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The BRECKINRIDGE PROJECT

Initial Effort

REPORT V

VOLUME 2

MASTER

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AIRCO ENERGY COMPANY, INC.

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REPORT V
VOLUME 2

INTRODUCTION

Report V, Volume 2 provides descriptions, data, and drawings pertaining to Steam Generation and Boiler Feedwater Treating (Plant 31), Water Systems: Raw, Potable, Cooling (Plant 32), Fire Systems (Plant 33), and Sewers and Wastewater Treatment (Plant 34).

Steam Generation and Boiler Feedwater Treating (Plant 31) supplies electrical power, process steam, and treated boiler feedwater to other plants.

Water Systems: Raw, Potable, Cooling (Plant 32), together with Sewers and Wastewater Treating (Plant 34) provide project-wide water management, based on river water use and total re-use of waters within the project.

Fire Systems (Plant 33) provides a fire water system for general fire protection of all plants, and also provides chemical and steam fire suppression.

The following information is included for each of the four plants described in this volume:

- A description of the plant's design, including the utility balance, catalysts, packings, and chemicals usage (if applicable), and process flow diagrams.
- An equipment list, including item numbers and descriptions.
- Data sheets and sketches for major plant components.
- Pertinent engineering drawings.

At the end of this volume is an appendix which contains:

- An overall site plan showing the locations of all plants.
- The symbols and legend for the piping and instrument diagrams included in this volume.

INITIAL EFFORT REPORTS REFERENCE

Report I - Executive Summary

Report II - Breckinridge Project Design Basis

Report III - Specifications
- Volume 1 - Specifications A through J
- Volume 2 - Specifications K through W

Report IV - Process Units
- Volume 1 - Plants 26, 27 and 1
- Volume 2 - Plants 2, 3 and 4
- Volume 3 - Plants 5, 6 and 17
- Volume 4 - Plant 7
- Volume 5 - Plants 8, 9 and 10
- Volume 6 - Plant 12
- Volume 7 - Plants 15 and 18

Report V - Utilities and Offsites Units
- Volume 1 - Plants 19, 20, 21, 22, 23 and 30
- Volume 2 - Plants 31, 32, 33 and 34
- Volume 3 - Plant 35
- Volume 4 - Plants 36, 37, 38, 39, 40, 41, 42 and 44

Report VI - Project Management Plan

Report VII - Environmental, Socioeconomic, Safety and Health
- Volume 1 - Introduction and Background
- Volume 2 - Environmental Baseline
- Volume 3 - Cultural and Socioeconomic
- Volume 4 - Health and Safety

Report VIII - Capital Cost Estimate

Report IX - Operating Cost Estimate

Report X - Economic Analysis and Financial Plan

Report XI - Technical Audit
Volume 1 - Engineering Comparisons
Volume 2 - Engineering Comparisons
Volume 3 - Critical Design Areas
Volume 4 - Critical Review of the Design Basis
Volume 5 - Critical Review of the Design Basis

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VOLUME 2

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PLANT 31 STEAM GENERATION AND BOILER FEEDWATER TREATING

1.0 INTRODUCTION

The project cogeneration plant supplies electric power, process steam and treated boiler feedwater for use by the project plants. The plant consists of multiple turbine generators and steam generators connected to a common main steam header. The major plant systems which are required to produce steam, electrical power and treated feedwater are discussed individually. The systems are:

- Steam
- Steam generator
  - Water and steam
  - Air and flue gas
- Steam generator fuel
- Condensate and feedwater deaeration
- Condensate and blowdown collection
- Cooling water
- Boiler feedwater treatment
- Coal handling
- Ash handling
  - Fly ash
  - Bottom ash
- Electrical
- Control system

The plant description that follows is based on the Phase Zero design basis established for Plant 31 in July of 1980 and the steam/condensate balance as presented on Drawing 31-E-B-1. Updating of steam requirements as more refined process information becomes available has generated some expected changes in the steam balance. Boiler operation with these updated requirements is reflected on Drawing 31-D-B-1A. The major impact of updating has been that less 600 psig steam generated within the process units requires more extraction steam from the turbine generators to close the 600 psig steam balance.

Since the 900 psig steam generation from the boilers was fixed at 1,200,000 lb/hr, the additional extraction steam required to close the 600 psig steam balance decreased the quantity of electrical power available from the turbine generators. In the next phase of engineering work, the production of 600 psig steam will be augmented by increasing convection bank steam generation in the Plant 3 fired heaters by 140,000-150,000 lb/hr. This modification will allow full rated power generation from the turbine generators.

PLANT 31 STEAM GENERATION AND BOILER FEEDWATER TREATING

2.0 PLANT DESIGN

2.1 Design Basis

The pertinent plant design criteria are summarized as follows:

- Primary steam header is 900 psig, 750°F.
- Four 400,000 lb/hr, 930 psig, 755°F steam generators (boilers) with a total normal steam production of 1,200,000 lb/hr are provided.
- Steam generators are balanced draft; suspended construction; solid pulverized fuel-fired; and use pipeline gas for light-off.
- Each steam generator has three 50% rated pulverizers and three coal silos.
- Primary steam generator fuel is coal middlings (an intermediate grade of coal from Coal Washing (Plant 27); three steam generators operating at maximum continuous rating (MCR) burn 78.5 TPH of middlings.
- Two full-capacity belt conveyor systems, each designed for 200 TPH of coal, are provided.
- Sulfur Plant (Plant 10) tail gas is incinerated in the steam generators.
- Two 3,600 rpm, single-automatic-extraction-condensing (SAC) turbine generator machines are provided. Extraction steam is 600 psig, 700°F. Throttle steam is 900 psig, 750°F.
- The two turbine exhaust steam flows are condensed in surface condensers which operate at 3.5 inches Mercury absolute.
- The two turbine driven electrical generators are hydrogen cooled and rated at 26.8 MW each.
- Flue gas exits the steam generators at approximately 320°F.

- One electrostatic precipitator for each steam generator is provided. They are cold side, rigid frame design.

- The particulate removal efficiency of the precipitators is at least 99.8% (equal to or less than 0.03 pounds per million Btu of heat input and stack plume opacity equal to or less than 20%) using middlings as fuel.

- Flue gas is desulfurized in Stack Gas Scrubbing (Plant 35).

- Preliminary stack heights of 400 feet have been used.

- The low-pressure boiler feedwater system receives makeup at 220°F from the sodium zeolite softeners and the treated suspect condensate. After deaeration, the boiler feedwater is pumped to users either at 700 psig and 293°F or at 185 psig and 293°F.

- The high-pressure feedwater system receives 2,870 GPM of makeup at 118°F from the demineralized water storage tank. After deaeration, the water is pumped to users at 1,035 psig and 293°F and at a design flow of 2,920 GPM.

- The water treatment system consists of

  - Sodium zeolite softeners that process clarified filtered water from Water Systems (Plant 32) at a normal flow rate of 760 GPM.

  - A demineralizer that treats water from the surface condensers and the sodium zeolite softeners. The demineralizer has a normal output of 2,870 GPM.

  - A suspect condensate system that receives hot condensate at 1,740 GPM. After cooling and filtration, the condensate is mixed with water from the zeolite softeners (1,340 GPM) and is fed to the low-pressure feedwater deaerator.

- Fly ash, assumed to be 85% of the total ash, is collected and trucked offsite to landfill (Plant 44).

- Bottom ash, economizer ash and mill rejects are sluiced to dewatering bins and trucked to landfill for disposal.
- A distributed digital control system is provided.
- A common supervisory operating center is provided for the control of certain process plants as well as the four steam generators, two turbine generators and auxiliary equipment.

2.2 Steam Distribution Process Description

The four steam distribution systems discussed in the following paragraphs are:

- 900 psig steam system
- 600 psig steam system
- 150 psig steam system
- 50 psig steam system

Safety valves are installed to prevent overpressuring the steam headers. Sentinel valves warn of closed valves in the drive turbine exhausts. The steam piping systems are drained to the atmospheric blowoff tanks during startup and normal operation. Nonreturn check valves (air-to-open and spring-to-close) prevent backflow of steam in the 600 psig system extraction lines to the condenser and possible overspeed of the electric power turbines.

Each power turbine has a system to collect gland steam leakage from the high-pressure zone shaft seals. This system also provides gland steam to the low-pressure zone shaft seals and condenses excess leakage. Because of the contamination possibility in the gland steam drains from turbine lube oil, the drains are first routed to the atmospheric blowoff tank and then to the suspect condensate tank.

2.2.1 900 psig Steam System

The main steam header in the boiler area operates at a nominal 900 psig and 750°F. Steam is supplied to this system from the four Plant 31 steam generators. A "loop" header main steam system ensures adequate isolation of major components and valving without requiring a project shutdown.

Steam from this system is supplied to the two turbine generators for throttle steam. In addition, the 900 psig superheated steam is exported as throttle steam to the Oxygen Plant (Plant 15) oxygen and air compressor drive turbines.

The steam generated serves as a backup supply of energy to the 900 psig saturated steam header by use of a desuperheater and to the 600 psig/700°F steam system by use of a pressure regulator and desuperheater (letdown station).

2.2.2 600 psig Steam System

This steam system normally receives extraction steam from the two electrical power turbines and excess saturated steam which has been superheated in the two 100%-capacity gas fired superheaters. The system operates at a nominal 600 psig and 700°F.

The pressure is maintained by modulating the extraction valve gear in the electric power turbines to maintain an input and output flow balance. During an upset, or when one or both electric power turbines are offline, the steam letdown station maintains the steam demands.

The 600 psig steam system supplies throttle steam to all the equipment drive turbines in Plant 31 and to the Gas Plant (Plant 7) refrigeration compressor. The system also supplies superheated steam to the Plant 31 sootblowing system. The 150 psig steam system header pressure is maintained with 600 psig steam via a letdown station.

2.2.3 150 psig Steam System

The 150 psig steam system operates at saturated or slightly above saturated conditions. The system mass and heat balance Flowsheet 31-E-B-1 shows that an excess of 150 psig steam is generated normally by the steam generation equipment. The 150 psig steam header pressure is controlled by a back-pressure control station dumping excess steam to the 50 psig system. This system is also arranged to supply 150 psig steam to control the 50 psig steam header pressure.

2.2.4 50 psig Steam System

The lowest pressure header system operates at a nominal 50 psig with a small amount of superheat. This system receives steam from drive turbine exhausts (superheated) and flash drum vents (saturated), in addition to the dump steam from the 150 psig system. During normal operation, the 50 psig header supplies steam to the deaerators, steam air heaters and process plant steam users.

The 50 psig steam header pressure is coarsely controlled by adjustment of mechanical drive turbines exhausting into the header. Fine control is provided by the letdown station from the 150 psig steam header.

2.3 Steam Generator Process Description

2.3.1 Water and Steam

Four 33%-capacity steam generators provide reliable process steam for the power plant as shown on Drawing 31-C-B-5. In normal operation each boiler delivers one-fourth the total main steam demand. Normally, each boiler operates at three-fourths of its maximum continuous rating (MCR). In the event of an outage, the remaining three boilers will operate at their MCR, allowing plant operation at full process steam and electrical output.

The boilers control main steam temperature, between three-fourths and full MCR rating, to maintain a 755°F level. This control is accomplished through a combination of intermediate superheater attemperation, tilting main burners, regulation of excess air and combustion controls.

Main steam pressure is regulated by the combustion control system to maintain 900 psig throttle pressure to the turbines. Since the four boilers operate in parallel and the total main steam demand varies with process steam demand and electrical load, boiler controls are load-following based upon the pressure in the main steam system.

Control of the 295°F feedwater flow from the boiler feed system to the boiler is regulated by three-element control of the control valves. Feedwater and main steam flow rates to each boiler are controlled by a level control in the boiler drum. Feedwater enters the economizer for further heating by the exhaust flue gas prior to entering the drum.

Flow of water and water-steam mixture in the boiler is by natural circulation from and returning to the boiler drum. Saturated steam from the drum flows through the primary superheater located in the flue gas path, then through the superheater attemperator and, finally, through the secondary superheater before leaving the boiler.

During low-load operation of the boiler, such as startup, an economizer bypass circulates water through the economizer to prevent steaming in the economizer.

Safety valves, in accordance with the ASME code, are installed on the drum and main steam line for overpressure protection.

Blowdown from the boiler drum is routed to flash tanks which provide a small amount of steam to the 50 psig steam header.

2.3.2 Air and Flue Gas

The steam generators for the plant are a balanced draft design. The boiler furnace and breeching, up to and including the induced draft fan, operate below atmospheric pressure, precluding leakage of hot flue gases from the boiler.

Combustion Air. Incoming combustion air is drawn into the forced draft fan (one per boiler) through inlet air silencers and inlet control vanes. Each forced draft fan has both an electric motor and a geared turbine-driver connected through clutches on either side of the fan. The inlet vane controls are adjusted to the boiler load by the combustion control system, thus maintaining the correct volume of excess air for complete combustion. The fan pressurized incoming air is discharged to the steam air heater. Combustion air is heated in the steam air heater to provide a minimum 80°F air temperature to the regenerative air heaters. Preheat of the incoming combustion air by a steam coil lessens the possibility of acidic condensate formation and corrosion in the regenerative air heater.

The regenerative air heaters remove heat from the exhaust flue gas and transfer it to the incoming combustion air. The heaters, a Lungstrom design, continuously rotate by means of an electric motor and gear drive. To ensure rotation, an air motor is also provided as backup. Combustion air proceeds through the regenerative air heater where it is heated to approximately 300°F. Separate combustion air streams are provided to the windboxes for overfire air (secondary air), and to the pulverizer-driven booster fans (primary air) and finally to the furnace or pulverizers respectively. Primary air is used as a transport fluid for coal in the pulverizers and acts as a drying medium for evaporation of water from the solid fuel.

Combustion and Flue Gas System. In the furnace, the fuel is burned and the combustion heat is transferred to the water walls by convection and radiant heat transfer. The hot flue gas proceeds through the secondary superheater, primary superheater and the economizer sections, before exiting into the flue gas breaching. The flue gas then passes through the regenerative air heater and exits at approximately 320°F to the electrostatic precipitator.

Particulate removal from the flue gas is by electrostatic precipitator which is a cold-side, rigid-frame design. The particulate removal efficiency of the precipitator is in excess of 99.8% when middlings only are fired as fuel. This requirement is based upon a fuel ash content of 17.4%, of which 80% is anticipated to be carried over in the flue gas as fly ash. Particulate emissions are less than 0.03 pounds per million Btu of heat input, and the plume opacity at the stack (assuming the flue gas desulfurization system neither creates nor removes particulate matter) is less than 20%.

Flue gas exits the electrostatic precipitator at 300°F and is drawn into the induced draft fan (one per boiler). Each induced draft fan is driven by both an electric motor with a variable speed hydraulic coupling, and a variable speed turbine and gear reducer. Clutches are provided on both sides of the fan. Variable speed drives for induced draft fans are desirable to protect the boiler from implosion and for control of boiler draft. The induced draft fan pressures the flue gas and exhausts to the SO_2 removal system which is described later under Stack Gas Scrubbing (Plant 35).

Flue gas from Plant 35 is directed to the plant stacks. Each stack has a double flue which enables the stack to service two boilers, each with its own flue. The height of the stack is assumed to be 400 feet and will be adjusted to a final design value during processing of the Prevention of Significant Deterioration Permit.

A water spray system with a booster pump ensures against damage by fires in the stacks which are lined with a high service temperature fiberglass reinforced polyester.

2.4 Steam Generator Fuel Process Description

2.4.1 Steam Generator Fuel Side

The power plant steam generators are solid fuel fired. In addition, waste gas from the Sulfur Plant (Plant 10) is incinerated in the boilers. Pipeline gas from Interconnecting Piping (Plant 21) at 1,000 Btu/ft^3 is used for light-off and initial operation.

The fuel systems for one boiler are shown on Flowsheet 31-C-B-8.

2.4.2 Solid Fuels

The primary boiler fuel is "middlings." Middlings is an intermediate grade of coal from the coal washing operation. An alternate boiler fuel is a blend consisting of 50% Illinois No. 6, 35% Kentucky No. 9 and 15% Kentucky No. 11 coals. The fuel analysis, as received at the power plant, is shown in Table 1 for middlings and for blended raw coal.

Solid fuel is directed from the fuel storage silos through gravimetric feeders to the solid fuel pulverizers. Three 50%-capacity motor driven pulverizers are provided for each boiler. The solid fuel, reduced to 200 mesh in the pulverizers, is transported to the boiler pneumatically. The normal burn rate for 1.2 million lb/hr of 900 psig steam is 78 TPH of middlings.

2.4.3 Sulfur Plant Tail Gas

Tail gas from the Sulfur Plant (Plant 10) is received for incineration in the boilers. During normal operation, 25% of the waste gas is incinerated in each of the four boilers. During emergency operation, with two boilers in service, 50% of the tail gas is incinerated in each

TABLE 1

BOILER FEED CHARACTERISTICS*

Proximate Analysis	Middlings As Received, %	Middlings Dry Basis,%	Raw Coal Blend As Received,%	Raw Coal Blend Dry Basis,%
Volatile matter	34.7	39.9	34.5	40.2
Fixed carbon	34.9	40.1	34.7	40.3
Ash	17.4	20.0 (max)	16.8	19.5
Total moisture	13.0	----	14.0	----
Total	100.0	100.0	100.0	100.0
Ultimate Analysis	**As Received,%**	**Dry Basis,%**	**As Received,%**	**Dry Basis,%**
Carbon	52.62	60.49	56.32	65.50
Hydrogen	3.75	4.31	4.02	4.67
Nitrogen	1.02	1.17	1.08	1.26
Oxygen	6.90	7.93	7.39	8.59
Sulfur	5.22	6.00 (max)	2.66	3.09
Chloride	0.09	0.10	0.08	0.09
Ash	17.40	20.0 (max)	14.45	16.80
Moisture	13.00	-----	14.00	-----
Total	100.00	100.00	100.00	100.00
HHV, Btu/lb		11,200		11,700

Size Fractions	Middlings,%	Raw Coal
3 inch x 3/8 inch	53	Wide variations expected
3/8 inch x 28 mesh	47	
28 mesh x 0	--	
Total	100	
Hardgrove Index	45-50 (assumed)	55 (assumed)

* Preliminary Estimate

iler. Flow measurement and control devices proportion the tail gas to operating boilers only. A sulfur plant tail gas analysis is provided in Table 2.

2.5 Condensate and Feedwater Deaeration Process Description

The condensate system receives water from surface condensers and discharges to the water treatment system. The feedwater system receives water from the water treatment facilities, increases the pressure and temperature and discharges it to the steam generators and the remainder of the feedwater users. The system is shown on Drawing 31-E-B-4.

2.5.1 Condensate System

The two main turbine exhaust steam flows are condensed in surface condensers operating at 3.5 inches of mercury absolute. Drains from each condenser are collected in the hotwells at 120°F. Each condenser provides suction to three 50%-capacity motor driven hotwell condensate pumps for a total of six pumps. The pumps discharge to the water treatment system. Makeup connections for initial fill and level control valves maintain storage in the hotwells.

2.5.2 Feedwater System

The feedwater system for Plant 31 and the other plants of the project is divided into a low-pressure system (up to and including 600 psig nominal pressure boilers) and a high-pressure system (900 psig nominal pressure).

Low-Pressure System. Makeup from the sodium zeolite softeners and treated suspect condensate flow to the low-pressure feedwater deaerator. In the deaerator, the makeup feedwater is stripped with steam from the 50 psig header and the deaerated water is stored in the deaerator storage tank. The deaerated water storage tank provides five minutes storage of deaerated water (17,000 gallons) at maximum expected load for transients. Deaerated

TABLE 2

SULFUR PLANT TAIL GAS DATA*

Component	mol/hr	lb/hr
H_2O	2,074.23	37,378
H_2S	50.19	1,710
SO_2	25.09	1,603
S_6 (vapor)	0.39	75
S_8 (vapor)	1.55	398
COS	3.82	230
CS_2	0.71	54
CO	133.88	3,750
CO_2	1,632.97	71,867
N_2+Ar	1,395.56	39,104
H_2	59.47	120
C_1	0.12	2
S (as S_1 liquid)	2.09	67
Total	5,380.07	156,363

Temperature: 320°F

Pressure (at boiler battery limits): 3.1 psig

HHV 18.1 Btu/scf

* Preliminary Estimate

water at 0.005 cc/liter dissolved oxygen and 293°F flows to the low-pressure boiler feed pumps.

Three 50%-capacity 600 psig system pumps and three 50%-capacity 150 psig pumps provide water to the 600 psig feedwater header and the 150 psig feedwater header. For each group of three pumps, one turbine driver and two electric drivers are provided. Normally, a turbine driven pump and motor driven pump are in service with a motor driven pump as a spare.

The 600 psig pumps supply H-Coal® Preheating and Reaction (Plant 3), the Sulfur Plant (Plant 10) and Naphtha Hydrotreating and Reforming (Plant 18) with feedwater. The 150 psig pumps supply Plant 3, H-Coal® Primary Separation (Plant 4), H-Coal® Recycle Slurry Preparation (Plant 5), Gasification and Purification (Plant 12), H-Coal® Distillate Separation (Plant 17) and Sewers and Wastewater Treatment (Plant 34) with feedwater.

High-Pressure System. The high-pressure feedwater system receives makeup from the demineralized water storage tank. The feedwater is first preheated to 278°F in Plant 12 in the Deaerator Feed Preheater (12E-115) and then is processed in the high-pressure feedwater deaerator. As in the low-pressure deaerator, makeup feedwater is stripped in the deaerator with steam from the 50 psig header and the deaerated water is stored in the deaerator storage tank. The deaerated water flows to the high-pressure feedwater pumps at 0.005cc/liter dissolved oxygen and 293°F, values identical to those provided by the low pressure feedwater deaerator.

The high-pressure feed pumps (900 psig nominal system) provide feedwater to Plant 12 waste heat boilers and Plant 31 steam generators. In addition, these pumps provide spray water for the letdown station desuperheaters in the steam distribution system.

Four 40%-capacity 900 psig system boiler feedpumps are provided. Two are turbine driven and two are motor driven. Normally, both turbine driven

pumps and one motor driven pump are in service with the remaining motor driven pump as spare.

Other Design Features. The feedwater pumps are connected on the suction side by means of a "loop" header. This allows repair of valving, instrumentation, and equipment without plant shutdown by isolating the desired component. The high-pressure system feed pump discharge is also provided with a "loop" header arrangement for ease of isolation of pumps and boilers.

A "swing" deaerator serves as a spare for either the low or high-pressure system.

Each main surface condenser is provided with a 100%-capacity steamjet air ejector and liquid ring vacuum pump for evacuation of noncondensable gases liberated in the condenser. Normally, the steam jet air ejector is in service.

2.6 Condensate and Blowdown Collection Process Description

Condensates from the process plants and Plant 31 are collected for re-use as makeup condensate. In addition, boiler blowdown from Plant 31 and process plants' waste heat boilers is collected in Plant 31 and routed to Sewers and Wastewater Treatment (Plant 34). The system is shown on Drawing 31-D-B-12.

2.6.1 Process Plant Condensate

Condensates from the Phosam unit reboiler in Sour Water Treating (Plant 9) and debutanizer reboiler in the Gas Plant (Plant 7) are collected at 600 psig at 489°F and routed to a series of flash drums in Plant 31.

Steam is vented from the flash drums to the 50 psig steam header and condensate at 298°F flows to three 50%-capacity motor driven condensate flash

um drain pumps. During normal operation, two of the pumps will operate, with the third as spare. Discharge from the drain pumps is routed to drain coolers in the Plant 31 water treatment area.

2.6.2 Boiler Blowdown

Boiler blowdown from the Plant 31 boilers and Gasification and Purification (Plant 12) waste heat boilers is collected at 900 psig and 534°F and routed to four flash drums in Plant 31. Waste heat boiler blowdown from H-Coal® Preheating and Reaction (Plant 3), the Sulfur Plant (Plant 10), and the Naphtha Hydrotreating and Reforming plant (Plant 18) is collected at 600 psig and 489°F and routed to the flash drums in Plant 31. Boiler blowdown from Plant 3 and H-Coal® Primary Separation (Plant 4), H-Coal® Recycle Slurry Preparation (Plant 5), Gasification and Purification (Plant 12), H-Coal® Distillate Separation (Plant 17), and Sewers and Wastewater Treatment (Plant 34) is collected and routed to one flash drum in Plant 31.*

Steam from the flash drums is vented to the 50 psig steam header and flashed blowdown flows to three 50%-capacity motor driven pumps. During normal operation two of the pumps will operate, with a third pump as spare. These pumps transfer flashed blowdown to Plant 34 for further treatment.

2.6.3 Miscellaneous Drains

Two atmospheric condensate tanks are provided to receive miscellaneous suspect condensate. This condensate is formed at steam piping low points during startup and normal operation and at gland steam drains from the power turbines and gland quench leakoffs from the boiler feed pumps.

*Area blowdown flash drums may be added during detail design.

These condensate tanks are vented to the atmosphere. The drainage produced is pumped to the suspect condensate storage tank for reuse. Four 100%-capacity motor driven pumps are provided, two for each tank. One pump will operate from each tank, with the other as spare.

2.7 Service Water and Closed Cooling Water Systems Process Description

A common cooling system provides equipment cooling and turbine surface condenser cooling. The diagram of the system is shown on Flowsheet 31-C-B-7.

2.7.1 Service Water System

Service water is supplied from Water Systems (Plant 32) through an underground header. The service water flows to the turbine surface condenser inlet water boxes and cooling water heat exchangers. Waste heat is rejected to the cooling water as the water flows through the exchanger tubes. The heated service water is returned to Plant 32 through the underground header.

The design service water inlet cooling water temperature is 85°F. The cooling water heat exchangers and turbine surface condensers are conservatively designed for a maximum 90°F inlet water temperature.

2.7.2 Closed Cooling Water System

A separate closed loop system cools the equipment. Corrosion inhibited (6,000 ppm Boron Nitrite) demineralized water circulates through equipment coolers and cooling water heat exchangers. This system protects the equipment coolers from plugging, scaling, and corrosion that is, at times, associated with the service water system.

The system consists of piping, valves, three 50%-capacity cooling water pumps, three 50%-capacity cooling water heat exchangers, chemical feed tank, and a head tank for thermal expansion and makeup. The closed loop system circulates demineralized water at a maximum of 95°F to the equipment coolers (5°F approach to 90°F service water temperature).

.8 Boiler Feedwater Treatment Process Description

The boiler feedwater makeup and treatment systems replenish the losses of the entire project steam, condensate and feedwater systems. The water treatment facilities consist of:

- Treated boiler feedwater subsystem
- Suspect condensate subsystem
- Demineralized water subsystem

Refer to Flowsheet 31-E-B-1 for the flow rates for system losses and normal system flow rates. The water treatment subsystems are shown on Flowsheet 31-E-Z-1. Table 3 presenting expected input and effluent water qualities, follows.

2.8.1 Treated Boiler Feedwater Subsystem

The project requires a large flow of treated feedwater to replenish losses in feedwater and steam systems. The treated boiler feedwater subsystem provides a portion of the water treatment required.

Ohio River water is treated by cold lime softening and gravity filtration in Water Systems (Plant 32). The pretreated water from Plant 32 cold lime softeners is routed to the Plant 31 sodium zeolite softening system. This system consists of the following major components:

- Three 50%-capacity softener units, Suspect Condensate Filters (31Z-102 A through C)
- Vessel charges of sodium zeolite resin, 215 ft^3 of resin per softener
- One belowground combination salt storage/brine sump, 17 ft diameter x 8 ft depth, with 38 day salt supply
- Two 100%-capacity Sodium Softener Regeneration Brine Pumps (31G-120A in service, 31G-120B, spare)
- Three 50%-capacity Sodium Softener Booster Pumps, (31G-119A through C)

Table 3

WATER ANALYSIS

WATER SOURCE OHIO RIVER

COLUMNS
1. Raw Water-Ohio River-Parameter Worst Month Value
2. Cold-Lime Softener-Clarifier/Gravity FIltered Effluent (Note 1)
3. Sodium-Cycle Softener ("Zeolite") Effluent
4. Returned Condensate-Effluent from Suspect Condensate Filters (Note 2)
5. Influent to Demineralizers (2,685 GPM Condensate; 185 GPM $\overset{+}{Na}$ Softened)
6. Demineralizer Effluent (Two Bed Strong Acid-Strong Base)

CONSTITUENT	PPM	COLUMNS 1	2	3	4	5	6
Calcium (Ca^{++})	$CaCO_3$	113	66	1			0 to 1
Magnesium (Mg^{++})	$CaCO_3$	50	45	1			0 to 1
Sodium (Na^{+})	$CaCO_3$	52	52	161			1 to 2
Potassium (K^{+})	$CaCO_3$	5	5	5			
	$CaCO_3$						
TOTAL CATIONS	$CaCO_3$	220	168	168	22	32	1 to 4
Bicarbonate (HCO_3^-)	$CaCO_3$	87*	48				
Carbonate (CO_3^{--})	$CaCO_3$		35				
Hydroxide (OH^-)	$CaCO_3$						0 to 2
Chloride (Cl^-)	$CaCO_3$	42	42	42			0 to 2
Sulfate (SO_4^{--})	$CaCO_3$	97	97	97			
Nitrate (NO_3^-)	$CaCO_3$						
TOTAL ANIONS	$CaCO_3$	226	174	187	22	32	1 to 4
Iron, Total	Fe				1		
Carbon Dioxide, Free	CO_2	3	1				
Silica	SiO_2	6	5	5	5	5	0.2
Residual Chlorine							
Turbidity							
Color							
pH (Range)		6.9to7.6	9.5to10.5	6.0to8.0	7.0to7.4	7.0to7.2	7.0to9.0
Temperature	°F	85	85	85	202	118	118
TDS	PPM	220**	170	170	50	60	2 to 4
TSS (Note 1)		472	< 1	None	<1	<1	None
Standard Conductivity	UMHOS						10 to 20

NOTES Note 1-Data Used for softener-clarifier design
Note 2-Representative condensate from similar cycle plants

HO-60750 (1/75) *Represents "M" Alkalinity ** Represents Average of 12 month value.

