)

20.0 Design Basis, Criteria and Considerations

The products are generally pumped from the storage tanks to the loading points at the required rate (See Table 20.1). One pump for each product delivers the required flow rate for phenol, ammonia, propane, and butane; however, two pumps are required for pumping molten sulfur. All operating pumps are provided with a spare. Loading pumps are included in Tankage (Plant 20). Nozzles are provided at both the Tank Car and Tank Truck loading racks such that any product can be loaded at two or more bays.

Each product is piped by a separate line to the loading racks, then branched to different loading nozzles.

All products are loaded at ambient temperatures (100 °F) except molten sulfur which is loaded at 300 °F.

20.1 Plant Description

Rail Tank Car Loading

Standard loading arms with telescopic nozzles and swivel joints are provided for top loading products such as phenol, and molten sulfur. For volatile products such as propane and butane, and anhydrous ammonia, loading arms with hose connections for bottom loading are used.

Tank Truck Loading

Top loading nozzles are used for phenols and molten sulfur. Nozzles with bottom loading hose connections are used for anhydrous ammonia and propane.

Piping and Valves

Piping and valves are carbon steel and conform to the required design conditions. Hydraulic shock absorbers are provided for sudden shut-offs and static neutralizing devices are sued for phenols and molten sulfur. Heat arcing and insulation are provided for molten sulfur at 300 °F. Vapor lines are provided from the tank truck and tank car loading racks in accordance with the vapor recovery system concept.

The loading nozzles have connections for bleeders and drains. Hand-operated block valves are provided just upstream of the loading nozzles and are accessible from the platforms. Connections for nitrogen purge are provided at the loading nozzles for products for which this is necessary.

Tabl 20.1
Truck & Tank Loading Facilities

PRODUCTS	OPERATING °F	LOADING (PSIG)	PUMP CAPACITY (GPM)
Propane (non-refrigerated)	100 °	288	2000
Butane (non-refrigerated)	100 °	150	2000
Anhydrous Ammonia (non-refrigerated)	100 °	272	2000
Phenols	100 °	80	660
Molten Sulfur	300 °	76	1000

Instrumentation

The following instrumentation is provided at each loading nozzle location:

1) Automatic excess flow shut-off control valves for emergency shut-down in case of a broken hose in the loading nozzles for all products.

2) Positive displacement meters with totalizers are provided for each product.

3) Digital counters with automatic printout are installed at the loading location.

4) Instrument air is provided at the loading racks.

Loading Platforms

These consist of structural steel, grating and handrailing. Swinging catwalks with counterweights are used for each loading bay for operator accessibility.

Tank Car Platform

The products are piped to three loading bays. The loading platform is 340 feet long, 4 feet wide and 12 feet in height. Stairs are provided at the two ends of the platform and on the sides.

Tank Truck Loading Platform

The dimensions of this platform are 10'X 8'X 10' with a 20 foot roof covering the loading area and one set of stairs, and a catwalk on either side.

Tank Truck Scale

A truck scale is provided for weighing both empty and loaded trucks.

Railroad Spur

A railroad system is provided for loading rail tank cars.

Capacity of tank cars	30,000 gallons
Capacity of tank trucks	10,000 gallons
Loading time	15 minutes
Ambient temperature	100 °F

PRODUCTS

1) Propane
2) Mixed Butanes
3) Ammonia
4) Phenol
5) Molten Sulfur

Loading Arrangement

The following factors are of primary importance:

Butane will be shipped only in dedicated tank cars

Propane, ammonia, and liquid sulfur will be filled in tank cars and/or dedicated tank trucks.

- Phenol will be filled in non-dedicated tank trucks.

Loading Bays

Based on the filling time required for tank cars/trucks, time required for completing documentation, line-up and position of tank cars/trucks, inclement weather, it is proposed to have:

> Three Loading Bays for tank trucks each with 2 filling positions. One bay will be dedicated to Propane (located at a safe distance from any source of flame or sparks), one for Liquid Sulfur, and one for both Ammonia and Phenol.
>
> Six Loading Bays for tank cars, each with one filling position. All bays are capable of filling all products.

Tank Truck Scale

A truck scale is provided for weighing empty and loaded trucks. The products, in general, are loaded per the level marker provided in tank cars and by set stop meters for tank cars. All trucks are weighed in and out. A sump pump is provided in the weighing pit to remove rain and cleaning water.

Sprinkler

A sprinkler fire water system is provided for the tank truck loading rack. The system is automatically energized in case of fire, covering the entire loading rack area with water at a minimum density of 0.25 GPM/ft^2.

Fire Hydrants and Extinguishers

Fire Hydrants and monitor are provided for the tank car loading rack in lieu of a deluge system. Portable day chemical fire extinguishes are also provided, at least at two locations for the tank truck loading rack and at fire places for the tank car loading tank.

Spill Clean-up

The loading area is paved and sloped towards the effluent drainage system. Utility steam and water provided in the rack are used for clean-up purposes.

Communication System

Communication systems are provided at both the Tank Car and Tank Truck locations and tied to the plant system. These include:

- Telephone System
- Portable Radios
- Portable Telephones

20.2 Major Equipment Summary

The major equipment summary for this plant is shown in Table 20.1.

20.3 Utility Summary

Connected Load = 226 KW, Actual Load = 90 KW (intermittent)
Electricity = 460 V, 3 phase, 60 Hz (27 KW)
Water = 50 GPM (For Cleaning) (intermittent)
Steam, Utility = 1000 lbs/hr (for cleaning)
Nitrogen, Utility = 50,000 SCFH (for purging)

Because these consumptions are small and intermittent, they are not reported in the utility summary (Table 4.1, p 4-3).

Table 20.1

Major Equipment Summary

EQUIPMENT LIST	EQUIPMENT DESCRIPTION	DESIGN CRITERIA	NUMBER
23M-101A	Tank Truck Loading Platform, structural steel construction	Per Attachment 1	3 sets
23M-101B	Tank Car Loading Platform, structural steel construction	Per Attachment 2	1 set
23L-101	Pipeline, valves and loading arms for transporting finished products form storage tanks to tank cars/tank trucks	Per Table 1	1 set
23J-101	Positive displacement flow meters with digital counters and printout capacity	Per Table 1	1 set
23K-101	A & B Butane vapor recovery compressor, CS construction	500 ACFM, suction pressure 55 PSIA, discharge pressure 75 PSIA	1 + 1 sets
3K-101A & B	Propane vapor recovery compressor, CS construction	500 ACFM, suction pressure 216 PSIA, discharge pressure 265 PSIA	1 + 1 sets

EQUIPMENT LIST	EQUIPMENT DESCRIPTION	DESIGN CRITERIA	NUMBER
23K-101A & B	Ammonia vapor recovery compressor, CS construction	500 ACFM, suction pressure 205 PSIA, discharge pressure 224 PSIA	1 + 1 sets
23K-104A & B	Molten Sulfur vapor recovery compressor, CS construction	500 ACFM, suction pressure 15 PSIA, discharge pressure 25 PSIA	1 + 1 sets
23V-101	Tank truck weigh scale with recording devices and automatic printout.	Suitable for weight of tank truck & 500 metric tons produced	1 set
23G-101	Sump Pump for weigh scale pit, CS	25 GPM, 5 HP, 3000 RPM	1 set
23V-102	Sprinkler fire system complete with alarms, sensors, energizers, & all instrumentation	water density minimum 0-25 GPM/ft^2	1 set
23V-103	Fire Hydrant System complete with approved hoses and nozzles		
23V-104	Communication system consisting of telephones (fixed & portable) and walkie talkies	6 sets	1 set

21. PLANT 24

21. Plant 24 (C al Refuse and Ash Disposal)

21. Design Basis, Criteria and Considerations

This plant is for the disposal of coal refuse from Coal Cleaning and Preparation (Plant 1) and ash or slag from the Hydrogen Production by Coal Gasification (Plant 9).

The coal refuse consists of fine and coarse material which requires separate methods of disposal. The coarse coal refuse and ash are conveyed to the coal mine via conveyor belt for disposal in land reclaimation.

The fine coal refuse material is piped as a coal-water slurry to a settling basin. The bottom of the settling basin is scraped continuously to move the fine refuse slurry to the basin shores. From the basin shores, bulldozers spread the material for air drying. After the spread material is sufficiently dry to have the consistency of a filter cake, bulldozers load the material onto the conveyor for transferral back to the mine.

The coarse coal refuse and ash are transported back to the coal mine via conveyor belt for disposal as land reclamation. The fine coal refuse is piped to a settling basin. The bottom of the settling basin is scraped continuously to move the fine refuse slurry to the basin shores. From the basin shores, bulldozers spread the material over 30 acres of land for air drying. This area of land provides up to 30 days of fine refuse storage to a maximum refuse depth of 1 ft. After the spread material is sufficiently dewatered to have the consistency of a filter cake, bulldozers load the material onto the conveyor for transferral to the mine.

21.1 Plant Description

Conveyor belt (24-T101) is provided for transferring coarse coal refuse from Coal Cleaning and Preparation (Plant 1), ash or slag from Hydrogen Production by Coal Gasification (Plant 9) back to the mine site.

The fine coal refuse material is piped as a slurry to the settling basin. The basin scraper (24-T104) operates continuously to move the fine refuse slurry material to the shores of the basin. From the basin shores, bulldozers (24-T103A and B) spread the wet material over 30 acres of land for air drying. Material which is sufficiently dewatered to have the characteristics of a vacuum filter cake, is loaded by the bulldozers onto the conveyor belt (24-T101) for transferral to the mine as land reclamation.

21.2 Major Equipment List

The major equipment list for this plant is shown in Table 21.1 below.

Table 21.1
EQUIPMENT LIST

Equipment No.	Type	Size or Capacity
24-T101	Refuse conveyor belt	8500 TPD
24-T103A,B	Bulldozer	480 yd^3/hr
24-T104	Settling Basin Scraper	1545 tons solid/day

21.3 Utility Summary

Utility requirements for processing Plant 1 coal refuse are included with the Plant 1 utility balance and are therefore not repeated here. The requirements summarized below are for Plant 9 coal ash disposal only.

Electricity, kW

Condition	Consumed
Operating	100

22. PLANT 25

22. Plant 25 (Catalyst and Chemical Handling)

22.0 Design Basis, Criteria and Considerations

This plant provides storage and handling for catalysts and chemicals used in all the plants. Additionally, it provides a consolidated location for tracking catalyst and chemical start-up and daily consumption requirements.

Plants requiring chemicals or catalysts include 2 (Coal Liquefaction), 3 (Gas Plant Separation), 4 (Naphtha Hydrotreater), 5 (Gas Oil Hydrotreater), 6 (Hydrogen Purification), 8 (Rose Solvent Recovery), 9 (Hydrogen Production via Coal Gasification), 11 (By-Product Sulfur Recovery), 32 (Raw, Cooling, and Service Water), 38 (Ammonia Removal), and 39 (Phenol Removal).

The equipment for this plant includes an enclosed warehouse for storing chemicals and catalysts and forklifts for transporting pallets of chemicals or catalysts into or out of the warehouse.

A warehouse is required to collect all chemicals into one area for distribution to the various plants as needed. Additionally, the warehouse is used as a temporary storage for spent catalyst that must be returned to the catalyst vendor for regeneration at the vendor's facilities.

This plant identifies all major plant catalyst and chemical requirements for startup and continuous operation.

22.1 Plant Description

A 6000 square foot chemical and catalyst warehouse (25-R101) is provided for temporary storage of chemicals. Electric forklifts (25-T101A and B) are provided for transporting pallets of chemicals or catalysts into or out of the warehouse.

22.2 Major Equipment List

Equipment No.	Type	Description
25-R101	Chemical & Catalyst Warehouse	100 ft. x 60 ft.
25-T101A,B	Forklift	Electric Motor, 25 hp

22.3 Utility Summary

Electricity = 50 kW

22.4 Chemical and Catalyst Summary

Plant 25 provides storage and handling for chemicals and catalysts used in all the plants. Table 22.1 below summarizes the start-up and consumption rates for the various chemicals or catalysts.

TABLE 22.1

Chemical or Catalyst	For Plant No.	Quantity Required for Start-Up	Consumption
Amocat-1C, 1-1/2" Extrudate	2	2,253,000 lb	68,130 lb/day
MEA	3	100 bbl	20 gal/day
Catalyst	4	80,000 lb	3 year life
Catalyst	5	490,000 lb	3 year life
MEA	6	1,200 bbl	30 gal/day
Rose Solvent	8	10,000 bbl	300 gal/day
BASF K8-11 or Haldor Topsoe SSK Catalyst	9	19,000 ft^3	3 year life
2" SS Pall Ring Packing	9	3,400 ft^3	3 year life
2" CS Pall Ring Packing	9	4,300 ft^3	3 year life
Methanol	9	2,500 bbl	200 gal/day
Claus Catalyst Kaiser S-201	11	18,400 ft^3	5 year life
SCOT Catalyst	11	6,500 ft^3	5 year life
2" SS Pall Ring Packing	11	2,500 ft^3	3 year life
MDEA	11	500 bbl50 gal/day	

Table 22.1 - continued

Chemical or Catalyst	For Plant No.	Quantity Required for Start-Up	Consumpti n
30% Ammonia	31	7,000 lbs	936 lb/day
Sodium Sulfite	31	2,000 lbs	240 lb/day
Polymer & Chelant	31	1,000 lbs	144 lb/day
Disodium Phosphate	31	1,000 lbs	144 lb/day
Alum	32	30,000 lbs	4,680 lb/day
Polymer	32	2,000 lbs	156 lb/day
98% H_2SO_4	32	15,000 gals	15,680 lb/day
50% NaOH	32	30,000 gals	38,754 lb/day
Polymeric Dispersion Non-ionic Surfactant	32	7,000 lbs	1,624 lb/day
Chlorine	34	2000 lbs	350 lbs/day
Polymer	34	3000 lbs	450 lbs/day
Pac	34	6000 lbs	2,000 lbs/day
Phosphoric Acid as 100% H_3PO_4	38	11,0331 lb	3,460 lb/day
Dephenoliz-ation Solvent	39	7,912 lb	170 lb/day

23. PLANT 30

23. Plant 30 (Electrical Distribution System)

23.0 Design Basis, Criteria and Considerations

Utility power is supplied by the Steam and Power Generating Plant (Plant 31) at 69 kV to six main switch gear centers.

The electrical generation is supplied by:

- Five trains of combustion turbine generators (CTG) and heat recovery steam generators (HRSG), approximately 410,000 kW total
- Two steam turbine-generator sets (STG), approximately 260,000 kW total
- One 2,500 MVA "Black Start" Diesel Generator

The output from the electrical generating plant (Plant 31) is transformed in the switchyard from 13.8 kV to 69 kV for transmission to the six main substations.

The following table shows the plant loading for the six main substations:

Substation	Plant Loads
Substation 1	Plant No. 9
Substation 2	Plant No. 10 (partial)
Substation 3	Plant No. 10 (partial)
Substation 4	Plants No. 3, 4, 5, 6, 11, 34, 36, 38, and 39
Substation 5	Plants No. 1, 1.4, 8, 24, 32, 41, and 42
Substation 6	Plants No. 2, 19, 20, 25, 33, and 37

All distribution from the substations is expected to be underground duct banks and/or direct-buried cables. However, during detailed design, if required, an overhead distribution system may be adapted.

23.1 Plant Description

Electrical output from the five gas turbines and two steam turbines are transformed from 13.8 to 69 kV and tied together by Bus 1 and Bus 2 for distribution to the six substations.

The black start diesel generator is provided for initial startup of Plant 31 and at least two Plant 32 cooling water pumps to guarantee providing cooling water to Plant 31. It is connected to both 69 kV buses to be able to start any one of the five gas turbines.

Each substation consists of two main power transformers and secondary distribution switchgear. One transformer is fed from Bus 1 and the other from Bus 2. Each transformer is capable of the total secondary load. Normally open, tie-breakers connect each dual bus section to maintain services upon loss of either Bus 1 or 2 or loss of either transformer.

Transformer ratings are adjusted to minimize the number of ratings and to provide adequate capacity for growth.

The distribution of the loads on the individual plant switchgears will be such that, when there is more than one drive for the same service, the load is connected to utility source A and the other half to utility source B with standby units also split between the sources. This minimizes the effect of failure of one source.

Table 23.1 attached, lists by individual plant, the expected electrical distribution on a stream day basis. This indicates Plant 31 has an excess capacity of 9.9 percent with all equipment operating at design. On average, however, Plant 31 has a 30 percent contingency.

23.2 On Lin Diagram

The one line diagram for the baseline coal liquefaction complex is given in Figure 23.1.

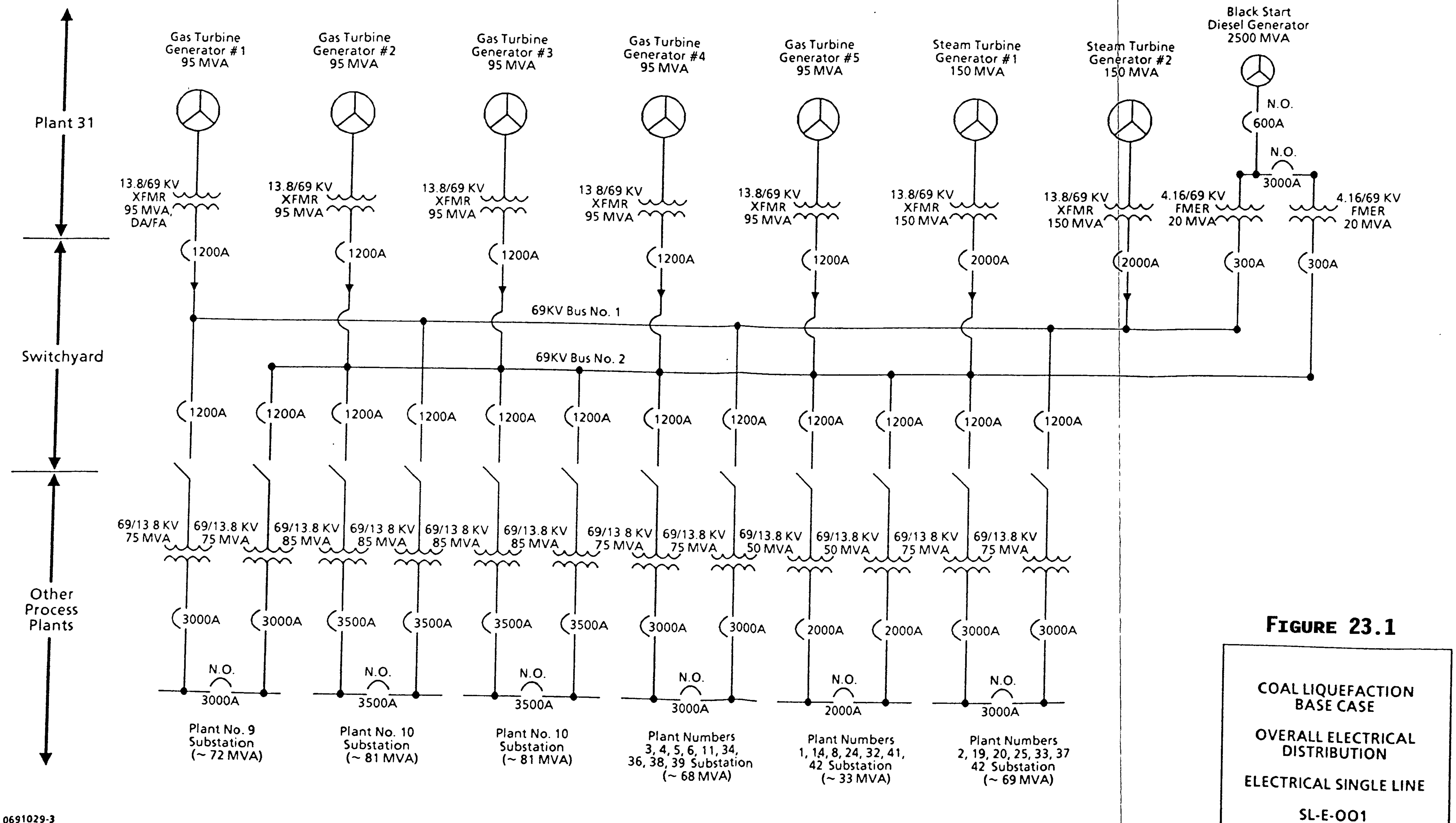


FIGURE 23.1

COAL LIQUEFACTION BASE CASE

OVERALL ELECTRICAL DISTRIBUTION

ELECTRICAL SINGLE LINE

SL-E-001

Table 23.1

OVERALL ELECTRICAL POWER DISTRIBUTION PLANT, PLANT 30 — 04-Dec-91
BASE CASE, NORMAL OPERATION — 07:29 AM

PLANT NAME	PLANT NO.	Consumption KW	Distribution Loss 3%	TOTAL KW
Coal Cleaning/Preparation	1	8,048	241	8,289
Coal Drying and Pulverizing	14	11,761	353	12,114
Coal Liquefaction	2	57,270	1,718	58,988
Gas Plant	3	886	27	913
Naphtha Hydrotreater	4	1,042	31	1,073
Gas Oil Hydrotreater	5	2,116	63	2,179
Hydrogen Purification	6	42,664	1,280	43,944
Solids/Liquids Sep. Rose	8	4,236	127	4,363
H2 Production (Syn Gas)	9	61,369	1,841	63,210
Air Separation	10	155,334	4,660	159,994
Sulfur Recovery	11	2,973	89	3,062
Relief and Blowdown	19	18	1	19
Raw Mat'l & Product Stor.	20	6,561	197	6,758
Steam & Power Generation	31	12,206	366	12,572
Raw,Cooling & Potable H2O	32	13,254	398	13,652
Fire Protection System	33	43	1	44
Waste Water Treatment Syst.	34	7,100	213	7,313
Instrument And Plant Air Syste	35	2,810	84	2,894
Purge and Flush Oil System	36	250	8	258
Solid Waste Disposal	37	47	1	48
Phosam-W Ammonia Removal	38	1,486	45	1,531
Phenol Removal	39	790	24	814
Buildings	41	2,616	78	2,694
Telecommunications Systems	42	13	0	13
Overall Plant Lighting	ALL	2,066	62	2,128
Total		396,958	11,909	408,867
Contingency %				5.71
Steam & Power Gen.(REQ'D)	31			432,206
Steam & Power Gen.(NET)	31			420,000

Assumptions:				
Distribution loss =				
Annual production on stream factor =				3.0%
Annual utility consumption factor =				76.0%
Average annual rate =				84.4%
	408,867	X	84.4%	345,265

TRASFORMER REQUIREMENTS (Estimated)	
110 Voltages, MW	5
460 Voltages, MW	70
4160 Voltages, MW	315
13.8KV Voltages, MW	30
TOTAL	420

23.3 Major Equipm nt List

Due to the nature of this plant, an equipment list is not required as the size and cost will be directly based on the one line diagram.

24. PLANT 31

24. Plant 31 (St am and Pow r Generation)

24.0 Design Basis Criteria and Considerations

The cogeneration plant supplies electric power and 600 psig, 720°F superheated steam to all plants. The cogeneration plant provides self sufficient, sole source of power to the complex. Since the power plant is not connected to any grid, Plant 31 has extra installed generating capacity to ensure 100 percent reliability.

A diesel fired generator, 2500 MVA, is used when making a black start. This generator supplies enough emergency electricity to start up a combustion turbine generator and allow the plant to "boot strap" itself up to capacity.

The important design criteria are summarized as follows:

- Primary steam header is 600 psig, 720°F superheated steam
- Five, 84,000 kW (ISO rated) combustion turbine generators
- Five, three pressure level heat recovery steam generators rated at 181,083 pounds per hour high pressure superheated steam (1355 psia, 906°F), and 198,691 pounds per hour intermediate pressure superheated steam (144 psia, 450°F)
- Two extraction, admission, and condensing steam turbine generators rated at 130,000 kW at 1,315 psia, 900°F throttle conditions and 3.5 inch HgA back pressure
- An AC synchronous totally enclosed, water-to-air cooled (TEWAC) generator, rated at 150 MVA and 0.85 power factor for each steam turbine
- An AC synchronous TEWAC generator, rated at 95 MVA and 0.85 power factor for each combustion turbine
- Natural gas is blended with medium BTU gas for the combustion turbines
- Steam output from the plant is 560,000 pounds per hour superheated steam at 600 psig, 720° F.
- Electrical output from the plant is 420,000 kW net

- Backup fuel is No. 2 fuel oil (heavy distillate from the complex)
- Generators produce electric power at 13.8 Kv, 3 phase, 60 Hz
- Distribution of electric power from the generators to the main switch-gear centers is 69Kv, 3 phase, 60 Hz

24.1 Process Description and Process Flow Diagram

Power Generation

Plant No. 31 is a cogeneration power plant. The plant provides both thermal and electrical energies to the process plants. Included in this cogeneration plant are five trains of combustion turbine generators (CTG), heat recovery steam generators (HRSG), and two steam turbine-generator sets (STG) among other major components.

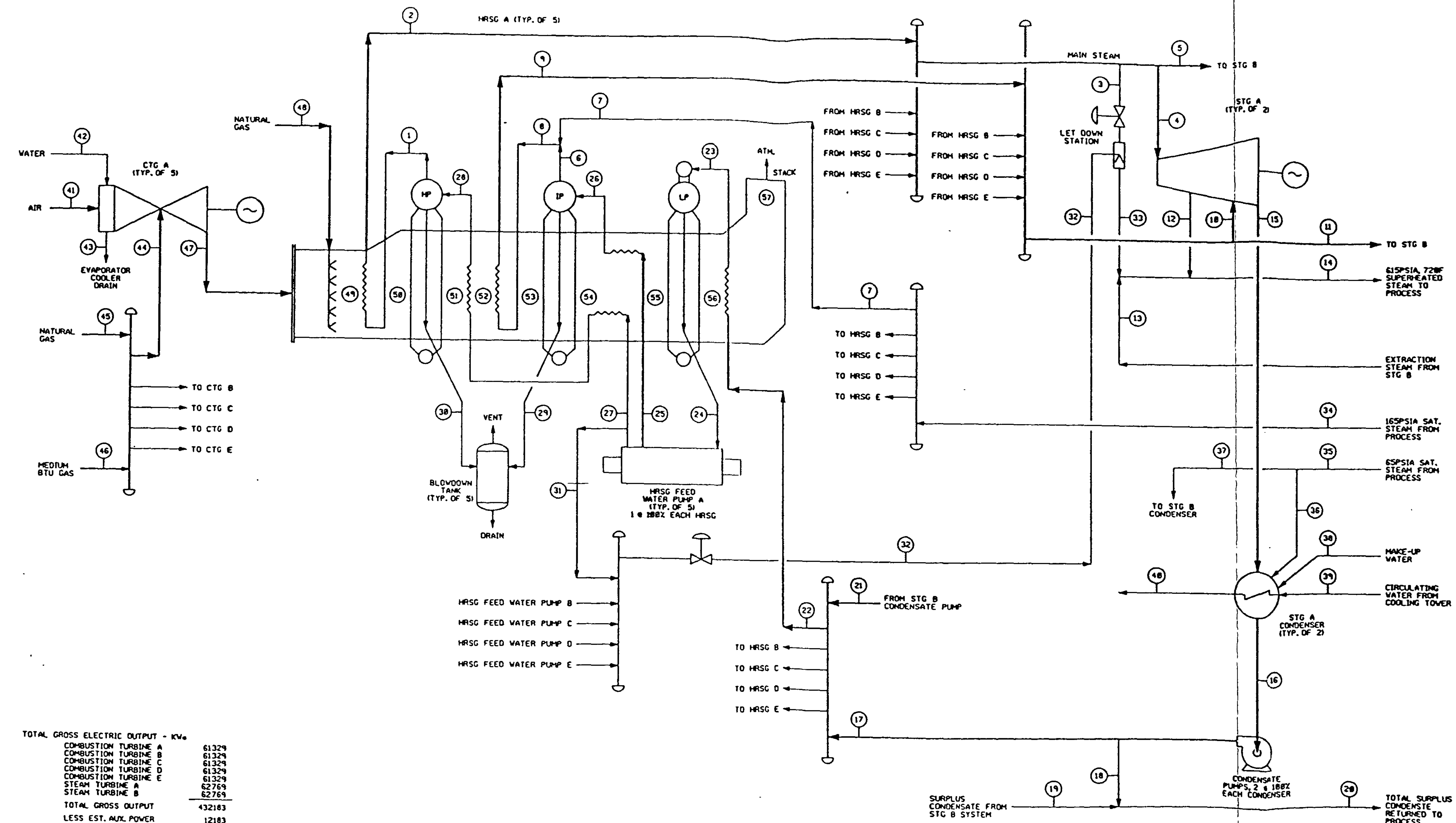
Each train consists of a G.E. PG7111EA combustion turbine, an HRSG, an HRSG feed water pump, and all necessary associated auxiliary equipment. Other major components are two steam turbine generators and two steam surface condensers. The plant Process Flow Diagram (PFD) is shown on Figure 24.1 (drawing 31-D-B-1). The stream conditions and energy balance of the PFD are also shown on this PFD. A dump condenser is provided to receive steam when steam turbines are off the line. Two full size spare feed water pumps are also provided for the five CTG/HRSG trains.

Each combustion turbine is rated at 84,000 kW at ISO conditions when fueled with natural gas. The turbine is equipped with dry NOx combustors to achieve 25 parts per million volumetric dry at 15% O_2 (ppmvd) NOx emission level. No steam injection is required. Turbine peak rating is 79,626 kW at 95°F ambient. The corresponding exhaust temperature is 1075°F.

A three-pressure level HRSG is utilized. The lowest pressure level is an integral deaerating/low pressure (LP) module. The five HRSG, are each capable of producing 181,083 pounds per hour high pressure (HP) superheated steam (1355 psia, 906°F) and 198,691 pounds per hour intermediate pressure (IP) superheated steam (144 psia, 450°F) when the hot gas flow is 2,077,920 pounds per hour and 936°F.

About 500,000 pounds per hour 150 psig saturated steam is provided from the process plants. This steam, along with the intermediate pressure steam produced by the HRSG, is superheated in the IP superheater module before being admitted into the steam turbine.

The HRSG is also equipped with natural gas fueled duct burners. Steam productions become 565,470 pounds per hour and 169,930 pounds per hour for HP steam and IP steam respectively at the combustion turbine peak, at 95°F ambient. When firing duct burners, the CTG exhaust temperature increases from 1075°F to 1465°F.



NO.	FLOW LB/HR	TEMP. DEG. F	PRESSURE PSIA	ENTHALPY BTU/LB
1	181083	587.3	1395.1	1174.2
2	181083	906.0	1354.5	1438.9
3	0			
4	452707	900.0	1315.0	1436.9
5	452707	900.0	1315.0	1436.9
6	98691	357.6	148.5	1194.8
7	100000	357.6	148.5	1194.8
8	198691	357.6	148.5	1194.8
9	198691	450.0	144.2	1249.2
10	496720	443.7	140.0	1246.2
11	496720	443.7	140.0	1246.2
12	280000	725.0	650.0	1363.4
13	280000	725.0	650.0	1363.4
14	560000	720.0	615.0	1362.5
15	669435	120.5	1.72	994.1
16	944435	120.5		88.4
17	713423	120.5		88.4
18	231012	120.5		88.4
19	231012	120.5		88.4
20	462024	120.5		88.4
21	713423	120.5		88.4
22	205369	120.5	30.7	88.4
23	205369	220.0	29.9	188.1
24	205369	250.0	29.9	218.5
25	100665	250.1	153.0	219.0
26	100665	347.6	148.5	319.6
27	184704	251.2	1480.0	224.0
28	184704	577.3	1395.1	587.5
29	1974	357.6	148.5	330.0
30	3621	587.3	1395.1	599.0
31	0			
32	0			
33	0			
34	500000	366.0	165.0	1195.6
35	550000	298.0	65.0	1179.1
36	275000	298.0	65.0	1179.1
37	275000	298.0	65.0	1179.1
38	0			
39	32366000	87.0		
40	32366000	115.0		
41	2018430	95.0		
42	2470	70.0		
43	500	70.0		
44	56000	70.0	315.0	
45	132725	70.0	315.0	
46	151275	70.0		
47	2077200	914.0		
48	720	70.0		
49	2077920	936.0		
50	2077920	853.5		
51	2077920	667.3		
52	2077920	584.0		
53	2077920	564.6		
54	2077920	407.6		
55	2077920	351.3		
56	2077920	335.3		
57	2077920	281.0		

NOTE:
ONE COMBUSTION TURBINE/HRSG SHOWN, TYPICAL OF 5, AND ONE STEAM TURBINE/CONDENSER SHOWN, TYPICAL OF 2.

TOTAL GROSS ELECTRIC OUTPUT - KWe

COMBUSTION TURBINE A	61329
COMBUSTION TURBINE B	61329
COMBUSTION TURBINE C	61329
COMBUSTION TURBINE D	61329
COMBUSTION TURBINE E	61329
STEAM TURBINE A	62769
STEAM TURBINE B	62769
TOTAL GROSS OUTPUT	432183
LESS EST. AUX. POWER	12183
NET PLANT OUTPUT	420000

NATURAL GAS ENERGY INPUT - MMBTU/HR (HHV)

COMBUSTION TURBINE A	633.94
COMBUSTION TURBINE B	633.94
COMBUSTION TURBINE C	633.94
COMBUSTION TURBINE D	633.94
COMBUSTION TURBINE E	633.94
HRSG A DUCT BURNER	17.20
HRSG B DUCT BURNER	17.20
HRSG C DUCT BURNER	17.20
HRSG D DUCT BURNER	17.20
HRSG E DUCT BURNER	17.20

MEDIUM BTU GAS ENERGY INPUT - MMBTU/HR (HHV)

COMBUSTION TURBINE A	121.02
COMBUSTION TURBINE B	121.02
COMBUSTION TURBINE C	121.02
COMBUSTION TURBINE D	121.02
COMBUSTION TURBINE E	121.02
TOTAL ENERGY INPUT	3860.00

NET PLANT HEAT RATE = 9192 BTU/KWHR (HHV)

22 x 34 'D' SIZE

FIGURE 24.1

NO.	DATE	REVISIONS	BY	CHKD	DESIGN SUPV	ENGR	PROJ ENGR	APPR
B	5/29/91	REVISED FOR STEAM FLOW						
A	5/3/91	ISSUED FOR REVIEW						

SCALE: NONE | DRAWN BY: VHY | DESIGNED | CHIEF ENGR

DOE/PETC COAL LIQUEFACTION
(BASE CASE)

BECHTEL POWER CORPORATION
HOUSTON, TEXAS

STEAM AND POWER GENERATION
HEAT BALANCE, 95°F AMBIENT
FLOW DIAGRAM

JOB NO.	DRAWING NO.	REV.
20952	31-D-8-1	B
DOE/PETC	NOT FOR CONSTRUCTION	

CADD FILE NO.: 31D81.DGN VHY 05/29/91

DOE8D.DGN

Two extraction, admission, and condensing steam turbines are provided. Each steam turbine is rated at 130,000 kW at 1315 psia, 900°F throttle conditions and 3.5 inch HgA back pressure. At a controlled extraction stage, 280,000 pounds per hour steam at 650 psia and 725°F is extracted from each turbine and exported to the process plants where it is desuperheated for process use.

Intermediate pressure steam at 140 psia and 444°F is admitted to the steam turbine low pressure section for more power generation. Steam, after expansion, is condensed in a water cooled surface condenser for re-use in the cycle.

Condensate from the condenser hotwell is then pumped to the low pressure economizer (LP) section of the HRSG where it is heated to 220°F. From there, the feed water enters the deaerating/LP section of the HRSG, thus completing the steam/water cycle. The flow of 550,000 pounds per hour of 50 psig saturated steam from the process plants is dumped into the condensers if it is of condensate quality. Surplus condensate of 462,024 pounds per hour is returned to the process plants.

A heat rejection system consists of water cooled condensers, circulating water pumps, and the cooling tower. Each condenser has a heat duty of 906 MMBtu/hr during normal operation. Circulating water flow to the condenser is 65,000 gpm. The cooling tower is designed for 87°F inlet water and 28°F range. While physically located in Plant 32, the tower has ten cells dedicated to the Steam and Power Generation plant.

An AC synchronous generator rated at 150 MVA and 0.85 power factor for each steam turbine is provided. The generator is a totally enclosed, water-to-air cooled (TEWAC) design. Five additional TEWAC generators, each rated at 95 MVA and 0.85 power factor, are coupled to the combustion turbines. Cooling water supply is 90°F for all above stated generator ratings.

Pipeline quality natural gas is the primary fuel for plant No. 31. The natural gas is blended with medium BTU gas for the combustion turbines. The medium BTU gas is assumed to have a low heating value of 259 Btu/scf. Natural gas pressure is assumed sufficiently high enough (approximately 300-400 psig) to be fed into the combustion turbines. This eliminates the need of gas compressors. HRSG duct burners, on the other hand, can operate under lower gas pressure.

The plant also utilizes No. 2 fuel oil (heavy distillate from the gas oil hydrotreater) as a back-up fuel. The fuel oil handling system consists of unloading pumps, day tanks, forwarding pumps and purifying equipment.

Steam Distribution

The four distribution systems discussed in the following paragraphs are:

- 600 psig, 720°F steam system
- 600 psig saturated steam system
- 150 psig saturated steam system
- 50 psig saturated steam system

Safety valves are installed to prevent over-pressuring of the steam headers. The steam piping systems are drained to the atmospheric blowoff tanks during startup and normal operation.

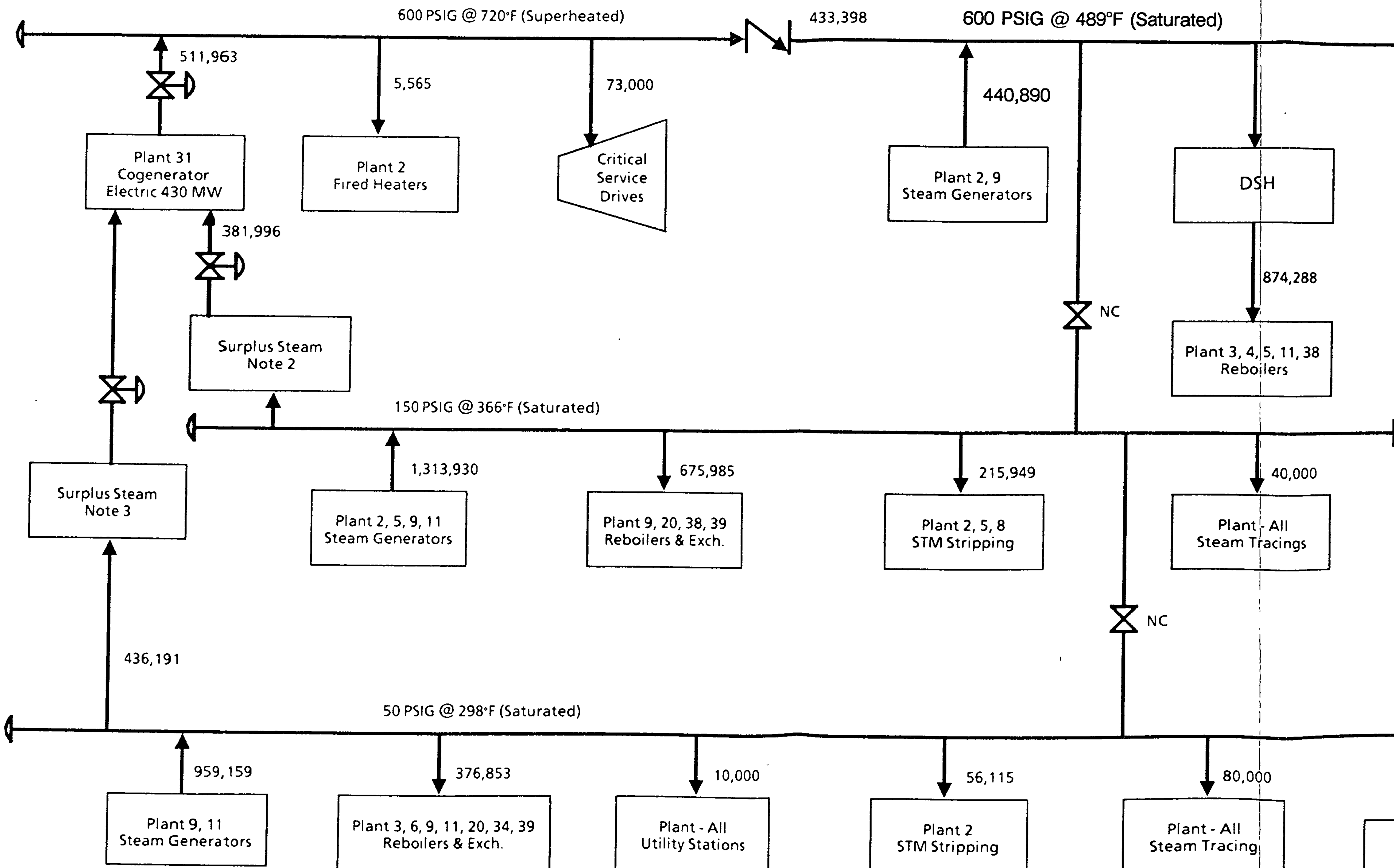
The overall steam distribution and balance for this plant is shown on Figure 24.2 (Flow Diagram 31-D-B-2).

600 psig, 720°F Steam System. This system supplies superheated steam to all the process plants in the complex. Each process plant is equipped with a desuperheater at its battery limits to ensure high quality steam throughout the complex.

600 psig Saturated Steam System. This system operates at saturated or slightly above saturated conditions. The overall steam balance, shown in Table 24.1, indicates the two 600 psig systems are in balance with the Plant 31 cogenerators and steam generators in Plants 2 and 9 supplying the steam reboilers for the remainder of the complex. The 150 psig steam system header is maintained with 600 psig steam via a letdown station.

150 psig Saturated Steam System. This system also operates at saturated or slightly above saturated conditions. The overall steam balance, shown in Table 24.1, shows an excess of 150 psig steam is generated normally by the steam generating equipment. This is normally returned to the cogeneration plant (Plant 31) where it's useful energy is recovered. This system is also arranged to supply 150 psig steam to control the 50 psig steam header pressure.

50 psig Saturated Steam System. This lowest pressure header operates at a nominal 50 psig with a small amount of superheat. The overall steam balance, shown in Table 24.1, shows an excess of 50 psig steam is generated normally by the steam generating equipment. During normal operation, the 50 psig header supplies steam to the process plant steam users. The excess steam is returned to the Cogeneration plant (Plant 31) and dumped into the water cooled condensers. During optimization, this energy could also be recovered if economical.



Notes:

1. Flows are for normal operation and in lbs./hr.
2. Useful energy is recovered in steam turbines.
3. Steam is dumped into water cooled condensers.

0691029-5

Process Flow Diagram

DOE / PETC
COAL LIQUEFACTION
BASE CASE

OVERALL STEAM FLOW DISTRIBUTION

Figure 24.2

Excess condensate from the complex, is returned to the Cogeneration plant for polishing, to enable its use in generating superheated 1355 psia, 906°F steam.

Plant Operations

Plant No. 31 is not tied to an outside network. It can not receive power from, nor export power to the network. For this reason, Plant 31 has extra installed generating capacity. The plant is capable of providing 420,000 kW to process plants with two generators being removed from the line. This could be one generator on planned maintenance and the other on forced outage.
In light of the above reliability criterion, four operational modes are defined:

Mode 1: Normal operation, all CTG and STG are on line:
Combustion turbines are loaded to about 84% of their rated base load capacity. Steam turbines are 50% loaded. HRSG duct burners will operate as warm-up torches to increase the CTG exhaust temperature in order to produce sufficient steam for steam turbines.

Mode 2: Loss of one CTG and one STG:
Combustion turbines are loaded to about 105% of their rated base load. Steam turbine is at full load. HRSG duct burners are not fired.

Mode 3: Loss of two CTG:
Combustion turbines will have to peak at their maximum firing temperature of 2120°F. Steam turbines are 75% loaded. HRSG duct burners are heavily fired.

Mode 4: Loss of both STG:
All combustion turbines will peak. Since all steam turbines are off the line this will be a simple cycle operation. However, the HRSGs will be utilized to produce process steam. Excess steam, if any, will be dumped into the dump condenser.

Plant Performance:

Plant performance under various operating modes is summarized below:

Mode 1: 5 CTG and 2 STG on line (normal operation)
CTG 84% load, STG 50% load, HRSG modestly fired

Ambient temperature	95° F
Gross output	432,183 kW
Estimated auxiliary load	12,183 kW
Net output	420,000 kW
Natural gas required (HHV)	3,256 MMBtu/hr
Medium BTU gas required (HHV)	605 MMBtu/hr
Net heat rate (HHV)	9,192 Btu/kWhr

Mode 2: 4 CTG and 1 STG on line
CTG 105% load, STG full load, HRSG unfired

Ambient temperature	95° F
Gross output	432,206 kW
Estimated auxiliary load	12,206 kW
Net output	420,000 kW
Natural gas required (HHV)	3,015 MMBtu/hr
Medium BTU gas required (HHV)	605 MMBtu/hr
Net heat rate (HHV)	8,620 Btu/kWhr

Mode 3: 3 CTG and 2 STG on line
CTG peak load, STG 75% load, HRSG fired

Ambient temperature	95° F
Gross output	428,451 kW
Estimated auxiliary load	12,051 kW
Net output	416,400 kW
Natural gas required (HHV)	3,074 MMBtu/hr
Medium BTU gas required (HHV)	605 MMBtu/hr
Net heat rate (HHV)	8,835 Btu/kWhr

Mode 4: 5 CTG on line
CTG peak load, simple cycle

Ambient temperature	95° F
Gross output	398,129 kW
Estimated auxilliary load	2,166Kw
Net output	396,013 kW
Natural gas required (HHV)	4,093 MMBtu/hr
Medium BTU gas required (HHV)	605 MMBtu/hr
Net heat rate (HHV)	11,864 Btu/kWhr

Steam outputs will be maintained in all above operating modes. However, net electrical output becomes 416,400 kW and 396,013 kW when operating in modes 3 and 4, assuming 2.8% auxiliary power.

24.2 Material Balance

The material balance for the plant is presented in Table 24.1.

Table 24.1

OVERALL STEAM BALANCE
PLANT 31
STEAM AND POWER GENERATION PLANT

DESCRIPTION PLANT NAME	PLANT NO.	STEAM PRODUCED lbs/hr	STEAM CONSUMED lbs/hr	CONDENSATE PRODUCED lbs/hr	COND.(BFW) CONSUMED lbs/hr
600 PSIG @720°F (sup)					
Steam & Power	31	511,963	0	0	511,963
Coal Liquefaction(1)	2	0	5,565	0	0
All Turbine Drives	ALL	0	73,000	73,000	0
Sub Total		511,963	78,565	73,000	511,963
Letdown 600(sup)/600 (3)		433,398			
600 PSIG @489°F (sat)					
Coal Liquefaction	2	149,090	0	0	149,090
Gas Plant	3	0	396,610	396,610	0
Naphtha Hydrotreater	4	0	26,622	26,622	0
Gas Oil Hydrotreater	5	0	65,048	65,048	0
Hydrogen Production	9	291,800	0	0	291,800
Sulfur Recovery	11	0	59,956	59,956	0
Phosam-W Ammonia Removal	38	0	326,052	326,052	0
Sub Total		440,890	874,288	874,288	440,890
150 PSIG @366°F(sat)					
Letdown 600/150					
Coal Liquefaction (1)	2	275,625	185,530	0	275,625
Gas Oil Hydrotreater(1)	5	38,864	5,000	0	38,864
Rose SR (1)	8	0	25,419	0	0
Hydrogen Production	9	812,900	50,000	50,000	812,900
Sulfur Recovery	11	186,541	0	0	186,541
Tanks warmup	20	0	22,000	22,000	0
Phosam-W Ammonia Removal	38	0	581,269	581,269	0
Phenol Removal	39	0	22,716	22,716	0
Stm Tracing	ALL	0	40,000	40,000	0
Sub Total		1,313,930	931,934	715,985	1,313,930
Surplus Stm to plt 31	31	381,996			
50 PSIG, 298°F(sat)					
Letdown 150/50					
Coal Liquefaction(1)	2	0	56,115	0	0
Gas Plant	3	0	17,186	17,186	0
Hydrogen Purification(1)	6	0	59,473	59,473	0
Hydrogen Production	9	894,300	113,000	113,000	894,300
Sulfur Recovery	11	64,859	119,327	119,327	64,859
Tanks warmup	20	0	3,300	3,300	0
Waste Water Treatment	34	0	3,000	3,000	0
Phenol Removal	39	0	61,567	61,567	0
Stm Tracing	ALL	0	80,000	80,000	0
Utility Stations (1)	ALL	0	10,000	0	0
Sub Total		959,159	522,968	456,853	959,159
Surplus Stm to plt 31	31	436,191			
Grand Total		3,225,942	2,407,755	2,120,126	3,225,942
Make-up Water(BFW), LBS/HR (2)					448,926
Mak -up Water(BFW), GPM (2)		(Estimated 592 gpm)			898
Boiler Blowdown 5%		(Estimated 309 gpm)			322
Total Surplus Stm to plt 31					818,187

NOTES:

(1) Used by strippers, vac stm ejectors and/or fire heaters i.e steam lost.

(2) Consists of Condensate Make-up and Blowdown.

Table 24.1 - continu d

OVERALL STEAM BALANCE
PLANT 31
STEAM AND POWER GENERATION PLANT

DESCRIPTION	IMPORTED lbs/hr	GPM	EXPORTED lbs/hr	GPM
CONDENSATE				
600 Psig(sup. Heated)	73,000	146		
600 Psig	874,288	1,747	440,890	881
150 Psig	715,985	1,431	1,313,930	2,626
50 Psig	456,853	913	959,159	1,917
SUB TOTAL CONDENSATE	2,120,126	4,237	2,713,979	5,424
COND. MAKEUP WATER (Demi)	287,629	575		
STEAM				
600 Psig (sup. Heated)			511,963	1,023
150 PSIG STEAM (surplus)	381,996	763		
50 PSIG STEAM (surplus)	436,191	872		
SUBTOTAL STEAM	818,187	1,635	511,963	1,023
TOTAL (Balance)	3,225,942	6,447	3,225,942	6,447

24.3 Major Equipment Summary

The major equipment summary for the plant is included in Table 24.2.

Table 24.2 Major Equipment Summary

· STEAM AND POWER GENERATION

Type of Equipment: Vessels and Tanks

Equipment No.	Equipment Description	Length (T-T in ft.)	Diameter (ID in ft.)	Material	Design Conditions Psig	Design Conditions oF	Remarks Capacity (hrs)	Capacity (gal)	No. of Vessels
31-D101A/B	Fuel Oil Day Tanks	40	50	C.S.	100	100	24	650,000	2
31-D102A/B	Condensate Storage Tank	30	30	C.S.	100	100	24	150,000	2
31-D103	CCW Head Tank	12	6.5	C.S.	150	100	N/A	3,000	1
31-D104	Emergency Diesel Gen. Fue	9	13	C.S.		100	48	8,800	1
31-D105	Fuel Gas Scrubber Tank	4	3	S.S.	0	100	N/A	200	2
31-D106A-E	Inlet Gas Scrubber	8	3	S.S.	500	100	125,000 SCFM		5

Table 24.2 Major Equipment Summary - continued

EQUIPMENT LIST OF PLANT 31 - STEAM AND POWER GENERATION

Type of Equipment: Heat Exchangers

Equipment No.	Equipment Description	Duty (MM Btu/hr)	Type of Exchanger	Tube Material	Tube Desig psig/oF	Shell Material	Shell Desi psig/oF	Area Ft2	No. of Exch.
31-E101A-E	Heat Recovery Steam Generators with Duct Burners and Deaerator	468		S.S.	1500HI 150IP /1500	C.S.	Atm/100	545,000	5
31-E102A/B	Steam Turbine Surface Condensers	1520		S.S.	50/200	C.S.	3.5" Hg/95	91,137	2
31-E103	Turbine Dump Condenser	2550		S.S.	50/200	C.S.	3.5" Hg/95	150,868	1
31-E104A/B	CCW Heat Exchangers	30			150/150				2

Tabl 24.2 Maj r Equipm nt Summary - continued

EQUIPMENT LIST OF PLANT 31 - STEAM AND POWER GENERATION

Type of Equipment: Pumps

Equipment No.	Equipment Description	Flow Rate GPM	Delta Press PSIa	Brake HP	Design Conditions Pres (psig)	Temp (oF)	Driver	Est. Drive HP	No. of Pumps
31-G101A-D	Hotwell Condensate Pumps	3,200	994.4	249	100	200	Elec	300	4
31-G102A-F	HRSG Feed Pumps	690	583.7 58.4	731	1500/150	300	Elec	750	5
31-G103A-D	Circulating Water Pumps	83,820	43.2	2647	50	95	Elec	3000	4
31-G104A/D	Circulating Water Booster Pumps	17,600	34.6	445	85	95	Elec	500	4
31-G105A/B	Closed Cooling Water Pumps	3,000	86.5	189	150	115	Elec	200	2
31-G106A/B	Dump Condenser Condensate pumps	4,120	99.4	321	100	400	Elec	350	2
31-G107A-F	Condenser Vacuum Pumps	25 SCFM		100	1.0" Hg	95	Elec	100	6
32-G108A/B	High Pressure Steam Generator Pumps	700	650.0	371	750	550	Elec	400	2
32-G109A/B	Medium Pressure Steam Generator Pumps	3,200	200.0	522	300	425	Elec	600	2
32-G110A/B	Low Pressure Steam Generator pumps	2,300	100.0	188	150	350	Elec	250	2

Tabl 24.2 Major Equipment Summary - continued

EQUIPMENT LIST OF PLANT 31 - STEAM AND POWER GENERATION

Type of Equipment: Steam and Turbine Generators

Equipment No.	Equipment Description	Design Power MV	Design PSIG HP/IP/LP	Design F HP/IP/LP	Main Stm Flow MLb/hr	Admission STM Flow MLb/hr	Exhaust STM Flow MLb/hr	No. of STM GEN
31-K101A/B	Steam Turbine - Generators	130	1300/125 /-13	900/444 /121	1,002	700	1,252	2

Equipment No. Number	Equipment Description	Design Power MV	Design Air Temp F	Air Flow MLb/hr	Exhaust Temp F	Turbine Exhaust MLb/hr	Turbine Exhaust F	No. of COMB GEN
31-K102A-E	Combustion Turbine - Generators	82	95	2,100	705	2,150	1,075	5
31-K103	Emergency Diesel Generato	2						1

Type of Equipment: Miscellaneous

Equipment No.	Equipment Description	Flow Rate	Other Design Criteria	Design Conditions Pres (psig)	Design Conditions Temp (oF)	Driver	Est. Drive HP	No. of Equip.
31-T101	Turbine Building Bridge Crane		75 tons, Width 65, CS					1

24.4 Utility Summary

Table 24.3 below presents a summary of the utilities required for Plant 31.

Table 24.3

PLANT 31 UTILITY SUMMARY

Steam, lbs/hr, 600 psig, 720°F	
Production	561,963
Consumption	50,000
Net Production	511,963
Demineralized water, gpm	898
Cooling water, gpm circulated	65,667
Fuel Gas, MMSCFD	
Medium Btu gas	90.9
Natural Gas	78.5
Electricity, kW	
Gross Output	432,183
Auxiliary Load	12,183
Net Output	420,000

25. PLANT 32

25. Plant 32 (Raw, Cooling and Potable Wat r)

25.0 Design Basis Criteria and Considerations

Raw Water Treatment

The principal source of raw water for the plant is from the nearby lake or river. The raw water treatment consists of:

- Clarification of water
- Gravity filtration
- Potable water chlorinator
- Demineralization

Clarified water is used for cooling tower makeup, fire fighting and utilities.

A package potable water system is used to treat water used for drinking, food preparation and sanitary facilities. This water has been clarified and filtered.

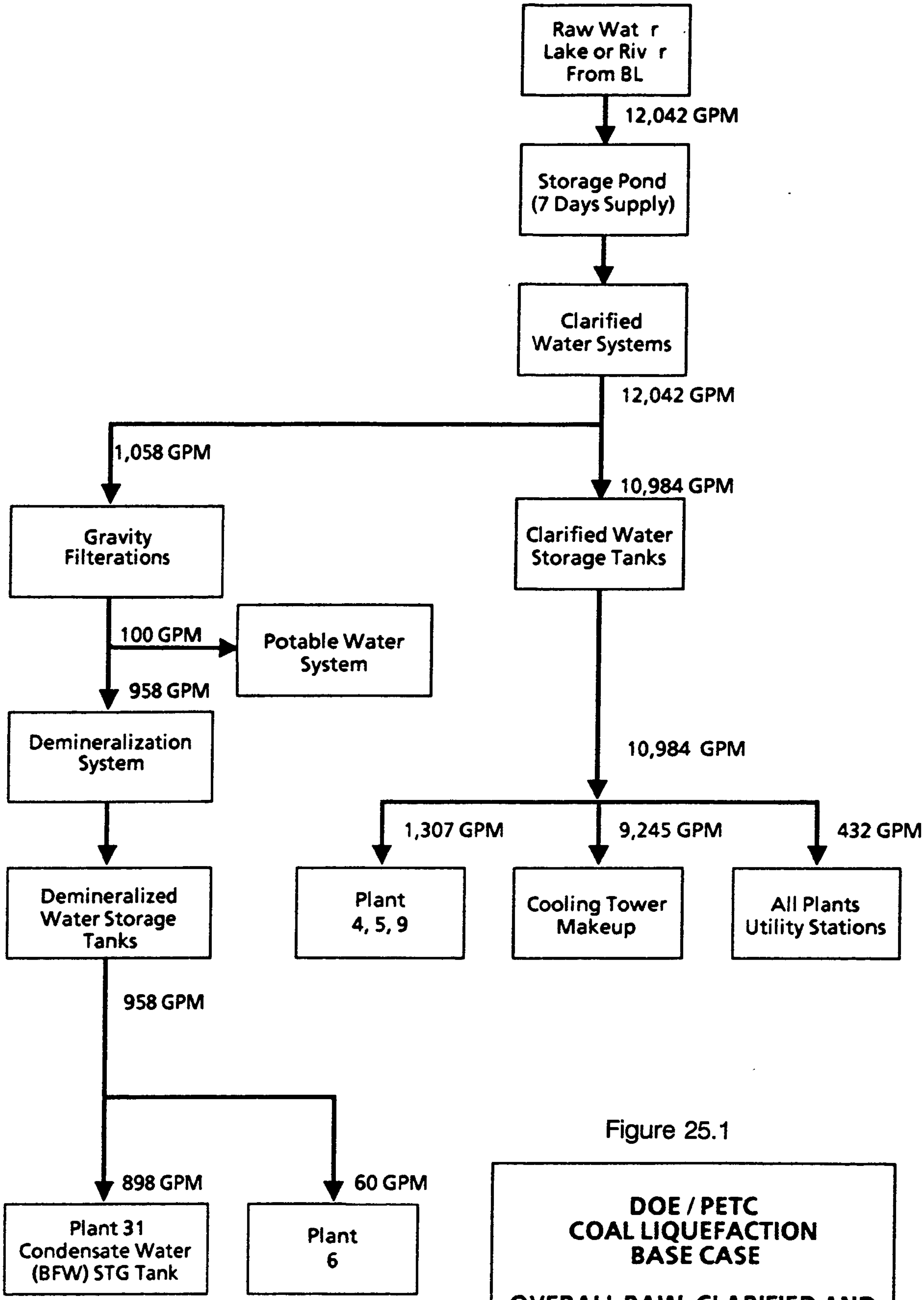
Boiler feed water has been clarified, filtered and demineralized.

Overall flow of raw, clarified and potable water is illustrated on Flow Diagram, Figure 25.1.

The process flow sketch is shown on Flow Diagram, Figure 25.2. The water clarification system is designed to treat approximately 12,000 GPM of raw water. The filtration system is designed for 1,200 GPM, demineralization for 1,100 GPM and potable water for 100 GPM. Normal flow rate through the system will vary between 6,000 to 12,000 GPM depending on the rainfall. Rain runoff from building roofs and uncontaminated areas of the plant as well as treated process wastewaters from Plant 34 will be used to supplement lake or river water.

Reactor/clarifiers are used to clarify the water. These units produce a much thicker sludge than is possible in a conventional clarifier. The thickened sludge can be pumped directly to a sludge dewatering press without the need of a thickener.

Raw water analysis is shown in Table 26.1. For raw water with these given quality (as shown in Table 26.1) conventional cold lime softening and soda ash treatments are not needed to reduce the content of calcium and magnesium as carbonate. Sodium aluminate and a polymer are added to aid settling of the suspended solids. The softened effluent does not require a pH adjustment.



NOTE: Flows are for normal operation.

Figure 25.1

DOE / PETC
COAL LIQUEFACTION
BASE CASE

OVERALL RAW, CLARIFIED AND POTABLE WATER DISTRIBUTION

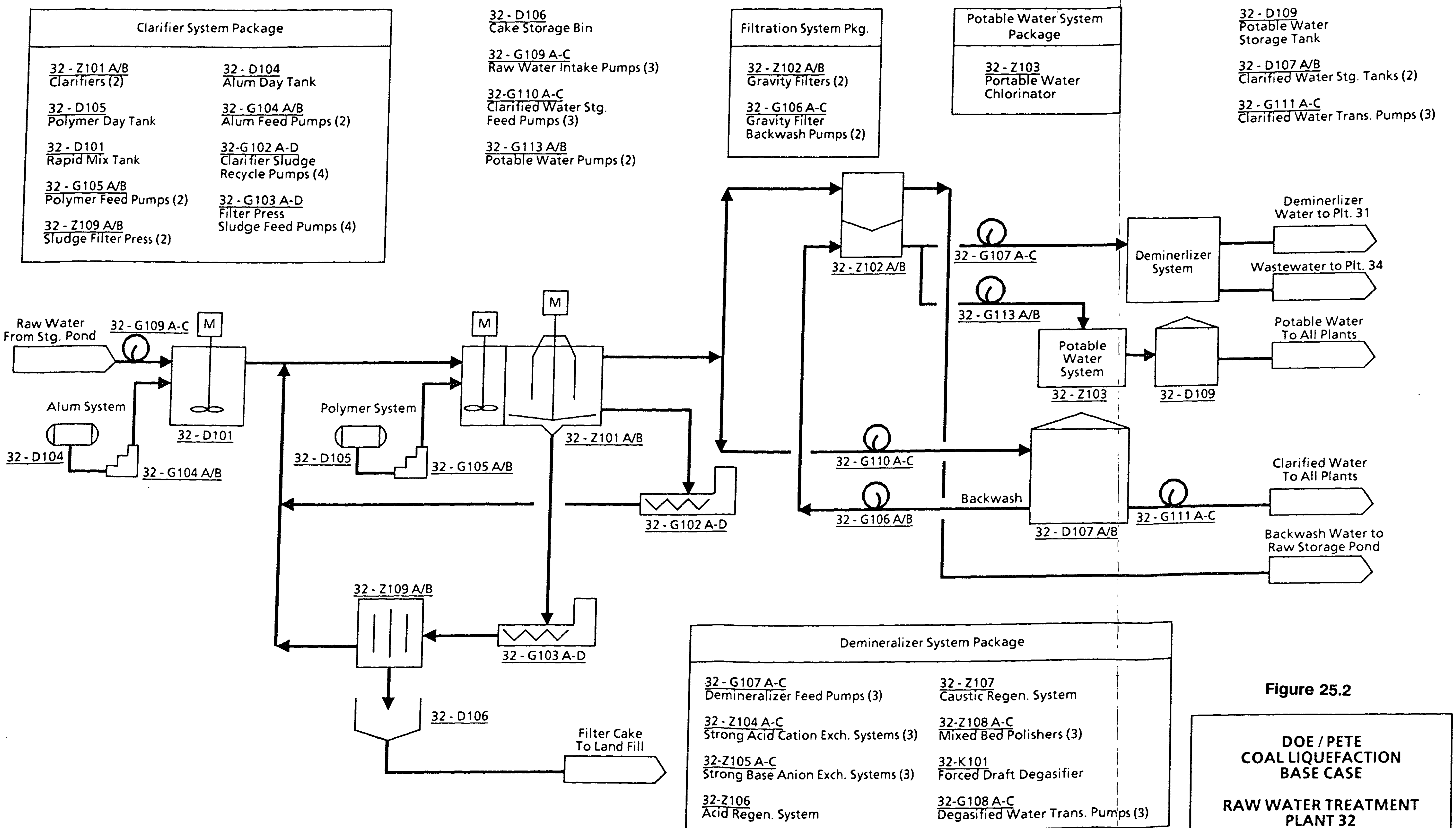


Figure 25.2

DOE / PETE COAL LIQUEFACTION BASE CASE

RAW WATER TREATMENT PLANT 32

FLOW DIAGRAM

0691029-3

TABLE 25.1

RAW WATER ANALYSIS FOR DESIGN

Water Properties	Mid Continent Location	
NAME	AVERAGE	MAXIMUM
RAW WATER		
Temperature, °F (Range)	40 -- 89	
pH	6	8.5
Calcium as CaCO3, ppm	140	180
Calcium as Ca, ppm	38	49
Magnesium as $MgCO_3$, ppm	96	130
Bicarbonate as HCO_3, ppm	137	173
Sulfate as SO_4, ppm	350	570
Silica as SiO_2, ppm	6.5	7.0
Total Dissolved Solids, ppm	662	1,449
Conductivity, MOH	1,000	1,200
Turbidity, Jackson Turbidity Units (JTU)	---	20
Clarified Water		
Turbidity, JTU units		3

The clarified water is filtered using two dual filter media gravity filters. The required amount of the filtered water is fed to a potable water chlorinator system and the rest goes to the demineralizer. The balance of the clarified water goes to storage tanks.

Sludge resulting from the clarification (clarifier underflow) is filtered with a filter press and the filter cake is sent to an approved landfill. The small flow of filtrate water is recirculated back to the reactor/clarifier.

Cooling Water System

One conventional, wood cross flow tower with splash type fill cooling water system with mechanical induced-draft cooling tower is provided.

The cooling tower (32-E101 A to R) is designed to supply the 3,923 MMBTU/hr cooling requirement of the process plants.

An objective of the cooling water system design is to minimize the use of imported water for cooling tower makeup. This results in maximizing the reuse of treated process waste water, including cooling tower makeup. The rest of makeup water is supplied with clarified water.

The cooling water distribution system, as well as individual plant uses and return water temperatures are presented on Flow Diagram Figure 25.3.

The cooling tower capacity is as follows:

Duty	=	3,923 MMBTU/Hr
Inlet Temperature	=	115°F
Outlet Temperature	=	87°F
Circulation Rate	=	280,000 GPM
Water Evaporation Loss	=	0.1% x Delta T Ave.
Drift Loss	=	0.1%
Blowdown	=	4 Cycles

Cooling water system is designed for a supply water temperature of 87°F.

The climatic conditions used for the cooling tower design are:

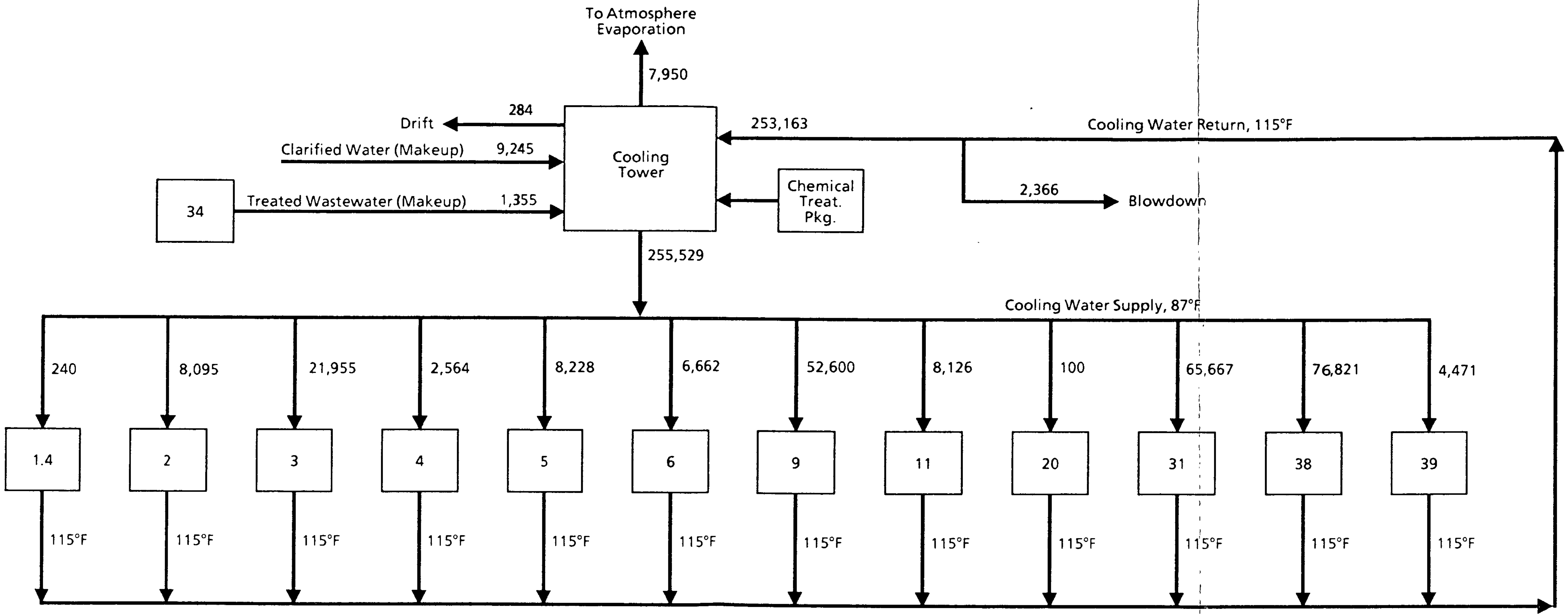
- Atmospheric press = 14.3 psig
- Air Temperatures
  - Inlet temperature: -6 to 95°F
  - Wet Bulb Temperature: 78°F
  - Dry Bulb Temperature: 95°F at 45% Relative Humidity

Cooling Tow r Makeup

Makeup water to the cooling tower (32-E101 A to R) is clarified raw water and treated process waste water from Plant 34. The total makeup requirement is 10,453 GPM.

Cooling Water Requirement

The design cooling requirements for the complex, including power and steam generator plant (Plant 31) is served by an 18 cell cooling tower (32-E101 A-R), including two spare cells. The supply water flow rates are summarized in Table 25.2. The total cooling duty is 3,923 MM BTU/hr including a contingency allowance of 11%.



Notes:

1. Flows are for normal operation and in GPM
2. Plant Number in the Box

0691029-1

Figure 25.3

DOE / PETC COAL LIQUEFACTION BASE CASE

COOLING WATER BALANCE PLANT 32

Table 25.2

RAW, COOLING & POTABLE WATER SYSTEMS, PLANT 32
OVERALL COOLING WATER BALANCE
BASELINE CASE, NORMAL OPERATION

PLANT NAME	PLANT NO.	DUTY MMBTU/Hr	CW Return TEMP. °F	CW Circulation RATE GPM
	Cooling Water Supply Temperature =			87 °F
Coal Crushing and Drying	1.4	3	115	240
Coal Liquefaction	2	113	115	8,095
Gas Plant	3	308	115	21,955
Naphtha Hydrotreater	4	36	115	2,564
Gas Oil Hydrotreater	5	115	115	8,228
Hydrogen Purification	6	93	115	6,662
Solids/Liquids Sep. Rose	8	0	115	0
H2 Production (Syn Gas)	9	737	115	52,600
Air Separation	10	0	115	0
Sulfur Recovery	11	114	115	8,126
Raw Mat'l & Product Stor.	20	1	115	100
Steam & Power Generation	31	920	115	65,667
Raw,Cooling & Potable H2O	32	0	0	0
Fire Protection System	33	0	0	0
Waste Water Treatment System	34	0	100	0
Solid Waste Disposal	37	0	0	0
Phosam-W Ammonia Removal	38	1,076	115	76,821
Phenol Removal	39	63	115	4,471
Subtotal		3,580	115	255,529
Contingency %		10		24,471
TOTAL (Design Flow)		3,923	115	280,000
Average Outlet Temp., F				115
MAKE-UP WATER REQUIRED				
Water Evaporation Loss				7,950
Drift Loss				284
Blowdown	Cycle=	4		2,366
TOTAL				10,600
SUPPLY OF MAKE-UP WATER				
Treated Waste Water	34			1,355
Clarified Water	32			9,245
TOTAL				10,600

WATBAL

25.1 Process Description and Block Flow Diagram

Raw Water Treatment

Overall normal flow distribution of raw, clarified and potable water is shown on Flow Diagram , Figure 25.4.

Raw water is supplied at the plant battery limit from a nearby lake or river. The water flows to a storage pond. The pond has a storage capacity of seven days supply of water. The storage pond water is screened to protect the intake pumps. Three 50% capacity pumps (32-G109 A-C) supply water to the reactor/clarifiers (32-101 A/B) via a rapid mix tank (32-D101). Alum is added with pump (32-G104 A/B) from a day tank (32-D104) to the rapid mix tank. Polymer is charged to the reactor/clarifier from a polymer day tank (32-D105) with pump (32-G105 A/B). The small underflow from the clarifier is recirculated with clarifier sludge recycle pump (32-G102 A-D) to the reactor.

After clarification, about 1,100 GPM of clarifier effluent, is diverted through dual media gravity filters (32-Z102 A/B). The balance of the reactor/ clarifier effluent is pumped with three 50% capacity clarified water storage pumps (32-G110 A-C) to the clarified water storage tanks (32-D107 A/B).

When the pressure drop across the gravity filters reaches the design value, they are backwashed with clarified water with filter backwash pumps (32-G106 A/B). The backwash water, containing the filtered solids, is returned to the storage pond. An estimated 12% of the throughput volume is required for backwash. The operation is intermittent.

Reactor/clarifier underflow containing an estimated 0.5-2 wt% of solids is pumped through the sludge filter press (32-Z109 A/B) with feed pump (32-G103 A-D). The filtrate is recycled to the reactor/clarifier and the filter cake to the storage bin (32-D106) from where it is periodically loaded onto trucks that transport it to an approved landfill.

Filtered clarified water is further treated in the demineralizer (ion exchange) system where it passes through strongly-acid cation exchangers (32-Z104 A-C), and degassed in the forced draft degasifier (32-K102) to remove CO_2. Degassed water is pumped with three, 50% capacity degasified water transfer pumps (32-G108 A-C), and passes through strongly-basic anion exchangers (32-Z105 A-C). Finally the water passes through mixed bed polishers (32-Z108 A-C) and to the demineralized water storage tanks (32-D108).

Demineralized water is fed to process steam generators, condensate tanks and as makeup water in the power and steam generation plant (Plant 31).

Regeneration of the strongly-acid cation exchangers and mixed bed polishers is performed by acid regeneration system (32-Z106). Similarly, regeneration of the strongly-basic anion exchangers and mixed bed polishers is carried out by caustic regeneration system (32-Z107).

The regeneration of a demineralizer is controlled automatically. The sequence of regeneration is: backwash, regeneration, slow rinse and fast rinse. The regeneration is performed sequentially.
The backwash, regeneration and rinse waste water is sent to the waste water treatment plant (Plant 34).

About 100 GPM of effluent from the gravity filters is pumped to the potable water gas chlorinator (32-Z103) where it is chlorinated and pumped to the potable water storage tank (32-D109). This water serves all the plants and buildings.

Water Distribution

Overall water distribution flow of the complex is illustrated on Flow Diagram, Figure 25.4. The recoverable waste and sour water from all plants are collected and treated in the waste water treatment plant (Plant 34). Treated water is used as makeup water in coal cleaning/preparation plant (Plant 1).

Cooling Water

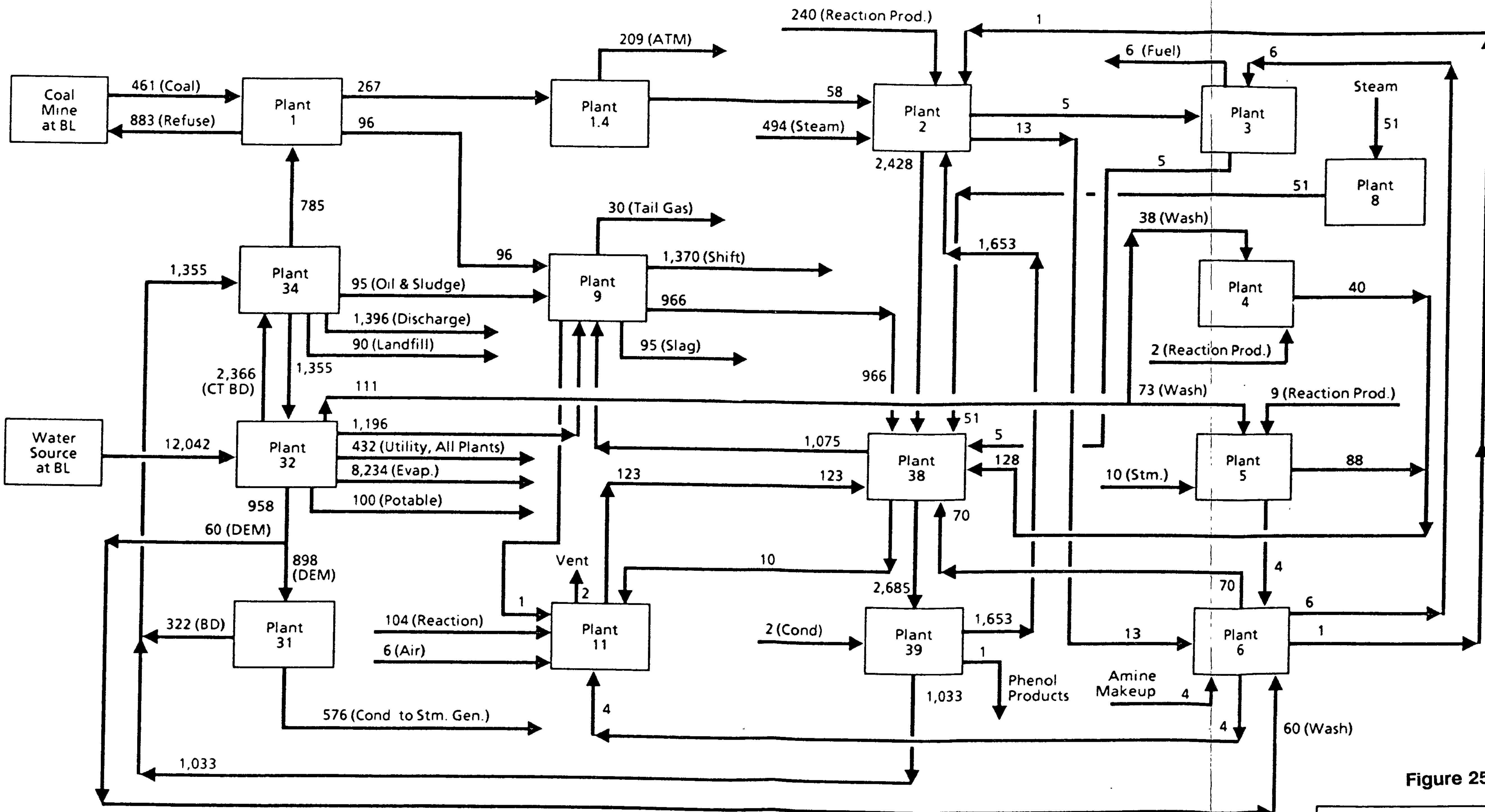
About 252,000 gallons of water is returned from the complex and is cooled with an 18 cell (2 spare) cross flow tower(32-E101A-R). The cooled water from the basin of the cooling tower is supplied to the main header supply line with six motor driven, 40,000 gpm cooling tower pumps (32-G101 A-F) including one spare pump. Cooling tower supply water temperature is controlled manually by turning on/off the cell fans.

Sulfuric acid is injected in the center of the supply water main header pipe for pH control. The polymeric dispersant corrosion inhibitor and non-ionic surfactant for removing microbiological slime deposits are uniformly distributed in the cooling tower basin with a chemical treating system.

For reliability, electric power is provided from the power and steam generation plant (Plant 31), which has three alternates of providing power during emergencies.

Blowdown of the cooling tower is about 2,333 gpm from the main return line to the cooling tower. Blowdown water is processed in the sewage and effluent treatment plant (Plant 34).

Makeup water for the cooling tower comes from the clarified water storage tank.



Notes:

1. Flows are for normal operation and in GPM

Figure 25.4

DOE / PETC
COAL LIQUEFACTION
BASE CASE

OVERALL WATER FLOW DISTRIBUTION

1091056-4

25.2 Major Equipm nt Summary

A major equipment summary for the plant is included in Table 25.3

Tabl 25.3
Major Equipment Summary

Type of Equipment: Vessels and Tanks

Equipment No.	Equipment Description	Length (T-T in ft.)	Diameter (ID in ft.)	Material	Design Conditions Psig	oF	Remarks	No. of Vessels
32-D101	Rapid mix tank with high speed mixer	20	10	CS	10	100	15 HP mixer	1
32-D104	Alum feed day tank	15	7.5	CS	10	100	5000 Gallons	1
32-D105	Polymer feed day tank	10	4	CS	10	100	1000 Gallons	1
32-D106	Cake storage bin			CS	ATM	100	10'x12'x12'	1
32-D107A/B	Clarified water storage tanks	48	200	CS	ATM	100	API STD TANK	2
32-D108A/B	Deminerlized water storage tanks	40	60	CS	ATM	100	API STD TANK	2
32-D109	Potable water storage tank	48	30	CS	ATM	100	API STD TANK	1
32-D110	Caustic tank	25	20	CS	10	200		1
32-D111	Acid tank	20	15	SS	10	200		1

Type of Equipment: Heat Exchangers

Equipment No.	Equipment Description	Duty (MM Btu/hr)	Type of Exchanger	Tube Material	Tube Design psig/oF	Shell Material	Shell Design psig/oF	Area Ft2	No. of Exch.
32-E101A-R	Cooling Towers 18 + 2 spare cells	157	Wood crossflow with splash type fill. total capacity 180,000 gals/hour.						18

Tabl 25.3 Major Equipm nt Summary - continued

Type of Equipment: Pumps

Equipment No.	Equipment Description	Flow Rate GPM	Delta Pres PSIa	Brake HP	Design Conditions Pres (psig)	Temp (oF)	Driver	Est. Driver HP	No. of Pumps
32-G101A-F	Cooling Tower Pumps 5 + 1 spare	40,000	65	2121	75	100	Elec	2500	9
32-G102A-D	Clarifier sludge recycle pumps (no spare)	25	15	2	50	100	Elec	5	4
32-G103A-D	Filter press sludge feed pumps (2 spare)	150	50	6	75	100	Elec	10	4
32-G104A/B	Alum feed pumps (one spare)	2	50		75	100	Elec	1	2
32-G105A/B	Polymer feed pumps (1 spare)	5	50		75	100	Elec	1	2
32-G106A/B	Gravity filter backwash pumps (1 spare)	1200	30	29	50	100	Elec	50	2
32-G107A-C	Deminerlizer feed water pumps (1 spare)	550	75	34	50	100	Elec	50	3
32-G108A-C	Degasified water transfe pumps (1 spare)	550	76	34	50	100	Elec	50	3
32-G109A-C	Raw water intake pumps (one spare)	7000	15	86	50	100	Elec	100	3
32-G110A-C	Clarified water stg feed pumps (one spare)	6400	31	162	50	100	Elec	200	3
32-G111A-C	Clarified water transfer pumps (one spare)	6400	75	392	100	100	Elec	500	3
32-G112A/B	Deminerlized wtr trans. pumps (one spare)	1100	50	45	75	100	Elec	50	2
32-G113A/B	Potable water transfer pumps(one spare)	120	75	7	100	100	Elec	10	2
32-G114A/B	Caustic metering pumps (one spare)	1	75	0	100	200	Elec	1	2

Tabl 25.3 Major Equipment Summary - continu d

Type of Equipment: Air Blow rs

Equipment No.	Equipment Description	Flow Rate (ACFM)	Diff Pres (psi)	Brake Horsepower	Design Conditions Pres (psig)	Design Conditions Temp (oF)	Driver	Est. Driver HP	No. of Equip.
32-K101A-R	Cooling Tower Fans (16 + 2 Spare)			189			Elec	200	27
32-K102	Forced draft degasifier			1.2			Elec	2	1

Type of Equipment: Miscellaneous

Equipment No.	Equipment Description	Flow Rate	Other Design Criteria	Design Conditions Pres (psig)	Design Conditions Temp (oF)	Driver	Est. Driver HP	No. of Equip.
32-Z101A/B	Clarifier/Reactors with mixers	7000	Two Mixers	ATM	100	Elec	10	2
32-Z102A/B	Gravity filters			ATM	100			2
32-Z103	Potable water gas chlorinator							1
32-Z104A-C	Strong acid cation exchangers (1 spare)	1100	ASME	100	150			3
32-Z105A-C	Strong base anion exchangers (1 spare)	1100	ASME	100	150			3
32-Z106	Acid regeneration system		one acid bulk tank two acid pumps			Elec	1	1
32-Z107	Caustic regeneration system		one caustic bulk tank, 2 caustic pumps, one steam heater			Elec	1	1
32-Z108A-C	Mixed bed polishers (one spare)			75	150			3
32-Z109A/B	Sludge filter press			100	100			2
32-Z110	Cooling tower chemical treat package		Nalco tower master plus Liquid metering pump, Water meter					1

25.3 Utility Summary

The utility requirement for the plant is summarized below.

The raw water requirement for demineralized water, potable water and clarified water is shown in Table 25.4.

Electricity requirement for this plant is 13,652 kW.