....s subsystem normally requires a total flow rate of 1,520 GPM of treated boiler feedwater. Approximately half, 760 GPM, of this requirement is provided by Sewers and Wastewater Treatment (Plant 34) waste evaporator and wet air oxidation system condensate. The remainder of the required makeup, 760 GPM, is provided by the sodium zeolite softening system.

The sodium zeolite softening system has a total design capacity of 2,280 GPM.

One softener is normally in operation with the other two softeners either regenerating or in standby. Each softener has a net service capacity of 24 hours based on the stated flow rate (760 GPM) and inlet water with 165 ppm total hardness. Salt (NaCl) consumption for regeneration during normal operation is 2,150 pounds per day. Regeneration waste is approximately 53,200 gallons per day (37 GPM average). This waste stream is routed to Plant 34.

The sodium zeolite system supplies the total plant makeup boiler feedwater requirement of 1,520 GPM when the waste evaporator and wet air oxidation system condensate are interrupted. The processing capacity during these circumstances is provided by operating two of the softeners installed, while the other is in standby or regeneration. During this condition, the total salt consumption is 4,300 pounds per day. Regenerant waste is 106,400 gallons per day (74 GPM average). This waste stream is also routed to Plant 34.

Treated water from the Plant 34 evaporator and wet air oxidation system is combined with softener effluent in the Treated Boiler Feedwater Tank (31D-101).

2.8.2 Suspect Condensate Subsystem

This subsystem collects, cools and filters hot condensate from 150 psig and 50 psig systems. The filtered suspect condensate flows to the low-pressure boiler feedwater system Deaerator (31C-103). This deaerator supplies the 600 psig, 150 psig, and 50 psig boiler feedwater systems.

Hot condensate from the 150 psig and 50 psig systems at 366°F and 298°F, respectively, is collected and routed through a series of coolers. The coolers reduce the temperature prior to storage. Three 50%-capacity high temperature U-tube-type 150 psig Suspect Condensate Coolers (31E-104 A through C) cool the 150 psig, 366°F suspect condensate to 216°F. Condensate from these coolers is mixed with the incoming 50 psig suspect condensate at 298°F and further reduced in temperature by three additional 50%-capacity 50 psig Suspect Condensate Coolers (31E-105 A through C). Suspect condensate exits the cooler system at 202°F and is stored in the Suspect Condensate Storage Tank (31D-104). The medium used for the cooling is the condensate feed to 31C-103. Effluent from the suspect condensate storage tank is pumped through filtration units.

Filtration is carried out in three 50%-capacity each, precoated leaf-type Suspect Condensate Filters (31Z-102 A through C). These filters remove particulates and traces of oil and grease from the condensate.

Solka flock is used as the precoat material. It has excellent oil removal characteristics and does not leach off undesirable constituents, such as silica.

The precoat filter system consists of the following major components:

- Three horizontal, multileaf precoat Suspect Condensate Filters (31Z-102 A through C), United States Filter "Auto Jet" 900 (or equal)
- One Suspect Condensate Filters Regenerant Assembly (31V-103)

waste water resulting from the operation of these filters is proportional to the amount of suspended materials removed from the condensate. Each precoating cycle normally produces one and one half to two vessel filter volumes of waste containing the contaminants removed from the condensate during the service run.

During normal operation (1,800 GPM) two filter units are in service. The third unit is precoating or is in ready standby.

Effluent from the filtration units is monitored for high hydrocarbon as total reactive carbon and high conductivity. In the event that high hydrocarbon content is detected, the effluent from the filters is recirculated to the suspect condensate storage tank for additional filtration. In the event that high conductivity is detected, indicating high dissolved solids, the treated suspect condensate is discharged to the low-solids cooling tower. Additional makeup required to replace the wasted suspect condensate is drawn from the Treated Boiler Feedwater Tank (31D-101).

2.8.3 Demineralized Water Subsystem

Condensate from turbine after condensors in the Gas Plant (Plant 7), Gasification and Purification (Plant 12), the Oxygen Plant (Plant 15), and Plant 31 is routed to the Demineralizer Feed Tank (31D-102). A small flow of sodium zeolite softened boiler feedwater also enters 31D-102.

Water from the Demineralizer Feed tank is treated by ion exchange demineralizers. The demineralizer subsystem consists of the following major components:

- Four 33%-capacity Demineralizer Cation Units (31Z-104 A through D)

- Four 33%-capacity Demineralizer Anion Units (31Z-105 A through D)
- One horizontal Acid Storage Tank (31D-109)
- Two horizontal Caustic Storage Tanks (31D-108 A and B)
- Cation Beds Regenerant Assembly (31V-102)
- Anion Beds Regenerant Assembly (31V-101)
- Three 50%-capacity Deaerator Feed Pumps (31G-103 A through C)

During full load operation three cation and anion exchangers are in service with a total flow of 2,870 GPM, while the fourth exchanger of each type is regenerating or in ready standby. With this operating mode and under design load conditions, one regeneration is required per eight-hour shift.

Under full load operation, the anion exchangers produce 93,525 gallons of low solids waste and 23,379 gallons of high solids waste per day. The cation exchangers produce 74,031 gallons of low solids waste and 23,559 gallons of high solids waste per day. This waste is routed to Sewers and Wastewater Treatment (Plant 34).

Based upon full load operating conditions, chemical consumption for the demineralizers is approximately 4,110 pounds of 98% sulfuric acid per day and 4,920 pounds of 100% sodium hydroxide per day, not considering neutralization of the regeneration waste effluent.

Effluent from the demineralizer plant is stored in the Demineralized Water Storage Tank (31D-103).

The majority of demineralized water, 2,870 GPM, is pumped from the demineralized water storage tank through Gasification and Purification

(Plant 12) where it recovers 230.6 x 10^6 Btu/hr of heat before returning to the Plant 31 Deaerator (31C-101) for the 900 psig boiler feedwater system. A small intermittent flow of 50 GPM is also delivered for use as wash water for the amine absorber in the Gas Plant (Plant 7).

2.9 Coal Handling

Two full-capacity belt conveyor systems are used intermittently to fill boiler silos for all four boilers. The coal handling reclaim system receives coal from a linear pile in the yard by a scraper type reclaimer and delivers it to the boiler coal silos at a rate to maintain full or nearly full coal silos during plant operation. To accomplish this, the entire reclaim system is operated intermittently for approximately four hours per shift. The system operates in a safe, reliable and economical manner with minimum vibration, noise and dust escape.

Each boiler has three pulverizers and three coal silos on the front side. Silos are sized such that any two silos (one silo, feeder and mill not operating) contain sufficient coal to provide 12 hours of operation at maximum continuous rating. Provision is made for selective filling of silos. The system is designed to operate for eight hours without offsite power.

A minimum of four hours storage is maintained in each silo, providing eight hours boiler operations at maximum continuous rating during loss of offsite power when the coal handling system is inoperative and coal silos cannot be replenished.

The stated capacities of coal handling equipment and silos are based upon an average coal bulk density of 50 lb/ft^3.

2.9.1 System Description

The coal handling reclaim system, shown schematically on Flowsheet I-D-B-9, originates with the scraper type reclaimers. Plant 31 portion of

the reclaim system originates at the Coal Surge Bin (31T-105) and extends to the Pulverizer Gravimetric Feeders (31T-104 A through L). Two full-capacity redundant reclaim systems consisting of crushers, belt feeders, and trippers are provided.

Occasionally wet coal, which has both a high moisture content and a high fines content, is received. Wet coal is difficult to handle because it does not flow evenly. To facilitate handling, all sloped hopper, chute and silo surfaces in sliding contact with the coal flow are stainless steel lined and steeply sloped (55° minimum valley angles and/or 60° side slopes).

The normal boiler feed coal will be dewatered middlings from Coal Washing (Plant 27). To minimize coal dust problems the surge bin, the belt feeders, the tripper belt conveyors and the silos are enclosed by a gallery which extends over all the silos. The five Dust Collection Systems (31T-102 A through E) collect fugitive dust from the transfer points, the surge bin, the belt feeders and the silos as shown on Flowsheet 31C-B-9. The collected dust is caught in bag filters and discharged on the belt conveyors to the coal silos.

Each dust control system has its own CO_2 fire protection system including gas supply. Deluge water systems are provided for fire protection of all conveyors. Provision is made for N_2 or CO_2 inerting of coal silos.

2.9.2 System Components

The system components are discussed in the following paragraphs.

The Coal Surge Bin (31T-105) is a common coal feed point for all four units. This bin is also used for purging all reclaim belt conveyors upstream of the surge bin. Two equally sized hopper outlets on the surge bin have a coal valve so that the feeder below can be isolated from the coal flow for maintenance.

...e surge bin feeders are variable speed belt type. This type is furnished because the feed rate is less affected by changes in coal characteristics than other types, Varying the feeder belt speed controls the feed-rate, and variable speed feeder drives are furnished for this purpose. The belt feeders have full length covered skirts to increase the maximum capacity. Each feeder has a 30-inch wide belt and is equipped with an adjustable strike-off plate for adjusting the profile of the material on the belt. Maximum design feed rate is 200 TPH. The feeders are completely enclosed to prevent dust escape, and two Belt Conveyors (31T-101 A and B) are positioned below their respective belt feeders to automatically gather and remove feeder belt spillage.

Two 24-inch-wide belt Coal Gallery Conveyors (31T-101 A and B) convey the coal from the belt feeders to the silos. The conveyor pulleys, of welded steel construction, are driven by 50 hp motors connected through double reduction parallel shaft reducers. All troughing idlers are three equal roll, 35-degree trough type. Belt elongation and tension are automatically controlled by gravity takeup pulleys. The conveyors are assembled from standard structural shapes. A 10-gauge spillage plate is provided under the troughing idlers at the conveyor loading area and above the gravity takeup.

2.10 Ash Handling

The ash handling system is composed of the fly ash and the bottom ash handling subsystems. It is designed for plant operation at 100% capacity on coal with a 24% maximum ash content. Since actual division of the fly and bottom ash is not known until operation of the boilers, each subsystem is designed for a maximum anticipated volume. The fly and bottom ash handling subsystems are designed for 85% and 35% respectively of the maximum ash content.

The stated capacities of ash handling equipment such as bottom ash dewatering bins and fly ash silos are based upon an average bulk density of 45 lb/ft^3.

2.10.1 Fly Ash Handling Subsystem

The fly ash handling subsystem removes the ash produced by combustion of coal in the boiler furnace and collected in air preheater and electrostatic precipitator (or bag filters) hoppers. This ash is conveyed pneumatically from individually controlled airlocks on precipitator and air preheater hoppers to a common dry storage silo for four units. A boiler operating at maximum continuous rating will generate approximately 4 TPH of fly ash. This sub-system is designed to remove fly ash at the rate of 20 TPH.

System Description. The subsystem handles the ash collected in the air preheater and the electrostatic precipitator hoppers. The fly ash subsystem, shown schematically in Flow Diagram 31-D-B-10, originates at precipitator and air preheater hoppers and extends to the fly ash storage silo. Ash storage capacity for electrostatic precipitators and air preheater hoppers is for 12 hours to permit an approximate eight-hour emergency shutdown of electrical supply prior to necessitating a shutdown of the boilers. Each boiler has a unitized fly ash handling subsystem, except for two 100%-capacity ash transport lines, fly ash storage silo and associated equipment common for four boilers.

Eight 100%-capacity electric motor driven positive displacement Transport Air Blowers (31K-103 A through H) are provided for four units. Each blower supplies the required air to convey ash from electrostatic precipitator and air preheater hoppers to a silo through either of the two ash transport lines. These blowers are equipped with the required lubrication/cooling system and silencers.

...l air-lock valve transfers fly ash from a hopper operated at one pressure to a conveying line operated at a higher pressure. Each precipitator and air preheater hopper will be equipped with an air-lock valve.

Two 100%-capacity blowers provide the seal air required for air lock valves. A total of eight Seal Air Booster Blowers (31K-104 A through H) are provided for four units. The seal air is taken at atmospheric pressure and pressurized to 17 psig for sealing the air lock valves on precipitator and air preheater hoppers.

Two 100%-capacity ash-conveying lines, common to all four boilers, are provided. These lines and fittings are of hard iron alloy. Integral wear-back tangent end fittings are used.

The Fly Ash Storage Silo (31D-118) provides for 72 hour storage of the ash produced in all units. The silo is a flat bottom type, equipped with air slides inducing the flow of fluidized ash to the discharge outlets. Two 100%-capacity electric motor driven Aeration Blowers (31K-105 A and B) are provided. Two 100%-capacity electric heaters are also provided downstream of the fluidizing air blowers. The silo has two 100%-capacity bag-vent filters to prevent the discharge of dust into the transporting air while the silo is being filled. Two full-capacity Truck Chute Exhaust Fans (31K-106 A and B) convey the dust laden air to the silo during ash unloading into trucks.

System Operation. The fly ash handling subsystem is completely automatic and sequential. The sequential operation encompasses either individual hoppers or selected groups of hoppers in accordance with the system supplier recommendations.

Controls operate on a timed basis determined by the amount of ash stored in each row of collector hoppers. Individual air locks on any given row

are carefully interlocked with the other air locks on the same row to prevent discharge of more than one at a time.

This subsystem transports ash to the fly ash storage silo from the precipitator and air preheater hoppers. Ash from each unit is removed for about two hours once each eight-hour shift. The ash removal from all four units can be accomplished in about three to four hours using both ash transport lines each shift. Fly ash from the silo is trucked offsite to Landfill (Plant 44) using special trucks.

The fly ash handling subsystem is designed to contain all dust within the system. Appropriate safeguards such as vent filters and truck chute fans are provided to preclude particle emmission to the environment.

2.10.2 Bottom Ash Handling Subsystem

This subsystem handles the ash collected in the bottom ash hopper and at the economizer. It also handles the rejects from the coal pulverizers collected in the mill rejects hoppers. Bottom ash, economizer ash and mill rejects are sluiced to dewatering bins from which they are taken to Landfill (Plant 44) for disposal. The subsystem is designed for an ash removal rate of 18 TPH and to be operated approximately one hour per boiler per shift when operating at design rates.

This ash handling subsystem, shown schematically on Flow Diagram 31-E-B-11, originates at the bottom ash hopper, economizer ash hoppers, and coal pulverizer rejects hoppers. The subsystem then extends to the Ash Transfer Tanks (31D-114 A and B) and Ash Dewatering Bins (31D-111 A and B). The water used for sluicing is recovered from the ash slurry and is recirculated by pumps to the various hoppers.

The bottom ash handling subsystem for each boiler is unitized except for common ash transport, recirculating water, seal water lines, dewatering bins, and settling and surge tanks.

rurnace bottom ash is collected and stored in a water impounded, gravity feed type hopper with a storage capacity of 16 hours. A water seal between the boiler and the upper rim of the hopper provides for furnace pressure differential and the downward and lateral expansion of the boiler. The steel shell of the hopper is refractory-lined for protection from abrasion and radiant heat. Recirculating water cools the bottom ash hopper refractory and the furnace hopper seal. The bottom ash hopper has one ash discharge opening in the center, with large sluice doors, a high-capacity extra heavy-duty double roll clinker crusher, and an ejector pump.

Recirculation water from a surge tank is used to sluice ash from the hopper upon initiation of the bottom ash subsystem by the plant operator. The crushed ash is sluiced by ejector pumps to the transfer tanks. The ash is then pumped to the bottom ash dewatering bins.

Economizer ash is assumed to be 10% of the total ash and is continuously conveyed by gravity, aided by flue gas flow, through downcomers from the economizer hopper to the economizer ash collection tank with a storage capacity of 16 hours. A generously sized vent line connected downstream of the air preheater ensures a good flue gas flow through the downcomers. This eliminates condensation in the downcomers by keeping them hot and also improves ash conveying. This tank is equipped with a high-capacity heavy-duty clinker crusher and ejector pump. Recirculation water is used for makeup and for sluicing ash from the collection tank to the transfer tanks. The economizer ash is then pumped to the dewatering bins.

Each pulverizer mill has a storage hopper in which mill rejects are continuously collected. Using the ejector pump under each hopper, the mill rejects are transferred into the transfer tank. All the hoppers for one boiler can be emptied simultaneously. The mill rejects are then pumped to the dewatering bins. The mill rejects are assumed to be 1% of the total ash.

Mill rejects, economizer, and bottom ash are collected in either of the two Ash Transfer Tanks (31D-114 A and B). These tanks are sized to hold at least four minutes supply of ash water to the bottom ash pumps. Two full-capacity Bottom Ash Pumps (31G-138 A and B) move ash from the transfer tanks to the dewatering bins.

Two Ash Dewatering Bins (31D-111 A and B) each with 6,750 ft^3 capacity, are provided as temporary storage for coarse ash from the sluice system and to separate the water and ash collected in the bins as a slurry. The majority of the ash in the slurry settles and is retained in the bin while the water overflows to the settling tank with a minimum amount of solid particulate matter. The dewatering bins are capable of dewatering the retained ash and of discharging it to trucks or other suitable transport on demand. The bins are used alternately, one receiving, the other dewatering or unloading ash. The bin selection is made from the control panel.

Overflow water from the dewatering bins is collected in a Ash Settling Tank (31D-112) where additional fine ash is removed and from which the water overflows to the surge tank. The sludge collected at the bottom of the tank is returned to the dewatering bin by Sludge Return Pumps (31G-125 A and B).

An Ash Surge Tank (31D-113) collects clear water received from the settling tank. Clear water is returned from the surge tank to the boiler area by recirculating pumps, and sludge collected at the bottom of the tank is returned to the dewatering bins.

Clarified water from the surge tank is recycled to the plant to minimize water makeup and plant water disposal requirements. The dewatering bins receive water from the transfer tank and the ash sump. Pumps used to circulate the clarified water in the surge tank are materials-handling type with wear resistant materials to minimize outages and maintenance due to wear from abrasive particles which fail to settle out while in the

settling and surge tanks. Two full-capacity continuous Recirculation Pumps (31G-122 A and B) are provided for continuous recirculation and two full-capacity conveyor Recirculating Pumps (31G-121 A and B) are provided for circulation of water required during ash sluicing.

Clarified water is recirculated from the surge tank after pH adjustment and filtration for use as seal water for the various bottom ash pump seals. Emergency backup water is supplied by the service water system in the plant. Plot plan considerations dictate that two separate seal water supply systems be provided: one for the pumps at the dewatering bin area and one at the boiler area.

A large sump with a decanting weir receives water from the various boiler area bottom ash drains and overflows and coal silo drains. A jet pump in the decanting section removes the accumulated solids and returns them to either the bottom ash hopper or the transfer tanks. Two full-sized Ash Sump Pumps (31G-126 A and B) with wear resistant materials pump the decanted water to the dewatering bins or the settling tank.

A sump in the dewatering bin area receives the drain water from the dewatering bin drip pan drain connection as well as the drained water from the dewatering bin decanters. In addition, the sump pit is utilized as a receiving pit for debris accumulated after an area cleanup. The slurry from the pit is then returned to the dewatering tanks by the bin area Dewatering Area Sump Pumps (31G-124 A and B). Two pumps are provided: one operating and one spare.

Bottom ash area cleaning is accomplished in the following manner. A three-inch header with two-inch hose connections, complete with quick disconnect couplings and isolation valves, runs alongside the boiler in the mill area and the back of the boiler in the bottom ash area. A two-inch by 50-foot long hose, with a quick disconnect coupling and a

nozzle, is supplied for cleaning the ground floor in the boiler area. Water for this header is supplied by the recirculation water pumps.

System Operation. The bottom ash handling subsystem allows for semi-automatic ash removal when it is manually initiated at the ash handling system control panel located near the bottom ash hopper. The operation of all pumps, clinker grinders and valves is initiated manually from the local control panel. Normal bottom ash sluice operation takes place in the following sequence:

1. The recirculation water pump and the material handling pump (bottom ash pump) are started first. Water pumped out by the material handling pump is compensated for by the recirculation water pump via a level control valve.

2. Ash sluice water booster pumps are started.

3. Bottom ash removal is then initiated.

4. After bottom ash removal, the economizer ash removal operation is initiated.

5. After economizer ash removal, the mill rejects removal operation is initiated.

6. After mill rejects removal, the ejector pump in the bottom ash sump is initiated.

7. After bottom ash sump material removal, ash sluice water booster pumps are stopped.

8. After the bottom ash sluice line is flushed clean, the bottom ash material handling and the recirculation water pumps are stopped (in that order).

9. In freezing weather the bottom ash sluice line is kept drained when not in use.

Bottom ash is sluiced from only one unit at a time and once each eight hour shift. The ash removal for all four units can be completed in about three to four hours each shift.

Makeup System. The bottom ash subsystem separates the ash from the water and recirculates the water contained in the subsystem. Water is lost by the system in two ways: by removal from the subsystem of that water retained in the voids of the dewatered ash when the ash is discharged from the bins, and by evaporation.

An automatic makeup valve adds service water into the surge tank as required to make up for the losses. This makeup valve operates only at low level in the surge tank and adds only the water required to maintain the operation of the subsystem. When makeup water is required, the rate of flow must be sufficient to keep up with the maximum rate at which the various pumps are removing water from the surge tank. This high flow rate occurs for only a short period of time.

System Parameters. System parameters are as follows:

• Boiler ash generated per boiler operating at maximum continuous rating	1.6 TPH
• Bottom ash removal rate (design)	18 TPH
• Ash removal time per boiler per eight-hour shift	0.75 hour
• When bottom ash is sluiced	(One unit at a time)
- Recirculating water from surge tank	2,000 GPM
- Seal water (treated recirculated water from surge tank)	140 GPM
- Ash slurry to dewatering bins (15% ash, 85% water by weight)	475 GPM

-	Overflow water returned from boiler ash area sumps	1,740 GPM
• When bottom ash is not sluiced		
-	Recirculating water from surge tank	1,600 GPM
-	Seal water (treated recirculating water from surge tank)	140 GPM
-	Ash slurry to dewatering bins	0 GPM
-	Overflow water returned from boiler area ash sumps	1,740 GPM
• Makeup water per day (from service water system)		36,000 gallons
• Makeup flow rate and time		1,600 GPM for 22.5 minutes

2.11 Electrial System

In-plant electrical generation is installed to provide electrical power to critical loads in the event of loss of offsite electrical power. Under normal operating conditions the plant generators are synchronized to the offsite power. The plant system is automatically disconnected from offsite power, isolating the plant system, if there is an electrical power failure external to the plant. The plant turbines in service, and their associated generators, will begin to slow down as they attempt to carry excessive loads which could lead to an entire plant collapse. To avoid such a collapse, selected loads will be dropped by means of high-speed under frequency relays in order to preferentially supply essential loads. Loads are grouped into feeders so that nonessential or noncritical loads can be dropped first, and that essential loads may be maintained to the limit of generation capacity.

2.11.1 Generators

Two turbine driven hydrogen-cooled generators, each rated 26.8 MW, .85 power factor, 13800 V, 3-phase, 60 Hz are provided. Each generator a 3,600 rpm single automatic extraction condensing machine, is connected to metal-clad switchgear via segregated phase bus duct and circuit breaker. The generator neutral is low-resistance grounded. The generators supply all essential service loads in the project.

2.11.2 Main Step-Up Transformers

Two main step-up transformers, each rated at 50/66.7/83.3 MVA, 65°C, 161/13.8 kV, forced air/forced air cooled, OA/FA/FA are provided. The low-voltage winding is wye connected, low-resistance grounded. The high-voltage side of each transformer is connected to a 161 kV substation via underground cable. The low-voltage side of the transformer is connected to the 13.8 substation via 15 kV nonsegregated phase bus duct and circuit breaker.

2.11.3 13.8 kV Substation

Two double-ended 13.8 kV substations are provided. The switchgear employs 13.8 kV circuit breakers rated for 1,000 MVA interrupting duty. The switchgear is of the indoor class.

2.11.4 Auxiliary Transformers

Four power distribution transformers are provided and are rated 12 MVA, 13800/4160 V. The high-voltage winding is delta connected. The low-voltage winding is wye connected. The low-voltage neutral is low-resistance grounded. Each transformer is sized to carry the full load power requirements of both ends of the 4160 V switchgear to which it connects. The high-voltage winding is connected via cable to the 13.8 kVA substation. The low-voltage winding shall be connected via nonsegregated phase bus duct to the 4160 V switchgear.

2.11.5 4.16 kV Substation

Two double-ended 4160 V substations are provided, one servicing Plant 31 and one servicing Stack Gas Scrubbing (Plant 35). The switchgear employs 4160 V breakers for nonmotor circuits and 4160 V fused motor starters for motor feeders. The switchgear is rated for 350 MVA interrupting duty. The switchgear is of outdoor design.

2.11.6 480 V Substation

A double-ended 480 V load center/MCC substation is provided to conveniently service 480 V loads in Plants 31 and 35. The transformers are 1500 kVA rated for outdoor service.

2.11.7 Batteries

Two station type 125 V batteries are installed common to Plants 31 and 35 for emergency oil pump motors, and normal d-c power to metal-clad switchgear and load center.

2.11.8 Division of Loads

In the event of loss of offsite power, the power source to the nonessential loads is tripped. Loads are tabulated per Tables 4 and 5. The total running load under normal operation for Plants 31 and 35 and Instrument and Plant Air Systems (Plant 36) is 14 MW, of which 10 MW is for essential service loads.

Motors up to and including 200 hp are supplied from 480 V motor starters. Motors from 250 hp up to and including 2,500 hp are supplied from 4160 V motor starters.

Table 4

ELECTRICAL LOAD TABULATION
PLANTS 31, 35 and 36
(Normal Operation)

	Per Boiler hp (MTR Drive)	Total Plant hp (MTR Drive)	Plant 35 Bus No. 1 kVA Connected	Plant 35 Bus No. 1 kVA Running	Plant 35 Bus No. 2 kVA Connected	Plant 35 Bus No. 2 kVA Running	Plant 31 Bus No. 1 kVA Connected	Plant 31 Bus No. 1 kVA Running	Plant 31 Bus No. 2 kVA Connected	Plant 31 Bus No. 2 kVA Running
Forced Draft Fan	500	2 000					975	(1)	975	(1)
Induced Draft Fan	600	2 400					1170	(1)	1170	(1)
Pulverizer	3=1050	4 200					2048	1024[3]	2048	1024[3]
FGDS 4160 V (Booster Fan)	1250	5 000	2438	1543	2438	1543				
FGDS 480 V (Absorber)	125	500	245	146	245	146				
FGDS 4160 V (Regeneration)	Common	2 700	1316	1003	1316	1003				
FGDS 480 V (Regeneration)	Common	830	405	205	405	205				
900 #BFP	Common	2= 1 700					829	829	829	(1)
600 #BFP	Common	2= 440					215	(1)	215	215
150 #BFP	Common	2= 240					117	(1)	117	117
D/A Feed Pump	Common	2= 200					98	98	98	(1)
Cooling Water Pump	Common	3= 180					59	(1)	117	117
Precipitator	416	1 664					812	373	812	373
Ash Handling (Bottom Ash)	Common	245					790	327	790	327
Ash Handling (Fly Ash)	Common	1 277					1216	380	1216	380
Coal Handling	Common	170					131	76	131	76
Boiler Accessories	50	200					98	49	98	49
Turbine & AC Cont. and Battery Charger	Common	385					188	188	188	188
Lighting & HVAC	Common	1 608					784	784	784	784
Plant 31 Water Treatment	Common	1 130					604	342	604	342
Plant 36 Air Compressor	Common	3= 3 000	975	(1)	1950	1950				
Total [5], [6]	3991[4]	30 069[5]	5379	2897	6154	4847	10134	4470	10192	3992

(1) Alternate or Spare

(2) kVA = $\frac{hp \times .746}{.85\ pf \times .9\ eff} = hp \times .975$

(3) Two pulverizers @ 263 hp per boiler normal operation
Two pulverizers @ 350 hp per boiler @ MCR.

(4) 2 867 kVA

(5) 32 059 kVA or 27 250 KW total connected

(6) 16 206 kVA or 13 775 KW total running

Table 5

ELECTRICAL LOAD TABULATION
PLANTS 31, 35 and 36
(With Loss of Offsite Power)[7]

	Per Boiler hp (MTR Drive)	Total Connected Plant hp (MTR Drive)	Plant 35 Bus No. 1 kVA Connected	Plant 35 Bus No. 1 kVA Running	Plant 35 Bus No. 2 kVA Connected	Plant 35 Bus No. 2 kVA Running	Plant 31 Bus No. 1 kVA Connected	Plant 31 Bus No. 1 kVA Running	Plant 31 Bus No. 2 kVA Connected	Plant 31 Bus No. 2 kVA Running
Forced Draft Fan	500	2 000					975	(1)	975	(1)
Induced Draft Fan	600	2 400					1170	(1)	1170	(1)
Pulverizer	3=1050	4 200					2048	683[3]	2048	683[3]
FGDS 4160 V (Booster Fan)	1250	5 000	2438	1029	2048	1029				
FGDS 480 V (Absorber)	125	500	245	98	245	98				
FGDS 4160 V (Regeneration)	Common	2 700	1316	1003[8]	1316	1003[8]				
FGDS 480 V (Regeneration)	Common	830	405	205[8]	405	205[8]				
900 #BFP	Common	2= 1 700					829		829	
600 #BFP	Common	2= 440					215		215	
150 #BFP	Common	2= 240					117		117	
D/A Feed Pump	Common	2= 200					98	98	98	(1)
Cooling Water Pump	Common	3= 180					59	(1)	117	117
Precipitator	416	1 664					812	373	812	373
Ash Handling (Bottom Ash)	Common	245					790	167[9]	790	167[9]
Ash Handling (Fly Ash)	Common	1 277					1216	281[10]	1216	281[10]
Coal Handling	Common	170					131	15	131	15
Boiler Accessories	50	200					98	49	98	49
Turbine & AC Cont. and Battery Charger	Common	385					188	188	188	188
Lighting & HVAC	Common	1 608					784	784	784	784
Plant 31 Water Treatment	Common	1 130					604	146	604	146
Plant 36 Air Compressor	Common	3= 3 000	975	(1)	1950	1950				
Total [5], [6]	3991[4]	30 069[5]	5379	2335	5964	4285	10134	2784	10192	2803

(1) Alternate or Spare

(2) $kVA = \frac{hp \times .746}{.85\ pf \times .9\ eff} = hp \times .975$

(3) Two pulverizers @ 263 hp per boiler normal operations
Two pulverizers @ 350 hp per boiler @ MCR.