Table 25.4

Raw Water Requirement Breakdown

Raw Water Requirements Plant Name	Plant No.	Plant GPM	Contingency %	Total GPM
Demineralized Water				
Boiler Feed Water Makeup	31	576	16	670
Boiler Blowdown (BD)	31	322	6	340
Hydrogen Purification	6	60	17	70
Sub Total		958	13	1,080
Potable Water	32	100	20	120
Clarified Water				
Naphtha Hydrotreater	4	38	5	40
Gas Oil Hydrotreater	5	73	23	90
H_2 Production (Syn Gas)	9	1,196	20	1,430
Cooling Tower Water Makeup	32	9,245	11	10,250
Utility Stations, etc	All	432	13	490
Sub Total		11,984	9	12,300
Total Raw Water (Design)		12,042	12	13,500

26. PLANT 33

26. Plant 33 (Fire Prot ction Syst ms)

26.0 Design Basis Criteria and Considerations

Fire protection and control systems for all facilities, structures and equipment within the plant area are designed in compliance with federal, state, and local jurisprudence codes and standards and with the recommendations of the American Petroleum Institute, National Fire Protection Association, Industrial Risk Insurer, and the Oil Insurance Association (OIA).

A comprehensive fire water system is provided for the general fire protection of the entire plant. Chemical and steam fire suppression systems are provided for specific facilities and equipment. These systems cover:

- Fire water to process plants, coal handling, water and waste treatment, and storage tankage
- Fireproofing for vessel supports, pipe racks, etc.
- Sprinkler systems for buildings, part of the process equipment such as pumps or heat exchangers (depending on the location), tank truck, tank car, filling rack
- Smothering steam for compressor buildings and fired heaters
- Halogen system for computer room and laboratory
- Nitrogen system for sulfur storage tanks

26.1 Plant Description

Supply Source

Fire water is supplied from the main pond. This source is capable of supplying 60,000 barrels, or 150% of the total requirements of the system for over 24 hours.

Fire Water Pumps

Four main fire water pumps, each rated for 3,500 GPM at 192 psig, deliver the water to the distribution system. Two vertical pumps are located at the pond. One is dual-driven by electric motor and turbine; a diesel engine powers the second pump. Two horizontal pumps powered by similar drivers deliver water from the fire water tank.

Two vertical fire water pressurizing "jockey" pumps, each rated for 275 GPM at 192 psig discharge pressure, are installed at the raw water pond 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. All pumps are capable of producing 150% rated capacity at 65% rated head and have a shut off pressure of not more than 120% rated head.

Distribution System

Fire water distribution system consists of three loops, one around each of the following areas:

- Process
- Coal handling
- Tank farm

The main loop and the main interconnecting piping are 18 inches in diameter; smaller branches are 12 inches or 10 inches accordingly, distributing water to users.

The fire water mains are coated and wrapped steel pipe and are installed underground. Provisions are made for valving off any loop without interfering with the other two loops.

Fire Hydrants, Fixed Monitors, and Firehous Stations

Fire water is supplied to fire hydrants and/or fixed monitors spaced at a maximum of 150 feet around each plant. The monitors are 500 GPM units with adjustable fig/straight stream tips and locking devices for both horizontal and vertical adjustment.

Fire hydrants have flanged connections with outside independent shut-off valves for hose connections. All fire hydrants are self-draining.

Each individual process plant has accessibility to at least four firehouse stations, with hose liens stored on reels preconnected to the fire water system.

The requirements are:

• 6-inch hydrants	250 units
• 4-inch hydrants with 3-inch monitor	125 units
• 1-1/2 inch hose on reels	60 units

Deluge System

Deluge systems are provided for propane, butane, and anhydrous ammonia spheres, and pipe racks located within 25 feet of heaters. Pump batteries, towers and major vessels containing flammable materials are also protected with deluge system.

Sprinkler systems are provided for office and storage buildings, tank truck loading rack, coal bins and the coal conveyors. Dry-pipe sprinkler systems are installed for all areas except those sheltered in a building.

F am Systems

Storage tanks with bottom injection foam systems are provided for products with 140°F flash point or less. The requirements include:

- One 3,000-gallon system for the naphtha product and phenol tanks

Mobile equipment consisting of Aer-O-Foam Dry Chemical Pumper (or equal) and one Aer-O-Foam Big Brother trailer (or equal) is provided. The pumper is equipped with a balanced pressure foam proportioning system and has a solution pumping capacity up to 1,500 GPM at 6% rate. The trailer is equipped with a 500 gallon tank, a hose bed, portable monitors and a balanced-pressure foam proportioning system.

Halogen System

The chemical laboratory and the computer room are protected by Halon 1301 fire extinguishing system. The systems are fully automatic, energized by thermal detectors, and have personnel alarms.

Nitrogen System

A nitrogen fire extinguishing system is provided for two heated sulfur tanks in the tank farm location. The system is fully automatic and energized by thermal detectors.

Snuffing Steam System

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.

Fire Extinguishers

Type BC 30 pound extinguishers are provided for process areas, buildings containing pumps and compressors and utility buildings. All other buildings are equipped with type 2A extinguishers. For each process plant area, 150 pound BC type wheeled extinguishers are also provided.

Detectors

Detector units with alarms are utilized in sheltered or enclosed areas handling or processing flammable liquids or gases and buildings where personnel are working.

Miscellaneous

The project also provides for various minor miscellaneous fire fighting equipment and personnel protective equipment and clothing.

26.2 Major Equipment Summary

Equipment No.	Type	Description
33.1D-101	Fire Water Tank	105' x 40' 50,000 bbl capacity, cone roof API-650
33.1G-101	Fire Water Main Pump	3500 gpm, 193 psi diff. press., 503 Bhp, 240 psig and 100°F design P&T, electric motor/steam turbine drivers, vertical
33.1G-102	Fire Water Main Pump	3500 gpm, 192 psi diff. press., 503 Bhp, 240 psig and 100°F design P&T, diesel engine driver, vertical
33.1G-103	Fire Water Main Pump	3500 gpm, 174 psi diff. press., 503 Bhp, 240 psig and 100°F design P&T, electric motor/steam turbine drivers, horizontal
33.1G-104	Fire Water Main Pump	3500 gpm, 174 psi diff. press., 503 Bhp, 240 psig and 100°F design P&T, diesel engine driver vertical
33.1G-105A	Fire Water Jockey Pump	275 gpm, 192 psi diff. press., 50 Bhp, 240 psig and 100°F design P&T, electric motor
33.1G-105B	Fire Water Jockey Pump	275 gpm, 192 psi diff. press., 50 Bhp, 240 psig and 100°F design P&T, electric motor

Equipment No.	Type	Description
33.3V-101	Foam to Gas. Ref.,	Skid mounted foam Phenol & Raw Heavy subsurface injectionNaphtha system including 3000 gal. C.S. storage drum, 300-2200 GPM foam proportioner, 550 gpm foam maker nozzles
33.4V-102	Aer-O-Foam Dry Mobile Dry Chemical Pump	Chemical Pump and trailer, capacity 1500 GPM at 6% rate

27. PLANT 34

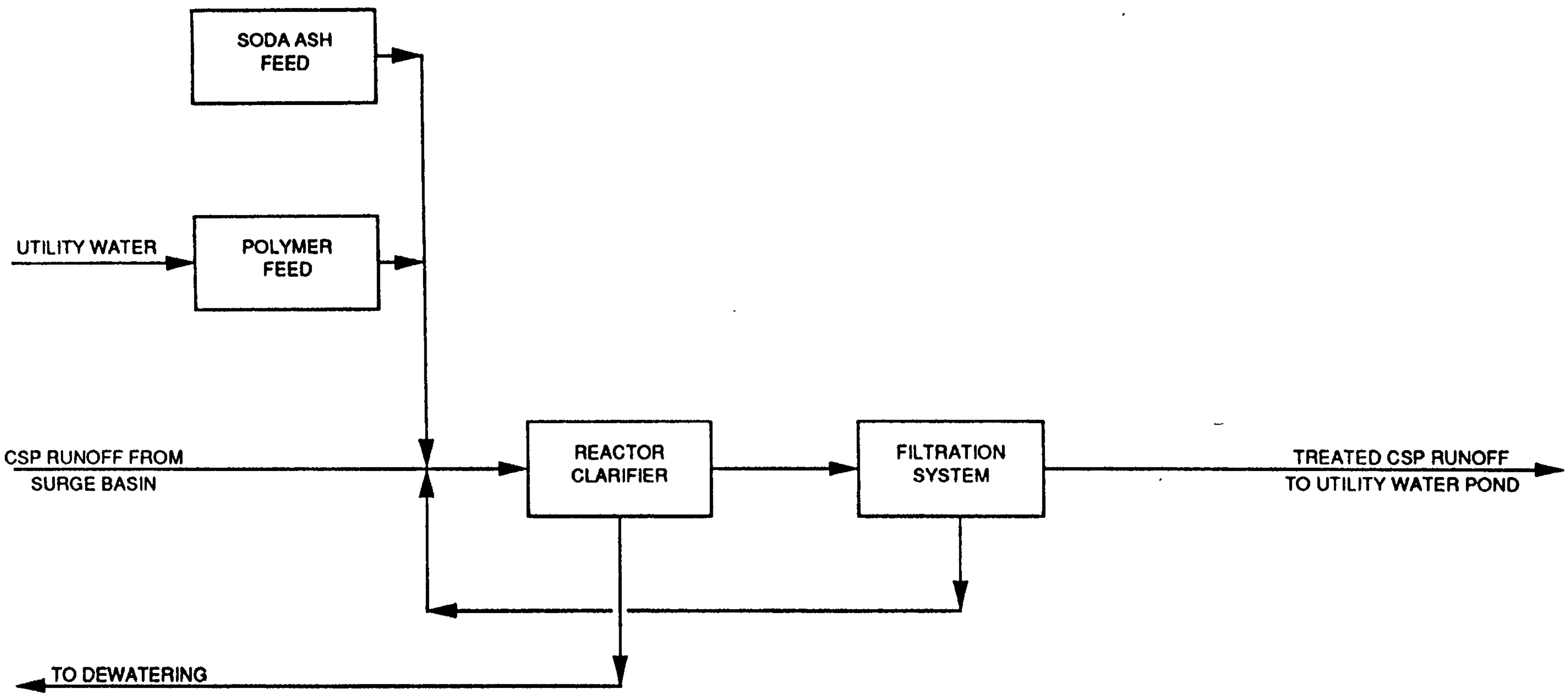


FIGURE 27.1 Block Flow Diagram

CSP RUNOFF TREATMENT

The design of the oily water treatment system is based on the following estimated wastewater characteristics and flow:

Influent Characteristics

Flow (maximum	2,650 gpm
PH	6-8
Oils (average)	350 mg/l
TSS	150 mg/l
COD	1,200 mg/l
BOD	500 mg/l

The performance requirements for the process units are as follows:

	Percent Removal Requirements			
Unit	Oils	TSS	COD	BOD
API Separator	50	50	33	30
DAF Units	85	50	40	40

The process is shown in Figure 27.2.

The oily wastewater, on its way to the API Separator flows through a specially designed concrete Static Flow Splitter Box utilizing a combination of weirs and pumps to permit excess flows to be diverted to the oily storm surge tank with a minimum of oil carry-over.

Upon entering the covered and vented API separator forebay, some of the lighter oils float to the surface and the heavier solids settle out. The water than flows on through the two 5 x 11 x 120-foot channels where the oil droplets float the solids (sludge) settles out. The floated oil and settled sludge are moved across the length of the channels in opposite directions, by means of motor-operated endless chains with flights, and are concentrated at opposite ends. Oil is skimmed off to a sump and pumped by the Skimmed Oil Pump to a small heated tank nearby for settling and rough phase separation. Water is drained back to the separator, and oil is withdrawn through a floating skimmer and pumped by the Oil Transfer Pump to Plant 2's distillation feed flash tank. Bottom sludge is pumped by the API Separator Sludge Pump to a sump where float and bottom sludges from the DAF units are also collected and pumped by the Oily Sludge Sump Pump to mix with the Rose bottoms (Plant 8.1) before going to the Coal Gasifiers (Plant 9).

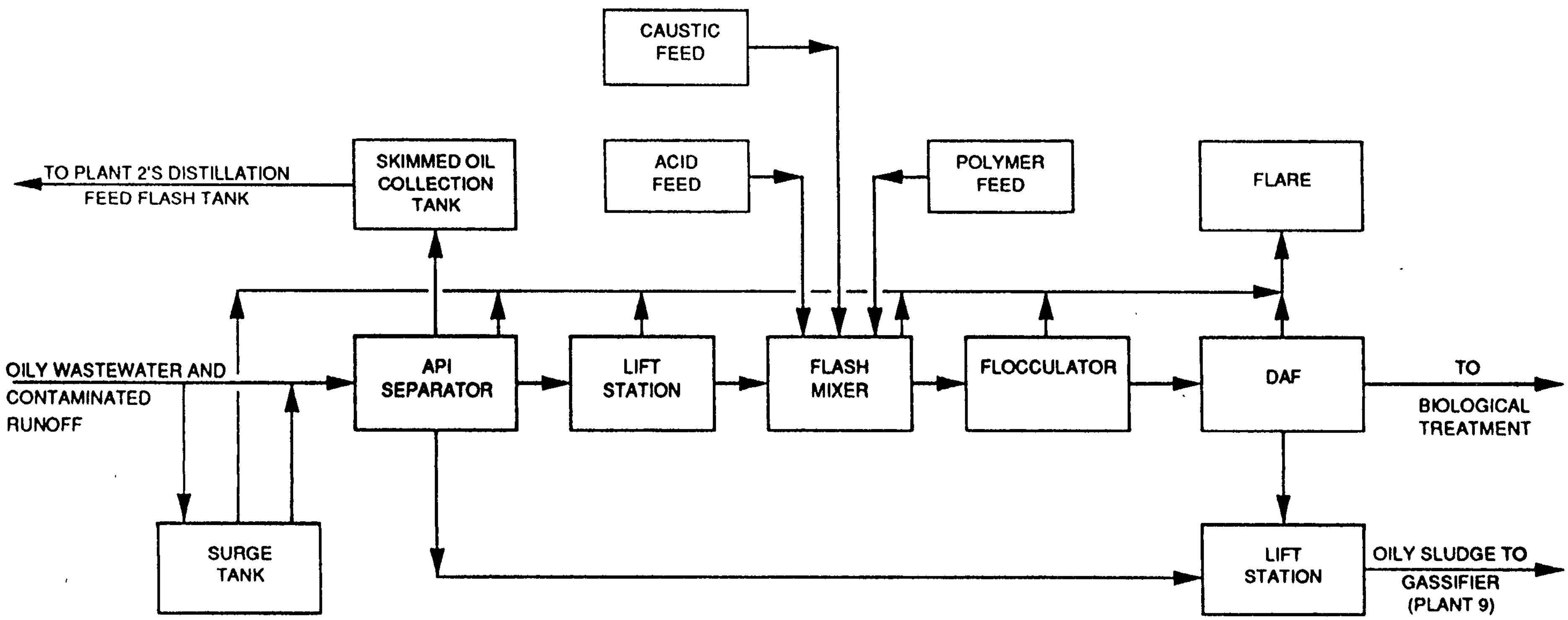


FIGURE 27.2 Block Flow Diagram

BLOCK FLOW DIAGRAM

OILY WATER TREATMENT SYSTEM

Suspended Solids Removal System (Dual Media Filter System). A dual media filtration system is used to remove suspended solids from the clarified water. The system consists of a Filter Feed Tank, four anthracite/garnet, dual media, pressure type filters, a polymer feed system, and a chlorine feeder.

- Filter Feed Tank - Wastewater flow of 2,650 GPM, four hours holding capacity.
- Chlorine Feeder

Wastewater flow	2,650 GPM
Chlorine dosage	10 mg/l

- Polymer Feed System

Wastewater flow	2,650 GPM
Polymer dosage	2 mg/l
Raw polymer storage capacity	2 weeks
Stock solution storage capacity	8 hours
Stock solution concentration	1%

Dual Media Filter System

Wastewater flow	2,650 GPM
Filtration Flux	12 gpm/ft^2
Backwash flux	15 gpm/ft^2

The key design characteristics of the incoming feed and of the filtered effluent are as follows:

	Incoming Feed	Filtered Effluent
Flow (GPM)	2,650	2,650
pH	6-8	6-8
COD (ppm)	480	72
BOD (ppm)	210	21
SS (ppm)	38	1

The process is shown in Figure 27.3.

Wastewater from the Oily Wastewater Treatment System flows directly from the Flotators to the Aeration Basins. Weirs regulate the split from the two flotators to the three basins. Recycled sludge from the Clarifiers, thickener overflow from the Sludge Thickener and backwash from the Media Filters are also fed to the front end of the basins. Since the flow from the thickener is small compared to the total flow, it is fed into only one of the three basins. The filter backwash rate is cyclic but of short duration, i.e. 750 GPM during backwash time which is only about 10 minutes out of several hours. Nevertheless, the high instantaneous rate is taken as it occurs, and the flow out of the basin and into the clarifier, which is sensitive to variations in flow rate, is averaged out by the use of "V" notch weirs on the outlet of the basins.

For initial operation, the aeration basins must be spiked with externally acclimated microorganisms. Once the system is in proper operation, there is a net production of microorganisms. Proper microorganism density, as required to destroy the organic matter, is obtained by proper elimination of microorganisms in the concentrated sludge.

Oxygen, wastewater and recycled sludge (microorganisms) are intimately mixed with the use of the Marox Aerators. Microorganisms feed on the biodegradable matter in the water and grow and multiply as the water moves from the feed end to the discharge end of the basins. The wastewater with the microorganisms overflows the basins into the clarifiers. A basin and clarifier work in unison.

Solid matter sinks to the bottom of the clarifier where slow revolving rakes draw it to a sump in the center. Clarified water overflows from the periphery of the clarifier, is collected in a trough, and discharged into the Filter Feed Tank.

Sludge from the center sump of the clarifier is split into two fractions. One part, as required for proper microorganism concentration in the aeration basins, is pumped to the feed end of the basins. The remainder, which represents net microorganism production, is concentrated in the sludge thickener. The thickener is nearly identical to the clarifier except for a special arrangement of paddles on the rakes that is conducive to better sludge concentration. Thus, the underflow is thicker in solids than the feed and goes to a belt press for dewatering. The clarity of the overflow is inconsequential since it is recycled to the aeration basins.

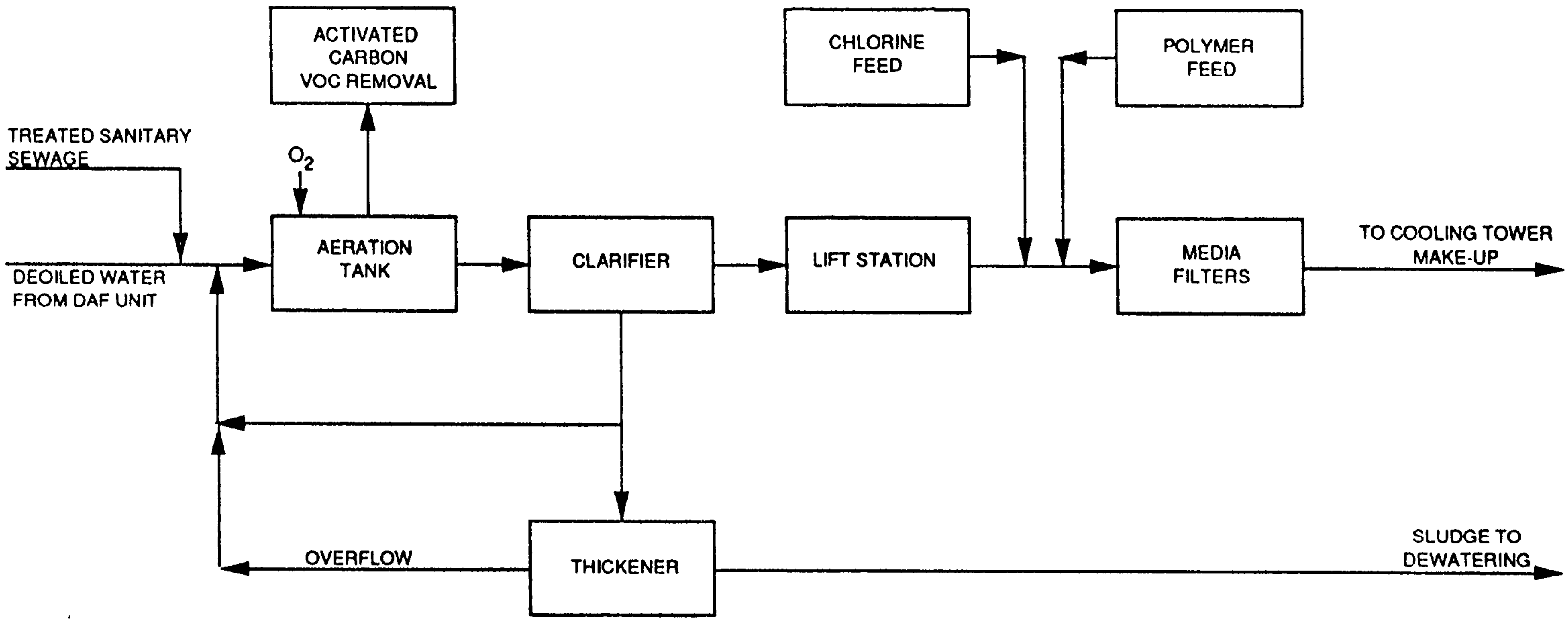


FIGURE 27.3 Block Flow Diagram

BLOCK FLOW DIAGRAM

DEOILED WASTEWATER TREATMENT

The effluent from the clarifier will not be free of suspended matter and, therefore, is filtered prior to final use as cooling tower makeup. Filtration is performed with multimedia pressure filters similar to those in other parts of the plant. Operation of such filters is cyclic, i.e., they filter for a time, and when they are loaded with solids as indicated by a high pressure drop, filtration is stopped and the filters are backwashed to flush out the accumulated solids. The filter feed tank is used to dampen flow differences between the clarifier effluent and the filters.

Material to be filtered is pumped at a regulated rate through the four filters. Chlorine is injected into the water to be filtered at a controlled rate to prevent plugging of the filter due to microbiological growth. A polymer is also added at a controlled rate to render the suspended solids more easily filterable.

27.4 Stripped/Dephenoled Wastewater Treatment

Following treatment in Plant 38 and 39, the stripped and extracted process wastewater will contain large quantities of dissolved organics and inorganic salts. The organics are those not removed by the extraction process for phenolics removal. Sodium chloride is the main inorganic constituent.

Cooling tower blowdown, boiler blowdown and regeneration water from the demineralizer units also have large quantities of dissolved salts.

The treatment systems for these waste streams consists of biophysical treatment (powdered activated carbon/activated sludge, PACT) to remove the organic matter.

Powdered Activated Carbon (PAC) Biophysical Treatment System. The PAC biophysical treatment system consists of five aeration basins with 30 pure oxygen aerators, the PAC feed system, and three clarifiers with two return sludge pumps.

Basic Data

Item	Design Basis
Feed	2,100 GPM
BOD of Feed	2,700 mg/l
BOD Reduction Required	99.3%

Expected Operation;

Item	Requirement
O_2	1.2 lb/lb BOD reduction
Recycle Sludge Ratio	100%
MLSS in Aeration Basin	4,500 mg/l
PAC in Aeration Basin	20,000 mg/l
Clarifier Loading	700 GPD/ft^2
Clarifier Underflow	5% solids

Wet Oxidation. The wet oxidation system is a proprietary process licensed by Zimpro, Inc., Rothschild, Wisconsin.

Basic Data:

Item	Design Basis
Reactor Feeds (Total)	
- PACT Slurry	56 GPM with 5% (wt) carbon
- Sanitary Waste Sludge	5 GPM with 3% solids
COD Concentration	4% (wt)
COD Reduction Required	85%

Expected Operation:

Item	Expected Operation
Reactor Pressure	1,400 - 1,500 psig
Reactor Temp	500 - 550°F

The PAC Activated Sludge/Wet Air Oxidation Treatment process is shown in Figure 27.4.

Stripped/extracted sour water and blow-downs are sent to the PAC activated sludge system where the partially oxidized wastewater is treated by an activated sludge process in the presence of activated carbon. The presence of powdered carbon allows operation of the activated sludge system with high concentrations of easily settleable mixed liquor suspended solids (MLSS). The presence of powdered carbon also allows the biological treatment of hard-to-treat, concentrated industrial wastes.

The PAC/effluent, together with returning sludge (PAC and MLSS mixture) and regenerated PAC is fed into five Aeration Basins equipped with a total of 30 pure oxygen aeration systems of the Marox rotating diffuser type. Organics in the PAC/system effluent are biologically degraded in the aeration basins. The effluent overflows from the aeration basins into three clarifiers where PAC and sludge settle out. The clarifier overflow drains to the Filter Feed Tank. Most of the settled solids are recycled to the aeration basin. A small portion constituting the net microorganism production is pumped to the Zimpro wet oxidation system. This stream also contains spent PAC which is regenerated in the wet oxidation system.

The Zimpro wet oxidation system receives waste activated sludge from the deoiled wastewater biological treatment system, the spent PAC and waste activated sludge mixture from the PAC activated sludge system, and digested waste activated sludge from the sanitary sewage treatment package unit. The spent PAC is treated for removal of organics in the reactor; regenerated carbon is then returned to the PAC activated sludge system.

Two parallel wet oxidation trains are used. The solids slurry is first pumped to system pressure (1500 psig) by a positive displacement pump and then passed through a heat exchanger where it is preheated by the hot, oxidized effluent. The temperature of the feed is raised to a point where the oxidation reaction will proceed autogenously (without auxiliary fuel) in the reaction vessel. Oxygen required to support the oxidation reaction is compressed to system pressure and bubbled through the liquid phase in the reactor.

As oxidation progresses within the reactor, the heat of combustion raises the temperature of the reaction products to 530-540°F. The reactor effluent is then passed through the feed preheated for cooling. After cooling, the stream is depressurized to atmospheric pressure. The resultant vapors, containing most of the hydrocarbons, are scrubbed with cold water, to condense as much of the water vapor as possible, and vented to the flare.

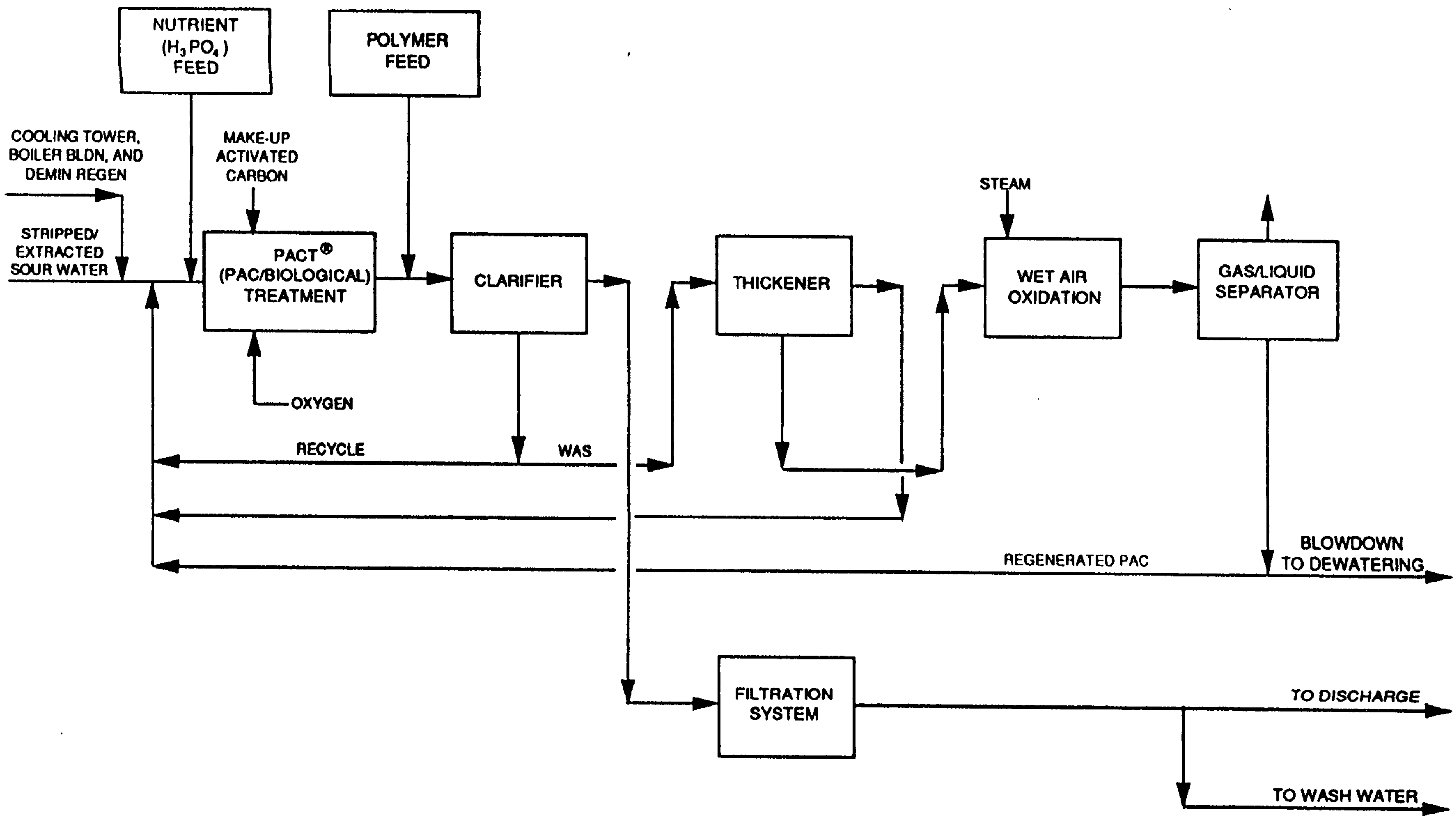


FIGURE 27.4 Block Flow Diagram

BLOCK FLOW DIAGRAM

STRIPPED/DEPHENOLED WASTEWATER TREATMENT

27.5 Solids D watering

The oily wastewater treatment system sludge, sanitary plant sludge, and wet air oxidation blowdown are dewatered by a pressure belt filter. The dewatered sludge is hauled to an approved landfill for disposal. The block flow diagram for this system is shown in Figure 27.5.

The design of the dewatering system is based on the following estimated sludge characteristics and flow:

	Influent Characteristics
Flow, gpm (maximum)	200
pH	6-8
Percent solids	3.0

The performance requirements of the process units are as follows:

Cake dryness, %	20-30
Polymer consumption, lb/ton Dry Solids	10
Electrical consumption, kWh/ton DS	15-30

Sludges from the oily wastewater treatment system, the sanitary plant and the blowdown from the wet air oxidation are routed to a surge/equalization tank where the sludges are blended together. An air operated diaphragm pump moves the blended sludge from the tank to two belt presses. Just prior to the sludge entering the belt filters, a polymer is added to the stream. The polymer conditions the sludge to enhance the dewatering.

The belt presses are located on the second level of a small building to facilitate the filter cake removal by allowing it to drop by gravity into a dumpster. The polymer storage and feed system are on the ground level with the dumpster. When full the dumpster is hauled off to an approved landfill.

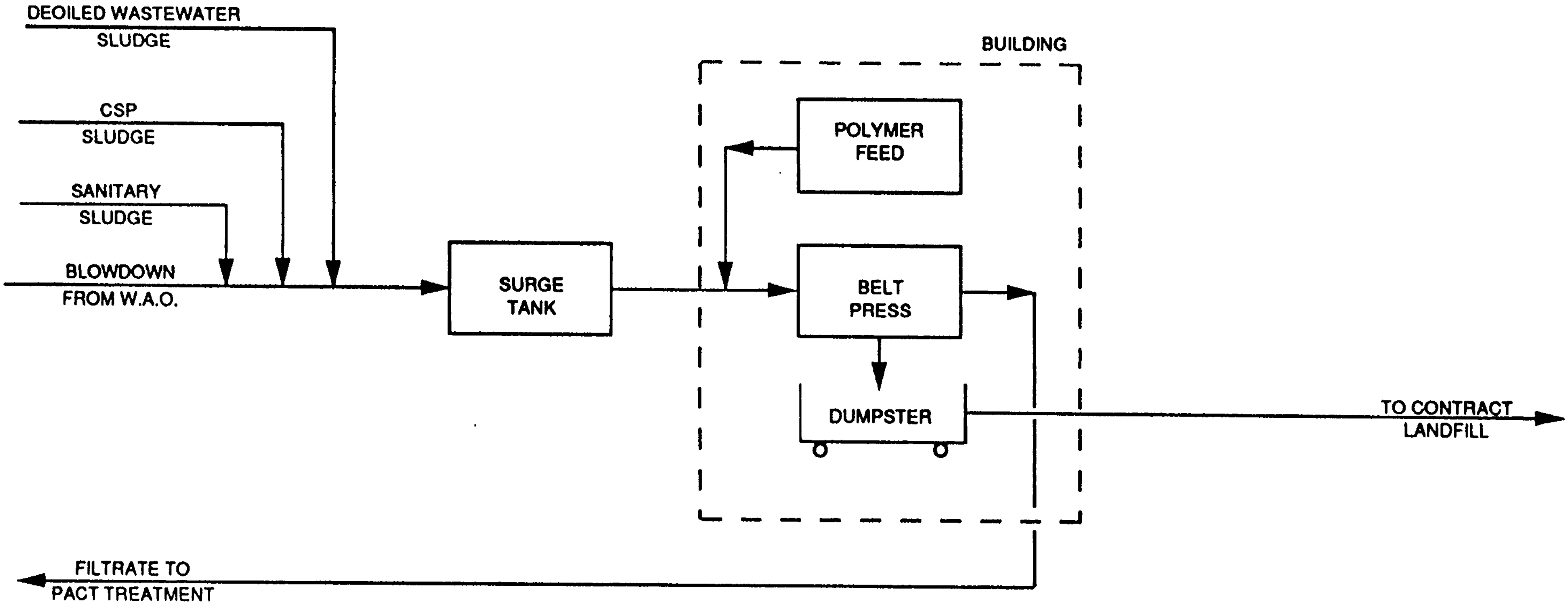


FIGURE 27.5 Block Flow Diagram

BLOCK FLOW DIAGRAM

SOLIDS DEWATERING

27.6 Sanitary Sewage Tr atment

Sanitary sewage from the various sanitary facilities throughout the complex is collected in an underground sewer pipe network terminating at the central sewage treatment facility located downhill/downgrade from the project facilities. To avoid excessively deep excavations, with the long sewer runs involved, there is a need to use several sewage lift stations before the sewage reaches its destination. At the terminal end of the sewer network there is a final lift station delivering feed to the above ground sewage treatment plant.

The sanitary sewage treatment plant is a package unit, pre-engineered, shop fabricated, knocked down and reassembled in the field. It is an above ground installation made of the kind used in many industrial plants and small communities.

The package treatment unit is designed to treat 150,000 GPD of sanitary sewage with a maximum five day BOD loading of 250 pounds per day. It is designed to meet the Ten State Standards, which is a widely used basis for municipal sewage treatment design. It is further based on average per capita use of 35 GPD of water and 1,500 employees working the day shift.

The average design feed rate through the system is 109 GPM. The system can tolerate short term hydraulic loadings of up to 400 GPM, which is the design capacity of the pump lift station ahead of the treatment plant.

The process is shown in Figure 27.6.

Sanitary Sewage Treatment Package. The package consists of two above-ground concentric circular tanks. The outer one is divided into three compartments to form an aeration tank, an aerobic digester, and an effluent chlorine contact tank. The inner one is a settling tank.

Sewage is pumped from the Lift Sump into the inner tank, Aeration Basin. The volume of this compartment is 7,160 ft^3 providing nine hours of detention time for the design flow rate of 109 GPM. Air from the Air blower is dispersed by special diffusers mounted circumferentially around the wall of the compartment.

Digested sewage overflows the aerator into the Clarifier where suspended solids settle to the bottom and clarified water overflows a circumferential weir into the Chlorine Contact Tank. The clarifier is sized for a minimum of four hours detention time and a rise rate of 700 GPD/ft^2. Sludge is removed via air lift mechanisms for recycle to the aerator and delivery to the Aerobic Digester.

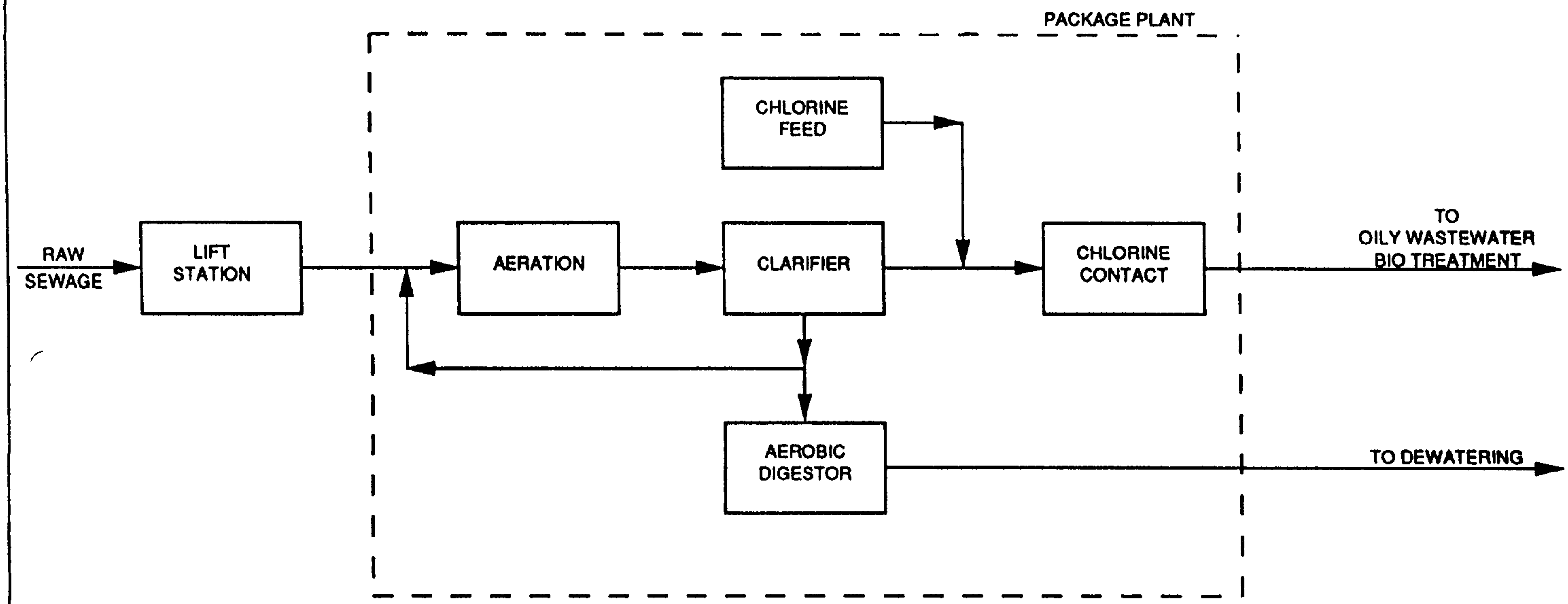


FIGURE 27.6 Block Flow Diagram

BLOCK FLOW DIAGRAM

SANITARY SEWAGE TREATMENT

Clarified water is chlorinated in the chlorine contact tank to destroy any remaining bacteria. This tank has a volume of 3,360 gallons. It is divided into three compartments to force flow over and under and avoid short circuiting. The chlorinated water is forwarded to bio-treatment. Chlorine gas is automatically controlled by the chlorinator which is sized to deliver up to 30 pounds/day. Chlorine supply is from chlorine cylinders.

The aerobic digester is also supplied with air from the blower. Digested sludge is pumped to the wet oxidation reactor for further decomposition. Holding time in the digester is four hours. Overflow from the digester is pumped by an air lift system back to the aerator.

27.7 Major Equipment Summary

A summary of the major equipment for Plant 34 is attached.

27.8 Utility Summary

Electricity - 7313 Kw
50 psig steam - 3000 lb/hr

Table 27.2 Major Equipment Summary

Equipment No.	BFD No.	Type
34-C101A,B	2	Air Solution Vessel
34-D101	1	Polymer Solution Tank
34-D102	1	Soda Ash Solution Tank
34-D103	1	Filter Backwash Make-up Tank
34-D104	6	Sewage Lift Sump
34-D105	2	Alum Day Tank
34-D106	2	Flow Splitter Sump
34-D107	2	Polymer Solution Tank
34-D108	2	Skimmed Oil Settling Tank
34-D109	2	Caustic Soda Day Tank
34-D110	2	Acid Day Tank
34-D111	2	Flash Mix Tank
34-D112	2	Flocculation Tank
34-D113	2	Oily Sludge Sump
34-D114	3	Filter Feed Tank
34-D115	3	Polymer Storage Tank
34-D116	3	Polymer Mixing Tank
34-D117	3	Polymer Feed Tank
34-D118	4	Equalization Tank
34-D119A,B	4	PAC Storage Tank
34-D120	4	PAC Slurry Tank
34-D121	4	Nutrient (H3PO4) Feed Tank
34-D122	5	Filtrate Supply Tank
34-D123	5	Sludge Surge Tank
34-E111	2	Skimmed Oil Tank Heater
34-G101A,B	1	Surge Basin Lift Pump
34-G102	1	Polymer Feed Pump
34-G103	1	Soda Ash Feed Pump
34-G104A,B	1	Sludge Pump
34-G105A,B	1	Clarified Effluent Pump
34-G106	1	Filter Backwash Pump
34-G107A,B	6	Lift Pump
34-G108	6	Froth Spray Feed Pump
34-G109	6	Digested Sludge Drawoff Pump
34-G110A,B	2	Screw Lift Pump
34-G111A,B	2	Alum Feed Pump
34-G112A,B	2	Oil Transfer Pump
34-G113A,B	2	Polymer Feed Pump
34-G114A,B	2	Caustic Soda Feed Pump
34-G115A,B	2	Skimmed Oil Pump
34-G116A,B	2	API Sludge Pump
34-G117A,B,C	2	API Separator Effluent Pump
34-G118A,B	2	Acid Feed Pump
34-G119A,B,C	2	Recycle Pressuring Pump
34-G120A,B	2	DAF Bottom Sludge Pump
34-G121A,B	2	Oily Sludge Sump Pump
34-G122A,B	3	Sludge Pump
34-G123A,B	3	Sludge Thickener Pump
34-G124A,B	3	Polymer Feed Pump
34-G125A-C	3	Filter Feed Pump

Table 27.2 Major Equipment Summary - Continued

Equipment No.	BFD No.	Type
34-G126A,B	3	Filter Backwash Pump
34-G127A,B	4	PAC Feed Pump
34-G128A,B	4	Sludge Recycle Pump
34-G129A,B	4	Waste Sludge Pump
34-G130	4	Nutrient (H3PO4) Metering Pump
34-G131A,B	3	Polymer Transfer Pump
34-G132A,B	5	Sludge Pump
34-G133A,B	5	Filtrate Return Pump
34-J101	1	Feed Pump Controller
34-K101	1	Filter Backwash Air Blower
34-K102A,B	6	Air Blower
34-K103A,B	2	Air Compressor
34-K104A-F	3	Marox Aerators
34-K105A,B	3	Filter Backwash Air Blower
34-K106A,B	4	Oxygen Supply Compressor
34-Q101	2	Surge Pond Lift Pump Sump
34-R101	5	Press Building
34-V101	6	Sanitary Sewage Treatment Pkg
34-V102A,B	2	Dissolved Air Flotation System
34-V103	4	Polymer Feed System
34-V104A,B	5	Polymer Feed System
34-Y101	2	Alum Mixer
34-Y102	2	Polymer Mixer
34-Y103	2	Flash Mixer
34-Y104	2	Flocculation Mixer
34-Z101	1	Polymer Mixer
34-Z102	1	Reactor Clarifier
34-Z103A,B	1	Media Filters
34-Z104	6	Aeration Compartment
34-Z105	6	Aerobic Digester
34-Z106	6	Clarifier Settling Tank
34-Z107	6	Airlift System
34-Z109	6	Comminutor
34-Z110	6	Froth Spray System
34-Z111	6	Chlorine Contact Tank
34-Z112	6	Chlorinator
34-Z113	2	API Separator
34-Z114	2	Oil Skimming Equip. for API Separ.
34-Z115A,B	2	Flotators
34-Z116A,B,C	3	Aeration Basin
34-Z117A,B,C	3	Clarifier
34-Z118	3	Sludge Thickener
34-Z119	3	Chlorine Feeder
34-Z120A-D	3	Media Filters

Table 27.2 Major Equipment Summary - Continued

Equipment No.	BFD No.	Type
34-Z121A,B,C	4	Wet Oxidation System
34-Z122A,B	4	PAC Feeders
34-Z123A-E	4	Aeration Basin
34-Z124A-C	4	Clarifier
34-Z133A-F	4	Aerator
34-Z134A-F	4	Aerator
34-Z135A-F	4	Aerator
34-Z136A-F	4	Aerator
34-Z137A-F	4	Aerator
34-Z138	4	Thickener
34-Z139A,B	5	Belt Press

28. PLANT 35

28. Plant 35 (Instrument and Plant Air Faciliti s)

28.0 Design Basis, Criteria and Considerations

The facilities include all equipment necessary to supply instrument and utility air to the process plants and support facilities. Distribution piping is included in Plant 21 (Interconnecting Piping)

Instrument and utility air is dry, oil-free and dirt-free at the following design conditions:

- Pressure 100 psig
- Temperature 100°F
- Dew Point -40°F
- Ambient air summer dry bulb temperature, 95°F
- Ambient air summer wet bulb temperature, 89°F
- Ambient air winter temperature, -6°F
- Ambient air extreme temperatures, -18°F and 104°F

The system consists of three packaged air compressors,two operating and one spare, to supply the requirement of 15,000 inlet scfm. Auxiliary equipment such as filters, knockout drums, air dryer packages, filters and air coolers are included.

28.1 Plant Description

Air Compressor Unit

The compressors supply 7,500 scfm each, at 125 psig discharge pressure. The three compressor packages include the following:

- Interstage coolers
- After-coolers to keep the air in the range of 100°F, (design temperature)
- Interconnecting piping between the stages

Knockout Drum

Condensed residual moisture for all three compressors is removed by one knockout drum. The knockout drum is designed for 155 psig at 300°F.

Air Dryer Package

Two air dryer packages are provided. One package is a complete spare. Each package provides for the design flow of 15,000 inlet scfm and for 150 psig. A filter, included in the air dryer package, guards against dessicant breakthrough.

Distribution System

Individual plant and main air distribution headers providing instrument and utility air are included in Interconnecting Piping (Plant 21)..

Controls

The air compressor system and air dryer package are fully automatic with the following control features:

- Surge control with excess air vented to the atmosphere
- Dewpoint control by moisture analyzer and instrumentation to energize the regeneration process for the desiccant bed
- Automatic startup of the standby unit in case of low pressure in the header

Noise

Noise emissions by the air compressor is in accordance with OSHA standards

28.2 Major Equipment List

Item Number	Item Description
35	Instrument Air and Plant Air System
35-C101A	Air Knockout Drum
35-C101B	Air Knockout Drum
35-K101A	Plant Air Compressor Package
35-K101B	Plant Air Compressor Package
35-K101C	Plant Air Compressor Package
35-V101A	Air Dryer Package
35-V101B	Air Dryer Package

28.3 Utility Summary

Electricity, kW = 2894

29. PLANT 36

29. Plant 36 (Purge and Flush Oil System)

29.1 Design Basis, Criteria and Considerations

Plant 36 delivers a light and heavy flush oil for pump seal flush and instrument purge. Seal flush and instrument purge are required on a continuous basis for plant areas where high solid (crushed coal and coal ash) content fluids are being transported. In these areas, each pump seal receives a specified flow of flush oil into seal housings, preventing solids from blocking the flow of lubricating fluids at sealing surfaces. Without the seal flush, pumps in these areas could fail in a few hours due to improper lubrication.

Likewise, each instrument receives a specified flow of light flush oil into instrument lines, preventing solids from blocking the lines and rendering the instruments (alarms, gauges, meters, etc.) ineffective.

Coal liquefaction (Plant 2) is the only plant requiring seal flush and instrument purge due to high quantities of coal and coal ash in several streams.

Both the light and heavy flush oils are obtained from Coal Liquefaction (Plant 2) and stored, filtered, and delivered to offsite Tankage (Plant 20). Interconnecting Piping (Plant 21) is utilized to transfer the flush oils to specific applications.

The light flush oil is obtained from the mixture of two Plant 2 streams: the atmospheric tower side stream and the overhead from the vacuum tower. The heavy flush oil is obtained from a vacuum tower side stream. Tables 29.1 and 29.2 summarize the flow requirements for both flush oils. Only light flush oil is used for instrument purge, and most of the pump seal flush utilizes the heavy flush oil. Light and heavy flush oil consumption is based on 0.25 gpm per instrument and 2.5 gpm per pump seal including spare pumps.

TABLE 29.1

LIGHT FLUSH OIL USAGE

APPLICATION	FLOW (GPM)
Instrument Purge	36
Seal Flush	45
Total	81

TABLE 29.2

HEAVY FLUSH OIL USAGE

APPLICATION	FLOW (GPM)
Instrument Purge	0
Seal Flush	263
Total	263

29.1 Plant Description

The light and heavy flush oils are stored, pumped, filtered, and delivered by two separate systems. These systems are located in Tankage (Plant 20).

The light flush oil is pumped from Plant 2 to a 36,000 barrel storage tank (20-D116) which provides 10 days of storage capacity. From the tank, pumps (20-G114A and B) deliver the oil at 3,300 psig to overcome the highest system pressure of the designated applications. A precoat filter package (20-V101) is utilized to remove particulates from the oil.

The heavy flush oil is pumped from Plant 2 to two 56,000 barrel storage tanks (20-D117A and B) which provide 10 days of storage capacity. From the tanks, pumps (20-G115A and B) deliver the oil at 250 psig to overcome the highest system pressure of the designated applications. A precoat filter package (20-V102) is utilized to remove particulates from the oil.

30. PLANT 37

30. Plant 37 (Solid Waste Manag ment)

30.0 Design Basis, Criteria and Considerations

This plant disposes of wastes from Raw, Cooling, and Potable Water (Plant 32), Wastewater Treatment (Plant 34), and miscellaneous sources which include plant refuse and flotsam.

All the solid waste excluding the miscellaneous plant refuse is stored in bins and hoppers and collected daily to minimize onsite storage. Once collected, it is transported to an approved landfill disposal site outside battery limits in off-road trucks.

Table 30.1 below summarizes the quantities of solid wastes.

Table 30.1
Solid Waste Summary

Waste Source Rate (TPD)	Waste Type	Waste Flow
Raw, Cooling, and Potable H2O (Plant 32)	Filter Cake	24
Wastewater Treatment (Plant 34)	Filter Cake, Sludge, Salts	96
Miscellaneous	Plant Refuse, Flotsam	5

Dewatering of the solid wastes identified above occurs within the battery limits of the source plant. Descriptions of these facilities are included in the source plant process descriptions.

Miscellaneous plant refuse and flotsam is stored in dumpsters. The estimated number of these containers required for the entire plant is 30. Conventional rear loader compactor trucks are used to transport this waste to the approved landfill site outside battery limits. These trucks are fully compatible with the wheeled, rear loader dumpsters used for storage. The trucks make one trip to the disposal site each day.

30.1 Plant Description

Plant 32 and 34 Waste Disposal

The waste bins and hoppers for Plants 32 and 34 are included with these plants. A 40 ton (37-T101) and an 85 ton (37-T102) off-road rear-dump hauler truck are provided for transporting waste to the approved landfill disposal site.

Miscellaneous Waste Disposal

Standard 4 yd^3, wheeled, rear loader dumpsters (37-T103A-Z and T104A-D) are provided for storing miscellaneous waste items. Conventional, rear loader, municipal type compactor trucks with 25 yd^3 capacity (37-T105A and B) are provided for transporting waste to the landfill disposal site.

30.2 Major Equipment Summary

Equipment No.	Type	Size or Capacity
37-T101	Off-road rear dump hauler	40 ton
37-T102	Off-road rear dump hauler	85 ton
37-T103A-Z, T104A-D	Rear loader dumpsters	4 yd^3
37-T105A,B	Conventional rear loader, municipal type, compactor trucks	25 yd^3

31. PLANT 38

31. Plant 38 (Ammonia Recov ry)

31.0 Design Basis, Criteria and Considerations

Ammonia Recovery (Plant 38) and Phenol Recovery (Plant 39) are closely related and together constitute the Project Sour Water Stripping, with the purpose of minimizing both raw water consumption and effluent discharge to public waters during normal plant operation. Sour water streams are segregated and treated as necessary to make them suitable for reuse, if practical, in lieu of fresh water.

Sour Water Treating

ARISTECH PHOSAM-W is a development technology of USX Corporation, licensed by USX Engineers and Consultants Inc. (UEC). The process removes free ammonia and acid gases from the sour waters. In the absorber the ammonia is chemically absorbed from the sour water stripper vapors by a circulating water solution of ammonium phosphate.

In the stripper, the ammonia is recovered from the solution and the solution is regenerated for feed to the absorber.

The aqueous ammonia vapor from the stripper overhead is condensed and fed to the fractionator where it is distilled under pressure to produce a high quality anhydrous product.

Design Basis

The capacity of the PHOSAM-W unit is 4000 GPM of concentrated sour water plant 2, 3, 4, 5, 6, 8, 9 and 11. This allows approximately 10 percent spare capacity to permit work-off of sour water produced during non scheduled shutdowns. Tankage for five days storage of sour water feed is also provided to smooth out operations of the PHOSAM-W plant. Feed compositions and quantities used in this design are given in Table 31.1, attached. There are 243.8 TPSD of anhydrous ammonia recovered in this process. The yields are based on the Breckinridge Initial Effort plant and have been reviewed by the licensor and deemed as reasonable.

Tabl 31.1

FEED STREAMS TO AMMONIA RECOVERY

POUNDS PER HOUR

BASE-LINE DESIGN

STREAM NO.	1	2	3	4	5	6	7	8	9
	Plt #2 SOUR WATER LB/HR	Plt #3 SOUR WATER LB/HR	Plt #4 SOUR WATER LB/HR	Plt #5 SOUR WATER LB/HR	Plt #6 SOUR WATER LB/HR	Plt #8 SOUR WATER LB/HR	Plt #9 SOUR WATER LB/HR	Plt #11 SOUR WATER LB/HR	TOTAL SOUR WATER LB/HR
NITROGEN									0
H2	0						5		5
WATER	1214145	2384	20066	43760	34938	25419	482877	61926	1885515
H2S	15655		22	220	1583		285		17765
NH3 FREE	14920		324	1586	2879		695		20404
CO	0								0
CO2	500				73		5837		6410
C1	5			4					9
ORGANICS	12495			182					12677
PHENOLICS	3785								3785
TOTAL	1261505	2384	20412	45752	39473	25419	489699	61926	1946570
TOTAL GPM	2428	5	40	88	70	51	966	124	3771

31.1 Process Description and Process Flow Diagram

Sour water is processed through the PHOSAM-W process with as much of the ammonia and hydrogen sulfide free water as possible being returned to Plant 9. The remaining water goes to the Phenol Recovery Unit (Plant 39). The acid gas product is sent to the Sulfur Plant (Plant 11) where the H_2S is converted to molten sulfur. The process is schematically represented in process flow diagram, Figure 31.1.

Sour water from the Coal Liquefaction complex,i.e.; Coal Liquefaction (Plant 2), Gas Plant (Plant3), Naphtha Hydrotreater (Plant 4), Gas Oil Hydrotreater (Plant 5), Hydrogen Purification (Plant 6), ROSE unit (Plant 8), Hydrogen Production by Coal Gasification (Plant 9), and Sulfur Recovery (Plant 11) are combined in the sour water feed tanks (20-D116A/B). The combined feed is preheated against the PHOSAM-W H_2S Stripper Feed/Bottoms Exchanger (38-E101A/B). The feed is then charged to the unit's 3 Sour Water Strippers (38-C101A/B/C) where acid gas and free ammonia is stripped from the water (See Figure 1). The stripped water is then cooled (38-E103A through F) and (38-E111A/B/C/D) and preferentially returned to the process units for reprocessing or to the Phenol Recovery Unit (Plant 39) for further treatment. Heat for the stripper is supplied by a 150 psig steam reboiler (38-E102A through F).

The Sour Water Stripper overhead vapor goes to the Ammonia Absorber (38-C102) where it is contacted with recirculated ammonium phosphate solution. Vapors released from the rich solution in the PHOSAM Contactor (38-E103) contain some ammonia and essentially all of the entrained acid gases. These vapors are recycled to the spray section of the absorber (38-C102) to recover the ammonia and purge the system of acid gases. About 75 percent of the ammonia is recovered here. The remaining vapors flow upward through trays where the ammonia is counter-currently scrubbed with lean ammonium phosphate solution returning to the top of the absorber from the regeneration section of the plant. The solution with the absorbed ammonia, drains from the bottom tray into the absorber sump.

The vapor leaving the Ammonia Absorber contains approximately 6,000 ppmv ammonia. It passes to the Absorber Quench Cooler (38-E105A through M) where enough ammoniacal water is condensed to lower the ammonia content of the gas to less than the specified 1,000 ppmv. The gas then passes to the Sulfur Plant (Plant 11). The ammoniacal water is recycled back to the H_2S Stripper with the sour water feed.

The net flow of the rich absorber solution is taken off the discharge of the Absorber Circulation Pump (38-G102A/B) and heated against the hot lean solution from the bottom of the PHOSAM-H_2S Stripper Bottoms/Lean Solution Exchanger(38-E104A/B). The heated rich solution is then flashed in the PHOSAM Contactor (38-C103) to remove acid gases which are recycled to the Ammonia Absorber.

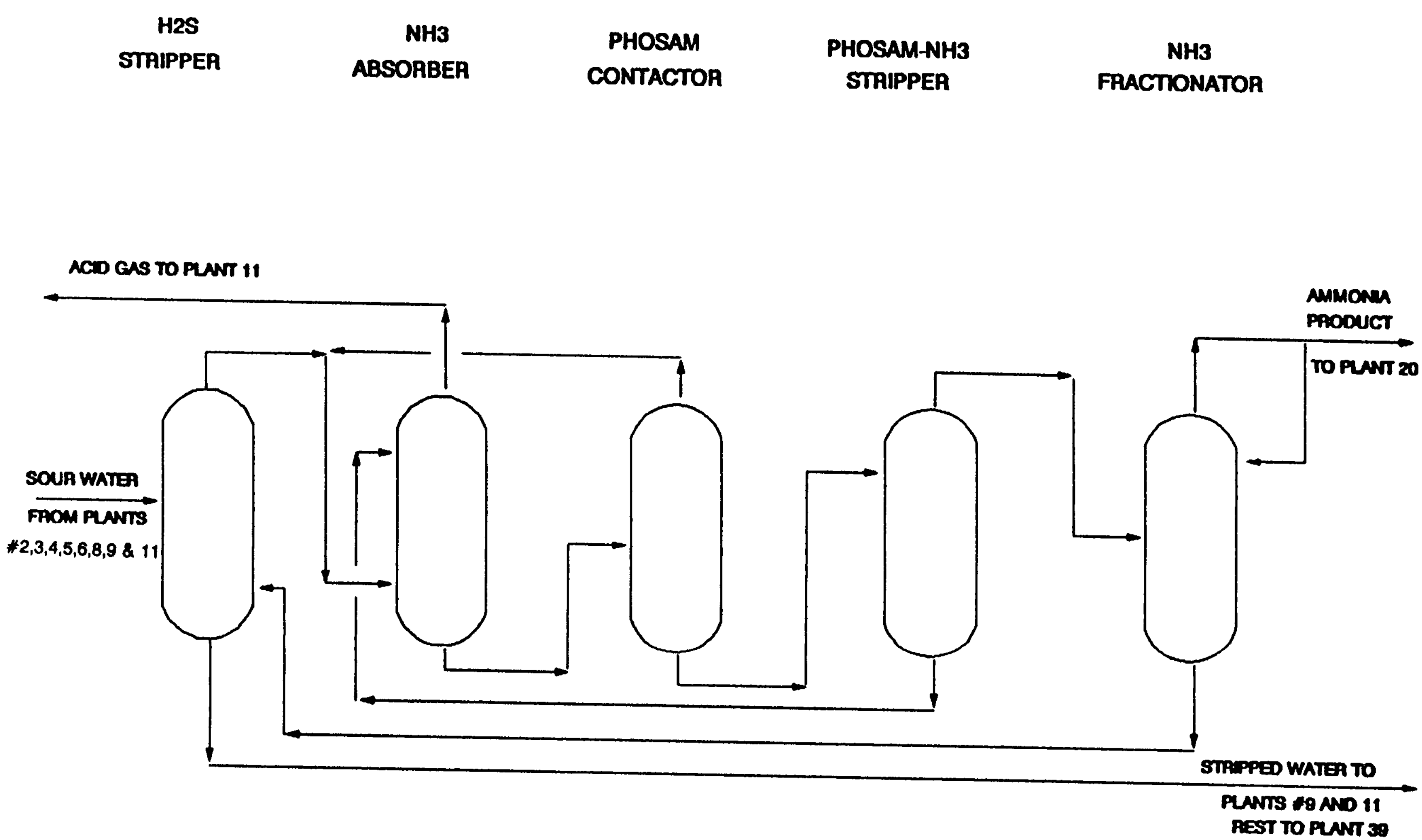


FIGURE 31.1 Process Flow Diagram

PROCESS FLOW SKETCH
PHOSAM-W AMMONIA RECOVERY

The rich solution, now free of acid gases, is pumped from the PHOSAM Contactor and preheated in the upper section of the PHOSAM-Ammonia Stripper Condenser (38-E108A through J). The preheated rich solution flows to the PHOSAM-Ammonia Stripper (38-C104) which operates at elevated pressure.

The PHOSAM-Ammonia Stripper removes the absorbed ammonia and the lean solution is recycled to the Ammonia Absorber. The Ammonia Absorber Reboiler (38-E106A/B/C/D) is heated with 600 psig steam, to provide the necessary heat for the stripper. The hot, lean solution is cooled first against the PHOSAM Feed Exchanger (38-E101A/B), then to preheat the sour water feed to the stripper and finally it is cooled with cooling water (38-E104A/B) before entering the top of the Ammonia Absorber.

The overhead vapor from the PHOSAM-Ammonia Stripper, containing 10 to 20 weight percent ammonia passes through the two section PHOSAM-Ammonia Stripper Condenser(38-E108A through J). The vapor is cooled and partially condensed in the upper section by exchange with the stripper feed. Cooling water condenses the remaining vapor in the lower section. The PHOSAM-Ammonia Stripper pressure is automatically controlled by running the lower section as a flooded condenser. The condensed aqueous ammonia is maintained at its boiling point with a warm vapor by pass. The condensate flows by gravity to the PHOSAM Stripper Overhead Drum (38-C106).

The aqueous ammonia is pumped from the PHOSAM Stripper Overhead Drum into Ammonia Fractionator (38-C105) where it is fractionated into an overhead anhydrous ammonia product (99.5% NH_3 min.) and a bottoms product containing a small amount of ammonia. The alkaline, pressurized hot water from the bottom of the fractionator is flashed directly into the bottom of the H_2S Stripper to provide a portion of the boil-up requirement. The Ammonia Fractionator Reboiler (38-E109) is heated with 600 psig steam and provides the necessary stripping vapor for fractionation of the ammonia and water. The overhead vapor is condensed with cooling water and the tower pressure controlled via a flooded condenser. Part of the overhead product is used for reflux to the top of the fractionator and the rest goes to Tankage (Plant 20).

31.2 Material Balance

The overall material balance, including the predicted product quantities and compositions from the PHOSAM-W process, for the Ammonia Recovery Unit (Plant 38) is presented in Table 31.2. The anhydrous ammonia stream will have a minimum purity of 99.50 percent.

Table 31.2

Ammonia Overall Material Balance

AMMONIA OVERALL MATERIAL BALANCE POUNDS PER HOUR BASE-LINE DESIGN STUDY					
STREAM NO.	9 WASTE WATER FEED LB/HR	10 ACID GAS PROD. LB/HR	11 STRIP'D WATER PROD. LB/HR	12 NH3 PROD. LB/HR	OVERALL MAT'L BAL 9-(10+11+12) LB/HR
NITROGEN	0		0		0
H2	5	5	0		0
WATER	1885515	5195	1880229	91	0
H2S	17765	17695	70		0
NH3 FREE	20404	13	170	20221	0
CO	0		0		0
CO2	6410	6400	10		0
C1	9	8	1		0
ORGANICS	12677	12033	644		0
PHENOLICS	3785	321	3464		0
TOTAL	1946570	41670	1884588	20312	0
TOTAL GPM	3771		3760	41	0

31.3 Major Equipment Summary

The Equipment Summary for PHOSAM-W Ammonia Recovery is shown in Table 31.3.

31.4 Utility Summary

Steam:

- 600 psig, saturated — 326,052 lb/hr
- 150 psig saturated — 581,269 lb/hr

Cooling water circulated at 87°F	76,821 gpm
Makeup Water	nil
Electricity (operating)	1,531 KW

Table 31.3 Major Equipment Summary

Type of Equipment: Columns and Drums

Equipment No.	Equipment Description
38–C–101	Sour Water Stripper
38–C–102	Ammonia Absorber
38–C–103	Contactor
38–C–104	Stripper
38–C–105	Fractionator
38–C–106	Fractionator Feed Drum
38–C–107	Fractionator R/F Drum
38–C–108	Phosphoric Storage

Type of Equipment: Heat Exchangers

Equipment No.	Equipment Description
38–E–101	Feed Preheater
38–E–102	Sour Water Stripper R/B
38–E–103	Stripped Water Cooler
38–E–104	Lean Solution Cooler
38–E–105	Absorber Quench Cooler
38–E–106	Solution Exchanger
38–E–107	Stripper Reboiler
38–E–108	Stripper Condenser
38–E–109	Fractionator Reboiler
38–E–110	Fractionator Condenser
38–E–111	Stripped Water Trim Cooler

Table 31.3 Major Equipment Summary - continued

Type of Equipment: Pumps

Equipment No.	Equipment Description
38-G-101	Stripped Water Pumps
38-G-102	Absorber Circulating Pumps
38-G-103	Quench Circulating Pumps
38-G-104	Rich Solution Pumps
38-G-105	Fractionator Feed Pumps
38-G-106	Fractionator R/F Pumps
38-G-107	Phos Acid Addition Pump

32. PLANT 39

32. Plant 39 (Phenol Recovery)

32.0 Design Basis, Criteria and Considerations

Ammonia Recovery (Plant 38) and Phenol Recovery (Plant 39) are closely related and together constitute the Project Sour Water Stripping, with the purpose of minimizing both raw water consumption and effluent discharge to public waters during normal plant operation. Sour water streams are segregated and treated as necessary to make them suitable for reuse, if practical, in lieu of fresh water.

Sour Water Treating

Dephenolization is a process technology development of LTV Corporation, licensed by the Packaged Plants Division of Glitsch Inc., for phenols recovery from sour water. This is accomplished by means of liquid-liquid extraction, in which the phenols are recovered as a salable product consisting of phenol and its homologs, cresols and xylenols. The phenols are extracted from the sour water with an organic solvent. The solvent is recovered by fractionation from the extracted phenols.

Design Basis

The capacity of the Dephenolization unit is 2,650 GPM of stripped sour water from the Ammonia Recovery Unit (plant 38). This allows approximately 10 percent spare capacity to permit work-off of sour water produced during nonscheduled shutdowns. This unit recovers 32.0 TPSD of phenols. Dephenolated water goes preferentially to the Coal Liquefaction (Plant 2) as wash water. The rest goes to the Sewage and Effluent Treatment (Plant 34) where it is treated by Pac/Biological treatment to remove the organics. It is then clarified and filtered before going to the cooling tower as make-up. The yields are based on the Breckinridge Initial Effort plant and have been reviewed by the licensor and deemed as reasonable.

32.1 Process Description and Process Flow Diagram

The Phenol recovery plant is schematically shown in the process flow diagram, Figure 32.1. As shown in this figure, sour water is processed first through the PHOSAM-W process where the ammonia and hydrogen sulfide are stripped out. As much of the phenol bearing water is returned to plant 9 as possible. This destruction of phenols reduces the size of both the Phenol Recovery Unit (Plant 39) and the Effluent Treatment Plant (Plant 34).

Dephenolization Section

Phenol bearing sour water from the Ammonia Recovery Plant (Plant 38) is pumped to the Saturation Column (39-C101) where the light ends are stripped out and sent to the Solvent Stripper (39-C106). (See Process Flow Diagram 39-D-B-1). A side stream is sent to the Solvent Recovery Scrubber (39-C110). The sour water is then charged to the top of the Extraction Column (39-C102A/B), where it is counter-currently contacted with solvent. Raffinate (dephenolized water) is fed to the Solvent Stripper Column, where entrained solvent is removed by distillation. The dephenolized water is pumped to the cooling towers as make-up. The gaseous solvent stripper overhead is returned to the bottom section of the Saturation Column.

Extract from the top of the Extraction Column flows under interface control, to maintain a constant interface level between extract and liquor at the top of the Extractor, to the Solvent Distillation Column (39-C107). The Solvent Distillation Column separates the solvent and the extracted phenols. The overhead product is condensed and is pumped back to the Extractor as recycle solvent. A side stream of the overhead product is pumped back to the column as reflux. The bottoms product is pumped to the Phenol Column (39-C112).

The Phenol Column operates under vacuum to reduce the solvent content of the crude phenols to less than one percent. The overhead product is condensed and sent to the Solvent Distillation Column (39-C107), with a side stream returned to the Phenol Column as reflux. The bottoms product is circulated to the Solvent Recovery Scrubber (39-C110) with a side stream being cooled as phenol product and sent to storage in Tankage (Plant 20).

Gaseous overhead product from the Solvent Recovery Scrubber is returned to the Saturation Column and the bottoms product is recycled to the Phenol Column.

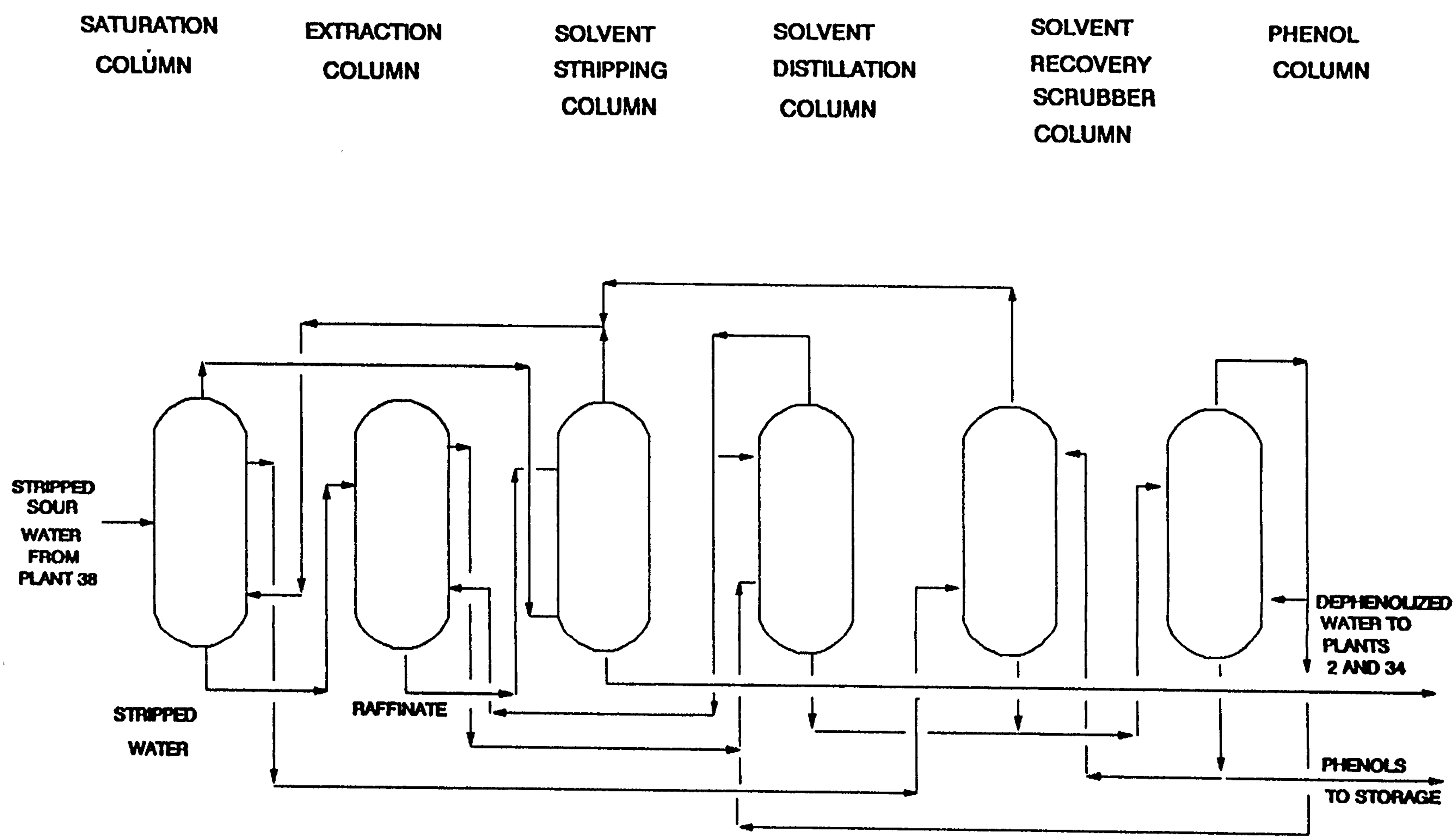


FIGURE 32.1

PROCESS FLOW SKETCH DEPHENOLIZATION

39-D-B-1

PHENOL.R

32.2 Material Balance

The overall material balance for the Phenol Recovery Unit (Plant 39) including the feed composition and predicted product quantities and compositions are presented in Table 32.1. The phenol stream will have a minimum purity of 87.5 percent mixed Phenols.

Table 32.1

PHENOL OVERALL MATERIAL BALANCE
POUNDS PER HOUR
WITH PHENOLIC WATER TO GASIFIERS

STREAM NO.	1 WASTE WATER FEED	30 COND. MAKEUP	24 N2 MAKEUP	26 CO2 MAKEUP	SOLV MAKEUP	3 SAT GAS TO INCIN.	20 PHENOL FREE WASTE WATER	32 PHENOL PROD.	OVERALL BALANCE
NITROGEN	0		224			163	61		0
H2	0						0		0
WATER	1342629	959				94	1343216	278	0
H2S	50					12	38		0
NH3 FREE	121						121		0
CO	0						0		0
CO2	7						7		0
C1	1						1		0
ORGANICS	460						430	30	0
PHENOLICS	2474						77	2397	0
SOLVENT					25		23	2	0
TOTAL	1345742	959	224	0	25	269	1343974	2707	0
TOTAL GPM	2685	2	0	0	0	0	2686	5	0

32.3 Major Equipm nt Summary

The equipment summary for the Phenol Recovery Unit is shown in Table 32.2.

Table 32.2

Major Equipment Summary

PLANT 39 – DEPHENOLIZATION

COLUMNS

Equipment No.	Equipment Description
39-C-101	Saturation Column
39-C-102	Extractor
39-C-103	Raffinate Separator
39-C-104	Extract Separator
39-C-105	Slop Drum
39-C-106	Solvent Stripper
39-C-107	Solvent Distillation Column
39-C-108	Reflux Drum
39-C-109	Compressor Suction Drum
39-C-110	Solvent Recovery Scrubber
39-C-111	Solvent Separator
39-C-112	Phenol Column
39-C-113	Crude Phenol Drum
39-C-114	Solvent/phenol Mix Drum
39-C-122	Solvent Drum

EXCHANGERS

Equipment No.	Equipment Description
39-E-101	Raffinate Heater
39-E-102	Solv Dist Col OHD Cond
39-E-103	SDolv Dist Col R/B
39-E-104	Crude Phenol Cooler
39-E-105	Phenol Col OHD Cond
39-E-106	Phenol Col R/B
39-E-107	Waste Water Cooler

Table 32.2 Major Equipm nt Summary - continued

PUMPS

Equipment No.	Equipment Description
39-G-101A/B	Raffinate Pump
39-G-102A/B	Slop Pump
39-G-103A/B	Extract Pumps
39-G-104A/B	Sour Water Pump
39-G-105A/B	Solvent R/F Pump
39-G-106A/B	Solv/Phenol Pump
39-G-107A/B	Crude Phenol Pump
39-G-108A/B	Solvent Make-up Pump

COMPRESSORS

Equipment No.	Equipment Description
39-K-101	Stripping Gas Comp.

32.4 Utility Summary

Steam:	
• 150 psig, saturated	22,716 lb/hr
• 50 psig saturated	61,567 lb/hr
Cooling water circulated at 87°F	4,471 gpm
Makeup Water	nil
Electricity (operating)	814 KW

33. PLANT 40

33. Plant 40 (G neral Site Pr paration)

33.0 Design Basis, Criteria and Considerations

The site is located in Southern Illinois with rail and road accessibility. The plant shall be built on a green field location, which will have to be made suitable for the purposes of building an industrial facility.

The preparation of the site involves the leveling of the approximately three square mile area, the addition of basic improvements such as roads fencing and drainage needed by the plant as a whole, and the placement of high load-bearing fills, pilings, spread footings and mat foundations for the plant structures in accordance with individual needs.

The general site is graded to a basic elevation of 650 feet above mean sea level (MSL) and the coal storage area is graded to 655 MSL. Most of the overburden removed in this operation is of low strength soil unsuitable for structural fill. It is stockpiled for to other uses.

Drainage of contaminated rain runoff from process and offplot areas is directed to ponds for treatment needed before plant usage. Uncontaminated storm runoff from building roofs, parking lots, outdoor storage areas and uncontaminated process plant areas is routed to the raw water storage pond.

33.1 Facility Description

Foundations

The low-strength soil extends on an average of 10 feet throughout most of the plant site.

Within plant units, this low-strength soil is completely excavated and stockpiled for other uses. Below the soil is a sandy mixture that is of a satisfactory strength for foundation support. The low-strength soil that was removed below MSL elevation is replaced with suitable structural fill borrowed elsewhere on the property.

Spread footings and mat foundations are placed at appropriate depths in the structural fills formed by compaction of the sand and placement of the structural fill.

Foundations supported by pilings are used instead of footings or mats for unusually heavy and settlement-sensitive structures and equipment. Two different capacity piles are used for foundations: 50 ton and 100 ton. End-bearing-type piling is used and the piles are driven with a design weight driver to "refusal."

Finish Grading and Drainage

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 water runoff is collected by catch basins and conveyed by means of buried pipes and open ditches to the raw water storage pond to the northeast of the plant, which are included in Sewers and Wastewater Treatment (Plant 34).

Sewers and Ponds

Sewers and containment ponds for treatment of contaminated waters from the process and offplot areas, sanitary effluents, landfill runoff and coal pile runoffs are included in Plant 34. Raw water storage is also covered by Plant 34.

Dikes for Tank Farm

Containment dikes for the tank farm area are of earthen construction with 3 to 1 side slopes. They are constructed from the excess low strength overburden material excavated and stored on the site.

R ads and Bridges

Plant roads are constructed of asphalt concrete on a crushed limestone base course which is placed on a compacted subgrade. 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 within the scope of Plant 40 and are of construction similar to that of plant roads.

A roadway approach embankment is constructed of structural quality fill for a new bridge from the existing highway to crossover existing railroad trackage. The fill is obtained on the property as described above for foundations.

Fencing

Perimeter fencing and gates are provided to restrict access. In addition, certain hazardous areas within the plant are contained by fencing.

Pre-construction Facilities

In order to facilitate site preparation work, temporary power generators, water purification facilities shall be provided. The base course of roads shall be laid out to provide easy access throughout the site. Temporary offices, telephone, canteen and toilet facilities shall be provided as soon as possible.

34. PLANT 41

34. Plant 41 (Buildings)

34.0 Design Basis, Criteria and Considerations

Five types of buildings are provided for different usages. The type of construction selected for each building is dependent on its location with respect to potential hazards, its criticality for plant operation and its function.

In addition to general good practice, the designs of the buildings include the incorporation of the recommendations or requirements of the following:

- Occupational Safety and Health Administration (OSHA)
- State of Illinois Codes
- Oil Insurance Association (OIA) Publication 101, Hydrorefining Process Units
- National Electrical Code

34.1 Facility Description

The five types of buildings are classified as types A, B, C, D or Administrative according to their major construction features. The types and their construction features are shown below.

<u>Type A</u>

Type A buildings house critical equipment and/or instrumentation for the continuous operation of the plant.

The structures are blast-proof. 3 to 3-1/2 psig design, in accordance with OIA, with air lock entrances and exits. Buildings are pressurized to 0.1 to 0.2 inches of water.

The supporting structure is steel framed with concrete walls on the outside. Bearing walls and steel columns support the roof framing of steel beams and decking. Structural parts are fireproofed with three-hour-rated materials.

Interior walls are plaster boards on metal studs or are concrete block. Ceilings are installed in all rooms except mechanical equipment rooms.

Buildings are provided with heating, air conditioning, lighting, glazing, hardware, carpeting, electrical, plumbing, and sanitary systems.

Type B

Type B buildings are the plant laboratory, the cafeterias, the medical building, and the change house.

The supporting structure is steel framed with masonry walls. Loadbearing walls and steel columns support the roof framing of steel beams and decking. Structural parts are fireproofed with three-hour-rated materials.

Interior walls are plaster boards on metal studs or are concrete block. Ceilings are installed in all rooms except mechanical equipment rooms.

Buildings are provided with heating, air conditioning, lighting, glazing, hardware, carpeting, electrical, plumbing, and sanitary systems.

Type C

Type C buildings serve a number of diverse functions which are generally plant operations or maintenance related. These buildings are steel-framed structures sheathed and roofed with prefabricated-building-type metal panels.

The structure is of rigid steel frame with steel-trussed roof frame of self-framing metal panels. Where required, the building frame is designed for the support of cranes and monorails. Roof and wall sheathing is factory finished. Compressor shelters have partial side covering only. Metal sandwich panels are used where buildings require insulation.

Office areas are heated and air conditioned with package units.

Buildings are provided with lighting, hardware, glazing, painting, electrical and plumbing systems. Sanitary facilities are provided only in those buildings in which they are required.

Type D

Type D buildings are for the transformer shelters and chemical storage. They have masonry walls and structural steel-framed roofs with decking cover.

Interior partitions and walls are concrete block. No finished ceilings are required.

Buildings are provided with lighting, hardware, glazing, painting, electrical and plumbing systems. Sanitary facilities are provided only in those buildings in which they are required.

Administrative

The Administration Building (which also contains the computer room) is identical in construction to that of type B buildings except that the exterior is finished with brick veneer masonry.

Fire Protection

All buildings have portable fire extinguishers. Some have hand-held extinguishers and others have these plus wheeled portable extinguishers in accordance with OSHA standards.

The laboratories and the computer room are protected by halogen-type extinguishing systems. Personnel alarms are provided for protection in buildings and halogen-type extinguishing systems. Water sprinkler systems are provided where applicable.

Fireproofing of structural members in building types A and B is in accordance with Specification 14222-N-6. For additional information on fire protection refer to Fire Systems (Plant 33).

Utilities and Other Services

Drinking water, compressed air and steam are provided where required. Gas is provided to the laboratories. Electric power is provided for general lighting, convenience outlets and air conditioning. Connected load for air conditioning of buildings and control rooms is estimated at 500 KW.

Telephones are provided as shown in Telecommunication Systems (Plant 42).

One ambulance is provided for the medical building and fire trucks for the fire station in Mobile Equipment (Plant 33).

34.2 Building List

Table 34.1 lists all buildings by name or function and shows the building type, linear dimensions, area and quantity.

Table 34.1 - Building List

DESCRIPTION	NUMBER REQUIRED	SIZE (FT)	AREA (FT^2)	TYPE
Distributed System Control Room				
Coal Liquefaction	1	70 x 70	4,900	A
Hydrotreaters & Gas Plant	1	70 x 70	4,900	A
By-products & waste water	1	50 x 70	3,500	A
Boiler Plant	1	50 x 70	3,500	A
Operating Equipment Rooms				
Tank Farm	1	20 x 26	520	A
Process Plants	15	20 x 26	7,820	A
Plant Laboratory	1	100 x 200	20,000	B
Change House (Clean and Dirty Laundry)	1	100 x 200	20,000	B
Cafeteria	1	100 x 200	20,000	B
Cafeteria	1	50 x 100	5,000	B
Medical	1	50 x 100	5,000	B
Ash Handling	1	80 x 150	12,000	C
Operator Shelters				
Coal Pile	2	10 x 20	400	C
Solid Waste Disposal	1	10 x 20	200	C
Cooling Water Tower	1	10 x 20	200	C
Water Pond	1	10 x 20	200	C
Tank Car Loading	1	10 x 20	200	C

DESCRIPTION	NUMBER REQUIRED	SIZE (FT)	AREA (FT^2)	TYPE
Tank Truck Loading	1	10 x 20	200	C
Gate Houses	3	20 x 20	1,200	C
Guard/Security	1	50 x 100	5,000	C
Switchgear Buildings				
34.5 kV	2	100 X 30	6,000	C
13.8 kV	2	100 X 30	6,000	C
Process Plant	17	30 x 30	15,300	C
Fire Station	1	60 x 80	4,800	C
Warehouse	1	200 x 400	80,000	C
Maintenance Buildings				
B-1	1	100 x 200	20,000	C
B-2	1	40 x 100	4,000	C
B-3	1	60 x 100	6,000	C
B-4	1	40 x 100	4,000	C
B-5	1	100 x 100	10,000	C
B-6	1	40 x 100	4,000	C
Garages				
Mobile Equipment	1	40 x 100	4,000	C
General	1	100 x 100	10,000	C
Compressor Shelters				
Plant 1.4	5	20 x 20	2,000	C
Roller Mill Shelters				
Plant 2	6	30 x 100	18,000	C
Plant 4	2	60 x 90	10,800	C
Plant 5	2	50 x 90	5,000	C

DESCRIPTION	NUMBER REQUIRED	SIZE (FT)	AREA (FT^2)	TYPE
Plant 6	15	30 x 40	18,000	C
Plant 10 (Air Blowers)	10	20 x 40	8,000	C
Plant 10	5	30 x 90	13,500	C
Pumps, Chemical Feed, Filter Shelters	15	20 x 30	9,000	C
Transformer Houses	4	50 x 26	5,200	C
Special Cleaning, Foam Chemicals	1	30 x 40	1,200	D
Administration Building	1	200 x 300	120,000 (2-story)	D

34.3 CONTROL SYSTEMS LIST

The overall concept for the Distributed Control System (DCS) and operator interface is to have one central control room, except for shipping and loading facilities. The central control room will have five operator consoles, one for each area, the supervisory computer and a DCS engineering console. Each area console will have three double stacked operator stations for each board operator expected to be assigned to each console plus three added operator stations and two printers. The central control building will also contain the racks for the controllers and Input/Output (I/O) serving process equipment located near the central control building.