(4) 2 867 kVA

(5) 29 434 kVA or 25 019 KW (16.7%) total connected

(6) 11 859 kVA or 10,080 KW (6.7%) total running

(7) Two boilers in operation; both @ MCR

(8) Regeneration system required under 8 hour tankage is available for absorber feed solution and for absorber product

(9) Required for ash water seals

(10) Required to prevent ash from setting up in ash hoppers

12 Control System

The distributed digital control system in Plant 31 is compatible with that supplied for the remainder of the process plants. Instrument requirements and application are similar to the other sections of the plant. An Area Control Room is provided. Local operator interfaces are provided, as required, to provide the roving operator with process variable data and local control capability in the event of an emergency.

Both the power plant complex and the oxygen plant are supervised and controlled from the Area Control Room. Because of the complexity and the distances involved, the major part of the control system is of the distributed control type with remote multiplexing of control signals. This greatly reduces the wiring cost and associated problems; further, it reduces the size of the control panel and provides a better operator-process interface. Matching control boards are supplied to house the control equipment for those packaged systems not totally integrated into the distributed control system.

2.13 Catalysts, Packings, and Chemicals

Based on all design load conditions the estimated chemicals consumption and waste generation rates of the Zeolite softeners and of the demineralizers are as follows:(1)

Zeolite Softeners

	Flow GPM	Salt (NaCl) Consumption lb/day	Waste Water Produced(2) gal/day
Normal operation case	760	2,150	72,880
Maximum throughput case	1,520	4,300	106,000

Demineralizers(4)

Sulfuric acid (98%) (lb/day)	4,110
Caustic soda (100%) (lb/day)	4,920
Low-solids wastewater gal/day	167,556
High-solids wastewater gal/day	46,938

Notes:

(1) Actual performance, following systems optimization, may differ.

(2) Includes regenerant, fast rinse and slow rinse flows.

(3) For routing and disposition of waste streams refer to Drawing 50-D-B-14 and the Sewers and Wastewater Treatment (Plant 34) writeup.

(4) Chemical consumption and wastewater numbers shown are for full load operation with a total flow rate of 2,870 GPM to three cation and anion exchangers. The fourth set of exchangers is regenerating or in standby.

ckings

	Initial Inventory	Consumption Rate or (Estimated Life)
Sodium Zeolite Resins	640 CF	(3 years)
Demineralizer Anion Beds	935 CF	(3 years)
Demineralizer Cation Beds	790 CF	(3 years)
CHEMICALS		
20 wt % Caustic Solution (as 100%)	32,000 lbs	4,920 lbs/day
Salt (NaCl)	70,000 lbs	2,150 lbs/day
20 wt Sulfuric Acid (as 100%)	11,000 lbs	4,110 lbs/day
Soda Ash	5,000 lbs	Nil

2.14 Utility Balance

Electricity, kW

Condition	Consumed	Generated
Operating	5,288	36,964

Steam lb/hr

Steam Level	Consumed	Generated	Imported (Exported)
900 psig	638,730	1,200,000	(561,270)
600 psig	132,840	290,800	(157,960)
150 psig	2,000	-	2,000
50 psig	32,723	185,600	(152,937)

Condensated Returned: lb/hr.

Demineralizer Feed: 788,970

Suspect Condensate: 696,923

Water, GPM

Boiler Feed Water: 1,736

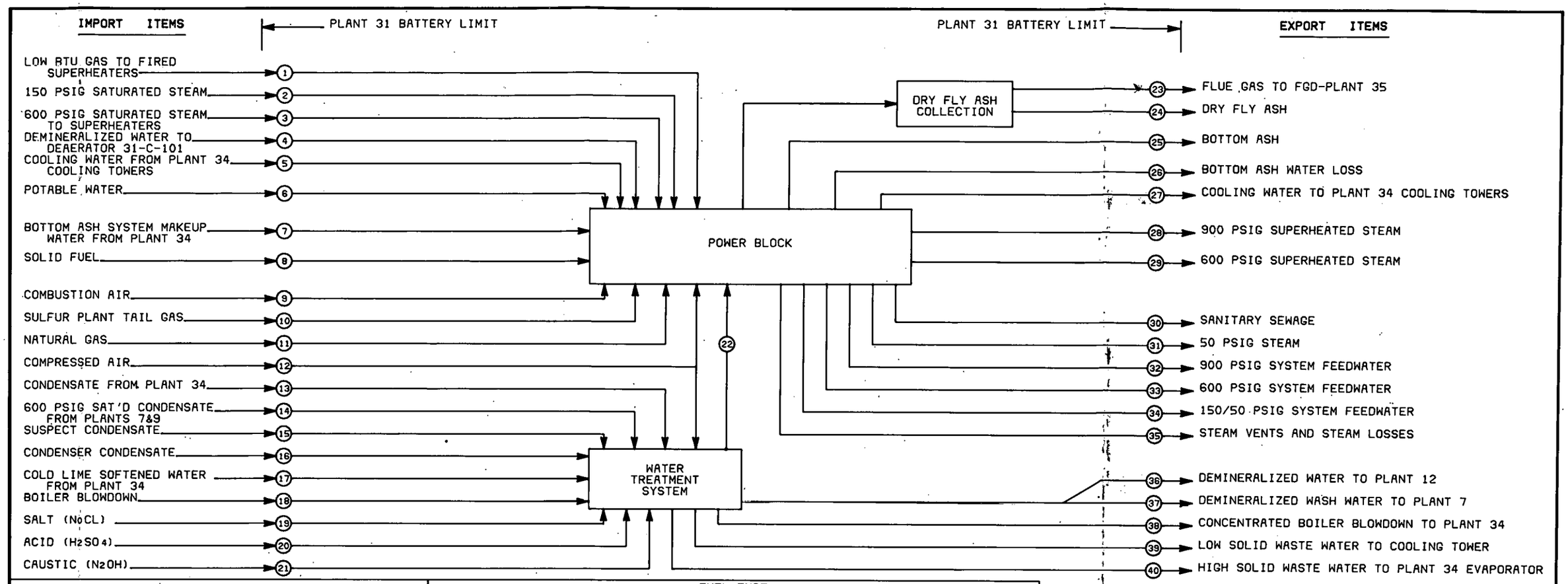
Cooling Water Circulation: 37,265

Fuel, MM Btu/hr*

Heat absorbed: 2.4 (Updated Phase Zero Steam/Condensate Balance /25/6 (Phase Zero Cost Estimate)

Total Fired Duty: 2.7 (Updated Phase Zero Steam/Condensate Balance /28.4 (Phase Zero Cost Estimate)

*Updated Phase Zero Steam/Condensate Balance on 31-E-B-1A indicates a reduction in 600 psig steam generated within the process units, and therefore only 2.4 MM Btu/hr heat absorption is required for superheat. In Phase 1, the production of 600 psig steam will be augmented by increasing convection bank steam generated in Plant 3 fired heaters. Fired heaters for supplying 25.6 MM Btu/hr of superheat have been provided in the Phase Zero Cost Estimate.



ITEM	DESCRIPTION		FUEL TYPE: MIDDLINGS & SULFUR PLANT TAIL GAS	MIDDLINGS ONLY	BLENDED COAL AND SULFUR PLT. TAIL GAS	BLENDED COAL ONLY
1	LOW BTU GAS TO FIRED SUPERHEATERS	- SCFM	(BY R & E)	(BY R & E)	(BY R & E)	(BY R & E)
2	150 PSIG STEAM TO PLANT 31	- PPH	39130	39130	39130	39130
3	600 PSIG SATURATED STEAM TO SUPERHEATERS	- PPH	157250	157250	157250	157250
4	DEMINERALIZED WATER TO 31-C-101 FROM PLANT 12	- PPH	1435231	1435231	1435231	1435231
5	COOLING WATER FROM COOLING TOWER	- GPM	48120	48120	48120	48120
6	POTABLE WATER FROM PLANT 34	- GPM	15	15	15	15
7	BOTTOM ASH SYSTEM MAKEUP WATER	- GPD	36000 (NOTE 5)	36000 (NOTE 5)	36000 (NOTE 5)	36000 (NOTE 5)
8	SOLID FUEL TO BOILERS	- TPH	77.39	78.51	75.29	76.38
9	COMBUSTION AIR TO BOILERS	- PPH	1380970	1367870	1414250	1401640
10	SULFUR PLANT TAIL GAS TO BOILERS	- PPH	156363	ZERO	156363	ZERO
11	NATURAL GAS (START UP ONLY)	- SCFM	8333	8333	8333	8333
12	COMPRESSED AIR	- SCFM	6000	6000	6000	6000
13	CONDENSATE FROM PLANT 34	- GPM	760	760	760	760
14	600 PSIG SATURATED CONDENSATE	- PPH	130890	130890	130890	130890
15	SUSPECT CONDENSATE FROM PROJECT	- PPH	838710	838710	838710	838710
16	CONDENSER CONDENSATE FROM PROJECT	- PPH	807620	807620	807620	807620
17	COLD LIME SOFTENED WATER	- GPM	946	946	946	946
18	BOILER BLOWDOWN FROM PROJECT	- PPH	113770	113770	113770	113770
19	SALT TO WATER TREATMENT	- PPD	2150	2150	2150	2150
20	ACID TO WATER TREATMENT	- PPD	4110 @ 100% CONC.	4110 @ 100% CONC.	4110 @ 100% CONC.	4110 @ 100% CONC.
21	CAUSTIC TO WATER TREATMENT	- PPD	4920 @ 100% CONC.	4920 @ 100% CONC.	4920 @ 100% CONC.	4920 @ 100% CONC.
22	MAKEUP TO DEAERATOR 31-C-103	- PPH	1539890	1539890	1539890	1539890
23	FLUE GAS TO PLANT 35	- PPH	1951680	1775170	1992290	1816380
24	DRY FLY ASH	- TPH	10.78	10.93	8.70	8.83
25	BOTTOM ASH	- TPH	2.69	2.73	2.18	2.21
26	WATER LOSS IN ASH SYSTEM	- GPD	36000	36000	36000	36000
27	COOLING WATER TO COOLING TOWERS	- GPM	48120	48120	48120	48120
28	900 PSIG SUPERHEATED STEAM TO PLANT 15	- PPH	549400	549400	549400	549400
29	600 PSIG SUPERHEATED STEAM TO PLANT 7	- PPH	140100	140100	140100	140100
30	SANITARY WASTE	- GPM	15	15	15	15
31	50 PSIG STEAM TO PROJECT	- PPH	29280	29280	29280	29280
32	900 PSIG SYSTEM FEEDWATER TO PLANT 12	- PPH	234700	234700	234700	234700
33	600 PSIG SYSTEM FEEDWATER TO PROJECT	- PPH	470360	470360	470360	470360
34	150/50 PSIG SYSTEM FEEDWATER TO PROJECT	- PPH	1191210	1191210	1191210	1191210
35	STEAM VENTS & STEAM LOSSES OF PLANT 31	- PPH	8000	8000	8000	8000
36	DEMINERALIZED WATER TO PLANT 12	- PPH	1435231	1435231	1435231	1435231
37	DEMINERALIZD WASH WATER TO PLANT 7	- PPH	25000 (NOTE 4)	25000 (NOTE 4)	25000 (NOTE 4)	25000 (NOTE 4)
38	CONCENTRATED BOILER BLOWDOWN	- PPH	114340	114340	114340	114340
39	LOW SOLID WASTE WATER	- GPD	212356	212356	212356	212356
40	HIGH SOLID WASTE WATER	- GPD	55388	55388	55388	55388

MAC03A 02/04/CG

GENERAL NOTES:

1. ALL FLOWS ARE AVERAGE FOR THE ENTIRE PLANT OPERATING AT 100% (1,200,000 PPH OF TOTAL 900 PSIG STEAM FROM PLANT 31 BOILERS)
2. WATER FLOW SHOWN IN GPM (500 LBS PER HOUR = 1 GPM)
3. SOLID FUEL RATES BASED ON AVERAGE CASE SOLID FUEL HEATING VALUES
   MIDDLINGS 11200 BTU/LBM DRY
   COAL 11700 BTU/LBM DRY
4. INTERMITTENT FLOW
5. MAXIMUM RATE 1600 GPM FOR 22.5 MINUTES

NO.	DATE	REVISIONS	BY	CK'D	SUPV.	ENG'G	PROJ. ENGR.
1	9/20/81	ISSUED FOR PHASE ZERO	CAD	MBS	[illegible]	UP	[illegible]
0	12/2/80	ISSUED FOR REVIEW & APPROVAL	CAD	MBS	[illegible]	UP	

DESIGNED LM/JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

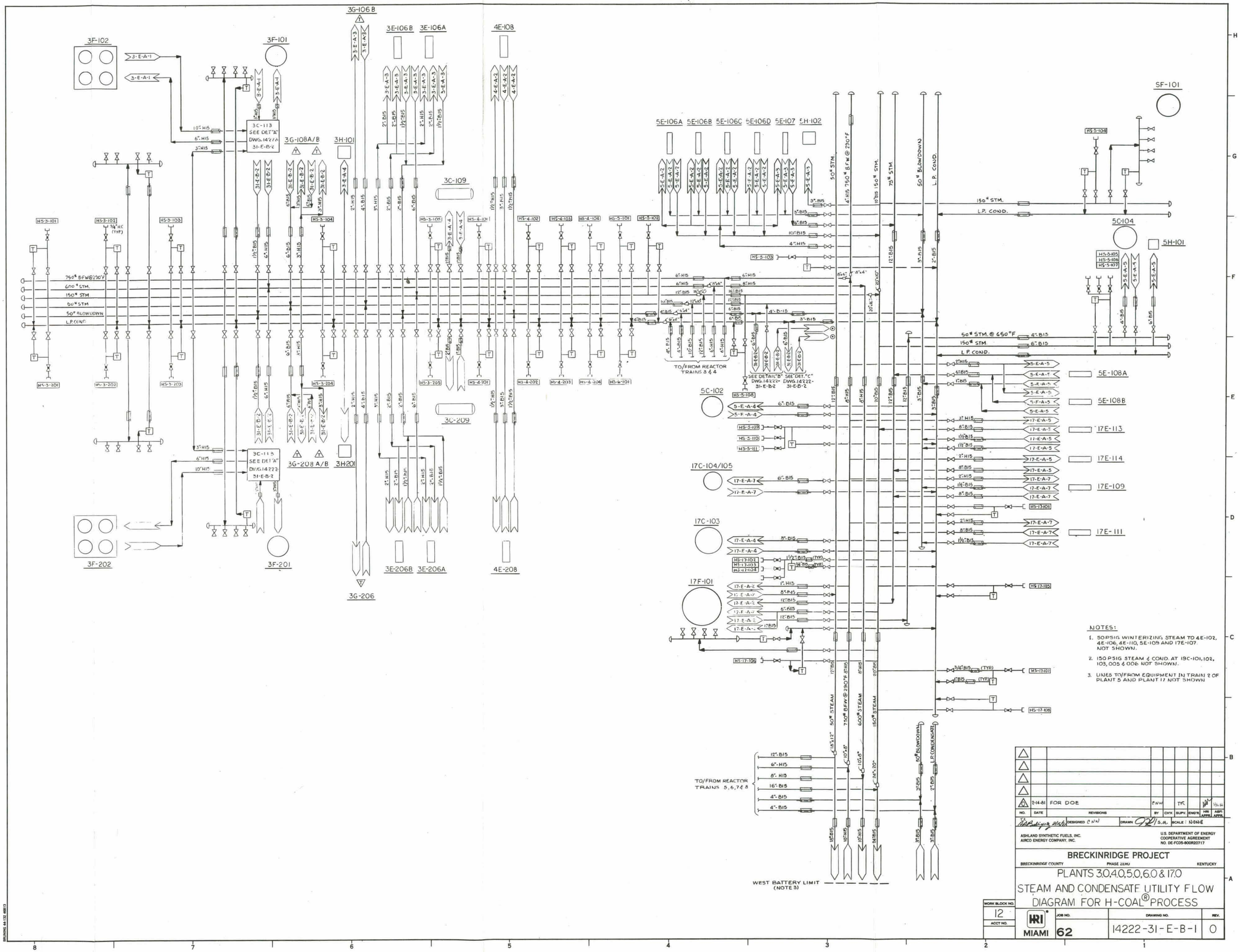
BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PLANT 31 - MASS BALANCE

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-C-B-2	1



NOTES:

1. 50 PSIG WINTERIZING STEAM TO 4E-102, 4E-106, 4E-110, 5E-109 AND 17E-107. NOT SHOWN.
2. 150 PSIG STEAM & COND. AT 19C-101, 102, 103, 005 & 006 NOT SHOWN.
3. LINES TO/FROM EQUIPMENT IN TRAIN 2 OF PLANT 5 AND PLANT 17 NOT SHOWN

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENGR	HRI APPR.	ASPI APPR.
0	2-14-81	FOR DOE	CNW		TK			

DESIGNED CNW | DRAWN SM | SCALE: NONE

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

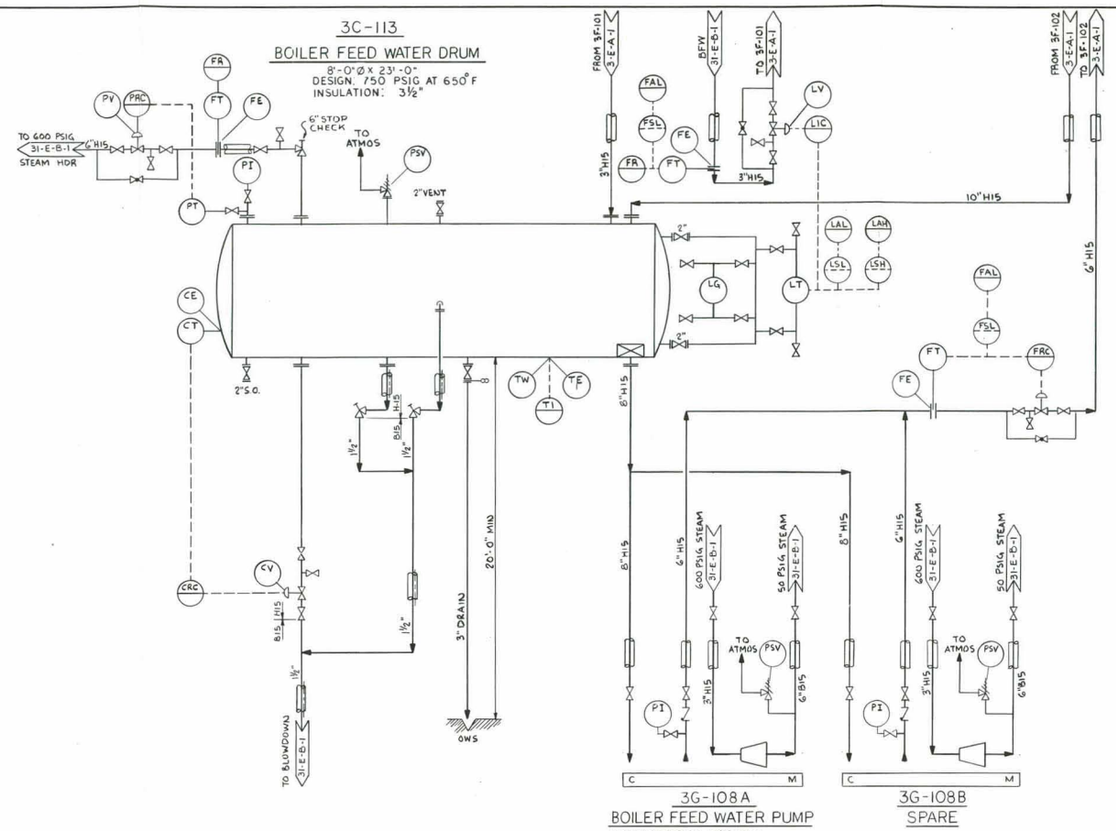
BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PLANTS 3.0, 4.0, 5.0, 6.0 & 17.0
STEAM AND CONDENSATE UTILITY FLOW DIAGRAM FOR H-COAL® PROCESS

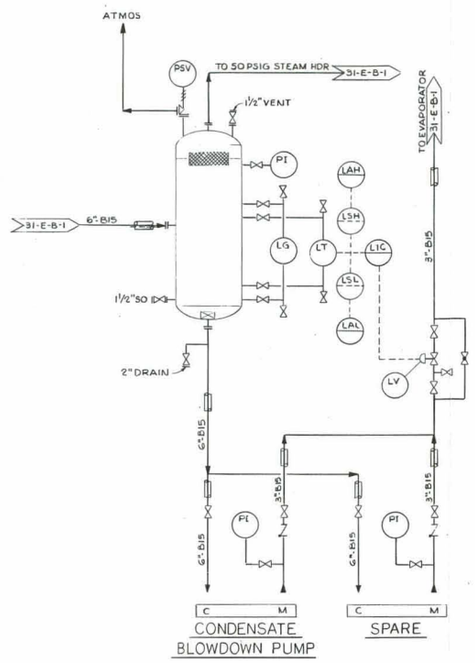
WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV.
12	62	14222-31-E-B-1	0
ACCT NO.	HRI MIAMI		

BRUNING 44-132 46813



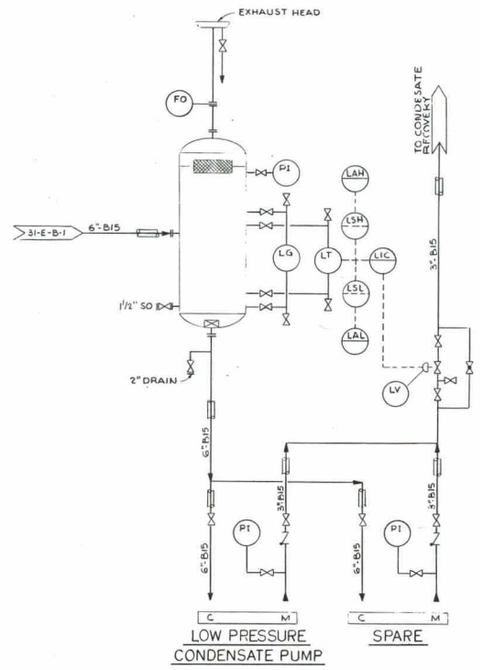
DETAIL "A"
600 PSIG STEAM DRUM
(8-REQ'D)

CONDENSATE BLOWDOWN DRUM
3'-0"Ø x 9'-0"



DETAIL "B"
BLOWDOWN FOR STEAM GENERATORS
(2-REQ'D)

LOW PRESSURE CONDENSATE DRUM
2'-6"Ø x 8'-0"



DETAIL "C"
LOW PRESSURE CONDENSATE
(2-REQ'D)

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R	HRI APPR.	ASPI APPR.
6	2-16-81	FOR DOE	CWW		TK			

DESIGNED CWW DRAWN R.S.A. SCALE: NONE

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

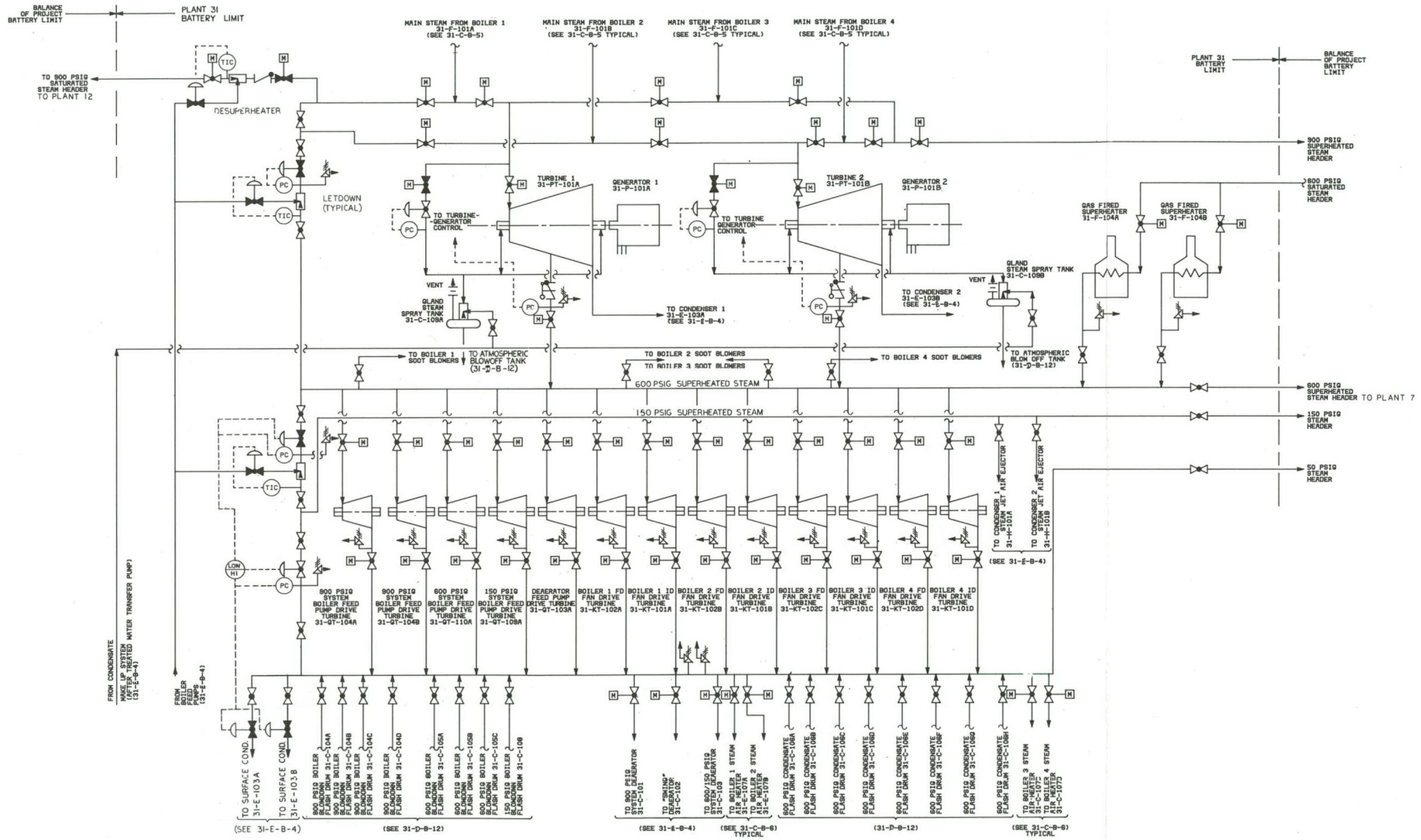
PLANTS 30, 40, 50, 60 & 170
DETAILS FOR STEAM AND CONDENSATE FOR H-COAL® PROCESS

WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV.
12	62	14222-31-E-B-2	0

ACCT NO.