The Shipping and Loading control building will contain all the controllers, I/O and operator interfaces serving the shipping and loading facilities.

Each of the four satellite buildings will contain the controllers and I/O for the process equipment surrounding each building. Each satellite will also contain one operator station for process information display to the field operators.

The Honeywell DCS has been scoped to have a separate Logic Control Network (LCN) highway system for each of the five areas. The sizing of the DCS equipment and redundancy philosophy are the same as used on previous estimates. The redundant Process Manager (PM)controllers are sized to each handle 50 control valves. The redundant PM modules control I/O, and thermocouple multiplexer cards for non-control thermocouples.

The overall I/O summary list by area of the plant is shown in Table 34.2. The individual area TDC 3000 requirements for areas 1 through 5 are shown in Tables 34.3 through 34.7. The engineering, computing and maintenance TDC 3000 requirements are shown in Table 34.8.

TABLE 34.2

I/O SUMMARY BY AREA, PROJECT NO. 20952

PLANT	UNITS CONTROLLED	TOTAL	DI	DO	HLAI	LLAI	AO	EQUIV. NO. CV'S	BOARD OPERS	OPERATOR STATIONS	TRAINS	AVG. WIRING DIST (FT)
1	COAL CLEANING	120	120	0	0	0	0	0			6	3000
1.4	GRIND & DRY	1020	480	360	0	120	60	60			12	2000
9	GASIFICATION	7110	1777	1208	1635	1778	711	711			7	700
10	AIR SEP.	850	212	144	196	213	85	85			5	400
TOTAL	AREA 1	8960						856	6	20		
2	COAL LIQUEFACTION	5280	1320	898	1214	1320	528	528			6	1200
8.1	SOLVENT DEASHING	240	60	41	55	60	24	24			1	400
TOTAL	AREA 2	5520						552	4	14		
3	GAS PLANT	980	245	167	225	245	98	98			2	1000
4	NAPHTHA HTU	640	160	109	147	160	64	64			2	1000
5	GAS OIL HTU	1280	320	218	294	320	128	128			2	600
6	HYDROGEN PURIF	1680	420	286	386	420	168	168			2	600
11	SULFUR RECVRY	2400	600	408	552	600	240	240			5	700
38	AMMONIA REMVL	540	135	92	124	135	54	54			1	600
39	PHENOL REMVL	670	168	114	154	167	67	67			1	1000
TOTAL	AREA 3	8190						819	5	16		
19	FLARE	30	8	5	7	7	3	3			1	5000
20	STORAGE TNKS	420	105	71	97	105	42	42			32 TANK	4000
22	SHIPPING	20	5	3	5	5	2	2			1	500
25	CATALYST HDLG	--------									1	--------
34	WASTEWATER	680	170	116	156	170	68	68			1	1800
24	SOLID WASTE	--------									1	--------
23	LOADING	84	36	24	12	12	0	0			6RR,6TR	2000
TOTAL	AREA 4	1234						115	2	6		
30	ELECT. DIST.	12	12	0	0	0	0	0			6 CNTRS	500
31	STM & POWER	2583	1480	75	469	469	90	90			5 GT,2S	800
32	H2O SYSTEM	345	150	150	15	15	15	15				5000
33	FIRE PROTECT.	54	15	10	14	15	0	0			3 LOOPS	1000
35	INST. & PLANT AIR	30	7	5	7	8	3	3				800
TOTAL	AREA 5	3024						108	2	6		
41	BUILDINGS	66	60	0	6	0	0	0				
GRAND TOTALS		27014	7897	4504	5770	6344	2450	2450	19	72		

OPERATOR STATIONS INCLUDE 3 FOR ENGINEERING AND 5 REMOTE STATIONS

TABLE 34.3

HONEYWELL TDC 3000 REQUIREMENTS -- AREA 1

EQUIPMENT & QUANTITIES

20	Double-stacked Universal Stations with station electronics, touchscreens, operator keyboards, one engineer's keyboard
1	Remote Universal station with touchscreens, operator keyboard, and station electronics
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
4	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateways/Hiway Gateway (redundant)
2	PLC Gateway/Hiway Gateway (non-redundant for OEM packages)
4	Network Interface Modules, redundant
19	Redundant Process Managers with I/O cabinents and FTA cards
	Computer communications software
	LCN Cable
	UCN Cable
	UCN Cable extenders
1	Flagstaff Engineering Drive
2	ASPI 46 printers
1	Logic system (PLC's, CPC's)

TABLE 34.4

HONEYWELL TDC 3000 REQUIREMENTS -- AREA 2

EQUIPMENT & QUANTITIES

14	Double-stacked Universal Stations with station electronics, touchscreens, operator keyboards, one engineer's keyboard
1	Remote Universal station with touchscreens, operator keyboard, and station electronics
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
2	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateway/Hiway Gateway (redundant)
1	PLC Gateway/Hiway Gateway (non-redundant for OEM packages)
3	Network Interface Modules, redundant
11	Redundant Process Managers with I/O cabinents and FTA cards
	Computer communications software
	LCN Cable
	UCN Cable
	UCN Cable extenders
1	Flagstaff Engineering Drive
2	ASPI 46 Printers
1	Logic system (PLC's, CPC's)

TABLE 34.5

HONEYWELL TDC 3000 REQUIREMENTS -- AREA 3

EQUIPMENT & QUANTITIES

18	Double-stacked Universal Stations with station electronics, touchscreens, operator keyboards, one engineer's keyboard
1	Remote Universal station with touchscreens, operator keyboard, and station electronics
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
6	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateway/Hiway Gateway (redundant)
2	PCL Gateway/Hiway Gateway (non-redundant for OEM packages)
4	Network Interface Modules, redundant
17	Redundant Process Managers with I/O cabinents and FTA cards
	Computer communications software
	LCN Cable
	UCN Cable
	UCN Cable extenders
1	Flagstaff Engineering Drive
2	ASPI 46 Printers
1	Logic system (PLC's, CPC's)

TABLE 34.6

HONEYWELL TDC 3000 REQUIREMENTS -- AREA 4

EQUIPMENT & QUANTITIES

6	Double-stacked Universal Stations with station electronics, touchscreens, operator keyboards
1	Remote Universal station with touchscreens, operator keyboard, and station electronics
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
1	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateway/Hiway Gateway (redudant)
1	PLC Gateway/Hiway Gateway (non-redundant for OEM packages)
1	Network Interface Modules, redundant
3	Redundant Process Managers with I/O cabinents and FTA cards
	Computer communications software
	LCN Cable
	UCN Cable
	UCN Cable extenders
1	Flagstaff Engineering Drive
2	ASPI 46 Printers
1	Logic system (PLC's, CPC's)

TABLE 34.7

HONEYWELL TDC 3000 REQUIREMENTS -- AREA 5

EQUIPMENT & QUANTITIES

6	Double-stacked Universal Stations with station electronics, touchscreens, operator keyboards
1	Remote Universal station with touchscreens, operator keyboard, and station electronics
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
1	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateway/Hiway Gateway (redundant)
1	PLC Gateway/Hiway Gateway (non-redundant for OEM packages)
1	Network Interface Modules, redundant
3	Redundant Process Managers with I/O cabinents and FTA cards
	Computer communications software
	LCN Cable
	UCN Cable
	UCN Cable extenders
1	Flagstaff Engineering Drive
2	ASPI 46 Printers
1	Logic system(PLC's, CPC's)

TABLE 34.8

TDC 3000 REQUIREMENTS – ENGINEERING, COMPUTING & MAINTENANCE

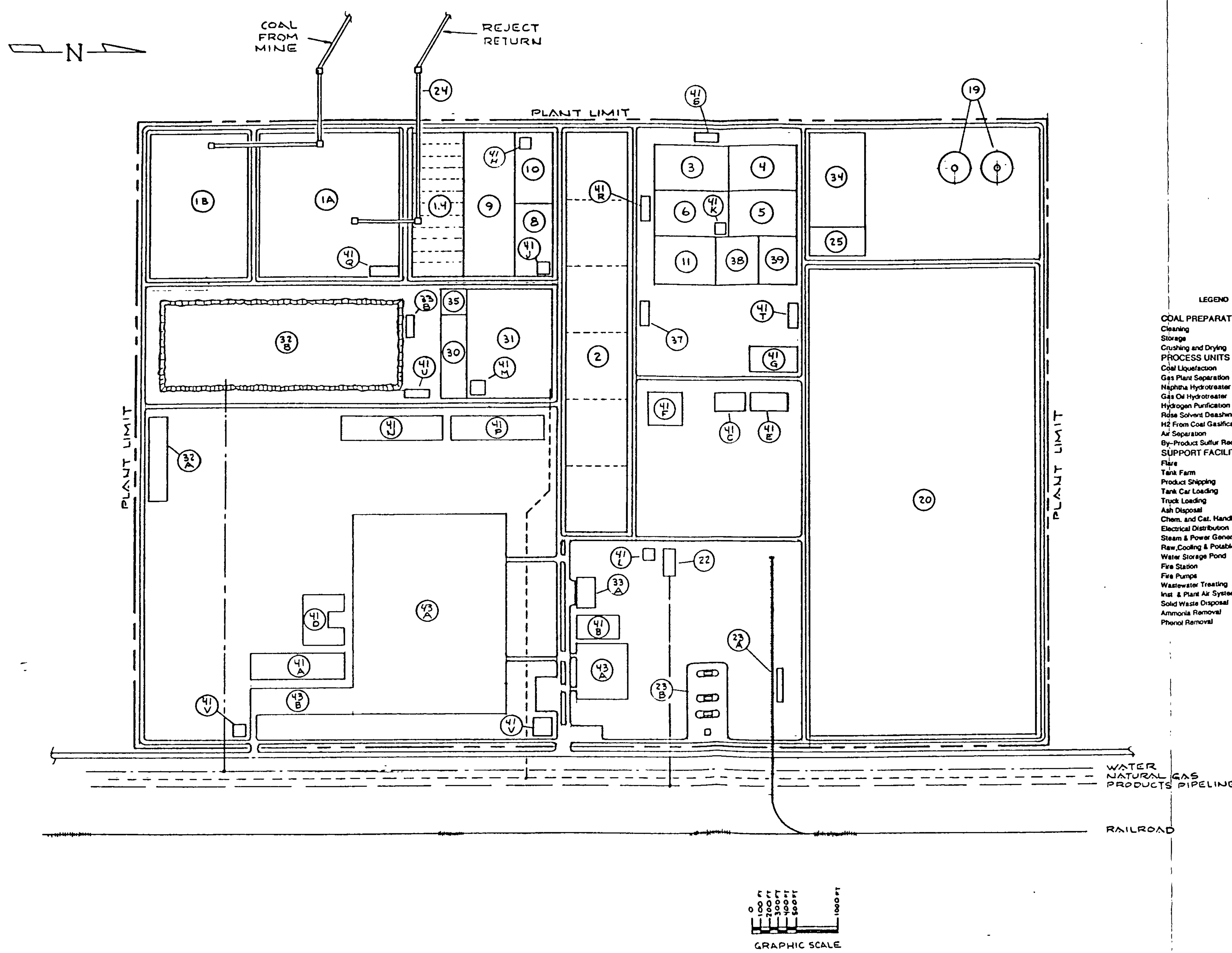
EQUIPMENT & QUANTITIES

3	Universal Stations with station electronics, touchscreens, engineer and operator keyboards
2	Work surfaces
2	Floppy drives
2	Bernoulli drives
1	WREN III History Modules
1	Application Module
1	Computer Module
1	PLC Gateways
1	Network Interface Modules, redundant
1	Midrange DEC/VAX computer
2	VAX workstations
2	VAX highspeed printers
	Computer communications software
1	ASPI 46 Printers

35. PLANT 42

36. Ov rall Sit Plan

The preliminary conceptual Site Plan for the D.O.E. Coal Liquefaction Base-Line Design Study is shown in FIG. 36.1 (DWG #600-A-D-100). The site plan is based on the approximate plot plans required for the various plants and the Design Criteria. The site plan assumes a mine mouth operation with water and natural gas availability. It also assumes access to a pipeline, rail and highway.



LEGEND	NO.	LEGEND	NO.
COAL PREPARATION		**ADMINISTRATION**	
Cleaning	1A	Administration	41A
Storage	1B	Medical	41B
Crushing and Drying	1.4	Change	41C
PROCESS UNITS		Cafeteria	41D
Coal Liquefaction	2	Lunch Room	41E
Gas Plant Separation	3	Laboratory	41F
Naphtha Hydrotreater	4	Central Control House	41G
Gas Oil Hydrotreater	5	Satellite Control Bldg. Area 1	41H
Hydrogen Purification	6	Satellite Control Bldg. Area 2	41J
Rose Solvent Deashing	8	Satellite Control Bldg. Area 3	41K
H2 From Coal Gasification	9	Control Room Area 4	41L
Air Separation	10	Satellite Control Bldg. Area 5	41M
By-Product Sulfur Recovery	11	Warehouse	41N
SUPPORT FACILITIES		Maintenance	41P
Flare	19	Maintenance Sub Station Area 1	41Q
Tank Farm	20	Maintenance Sub Station Area 2	41R
Product Shipping	22	Maintenance Sub Station Area 3	41S
Tank Car Loading	23A	Maintenance Sub Station Area 4	41T
Truck Loading	23B	Maintenance Sub Station Area 5	41U
Ash Disposal	24	Gate House/Security	41V
Chem. and Cat. Handling	25	Employee Parking	43A
Electrical Distribution	30	Visitor Parking	43B
Steam & Power Generation	31		
Raw,Cooling & Potable H2O	32A		
Water Storage Pond	32B		
Fire Station	33A		
Fire Pumps	33B		
Wastewater Treating	34		
Inst & Plant Air Systems	35		
Solid Waste Disposal	37		
Ammonia Removal	38		
Phenol Removal	39		

FIGURE 36.1

BECHTEL CORPORATION
HOUSTON

D.O.E. COAL LIQUEFACTION
BASE-LINE DESIGN STUDY

CONCEPTUAL SITE PLAN

JOB No.	DRAWING No.	REV
20952	600-A-D100	A

22 X 34 "D" SIZE

37. OVERALL STAFFING PLAN

37. Overall Staffing Plan

The overall staffing plan for the liquefaction complex is based on the following premises:

- The complex is operated by a major oil company with support from corporate engineering
- Process plants are divided into 5 areas with dedicated maintenance for each area
- Contract maintenance will be utilized during any plant turn-around and other non-routine maintenance
- Complex is operated from one central control house, except for shipping and loading
- Fin-Fan usage has been maximized to minimize water usage
- Steam and power generation, (Plant 31) stands alone and is not connected to any electrical power grid
- Coal is washed at the complex, rather than the mine
- Effluent discharge to public waters is permitted but minimized.

Figures 37.1 through 37.7 describes the organization and manpower for overall plant, laboratory, engineering, environment, health, safety and security, administrative, and maintenance department, respectively.

The detailed number and function for all labor requirements by plant area and by function along with payroll costs will be covered in Task III.

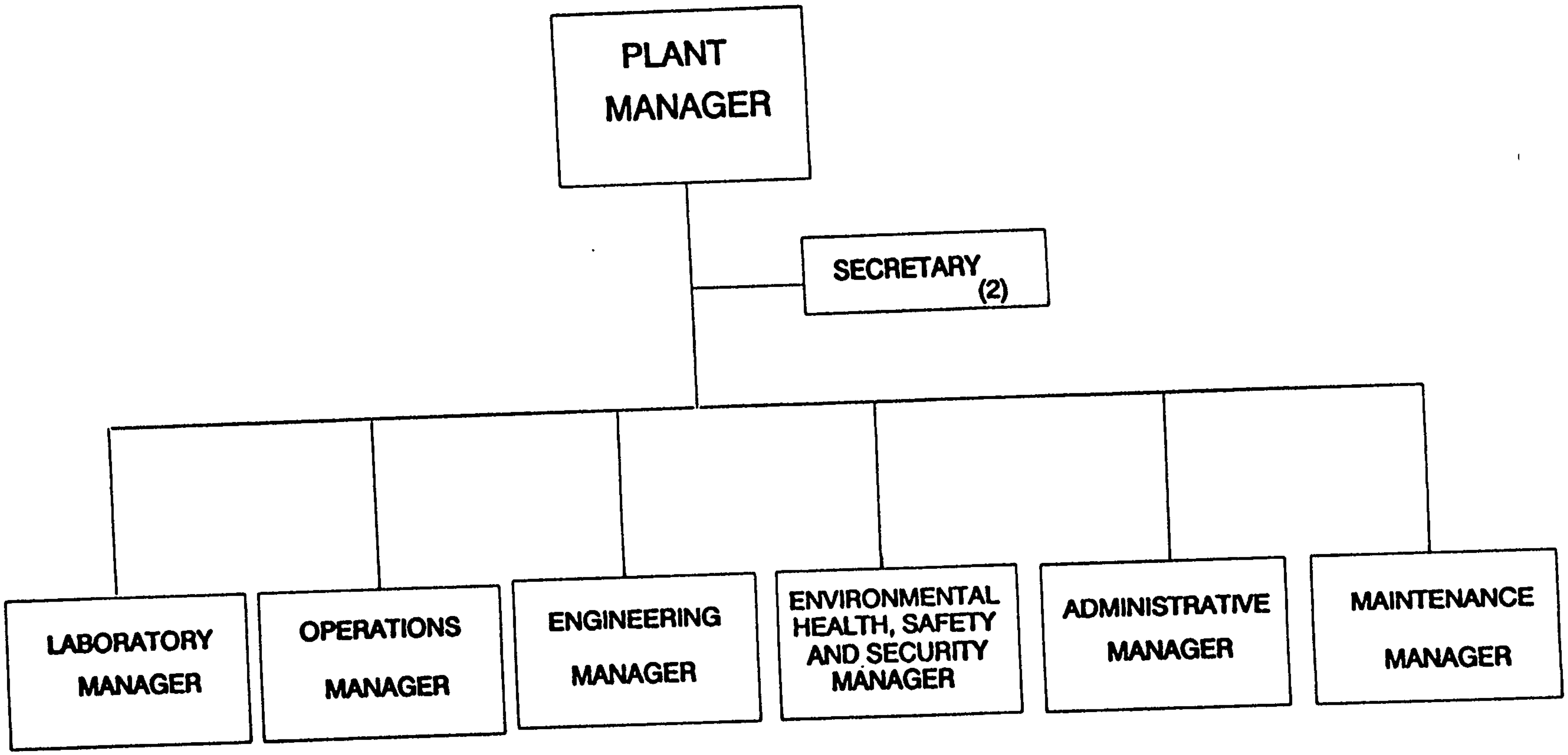


FIGURE 37.1

OVERALL PLANT ORGANIZATION

LABORATORY
ORGANIZATION
AND PERSONNEL

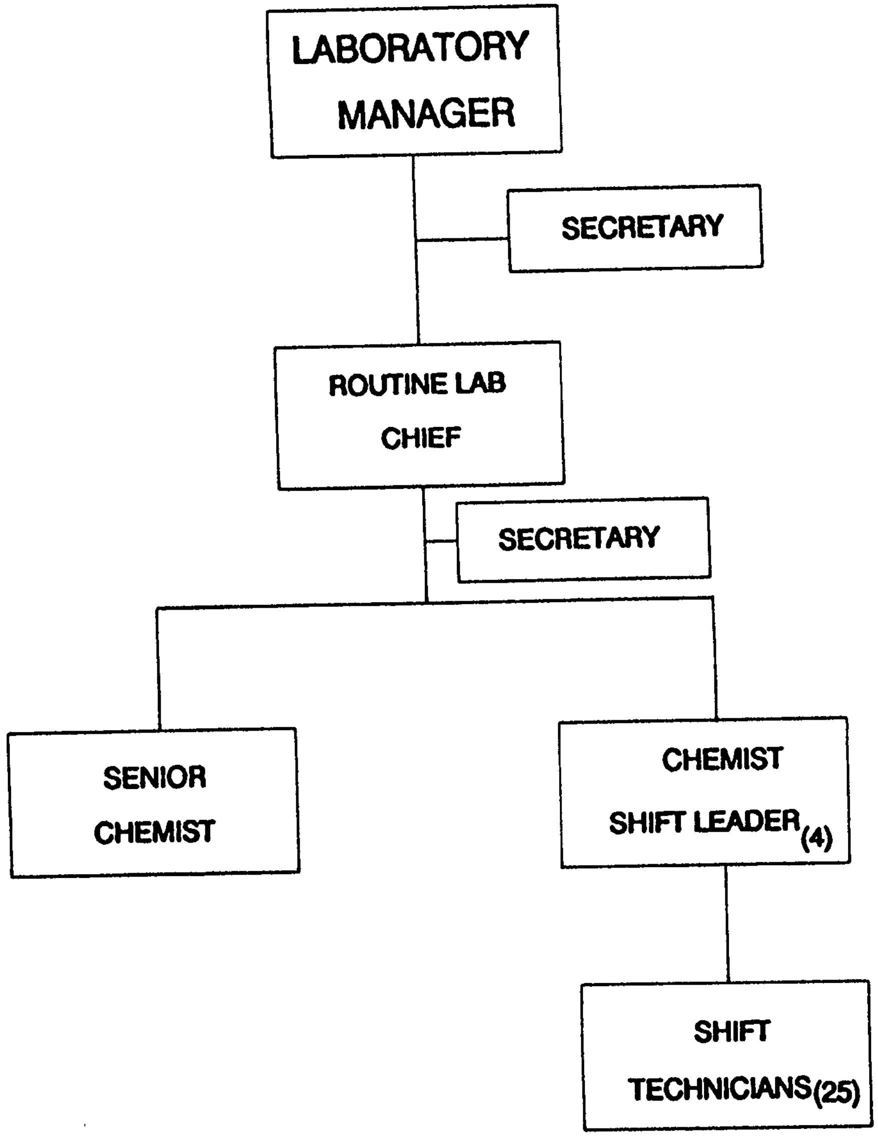


FIGURE 37.2

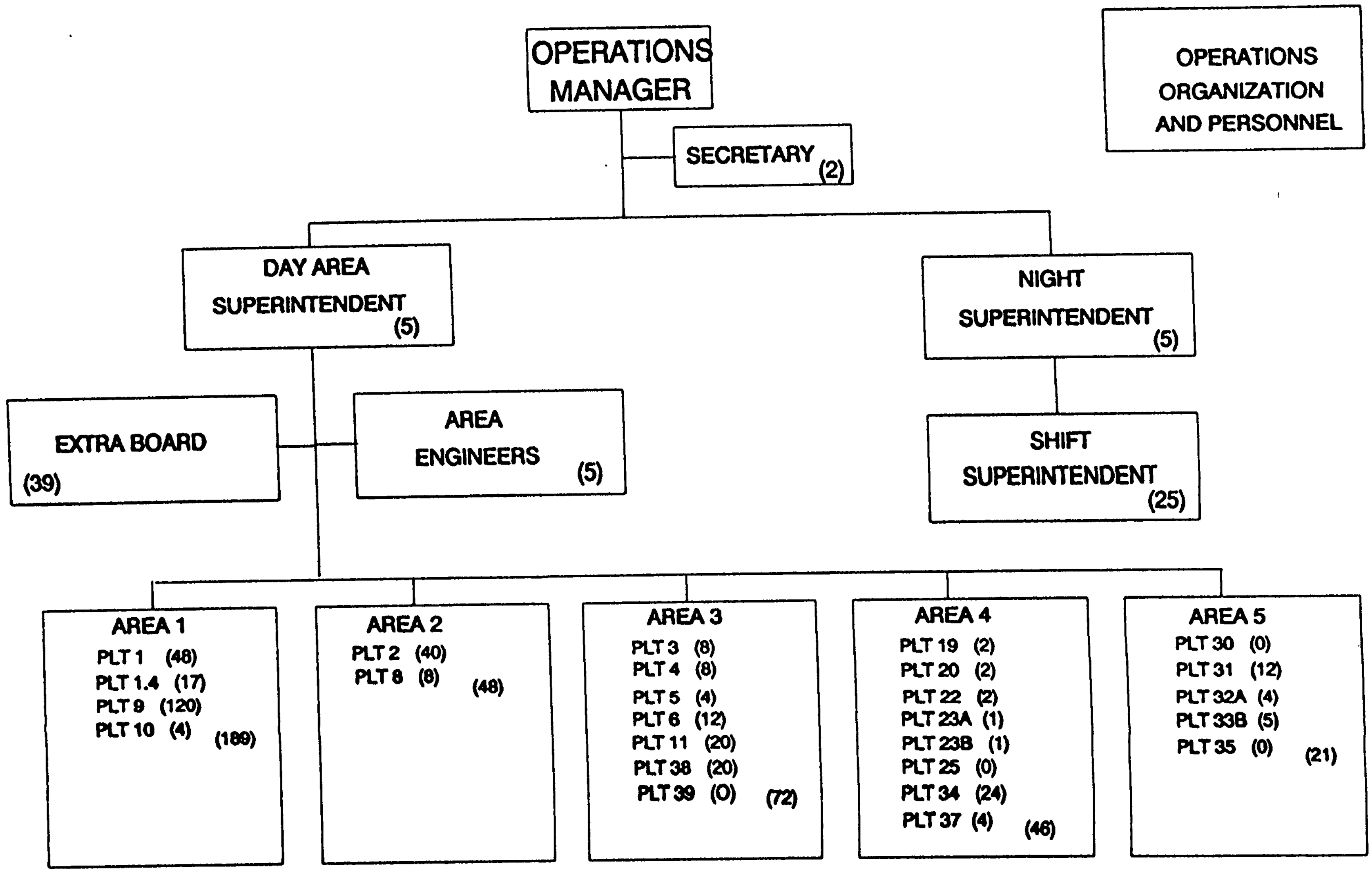

OPERATIONS ORGANIZATION AND PERSONNEL
OPERATIONS MANAGER
SECRETARY (2)
DAY AREA SUPERINTENDENT (5)
NIGHT SUPERINTENDENT (5)
EXTRA BOARD (39)
AREA ENGINEERS (5)
SHIFT SUPERINTENDENT (25)
AREA 1
PLT 1 (48)
PLT 1.4 (17)
PLT 9 (120)
PLT 10 (4)
(189)
AREA 2
PLT 2 (40)
PLT 8 (8)
(48)
AREA 3
PLT 3 (8)
PLT 4 (8)
PLT 5 (4)
PLT 6 (12)
PLT 11 (20)
PLT 38 (20)
PLT 39 (O)
(72)
AREA 4
PLT 19 (2)
PLT 20 (2)
PLT 22 (2)
PLT 23A (1)
PLT 23B (1)
PLT 25 (0)
PLT 34 (24)
PLT 37 (4)
(46)
AREA 5
PLT 30 (0)
PLT 31 (12)
PLT 32A (4)
PLT 33B (5)
PLT 35 (0)
(21)

FIGURE 37.3

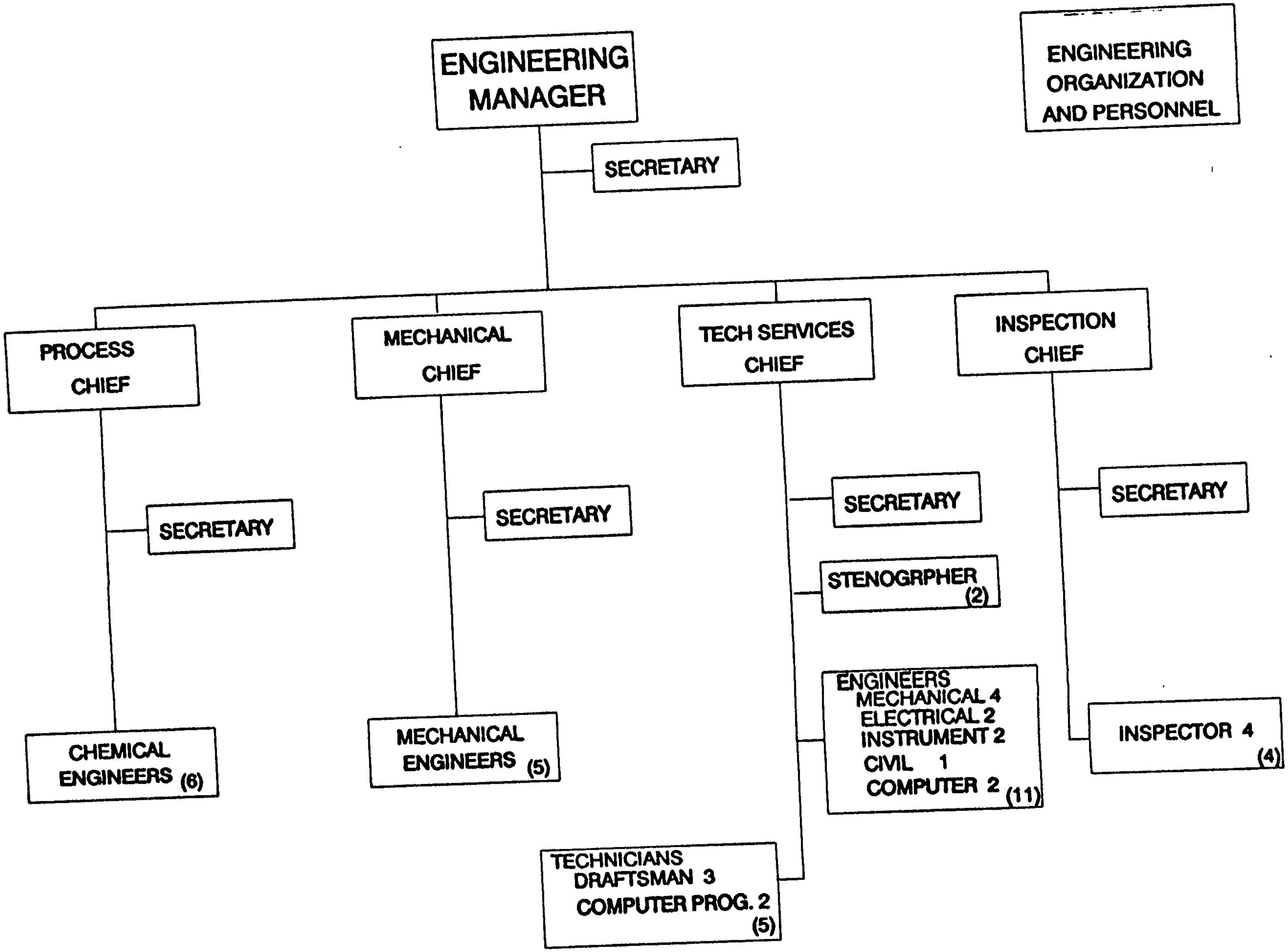
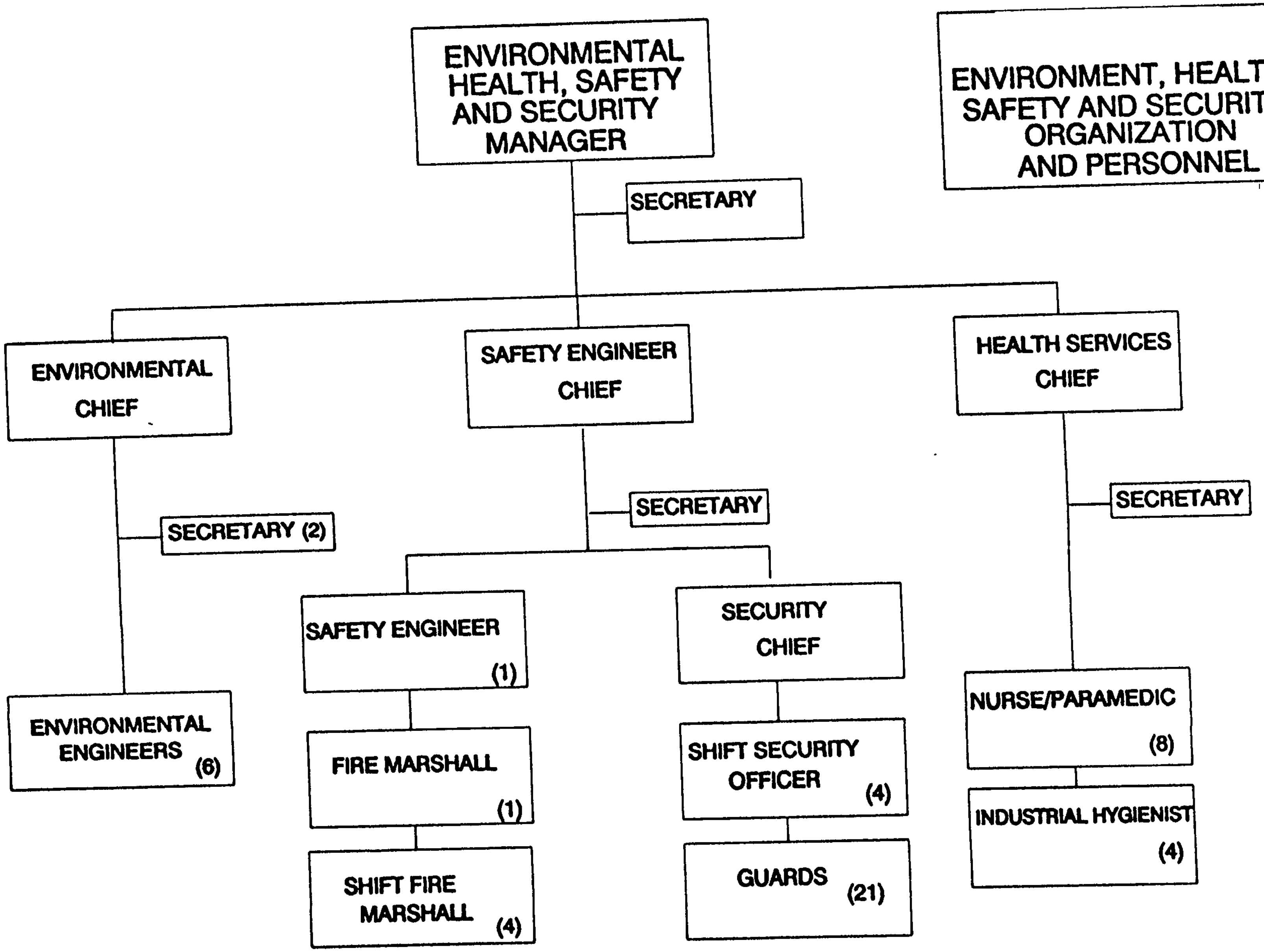

ENGINEERING MANAGER
SECRETARY
ENGINEERING ORGANIZATION AND PERSONNEL
PROCESS CHIEF
SECRETARY
CHEMICAL ENGINEERS (6)
MECHANICAL CHIEF
SECRETARY
MECHANICAL ENGINEERS (5)
TECH SERVICES CHIEF
SECRETARY
STENOGRPHER (2)
ENGINEERS
MECHANICAL 4
ELECTRICAL 2
INSTRUMENT 2
CIVIL 1
COMPUTER 2 (11)
TECHNICIANS
DRAFTSMAN 3
COMPUTER PROG. 2 (5)
INSPECTION CHIEF
SECRETARY
INSPECTOR 4 (4)

FIGURE 37.4



ENVIRONMENT, HEALTH, SAFETY AND SECURITY ORGANIZATION AND PERSONNEL

FIGURE 37.5

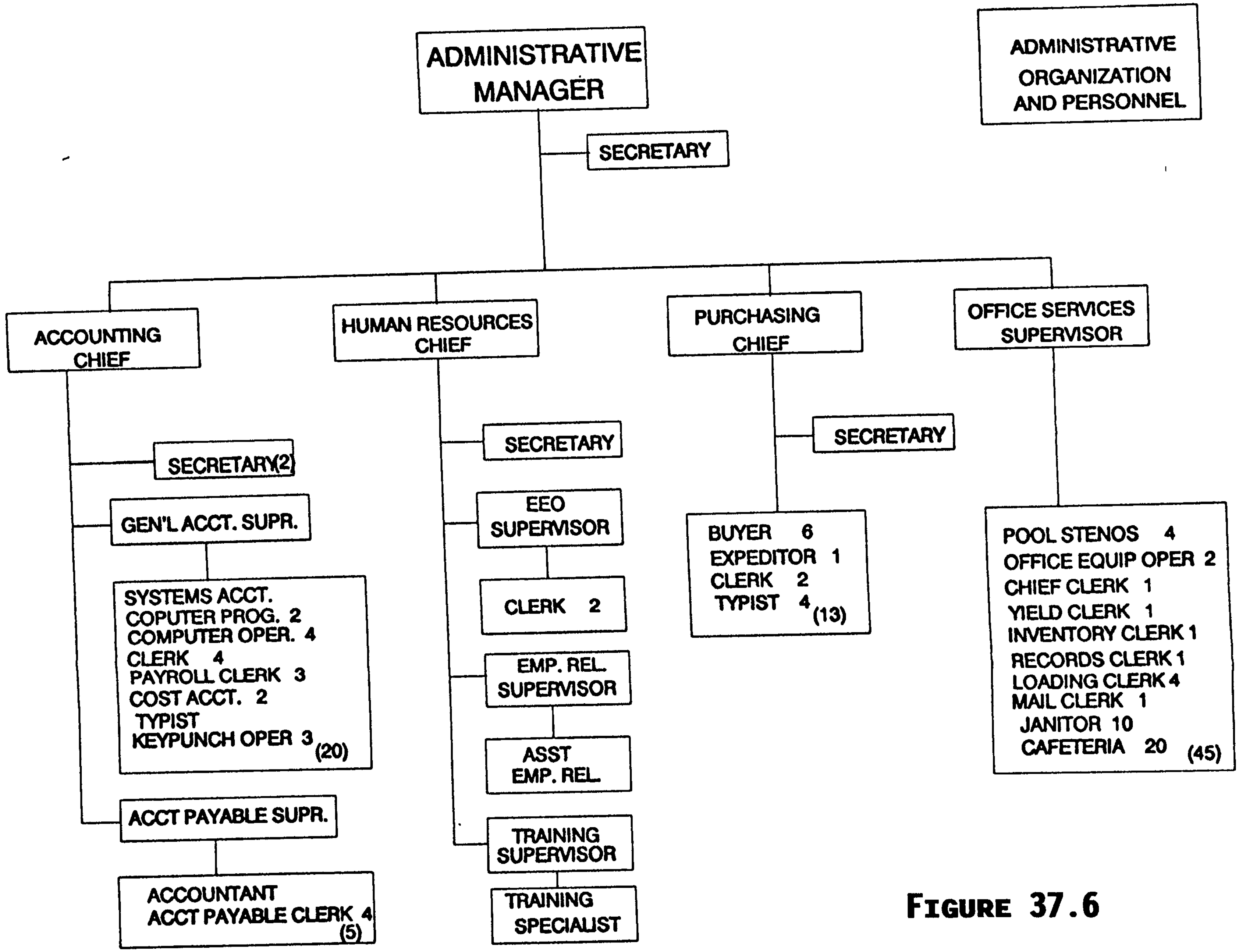

ADMINISTRATIVE MANAGER
SECRETARY
ADMINISTRATIVE ORGANIZATION AND PERSONNEL
ACCOUNTING CHIEF
SECRETARY(2)
GEN'L ACCT. SUPR.
SYSTEMS ACCT.
COPUTER PROG. 2
COMPUTER OPER. 4
CLERK 4
PAYROLL CLERK 3
COST ACCT. 2
TYPIST
KEYPUNCH OPER 3
(20)
ACCT PAYABLE SUPR.
ACCOUNTANT
ACCT PAYABLE CLERK 4
(5)
HUMAN RESOURCES CHIEF
SECRETARY
EEO SUPERVISOR
CLERK 2
EMP. REL. SUPERVISOR
ASST EMP. REL.
TRAINING SUPERVISOR
TRAINING SPECIALIST
PURCHASING CHIEF
SECRETARY
BUYER 6
EXPEDITOR 1
CLERK 2
TYPIST 4
(13)
OFFICE SERVICES SUPERVISOR
POOL STENOS 4
OFFICE EQUIP OPER 2
CHIEF CLERK 1
YIELD CLERK 1
INVENTORY CLERK 1
RECORDS CLERK 1
LOADING CLERK 4
MAIL CLERK 1
JANITOR 10
CAFETERIA 20
(45)

FIGURE 37.6

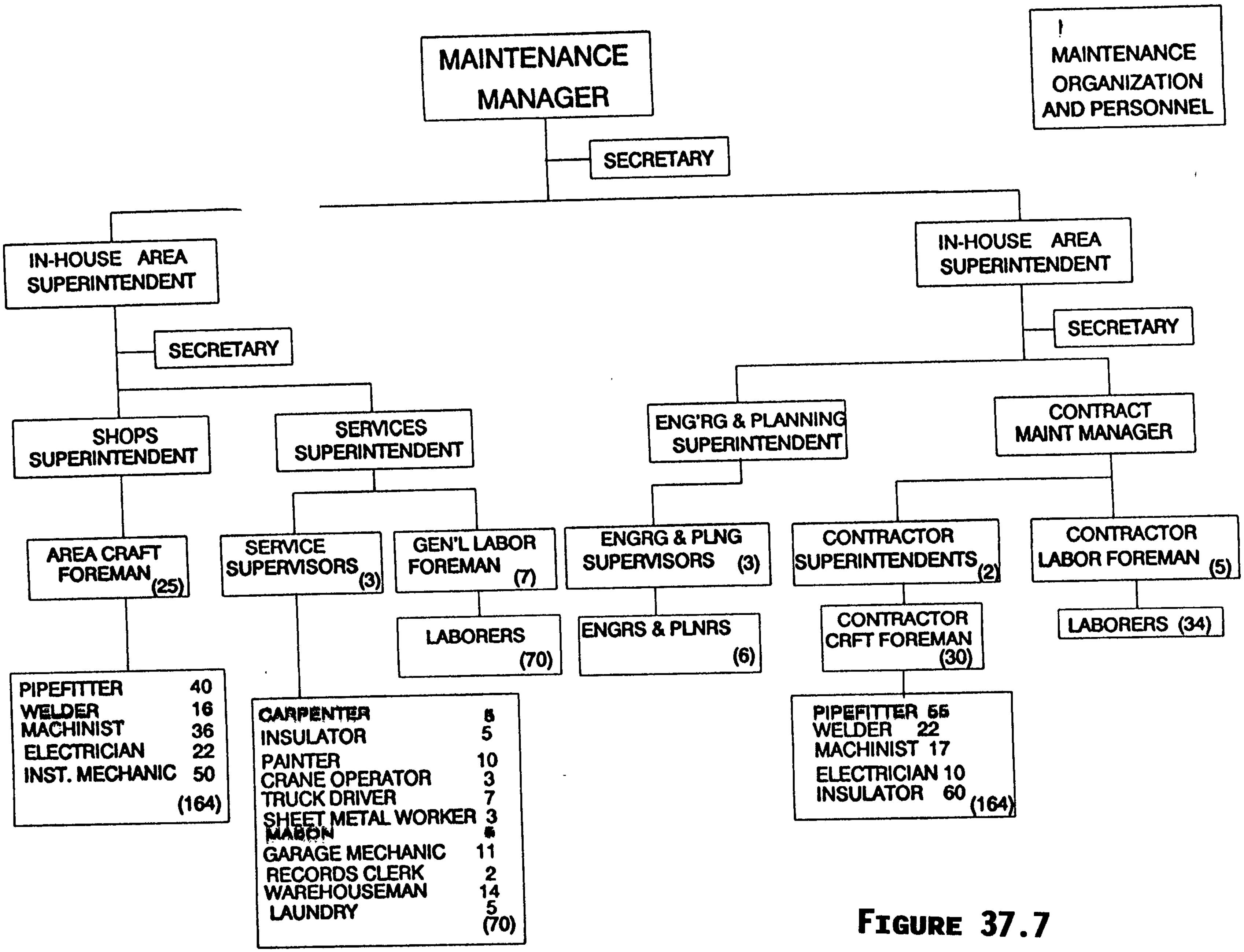

MAINTENANCE ORGANIZATION AND PERSONNEL
MAINTENANCE MANAGER
SECRETARY
IN-HOUSE AREA SUPERINTENDENT
SECRETARY
SHOPS SUPERINTENDENT
SERVICES SUPERINTENDENT
AREA CRAFT FOREMAN (25)
SERVICE SUPERVISORS (3)
GEN'L LABOR FOREMAN (7)
LABORERS (70)
PIPEFITTER 40
WELDER 16
MACHINIST 36
ELECTRICIAN 22
INST. MECHANIC 50
(164)
CARPENTER 8
INSULATOR 5
PAINTER 10
CRANE OPERATOR 3
TRUCK DRIVER 7
SHEET METAL WORKER 3
MASON
GARAGE MECHANIC 11
RECORDS CLERK 2
WAREHOUSEMAN 14
LAUNDRY 5
(70)
IN-HOUSE AREA SUPERINTENDENT
SECRETARY
ENG'RG & PLANNING SUPERINTENDENT
CONTRACT MAINT MANAGER
ENGRG & PLNG SUPERVISORS (3)
ENGRS & PLNRS (6)
CONTRACTOR SUPERINTENDENTS (2)
CONTRACTOR CRFT FOREMAN (30)
PIPEFITTER 55
WELDER 22
MACHINIST 17
ELECTRICIAN 10
INSULATOR 60
(164)
CONTRACTOR LABOR FOREMAN (5)
LABORERS (34)

FIGURE 37.7

38. ENVIRONMENTAL COMPLIANCE STRATEGY/PLAN

38. ENVIRONMENTAL COMPLIANCE STRATEGY/PLAN

This section summarizes the major Federal and Illinois environmental considerations that will need to be addressed in the coal liquefaction study during the pre-construction, construction, and operation phases of the proposed southern Illinois commercial scale coal liquefaction facility.

The proposed plant, which is a baseline process configuration contains a two-stage catalytic-catalytic closed coupled reactor with ash recycle and ROSE^{SR} deashing with no residuum product. The facility will produce approximately 60,000 BPSD of liquid products plus propane and mixed butane, and will be sited at the mouth of the coal mine (#6 Illinois coal). Other by-products generated from the plant manufacturing operations (e.g. sulfur, ammonia, and phenol) will be sold as marketable products.

The Illinois Environmental Protection Agengy (IEPA) can assist in the identification and understanding of the pollution control requirements which apply to the project. They can also assist in the review of the adequacy of the proposed pollution control measures. When permits are required, the IEPA can further aid in identifying the material to be assembled for permit applications and in expediting review of the applications once submitted.

The IEPA's handling of individual air, water, and solid and hazardous waste permits is coordinated for significant projects, and also when requested by an applicant. This assures that a project is fully permitable by the IEPA before any single permit will be issued. It also means that development of one aspect of a project will not begin until all aspects of the project are adequately addressed at the conceptual level. Coordination can be achieved either by submitting all applications at the same time, or by supplying a comprehensive project plan with the first application.

The U.S. Environmental Protection Agency authorizes the IEPA to act on most permit applications within 90 days. This period is extended to 180 days for permit applications involving the development of a landfill, or when public notice and opportunity for public hearing are required by state or federal regulations as anticipated for this project.

Although environmental regulations, standards, and design considerations relative to the proposed coal liquefaction facility have been provided in this document, the final acceptability from the regulatory agencies will be determined at the time of permit submittal. After subsequent discussions with the various regulatory agencies can the performance requirements and regulatory can applicability be better defined.

There are several pertinent environmental policies and regulations which need to be addressed. These are grouped under eight categories as shown below:

38.1	National Environmental Policy Act (NEPA)
38.2	Air pollution Control Regulations
38.3	Solid and Hazard Waste Regulations
38.4	Water Pollution Control Regulations
38.5	Toxic Substances Control Act
38.6	Occupational Safety and Health Act (OSHA)
38.7	Noise Regulations
38.8	Federal Aviation Administration (FAA) Policies

38.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

The National Environmental Policy Act (NEPA) provides for the consideration of environmental consequences of federal actions. Under this Act, all federal agencies must submit an Environmental Impact Statement (EIS) for any project that directly or indirectly affects the human environment and uses federal funding, federal land leasing, or requires federal permits for operation.

NEPA also created a Council for Environmental Quality (CEQ). It is the duty of this council to review all environmental impact statements and make recommendations on the environmental merits of federal actions. The council also develops and recommends policies to enhance the environmental quality of the United States.

Environmental Impact Statements

Federal agencies begin to assess the environmental impact of a project when they begin the technical and economic feasibility studies. If this initial assessment indicates a significant environmental effect, the agency prepares a draft EIS to be circulated with the project proposal. The United States Environmental Protection Agency (EPA) has been designated as the lead agency for the EIS. The draft EIS should contain a discussion of the following topics:

- a complete description of the proposed project
- a discussion of both the positive and negative effects on the environment
- a discussion of the relationship of the proposed action to land use plans and policies
- an evaluation of primary, secondary, direct and indirect environmental impacts
- a thorough discussion of alternatives to the proposed action including environmental consequences
- any unavoidable negative environmental effects such as air or water pollution
- the relationship between the short and long-term effects of the project
- other interests and considerations that might offset the negative environmental aspects of the proposed action

The draft EIS must first receive an internal review by the initiating agency. Next, it is sent for review to other federal agencies having jurisdiction or special expertise in fields affected by the project. The EPA must also review each draft EIS prepared. The state and local agencies in the area of the proposed project are also provided with copies of the draft EIS. The draft should be made available to interested private citizens or groups of citizens. Each of the above groups may submit written comments and recommendations for improvements to, or alternatives for, the project under consideration. If a significant number of comments are received, a public hearing will be held on the EIS draft. The EIS process typically requires a significant amount of design and detailed engineering and operating information to support the impact assessment activities.

At the conclusion of the review process, a final draft EIS is prepared. It should include references to responsible opposing points of view raised in the review period. A copy or summary of all comments received during the review period should be attached to the final draft. A copy of the final draft EIS should be sent to each reviewer and to the EPA. Ten copies of the EIS and five copies of the comments should be sent to the Council for Environmental Quality (CEQ). A period of ninety days is then allowed for further comments before the CEQ makes a final recommendation on the proposal.

Activities Authorized by the Army Corps of Engineers

The Army Corps of Engineers regulation 33 CFR 320 outlines the general criteria used to evaluate all Corps permit applications. This regulation is designed to protect wetlands, floodplains, navigation, surface and groundwater quality, fish and wildlife, and historical and archaeological resources.

Wetlands Protection

The Corps regulates activities in wetlands to avoid adverse impacts, where possible, and to minimize destruction and to preserve the values of wetlands pursuant to Executive Order 11990 entitled "Protection of Wetlands." The Corps will consider whether the proposed activity is primarily dependent on being located in or in close proximity to the aquatic environment and whether feasible alternative sites are available. The Corps will also consult with various federal agencies to assess the cumulative effects of activities in the region. Avoidance or minimization of impacts on wetlands is an appropriate project strategy. Mitigation considerations are required if there is an impact on wetlands.

Floodplain Management

The Corps of Engineers has established regulations for activities in the floodplain, pursuant to Executive Order 11988 on Floodplain Management. An evaluation must be performed of the activities located in a 100-year floodplain which require a Department of the Army permit to protect the public interest. An evaluation is necessary in order to determine if alternatives exist to avoid possible adverse effects and, if not, to decide if development in the floodplain should occur.

Fish and Wildlife

Consideration of the impact of the activity on fish and wildlife is a major concern of the Army Corps of Engineers. In accordance with the Fish and Wildlife Coordination Act, the Corps of Engineers will consult with the Regional Director, U.S. Fish and Wildlife Service, and the head of the agency responsible for fish and wildlife for the state in which the work is to be performed, with a view to the conservation of wildlife resources by prevention of their direct and indirect loss and damage due to the activity proposed in a permit application. They will give much emphasis to these views on fish and wildlife considerations in evaluating the application. The applicant will be urged to modify his proposal to eliminate or mitigate any damage to such resources, and in appropriate cases, the permit may be conditioned to accomplish this purpose.

Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act gives the Army Corps of Engineers a mandate to prohibit the obstruction or alteration and construction of any structure in or over any navigable water of the United States without a permit.

Water Quality

Applications for permits for activities which may affect water quality and discharge of dredge or fill material will be evaluated for compliance with applicable effluent limitations, water quality standards, and management practices during the construction, operation, and maintenance of the proposed activity. State certification of compliance with applicable effluent limitations and water quality standards required under provisions of the Clean Water Act will be considered conclusive with respect to water quality considerations unless the Regional Administrator of the U.S. Environmental Protection Agency advises of other water quality aspects to be taken into consideration. Any permit issued may be conditioned to implement water quality protection measures.

The Corps of Engineers will not issue a permit for structures of work which would interfere with adjacent properties or water resource projects. Interferences such as increased siltation or erosion and reduced general public access or right of navigation must be avoided.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act authorizes the Secretary of the Interior to:

- Provide assistance to and cooperate with federal, state and public or private agencies in the development, rearing, and stocking of all species of wildlife resources and their habitat, in controlling losses of the same from disease or other causes, in minimizing damages from over-abundant species, in providing public shooting and fishing areas, including easements across public lands for access, and in carrying out other measures necessary to affect the purposes of said sections;

- To make surveys and investigations of the wildlife of the public domain, including lands and waters or interest therein and;

- To accept donations of land and contributions of funds in furtherance of the purposes of said sections.

Of particular relevance to new industrial facilities are provisions within the Act that require any permitting agency or department to consult with the U.S. Fish and Wildlife Service with a view to the consequences of the proposed action upon the wildlife resources. Examples of the type of actions proposed by the industrial applicant would be impounding, diverting or controlling waters, and discharge of sewage and industrial wastes.

The Secretary of the Interior, through the Fish and Wildlife Service and the Bureau of Mines, is authorized to make such investigations as deemed necessary to determine the effects of such actions upon wildlife.

Endangered Species Act

The Endangered Species Act charges all federal agencies with the responsibility to aid in the protection of the species listed as endangered in the United States. In addition to prohibiting actions against endangered species by private citizens, the Act prohibits federal agencies from funding or authorizing a project which jeopardizes any one of the species. This includes entering into a cooperative agreement such as an agreement to supplement a project of private industry or local government with federal funds. It authorizes funds for research on U.S. endangered species and describes procedures for adding a species to the list. It mandates that all federal agencies shall cooperate with state agencies in programs that benefit endangered species, including those for the identification of critical habitats. The Act does not void state laws designed to protect wildlife. For instance, states may compile endangered species lists more inclusive than the federal list, or may define more stringent criteria for certain species than those contained in the federal Act.

Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System, as well as rivers designated on the National Rivers Inventory to be studied for inclusion in the National System. Under the Act, a federal agency may not assist, through grant, loan, license, or otherwise, the construction of a water resources project that would have a direct and adverse effect on the scenic, recreational, or fish and wildlife values for which a river in the National System was established.

Farmland Protection Policy Act

The Farmland Protection Policy Act (FPPA) requires federal agencies to use criteria developed by the U.S. Department of Agriculture to:

- Identify and take into account the adverse effects of their programs on the preservation of farmlands from irreversible conversion to other uses which result in its loss as an environmental or essential food production resource;
- and consider alternative actions that could lessen such adverse impacts.

If categories of important farmlands, which include those defined in both the FPPA and EPA policy, are identified in the project area, both direct and indirect effects of the undertaking on the project area and immediate environs shall be evaluated. Adverse effects shall be avoided or mitigated to the extent possible.

Archaeological and Historic Preservation Act

The National Historic Preservation Act directs that "the historical and cultural foundations of the nation shall be preserved as a living part of our community life and development...".

Title I, Section 101 of the Act provides for a National Register of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture.

Title I, Section 106 requires that any federal agency having direct or indirect jurisdiction over any undertaking (including the granting of licenses and permits) shall take into account the effects of the undertaking on any National Register property.

Of particular relevance are procedures that require a review process in which the agency proposing the undertaking, the State Historic Preservation Officer, the Council on Historic Preservation, and interested organizations and individuals participate. The process is designed to assure that alternatives to avoid or mitigate an adverse impact on a National Register property are adequately considered in the planning processes. In all likelihood, this process would result in a Memorandum of Agreement between the industrial developer, the Federal Council, and the State Historic Preservation Officer that outlines a development plan that maximizes the preservation and/or recovery of historically or culturally significant articles.

Table 38.1 Nati nal Ambient Air Quality Standards

AVERAGING PERIOD	PRIMARY STANDARD µg/m3	PRIMARY STANDARD ppm	SECONDARY STANDARD µg/m3	SECONDARY STANDARD ppm
Carbon Monoxide				
8-hour	10000	9	10000	9
1-hour	40000	35	40000	35
Nitrogen Dioxide				
Annual arithmetic	100	0.053	100	0.053
Particulate Matter				
Annual geometric	50		50	
24-hour	150		150	
Sulfur Dioxide				
Annual arithmetic	80	0.03		
24-hour	365	0.14		
3-hour			1300	0.5
Ozone				
1-hour	235	0.12	235	0.12
Nonmethane Hydrocarbons				
3-hour	160	0.24	160	0.24
Lead				
Calendar quarter	1.5		1.5	

38.2 AIR POLLUTION CONTROL REGULATIONS

Major new construction of facilities in the United States must be in accordance with a variety of air quality regulations and standards. Existing standards are based on criteria that limit the increase in existing levels of pollutants at the proposed site and set absolute upper limits that cannot be exceeded.

National Ambient Air Quality Standards (NAAQS)

These standards define levels of ambient air quality which the Environmental Protection Agency (EPA) judges to be necessary to protect the public health and welfare from any known or anticipated adverse effects of a pollutant. Standards cover particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, non-methane hydrocarbons, and lead. For each specific pollutant, an area (usually a county or air quality region) is classified as "attainment", "unclassified", or "non-attainment" based on compliance with ambient standards for the aforementioned pollutants. Attainment areas are ones in which compliance has been demonstrated with the NAAQS for specific pollutants while, in contrast, non-attainment areas are ones in which the NAAQS have not been met for certain pollutants. Primary standards have been established for the protection of human health, and secondary standards for the protection of human welfare. Table 38.1 lists both sets of standards.

The location of the proposed DOE Coal Liquefaction facility will significantly affect the extent of regulatory applicability and air permitting that will be necessary. New sources located in areas designated as attainment or unclassified for specific pollutants require a Prevention of Significant Deterioration (PSD) review (requirements of which are discussed later. In areas designated as nonattainment for certain pollutants, new sources must perform a nonattainment area (NAA) review and may also possibly need to apply for a state permit. Discussions with the Illinois EPA indicate that there are currently few (if any) non-attainment areas located in the south central region of Illinois. It is therefore likely that a non-attainment area review may not be necessary. Once a specific candidate site is selected, this determination can be finalized.

It is entirely possible for one new source to be required to perform a PSD review for some pollutants in addition to performing a NAA review for others. The basic rule is that a major new plant is subject to PSD requirements if it is built in a clean area, and subject to nonattainment requirements if built in a dirty area; but, a new plant can be subject to both PSD and nonattainment reviews if:

- cross-boundary effects would cause emissions from a plant in a PSD area to impact a nonattainment area or vice versa; or
- the plant's location is classified as PSD regarding certain pollutants, but classified as nonattainment regarding other pollutants.

If a new plant is subject to both PSD and nonattainment, it may be required to undergo two separate reviews; one by the federal EPA (PSD review) and one by the state agency (nonattainment review).
As part of the air permit reviews described above, the applicant will also need to address the emission standards established by the EPA for specific industrial categories (New Source Performance Standards) and specific highly toxic pollutants (National Emission Standards for Hazardous Air Pollutants). The relevant EPA emission standards applicable to a coal liquefaction facility are described in greater detail in Sections 3.4 and 3.5.

Prevention of Significant Deterioration (PSD)

The main purpose of a PSD review is to prevent deterioration of existing clean (attainment) areas, as classified in the regulations. Within a NAAQS attainment or unclassified area (as determined for each specific pollutant), a PSD review is required prior to the construction of new "major sources" of emissions. A source is "major" if it has the "potential to emit" any one of the criteria or non-criteria pollutants listed in Table 38.2 in excess of 250 tons per year (or 100 tons per year if the source is on the special list of 28 industrial categories as detailed in the Clean Air Act). Once a source is classified as "major" for any one criteria pollutant, then a PSD review is also necessary for all other pollutants which are in excess of their associated Deminimis emission rates as detailed in Table 38.2. Furthermore, a PSD review is also required for a modification to an existing major source if the increase in emissions resulting from the modification exceeds the Deminimis emission rates shown in Table 38.2. Under the PSD program, maximum allowable increases, or "increments", in ambient pollutant concentrations must also not be exceeded. Increments may be depleted for specific pollutants due to prior permit applications being submitted. If existing or proposed facilities have filed for a PSD permit, they may have used up a portion of the increment. Table 38.3 lists the PSD Increments for each area classification (Class I thru Class III).

Since the proposed south central Illinois facility will most likely be a major source (based upon emission estimates from the facility) located in an attainment area (as per the Illinois EPA), a PSD review will probably be necessary. The PSD permit application for the facility was structured so that the boilers in the Steam Generation Plant could burn either coal or medium BTU fuel gas. For coal combustion, the boilers would emit primarily particulate matter and sulfur dioxide. During combustion of the medium BTU fuel gas, the same boilers would emit primarily nitrogen oxides and carbon monoxide. As Table 38.4 illustrates, emission control methods were provided for each of these pollutants. The proposed facility will have the same boiler capabilities as , except now the required control technology for several of the pollutants has been upgraded since the time of 's PSD permit application submittal (especially for NOx). The proposed coal liquefaction facility will be required to implement the best available control technology. The Illinois EPA will perform the PSD application review and will issue the PSD permit under a "Delegation of Authority" from the USEPA following the technical review and public participation phases of the permitting process.

TABLE 38.2

DEMINIMIS EMISSION LIMITS

POLLUTANTS	DEMINIMIS EMISSION RATE tons/year
Carbon Monoxide §	100
Nitrogen Oxides §	40
Particulate Matter §	15
Sulfur Dioxide §	40
Organics §	40
Hydrogen Sulfide	10
Carbonyl Sulfide (as TRS) §	10
Fluorides	3
Beryllium §	0.0004
Lead	0.6
Mercury	0.1
Sulfuric Acid Mist	7
Vinyl Chloride	1

§ a PSD review is required for these pollutants.

The preparation of a PSD permit application may take from six months to over a year (not including one year of preconstruction monitoring which may be required as part of an Ambient Air Quality Analysis), depending on the availability of necessary data. The state agency may require an additional six months to process the permit application prior to final approval. Figure 38.1 illustrates the timing involved in obtaining a PSD permit.

The following elements are necessary in a PSD review:

- Ambient Air Quality Analysis
- Air Quality Impact Analysis
- Additional Impacts Analysis
- Best Available Control Technology (BACT) Analysis

Ambient Air Quality Analysis

One year of preconstruction monitoring may be necessary to determine present air quality unless dispersion modeling demonstrates that maximum projected ground level concentrations due to the facility will be less than the Deminimis concentrations contained in Table 38.5.

Air Quality Impact Analysis

A 5-year dispersion modeling analysis must be conducted to determine if new pollutant emissions will cause or contribute to a violation of the NAAQS or PSD increment.

Additional Impacts Analysis

An additional impacts analysis must be conducted to assess the predicted impacts from the new source on visibility, soils, and vegetation, in primarily Class I areas such as national parks.

Best Available Control Technology (BACT) Analysis

In the PSD review process for major sources, Best Available Control Technology (BACT) must be addressed to determine the extent of equipment and procedures which will be used to control emissions. The following sections detail possible equipment specifications and emission limits which may be required as a result of the BACT analysis. References to other applicable regulations are provided in each of the following sections. However, BACT may require more stringent emission limits than those contained in the referenced regulations. Table 38.4 details the Best Available Control Technology (BACT) and design data that was proposed for the emission points addressed in the 1981 PSD permit application. Table 38.2 expands the particulate matter (PM) pollution control equipment proposed in the PSD permit application to include design data. The USEPA presently requires a top-down BACT approach to analyzing control equipment requirements. This may result in different limits and control technologies from those which were proposed for the facility. The magnitude in difference from to the proposed facility can not be determined until submittal of the permit application to the regulatory agencies.

Sulfur Dioxide (SO_2) Emissions

Control of sulfur dioxide emissions will be divided into two categories: bulk sulfur removal and residual sulfur removal.

TABLE 38.3

PSD INCREMENTS AND SIGNIFICANT IMPACT LEVE:

AVERAGING PERIOD	CLASS I INCREMENT µg/m3	CLASS II INCREMENT µg/m3	CLASS III INCREMENT µg/m3	SIGNI. IMPACT µg/n
Carbon Monoxide				
8-hour				500
1-hour				2000
Nitrogen Dioxide				
Annual arithmetic	2.5	25	50	1
Particulate Matter				
Annual geometric	5	19	37	1
24-hour	10	37	75	5
Sulfur Dioxide				
Annual arithmetic	2	20	40	1
24-hour	5	91	182	5
3-hour	25	512	700	25

TABLE 38.4, P.1

POSSIBLE AIR EMISSION POINTS AND CONTROL METHODS

Air Emission Point Identification	Pollutant	Control Technology	Control Efficiency/ Reference
Fluid Bed Combustion (FBC)	PM	Electrostatic Precipitators	99.80%
H2 Heaters	PM	None	NA
Slurry Heaters			
Fractionator Heaters	PM	None	NA
Hydrotreating Heaters	PM	None	NA
Transfer Houses	PM	Enclosed, Spray and Baghouses	99.80%
Transfer Houses	PM	Enclosed, Spray and Baghouses	99.80%
Coal Pulverizing and Drying	PM	Baghouses	99.80%
Active Storage Pile	PM	Chemical Spray	80.00%
Inactive Storage Pile	PM	Surfacant	80.00%
Dried Coal Storage Vent	PM	Baghouses	99.8%
Stacker	PM	Chemical Spray	80.00%
Haul Road	PM	Covered Trucks & Paved Roads	NA
Non-Hazardous Landfills	PM	NA	NA
Coal Conveyors	PM	Covered	90.00%
Boiler Stacks	SO2	Wellman-Lord FGD	92.38%
H2 Heaters	SO2	None	NA
Slurry Heaters	SO2	None	NA
Fractionator Heaters	SO2	None	NA
Hydrotreating Heaters	SO2	None	NA

PM: PARTICULATE MATTER

TABLE 38.4, P.2

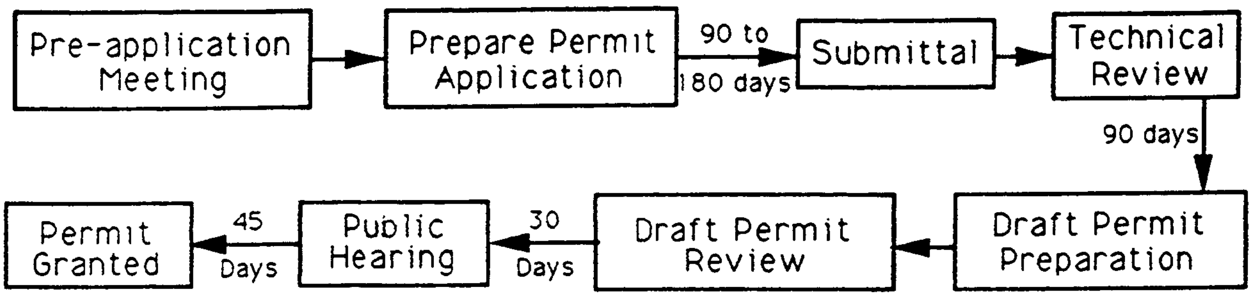
POSSIBLE AIR EMISSION POINTS AND CONTROL METHODS

CO2 Stripper	CO	NA	NA
Boiler Stacks	CO	NA	NA
H2 Heaters	CO	NA	NA
Slurry Heaters	CO	NA	NA
Fractionator Heaters	CO	NA	NA
Hydrotreating Heaters	H2S	NA	NA
Boiler Stacks	NOx	Proper Boiler Design	40.00%
H2 Heaters	NOx	NA	10.00%
Slurry Heaters	NOx	NA	10.00%
Fractionator Heaters	NOx	NA	10.00%
Hydrotreating Heaters	NOx	NA	10.00%
Boiler Stacks	VOC	NA	NA
H2 Heaters	VOC	NA	NA
Slurry Heaters	VOC	NA	NA
Fractionator Heaters	VOC	NA	NA
Hydrotreating Heaters	VOC	NA	NA
600# Steam	VOC	NA	NA
Intermediate Storage Tanks	VOC	Floating Roofs and Temperature Constant	NA
Final Products Storage Tanks	VOC VOC	Floating Roofs and Temperature Constant	NA
Tank Cars/Truck Loading	VOC	Vapor Recovery System	NA
Fugitives (drains, seals valves)	VOC	Dual Seals and Good Maintenance	NA
Boiler Stacks	Fluorides	ESP and Wet Scrubber	99.80%
Boiler Stacks	Beryllium	ESP and Wet Scrubber	99.80%
Boiler Stacks	Lead	ESP and Wet Scrubber	99.80%
Boiler Stacks	Mercury	ESP and Wet Scrubber	99.80%

VOC: VOLATILE ORGANIC COMPOUND

FIGURE 38.1

Timing for a PSD Permit (1)



(1) This figure illustrates the typical timing requirements as indicated in the regulations and confirmed through conversations with the Illinois EPA. Individual permits may require more or less time than that indicated above depending on the complexity of the source(s) to be permitted.

TABLE 38.5

DEMINIMIS CONCENTRATIONS BELOW WHICH PRECONSTRUCTION MONITORING MAY NOT BE REQUIRED

POLLUTANTS	DEMINIMIS CONCENTRATION µg/m3	MAXIMUM AVERAGING TIME hours
Carbon Monoxide	575	8
Nitrogen Oxides	14	annual
Particulate Matter	10	24
Sulfur Dioxide	13	24
Reduced Sulfur Compounds	10	1
Hydrogen Sulfide	0.04	1
Carbonyl Sulfide (as TRS)	10	1
Fluorides	0.25	24
Beryllium	0.0005	24
Lead	0.1	24
Mercury	0.25	24
Vinyl Chloride	15	24

For bulk sulfur removal, the highest percentage of control (as discussed in the PSD permit application) may be offered by combusting the off-gases of both the Claus and incinerator within the boiler, cycling the resultant SO_2 back through the Claus units, and treating the remaining residual SO_2 with one of the methods mentioned below. Other bulk sulfur removal/recovery methods are limited with respect to their applicability to the H-coal liquefaction process.

For residual sulfur removal, a wider selection of alternatives is available. First analysis indicates that any of the following may be viable residual SO_2 control alternatives:

- low sulfur fuel
- wet flue gas desulfurization (FGD) utilizing one of the following reagents: lime, limestone, sodium, or dual alkali.
- dry flue gas desulfurization (FGD); eg. spray dryer absorber with a rotary atomizer.

SO_2 emission limits applicable to a coal liquefaction facility are contained in the following regulations, details of which are discussed later.

- Illinois Sulfur Emission Standards and Limitations; Subpart B - New Fuel Combustion Emission Sources
- NSPS Subpart Db - Industrial-Commercial-Institutional Steam Generating Units
- NSPS Subpart J - Petroleum Refineries (Claus Sulfur Recovery)

Particulate Matter (PM) Emissions

Sources within the coal liquefaction project which could potentially contribute to particulate matter emissions are:

- Process and boiler off-gases
- Coal conveying, handling and fugitive emissions

Particulate matter emission limits applicable to a coal liquefaction facility are contained in the following regulations:

- Illinois Particulate Matter Emission Standards and Limitations; Subpart D - PM Emissions from Incinerators; Subpart E - PM Emissions from Fuel Combustion Emission Sources; Subpart K - Fugitive PM Emissions
- NSPS Subpart Db - Industrial-Commercial-Institutional Steam Generating Units
- NSPS Subpart E - Incinerators
- NSPS Subpart J - Petroleum Refineries
- NSPS Subpart Y - Coal Preparation Plants

Pr cess and Boiler Particulate Matter (PM) Emissions

The following control strategies are viable alternatives for controlling the process and boiler particulate matter emissions from a coal liquefaction facility:

- Cold and Hot Side Electrostatic Precipitators (ESP)
- Fabric Filters (Baghouses)

For the control of fly ash from coal-fired boilers requiring high collection efficiency, the use of cold side electrostatic precipitators and baghouses typically represent BACT for process and boiler particulate matter emissions.

Coal Conveying, Handling and Fugitive Emissions

For coal conveying throughout the plant, BACT typically involves all conveyors being covered and transfer points and stations being enclosed and exhausted to local dust collection systems (usually baghouses). In order to minimize emissions, conveyors should be designed to have moderate belt speeds with minimal transfer points and minimal transfer drop distances. Use of water and surfactant suppression sprays from the screening bin and partially covering the conveyors are effective dust control methods which may also be required as BACT.

Coal Drying and Pulverizing Areas

Emissions from the coal dryer and pulverizing area should be controlled by utilization of dust collection baghouse systems and pneumatic conveying systems for pulverized coal conveying.

If possible, dust collected from the dust collection systems should be charged back on to the belt conveyors so that minimal dust emissions will be produced from this operation.

Coal Storage and Stacking

Emissions from coal storage areas are primarily from the load-in process. The drop height of the material should be reduced to minimize the fugitive emissions. A water and surfactant spray system may also be utilized to reduce emissions. Wetting chemicals sprayed during conveying and stacking retain their effectiveness in storage. Wetting agents retain surface moisture for extended periods thereby preventing dusting during storage.

The coal (and ash) storage facilities should be enclosed and should exhaust to a local dust collection system (usually a baghouse).

For dead coal storage piles, the top and sides of the piles should be covered with surface crusting agents after compaction.

Other Minor Sources of Particulate Matter

Other minor sources of particulate matter will most likely be controlled separately for practical reasons, e.g. using small local collection systems instead of using ductwork and fans for transport to other areas of the plant. Unlike large, custom-designed collection systems, these local collection systems are small packaged systems that are typically permitted as achieving BACT.

Carbon Monoxide (CO) Emissions

CO emissions are expected from the main boiler stacks, the process heater stacks, and the process CO_2 waste gas stream from the gasification and purification processes. Boilers and heaters are designed by the manufacturers for optimum combustion efficiency and this design inherently minimizes the production of carbon monoxide. There are no specific external controls or associated emission limits available for carbon monoxide. In addition, there are no existing or proposed limits for CO associated with the New Source Performance Standards (NSPS) as identified in 40 CFR Part 60. Therefore, optimum boiler and heater design should be representative of BACT. Based on the low CO emission rate, the stack height, and the high exit velocity in the project, ground level impacts from the CO_2 waste gas stream should be minimal.

Carbon monoxide emission limits applicable to a coal liquefaction facility are contained in the following regulations, details of which are contained in Section 3.3.

- Illinois Carbon Monoxide Emission Standards and Limitations; Subpart B - Fuel Combustion Emission Sources; Subpart C - Incinerators; Subpart N - Petroleum Refining and Chemical

Nitrog n Oxides (NO_x) Emissions

Nitrogen oxides emissions are expected from the main boiler stacks and the process heater stacks at the proposed coal liquefaction facility. The following technologies have been demonstrated or are being investigated to control NO_x emissions:

- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)
- Fluidized Bed Combustion (FBC)
- Combustion Modifications including:

  Flue Gas Recirculation
  Low Excess Air (LEA)
  Wet Flue Gas Denitrification (FGDN)
  Overfire Air (OFA)
  Low NO_x Burners
  Burners Out of Service (BOOS)
  Reburning with Natural Gas
  Staged Combustion

Recent BACT determinations indicate that NO_x emission limits for recently permitted coal-fired units range from 0.3 to 0.6 lb/MMBTU.

NO_x emission limits applicable to a coal liquefaction facility are contained in the following regulations:

- Illinois NO_x Emission Standards and Limitations; Subpart B - New Fuel Combustion Emission Sources
- NSPS Subpart Db - Industrial-Commercial-Institutional Steam Generating Units

Volatile Organic Compound (VOC) Emissions

The VOC emissions are expected from the product and intermediate product storage tanks, and from equipment leaks at the proposed coal liquefaction facility. The following regulations contain design specifications pertinent to storage tanks and equipment leaks:

- Illinois Organic Material Emission Standards and Limitations; Subpart B - Organic Emissions from Storage and Unloading Operations; Subpart C - Organic Emissions from Miscellaneous Equipment
- NSPS for petroleum storage vessels
- NSPS for equipment leaks
- NSPS for SOCMI operations
- NESHAP for equipment leaks

Beryllium

Emissions of beryllium from the coal liquefaction facility (particularly the boiler stacks) are expected to be significant (greater than 0.0004 tons per year), based upon the project. The control techniques utilized on the boilers to control particulate matter (PM) emissions will, at the same time, control beryllium and other heavy metal emissions. Beryllium emission limits applicable to a coal liquefaction facility are contained in the following regulation:

- NESHAP for Beryllium

Air Quality Nonattainment Area (naa) Review and Illinois State Air Regulations

The basic provision is that in any area where an ambient air quality standard is being violated (nonattainment), no major new source can be constructed without a permit, which shall impose stringent control requirements and require sufficient emission "offsets" to assure progress toward compliance.

Sources subject to nonattainment requirements include any new plant (or modification) with potential emissions equal to or greater than 100 tons per year of particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, or volatile organic compounds.

Typically, the permit requirements of a nonattainment review fall under the jurisdiction of the state agency. Therefore, the permit requirements for a nonattainment review and any applicable Illinois state air regulations have been summarized in the following sections. The nonattainment permit requirements are as follows:

- Emission offsets - enforceable reductions in existing sources of pollution, which exceed anticipated emissions from the new source.

- LAER - Lowest Achievable Emission Rate, which determines the extent of equipment necessary to control emissions, as defined case by case under tight standards.

- Other sources in compliance - all other plants in the state owned or operated by the same company must be on approved compliance schedules.

- Compliance with the applicable SIP - this is applied overall to the State's program. State Implementation Plans (SIPs) developed by the states and approved by the EPA contain the actual abatement requirements devised to reduce air pollution as necessary to achieve compliance with the NAAQS. New plants will be subject to requirements of any applicable SIP. These normally specify both limitations on allowable emissions and procedural requirements for preconstruction review. Since many SIPs have been revised repeatedly, care must be used to verify currently applicable SIP revisions.

The State of Illinois Environmental Protection Agency (IEPA) has developed ambient air quality standards identical to the National Ambient Air Quality Standards (NAAQS) listed in Table 38.2. Illinois also has new source standards but, like the United States Environmental Protection Agency, the State has not developed standards specifically for coal liquefaction plants. Those sections of the Illinois State Air Regulations relevant to equipment that is similar to that contained in coal liquefaction plants are detailed below.

Visible and Particulate Matter Emission Standards and Limitations

Subpart B - Visual Emissions

212.122(a) No person shall allow the emission of smoke or other particulate matter into the atmosphere from any new fuel combustion emission source with actual heat input greater than 73.2 MW (250 mmbtu/hr), having an opacity greater than 20 percent.

Subpart D - Particulate Matter Emissions from Incinerators

The following rules would apply to the waste sludge incinerator at the proposed coal liquefaction facility.

212.181(a) No person shall allow the emission of particulate matter into the atmosphere from any incinerator burning more than 27.2 Mg (60,000 lbs) of refuse per hour to exceed 115 mg (0.05 gr/scf) of effluent gases corrected to 12 percent carbon dioxide.

212.181(b) No person shall allow the emission of particulate matter into the atmosphere from any incinerator burning more than 0.907 Mg (2000 lbs) but less than 27.2 Mg (60,000 lbs) of refuse per hour to exceed 183 mg (0.08 gr/scf) of effluent gases corrected to 12 percent carbon dioxide.

212.181(d) No person shall allow the emission of particulate matter into the atmosphere from all other new incinerators to exceed 229 mg (0.1 gr/scf) of effluent gases corrected to 12 percent carbon dioxide.

Subpart E - Particulate Matter Emissions from Fuel Combustion Emission Sources

This rule would apply to any boilers, heaters or other fuel combustion devices using solid fuel exclusively at the proposed coal liquefaction facility.

212.204 No person shall allow the emission of particulate matter into the atmosphere from any new fuel combustion emission source using solid fuel exclusively to exceed 0.15 kg of particulate matter per MW-hr of actual heat input (0.1 lbs/mmbtu) in any one hour period.

Subpart K - Fugitive Particulate Matter

212.304(a) All storage piles of materials with uncontrolled emissions of fugitive particulate matter in excess of 45.4 Mg per year (50 T/year) which are located within a facility whose potential particulate emissions from all sources exceed 90.8 Mg per year (100 T/year) shall be protected by a cover or sprayed with a surfactant solution or water on a regular basis, as needed.

212.305 All conveyor loading operations to storage piles shall utilize spray systems, telescope chutes, stone ladders, or other equivalent methods.

212.307 All unloading and transporting operations of materials collected by pollution control equipment shall be enclosed or shall utilize spraying, pelletizing, screw conveying or other equivalent methods.

212.308 Crushers, grinding mills, screening operations, bucket elevators, conveyor transfer points, conveyors, bagging operations, storage bins and fine product truck and railcar loading operations shall be sprayed with water or a surfactant solution, utilize choke-feeding or be treated by an equivalent method.

212.313 If particulate collection equipment is operated, emissions from such equipment shall not exceed 68 mg/dscm (0.03 gr/dscf).

Sulfur Emission Standards and Limitations

Subpart B - New Fuel Combustion Emission Sources

The following rules would apply to any boilers, heaters, or other fuel combustion devices using solid fuel exclusively at the proposed coal liquefaction facility.

214.121(a) No person shall allow the emission of sulfur dioxide into the atmosphere in any one hour period from any new fuel combustion emission source greater than 73.2 MW (250 mmbtu/hr), burning solid fuel exclusively, to exceed 1.86 kg of sulfur dioxide per MW-hr of actual heat input (1.2 lbs/mmbtu).

214.122(a) No person shall allow the emission of sulfur dioxide into the atmosphere in any one hour period from any new fuel combustion emission source with actual heat input smaller than, or equal to, 73.2 MW (250 mmbtu/hr), burning solid fuel exclusively, to exceed 2.79 kg of sulfur dioxide per MW-hr of actual heat input (1.8 lbs/mmbtu).

214.301 No person shall allow the emission of sulfur dioxide into the atmosphere from any process emission source to exceed 2000 ppm.

Organic Material Emission Standards and Limitations

Subpart B - Organic Emissions from Storage and Loading Operations

For the proposed coal liquefaction facility, these rules would apply to several of the product and intermediate product storage tanks since the sizes of the tanks and the vapor pressures of the liquids fall into the categories prescribed by this subpart (based upon tank data from the project).

215.121 No person shall allow the storage of any volatile organic liquid with a vapor pressure of 17.24 kPa (2.5 psia) or greater at 294.3 K (70°F) or any gaseous organic material in any stationary tank, reservoir, or other container of more than 151 cubic meters (40,000 gal) capacity unless such container:

- is a pressure tank capable of withstanding the vapor pressure of such liquid or the pressure of the gas; or
- is equipped with one of the following vapor loss control devices: (1) a floating roof which rests on the surface of the volatile organic liquid and is equipped with a closure seal or seals between the roof edge and the tank wall; or (2) a vapor recovery system consisting of a vapor gathering system capable of collecting 85% or more of the uncontrolled volatile organic material that would otherwise be emitted to the atmosphere; and a vapor disposal system capable of processing such volatile organic material so as to prevent its emission to the atmosphere.

215.122(a) No person shall allow the discharge of more than 3.6 kg/hr (8 lbs/hr) of organic material into the atmosphere during the loading of any organic material from the aggregate loading pipes of any loading facility having through-put of greater than 151 cubic meters per day (40,000 gal/day) into any railroad tank car, tank truck, or trailer unless such loading facility is equipped with submerged loading pipes.

215.122(b) No person shall allow the loading of any organic material into any stationary tank having a storage capacity of greater than 946 liters (250 gal), unless such tank is equipped with a permanent submerged loading pipe.

215.123(b) No owner or operator of a stationary storage tank with a capacity greater than 151.42 cubic meters shall allow the storage of any volatile petroleum liquid unless:

- the tank is equipped with one of the vapor loss control devices specified in Section 215.121;

- there are no visible holes, tears, or other defects in the seal or any seal fabric or material of any floating roof;
- all openings of any floating roof deck, except stub drains, are equipped with covers, lids or seals.

215.124(a) No owner or operator of a stationary storage tank equipped with an external floating roof shall allow the storage of any volatile petroleum liquid in the tank unless:

- the tank has been fitted with a continuous secondary seal extending from the floating roof to the tank wall (rim mounted secondary seal);
- each seal is intact and uniformly in place around the circumference of the floating roof between the floating roof and the tank wall;
- the accumulated area of gaps exceeding 0.32 centimeter (1/8 inch) in width between the secondary seal and the tank wall shall not exceed 21.2 square centimeters per meter of tank diameter (1.0 square inch per foot of tank diameter);
- emergency roof drains are provided with slotted membrane fabric covers (or equivalent) across at least 90 percent of the area of the opening;
- openings are equipped with projections into the tank which remain below the liquid surface at all times.

Subpart C - Organic Emissions from Miscellaneous Equipment

215.141(a) No person shall use any single or multiple compartment effluent water separator which receives effluent water containing 757 liter/day (200 gal/day) or more of organic material from any equipment processing, refining, treating, storing or handling organic material unless such water effluent separator is equipped with air pollution control equipment capable of reducing by 85% or more the uncontrolled organic material emitted to the atmosphere.