HRI MIAMI

BRUNING 44-132 46813



NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	SL APPR.	AMF APPR.
1	1/15/91	ISSUED FOR PHASE ZERO	CAD	YL	JB	WP		
2	12/5/90	ISSUED FOR REVIEW & APPROVAL	CAD	YL	JB	WP		

DESIGNED YL / JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

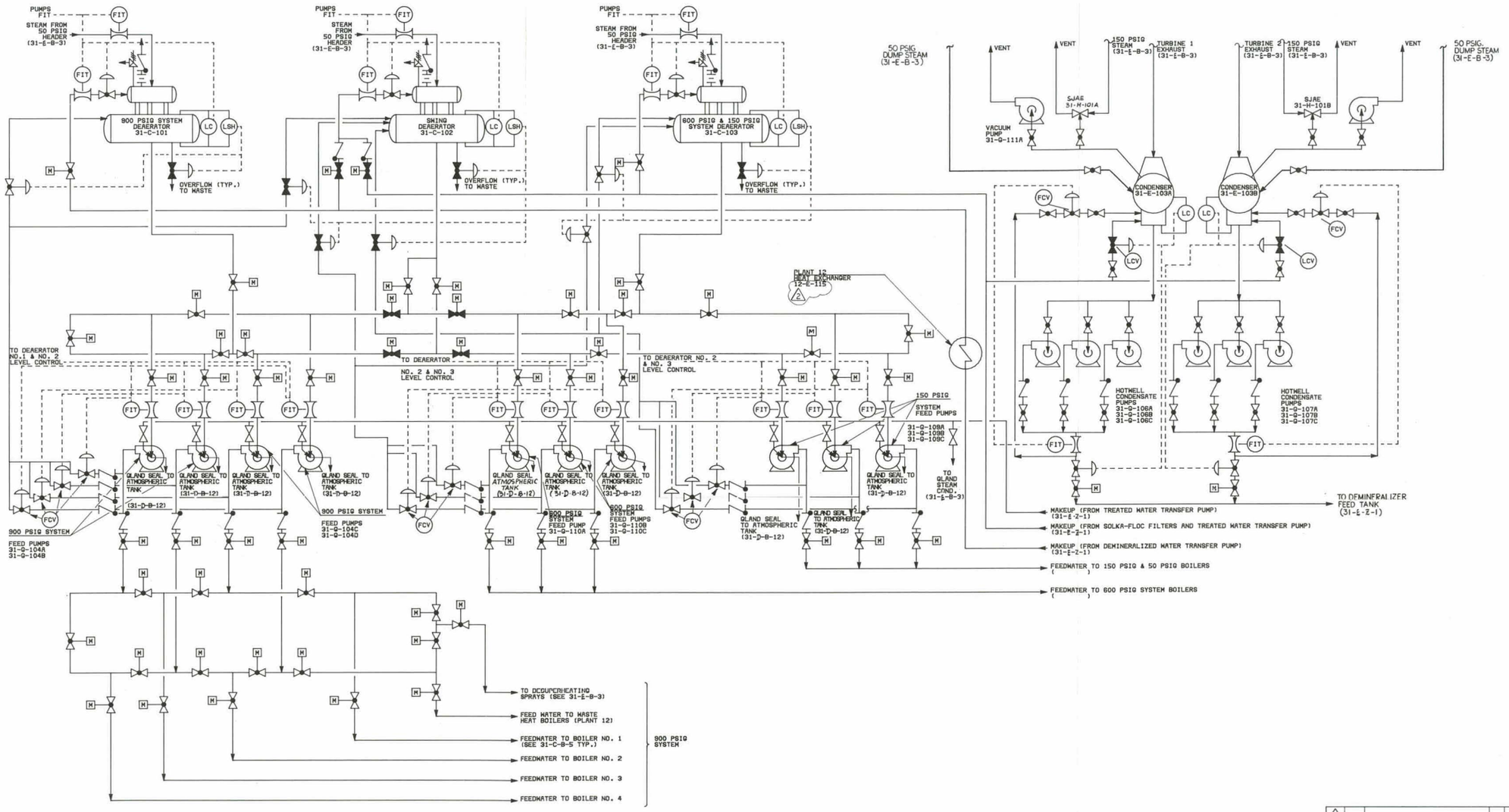
STEAM SYSTEM FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-E-B-3	1

34X44 "E" SIZE

MAC10 02/18/91 SS



NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	PROJ. MGR.	DEPT. MGR.
3	3/25/81	DOE COMMENT			JB	LR		
2	2/26/81	ISSUE FOR PHASE ZERO	CAD	YL	JB	WP		
1	12/4/80	ISSUE FOR REVIEW AND APPROVAL	CAD	YL	JB	WP		

DESIGNED YL/JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

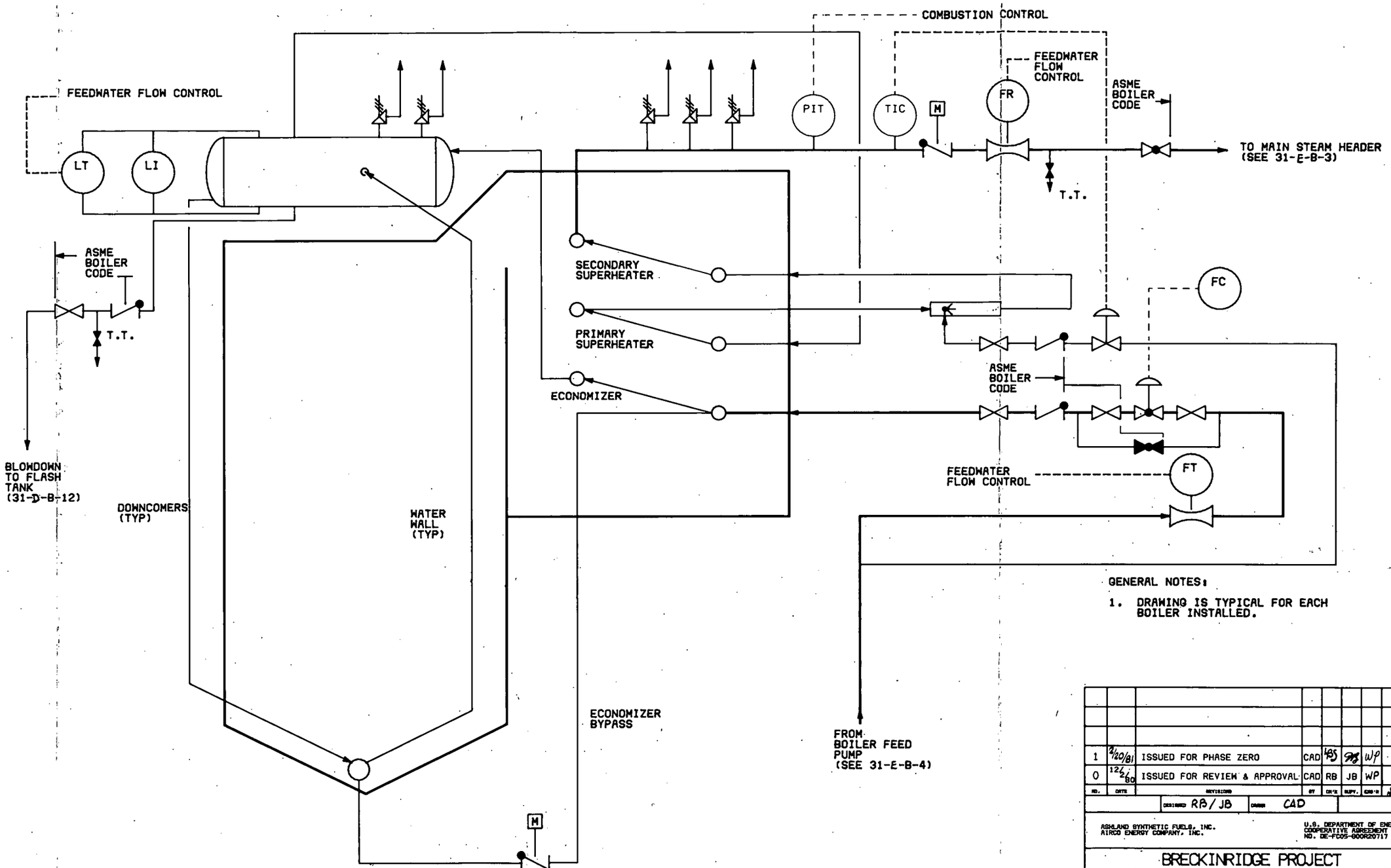
CONDENSATE AND FEEDWATER FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-E-B-4	2

34X44 "E" SIZE

MKC09 02/19/81 SS



GENERAL NOTES:

1. DRAWING IS TYPICAL FOR EACH BOILER INSTALLED.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	PROJ. ENGR.	OPER. ENGR.
1	2/20/81	ISSUED FOR PHASE ZERO	CAD	HBS	RB	WP		HBS
0	12/4/80	ISSUED FOR REVIEW & APPROVAL	CAD	RB	JB	WP		

DESIGNED RB/JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

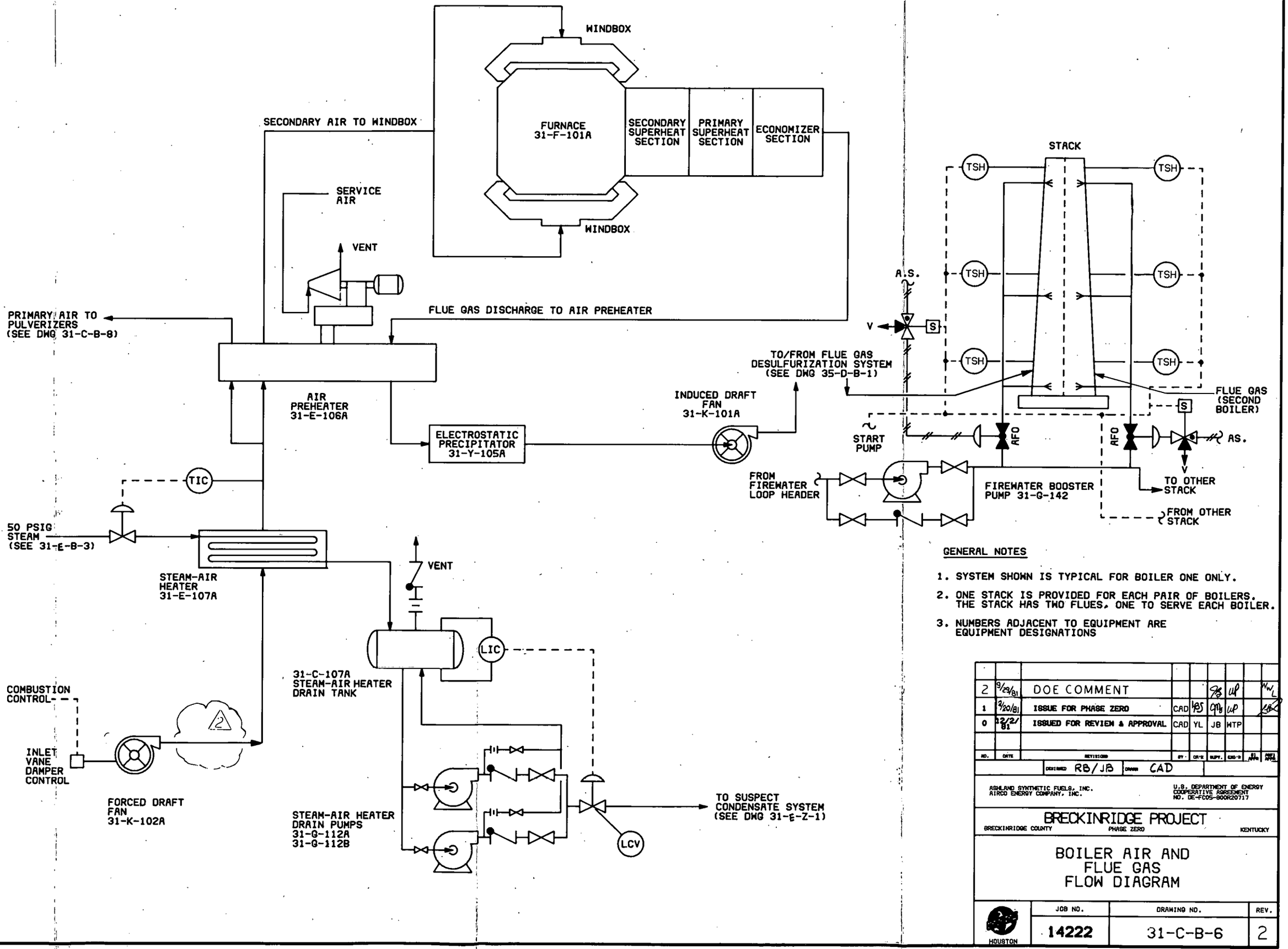
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

BOILER WATER AND STEAM SIDE FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-C-B-5	1

MAC01B 02/04/81 DI



GENERAL NOTES

1. SYSTEM SHOWN IS TYPICAL FOR BOILER ONE ONLY.
2. ONE STACK IS PROVIDED FOR EACH PAIR OF BOILERS. THE STACK HAS TWO FLUES, ONE TO SERVE EACH BOILER.
3. NUMBERS ADJACENT TO EQUIPMENT ARE EQUIPMENT DESIGNATIONS

NO.	DATE	REVISIONS	BY	CK'E	SUPV.	ENG'G	PROJ. MGR.
2	3/23/81	DOE COMMENT					
1	3/20/81	ISSUE FOR PHASE ZERO	CAD				
0	12/2/81	ISSUED FOR REVIEW & APPROVAL	CAD	YL	JB	WTP	

DESIGNED RB/JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

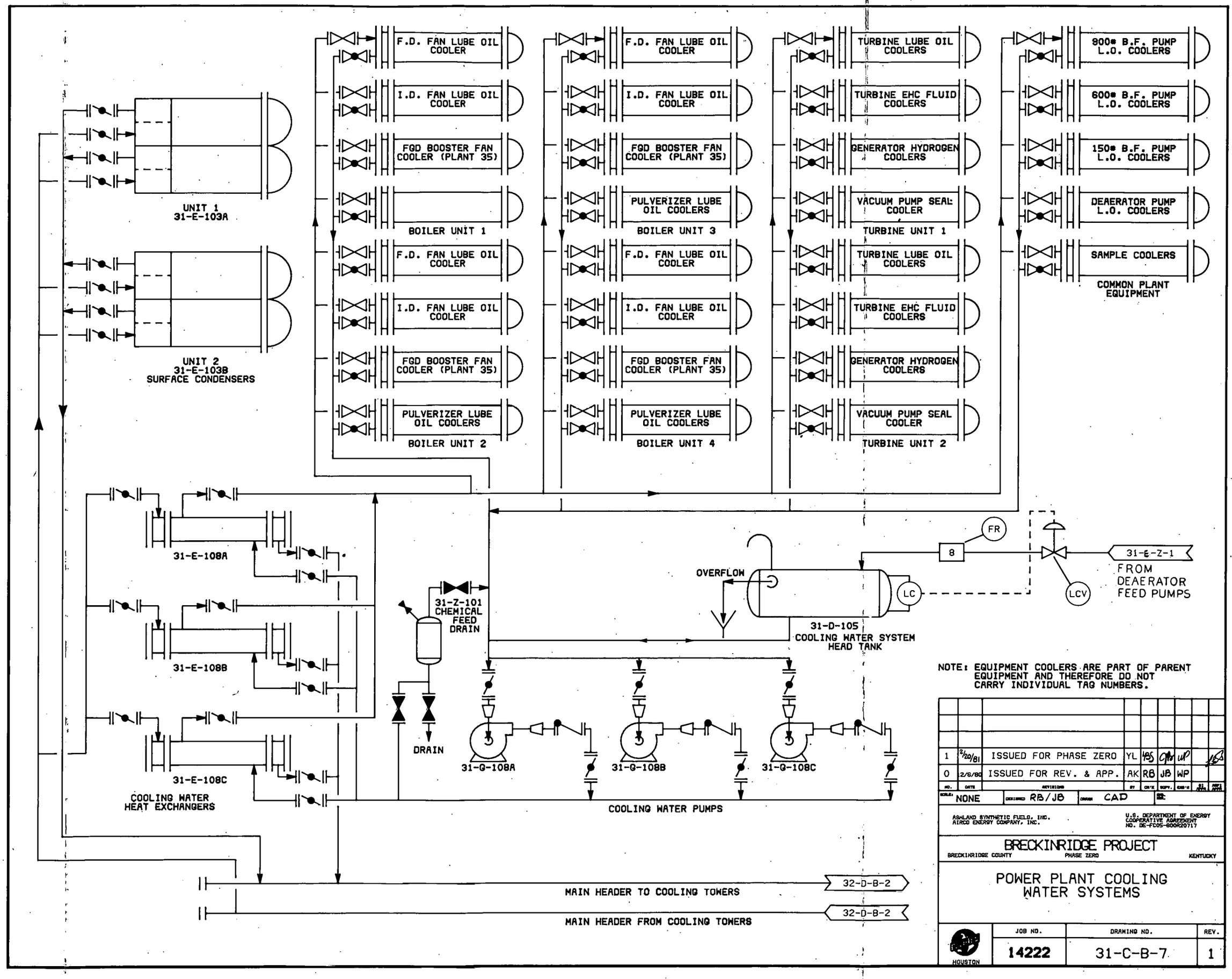
BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

BOILER AIR AND FLUE GAS FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-C-B-6	2

MAC02D 02/04/81 VR



NOTE: EQUIPMENT COOLERS ARE PART OF PARENT EQUIPMENT AND THEREFORE DO NOT CARRY INDIVIDUAL TAG NUMBERS.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'G	DES. APPR.	PROJ. APPR.
1	2/20/81	ISSUED FOR PHASE ZERO	YL	[illegible]	[illegible]	[illegible]		
0	2/6/80	ISSUED FOR REV. & APP.	AK	RB	JB	WP		

SCALE: NONE | DESIGNED RB/JB | DRAWN CAD | CHK:

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

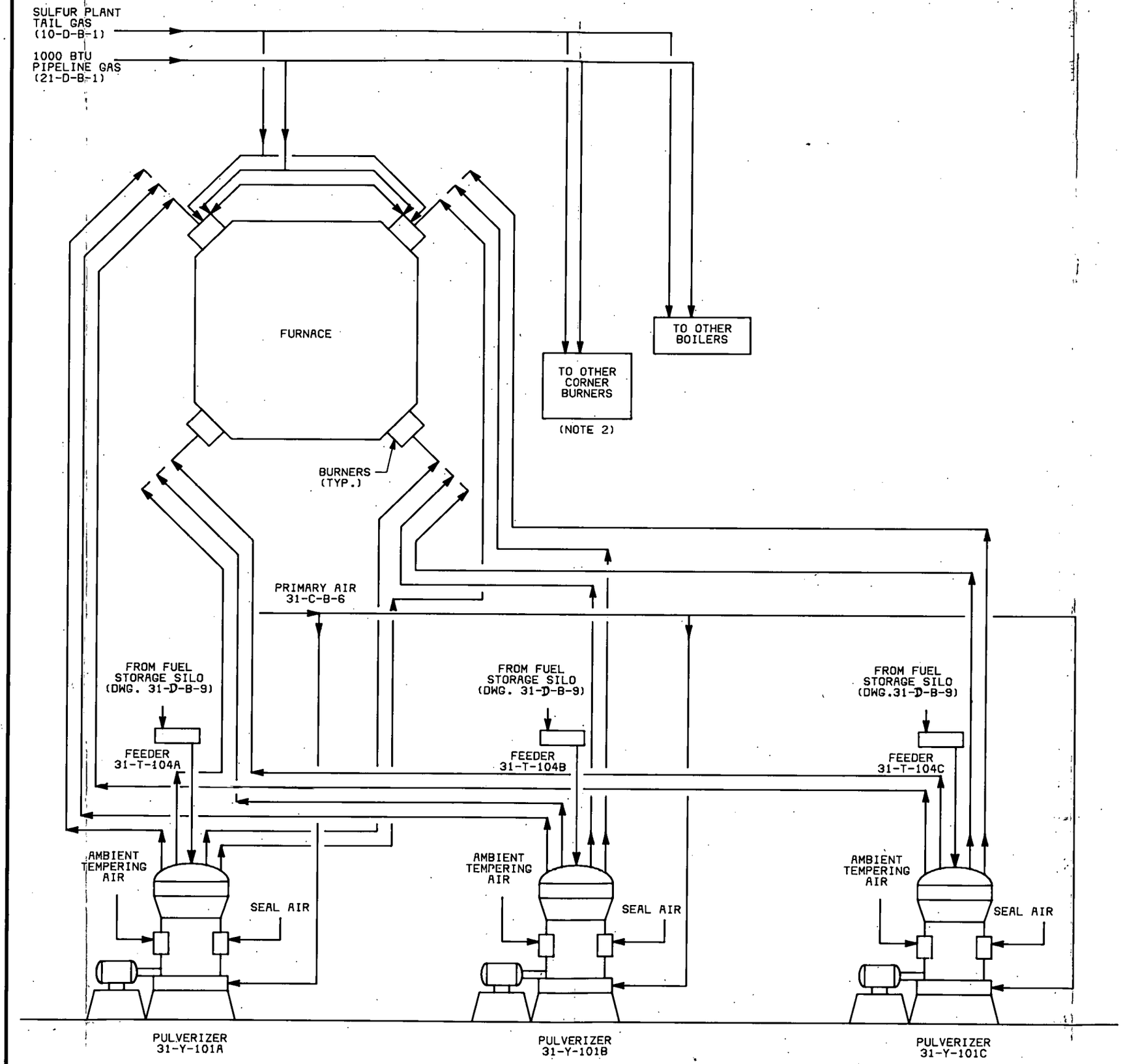
BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

POWER PLANT COOLING WATER SYSTEMS

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-C-B-7	1



GENERAL NOTES

1. SYSTEM IS TYPICAL FOR ONE BOILER
2. ONLY TWO CORNERS HAVE BEEN SHOWN WITH PIPE TO THE BURNERS, OTHER TWO ARE SIMILAR TO THE ONES SHOWN.

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	ENG'R	G.E. APPR.	OPER. APPR.
1	2/20/81	ISSUE FOR PHASE ZERO	CAD	RS	CJA	WP		
0	12/2/80	ISSUED FOR REVIEW & APPROVAL	YL	RB	JB	WP		

DESIGNED RB/JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

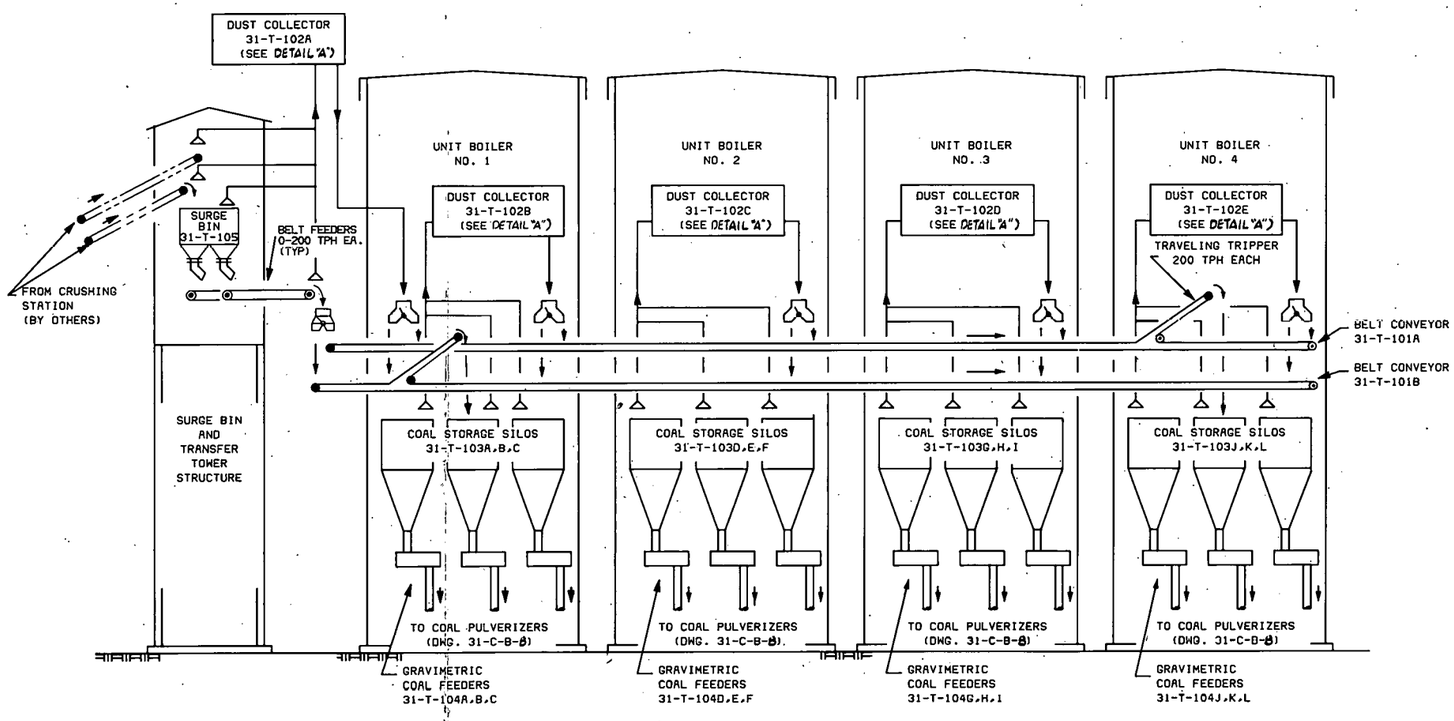
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

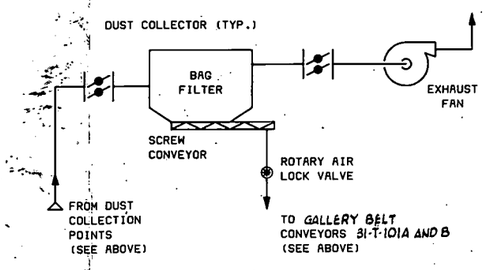
FUEL SYSTEM FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-C-B-8	1

MACOSA 02/18/81 BB





DETAIL "A"

DUST COLLECTION SYSTEM
(TYPICAL)

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	B1 APPR.	ASPI APPR.
1	8/29/81	ISSUE FOR PHASE ZERO	CAD	LM	AA	WP		
0	12/10/80	ISSUE FOR CLIENT REVIEW	CAD	LM	AA	WP		

DESIGNED AA/LM DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

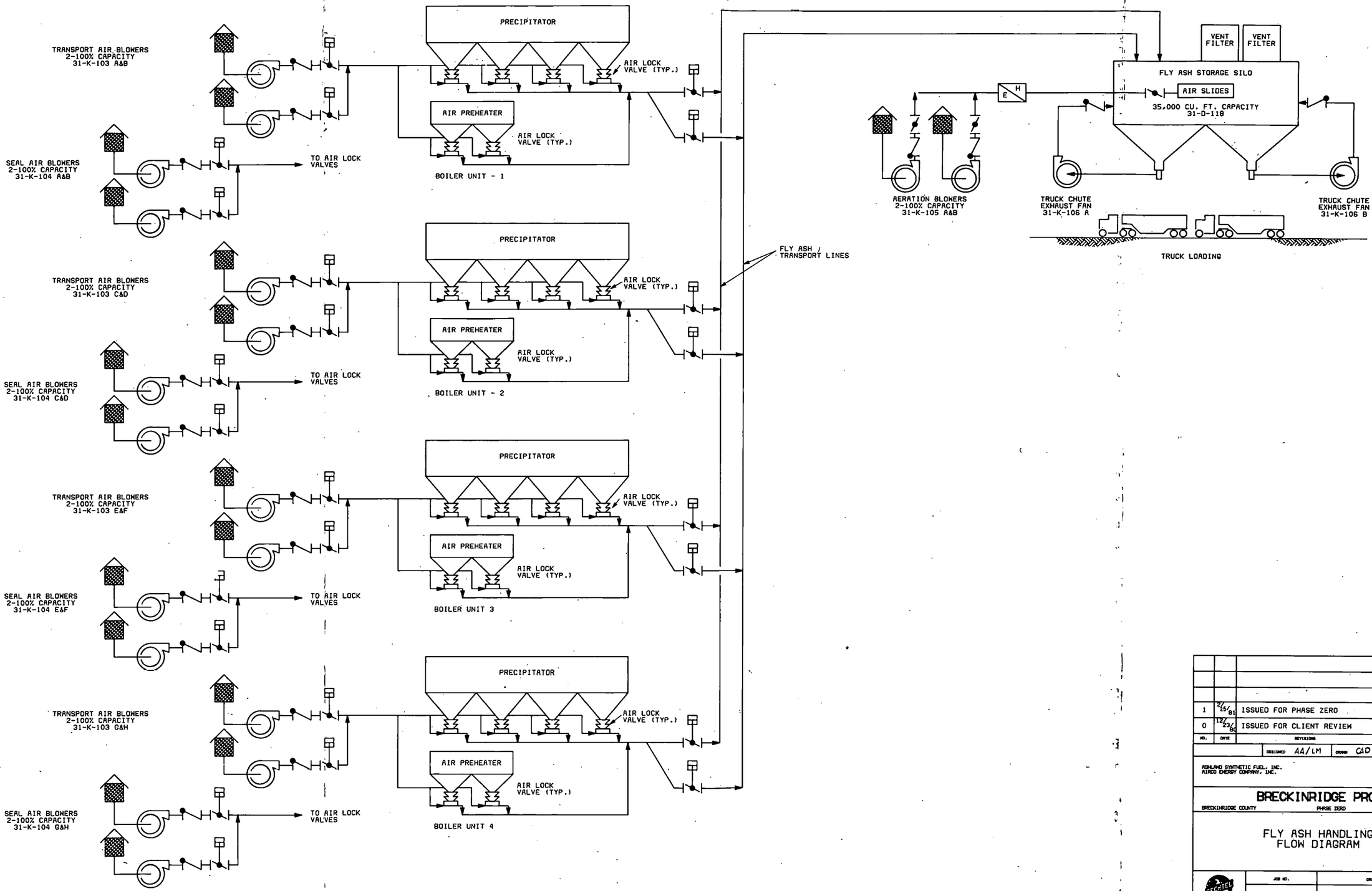
BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

COAL HANDLING DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-D-B-9	1



NO.	DATE	REVISIONS	BY	CK'D	SUPV.	ENG'G	ELEC. APPR.	PROJ. APPR.
1	2/25/81	ISSUED FOR PHASE ZERO	CAD	LM	AA	WP		
0	12/23/80	ISSUED FOR CLIENT REVIEW	CAD	LM	AA	WP		

DESIGNED AA/LM DRAWN CAD

ASHLAND SYNTHETIC FUEL, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

FLY ASH HANDLING FLOW DIAGRAM

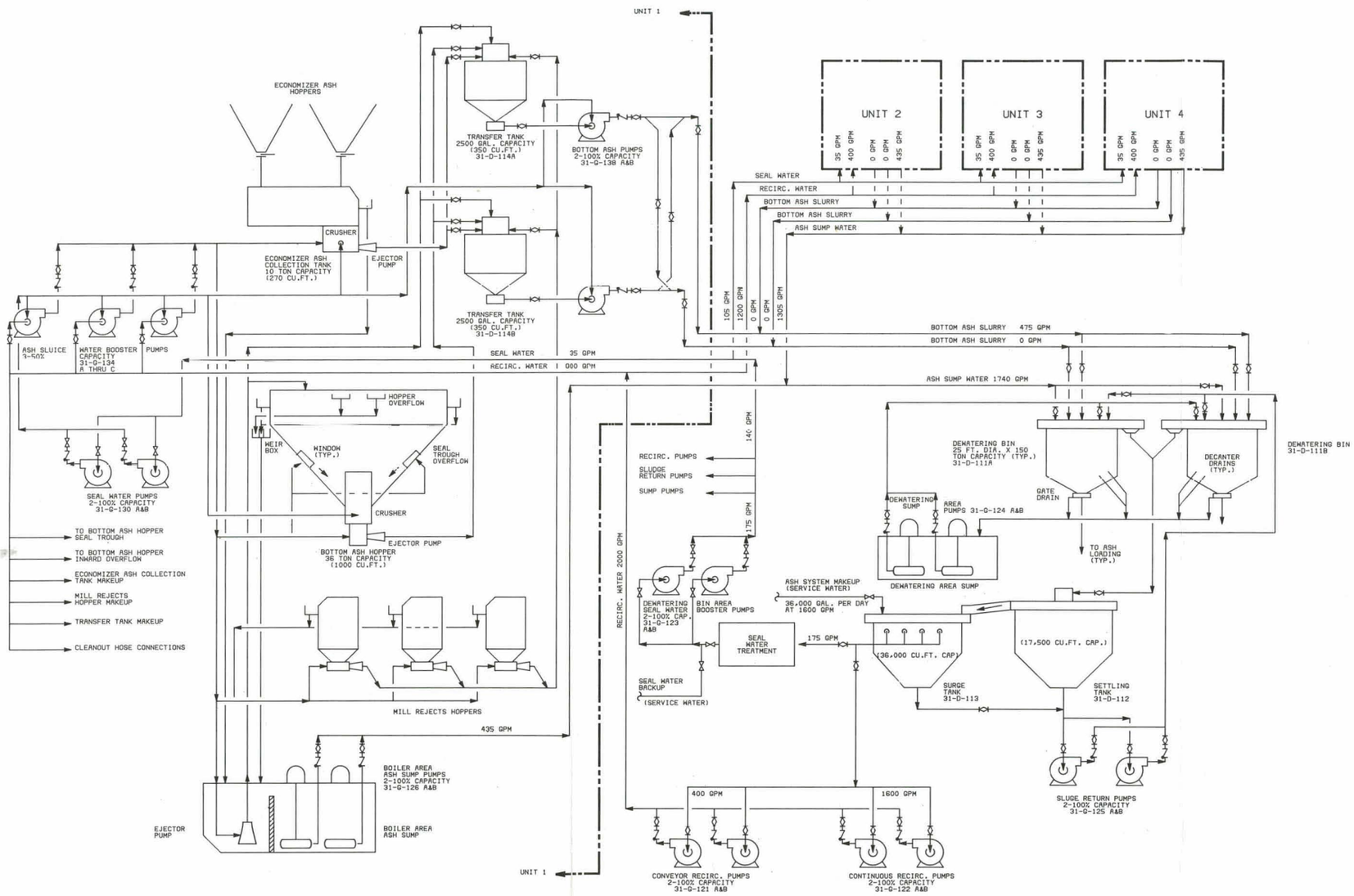
BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-D-B-10	1

MAE05 02/02/81 JK

NOTES

1. BOTTOM ASH IS SLUICED FOR ONLY ONE UNIT AT A TIME, ONE HOUR PER UNIT (OPERATING AT MCR) PER SHIFT. UNIT 1 BOTTOM ASH SLUICING IS SHOWN IN FLOW DIAGRAM.
2. SYSTEM IS DESIGNED FOR BOTTOM ASH REMOVAL RATE OF 18 TONS PER HOUR. IF LESS ASH IS PRODUCED, SYSTEM WILL BE OPERATED FOR REDUCED TIME.
3. BOTTOM ASH EQUIPMENT SHOWN WITHIN THE CONFINES OF UNIT 1 BOUNDARY IS PROVIDED FOR EACH BOILER. ALL OTHER EQUIPMENT IS COMMON TO FOUR UNITS AS SHOWN.



NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	PROJ. MGR.
1	7/25/101	ISSUED FOR PHASE ZERO	CAD	LH	AAE	WP	
0	12/23	ISSUED FOR REVIEW & COMMENT	CAD	RB	AA	WTP	

DESIGNED RB/AA DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

BOTTOM ASH HANDLING
FLOW DIAGRAM

HOUSTON

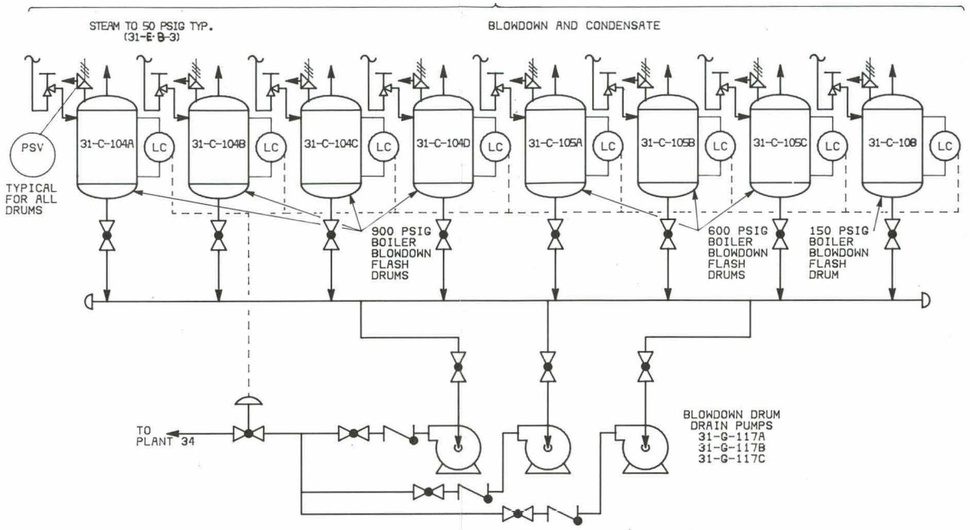
JOB NO.	DRAWING NO.	REV.
14222	31-E-B-11	1

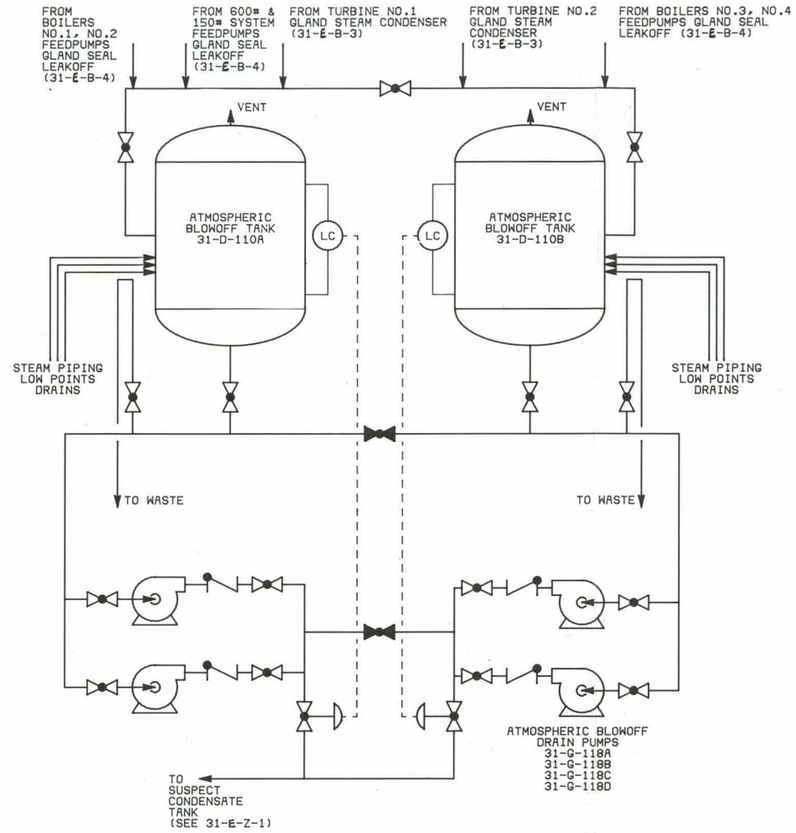
34X44 "E" SIZE

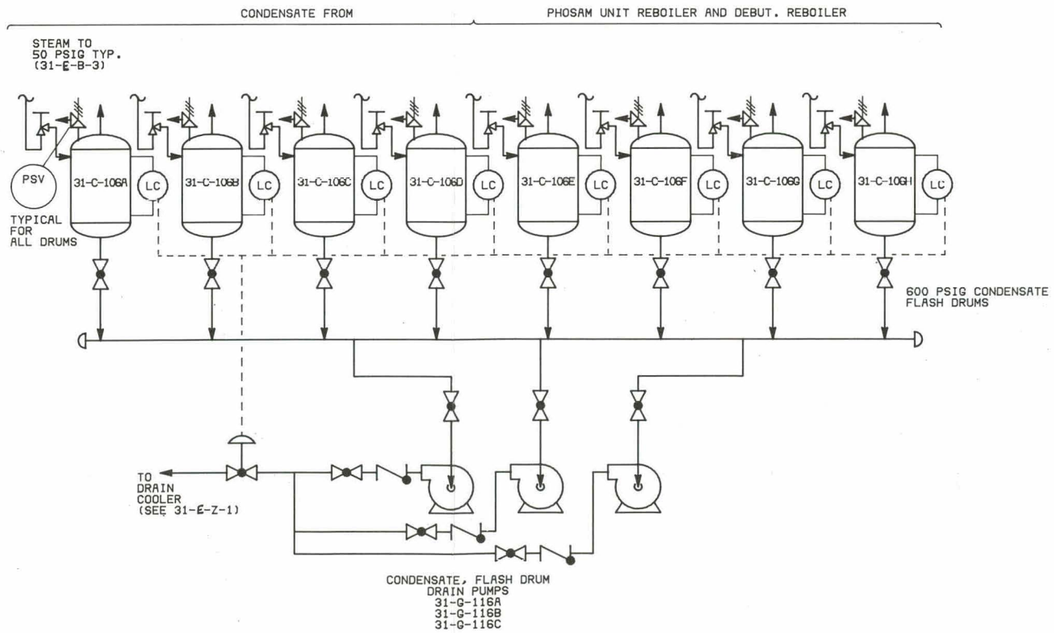
MEA04A 02/26/81 CS

8 7 6 5 4 3 2 1

H G F E D C B A







NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	BE APPR.	DEPT APPR.
1	2/20/81	ISSUE FOR PHASE ZERO	YL	PS		WP		
0	12/4/80	ISSUE FOR REVIEW AND APPROVAL	YL	RB		WP		

DESIGNED RB/JB DRAWN CAD

ASHLAND SYNTHETIC FUEL, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ORO0717

BRECKINRIDGE PROJECT

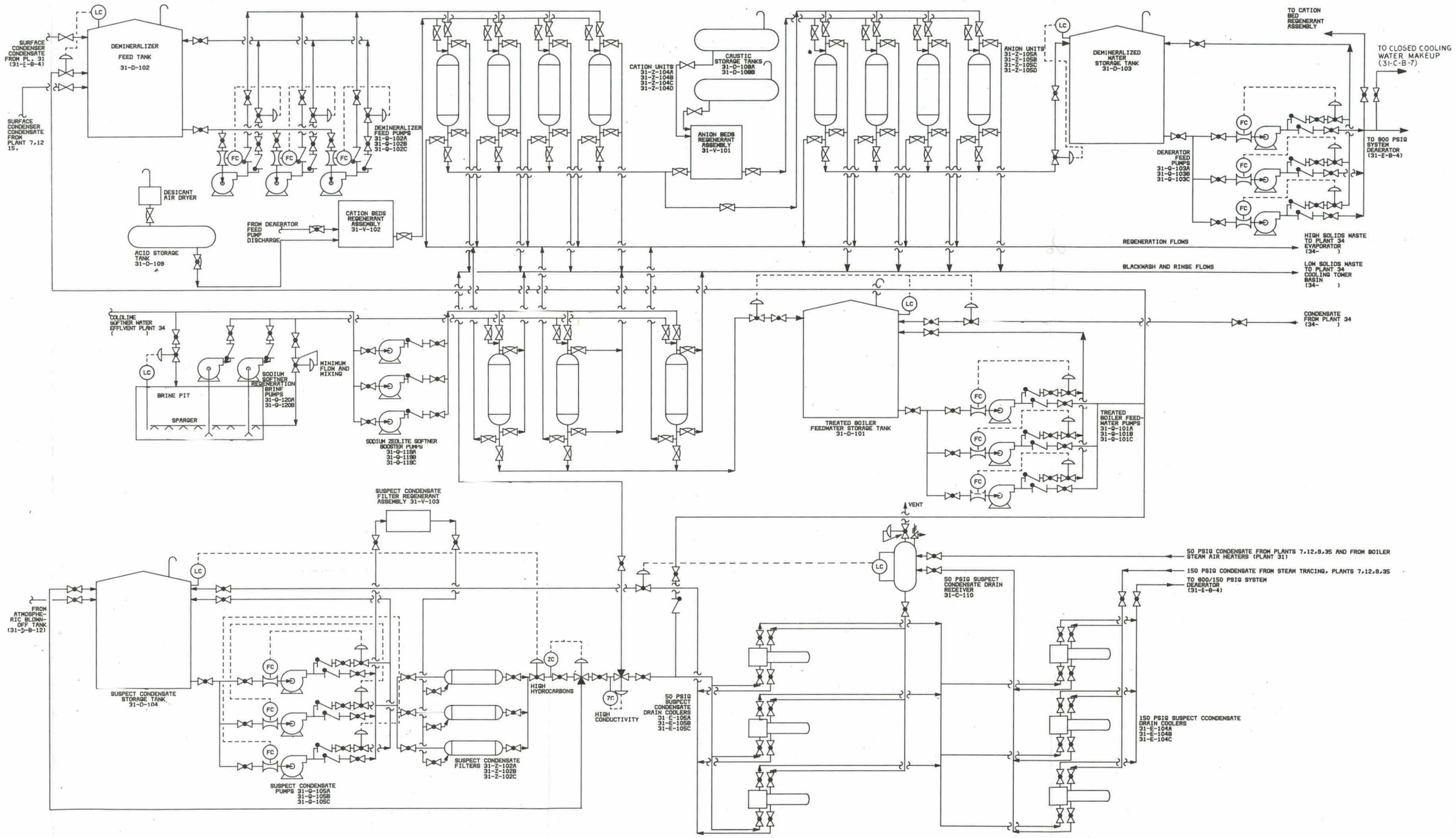
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

CONDENSATE DRAINS FLOW DIAGRAM

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-D-B-12	1

MACO8A 02/05/81 BW



NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	PROJ. APPR.
1	12/19/91	ISSUE FOR PHASE ZERO	CAD	YL	JB	WP	
0	12/16/91	ISSUE FOR REVIEW AND APPROVAL	CAD	YL	JB	WP	

DESIGNED YL / JB DRAWN CAD

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-900R20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

WATER TREATMENT FLOW DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-E-Z-1	1

34X44 "E" SIZE

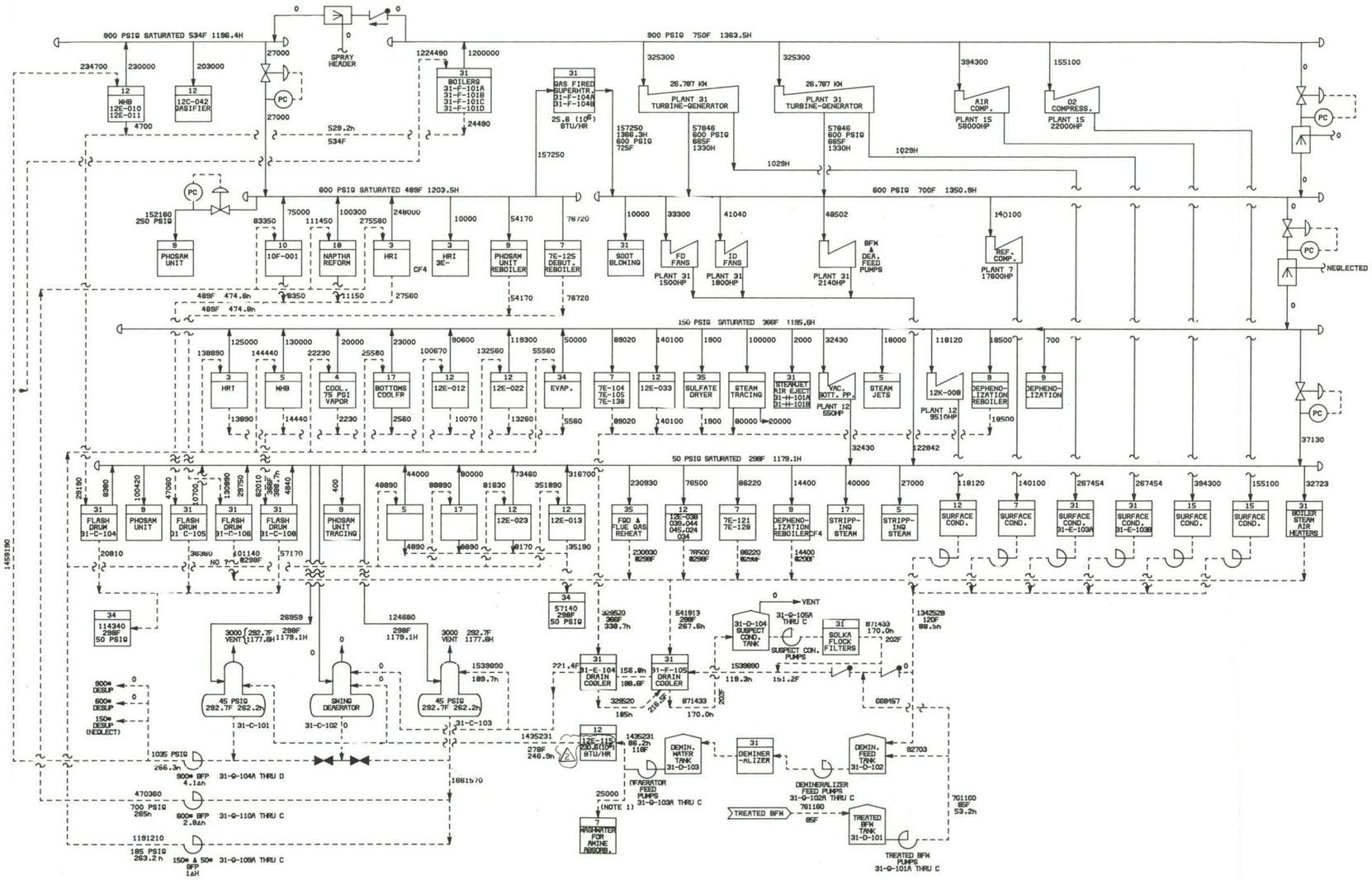
MRC06 02/19/91 SG

8 7 6 5 4 3 2 1

H G F E D C B A

NOTES

1. INTERMITTENT FLOW NOT INCLUDED IN MAKEUP.



LEGEND

———	STEAM
- - - -	WATER
H	ENTHALPY-BTU/lb OF STEAM
h	ENTHALPY-BTU/lb OF WATER

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	BE APPL.	PROJ. MGR.
2	5/14/81	DOE COMMENT						
1	2/27/81	ISSUE FOR PHASE ZERO	CAD	YL				

DESIGNED J.BAYERS DRAWN Y.LERNER

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

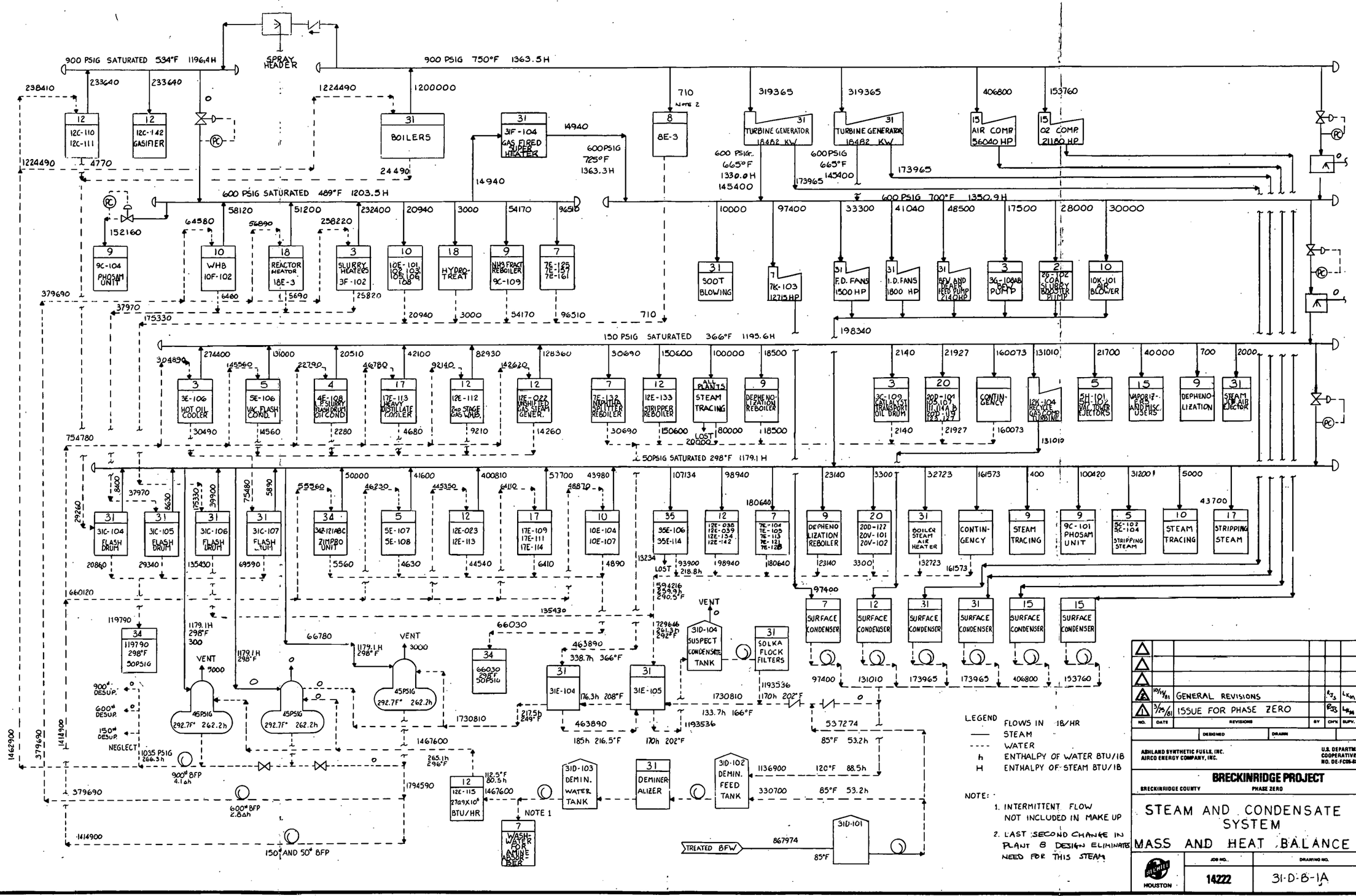
STEAM AND CONDENSATE
SYSTEM MASS & HEAT BALANCE

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-E-B-1	2

34X44 "E" SIZE

MAC04A 02/02/81 MY/GSR



LEGEND
- FLOWS IN LB/HR
- —— STEAM
- ---- WATER
- h ENTHALPY OF WATER BTU/LB
- H ENTHALPY OF STEAM BTU/LB

NOTE:
1. INTERMITTENT FLOW NOT INCLUDED IN MAKE UP
2. LAST SECOND CHANGE IN PLANT 8 DESIGN ELIMINATES NEED FOR THIS STEAM

NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENGR.	BI APPR.	ASPI APPR.
2	10/14/81	GENERAL REVISIONS						
1	3/16/81	ISSUE FOR PHASE ZERO						

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

STEAM AND CONDENSATE SYSTEM
MASS AND HEAT BALANCE

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	31-D-B-1A	2

M EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31	STEAM GENERATION & BFW TREATING	000000
31C-101	DEAERATOR	000000 NA
31C-102	DEAERATOR	000000 NA
31C-103	DEAERATOR	000000
31C-104A	900 PSIG BOILER FLASH DRUM	000000 NA
31C-104B	900 PSIG BOILER FLASH DRUM	000000 NA
31C-104C	900 PSIG BOILER FLASH DRUM	000000 NA
31C-104D	900 PSIG BOILER FLASH DRUM	000000 NA
31C-105A	600 PSIG BOILER BLOWDOWN FLASH DRUM	000000 NA
31C-105B	600 PSIG BOILER BLOWDOWN FLASH DRUM	000000 NA
31C-105C	600 PSIG BOILER BLOWDOWN FLASH DRUM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31C-106A	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106B	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106C	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106D	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106E	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106F	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106G	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-106H	600 PSIG CONDENSATE/ FLASH DRUM -	000000 NA
31C-107A	STEAM AIR HEATER DRAIN TANK -	000000 NA
31C-107B	STEAM AIR HEATER DRAIN TANK -	000000 NA
31C-	STEAM AIR HEATER DRAIN TANK -	000000 NA

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31C-107D	STEAM AIR HEATER DRAIN TANK	000000 NA
31C-108	150 PSIG BOILER BLOWDOWN FLASH DRUM	000000 NA
31C-110	50 PSIG SUSPECT CONDENSATE DRAIN RECEIVER	000000 NA
31D-101	TREATED BOILER FEEDWATER TANK	000000
31D-102	DEMINERALIZED FEED TANK	000000 NA
31D-103	DEMINERALIZED WATER/ STORAGE TANK	000000
31D-104	SUSPECT CONDENSATE/ STORAGE TANK	000000
31D-105	COOLING WATER HEAD TANK	000000 NA
31D-106	CLEAN LUBE OIL STORAGE TANK	000000 NA
31D-107	DIRTY LUBE OIL STORAGE TANK	000000 NA
31D-108A	CAUSTIC STORAGE TANK	000000 NA

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31D-108B	CAUSTIC STORAGE TANK	000000 NA
31D-109	ACID STORAGE TANK	000000 NA
31D-110A	ATMOSPHERIC BLOWOFF TANK	000000 NA
31D-110B	ATMOSPHERIC BLOWOFF TANK	000000 NA
31D-111A	ASH DEWATERING BIN	000000 NA
31D-111B	ASH DEWATERING BIN	000000 NA
31D-112	ASH SETTING TANK	000000 NA
31D-113	ASH SURGE TANK	000000 NA
31D-114A	ASH TRANSFER TANK/ BOILER 1	000000 NA
31D-114B	ASH TRANSFER TANK/ BOILER 1	000000 NA
31 5A	ASH TRANSFER TANK/ BOILER 2	000000 NA

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31D-115B	ASH TRANSFER TANK/ BOILER 2 -	000000 NA
31D-116A	ASH TRANSFER TANK/ BOILER 3 -	000000 NA
31D-116B	ASH TRANSFER TANK/ BOILER 3 -	000000 NA
31D-117A	ASH TRANSFER TANK/ BOILER 4 -	000000 NA
31D-117B	ASH TRANSFER TANK/ BOILER 4 -	000000 NA
31D-118	FLY ASH STORAGE SILO -	000000 NA
31E-103A	MAIN TURBINE SURFACE CONDENSER -	000000 NA
31E-103B	MAIN TURBINE SURFACE CONDENSER -	000000 NA
31E-104A	150 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA
31E-104B	150 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA
31E-104C	150 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31E-105A	50 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA
31E-105B	50 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA
31E-105C	50 PSIG SUSPECT CONDENSATE DRAIN COOLER -	000000 NA
31E-108A	COOLING WATER HEAT/ EXCHANGER -	000000 NA
31E-108B	COOLING WATER HEAT/ EXCHANGER -	000000 NA
31E-108C	COOLING WATER HEAT/ EXCHANGER -	000000 NA
31F-101A	PLANT 31 MAIN BOILER PACKAGE -	000000
31F-101B	PLANT 31 MAIN BOILER PACKAGE -	000000
31F-101C	PLANT 31 MAIN BOILER PACKAGE -	000000
31F-101D	PLANT 31 MAIN BOILER PACKAGE -	000000 NA
3)4A	600 PSIG STEAM/SUPER- HEATER -	000000 NI

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31F-104B	600 PSIG STEAM/SUPER-HEATER	000000 NA
31GT103	DEAERATOR FEED PUMP DRIVE TURBINE	000000 NA
31GT104A	900 PSIG SYSTEM BOILER FEED PUMP DRIVE TURBINE	000000 NA
31GT104B	900 PSIG SYSTEM BOILER FEED PUMP DRIVE TURBINE	000000 NA
31GT109	150 PSIG SYSTEN BOILER FEED PUMP DRIVE TURBINE	000000 NA
31GT110	600 PSIG SYSTEN BOILER FEED PUMP DRIVE TURBINE	000000 NA
31G-101A	TREATED BOILER FEEDWATER PUMP	000000 NA
31G-101B	TREATED BOILER FEEDWATER PUMP	000000 NA
31G-101C	TREATED BOILER FEEDWATER PUMP	000000 NA
31G-102A	DEMINERALIZER FEED PUMP	000000 NA
31G-102B	DEMINERALIZER FEED PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-102C	DEMINERALIZER FEED PUMP -	000000 NA
31G-103A	DEAERATOR FEED PUMP -	000000 NA
31G-103B	DEAERATOR FEED PUMP -	000000 NA
31G-103C	DEAERATOR FEED PUMP -	000000 NA
31G-104A	900 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-104B	900 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-104C	900 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-104D	900 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-105A	SUSPECT CONDENSATE PUMP -	000000 NA
31G-105B	SUSPECT CONDENSATE PUMP -	000000 NA
3 05C	SUSPECT CONDENSATE PUMP -	00000 N

MA EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-106A	HOTWELL CONDENSATE PUMP	000000 NA
31G-106B	HOTWELL CONDENSATE PUMP	000000 NA
31G-106C	HOTWELL CONDENSATE PUMP	000000 NA
31G-107A	HOTWELL CONDENSATE PUMP	000000 NA
31G-107B	HOTWELL CONDENSATE PUMP	000000 NA
31G-107C	HOTWELL CONDENSATE PUMP	000000 NA
31G-108A	COOLING WATER PUMP	000000 NA
31G-108B	COOLING WATER PUMP	000000 NA
31G-108C	COOLING WATER PUMP	000000 NA
31G-109A	150 PSIG SYSTEM BOILER/ FEED PUMP	000000 NA
31G-109B	150 PSIG SYSTEM BOILER FEED PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-109C	150 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-110A	600 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-110B	600 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-110C	600 PSIG SYSTEM BOILER/ FEED PUMP -	000000 NA
31G-111A	CONDENSER VACCUM PUMP -	000000 NA
31G-111B	CONDENSER VACCUM PUMP -	000000 NA
31G-112A	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-112B	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-113A	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-113B	STEAM AIR HEATER DRAIN PUMP -	000000 NA
3 14A	STEAM AIR HEATER DRAIN PUMP -	00000 N