215.142 No person shall allow the discharge of more than 32.8 ml (2 cubic inches) of volatile organic liquid with vapor pressure of 17.24 kPa (2.5 psia) or greater at 294.3 K (70°F) into the atmosphere from any pump or compressor in any 15 minute period at standard conditions.

215.143 No person shall allow the emission of organic material into the atmosphere from any vapor blowdown system or any safety relief valve unless such emission is controlled to 10 ppm equivalent methane (molecular weight 16.0) or less, or by combustion in a smokeless flare.

Carbon Monoxide Emission Standards and Limitations

This rule would apply to any boilers, heaters, or other fuel combustion devices at the proposed coal liquefaction facility.

Subpart B - Fuel Combustion Emission Sources

> 216.121 No person shall allow the emission of carbon monoxide into the atmosphere from any fuel combustion emission source with actual heat input greater than 2.9 MW (10 mmbtu/hr) to exceed 200 ppm, corrected to 50 percent excess air.

Subpart C - Incinerators

The following rule would apply to the waste sludge incinerator at the proposed coal liquefaction facility.

> 216.141 No person shall allow the emission of carbon monoxide into the atmosphere from any incinerator to exceed 500 ppm, corrected to 50 percent excess air.

Subpart N - Petroleum Refining and Chemical

This rule would apply to the CO_2 waste gas stream from the gasification and purification process at the proposed coal liquefaction facility.

> 216.361(a) No person shall allow the emission of a carbon monoxide waste gas stream into the atmosphere from a petroleum or petrochemical process unless such waste stream is burned in a direct flame afterburner or carbon monoxide boiler (or other equivalent air pollution control equipment) so that the resulting concentration of carbon monoxide in such waste gas stream is less than or equal to 200 ppm corrected to 50 percent excess air.

Nitrogen Oxide Emission Standards and Limitations

This rule would apply to any boilers, heaters, or other solid fossil fuel-firing devices at the proposed coal liquefaction facility.

Subpart B - New Fuel Combustion Emission Sources

217.121 No person shall allow the emission of nitrogen oxides into the atmosphere in any one hour period from any new fuel combustion emission source with an actual heat input equal to or greater than 73.2 MW (250 mmbtu/hr) to exceed the following:

- for solid fossil fuel firing, 1.08 kg/MW-hr (0.70 lbs/mmbtu) of actual heat input.

NEW SOURCE PERFORMANCE STANDARDS (NSPS)

Emission standards have been established for specific industrial categories. Standard criteria are based on proven best available control technology for each listed industry. Since NSPS have not been established specifically for coal liquefaction facilities, the NSPS for similar facility processes have been presented below as guidelines for the coal liquefaction facility.

Subpart Db - Industrial-Commercial-Institutional Steam Generating Units

This subpart applies to each steam generating unit that commences construction, modification, or reconstruction after June 19, 1984, and that has a heat input capacity from fuels combusted in the steam generating unit of greater than 29 MW (100 million Btu/hr). These rules would apply to any of the boilers, heaters, or other coal-combusting devices at the proposed coal liquefaction facility meeting the heat input requirements described earlier.

Sulfur Dioxide (SO_2) Limits

No owner or operator of an affected facility that combusts coal or oil shall cause to be discharged into the atmosphere any gases that contain sulfur dioxide in excess of 10 percent of the potential sulfur dioxide emission rate (90 percent reduction) and that contain sulfur dioxide in excess of the emission limit determined according to the formula contained in the regulations.

No owner or operator of an affected facility that combusts coal refuse alone in a fluidized bed combustion steam generating unit shall cause to be discharged into the atmosphere any gases that contain sulfur dioxide in excess of 20 percent of the potential sulfur dioxide emission rate (80 percent reduction) and that contain sulfur dioxide in excess of 520 ng/J (1.2 lb/million Btu) heat input.

No owner or operator of an affected facility that combusts coal or oil, either alone or in combination with any other fuel, and that uses an emerging technology for the control of sulfur dioxide emissions, shall cause to be discharged into the atmosphere any gases that contain sulfur dioxide in excess of 50 percent of the potential sulfur dioxide emission rate (50 percent reduction) and that contain sulfur dioxide in excess of the emission limit determined according to the formula contained in the regulations.

Compliance with the emission limits and percent reduction requirements is determined on a 30-day rolling average basis.

Particulate Matter (PM) Limits

No owner or operator of an affected facility which combusts coal or combusts mixtures of coal with other fuels, shall cause to be discharged into the atmosphere any gases that contain particulate matter in excess of the following emission limits:

- 22 ng/J (0.05 lb/million Btu) heat input if the affected facility combusts only coal, or if the affected facility combusts coal and other fuels and has an annual capacity factor for the other fuels of 10 percent.

- 20 percent opacity (6-minute average), except for one 6-minute period per hour of not more than 27 percent opacity.

Nitrogen Oxides (NO_x) Limits

No owner or operator of an affected facility that combusts only coal, oil, or natural gas shall cause to be discharged into the atmosphere any gases that contain nitrogen oxides (expressed as NO_2) in excess of the specific emission limits associated with this subpart as detailed in Table 38.6.

Subpart E - Incinerators

This subpart applies to each incinerator of more than 45 metric tons per day charging rate (50 tons per day).

No owner or operator subject to the provisions of this part shall cause to be discharged into the atmosphere from any affected facility any gases which contain particulate matter in excess of 0.18 g/dscm (0.08 gr/dscf) corrected to 12 percent CO_2.

Subpart J - Petroleum Refineries

This subpart applies to the following affected facilities in petroleum refineries: fluid catalytic cracking unit catalyst regenerators, fuel gas combustion devices, and all Claus sulfur recovery plants except Claus plants of 20 long tons per day (LTD) or less. For the proposed coal liquefaction facility, this subpart would apply to the hydrotreatment stages and the Claus sulfur recovery plant (the Claus plant for the project was designed to produce 640 LTD of sulfur).

TABLE 38.6

NSPS SUBPART Db - NITROGEN OXIDE LIMITS (30-DAY ROLLING AVERAGES)

STEAM GENERATOR TYPE	EMISSION LIMIT ng/J	EMISSION LIMIT lb/mmbtu
Natural Gas and Distillate Oil		
Low heat release	43	0.1
High heat release	86	0.2
Residual Oil		
Low heat release	130	0.3
High heat release	170	0.4
Coal		
Mass-feed stoker	210	0.5
Spreader stoker and fluidized bed combustion	260	0.6
Pulverized coal	300	0.7
Lignite	260	0.6
Coal-derived synthetic fuels	210	0.5

Particulate Matter (PM) Limit

No owner or operator shall discharge into the atmosphere from any fluid catalytic cracking unit catalyst regenerator:

- Particulate matter in excess of 1.0 lb/1000 lb of coke burn-off in the catalyst regenerator.
- Gases exhibiting greater than 30 percent opacity, except for one six-minute average opacity reading in any one hour period.

Carbon Monoxide (CO) Limit

No owner or operator shall discharge into the atmosphere from any fluid catalytic cracking unit catalyst regenerator any gases which contain carbon monoxide in excess of 0.050 percent by volume.

Sulfur Oxides Limits

No owner or operator subject to this subpart shall discharge any gases into the atmosphere from any Claus sulfur recovery plant of 20 long tons per day (LTD) or less containing in excess of:

- 0.025 percent by volume of sulfur dioxide at zero percent oxygen on a dry basis if emissions are controlled by an oxidation control system, or a reduction control system followed by incineration, or
- 0.030 percent by volume of reduced sulfur compounds and 0.0010 percent by volume of hydrogen sulfide calculated as sulfur dioxide at zero percent oxygen on a dry basis if emissions are controlled by a reduction control system not followed by incineration.

Each owner or operator subject to this subpart shall comply with one of the following conditions for each affected fluid catalytic cracking unit catalyst regenerator:

- With an add-on control device, reduce sulfur dioxide emissions to the atmosphere by 90 percent or maintain sulfur dioxide emissions to the atmosphere less than or equal to 50 ppm by volume (ppmv), whichever is less stringent, or

  Without the use of an add-on control device, maintain sulfur oxides emissions calculated as sulfur dioxide to the atmosphere less than or equal to 9.8 kg/1000 kg coke burn-off.

Subpart Kb - Volatile Organic Liquid Storage Vess ls

This subpart applies to each storage vessel with a capacity greater than or equal to 40 cubic meters that is used to store volatile organic liquids (VOLs). For the proposed coal liquefaction facility, this rule would apply to many of the product and intermediate product storage tanks since the sizes of the tanks and the vapor pressures of the liquids fall into the categories prescribed by this subpart (based on tank data from the project).

The owner or operator of each storage vessel either with a design capacity greater than or equal to 151 cubic meters containing a VOL that, as stored, has a maximum true vapor pressure equal to or greater than 5.2 kPa but less than 76.6 kPa or with a design capacity greater than or equal to 75 cubic meters but less than 151 cubic meters containing a VOL that, as stored, has a maximum true vapor pressure equal to or greater than 27.6 kPa but less than 76.6 kPa, shall equip each storage vessel with one of the following:

A fixed roof in combination with an internal floating roof meeting the following specifications:

The internal floating roof shall rest or float on the liquid surface inside a storage vessel that has a fixed roof. The internal floating roof shall be floating on the liquid surface at all times, except during initial fill and during those intervals when the storage vessel is completely emptied or subsequently emptied and refilled. When the roof is resting on the leg supports, the process of filling, emptying, or refilling shall be continuous and shall be accomplished as rapidly as possible.

Each internal floating roof shall be equipped with one of the following closure devices between the wall of the storage vessel and the edge of the internal floating roof:

- A foam- or liquid-filled seal mounted in contact with the liquid (liquid-mounted seal).

- A mechanical shoe seal.

Two seals mounted one above the other so that each forms a continuous closure that completely covers the space between the wall of the storage vessel and the edge of the internal floating roof.

Each opening in a noncontact internal floating roof except for automatic bleeder vents (vacuum breaker vents) and the rim space vents is to provide a projection below the liquid surface.

Each opening in the internal floating roof except for leg sleeves, automatic bleeder vents, rim space vents, column wells, ladder wells, sample wells, and stub drains is to be equipped with a cover or lid which is to be maintained in a closed position at all times except when the device is in actual use. The cover or lid shall be equipped with a gasket. Covers on each access hatch and automatic gauge float well shall be bolted except when they are in use.

Automatic bleeder vents shall be equipped with a gasket and are to be closed at all times when the roof is floating except when the roof is being floated off or is being landed on the roof leg supports.

Rim space vents shall be equipped with a gasket and are to be set to open only when the internal floating roof is not floating or at the manufacturer's recommended setting. Each penetration of the internal floating roof for the purpose of sampling shall be a sampling well with a slit fabric cover that covers at least 90 percent of the opening.

Each penetration of the internal floating roof that allows for passage of a column supporting the fixed roof shall have a flexible fabric sleeve seal or a gasketed sliding cover.

Each penetration of the internal floating roof that allows for passage of a ladder shall have a gasketed sliding cover.

An external floating roof meeting the following specifications:

Each external floating roof shall be equipped with a closure device between the wall of the storage vessel and the roof edge. The closure device is to consist of two seals, one above the other. The lower seal is referred to as the primary seal, and the upper seal is referred to as the secondary seal.

- The primary seal shall be either a mechanical shoe seal or a liquid-mounted seal. The seal shall completely cover the annular space between the edge of the floating roof and tank wall.
- The secondary seal shall completely cover the annular space between the external floating roof and the wall of the storage vessel in a continuous fashion.

Except for automatic bleeder vents and rim space vents, each opening in a noncontact external floating roof shall provide a projection below the liquid surface.

Except for automatic bleeder vents, rim space vents, roof drains, and leg sleeves, each opening in the roof is to be equipped with a gasketed cover, seal, or lid that is to be maintained in a closed position at all times except when the device is in actual use.

Automatic bleeder vents are to be closed at all times when the roof is floating except when the roof is being floated off or is being landed on the roof leg supports.

Rim vents are to be set to open when the roof is being floated off the roof leg supports or at the manufacturer's recommended setting.

Automatic bleeder vents and rim space vents are to be gasketed.

Each emergency roof drain is to be provided with a slotted membrane fabric cover that covers at least 90 percent of the area of the opening.

The roof shall be floating on the liquid at all times except during initial fill until the roof is lifted off leg supports and when the tank is completely emptied and subsequently refilled.

A closed vent system and control device meeting the following specifications:

The closed vent system shall be designed to collect all VOC vapors and gases discharged from the storage vessel and operated with no detectable emissions as indicated by an instrument reading of less than 500 ppm above background.

The control device shall be designed and operated to reduce inlet VOC emissions by 95 percent or greater.

Subpart Y - Coal Preparation Plants

This subpart applies to any of the following affected facilities in coal preparation plants which process more than 200 tons per day: thermal dryers, pneumatic coal-cleaning equipment, coal processing and conveying equipment (including breakers and crushers), coal storage systems, and coal transfer and loading systems. For the proposed coal liquefaction facility, each of these affected facilities will process more than 200 tons of coal per day (based upon the project) and therefore the rules in this subpart apply to the proposed coal liquefaction facility.

No owner or operator shall cause to be discharged into the atmosphere from any thermal dryer, gases which:

- contain particulate matter in excess of 0.070 g/dscm (0.031 gr/dscf).
- exhibit 20 percent opacity or greater.

No owner or operator shall cause to be discharged into the atmosphere from any pneumatic coal cleaning equipment, gases which:

- contain particulate matter in excess of 0.040 g/dscm (0.018 gr/dscf).
- exhibit 10 percent opacity or greater.

No owner or operator shall cause to be discharged into the atmosphere from any coal processing and conveying equipment, coal storage system, or coal transfer and loading system processing coal, gases which exhibit 20 percent opacity or greater.

Subpart VV - Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry

The rules in this subpart would apply to the specific types of equipment listed below which would be used at a coal liquefaction facility, particularly the equipment in those stages of the process where product and intermediate product is being produced, transported, or stored.

Design specifications are contained in the regulations for the following types of equipment:

- Pumps in light liquid service.
- Compressors.
- Pressure relief devices in gas/vapor service.
- Sampling connection systems.
- Open-ended valves or lines.

  Valves in gas/vapor service or in light liquid service.
- Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.
- Closed vent systems and control devices for the above equipment.

Subparts NNN and RRR - Volatile Organic Compound (VOC) Emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation and Reactor Processes

The rules of this subpart would apply to the reactor and hydrotreatment equipment to be used at the proposed coal liquefaction facility.

The provisions of this subpart apply to each affected facility that is part of a process unit that produces any of the chemicals listed in the regulation as a product, co-product, by-product, or intermediate. Applicability will be determined by evaluating each pertinent stream for chemicals contained in the list.

For distillation processes, the affected facility is any of the following for which construction, modification, or reconstruction commenced after December 30, 1983:

- Each distillation unit not discharging its vent stream into a recovery system.

  Each combination of a distillation unit and the recovery system into which its vent stream is discharged.

- Each combination of two or more distillation units and the common recovery system into which their vent streams are discharged.

For reactor processes, the affected facility is any of the following for which construction, modification, or reconstruction commenced after June 29, 1990:

- Each reactor process not discharging its vent stream into a recovery system.

- Each combination of a reactor process and the recovery system into which its vent stream is discharged.

- Each combination of two or more reactor processes and the common recovery system into which their vent streams are discharged.

Each owner or operator shall either:

- Reduce emissions of total organic compounds (TOC) less methane and ethane by 98 weight-percent, or to a TOC concentration (less methane and ethane) of 20 ppmv, on a dry basis corrected to 3 percent oxygen, whichever is less stringent. If a boiler or process heater is used to comply, then the vent stream shall be introduced into the flame zone of the boiler or process heater; or

  Combust the emissions in a flare that meets the requirements of NSPS; or

  Maintain the TRE Cost Index Value (as calculated in the regulation) greater than 1.0 without the use of VOC emission control devices.

The owner or operator of an affected facility that uses an incinerator to seek to comply with the TOC emission limit shall operate according to manufacturer's specifications the following equipment:

  A temperature monitoring device equipped with a continuous recorder and having an accuracy of +/- 1 percent of the temperature being monitored expressed in degrees Celsius, or +/- 0.5 degrees Celsius, whichever is greater.

  Where an incinerator other than a catalytic incinerator is used, a temperature monitoring device shall be installed in the firebox.

- Where a catalytic incinerator is used, temperature monitoring devices shall be installed in the gas stream immediately before and after the catalyst bed.

- A flow indicator that provides a record of vent stream flow to the incinerator at least once every hour for each affected facility. The flow indicator shall be installed in the vent stream from each affected facility at a point closest to the inlet of each incinerator and before being joined with any other vent stream.

The owner or operator of an affected facility that uses a flare to seek to comply with the TOC emission limit shall operate according to manufacturer's specifications the following equipment:

A heat sensing device, such as an ultra-violet beam sensor or thermocouple, at the pilot light to indicate the continuous presence of a flame.

- A flow indicator that provides a record of vent stream flow to the flare at least once every hour for each affected facility. The flow indicator shall be installed in the vent stream from each affected facility at a point closest to the flare and before being joined with any other vent streams.

The owner or operator of an affected facility that uses a boiler or process heater to seek to comply with the TOC emission limit shall operate according to manufacturer's specifications the following equipment:

- A flow indicator that provides a record of vent stream flow to the boiler or process heater at least once every hour for each affected facility. The flow indicator shall be installed in the vent stream from each affected facility at a point closest to the inlet of each boiler or process heater and before being joined with any other vent stream.

- A temperature monitoring device in the firebox equipped with a continuous recorder and having an accuracy of +/- 1 percent of the temperature being measured expressed in degrees Celsius, or +/- 0.5 degrees Celsius, whichever is greater, for boilers or process heaters of less than 44 MW (150 million Btu/hr) heat input design capacity.

- Monitor and record the periods of operation of the boiler or process heater if the design heat input capacity of the boiler or process heater is 44 MW (150 million Btu/hr) or greater. The records must be readily available for inspection.

Subpart QQQ - VOC Emissions from Petroleum R finery Wastewater Systems

Design specifications for the following petroleum refinery wastewater systems are contained in the regulations:

Individual drain systems.

Junction boxes and sewer lines.

Oil-water separators.

Closed vent systems and control devices for the above listed equipment.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

The EPA has established specific emission standards for several highly toxic pollutants. Details of these standards are described below for each regulated pollutant.

Subpart C - Beryllium

Emissions to the atmosphere from stationary sources shall not exceed 10 grams of beryllium over a 24-hour period, or shall meet an ambient concentration limit on beryllium in the vicinity of the stationary source of 0.01 micrograms per cubic meter, averaged over a 30-day period. For the proposed coal liquefaction facility, this rule would apply to emissions primarily from the boiler stacks.

Subpart F - Vinyl Chloride

The concentration of vinyl chloride in each exhaust gas stream from any equipment used in vinyl chloride formation and/or purification is not to exceed 10 ppm averaged for a 3-hour period (proposed: 5 ppm). For the proposed coal liquefaction facility, this rule would apply to emissions primarily from the boiler stacks.

Subpart V - Equipment Leaks of Volatile Hazardous Air Pollutants (Fugitive Emission Sources)

The rules in this subpart would apply to the specific types of equipment listed below which would be used at a coal liquefaction facility, particularly the equipment in those stages of the process where product and intermediate product is being produced, transported, or stored.

Pumps (in fluid service)

- Each pump shall be monitored monthly to detect leaks.

  Each pump shall be visually inspected each calendar week for indications of liquids dripping from the pump seal.

  When a leak is detected, it shall be repaired no later than 15 calendar days after it is detected.

  A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

  Each pump equipped with a dual mechanical seal system that includes a barrier fluid system is exempt from the monthly monitoring requirements.

  Any pump that is designated for no detectable emissions (less than 500 ppm above background) is exempt from the monthly monitoring and 15-day repair requirements.

  If any pump is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal(s) to a control device, then it is exempt from these requirements.

Compressors (in fluid service)

Each compressor shall be equipped with a seal system that includes a barrier fluid system and that prevents leakage of process fluid to the atmosphere.

Each compressor seal system shall be:

- o operated with the barrier fluid at a pressure that is greater than the compressor stuffing box pressure; or
- o equipped with a barrier fluid system that is connected by a closed-vent system to a control device; or
- o equipped with a system that purges the barrier fluid into a process stream with zero VHAP emissions to the atmosphere.

- Each barrier fluid system shall be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both.

  Each sensor shall be checked daily or shall be equipped with an audible alarm.

If any compressor is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal(s) to a control device, then it is exempt from these requirements.

Pressure Relief Devices in Gas/Vapor Service

- Except during pressure releases, each pressure relief device in gas/vapor service shall be operated with no detectable emissions (less than 500 ppm above background).

  After each pressure release, the pressure relief device shall be returned to a condition of no detectable emissions (less than 500 ppm above background) no later than 5 calendar days after each pressure release.

- Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device is exempt from these requirements.

Sampling Connection Systems

Each sampling connection system shall be equipped with a closed-purge or closed-vent system which will:

- return the purged process fluid directly to the process line with zero VHAP emissions to the atmosphere; or

- collect and recycle the purged process fluid with zero VHAP emissions to the atmosphere; or

- be designed and operated to capture and transport all of the purged process fluid to a control device.

Open-ended Valves (one side in contact with process fluid and one side open to atmosphere)

- Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve.

- The cap, blind flange, plug, or second valve shall seal the open end at all times except during operations requiring process fluid flow through the open-ended valve or line.

  Each open-ended valve or line equipped with a second valve shall be operated in a manner such that the valve on the process fluid end is closed before the second valve is closed.

- When a double block and bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves.

Valves (in fluid service)

Each valve shall be monitored monthly to detect leaks.

When a leak is detected, it shall be repaired no later than 15 calendar days after the leak is detected.

- A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

Any valve that is designated for no detectable emissions (less than 500 ppm above background) is exempt from the monthly monitoring requirements.

Pressure Relief Devices and Flanges in Liquid Service

- Pressure relief devices in liquid service and flanges and other connectors shall be monitored within 5 days if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method.
- When a leak is detected, it shall be repaired no later than 15 calendar days after it is detected.
- The first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

Product Accumulator Vessels

Each product accumulator vessel shall be equipped with a closed-vent system capable of capturing and transporting any leakage from the vessel to a control device.

Closed-vent Systems and Control Devices

Vapor recovery systems (eg. condensers, adsorbers, etc.) shall be designed and operated to recover the organic vapors vented to them with an efficiency of 95 percent or greater.

Enclosed combustion devices shall be designed and operated to reduce the VHAP emissions vented to them with an efficiency of 95 percent or greater, or to provide a minimum residence time of 0.5 seconds at a minimum temperature of 760 degrees C.

- If flares are used they will comply with the requirements of Section 60.18 of the National Emission Standards for Hazardous Air Pollutants (NESHAP).
  Owners or operators of the control devices that are used to comply with these provisions shall monitor these control devices to ensure that they are operated and maintained in conformance with their design.

- Closed-vent systems and control devices used to comply with these provisions shall be operated at all times when emissions may be vented to them.

1990 Amendments to the Clean Air Act

On November 15,1990, President Bush signed into law the 1990 Amendments to the Clean Air Act. The Amendments are divided into four main titles dealing with attainment and maintenance of air quality standards (smog), motor vehicles and alternative fuels, toxic air pollutants, and acid deposition (acid rain). Other titles outline permit and enforcement requirements and provisions for phasing out chemicals that contribute to the depletion of the ozone layer. The following sections will discuss in general terms these titles as they relate to coal liquefaction facilities.

Title III - Air Toxics

Congress established a list of 189 toxic chemicals that must be controlled. Any facility releasing over 10 tons per year of a listed chemical or 25 tons of any combination of listed chemicals would be classified as a major emission source and would be subject to controls. For each category of point sources (chemical plants, oil refineries, steel mills, etc.) EPA must issue a standard for maximum available control technology (MACT). About 250 source categories will be subject to the regulations.

The EPA is to have standards available for at least 41 source categories within two years, and all of them within three years after they are issued. Compliance will be managed through a permit program. The target is 90% reduction of toxic air emissions by the year 2000.

Title IV - Acid Rain

To control acid rain, sulfur dioxide (SO_2) emissions must be reduced. About 111 utility power plants, mostly in the eastern U.S., are the targets of these reductions. Beginning in 1995, the plants would have to reduce SO_2 emissions below 2.5 pounds per million BTU of power generated. By the year 2000, the SO_2 emission rate would have to be below 1.2 pounds per million BTU generated.

Also under the acid rain provisions, EPA is required by 1993 to establish standards reducing nitrogen oxides (NO_x) by approximately 2 million tons per year. The standards will be based on low-NO_x burner technology.

Chemical Hazard Ass ssment and Chemical Accidents

Each owner of a facility that handles extremely hazardous substances must prepare an engineering study of the facility to identify possible hazards to public health. These studies must be made available to the public and local emergency planning agencies.

EPA is authorized to promulgate prevention regulations for chemical accidents. The bill also establishes a Chemical Safety Board to investigate chemical accidents.

Permitting and Enforcement

The EPA is required to issue new permit regulations within one year. The individual states which operate the permit programs have four years to include those regulations in their programs. Permits will be issued to include an entire facility, rather than individual units, and will have to be renewed every five years.

The Amendments also give EPA broader enforcement powers, comparable to those in newer environmental statutes, such as the Clean Water Act. Criminal violations of the Clean Air Act are upgraded from misdemeanors to felonies. For violators, there are civil penalties of up to $25,000 a day and possible criminal prosecution of corporate executives in cases where they knowingly pollute and significantly endanger public health.

38.3. SOLID AND HAZARDOUS WASTE REGULATIONS

Waste Characterization

The wastes listed in Table 38.7 have been identified as having the potential to be generated at the proposed facility.

Almost all of the solid waste streams that will be generated at the proposed facility will be considered non-hazardous solid wastes because they either do not meet the definition of a hazardous waste, or they meet the regulatory exclusion of being a hazardous waste under Section 721.104(b)(4) of the Illinois Hazardous Waste Rules. The sulfate byproduct, the filter cake, and the salts from the wastewater plant have the potential to be defined as hazardous wastes due to the potential presence of heavy metals and compounds that could make the wastes characteristically toxic as a hazardous waste. In addition, these waste streams may also be highly corrosive, in which case they would become classified as characteristically corrosive hazardous waste. At the present time, no analytical tests have been received that verify whether the sulfate byproduct, the filter cake, or the salts meet the criteria of a characteristically toxic and/or corrosive hazardous waste. Toxicity Characteristic Leaching Procedure (TCLP) testing will be required to determine if streams are technically classified as hazardous waste. Once it has been determined whether or not the waste is hazardous, then segregation of the waste into hazardous and non-hazardous should be performed prior to any storage or disposal.

Waste Management and Disposal

Solid Waste

The solid wastes generated throughout the proposed facility will be collected in storage containers, elevated bins, and hoppers. All solid wastes generated will be collected on off-road rear dump trucks, fly ash trucks, and compactor trucks and hauled one-way to the on-site sanitary landfill that will be subdivided into four cells. Leachate that is generated from the leachate collection system will be pumped to a leachate pond which will collect the leachate and direct it to the facility's wastewater treatment plant. The run-off from active portions of the cell will also be diverted and collected in the leachate pond for settling and ultimate treatment within the wastewater treatment plant.

Hazardous Waste

The hazardous wastes generated from the facility will be collected daily (e.g., once during every eight hour shift) to minimize on-site storage. These wastes will be placed on off-road rear dump trucks specifically used to haul only hazardous waste, and disposed in an on-site landfill designed to accept hazardous waste. The leachate and run-off generated during the operation of the landfill will be placed in the leachate pond, and in turn will be pumped to the facility's wastewater treatment plant.

Table 38.7

IDENTIFIABLE SOLID AND HAZARDOUS WASTES

SOURCE	WASTE IDENTIFICATION
Coal Crushing/Washing	Refuse
Gasifier	Ash, Slag, and Soot
FBC	Fly Ash, Bottom Ash
Water Treatment	Sludge
Miscellaneous	Facility Refuse and Flotsam
Wastewater Treatment	Filter Cake and Salts*

* Considered a possibly hazardous waste due to the potential presence of heavy metals.

Permitting and Engin ering Requirements

The following sections outline the permitting and engineering requirements that are applicable to the on-site management and disposal of solid and hazardous wastes that have a potential to be generated at the proposed facility.

Solid Waste

In Section 21(d)(1) of the Illinois Environmental Protection Act, it specifies that no person shall conduct any waste storage, waste treatment, or waste disposal without a permit granted by the agency. However, no permit would be required for any waste generated by a facility that is treated, stored, or disposed within the site of the facility (not applicable to hazardous waste). Since the solid wastes that will be generated at the proposed facility will be stored and disposed of on-site, the permitting requirements of Part 807, Subpart B of the Illinois Solid and Special Waste Management Regulations will not be required for the proposed facility. This exemption, however, does not preclude the facility from complying with the sanitary landfill requirements specified in Part 807, Subpart C of the regulations. These regulations require that the sanitary landfill (e.g., cells) be designed, operated, and maintained to meet the following requirements.

1. All refuse shall be deposited into the toe of the fill or into the bottom of the trench.

2. As rapidly as refuse shall be deposited into the toe of the fill, it shall be spread and compacted into layers not to exceed a depth of two feet.

3. The slope of the working face shall be maintained at a ratio of no greater than two horizontal to one vertical.

4. A daily cover consisting of at least six inches of compacted suitable material shall be placed on all exposed refuse at the end of each day of operation.

5. Areas within the landfill in which no refuse will be deposited for a period of at least 60 days shall have a 12-inch intermediate cover made of suitable materials.

6. After a landfill has been filled to capacity, a final cover must be placed on top of the entire unit no later than 60 days following the placement of refuse in the final lift. The final cover must be at least two feet of compacted suitable material.

7. No hazardous waste shall be placed within the sanitary landfill unless it is authorized by a permit.

8. When designing and developing the sanitary landfill, the following requirements shall be met:

   - Adequate shelter, sanitary facilities, and emergency communications must be provided at the landfill area.

   - Sufficient roads must be constructed to allow orderly operation within the landfill site.

   - The landfill area must have fencing, gates, or other measures to control access to the site.

   - Adequate measure for fire protection (Agency approved) must be provided at the landfill site.

   - The landfill must be designed to adequately monitor and control leachate (e.g., primary leachate collection system).

   - The landfill must be designed to adequately control dust.

   - An operational safety program (Agency approved) shall be followed by all personnel working within the landfill site.

9. During the development and operation of the landfill, emissions and discharge of any contaminants into the environment that cause violation of air and water quality regulations, respectively, shall be prohibited.

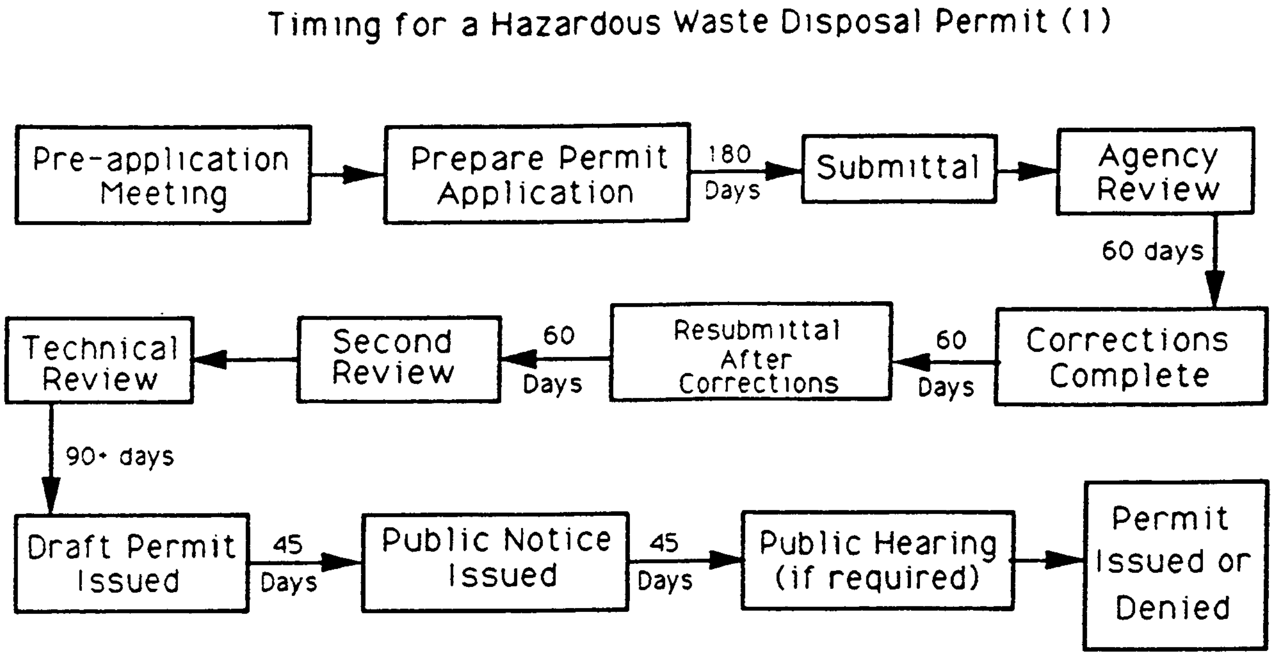
Hazardous Waste

Landfilling of hazardous waste requires that the facility obtain a hazardous waste permit as required in Section 703.121 of the Illinois Hazardous Waste Management Regulations. In addition, on-site treatment of hazardous waste may also need to be performed at the facility which, in turn would also require a permit. For a new facility, physical construction of a hazardous waste management unit(s) shall not begin unless the facility has submitted both a Part A and Part B of the permit application and received a final effective hazardous waste permit under the Resource Conservation and Recovery Act (RCRA). The permit application for both the Part A and Part B must be submitted at least 180 days before physical construction of the hazardous waste unit. Figure 38.2 illustrates the timing that is necessary to obtain a hazardous waste disposal permit. Conversations with the Illinois EPA indicate that many applications take as long as 2-3 years before a permit is granted after the application is complete. In addition, this permit application must address the information contained in Section 703, Subpart D of the regulations as follows.

1. Contents of Part A Application (Section 703.181): Note: The Part A Application requirements can usually be obtained in a form format that is distributed by the authorized state agency. The information required in this form corresponds to the following information required in the Part A application.

- The description of the activities conducted by the applicant which require it to obtain the RCRA permit.
- Name, mailing address and location of the facility for which the application is submitted.
- The latitude and longitude of the facility.
- The operator's name, address, telephone number, ownership status and status as Federal, State, private, public, or other entity.
- The name, address and phone number of the owner of the facility.
- Indication of facility status (e.g., new or existing).
- Listing of all permits or construction approvals received or applied for under the following programs: Underground Injection Control (UIC) permits; National Pollutant Discharge Elimination System (NPDES) permits; Prevention of Significant Deterioration (PSD) permits; Nonattainment programs; NESHAP Preconstruction approvals; Ocean Dumping permits; Dredge or Fill permit; or other relevant environmental permits.
- A topographic map extending 1609 meters (one mile) beyond the property boundaries of the source depicting the following:
  a. outline of facility and all intake and discharge structure;
  b. each hazardous waste treatment, storage, and disposal unit;
  c. each underground injection well;
  d. those wells (including drinking water wells) listed in public record or otherwise known to the applicant; and
  e. surface water bodies and springs within 402 meters from the facility property.
  - A brief description of the nature of the business.
  - A description of the processes to be used for treating, storing , and disposing of hazardous waste, and the design capacity of such items.
  - A specification of the hazardous waste listed or designated under Section 721 of these regulations.

FIGURE 38.2



(1) This figure illustrates the typical timing requirements as indicated in the regulations and confirmed through conversations with the Illinois EPA. Individual permits may require more or less time than that indicated above depending on the complexity of the source(s) to be permitted. Conversations with the Illinois EPA indicate that many of these types of applications take as long as two to three years before a permit is granted after the application is complete.

2. Contents of the Part B Application Section 703.182 to 188, and 200 to 207: The following detailed information must be addressed and/or submitted with the Part B application.

- General information required in the Part B application consists of the following items:
  a. general facility description;
  b. chemical and physical analysis of the hazardous waste to be handled in the unit(s) in accordance with Section 724.113 of the regulations;
  c. a copy of the waste analysis plan that meets the requirements in Section 724.113(c);
  d. a description of the security procedures and equipment required under Section 724.114;
  e. a copy of the general inspection schedule prepared in accordance with Section 724.115(b) (included the specific inspection schedule for the hazardous waste unit(s) to be permitted).
  f. a copy of the contingency plan that meets the requirements of Section 724, Subpart D;
  g. a description of precautions to prevent accidental ignition or reaction of ignitable, reactive or incompatible waste to demonstrate compliance with Section 724.117;
  h. description of traffic patterns, estimated volumes, control lanes, stacking lanes, load bearing capacity, and traffic control signals;
  j. an outline of both the introductory and continuing training programs for personnel involved in hazardous waste management that meets the requirements of Section 724.116;
  k. a copy of the closure and post-closure plan that is developed in accordance with the requirements of Section 724.212, 218, and 297;
  l. the most recent closure cost estimate for the facility prepared in accordance with Section 724.242;
  m. a copy of the documentation required to demonstrate financial assurance under Section 724.243;
  n. the most recent post-closure cost estimate for the facility prepared in accordance with Section 724.244;
  o. a copy of the documentation required to demonstrate financial assurance under Section 724.245;
  p. a copy of the documentation which shows compliance with liability requirements under Section 724.247; and
  q. a topographic map in a scale of 1 in equal to 200 feet, that shows a distance of 1000 feet around the facility with the following: contour lines; map scale and date; 100-yr flood plain area; surface water and intermittent streams;

surrounding land use; a wind rose; orientation of the map; legal boundaries of the facility; access control; injection and withdrawl wells both on and off-site; buildings; barriers for drainage or flood control; and location of hazardous waste management units.

- Location information of the Part B application must contain the following information:
  a. location of any active or inactive shaft or tunneled mine below the facility;
  b. location of any active faults in the earth's crust within 2 miles of the facility boundary;
  c. location of existing private wells or existing sources of a public water supply within 100 feet of any disposal unit;
  d. location of the corporate boundaries of any municipalities within one and one-half miles of the facility boundary;
  e. documentation showing approval of municipalities if such approval is required;
  f. identification of whether the facility is located within a 100-year floodplain (provide NFIP map, or map with calculations);
  g. description of the 100-year floodplain factors (e.g., wave action) which must be considered in designing, constructing, operating or maintaining the facility to withstand washout; and
  h. various engineering analysis to be performed in accordance with the requirements of Section 703.184 (d) (if facility is located in 100-year floodplain).

- Groundwater Monitoring information must be addressed in the Part B application and include the following items:
  a. identification of the uppermost aquifer and aquifers hydraulically interconnected beneath the facility property including, groundwater flow rate and direction, and the basis for making the determination;
  b. in the topographic map required above, the proposed point of compliance as identified in Section 724.195 and proposed groundwater monitoring wells required in Section 724.197 must be shown;
  c. detailed plans and engineering report describing the proposed groundwater monitoring system to be implemented to meet the requirements of Section 274.197.

d. a description of the groundwater monitoring program that addresses the requirements for detection monitoring under Section 274.198 that will include a proposed list of indicator parameters, waste constituents, or reaction products that can provide a reliable indication of the presence of hazardous constituents in the groundwater;

e. procedures to calculate background values for each proposed monitoring parameter or constituent; and

f. a description of the proposed sampling and analysis, and statistical comparison procedures to be utilized in evaluating groundwater monitoring data.

- Exposure information must be included in the Part B application for the disposal of hazardous waste in the landfill, and must include the following information :

  a. reasonably foreseeable potential releases form both normal operations and accidents at the unit, including releases associated with transportation to and from the unit;

  b. the potential pathways of human exposure to hazardous wastes or constituents through releases described above; and

  c. the potential magnitude and nature of the human exposure resulting from such releases.

- Identification of Solid Waste Management Units (SWMUs) must be included in the Part B application, and must address the following:

  a. the location of all SWMUs on the topographic map described above;

  b. designation of the type of unit (e.g., tank, surface impoundment, etc...);

  c. general description and structural description of the SWMUs;

  d. the operation date of when these SWMUs will begin operation; and

  e. specification of all wastes that will be managed at the SWMUs.

- Specific information on the units that will be permitted must be included in the Part B application. For this document, specific information requirements will be addressed for landfills and tanks, since these units have the highest probability for requiring a hazardous waste permit for the proposed facility.

Specific Information for Tank(s): The following information must be included in the Part B application for the permitting of a hazardous waste tank:

a. a written assessment of the structural integrity and suitability for handling hazardous waste in the tank system, including certification of a registered independent professional engineer as required in Section 724.291 and 292;

b. dimensions and capacity of each tank;

c. description of feed system, safety cutoff, bypass systems and pressure controls;

d. a diagram of the piping, instrumentation, and process flow for each tank system;

e. a description of materials and equipment used to provide external corrosion protection meeting the requirements of Section 724.292(a)(3)(B), as follows:
   - corrosion-resistant materials of construction such as special alloys, fiberglass reinforced plastic, etc.,
   - corrosion-resistant coating with cathodic protection, or
   - electrical isolation devices such as insulating joints, flanges, etc;

f. a detailed description of how the tank system(s) will be installed in compliance with Section 724.292(b), (c), (d), and (e);

g. detailed plans and description of how the secondary containment system for each tank system is or will be designed, constructed and operated to meet the requirements of 724.293(a), (b), (c), (d), (e), and (f), as follows:
   - constructed of or lined with a material compatible with the waste(s) to be stored in the tanks system,
   - must have sufficient strength and thickness to prevent failure owing to pressure gradients (e.g., static head, external hydrogeological forces), physical contact with the waste to which it is exposed, climatic conditions, and the stress of daily operation,
   - placed on a foundation or base capable of providing support to the system, resistance to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift,

- provided with a leak-detection system that is designed and operated so that it can detect the presence of any releases of hazardous waste in the secondary containment system within 24 hours from the time the release first occurred,
- sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation,
- an external liner must be capable of containing 100 percent of the capacity of the largest tank within the secondary containment system and prevent **run-on** or infiltration of precipitation into the secondary containment system unless the system has excess capacity to contain precipitation resulting from a 25-year, 24-hour rainfall event,
- the external liner must be free of cracks or gaps, and must completely surround the tanks and cover the surrounding earth likely to come into contact with the waste being released from the tank,
- the vault system must be capable of containing 100 percent of the capacity of the largest tank within the secondary containment system and prevent **run-on** or infiltration of precipitation into the containment system unless the system has excess capacity to contain precipitation from a 25-year, 24-hour rainfall event,
- the vault system must be constructed with chemical-resistant water stops in place at all joints (if any),
- the vault system must be provided with an impermeable interior coating or lining that is compatible with the stored waste and will prevent the migration of any waste released into the containment system,
- the vault system must be provided with a means to protect against the formation of and ignition of vapors within the vault (only applicable if the waste meets definition of ignitable or reactive characteristic hazardous waste),
- the vault system must be provided with an exterior moisture barrier to prevent migration of moisture into the vault if the vault is subject to hydraulic pressures, and

- all ancillary equipment associated with the tank must be provided with secondary containment (e.g., trench, jacketing, double-walled pipe) unless it is exempted under Section 724.293(f);

h. description of control and practices to prevent spills and overflows, as required under Section 724.294(b); and

i. for tank systems in which ignitable, reactive or incompatible wastes are to be stored or treated, a description of how operating procedures, the tank system, and facility design will achieve compliance with the requirements of Section 724.298 and 724.299.