M[illegible] EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-114B	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-115A	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-115B	STEAM AIR HEATER DRAIN PUMP -	000000 NA
31G-116A	CONDENSATE FLASH DRUM DRAIN PUMP -	000000 NA
31G-116B	CONDENSATE FLASH DRUM DRAIN PUMP -	000000 NA
31G-116C	CONDENSATE FLASH DRUM DRAIN PUMP -	000000 NA
31G-117A	BLOWDOWN FLASH DRUM DRAIN PUMP -	000000 NA
31G-117B	BOILER FLASH DRUM DRAIN PUMP -	000000 NA
31G-117C	BOILER FLASH DRUM DRAIN PUMP -	000000 NA
31G-118A	ATMOSPHERIC BLOWOFF DRAIN PUMP -	000000 NA
31G-118B	ATMOSPHERIC BLOWOFF DRAIN PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-118C	ATMOSPHERIC BLOWOFF DRAIN PUMP -	000000 NA
31G-118D	ATMOSPHERIC BLOWOFF DRAIN PUMP -	000000 NA
31G-119A	SODIUM SOFTENER BOOSTER PUMP -	000000 NA
31G-119B	SODIUM SOFTENER BOOSTER PUMP -	000000 NA
31G-119C	SODIUM SOFTENER BOOSTER PUMP -	000000 NA
31G-120A	SODIUM SOFTENER/ REGENERATION BRINE PUMP -	000000 NA
31G-120B	SODIUM SOFTENER/ REGENERATION BRINE PUMP -	000000 NA
31G-121A	CONVEYOR RECIRCULATION PUMP -	000000 NA
31G-121B	CONVEYOR RECIRCULATION PUMP -	000000 NA
31G-122A	CONTINUOUS RECIRCULATION PUMP -	000000 NA
31G B	CONTINUOUS RECIRCULATION PUMP -	000000 NA

M EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-123A	DEWATERING BIN AREA SEAL WATER BOOSTER PUMP -	000000 NA
31G-123B	DEWATERING BIN AREA SEAL WATER BOOSTER PUMP -	000000 NA
31G-124A	DEWATERING AREA SUMP PUMP -	000000 NA
31G-124B	DEWATERING AREA SUMP PUMP -	000000 NA
31G-125A	SLUDGE RETURN PUMP -	000000 NA
31G-125B	SLUDGE RETURN PUMP -	000000 NA
31G-126A	BOILER AREA ASH SUMP PUMP BOILER 1 -	000000 NA
31G-126B	BOILER AREA ASH SUMP PUMP BOILER 1 -	000000 NA
31G-127A	BOILER AREA ASH SUMP PUMP BOILER 2 -	000000 NA
31G-127B	BOILER AREA ASH SUMP PUMP BOILER 2 -	000000 NA
31G-128A	BOILER AREA ASH SUMP PUMP BOILER 3 -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-128B	BOILER AREA ASH SUMP PUMP BOILER 3 -	000000 NA
31G-129A	BOILER AREA ASH SUMP PUMP BOILER 4 -	000000 NA
31G-129B	BOILER AREA ASH SUMP PUMP BOILER 4 -	000000 NA
31G-130A	SEAL WATER PUMP BOILER 1 -	000000 NA
31G-130B	SEAL WATER PUMP BOILER 1 -	000000 NA
31G-131A	SEAL WATER PUMP BOILER 2 -	000000 NA
31G-131B	SEAL WATER PUMP BOILER 2 -	000000 NA
31G-132A	SEAL WATER PUMP BOILER 3 -	000000 NA
31G-132B	SEAL WATER PUMP BOILER 3 -	000000 NA
31G-133A	SEAL WATER PUMP BOILER 4 -	000000 NA
31 3B	SEAL WATER PUMP BOILER 4 -	000000 NA

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-134A	ASH SLUICE WATER BOOSTER PUMP BOILER 1	000000 NA
31G-134B	ASH SLUICE WATER BOOSTER PUMP BOILER 1	000000 NA
31G-134C	ASH SLUICE WATER BOOSTER PUMP BOILER 1	000000 NA
31G-135A	ASH SLUICE WATER BOOSTER PUMP BOILER 2	000000 NA
31G-135B	ASH SLUICE WATER BOOSTER PUMP BOILER 2	000000 NA
31G-135C	ASH SLUICE WATER BOOSTER PUMP BOILER 2	000000 NA
31G-136A	ASH SLUICE WATER BOOSTER PUMP BOILER 3	000000 NA
31G-136B	ASH SLUICE WATER BOOSTER PUMP BOILER 3	000000 NA
31G-136C	ASH SLUICE WATER BOOSTER PUMP BOILER 3	000000 NA
31G-137A	ASH SLUICE WATER BOOSTER PUMP BOILER 4	000000 NA
31G-137B	ASH SLUICE WATER BOOSTER PUMP BOILER 4	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31G-137C	ASH SLUICE WATER BOOSTER PUMP BOILER 4	000000 NA
31G-138A	BOTTOM ASH PUMP BOILER 1	000000 NA
31G-138B	BOTTOM ASH PUMP BOILER 1	000000 NA
31G-139A	BOTTOM ASH PUMP BOILER 2	000000 NA
31G-139B	BOTTOM ASH PUMP BOILER 2	000000 NA
31G-140A	BOTTOM ASH PUMP BOILER 3	000000 NA
31G-140B	BOTTOM ASH PUMP BOILER 3	000000 NA
31G-141A	BOTTOM ASH PUMP BOILER 4	000000 NA
31G-141B	BOTTOM ASH PUMP BOILER 4	000000 NA
31G-142	FIRE WATER BOOSTER PUMP	000000 NA
31 01A	INDUCED DRAFT FAN DRIVER	000000 NA

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31KT-101B	INDUCED DRAFT FAN DRIVER -	000000 NA
31KT-101C	INDUCED DRAFT FAN DRIVER -	000000 NA
31KT-101D	INDUCED DRAFT FAN DRIVER -	000000 NA
31KT-102A	FORCED DRAFT FAN DRIVER -	000000 NA
31KT-102B	FORCED DRAFT FAN DRIVER -	000000 NA
31KT-102C	FORCED DRAFT FAN DRIVER -	000000 NA
31KT-102D	FORCED DRAFT FAN DRIVER -	000000 NA
31K-103A	TRANSPORT AIR BLOWER -	000000 NA.
31K-103B	TRANSPORT AIR BLOWER -	000000 NA
31K-103C	TRANSPORT AIR BLOWER -	000000 NA
31K-103D	TRANSPORT AIR BLOWER -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31K-103E	TRANSPORT AIR BLOWER	000000
	-	NA
31K-103F	TRANSPORT AIR BLOWER	000000
	-	NA
31K-103G	TRANSPORT AIR BLOWER	000000
	-	NA
31K-103H	TRANSPORT AIR BLOWER	000000
	-	NA
31K-104A	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-104B	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-104C	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-104D	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-104E	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-104F	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K	SEAL AIR BOOSTER BLOWER	000000
	-	NA

EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31K-104H	SEAL AIR BOOSTER BLOWER	000000
	-	NA
31K-105A	AERATION BLOWER	000000
	-	NA
31K-105B	AERATION BLOWER	000000
	-	NA
31K-106A	TRUCK CHUTE EXHAUST FAN	000000
	-	NA
31K-106B	TRUCK CHUTE EXHAUST FAN	000000
	-	NA
31PT101A	MAIN POWER TURBINE	000000
	-	NA
31PT101B	MAIN POWER TURBINE	000000
	-	NA
31P-101A	ELECTRIC GENERATOR	000000
	-	NA
31P-101B	ELECTRIC GENERATOR	000000
	-	NA
31T-101A	COAL GALLERY CONVEYOR	000000
	-	NA
31T-101B	COAL GALLERY CONVEYOR	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31T-102A	DUST COLLECTOR	000000 NA
31T-102B	DUST COLLECTOR	000000 NA
31T-102C	DUST COLLECTOR	000000 NA
31T-102D	DUST COLLECTOR	000000 NA
31T-102E	DUST COLLECTOR	000000 NA
31T-103A	COAL STORAGE SILO	000000 NA
31T-103B	COAL STORAGE SILO	000000 NA
31T-103C	COAL STORAGE SILO	000000 NA
31T-103D	COAL STORAGE SILO	000000 NA
31T-103E	COAL STORAGE SILO	000000 NA
31 3F	COAL STORAGE SILO	000000 NA

N EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31T-103G	COAL STORAGE SILO	000000 NA
31T-103H	COAL STORAGE SILO	000000 NA
31T-103I	COAL STORAGE SILO	000000 NA
31T-103J	COAL STORAGE SILO	000000 NA
31T-103K	COAL STORAGE SILO	000000 NA
31T-103L	COAL STORAGE SILO	000000 NA
31T-104A	PULVERIZER GRAVINMETRIC FEEDER	000000 NA
31T-104B	PULVERIZER GRAVINMETRIC FEEDER	000000 NA
31T-104C	PULVERIZER GRAVINMETRIC FEEDER	000000 NA
31T-104D	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104E	PULVERIZER GRAVIMETRIC FEEDER	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31T-104F	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104G	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104H	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104I	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104J	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104K	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-104L	PULVERIZER GRAVIMETRIC FEEDER	000000 NA
31T-105	COAL SURGE BIN	000000 NA
31V-101	ANION BEDS REGENERANT ASSEMBLY	000000 NA
31V-102	CATION BEDS REGENERANT ASSEMBLY	000000 NA
31[illegible]3	SUSPECT CONDENSATE FILTERS REGENERANT ASSEM	000000 NA

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31Y-105A	ELECTROSTATIC PRECIPITATOR -	000000 NA
31Y-105B	ELECTROSTATIC PRECIPITATOR -	000000 NA
31Y-105C	ELECTROSTATIC PRECIPITATOR -	000000 NA
31Y-105D	ELECTROSTATIC PRECIPITATOR -	000000 NA
31Z-101	COOLING WATER CHEMICAL FEED TANK -	000000
31Z-102A	SUSPECT CONDENSATE FILTER -	000000 NA
31Z-102B	SUSPECT CONDENSATE FILTER -	000000 NA
31Z-102C	SUSPECT CONDENSATE FILTER -	000000 NA
31Z-103A	SODIUM ZEOLITE SOFTENER -	000000 NA
31Z-103B	SODIUM ZEOLITE SOFTENER -	000000 NA
31Z-103C	SODIUM ZEOLITE SOFTENER -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
31Z-104A	DEMINERALIZER CATION UNIT -	000000 NA
31Z-104B	DEMINERALIZER CATION UNIT -	000000 NA
31Z-104C	DEMINERALIZER CATION UNIT -	000000 NA
31Z-104D	DEMINERALIZER CATION UNIT -	000000 NA
31Z-105A	DEMINERALIZER ANION UNIT -	000000 NA
31Z-105B	DEMINERALIZER ANION UNIT -	000000 NA
31Z-105C	DEMINERALIZER ANION UNIT -	000000 NA
31Z-105D	DEMINERALIZER ANION UNIT -	000000 NA

4.1 Data Sheets for Columns and Pressure Vessels

31-DS-C-1: 900, 600, and 150 psig Systems Deaerator (31C-101, 102, 103)

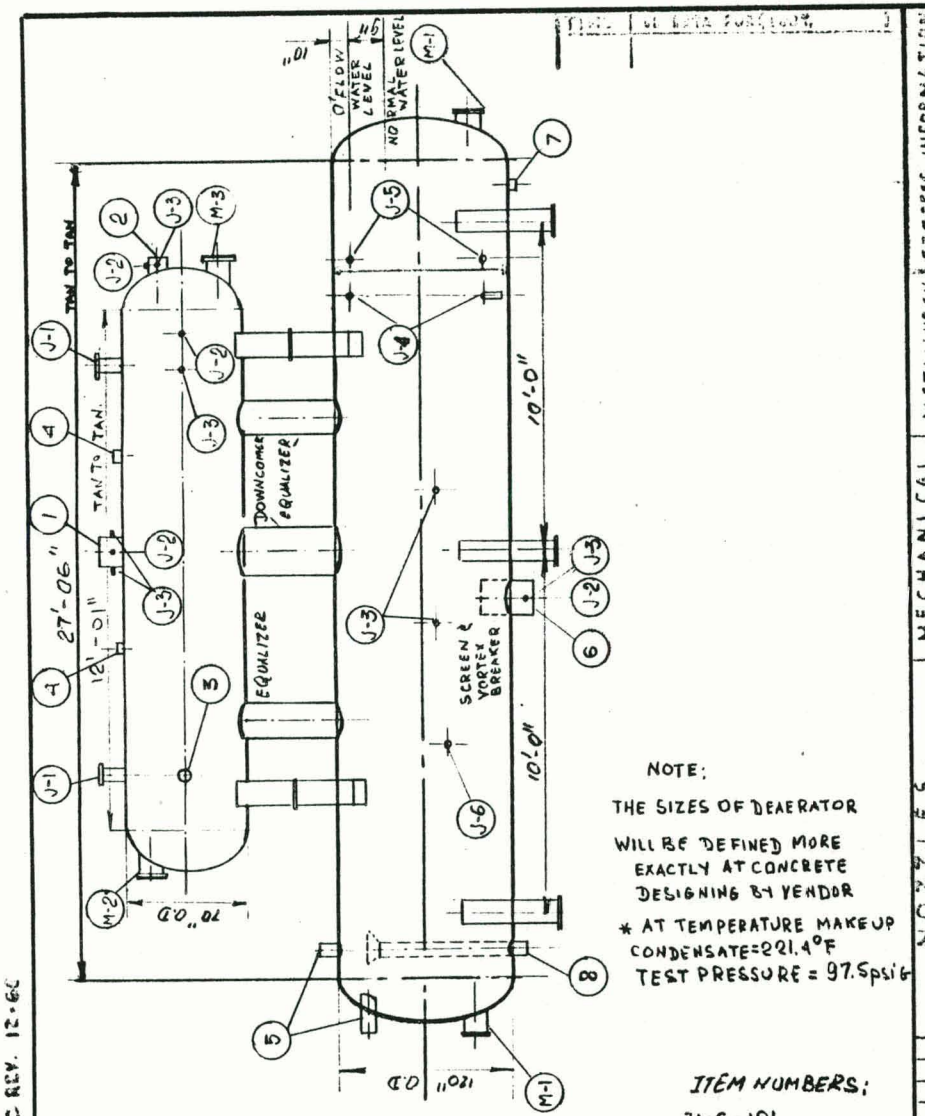
31-DS-C-2: 900 psig Boiler Blowdown Flash Drums (31C-104 A, B, C, D)

31-DS-C-3: 600 psig Boiler Blowdown and Condensate Flash Drums (31C-105 A, B, C, D, 106 A, B, C, D, E, F, G, H)

31-DS-C-5: Steam Air Heater Drain Tanks (31C-107 A, B, C, D)

31-DS-C-6: 150 psig Boiler Blowdown Flash Drum (31C-108)

31-DS-C-7: 50 psig Suspect Condensate Drain Receiver (31C-110)



NOTE:

THE SIZES OF DEAERATOR WILL BE DEFINED MORE EXACTLY AT CONCRETE DESIGNING BY VENDOR

* AT TEMPERATURE MAKE UP CONDENSATE=221.4°F
TEST PRESSURE = 97.5psig

ITEM NUMBERS:

31-C-101
31-C-102
31-C-103

OPERATING DATA — PROCESS INFORMATION

LINE OR NOZ.	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F NORM	TEMP °F MIN	PRESS PSIG NORM	PRESS PSIG MAX
1	MAKE UP CONDENS.	1539890	59.9	221.4	221.4*/151	120	120
2	STEAM	124680	0.15	298	302/298	50	65

VAPOR PRESS @ MAX. & 298 °F = 64.7 PSIA
PROCESS CONTAMINANTS NONE

RESIDENCE TIME — LL DATA FOR:

LCH
HLL
LAH
NLL
LAL
LLL
LCL

LG 12 (2) 10" 24" 31" 48"

(1) STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDIT OVER 48"
(2) REFER TO DWG'S J-L-6701 & 6702
(3) SURGE, ETC.
(4) LG WILL BE NEAREST STD. SIZE TO COVER LG RANGE. IF NO LG IS USED OR LG OVER 48" INDICATE LG DIMENSIONS BELOW & ON SKETCH

METALLURGY — PROCESS INFORMATION

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		A-516 GR. 60	1/16" MIN.	SHELL & HEAD TOTAL "T" BY VENDOR
INT'LS	WELD-IN	STAINLESS	BY TOTAL	VORTEX BREAKER.
	REMOVABLE	STAINLESS	VENDOR TOTAL	TRAY TYPE DEAERATOR REQ'D

POST WELD HEAT TREATMENT FOR BY VENDOR (OTHER THAN STOVE)

MECHANICAL DESIGN REQM'TS

PRESS MARGIN: MIN SPEC + 15 = 15 PSI
MIN. DESIGN PRESS AT TOP 65 PSIG (MARG. OPER.)
SYSTEM PSV SET AT 65 PSIG LOCATED J-1
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ___ LUGS ___
SADDLES (C-527) ✓
HEIGHT ___ MIN. ABV GRADE FIREPROOFING N/A

SPECIAL REQUIREMENTS

CODE: ASME, SECTION VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.) CONTINUOUS

INSULATION: YES THK. 2"

NOZZLES — EQUIPMENT

NOZ. NO.	SERVICE	NO. REQ'D	EST SIZE	RATING & FACING	INT'L TYPE OR NOTE
J-6	SAMPLE CONN.	1	1"		SCRD COUP
J-5	INSTRUMENT BRIDLE CON	2	2"		SW COUP
J-4	INSTRUMENT BRIDLE CON	2	3"		SW COUP
J-3	THERM CONN.	9	1"		SW COUP
J-2	PRESSURE SWITCH CONN	5	1"		SW COUP
J-1	PSV	2	6"	150 R.F	
9					
8	OVERFLOW OUTLET	1	10"	SCH. 40	
7	DRAIN	1	6"	SCH 40	
6	B.F.P. OUTLET	1	16"	SCH. 40	
5	B.F.P. RECIRC. INLET	5	4"	SCH 80	
4	VENT TO ATMOSPH	2	2"	SCH 40	S.W. COUP
3	DRAINS INLET	1	8"	SCH. 40	BW NOZ
2	STEAM INLET	1	10"	SCH. 40	BW NOZ
1	CONDENSATE INLET	1	12"	SCH. 40	BW NOZ

NOZ. NO.	SERVICE	NO. REQ'D	EST SIZE	RATING & FACING	INT'L TYPE OR NOTE
M-3	INSPECTION MANHOLE	1	18"		FLANG
M-2	TRAY ACCESS MANHOLE	1	18"		FLANG
M-1	MANWAY	2	18"		FLANG

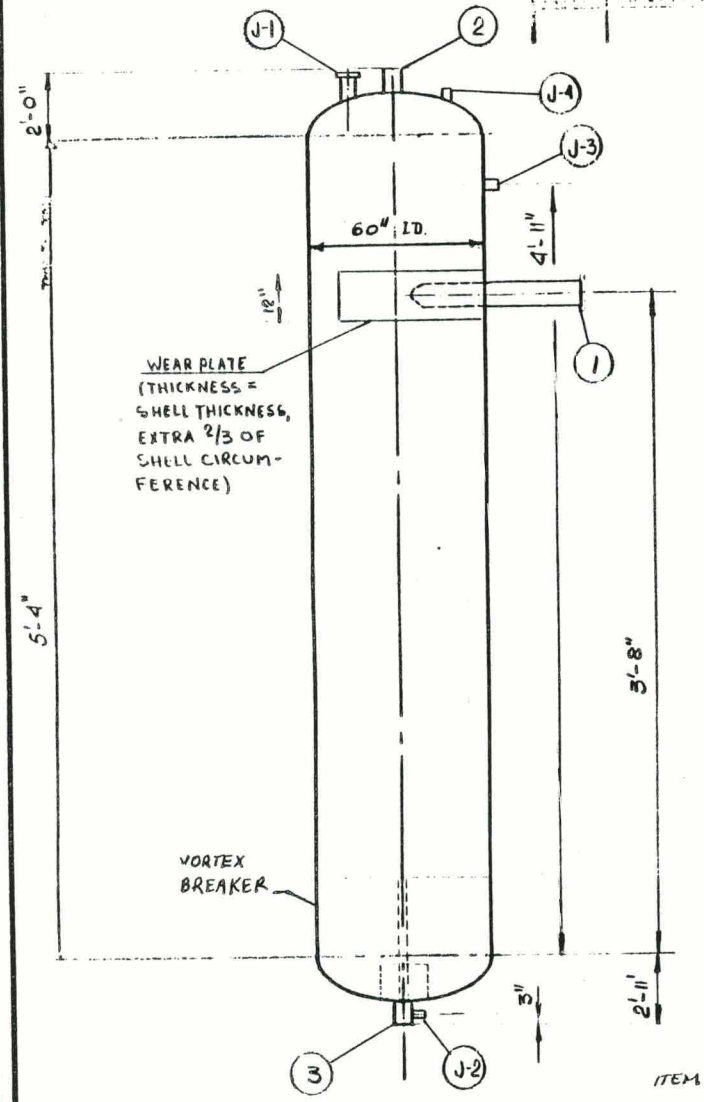
REV	DATE	
	12/8/6	DESIGN BASIS ISSUED FOR PHASE ZERO
		ISSUED FOR

ASF
HNH
LLP

JOB NO.	VESSEL DESIGN DATA SHEET	PROCESS	INSTRUMENT UNIT	PROJECT
14222	SERVICE PLANT 31, 900 PSIG AND 600 PSIG AND UNIT 150 PSIG SYSTEMS DEAERATOR V=17000 GL		VESSEL NO. 31-DS-C-1	REV. 0

(ENTER "B" ON PROCESS MASTER ONLY)

FORM 4206C REV. 12-66



ITEM NUMBERS
31-C-104A
31-C-104B
31-C-104C
31-C-104D

	FLUID	FLOW RATE						
1)	BLOWDOWN FROM BOILER DRUMS PLANT 12/31	7500	47.0	534	540/528	900	945	

DESIGN PRESS. MAX. ABV. GRADE 298 @ 65 PSIA
TEMPERATURES NONE

COMPONENT		TYP. MAT'L	CORR. ALLOW.	REMARKS
SHELL & HEADS		SA-516 GR 60 CARBON STEEL	1/16" MIN. VENDOR OPTIONAL	MIN SHELL PLATE THICKNESS 5/8 INCH
NOZZLES	WELD-IN			
	REINFORCED			

MECHANICAL PROCESS DESIGN DATA

GROSS HYDROSTATIC TEST PRESS. 150 @ 150 PSI
MIN. DESIGN PRESS AT TOP 200 PSIG (MAX. OPER.)
SYSTEM PSV SET AT 200 PSIG LOCATED (J-1)
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: PSIA
VESSEL SUPPORT DATA: SKIRT ___ LEGS ___ LUGS V
SADDLES (C-527) ___
HEIGHT ___ MIN. ABV GRADE FOR PADDING ___

LL DATA FOR:
LCH
HLL
LAH
NLL
LAL
LLL
LCL

(1) TD DISPLACER GAUGES (CHECK ONE)
(2) SPECIAL CONDIT OVER 48"
(3) REFER TO DWG'S J-L-8751 & ETC
(4) SURGE, ETC.

POST WELD HEAT TREAT: NOT REQUIRED
FOR BY VENDOR (OTHER)

SPECIAL REQUIREMENTS
CODE: ASME, SECTION VIII

LOADINGS
SERVICE (CYCLIC, LETHAL ETC.)
CONTINUOUS

INSULATION: YES THK. 2"

MARK	SERVICE	NO. REQ'D	NOZ. SIZE	RATING OR WALL	TYPE OR FACING	MARK	SERVICE	NO. REQ'D	NOZ. SIZE
J-6									
J-5									
J-4	PRESSURE GAGE	1	3/4"	6000					
J-3	LEVEL INDICATOR	1	3/4"	6000					
J-2	LEVEL INDICATOR	1	3/4"	6000					
J-1	PSV	1	4"	300 R.F					
9									
8									
7									
6									
5									
4									
3	WATER OUTLET	1	4"	SCHED 40	BUTT WELD				
2	STEAM VENT	1	8"	SCHED 40	BUTT WELD				
1	BLOWDOWN INLET	1	4"	SCHED 80	BUTT WELD				

MANWAY

NO.	DATE	REVISION	BY	CHK'D	APP'D
0	12/4/80	DESIGN BASIS - ISSUED FOR PHASE ZERO	YL		JP

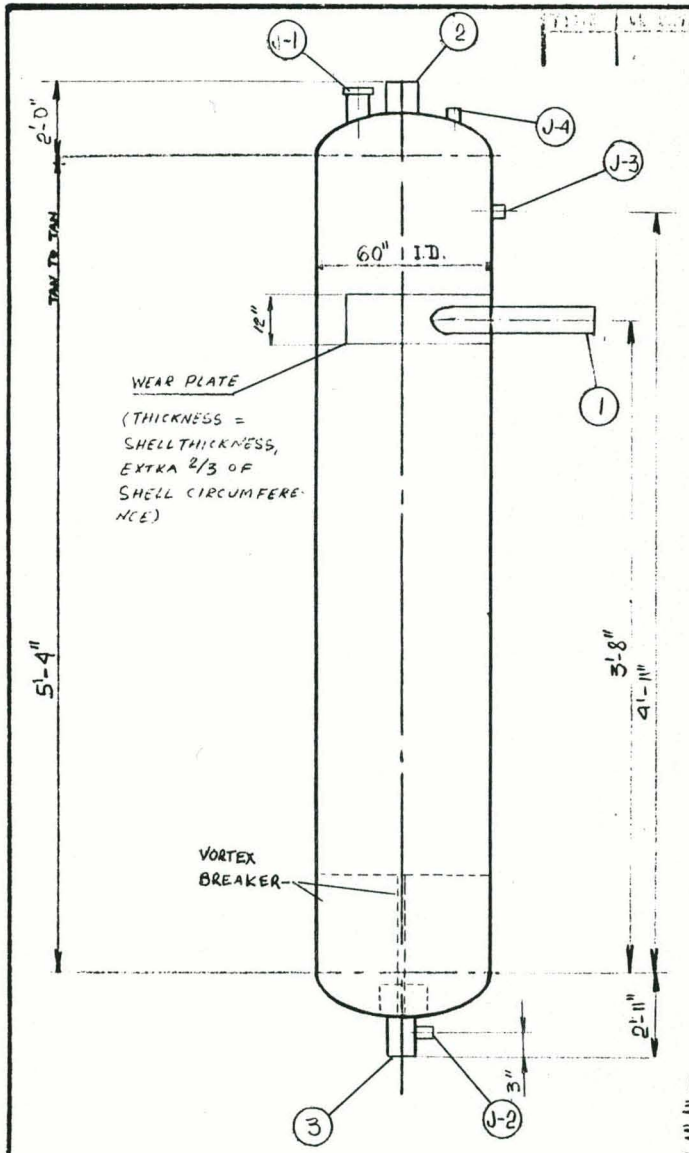
ISSUED FOR

JOB NO. 14222 — VESSEL DESIGN DATA SHEET — VESSEL NO. 31-DS-C-2 — REV. 0

SERVICE PLANT-31 DRUM - 900 PSIG, BOILER BLOWDOWN FLASH DRUMS

ASME HNH

(ENTER "0" ON PROCESS MASTER ONLY)



ITEM NUMBERS
31-C-105A
31-C-105B
31-C-105C
31-C-106A
THRU
31-C-106H

FORM 4660 REV. 12-80

PROCESS INFORMATION

	FLUID	FLOW LB/HR	DENSITY LB/CU FT	T °F	P PSIG	DESIGN PSIG
1	BLOWDOWN FROM PLANT 3,10,18	16400	49.53	489	497/485	600 / 650
	CONDENSATE FROM PLANT 7,9					

VAPOR PRESS @ MAX. ABS. 298°F = 65 PSIA
PROCESS CONTAMINANTS NONE

METALLURGY

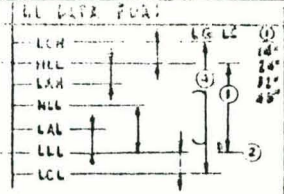
COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA-516 GR.60	1/16" MIN.	MIN SHELL PLATE THICKNESS 3/8 INCH
INT'LS	WELD-IN	CARBON STEEL	VENDOR TOTAL	
	REMOVABLE		TOTAL	

POST WELD HEAT TREATMENT FOR BY VENDOR ____ (OTHER THAN STEEL)

MECHANICAL DESIGN REQ'S

PRESS MARGIN: MIN SPEC ____ + 115 = 115 PSI
MIN. DESIGN PRESS AT TOP 165 PSIG (MAKE OPER.)
SYSTEM PSV SET AT 165 PSIG LOCATED J-1
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: ____ FOR ____
VESSEL SUPPORT DATA: SKIRT ___ LEGS ___ LUGS V
SADDLES (C-527) ___
HEIGHT ___ MIN. ASV GRADE FIREPROOFING N/A

TIME vs LL DATA POINT



① STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CIRCUIT OVER 48"
② REFER TO DWG'S J-L-8701 & 0702
③ SURGE, ETC.
④ LG WILL BE NEAREST STD. SIZE TO SERVICE OR MIN. IF NOT AVAILABLE OR SPECIAL REQUIRED

SPECIAL REQUIREMENTS
CODE: ASME, SECTION VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.) CONTINUOUS

INSULATION: YES THK. 2"

NOZZLES & INSTRUMENTS PROCESS

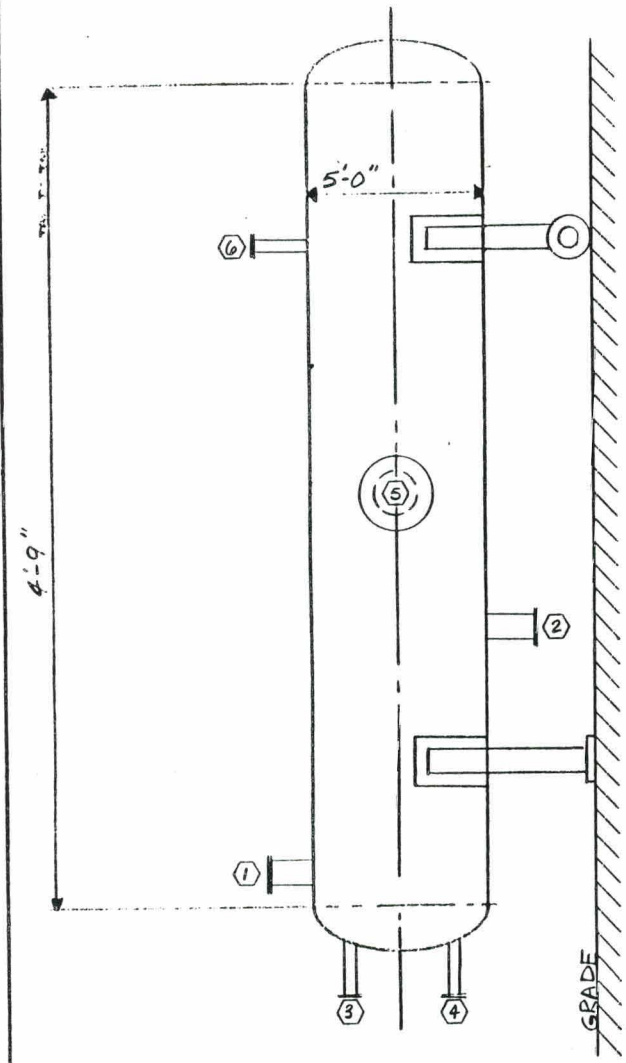
NOZZLE NO.	SERVICE	NO. REQ'D	BODY SIZE	RATING (FACING)	END TYPE OR USE	NOZZLE NO.	SERVICE	NO. REQ'D	BODY SIZE	RATING (FACING)	END TYPE OR USE
J-6											
J-5											
J-4	PRESSURE GAGE	1	3/4 Boss								
J-3	LEVEL INDICATOR	1	3/4 Boss								
J-2	LEVEL INDICATOR	1	3/4 Boss								
J-1	PSV	1	4"	300 R.F							
9											
8											
7											
6											
5											
4											
3	WATER OUTLET	1	4"	SCH 40	BUTT WELD						
2	STEAM VENT	1	8"	SCH 40	BUTT WELD						
1	BLOWDOWN INLET	1	4"	SCH 80	BUTT WELD	M-1	MANWAY				

NO.	DATE	ISSUED FOR	BY	CHK'D	APP'D
0	12/4/80	DESIGN BASIS - ISSUED FOR PHASE ZERO	YL		

ASFI HWH

JOB NO. 14222 | SERVICE UNIT PLANT 31 - 600 PSIG BOILER BLOWDOWN & 600 PSIG CONDENSATE FLASH DRUMS | VESSEL DESIGN DATA SHEET | VESSEL NO. 31-DS-C-3 | REV. 0

(ENTER "B" ON PROCESS MASTER ONLY)



NOTE THICKNESS = BY VENDOR
TYPE = HORIZONTAL

STEAM AIR HEATER DRAIN TANKS 31-C-107A THRU 107D

	FLUID						
1	HOT CONDENSATE	8180	57.5	293	FIB/250	45	50
2	HOT CONDENSATE	8180	57.5	293	FIB/250	45	50
7	HOT CONDENSATE	4000	57.5	293	FIB/250	45	50

VAPOR PRESS @ MAX. OPE. TEMP. N/A PSIA
CORROSION ALLOWANCES NONE

COMPONENT		TYP. MATL	CORR. ALLOW	RADIOGRAPHY
SHELL & HEADS		SA 516 GR. 60	1/8" MIN.	
NTLS	WELD-IN	NONE	TOTAL	
	REMOVABLE	NONE	TOTAL	

PRESS MARGIN: MIN SPEC. + ____ = 20 PSIG
MIN. DESIGN PRESS AT TOP 70 PSIG (MAX. OPER.)
SYSTEM PSV SET AT N/A PSIG LOCATED
MIN DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ___ LUGS ___
SADDLES (C-527) ✓
HEIGHT 4FT MIN ADV GRADE FIREPROOFING ____

LIQUID LEVEL DATA FOR:
LCH
HLL
LAH
NLL
LAL
LLL
LCL

(1) STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONSULT OVER 4ft
(2) REFER TO DWG'S J-L-8701 & 8702
(3) SURGE, ETC.
(4) IF VSL TO BE NUCLEAR STD. NOZ. TO BE SEAMLESS & MAG. IF NO LC IS SHOWN ON NOZ. SEE LC & SEAM REQUIREMENTS ON CONSTRUCTION SPECIFICATIONS

POST WELD HEAT TREATMENT FOR _____ (OTHER THAN CODE)

SPECIAL REQUIREMENTS
CODE: VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.)
CYCLIC

INSULATION: YES THK. 2"

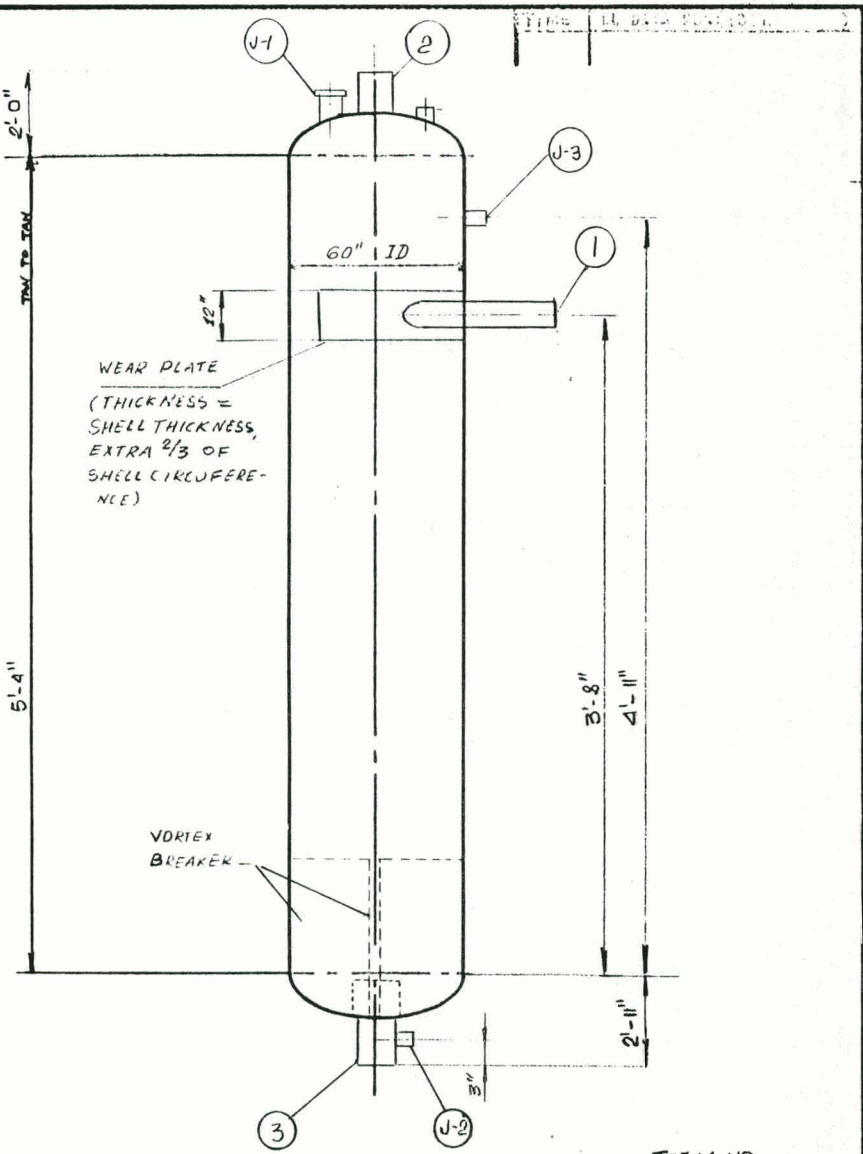
	SERVICE	NO. REQ'D	SIZE	RATING (FACING)	DET'L TYPE OR SEC'T	SKETCH NO.	SERVICE	NO. REQ'D	SIZE	RATING	DET'L TYPE OR SEC'T
8											
7	PUMP RECIRC	1	2" SCH 40	150 RF							
6	VENT	1	24" SCH 40								
5	MANHOLE	1	2" SCH. 40								
4	LEVEL GAGE CONN.	1	2" SCH. 40								
3	LEVEL GAGE CONN.	1	3" SCH. 40								
2	OUTLET	1	3" SCH. 40								
1	INLET	1	3" SCH. 40				MANWAY				

REV.	DATE	DESCRIPTION	PROJECT	ISSUE	REV.
0	12/8/80	DESIGN BASIS - ISSUED FOR PHASE ZERO ISSUED FOR	98		

JOB NO.	VESSEL DESIGN DATA SHEET	VESSEL NO.	REV.
14222	SERVICE STEAM AIR HEATER DRAIN TANKS UNIT BRECKINRIDGE - PLANT 31	DS-C-5	0

(ENTER "0" ON PROCESS MASTER ONLY)

ASFI HNH UP



ITEM NO. 31-C-108

PROCESS INFORMATION

	NO. OF UNITS	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F NORM	TEMP °F MAX/MIN	PRESS PSIG NORM	PRESS PSIG MAX
OPERATING DATA	1	BLOWDOWN FROM PLANT 3, 4,5,12,17, 24	62000	55	366	375/365	150	175

VAPOR PRESS @ MAX. ANN. 208°F = 65.7 PSIA
PROCESS CONTAMINANTS NONE

METALLURGY

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA 516 GR 60	1/16" MIN.	MIN SHELL PLATE THICKNESS 3/4 INCH
INT'LS	WELD-IN	CARBON STEEL	VENDOR TOTAL	
	REMOVABLE		TOTAL	

MECHANICAL DESIGN DATA

PRESS MARGIN: MIN SPEC + 20 = 20 PSI
MIN. DESIGN PRESS AT TOP 70 PSIG (MAR. OPER.)
SYSTEM PSV SET AT 70 PSIG LOCATED J-1
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ___ LUGS ✓
SADDLES (C-527) ___
HEIGHT ___ MIN. ABV. GRADE FIREPROOFING ___

TITLE ILL DATA FOR:
RESIDENCE
LCH
HLL
LAH
NLL
LAL
LLL
LCL
LG L2
(1) STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDIT OVER 48"
(2) REFER TO DWG'S J-L-6701 & 6702
(3) SOURCE, ETC.
(4) [illegible]

POST WELD HEAT TREATMENT FOR BY VENDOR (OTHER THAN NONE)

SPECIAL REQUIREMENTS
CODE: ASME, SECTION VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.) CONTINUOUS
INSULATION: YES THK. 2"

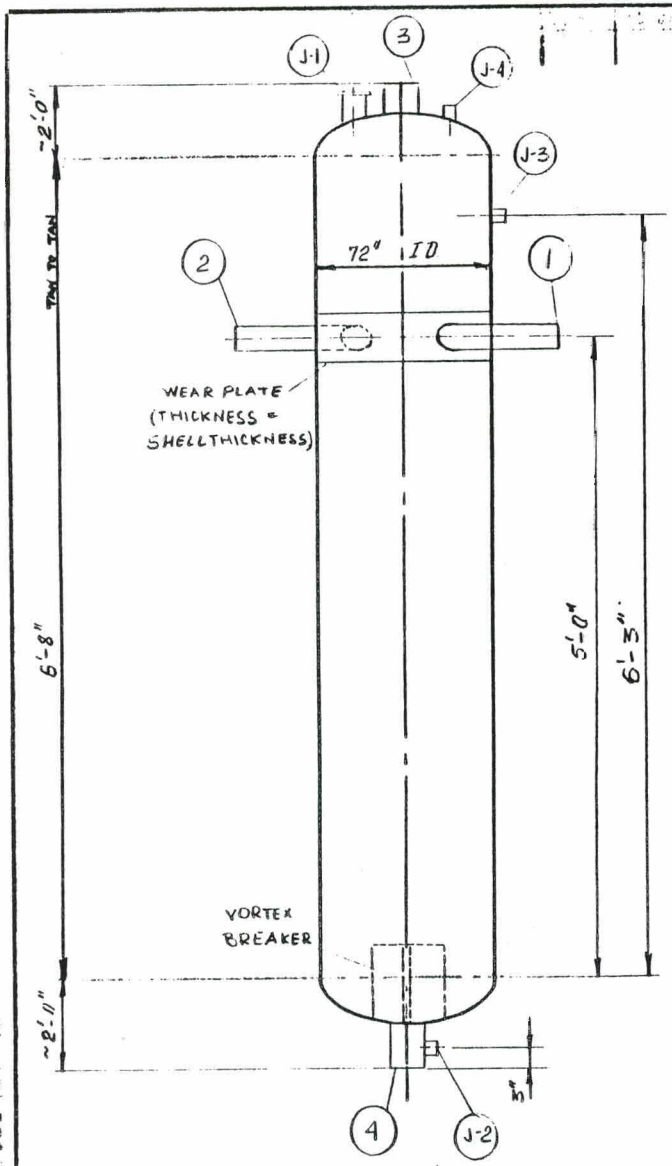
NOZZLES & INSTRUMENTS

NOZZ NO.	SERVICE	NO. REQ'D	EST SIZE	RAISING FACING	INT'L TYPE OR RTG	NOZZ NO.	SERVICE	NO. REQ'D	EST. SIZE	MATERIAL SPEC	MISC. NOTES
J-6											
J-5											
J-4	PRESSURE GAGE	1	3/4 BOSS								
J-3	LEVEL INDICATOR	1	3/4 BOSS								
J-2	LEVEL INDICATOR	1	3/4 BOSS								
J-1	PSV	1	4"	150 RF							
9											
8											
7											
6											
5											
4											
3	WATER OUTLET	1	4"	SCHED 40	BUTT WELD						
2	STEAM VENT	1	8"	SCHED 40							
1	CONDENS. INLET	1	4"	SCHED 40		M-1	MANWAY				

REV	DATE				
A	12/6/80	DESIGN BASIS - ISSUED FOR PHASE ZERO	YL		ASFI HNH
		ISSUED FOR	PROCESS	INSTRUM.	UNIT
		VESSEL DESIGN DATA SHEET		VESSEL NO.	REV.
		JOB NO. 14222 SERVICE UNIT PLANT-31 150PSIG BOILER BLOWDOWN FLASH DRUM.		31-DS-C-6	O

(ENTER "B" ON PROCESS MASTER ONLY)

FORM 6800 REV. 12-82



ITEM NO
31-C-110

OPERATING DATA	1	CONDENSATE FROM PLANTS							
		7/2/85	541,913	57.4	298	298/298	60	50	
	2	CONDENSATE FROM ISOPIP							
		DRAIN COOLERS	329,520	55	211	298/298	150	150	

DESIGN PRESS 285 PSIG MAX. ALLOW. 250 PSIG @ 50 °F

CONTAINMENTS NONE

COMPONENT	TYP. MATL	CORR ALLOW	REMARKS
SHELL & HEADS	SA 516 GR60	1/16" MIN.	MIN SHELL PLATE THICKNESS 3/4 INCH
NOZZLES WELD-IN	CARBON STEEL	VENDOR TBA	
NOZZLES REMOVABLE		TBA	

PRESS MARGIN: MIN SPEC + 35 ; 35 PSI

MIN. DESIGN PRESS AT TOP 70 PSIG (WARM & OPER.)

SYSTEM PSV SET AT 70 PSIG LOCATED J-1

MIN DESIGN TEMP -20 °F @ 14.7 PSIA

EXTERNAL PRESS DESIGN: PSI

VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___
SADDLES (C-527) ___

HEIGHT ___ MIN. ADJ GRADE FIREPROOFING ___

TIME LL DATA FOR:

(1) STD DISPLACER RANGES (CIRCLE ONE) & SPECIAL LENGTH OVER 42"
(2) REFER TO DWG'S J-L-GT-1 (67102
(3) SOURCE, ETC.
(4) [illegible]

POST WELD HEAT TREATMENT
FOR BY VENDOR (CODE)

SPECIAL REQUIREMENTS:
CODE: ASME, SECTION VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.)
CONTINUOUS

INSULATION: YES TYP. THICK

PIPE MK	SERVICE	NO. REQ'D	NOZ SIZE	RATING & FACING	END TYPE OR LAP	PIPE MK	SERVICE	NO. REQ'D	NOZ SIZE	RATING & FACING
J-5										
J-4	PRESSURE GAGE	1	3/4 Boss							
J-3	LEVEL INDICATOR	1	3/4 Boss							
J-2	LEVEL INDICATOR	1	3/4 Boss							
J-1	PSV	2	4"	ISORF						
9										
8										
7										
6										
5										
4	WATER OUTLET	1	4"	SCHED 40	BUTT					
3	STEAM VENT	1	8"	SCHED 40	WELD					
2	CONDENSATE INLET	1	4"	SCHED 40						
1	CONDENSATE INLET	1	4"	SCHED 40		1	MANWAY			

A	12/6/80	DESIGN BASIS - ISSUED FOR PHASE ZERO	YLP		
		ISSUED FOR			
	JOB NO.	VESSEL DESIGN DATA SHEET		VESSEL NO.	REV.
	14222	SERVICE PLANT-31 50PSIG SUSPECT CONDENSATE UNIT DRAIN RECEIVER		31-DS-C-7	0

(ENTER "B" ON PROCESS MASTER ONLY)

4.2 Data Sheets for Tanks

31-DS-D-1: Treated Boiler Feedwater Tank (31D-101)

31-DS-D-2: Demineralizer Feed Tank (31D-102)

31-DS-D-3: Demineralized Water Storage Tank (31D-103)

31-DS-D-4: Suspect Condensate Storage Tank (31D-104)

31-DS-D-5: Cooling Water Head Tank (31D-105)

31-DS-D-6: Turbine Lube Oil Storage Tanks (31D-106, 107)

31-DS-D-7: Caustic Storage Tank (31D-108 A, B)

31-DS-D-8: Acid Storage Tank (31D-109)

31-DS-D-9: Atmospheric Blowoff Tank (31D-110 A, B)

31-DS-D-10: Ash Dewatering Bins (31D-111 A, B)

31-DS-D-11: Ash Settling Tank (31D-112)

31-DS-D-12: Ash Surge Tank (31D-113)

31-DS-D-13: Ash Transfer Tank (31D-114 A, B, 115 A, B, 116 A, B, 117 A, B)

31-DS-D-14: Fly Ash Storage Silo (31D-118)

TANK DATA

TANK NO.	31-T-101
SIZE, DIA. X HEIGHT	70 x 48
CAPACITY (42 GAL. BBLS)	32,899
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	2,286
EMPTYING RATE-BPH	2,286
BEARING PLATES	-
DRAW-OFF SUMP	-
WATER DRAW CONN.	12"
STORAGE TEMP. °F	80
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	-20/120
DESIGN SPECIFIC GRAVITY	1
TOTAL NET WORKING CAP. – MBBLS	26.7
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	NO

ROOF APPURTENANCES

VENT NOZZLE	YES
RIM VENTS	N/A
MANHOLE – 20"	YES
MANHOLE – COMB. EMER. RELIEF	NO
PONTOON MANHOLE – 20"	NO
GAUGE HATCH NOZZLE	NO
ROOF DRAIN, FLEX. PIPE	NO
BLANKET GAS INLET – 2": FLG.	NO
GAS BLANKET PC 2" FLG. NOZZLE	NO
AUTOMATIC BLEEDER VENT	NO
AUTO. GAUGE FLOAT WELL & COVER	YES
AUTO. GAUGE INSPECT. OPEN. & COVER	YES
LEVEL GAUGE CONNS.	YES
AVERAGING TEMP. BULB CONN.	NO
AUTO. GAUGE FLOAT STILLING WELL	YES

SHELL APPURTENANCES

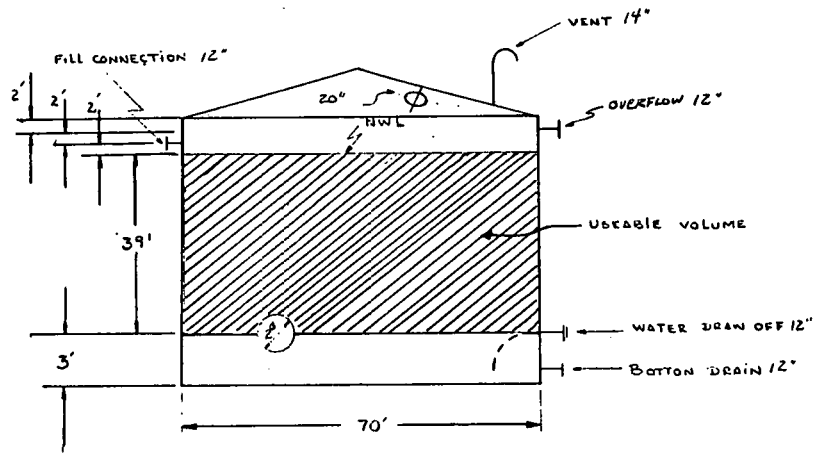
SUCTION NOZZLE	12"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	12"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	N/A
CONDENSATE NOZZLE – DOUBLE FLGD.	N/A
ROOF DRAIN NOZZLE – DOUBLE FLGD.	N/A
FOAM CHAMBER	N/A
FOAM TROUGHS	N/A
MANHOLES – 20" OR 24" DIA.	24
MIXER NOZZLE	N/A
MIXER NOZZLE – W/BLIND FLG. (MH)	N/A
FLUSH TYPE CLEANOUT, 3' X 4'	N/A
SAMPLE CONNECTION – 1" COUPLING	1"
TEMP. GAUGE CONN. – 1" COUPLING	N/A
PRESSURE GAUGE CONN.	N/A
TEMP. CONTROLLER CONN. – 1" CPLG.	N/A
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	N/A
SPECIAL CONNECTIONS	N/A
HIGH & LOW LEVEL ALARMS	YES
LEVEL GAUGE CONNS.	YES
HIGH & LOW PRESS. ALARMS	NO

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	NO
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	NO
GROUNDING LUGS	NO
MIXER SUPPORT LUGS	NO
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	NO
INSULATION SUPPORTS	NO
CATHODIC PROTECTION	YES
AUTO. LEVEL GAUGE	YES
AUTO. LEVEL GAUGE, REMOTE	YES
AUTO. LEVEL GAUGE, REMOTE PRESS.	NO
TARGET LEVEL GAUGE	NO
TARGET LEVEL GAUGE, W/ALARM	YES
TARGET LEV. GA., W/LIQ. SEAL, ALARM	NO
TEMPERATURE GAUGE	NO
FOAM GENERATOR	NO
TANK HEATER (INSTALL BY	N/A
HEATER MANIFOLDS (INSTALL BY	N/A
PRESSURE VACUUM RELIEF VALVE	NO
OPEN VENT (WITH RETURN BEND)	YES
OPEN VENT (MUSHROOM)	NO
INSULATION	NO
SAMPLE COOLER	NO
CENTER PIN FOR PAINTER'S TROLLEY	NO

GENERAL

PAINTING	PLASITE NT 600
BOTTOM PLATE COATING	Coal Tar Epox.
WINDGIRDERS	N/A
TANK STRAPPING	YES
SPECIFICATIONS	API 620
FOUNDATION	CONCRETE



NOTE: ALL NOZZLES 150# F.F., SCHEDULE 40 CARBON STEEL PIPE

△										
△										
△										
△										
△										
△	11/11/80	ISSUE FOR PLANT ZERO						JS	WP	HWH
No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR.	CONST.	PROJ. ENGR.	CONST.	APPVD.	

SCALE NONE DESIGNED DRAWN

ITEM NO. 31-D-101

TREATED BOILER FEEDWATER TANK

BECHTEL

BRECKINRIDGE PROJECT

PLANT 31

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-1	0

R&C S.F. Form 173

TANK DATA

TANK NO.	31-D-102
SIZE, DIA. X HEIGHT	80' x 48'
CAPACITY (42 GAL. BBLS)	42,970
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	4143
EMPTYING RATE-BPH	4143
BEARING PLATES	-
DRAW-OFF SUMP	NO
WATER DRAW CONN.	16"
STORAGE TEMP. °F	120
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	-20/140
DESIGN SPECIFIC GRAVITY	1
TOTAL NET WORKING CAP. – MBBLS	34.9
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	NO

ROOF APPURTENANCES

VENT NOZZLE	18"
RIM VENTS	NO
MANHOLE – 20"	YES
MANHOLE – COMB. EMER. RELIEF	NO
PONTOON MANHOLE – 20"	NO
GAUGE HATCH NOZZLE	NO
ROOF DRAIN, FLEX, PIPE	NO
BLANKET GAS INLET – 2" FLG.	NO
GAS BLANKET PC 2" FLG. NOZZLE	NO
AUTOMATIC BLEEDER VENT	NO
AUTO. GAUGE FLOAT WELL & COVER	YES
AUTO. GAUGE INSPECT. OPEN. & COVER	YES
LEVEL GAUGE CONNS.	YES
AVERAGING TEMP. BULB CONN.	NO
AUTO. GAUGE FLOAT STILLING WELL	YES

SHELL APPURTENANCES

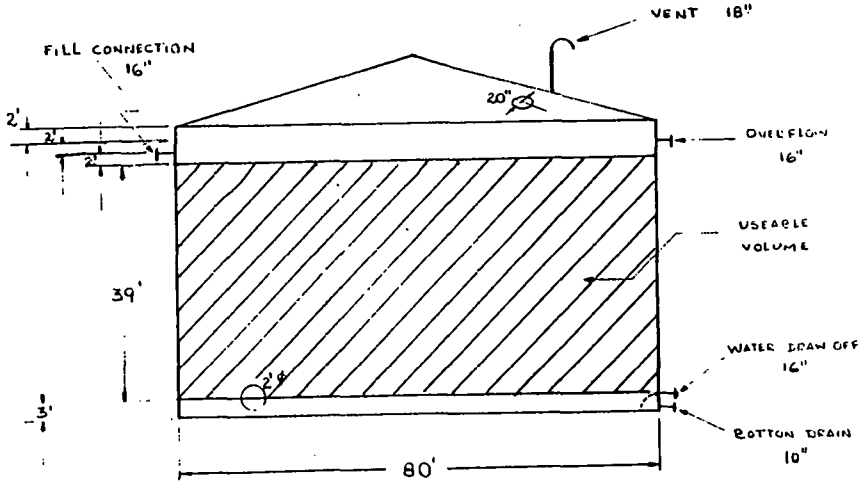
SUCTION NOZZLE	16"
SUCTION NOZZLE W/1" COUPLING	-
FILL NOZZLE	16"
FILL NOZZLE W/1" COUPLING	-
STEAM NOZZLE – DOUBLE FLANGED	NO
CONDENSATE NOZZLE – DOUBLE FLGD.	NO
ROOF DRAIN NOZZLE – DOUBLE FLGD.	NO
FOAM CHAMBER	NO
FOAM TROUGHS	NO
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	NO
MIXER NOZZLE – W/BLIND FLG. (MH)	NO
FLUSH TYPE CLEANOUT, 3' X 4'	NO
SAMPLE CONNECTION – 1" COUPLING	YES
TEMP. GAUGE CONN. – 1" COUPLING	NO
PRESSURE GAUGE CONN.	NO
TEMP. CONTROLLER CONN. – 1" CPLG.	NO
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	NO
SPECIAL CONNECTIONS	NO
HIGH & LOW LEVEL ALARMS	YES
LEVEL GAUGE CONNS.	YES
HIGH & LOW PRESS. ALARMS	NO

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	NO
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	NO
GROUNDING LUGS	NO
MIXER SUPPORT LUGS	NO
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	NO
INSULATION SUPPORTS	NO
CATHODIC PROTECTION	YES
AUTO. LEVEL GAUGE	YES
AUTO. LEVEL GAUGE, REMOTE	YES
AUTO. LEVEL GAUGE, REMOTE PRESS.	NO
TARGET LEVEL GAUGE	NO
TARGET LEVEL GAUGE, W/ALARM	NO
TARGET LEV. GA., W/LIQ. SEAL, ALARM	YES
TEMPERATURE GAUGE	NO
FOAM GENERATOR	NO
TANK HEATER (INSTALL BY	N/A
HEATER MANIFOLDS (INSTALL BY	N/A
PRESSURE VACUUM RELIEF VALVE	N/A
OPEN VENT (WITH RETURN BEND)	YES
OPEN VENT (MUSHROOM)	NO
INSULATION	NO
SAMPLE COOLER	NO
CENTER PIN FOR PAINTER'S TROLLEY	NO

GENERAL

PAINTING	PLASITE INT. COND
BOTTOM PLATE COATING	COAL TAR EPOX.
WINDGIRDERS	NO
TANK STRAPPING	YES
SPECIFICATIONS	API 620
FOUNDATION	CONCRETE



NOTE: ALL NOZZLES 150# F.F., SCHEDULE 40 CARBON STEEL PIPE

ITEM NO 31-D-102

DEMINERALIZER FEED TANK

△												
△												
△												
△												
△												
0	12/9/77	ISSUE FOR PHASE ZERO										
No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR. APPD.	CONST. ENGR.	PROJ. MGR. APPD.	CONST. MGR. APPD.				