Sp cific Information for Landfill(s): The following types of information must be included in the Part B application for the permitting of a hazardous waste landfill:

a. a list of the hazardous wastes placed or to be placed in each landfill or landfill cell;

b. detailed plans and an engineering report describing how the landfill will be designed, constructed, operated and maintained to comply with the requirements of Section 724.401 (e.g., the liner system and leachate collection system; control of run-on and run-off; management of collection and holding facilities; control of wind dispersal of particulate matter);

c. the liner system and leachate collection and removal system must be designed to be in compliance with the minimum technological requirement (MTR), as follows:

   - the system must consist of a two-liner, two-leachate collection system;
   - the lower liner (secondary) must, at a minimum, be constructed of clay (3 feet minimum) or other material with a permeability of no mmore than 1 x 10^{-7} cm/sec.
   - one leachate collection (detection) system will be placed immediately above the secondary liner and will be designed to detect (in a timer manner), collect, and remove liquids and leaks occurring from the top (primary) liner;
   - the primary liner will be placed above the leachate collection system (should have the same permeability as the secondary liner); and
   - a primary leachate collection system will be placed on top of the primary liner and will be designed to quickly collect and remove leachate which percolate through the landfilled waste materials.

d. a description of how each landfill, including the liner and cover system will be inspected in order to meet the requirements of Section 724.403(a) and (b);

e. detailed plans and engineering report that will be incorporated into the closure plan, will describe the final cover which will be applied to each landfill or landfill cell at closure to meet the requirements of Section 724.410(a), as follows:

   - provide long-term minimization of migration of liquids through the landfill;
   - function with minimal maintenance;
   - promote drainage and minimize erosion or abrasion of the cover;
   - accommodate settling and subsidence so that the cover's integrity is maintained; and
   - have a permeability less than or equal to the permeability of the bottom liner;

f. a description of how each landfill will be maintained and monitored after closure in accordance with Section 724.410(b) will be incorporated in the ppost-closure plan; and

g. if bulk or noncontainerized liquid wastes or waste containing free liquids is to be landfilled, an explanation of how Section 724.414 will be complied with.

3. Land Disposal Restriction Requirement: Due to the recent finalization of the land disposal restriction for all existing hazardous wastes (effective May 8, 1990); hazardous wastes may not be placed into the landfill unless they have met specific treatment standards that have been established for each waste. Wastes that may be generated at the proposed facility (e.g., sulfate byproduct, and filter cake, salts) that meet the definition of a characteristic hazardous waste would have to meet treatment standards before being landfilled. Although extensions to the effective date of treatment standards for specific hazardous wastes have been granted by EPA, by the time the proposed facility is constructed and waste disposal operation begin, all land disposal treatment standards will most likely be in effect including the standard for the newly identified toxic characteristic (TC) hazardous waste (effective September 25, 1990). The land disposal restriction for each type of hazardous waste that has a potential to be generated at the proposed facility is discussed in the following sections.

- Characteristically Corrosive Hazardous Waste, EPA Waste No. D002: The land disposal restriction treatment standards for hazardous waste that exhibits the characteristics of corrosivity became effective of August 8, 1990. The treatment standards for this type of hazardous waste were broken into three waste types and is presented in the following table.

Corrosive Waste Type D002BDAT Treatment Standard

Acid Category (e.g., pH $\leq$ 2.0)Deactivation (DEACT) to remove characteristic of corrosivity (e.g., treat waste to make pH > 2.0).

Corrosive Waste Type D002BDAT Treatment Standard

Alkaline Category (e.g.,pH $\geq$ 12.5)DEACT to remove the characteristic of corrosivity (e.g., treat waste to make pH < 12.5).

Other Corrosives (e.g., steel corrosives)DEACT to remove the corrosive characteristic.

- Toxicity Characteristic (TC) Hazardous Waste: The toxicity characteristic (TC) rule became effective on September 25, 1990, and expands the existing EP-toxicity characteristic constituents (8 metals and 6 pesticides) by adding an additional 25 compounds. The regulation also requires a different procedure for determining toxicity characteristics; from the old EP-toxicity test to the Toxicity Characteristic Leaching Procedure (TCLP). All wastes that will be generated at the proposed facility must be evaluated under this new TC criteria. In terms of the applicability of the land disposal restrictions to the TC hazardous waste, EPA has determined that until such time treatment standards are developed, wastes that solely exhibit the TC criteria are not presently prohibited from land disposal. Although, at the present time, EPA has not proposed treatment standards for these types of hazardous wastes, it is highly possible that most of the TC constituents will have their respective treatment standards set at the hazardous waste concentration level (e.g., for Arsenic, the TC concentration level based on the TCLP is 5.0 mg/l). As an important note, the rainfall leachate that will be generated from the proposed hazardous waste landfill should be examined under the TC criteria. If this criteria is met, then the leachate pond may become subject to permitting.

- Land Disposal Restriction Effect on Permitting Requirements Under RCRA: Since the treatment standards for the TC hazardous wastes have not yet been established, the effects that the land disposal restrictions will have on the permitting requirements for the proposed site cannot be determined.

If a facility was to manage only the **corrosive** hazardous waste on-site (e.g., treatment, storage, and/or disposal), compliance with the land disposal treatment standards will have the following effect on the permitting requirements.

a. Since the land disposal restriction treatment standards requires that the waste(s) be treated to remove the corrosive characteristics, the waste, once treated, will no longer be considered a hazardous waste. Subsequently, the landfill that will receive this treated waste will no longer be classified as a hazardous waste management unit, and will not require a hazardous waste permit.

b. The on-site treatment of the corrosive hazardous waste will not require a hazardous waste permit because it is exempted under Section 724.101(f)(6) and 720.110 of the Illinois regulations (this exemption is only applicable if the elementary neutralization unit meets the definition of a tank, tank system, container, transport vehicle, or vessel).

c. The storage of the corrosive hazardous waste prior to treatment may require a hazardous waste permit. However, if the corrosive hazardous waste is stored in tanks and/or containers for a period of less than 90 days prior to treatment and disposal, the storage units would be exempt from permitting.

38.4. WATER POLLUTION CONTROL REGULATIONS

For this Coal Liquefaction facility, the Water Management Plan was developed for permitting purposes based on segregation and discharge of storm water run-off. The process wastewater is treated in order to obtain by-products such as ammonia and phenols.

National Pollutant Discharge Elimination System (NPDES)

The Environmental Protection Agency (EPA) prohibits any discharge to public waters without a permit, and imposes stringent pollution control requirements on all discharges, whether existing or new. An applicant who intends to make any discharge to navigable waters (under the definitions, almost any water is considered navigable) must apply for and receive a NPDES permit which will set forth the parameters and conditions allowed for the discharges.

These NPDES permits are issued by the EPA, except where a state has received authority from the EPA to administer their own NPDES permit system. Before a NPDES permit will be issued, the state in which the discharge originates must certify to the EPA that all discharges will comply with the applicable effluent limitations.

EPA regulations require new dischargers to apply for a permit 180 days before commencing operations. However, abatement requirements may not be finalized until the permit application is approved. Therefore, the company should apply much earlier (during the design stage preferably) than the 180 days in order to determine the extent of abatement equipment which may be required of them in their permits. Figure 38.3 illustrates the timing necessary to obtain a NPDES Wastewater Discharge Permit.

The wastewater permitting for the State of Illinois is administered by the Illinois EPA, which has been authorized under the federal Clean Water Act to issue NPDES permits in lieu of the USEPA, although the USEPA may review permit applications for major projects. In addition to the permit forms used by the USEPA, the Illinois EPA also requires a construction permit prior to the construction of wastewater collection systems and treatment works. In general practice, both the NPDES and the Illinois construction permit applications are submitted simultaneously for processing convenience. The Illinois construction permit application will require the submittal of plans and specifications for the sewer and wastewater treatment systems.

The following sections describe items which must be addressed in a NPDES permit aapplication.

Effluent Guidelines and Standards

EPA has issued standards for numerous industrial categories, defining the levels of pollution control required for new plants. At this time, no effluent standards have been developed specifically for coal liquefaction facilities. Therefore, limits associated with specific processes in the regulations have been applied to similar processes at the proposed coal liquefaction facility. Discussions with the Illinois EPA will be conducted prior to the preparation of the permit application to determine the accepted method of applying the effluent guidelines. The New Source Performance Standards (NSPS) and Pretreatment Standards for New Sources (PSNS) apply to plants if construction commences after the standards have been promulgated or proposed. Plants discharging wastes into municipal systems do not require permits, but may be subject to the user charges and pretreatment standards. The standards relevant to a coal liquefaction facility are summarized in the following sections.

Part 414 - Organic Chemicals, Plastics, and Synthetic Fibers; Subpart F - Commodity Organic Chemicals and Subpart G - Bulk Organic Chemicals

For the proposed coal liquefaction facility, this subpart would apply to the wastewater discharges resulting from the manufacture of organic chemicals. This would include wastewater discharges from Plants 2, and 4 thru 8-1 at the proposed facility. The following standards of this Subpart would apply.

New Source Performance Standards - Any new source subject to this Subpart must not exceed the quantitiy (mass) determined by multiplying the wastewater flow times the following concentrations.

- BOD5 : 80 mg/L maximum for any one day, and 30 mg/L maximum for a monthly average.

- TSS : 149 mg/L maximum for any one day, and 46 mg/L maximum for a monthly average.

- pH : within a range of 6.0-9.0 at all times.

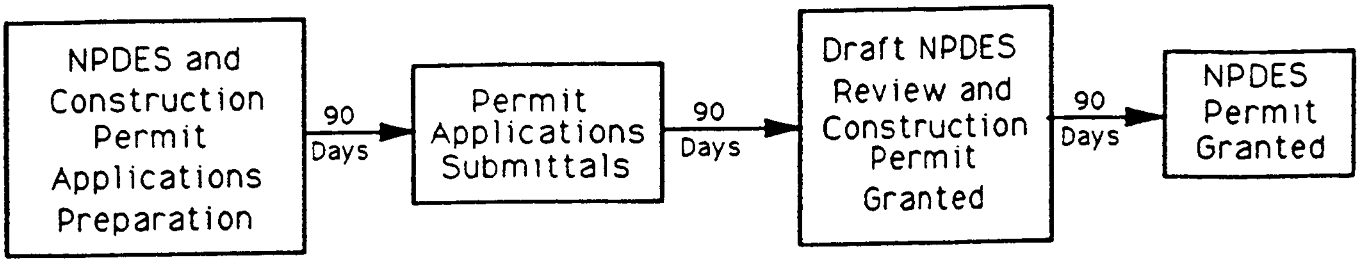
Also included under NSPS are the standards detailed for the Pretreatment Standards for New Sources (PSNS) as follows.

Pretreatment Standards for New Sources - Any new point source subject to this Subpart must achieve discharges not exceeding the quantitiy (mass) determined by multiplying the wastewater flow times the following concentrations (Note: Only the standards for those priority pollutants relevant to the Project Wastewater Characterization were provided below).

- Acenaphthene, Naphthalene, and Phenanthrene: 47 μg/L maximum for any one day, and 19 μg/L maximum for a monthly average (standards are for each pollutant).

FIGURE 38.3

Timing for Wastewater Discharge Permits (1)



(1) This figure illustrates the typical timing requirements as indicated in the regulations and confirmed through conversations with the Illinois EPA. Individual permits may require more or less time than that indicated above depending on the complexity of the source(s) to be permitted.

Part 419 - Petroleum R fin ry Point Source Category; Subpart B - Cracking Subcategory

This Subpart applies to all wastewater discharges from any facility that produces petroleum products by use of topping or cracking. For the proposed coal liquefaction facility, this Subpart would apply to the hydrotreatment operations contained in Plants 4 through 7.

Any new source subject to this Subpart must achieve the New Source Performance Standards (NSPS) specified in Table 38.9. The standards in Table 38.8 are to be multiplied by the size and process factors contained in the regulations to calculate the maximum for any one day and maximum averages of daily values for 30 consecutive days.

Any new source subject to this Subpart which introduces pollutants into a publicly owned treatment works (POTW) must comply with 40 CFR Part 403 and the following Pretreatment Standards for New Sources (PSNS).

Oil and grease: 100 mg/L maximum for any one day

Ammonia (as N): 100 mg/L maximum for any one day; where the discharge to the POTW consists solely of sour waters, the owner or operator has the option of complying with this limit or the daily maximum mass limitation for ammonia set forth in the NSPS listed in Table 38.8.

Part 420 - Iron and Steel Manufacturing Point Source Category; Subpart A - Cokemaking Subcategory

Any new source subject to this Subpart which introduces pollutants into a publicly owned treatment works (POTW) must comply with 40 CFR Part 403 and achieve the following Pretreatment Standards for New Sources (for the proposed coal liquefaction facility, this Subpart would apply to the coking operations in Plant 8-1).

- Ammonia (as N): 0.0645 lb/1000 lb product maximum for any one day, and 0.0322 lb/1000 lb product average of daily values for 30 consecutive days.

  Cyanide: 0.0172 lb/1000 lb product maximum for any one day, and 0.00859 lb/1000 lb product average of daily values for 30 consecutive days.

  Phenols: 0.0430 lb/1000 lb product maximum for any one day, and 0.0215 lb/1000 lb product average of daily values for 30 consecutive days.

TABLE 38.8

SUBPART B - CRACKING SUBCATEGORY
NSPS EFFLUENT LIMITATIONS
(LBS/1000 BBL FEEDSTOCK)

EFFLUENT CHARACTERISTIC	MAXIMUM FOR ANY ONE DAY	AVERAGE OF DAILY VALUES FOR 30 CONSECUTIVE DAYS SHALL NOT EXCEED
BOD5	5.8	3.1
TSS	4	2.5
COD (note 1)	41.5	21
Oil and Grease	1.7	0.93
Phenolic Compounds	0.042	0.02
Ammonia (as N)	6.6	3
Sulfide	0.037	0.017
Total Chromium	0.084	0.049
Hexavalent Chromium	0.0072	0.0032
pH	note 2	note 2

Note 1. In any case in which the applicant can demonstrate that the chloride ion concentration in the effluent exceeds 1000 mg/L (1000 ppm), the permitting authority may substitute TOC as a parameter in lieu of COD.

2. Within the range of 6.0-9.0 at all times.

Part 423 - Steam Electric Pow r Generating Point Source Cat gory

For the proposed coal liquefaction facility, this Subpart would apply to Plant 31 (Steam and Power Generation Plant). Any new source subject to this Subpart must achieve the following New Source Performance Standards.

- The pH of all discharges, except once through cooling water, shall be within the range of 6.0-9.0.

- There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

- Any untreated overflow from facilities designed, constructed, and operated to treat the coal pile runoff which results from a 10-year, 24-hour rainfall event shall not be subject to the following limitations: TSS limitation for any time not to exceed 50 mg/L.

Part 434 - Coal Mining Point Source Category; Subpart B - Coal Preparation Plants

The following New Source Performance Standards shall apply to discharges from new source coal preparation plants and their associated areas, if such discharges normally exhibit a pH of less than 6.0 prior to treatment.

- Total Iron: 6.0 mg/L maximum for any one day, and 3.0 mg/L average of daily values for 30 consecutive days.
- Total Manganese: 4.0 mg/L maximum for any one day, and 2.0 mg/L average of daily values for 30 consecutive days.
- TSS: 70 mg/L maximum for any one day, and 35 mg/L average of daily values for 30 consecutive days.
- pH: 6.0-9.0 at all times.

If such discharges normally exhibit a pH equal to or greater than 6.0 prior to treatment, then the total manganese standard listed above is not applicable.

Illinois Water Quality Standards and Limitations

The Illinois EPA water quality effluent standards and limitations are identical to those promulgated by the USEPA.

External Sources of Water

The Phase Zero Water Management Plan is based on the total reuse of waters and wastewaters until all water has either evaporated, been chemically consumed, or taken to landfill as surface moisture on solid waste materials. This approach reduces the need for freshwater make-up to an absolute minimum and, under normal operating conditions, eliminates any wastewater discharge. There will be occasional short-term discharges when conditions are abnormal, such as during plant start-up or shut-down, when the cooling towers are not operating at full design capacity, or during periods of heavy rainfall exceeding the design when excess storm run-off will be allowed to overflow. These occasional short-term discharges of excess water will come from large storage ponds. Although the overflowing water will not be pure rain water, its level of contamination is expected to be very low. During detailed design, provisions should be made to ensure that the overflowing water will be the least contaminated of the ponds' contents. Overflow pipes will be located far from inlet pipes, in deep quiescent portions of the pond to facilitate settling of any settleables, and baffled to keep floatables from escaping.

The main external sources of water for the project will most likely be storm run-off and moisture imported with the run-of-mine coal. These sources, the water they furnish, and the disposition of these waters are discussed individually in the following sections.

Storm Water Run-off

Outfalls that discharge storm water associated with industrial activities must be permitted. Those outfalls that discharge storm water not associated with industrial activity do not require permitting unless the storm water is from a municipal separate storm sewer system serving a population greater than 100,000. Non-storm waters are prohibited from entering storm sewers and must have individual NPDES construction permits prior to the commencement of construction. In the past, the NPDES permits addressed discharges of water without much concern for storm water run-off. The storm water regulations require that a more detailed assessment of industrial and non-industrial storm water run-off be included in the NPDES permit application.

The Project storm water run-off was segregated into four categories:

- Uncontaminated run-off
- Coal storage pile run-off
- Contaminated and oily run-off
- Landfill area run-off and leachate

Uncontaminated run-off is that which is not expected to come into contact with any contaminants. Included are areas located on plant lands separate from the plant's industrial activities, such as parking lots and administrative and employee buildings. Large parking lots, however, due to their impervious nature, may generate large amounts of oil, grease, and heavy metals which may have adverse impacts on receiving waters. Permits may be required for specific storm water discharges by the Director who has authority to designate storm water discharges, such as those from parking lots, as significant contributors of pollutants or a contributor to a water quality violation.

Run-off from coal storage piles and surrounding areas will be collected and conveyed in a separate drainage system and routed to a surge pond. This stream is expected to be acidic and to contain variable levels of suspended and dissolved solids. The coarse solids will settle out in the pond. The finer solids will be removed in a clarifier-softener followed by media filtration. In addition, the pH will be adjusted and some of the hardness will be reduced. The cleaned, pH-adjusted effluent will be routed to the utility water storage pond to be blended with uncontaminated run-off.

Storm water discharge associated with industrial activity is defined in the regulations as a point source used for collecting and conveying storm water that is located at an industrial plant or is directly related to manufacturing, processing, or raw materials storage areas at an industrial plant. Included are storm water discharges from drainage areas which are located in:

- industrial plant yards
- immediate access roads and rail lines
- drainage ponds
- material handling sites
- refuge sites
- sites used for the application or disposal of process waters
- sites used for the storage and maintenance of material handling equipment
- sites that are presently used, or have been used in the past, for residual treatment, storage or disposal

This category of run-off receives the most careful handling and most thorough treatment. Chemical spills and drips can be contained within the immediate storage and use areas, and can be either recovered or neutralized before being released into the general contaminated sewer system. Run-off from liquid storage areas is temporarily contained behind dikes. Valves in the dike openings normally will be closed to insure that major spills will be contained. The impounded run-off will be released by an operator after making certain that no spill has occurred or, if it has, after suitable clean-up.

Run-off from the portions of the plant that are within the equipment lines, by definition, is contaminated because this is where the greatest chances are for losing hydrocarbons or other materials from process equipment. Although individually small, the sum of these minor losses can be significant.

Run-off and leachate from solid waste disposal landfill sites are classified as contaminated. These streams will be collected behind watertight dams in leakproof basins and then pumped to the wastewater treatment system for reuse.

Facilities to which the storm water regulations apply include, but are not limited to, the following:

- facilities subject to effluent limitation guidelines, new source performance standards, or toxic pollutant effluent standards
- active and inactive landfills, land application wastes, and open dumps that have received any industrial wastes
- steam electric power generating facilities including coal handling sites and on-site and off-site ancillary transformer storage areas

- Department of Energy and Department of Defense facilities which are affected by these regulations

Operators of storm water discharges associated with industrial activity which require permits shall meet the following permitting requirements:

- discharges to privately or Federally owned storm water conveyance systems (conveyance that is not a municipal separate storm system) are required to be covered by an individual permit.
- individual permits for storm water discharges associated with industrial activities are required to meet all of the provisions of Sections 402 and 301 of the Clean Water Act. These sections require the control for the discharge of pollutants to utilize the Best Available Technology (BAT). These requirements include meeting technology-based and, where necessary, water quality-based requirements.
- specific monitoring and sampling procedures are outlined in the regulations. Monitoring and sampling shall occur during both storm and non-storm conditions.
- proper forms, as specified in the regulations, must also be completed and submitted as part of the permit application.
- permit applicants for storm water discharges associated with industrial activities must certify that all of the outfalls covered in the permit application have been tested for non-storm water discharges which are not covered by a NPDES permit.
- applicants must also submit known information regarding the history of significant spills at the facility. This information is necessary to aid in the determination of which drainage areas are likely to generate storm water discharges associated with industrial activity, evaluate pollutants of concern, and to develop appropriate permit conditions. A significant spill is one that releases oil or hazardous substances in excess of the reportable quantity for that material.

Construction operations that result in the disturbance of one acre or more of total land area, except for operations that are for single family residential projects that result in the disturbance of less than five acres total land area, are included in the regulatory definition of storm water discharges associated with industrial activity.

Specific permit application requirements are necessary for construction activities, including narrative descriptions of:

- the nature of the construction activity
- the total area of the site and the area of the site that is expected to undergo excavation during the life of the permit
- proposed measures to control pollutants in storm water discharges during and after construction

an estimate of the run-off coefficient of the site and the increase in impervious area after the construction addressed in the permit application is completed, a description of the nature of fill material and existing data describing the soil or the quality of the discharge

- the name of the receiving water

Surge Attenuation

Because storm water run-off results in variable and, at times, very large flow rates that can easily overload and upset treatment facilities, it is necessary to regulate these flow rates. This is done by use of a surge attenuation pond. At the inlet to the API separator, flows of contaminated water in excess of separator capacity are diverted automatically to the surge pond. After flow subsides below a design level, the settled contents of the surge pond are pumped back into the inlet of the separator at rates which are a function of the level in the pond: the higher the level, the greater the pumping rate.

38.5. TOXIC SUBSTANCES CONTROL ACT

The Toxic Substances Control Act (TSCA) provides the authority for the Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause unreasonable risk to the public health or environment.

Section 8 of the Act requires chemical manufacturers and, in some cases, processors to report production and exposure-related data on approximately 2,300 chemicals to the EPA. Specifically, Section 8 (e) states:

> Any person who manufactures, processes, or distributes in commerces a chemical substance or mixture and who obtains information which reasonably supports the conclusion that such substance or mixture presents a substantial risk of injury to health or the environment, shall immediately inform the Administrator of such information unless such person has actual knowledge that the Administrator has been adequately informed of such information.

The list of chemicals subject to these regulations is found in 40 CFR 712.18. This list is periodically updated in the Federal Register. These regulations would apply to the hydrocarbon products from the coal liquefaction facility, specifically naphtha, light distillate, heavy distillate, and gas oil.

Under Section 5 of the Act, any person who intends to manufacture a new chemical substance for commercial purposes must submit notice to the EPA at least 90 days before he commences manufacture. Section 3 (9) defines a "new chemical substance" as any chemical substance which is not included on the list, or "inventory", of existing chemical substances compiled by EPA under Section 8. The inventory was published in the Federal Register on May 15, 1979.

Section 5 (d) (1) of the Act defines the contents of a premanufacture notice (PMN). It requires the manufacturer to report certain information described in Section 8 (a) (z), e.g., chemical identity, uses, and exposure data. In addition, Section 5 (d) (1) requires the submission of test data, in the possession of the person submitting the notice, which are related to the effects on health or the environment from the manufacture, processing, distribution in commerce, use, and disposal of the chemical substance.

38.6 OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

The Occupational Safety and Health Act (OSHA) intends to assure safe and healthful working conditions by authorizing enforcement of the standards developed under the Act, by assisting and encouraging the States in their efforts to assure safe and healthful working conditions and by providing for research, information, education, and training in the field of occupational safety and health. The Occupational Safety and Health Act created the Occupational Safety and Health Administration and charged the agency with the regulatory responsibility to protect workers from hazards of the workplace. The Act also created the National Institute for Occupational Safety and Health (NIOSH), which has among its responsibilities the duty to make recommendations for the OSHA regulatory standards.

Both safety and health regulations have been promulgated by OSHA under the Occupational Safety and Health Act. Safety regulations include handling and labeling requirements and safety precautions (such as protective clothing or equipment). Health regulations are exemplified by employee health record requirements, and the setting of contaminant exposure limits and maximum contaminant levels for workplace air.

Recommendations for regulations are made to OSHA by NIOSH, the scientific advisory body of OSHA and other recognized standards-setting organizations, including the American Conference of Governmental and Industrial Hygienists and the American National Standards Institute.

Recommended Contaminant Limits for Workplac Air

Recommendations for contaminant limits in workplace air are made by the National Institute of Occupational Safety and Health, the American Conference of Governmental and Industrial Hygienists, and the American National Standards Institute.

NIOSH is the sister research body of OSHA, and its responsibilities include developing criteria for setting occupational standards. This information is generally developed on either a substance-by-substance basis or a process-specific basis. Results of the NIOSH literature investigations are published in criteria documents. Preparation of a criteria document addressing a single chemical contaminant or industry requires about 45 weeks. Approximately 24 criteria documents are produced in a year by NIOSH.

NIOSH also prepares documents addressing health and safety guidelines for various occupations. An example of one of these is a document entitled "Recommended Health and Safety Guidelines for Coal Gasification Pilot Plants." This document addresses the various coal gasification processes and attempts to identify the associated potential health hazards. On the basis of identified hazards, guidelines for worker protection are prescribed in terms of engineering controls, work practice, workplace monitoring, medical surveillance, and personal protection. Table 38.9 lists those compounds known to be present in coal liquefaction processes for which occupational standards have been established.

TABLE 38.9

EXPOSURE LIMITS FOR COMPOUNDS FOUND IN COAL LIQUEFACTION PLANTS (a)

COMPOUND	WHERE FOUND	TLV-TWA mg/m3 (ppm)	TLV-STEL mg/m3 (ppm)
Acetic Acid	Gas Stream	25(10)	37(15)
Acetone	Laboratory	1780(750)	2380(1000)
Ammonia	Gas Stream	17(25)	24(35)
Aniline (skin)	Gas Stream	7.6(2)	(b)
Antimony	Trace Element in Coal	0.5(b)	(b)
Arsenic	Trace Element in Coal	0.2(b)	(b)
Benzene	Laboratory Gas	32(10)	(b)
Beryllium	Trace Element in Coal	0.002(b)	(b)
1,3-Butadiene	Gas Stream	22(b)	(b)
Cadmium fume dust	Trace Element in Coal	0.05(b,c)	(b)
Carbon dioxide	Gas Stream	9,000(5,000)	54,000(30,000)
Carbon disulfide	Gas Stream	31(10)	(b)
Carbon monoxide	Gas Stream	57(50)	458(400)
Carbon tetrachloride	Laboratory	31(5)	(b)
Chromium (soluble & metal)	Trace Element in Coal	0.5(b)	(b)
Coal dust (> 5% SiO2)	Coal Preparation Area	2.4(b)	(b)
Coal dust (< 5% SiO2)	Coal Preparation Area	10(b)	(b)
Coal tar pitch volatiles	Gas Stream	0.2(b)	(b)
Cresol (skin)	Gas Stream	0.2(b)	(b)
Ethyl mercaptan	Gas Stream	1.3(0.5)	(b)
Hydrogen chloride	Gas Stream	7.5(5) (d)	(b)
Hydrogen sulfide	Gas Stream	14(10)	21(15)
Lead and lead compounds	Trace Element in Coal	0.15(b)	(b)
Manganese	Trace Element in Coal	5(b)	(b)
Mercury	Trace Element in Coal	0.05(b)	(b)
Methyl ethyl ketone	Laboratory	590(200)	885(300)
Methyl mercaptan	Gas Stream	0.98(0.5)	(b)
Naphtha (coal tar)	Gas Stream	(b,e)(100)	(b)
Naphthalene	Gas Stream	52(10)	79(15)
Nickel carbonyl	Methanation	0.12(0.05)(c)	(b)
Nickel (soluble and metal)	Trace Element in Coal	1(b,c)	(b)
Phenol (skin)	Gas and Effluent Stream	19(5)	(b)
Propane	Gas Stream	(b,e)(1,000)	(b)
Pyridine	Gas Stream	16(5)	(b)
Selenium compounds	Trace Element in Coal	0.2(b)	(b)
Silica dust (total)	Trace Element in Coal	10(b)	(b)
Silica dust (respirable)	Trace Element in Coal	0.05(b)	(b)
Styrene (skin)	Gas Stream	213(50)	426(100)
Sulfur dioxide	Thermal Oxidizer	5.2(2)	13(5)
Toluene	Slurry Oil, Gas Stream	377(100)	565(150)
Vanadium	Trace Element in Coal	0.05(b)	(b)
Xylene (V2O5 dust and fume)	Gas Stream	434(100)	651(150)

(a) From American Conference of Governmental and Industrial Hygienists, "Threshold Limit Values and Biological Exposure Indices for 1989-1990."
(b) Value no available or adopted.
(c) Value recommended for change.
(d) Ceiling or not-to-be-exceeded value.
( ) From Sax, N. Irving and Richard J. Lewis, Sr., "Danger us Propérties of Industrial Material."

38.7 NOISE REGULATIONS AND DESIGN IMPLICATIONS

Illinois Community Noise Regulations

In Illinois, regulation of noise in the community or on the property line of an industrial facility is regulated by the State of Illinois. It is possible, but unlikely, that a local community would also have community noise regulations. The State regulations have three basic provisions, as follows:

- Limits on noise levels in octave (frequency) bands
- Prohibition on tones
- Limits on impulsive noises
- A complaint resolution procedure, based largely on avoiding a nuisance.

Upon identification of candidate site(s), the specific limits which are controlling with respect to plant design and equipment requirements can be determined.

Noise Limits in Octave Bands

The specific octave band limits during the nighttime for noise from an industrial facility, such as a coal liquefaction plant, are based on land use and are detailed in Table 38.10. The limits in Table 38.10 are in octave bands; the approximate A-weighted equivalent is given for reference only. These limits are taken as an hourly equivalent noise level (Leq). The Leq is a constant A-weighted sound pressure level that has the same energy as the actual fluctuating level. There are corresponding limits during the daytime, but the nighttime limits are expected to apply because of 24-hour operation of the plant. Measurements are to be made no closer than 25 feet from a noise source.

Land Use A is for libraries, prisons, schools, and for any dwellings or places where people sleep. Land Use B is for commercial establishments, including communications facilities, stores (wholesale and retail), financial services, real estate services, personal and professional services, military bases, most government services, amusement parks, resorts, and churches.

Limits on Impulsive Sound

The following noise limits apply to impulsive sounds emanating from an industrial facility, such as a coal liquefaction plant. These limits describe the allowable A-weighted sound pressure levels (in dBA) emitted from an industrial facility to a receiver on:

Class A Land:
Daytime: 56 dBA
Nighttime: 46 dBA

Class B Land: 61 dBA

Nighttime is defined in the regulations as 10:00 pm to 7:00 am. The State of Illinois defines impulsive sound as "either a single pressure peak or a single burst (multiple peaks) for a duration of usually less than one second." This implies a very fast rise and decay time for sound. Dropping pipe, slamming a car door, blasting, or a drop hammer forge are examples of impulsive sounds.

Prohibition on Tones

Prominent discrete tones are prohibited. A tone exists if the arithmetic average of the sound pressure levels in the two adjacent 1/3 octave bands exceeds the level in the 1/3 octave band by more than the following:

TABLE 38.10

NIGHTTIME NOISE LIMITS IN OCTAVE BANDS

OCTAVE BAND CENTER FREQUENCY (HERTZ)	ALLOWABLE SOUND PRESSURE LEVELS (IN dB) EMITTED FROM AN INDUSTRIAL FACILITY TO A RECEIVER ON: CLASS A LAND	CLASS B LAND
31.5	69	80
63	67	79
125	62	74
250	54	69
500	47	63
1000	41	57
2000	36	52
4000	32	48
8000	32	45
Approximate Equivalent A-weighted Level (dBA)	55	66

- 5 dB for 1/3 octave bands with center frequencies between 500 and 10,000 Hertz (Hz)
- 8 dB for 1/3 octave bands with center frequencies between 160 and 400 Hz
- 10 dB for 1/3 octave bands with center frequencies between 25 and 125 Hz.

In additon, the sound pressure level in the 1/3 octave band in question must exceed each adjacent 1/3 octave band.

V rification Measurements

Measurements used to determine compliance with these regulations are taken downwind. Since atmospheric conditions are more favorable to propagation of sound downwind, sound pressure levels will typically be higher downwind. However, the limits should be assumed to apply in all directions, because the wind will eventually blow in all directions. In all cases, these limits apply no closer than 25 feet from a noise source. The regulations include a provision for correcting measured levels for background noise levels (noise from other nearby and far-away sources that are continuing). Measurements to verify compliance are expected to be cumbersome, because most sound level meters measure only one frequency at a time, need to measure each frequency for a minimum of one hour, need to measure downwind, and the need to measure nominally steady state noises as well as tones and impulsive noises.

Exceptions and Enforcement

The regulations include exceptions, including emergency warning devices, construction equipment, and unregulated safety relief valves. However, safety valves that lift too often could be considered a nuisance. The noise limits would presumably apply to construction equipment used as part of operating the plant.

The State of Illinois relies mostly on complaints and usually does not attempt to enforce its regulations. Violating a provision of the regulations can be used to help demonstrate that a nuisance exists. It should be assumed that all Illinois regulations must be met on the property line of the site and at all locations in the nearby community. Generally, the State seems to interpret its noise regulations in a "reasonable" manner.

Annoyance and Community Reaction

If people are annoyed, they can file a complaint. The complaint resolution procedure includes a hearing before the Illinois Pollution Control Board. If the Board determines that a nuisance has been created by the noise, then abatement can be ordered. Meeting all of the noise limits and prohibitions is not sufficient to avoid annoyance of nearby residents and complaints. Most complaints heard by the Board are based on subjective evaluation and not on specific noise measurements.

R gulation of Transportation Noise

The State has noise limits and requirements for motor vehicles and the U.S. Department of Transportation has limits for railroad vehicles and operations. Vehicular traffic entering and leaving the site are excluded from the noise limits. However, in some cases, transportation noise might be considered to contribute to a nuisance.

Occupational Noise Regulations

The following sections describe the OSHA noise exposure regulations related to a coal liquefaction facility.

Hearing Conservation Program

A hearing conservation program is required by OSHA (46 CFR 4078) for each employee whose TWA equals or exceeds 85 dBA. The TWA is the average sound pressure level to which an employee is subjected to during a day. An employee who is exposed to 85 dBA for eight hours will have a TWA of 85 dBA. The regulations describe how the TWA and noise doses can be computed for employees, such as most maintenance workers in a coal liquefaction plant , exposed to varying noise levels. A hearing conservation program must include both an audiometric testing program and use of hearing protectors in cases where hearing loss is detected.

Hearing Loss Claims

Employees who suffer hearing loss may file for compensation from the employer. More and more employees are receiving compensation for hearing loss, even though some hearing loss may be due to age and some may be caused by exposure to noise outside of the work place. Monetary awards can be sizeable. A hearing conservation program to identify new workers who already have hearing loss helps limit awards for hearing loss.

Noise Criteria in Normally Quiet Ar as

Noise levels in normally quiet areas of the plant must be sufficiently low so that communication (speech and telephone) can be easily maintained. Adequate communication can typically be maintained and undue annoyance avoided if the noise levels listed in Table 38.11 are maintained in normally quiet areas.

Potential Effects on the Site Selection and Layout

Community noise regulations and the need to avoid creating a noise nuisance are expected to affect the selection of the site, the size of the site, the layout of the site, and provisions for transporting materials from the site. Mining activities, the coal liquefaction plant, and transportation of products off of the site are expected to have an impact on noise.

Site Selection

Site selection is likely to be impacted by noise considerations. Noise criteria for sites with noise sensitive neighbors are likely to be more stringent and, hence, more noise control is likely to be required. Not only is the presence of noise sensitive neighbors likely to have an adverse effect, but the existing transportation on or adjacent to the site is likely to reduce the impact of transportation noise. While traffic entering or leaving the site is exempted from the noise limits and restrictions, transportation noise should be considered in site selection. The following are generally favorable methods to reduce the impact of noise on the environmental assessment, planning, design, and operation of the coal liquefaction plant:

- Larger sites
- Further from noise sensitive receptors, including Land Use A
- Absence of important historical, recreational, or cultural sites
- Nearby availability of existing transportation
- Property lines further from mining activities
- Topography where the coal liquefaction plant can be located away from the property line and away from the tops of hills
- Absence of noise sensitive receptors that overlook the site.

TABLE 38.11

NOISE CRITERIA IN NORMALLY QUIET AREAS

SPACE	TYPICAL A-WEIGHTED NOISE LEVELS (dBA)	TYPICAL NC CRITERIA
Control Rooms	50-60	45-55
Laboratories	40-50	35-45
Private Offices	40-50	30-40
Large Offices	45-55	35-45
General Secretarial Areas	45-55	40-50
Lunch Rooms	50-60	45-55
Large Conference Rooms	35-45	25-35
Small Conference Rooms	40-50	30-40

38.8 FEDERAL AVIATION ADMINISTRATION (FAA) POLICIES

The following FAA policies influence the layout, design, and proximity of new plants relative to nearby airports.

Good Engineering Practice (GEP) Stack Heights

When a building or buildings interrupt wind flow, an area of turbulence called building downwash is created. Pollutants being emitted from a fairly low level (i.e. a roof vent or even a short stack) can be caught in this turbulence, affecting the dispersion of the pollutants.

The effects of building downwash can be significantly reduced or even eliminated by designing stacks at good engineering practice (GEP) heights. The GEP stack height is calculated by the following equation:

$$GEP = H_b + 1.5\,L$$

Where,

H_b = height of the building

L = lesser of the height and the projected width of the building

In dispersion modeling demonstrations, credit is not given for actual stack heights above GEP stack height.

Proximity to Airports

As part of the preliminary site assessment and environmental impact statement, the FAA and nearby airports should be contacted in order to ascertain whether or not the building and stack configurations proposed for the coal liquefaction facility will in any way impact or affect local air traffic or operations at nearby airports.

SAFETY PLANNING

Hazards Analysis

A hazards analysis is a necessary step in comprehensive emergency planning for a community. Comprehensive planning depends upon a clear understanding of what hazards exist and what risk they pose for various members of the community. A hazards analysis is a 3-step decision-making process used to identify the potential hazards facing a community with respect to the accidental releases of extremely hazardous substances (EHSs).

The hazards analysis is designed to consider all potential acute health hazards within the planning district and to identify which hazards are of high priority and should be addressed in the emergency response planning process. The emergency response planning covered under Title III of the Superfund Amendments and Reauthorization Act

(SARA) must address all EHSs that are reported to the State Emergency Response Commission (SERC), but other substances including EHSs below their threshold planning quantity (TPQ) may also be included (see Section 10.2). A brief overview of the three components of a hazards analysis is presented below.

Hazards Identification

Hazards identification typically provides specific information on situations that have the potential for causing injury to life or damage to property and the environment due to a hazardous materials spill or release. A hazards identification includes information about:

- chemical identities
- the location of facilities that use, produce, process, or store hazardous materials
- the type of design of chemical container or vessel
- the quantity of material that could be involved in an airborne release
- the nature of the hazard (e.g., airborne toxic vapors, fire, explosion, handling conditions) most likely to accompany hazardous materials spills or releases.

Vulnerability Analysis

A vulnerability analysis identifies areas in the community that may be affected or exposed, individuals in the community who may be subject to injury or death from certain specific hazardous materials, and what facilities, property, or environment may be susceptible to damage should a hazardous materials release occur. A comprehensive vulnerability analysis provides information on:

- the extent of the vulnerable zones (i.e., an estimation of the area that may be affected in a significant way as a result of a spill or release of a known quantity of a specific chemical under defined conditions)
- the population, in terms of numbers, density, and types of individuals (e.g., facility employees, neighborhood residents, people in hospitals, schools, prisons, day care centers) that could be within a vulnerable zone
- the private and public property that may be damaged, including essential support systems (e.g., water, food, power, communication, medical) and transportation facilities
- the environment that may be affected, and the impact of a release on sensitive natural areas and endangered species.

Risk Analysis

A risk analysis is an assessment by the community of the probability of an accidental release of a hazardous material and the actual consequences that might occur, based on the estimated vulnerable zones. The risk analysis provides an estimation of:

- the probability of an accidental release based on the history of current conditions and controls at the facility
- the severity of consequences of human injury that may occur (acute, delayed, and/or chronic health effects), the number of possible injuries and deaths, and the associated high-risk groups
- the severity of consequences on critical facilities such as fire and police stations, hospitals, and communication centers
- the severity of consequences of damage to property
- the severity of damage to the environment

Superfund Amendments and Reauthorization Act (SARA) Title III Community Emergency Planning and Right-to-Know Act

On October 17, 1986, SARA was promulgated into law. Title III of SARA contains numerous requirements for federal, state, and local governments, as well as private industry, in the areas of emergency planning, community right-to-know, hazardous emissions reporting, and emergency notification. These requirements build upon the original Chemical Emergency Preparedness Program (CEPP), numerous existing state and local programs aimed at community right-to-know and preparedness.

The objectives of Title III are to improve local chemical emergency response capabilities and to provide citizens and local governments access to information about chemicals in their localities. Title III addresses planning by:

- identifying the EHSs that trigger the planning process
- requiring facilities to identify themselves if they have quantities of EHSs exceeding the TPQs
- requiring the establishment of a state and local planning structure and process
- requiring facilities to make information available to local planners
- specifying the minimum contents of local emergency plans

Title III required EPA to publish a list of EHSs and TPQs for each substance triggering the planning process. EPA fulfilled this requirement in a rule published on April 22, 1987 (Federal Register, Vol. 52, No. 77, pp. 13378-13410). The list of EHSs included the 402 chemicals found in the CEPP Interim Guidance List of Acutely Toxic Chemicals and four additional chemicals added as a result of new information. Four chemicals have been removed from the list and 36 others are proposed for delisting as they do not meet the acute lethality criteria (see the above-referenced Federal Register for the list chemicals triggering the planning process).

ILLINOIS EPA CONTACTS

The persons listed below are those from whom information or assistance was obtained with respect to the coal liquefaction study. Other staff members at these agencies should also be able to offer assistance.

Air Permits

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