BECHTEL

BRECKINRIDGE PROJECT
PLANT-31

TANK DATA &
LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-2	0

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO.	DEMINERALIZED WATER STORAGE TANK 31-D-103
SIZE, DIA. X HEIGHT	100'x48'
CAPACITY (42 GAL. BBLS)	67,140
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	4143
EMPTYING RATE-BPH	4143
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	16"
STORAGE TEMP. °F	120
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	-20/130
DESIGN SPECIFIC GRAVITY	1
TOTAL NET WORKING CAP. – MBBLS	49.2
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	16"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	16"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	YES
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	YES
LEVEL GAUGE CONNS.	YES
HIGH & LOW PRESS. ALARMS	

GENERAL

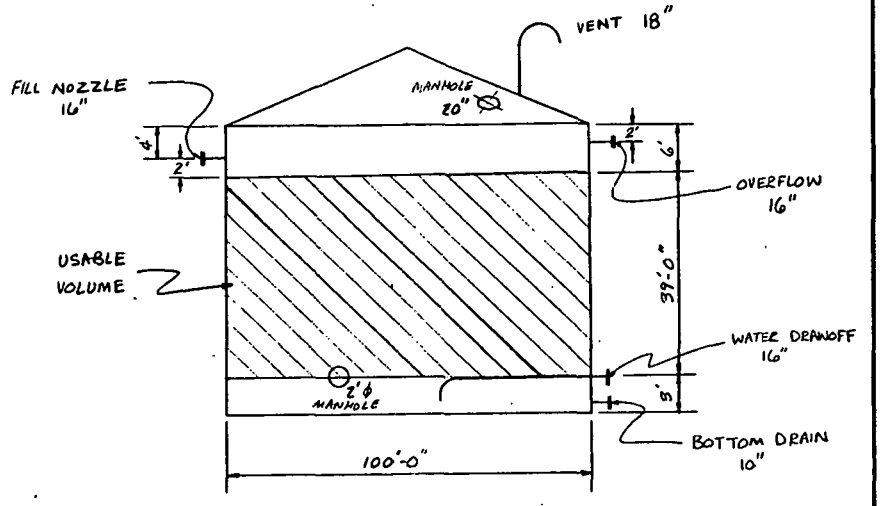
PAINTING	PLASITE INT. COND.
BOTTOM PLATE COATING	COAL TAR EPOX.
WINDGIRDERS	
TANK STRAPPING	YES
SPECIFICATIONS	API 620
FOUNDATION	CONCRETE
FLANGES	150 # F.F.

ROOF APPURTENANCES

VENT NOZZLE	18"
RIM VENTS	
MANHOLE – 20"	YES
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	YES
AUTO. GAUGE FLOAT WELL & COVER	YES
AUTO. GAUGE INSPECT. OPEN. & COVER	YES
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	YES

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	48'
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	YES
AUTO. LEVEL GAUGE	YES
AUTO. LEVEL GAUGE, REMOTE	YES
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	YES
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	YES
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE :- ALL NOZZLES 150 # F.F. SCH.40 C.S. PIPE

ITEM. No. 31-D-103

DEMINERALIZED WATER STORAGE TANK

A	12/11/80	ISSUE FOR PHASE ZERO								RJS	HWH
No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR. APPR.	CNSTR. ENGR. APPR.	PROJ. MGR. APPR.	CNSTR. MGR. APPR.	OTHER APPR.		
SCALE		DESIGNED	DRAWN	CHKD							

BECHTEL

BRECKINRIDGE PROJECT
PLANT-31

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-D5-D-3	0

R&C S.F. Form 173 (4/77)

TANK DATA

SUSPECT CONDENSATE STORAGE TANK NO.	31-D-104
SIZE, DIA. X HEIGHT	80'x 48'
CAPACITY (42 GAL. BBLS)	42,970
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	2286
EMPTYING RATE-BPH	2286
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	12"
STORAGE TEMP. °F	205
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	-20/225
DESIGN SPECIFIC GRAVITY	1
TOTAL NET WORKING CAP. – MBBLS	29.9
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	12"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	12"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	YES
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	YES
LEVEL GAUGE CONNS.	YES
HIGH & LOW PRESS. ALARMS	

GENERAL

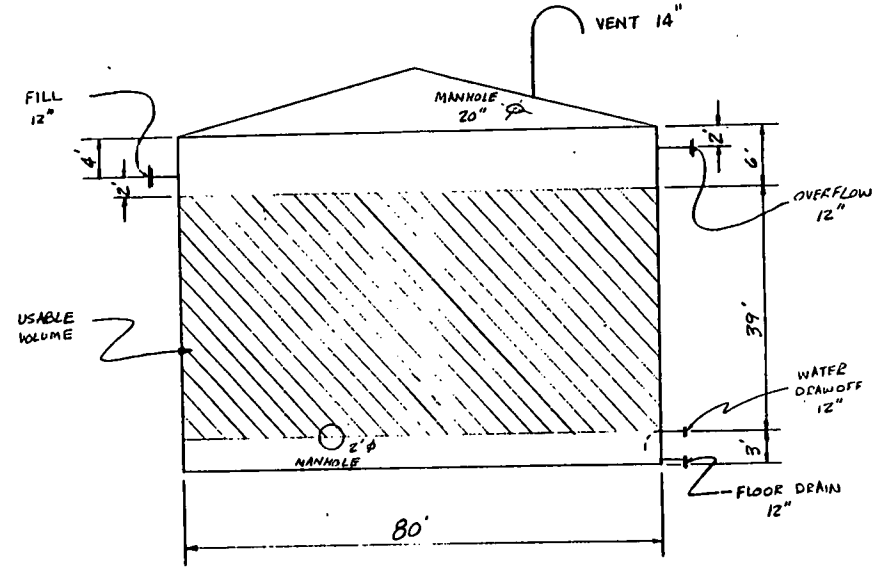
PAINTING	PRIME INT. COND. COAL TAR EPOX.
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	YES
SPECIFICATIONS	API 620
FOUNDATION	CONCRETE
FLANGES	150 # F.F.

ROOF APPURTENANCES

VENT NOZZLE	14"
RIM VENTS	
MANHOLE – 20"	YES
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	YES
AUTO. GAUGE FLOAT WELL & COVER	YES
AUTO. GAUGE INSPECT. OPEN. & COVER	YES
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	YES

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	48'
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	YES
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	YES
AUTO. LEVEL GAUGE, REMOTE PRESS.	YES
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	YES
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	YES
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE: ALL NOZZLES 150 # F.F.
SCH. 40 C.S. PIPE

ITEM. 31-D-104
SUSPECT CONDENSATE STORAGE TANK

NO.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR	CHIEF ENGR	APPD
0	9/12/86	ISSUE FOR PHASE ZERO	MS	WP			

BECHTEL

BRECKINRIDGE PROJECT
PLANT- 31

TANK DATA &
LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-4	0

R&C S.F. Form 173 (4/77)

TANK DATA

COOLING WATER HEAD TANK	
TANK NO.	31-D-105
SIZE, DIA. X HEIGHT	5'x6'-6"
CAPACITY (42 GAL. BBLS)	1000 GAL
ROOF TYPE HORIZONTAL DISHED HEAD	
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	1-4"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	1-4"
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	1-24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	2-2"
HIGH & LOW PRESS. ALARMS	
OVERFLOW	1-4"

GENERAL

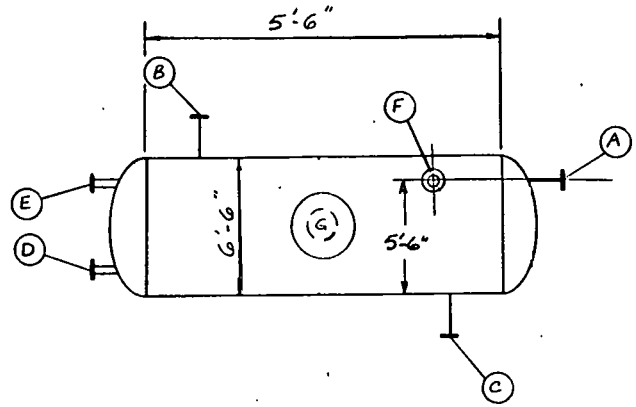
PAINTING	GALVANIZED
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	API
FOUNDATION	
FLANGES	150 # F.F.
SHELL PLATE	3/8 IN.

ROOF APPURTENANCES

VENT NOZZLE	1-4"
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	NONE
CIRCUMFERENTIAL STAIRS	
PLATFORM	NONE
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	NONE
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	NONE
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	NONE
CENTER PIN FOR PAINTER'S TROLLEY	



A = FILL NOZZLE = 4 INCH
B = VENT NOZZLE 4 INCH
C = CONDENSATE NOZZLE 4 INCH
D = } LEVEL GAUGE CONN. 2 INCH
E = }
F = OVERFLOW NOZZLE, 4 INCH
G = MAN HOLE - 24 INCH.

ITEM NO. 31-D-105
COOLING WATER HEAD TANK

△											
△											
△											
△											
△											
△	4/4/80	ISSUED FOR PHASE ZERO		AR	7/5				YP	HWR	
No.	DATE	REVISIONS		BY	CHKD	PROJ. ENGR.	CHKD	PROJ. ENGR.	APPD		
SCALE		DESIGNED		DRAWN		CHKD					

BECHTEL

BRECKINRIDGE PROJECT
PLANT 31

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-5	0

R&C S.F. Form 173 (4/77)

TANK DATA

LUBE OIL STORAGE TANKS CLEAN & DIRTY	
TANK NO.	31-D-106 & 107
SIZE, DIA. X HEIGHT	13' x 16'
CAPACITY (42 GAL. BBLS)	14,000 GAL.
ROOF TYPE	CONEHEAD
BOTTOM TYPE	FLAT
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
(E) WATER DRAW CONN.	1-3"
STORAGE TEMP. °F	
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

(C) SUCTION NOZZLE	1-3"
SUCTION NOZZLE W/1" COUPLING	
(H) FILL NOZZLE	1-3"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
(J) MANHOLES – 20" OR 24" DIA.	1-24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
(D) SAMPLE CONNECTION – 1" COUPLING	1-1"
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	
(B) OIL RETURN	1-3"
(G) CENTRIFUGE CONN.	2-2"
(F) OVERFLOW	1-4"

GENERAL

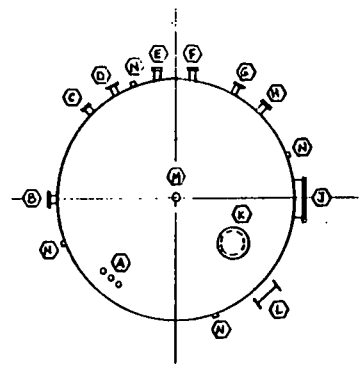
PAINTING	OUTSIDE
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	API
FOUNDATION	CONCRETE
FLANGES	150 # F.F.

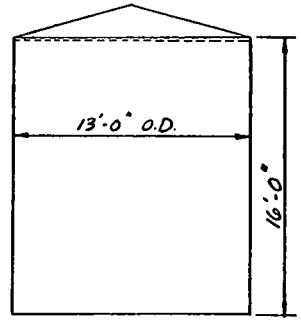
ROOF APPURTENANCES

(M) VENT NOZZLE	1-3"
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
(A) LEVEL GAUGE CONNS. SHAND & JURS MODEL 18322-12 ZA FIT	1-1
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	
(K) EMERGENCY VENT	1-20"

MISCELLANEOUS APPURTENANCES

(L) LADDER W/CAGE	1-16'
CIRCUMFERENTIAL STAIRS	
PLATFORM	
ROLLING LADDER W/SELF-LEVEL TRDS.	
(N) GROUNDING LUGS	4
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	INSIDE
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	NONE
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	NONE
CENTER PIN FOR PAINTER'S TROLLEY	





ITEM NOS 31-D-106
31-D-107

TURBINE LUBE OIL STORAGE TANKS

BECHTEL

BRECKINRIDGE

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-D5-D-6	0

0	13/5/81	ISSUE FOR PHASE ZERO	AK			18	CW	

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO. CAUSTIC STORAGE TANK	31-D-108A/B
SIZE, DIA. X HEIGHT	10'x21'-4"
CAPACITY (42 GAL. BBLS)	13338 GAL.
ROOF TYPE	DISHED HEADS
BOTTOM TYPE	
FILLING RATE	200 GPM
EMPTYING RATE	100 GPH
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F MINIMUM	60F
CORROSION ALLOWANCE	
DESIGN METAL TEMP. – °F MIN./MAX.	-20/120
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP.	12000 GAL.
MINIMUM NO. OF TANKS	2
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	2"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	4"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	YES
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	YES
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	2 - 1"
HIGH & LOW PRESS. ALARMS	

GENERAL

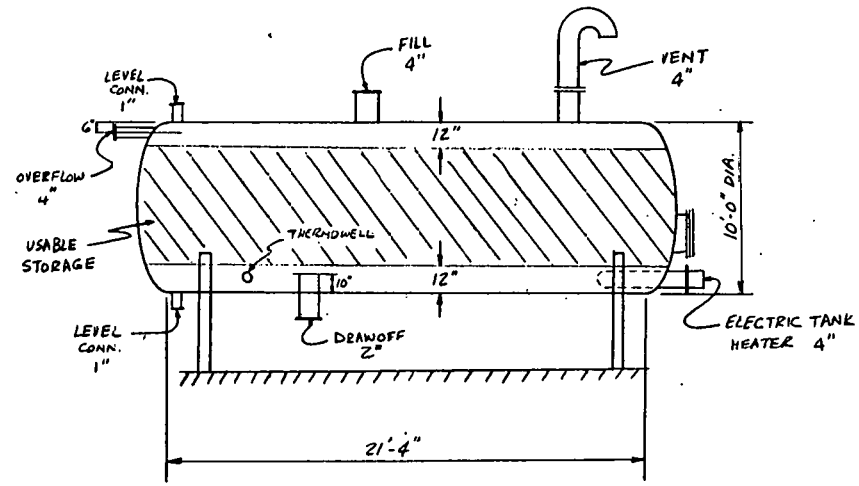
PAINTING	YES
BOTTOM PLATE COATING	RUBBER LINING
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	API
FOUNDATION	CONCRETE
FLANGES	150 # F.F.

ROOF APPURTENANCES

VENT NOZZLE	4"
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	12'
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	YES
FOAM GENERATOR	
TANK HEATER (INSTALL BY VENDOR)	4"
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	4"
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	NO
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE:- TANK - C.S. W/ RUBBER LINING
NOZZLES - SCH. 40 C.S. 150# F.F.

ITEM :- 31-D-108A & B

CAUSTIC STORAGE TANK

BECHTEL

BRECKINRIDGE PROJECT
PLANT- 31

TANK DATA & LIST OF APPURTENANCES

No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR.	ENGR.	PROJ. ENGR.	APPD.
0	12/1/80	ISSUE FOR PHASE ZERO	K		JS	JJP	HWH	

SCALE | DESIGNED | DRAWN | CHECKED

JOB No.	DRAWING No.	REV.
14222	31-05-D-7	0

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO. ACID STORAGE TANK	31-D-109
SIZE, DIA. X HEIGHT	9'x17'-6"
CAPACITY (42 GAL. BBLS)	8919 GAL.
ROOF TYPE	DISHED HEADS
BOTTOM TYPE	
FILLING RATE	200GPM
EMPTYING RATE	100GPH
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	80
CORROSION ALLOWANCE	RUBBER LINED
DESIGN METAL TEMP. – °F MIN./MAX.	-20/120
DESIGN SPECIFIC GRAVITY (WATER = 1.0)	1.84
TOTAL NET WORKING CAP. – GAL.	8200
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	
FLUID STORED	98%H2SO4

SHELL APPURTENANCES

SUCTION NOZZLE	2"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	4"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	2-1"
HIGH & LOW PRESS. ALARMS	

GENERAL

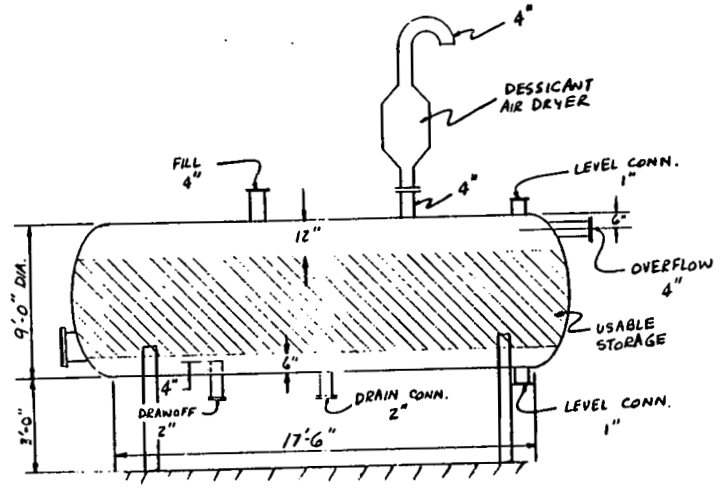
PAINTING	OUTSIDE
BOTTOM PLATE COATING	RUBBER LINING
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	API
FOUNDATION	CONCRETE
FLANGES	150# F.F.

ROOF APPURTENANCES

VENT NOZZLE	1"
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	
DESSICANT AIR DRYER	4"

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	12'
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	NO
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	NO
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE :- TANK - C.S. W/RUBBER LINING
NOZZLES - C.S. SCH. 40 150# F.F. RUBBER LINED WITH RUBBER EXTENDING OVER FLANGE FACE

No.	Date	Revisions	By	Check	Design Supv.	Check	Proj. Engr.	Appd.
1	9/12/80	ISSUE FOR PHASE ZERO	AK			16'-4"		JNH

Scale: NONE | Designed | Drawn | Check | Check

ITEM 31-D-109

ACID STORAGE TANK

BECHTEL

BRECKINRIDGE PROJECT
PLANT - 31

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV
14222	31-05-D-8	0

R&C S.F. Form 173 (4/7)

TANK DATA

TANK NO.	31-D-110B
SIZE, DIA. X HEIGHT (INCH X FEET)	120X12
CAPACITY (42 GAL. BBLS)	210
ROOF TYPE	ELLIPTICAL
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	10"
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	2 x 6"
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	20"
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	2 @ 3/4"
HIGH & LOW PRESS. ALARMS	

GENERAL

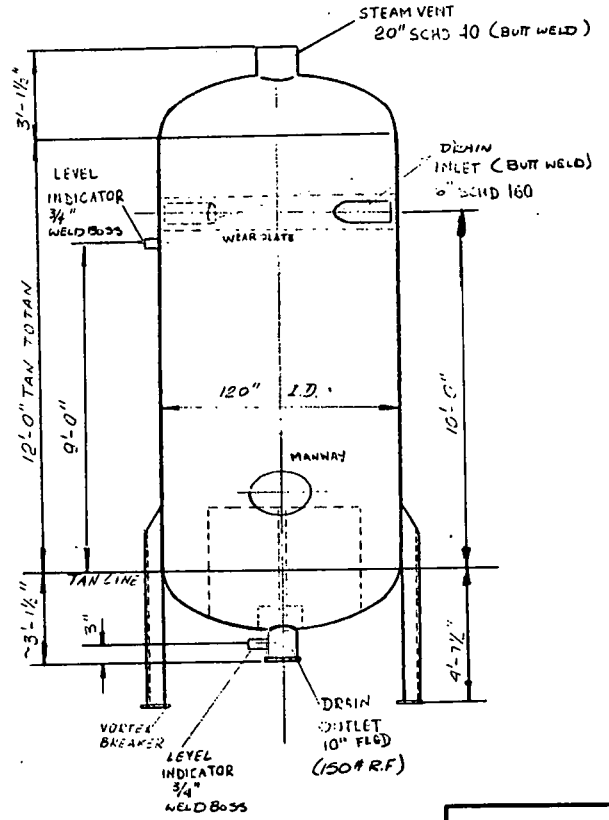
PAINTING	ANTICORR.
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE
DESIGN TEMP (MAX)	150F
FLANGES	150 RF

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	
CIRCUMFERENTIAL STAIRS	
PLATFORM	
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



ATMOSPHERIC BLOWOFF TANK
31-D-110A
31-D-110B

NO.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR.	CHKD	PROJ. ENGR.	APPD.
A	12/4/80	ISSUED FOR PHASE ZERO	YL					

SCALE NONE DESIGNED DRAWN CHECKED

BECHTEL
HOUSTON

BRECKINRIDGE PROJECT

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-9	0

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO. ASH DEWATERING BIN	31-D-111A&B
SIZE, DIA. X HEIGHT	25'x 29'
CAPACITY ~~(42 GAL. BBLS)~~	150 TONS ASH
ROOF TYPE	FLAT
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	2
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

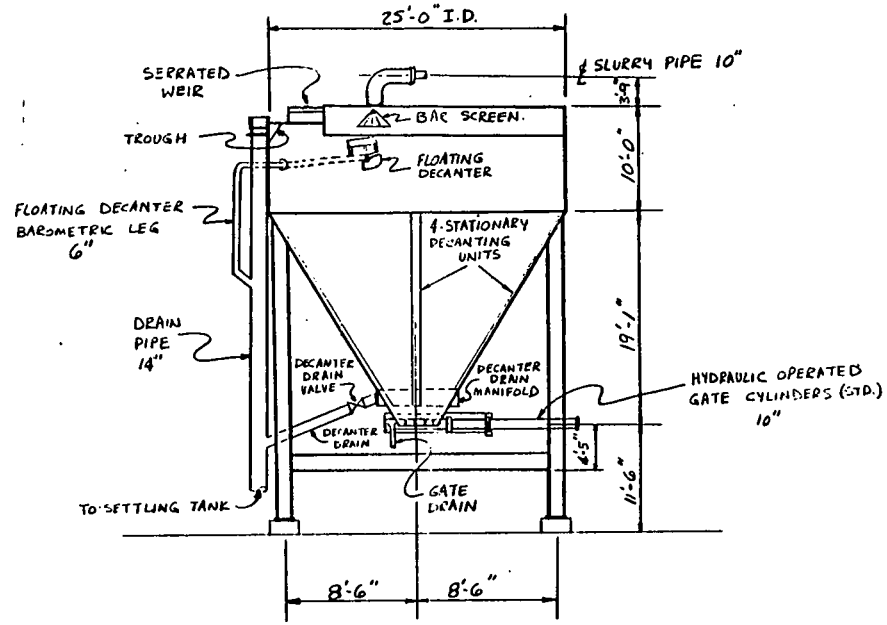
PAINTING	ZINC RICH EPOXY PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE: ALL PIPES STD. SCH. 40
FLANGES 150# F.F.
MAT'L C.S. R 3/8" THICK

ITEM NO. 31-D-111A&B
ASH DEWATERING BINS

| | | |

TANK DATA

TANK NO. ASH SETTLING TANK	31-D-112
SIZE, DIA. X HEIGHT	45'x 30'
CAPACITY	17,500 FT³
ROOF TYPE	OPEN
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

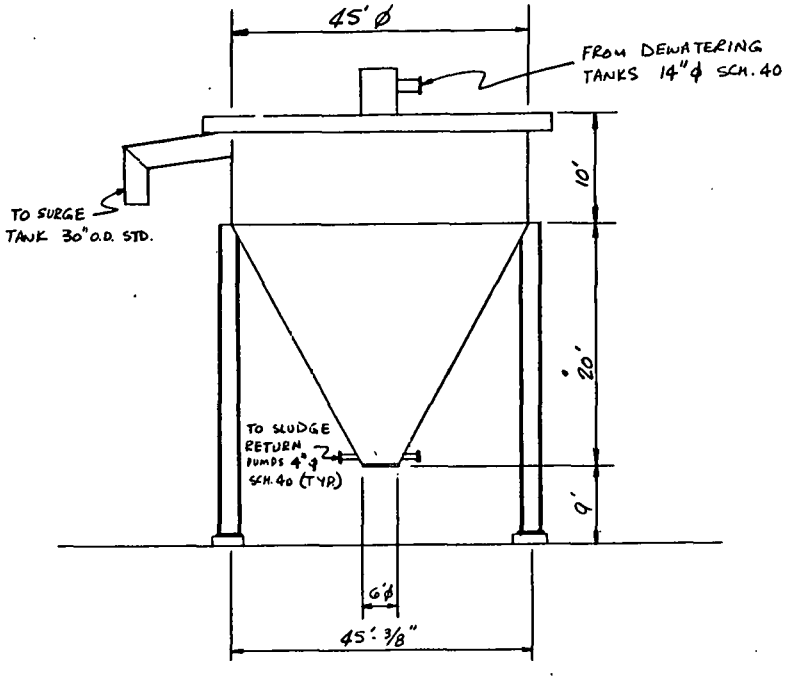
PAINTING	INC. RICH EPOXY PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



NOTE: FLANGES 150# F.F.
MAT'L C.S. PLATE 3/8" THICK

ITEM: 31-D-112
ASH SETTLING TANK

△											
△											
△											
△											
△	12/4/81	ISSUE FOR PHASE ZERO	AK	AA				4'	HWH		
No.	DATE	REVISIONS	BY	CHKD	RELEASED FOR DESIGN	RELEASED FOR CONST.	RELEASED FOR PROC.	APPD			
SCALE		RELEASED		DRAWN		CHKD					

BECHTEL

BRECKINRIDGE PROJECT
31- POWER PLANT

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-11	0

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO. ASH SURGE TANK	31-D-113
SIZE, DIA. X HEIGHT	50'x 33'
CAPACITY	36,650 FT³
ROOF TYPE	OPEN
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

SHELL APPURTENANCES

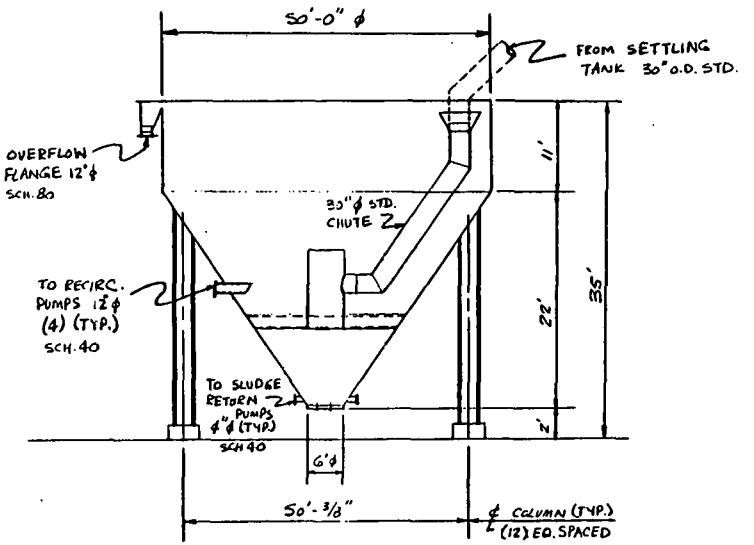
SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	

GENERAL

PAINTING	ZINC RICH 1 POLY PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE



SECTION VIEW

NOTE: FLANGES 150# R.F.
MAT'L C.S. @ 3/8" THICK

ITEM: 31-D-113

ASH SURGE TANK

△													
△													
△													
△													
△													
0	7/19/78	ISSUE FOR PHASE 2 FEED	AK	AK									
No.	DATE	REVISIONS	BY	CHK'D	APP'D								

BECHTEL

BRECKINRIDGE PROJECT
31-POWER PLANT

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-12	0

R&C S.F. Form 173 (4-77)

TANK DATA

TANK NO. ASH TRANSFER TANK	31-D-114 thru 117 (A & B)
SIZE, DIA. X HEIGHT	9' x 12'
CAPACITY	350 FT.^{3}
ROOF TYPE	
BOTTOM TYPE	
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	8
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

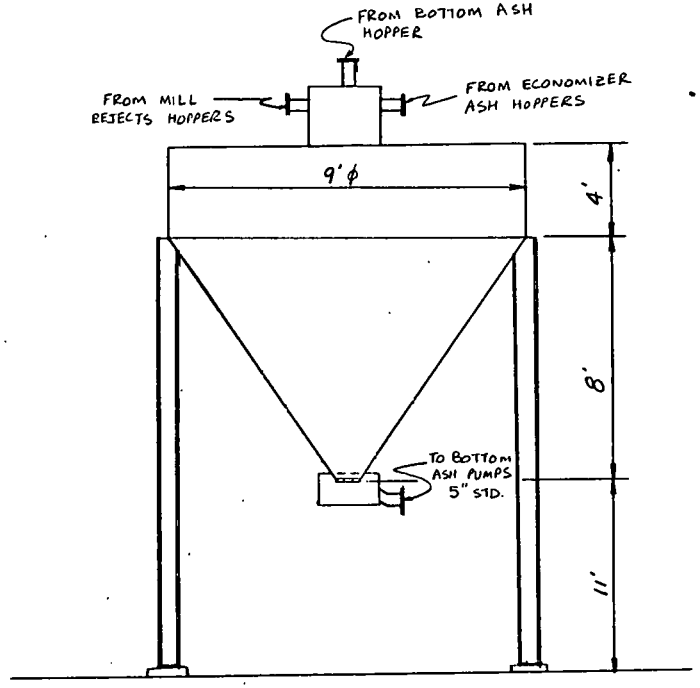
PAINTING	ZINC RICH EPOXY PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



NOTES: ALL FLANGES 150 # F.F.
MAT'L C.S. R 1/4" THICK

ITEM NO.: 31-D-114 A & B
115 A & B
116 A & B
117 A & B

ASH TRANSFER TANK

0	12/12/82	ISSUE FOR PHASE ZERO	AK	AA				VP	HNK
No.	DATE	REVISIONS	BY	CHKD	PROJ ENGR DATE	CHKD	PROJ ENGR DATE	APPD	

SCALE | DESIGNED | DRAWN

BECHTEL

BRECKINRIDGE PROJECT
31-POWER PLANT

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-D-13	0

R&C S.F. Form 173 (4/77)

TANK DATA

TANK NO. FLY ASH STORAGE SILO	31-D-118
SIZE, DIA. X HEIGHT	36'x 36'
CAPACITY	35,000 FT.³
ROOF TYPE	CONE HEAD
BOTTOM TYPE	FLAT
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	350 °F
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN ~~SPECIFIC GRAVITY~~ DENSITY	45 LB/FT³
TOTAL NET WORKING CAP. – ~~MBBLS~~ FT³	35,000
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLES	YES
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.,	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

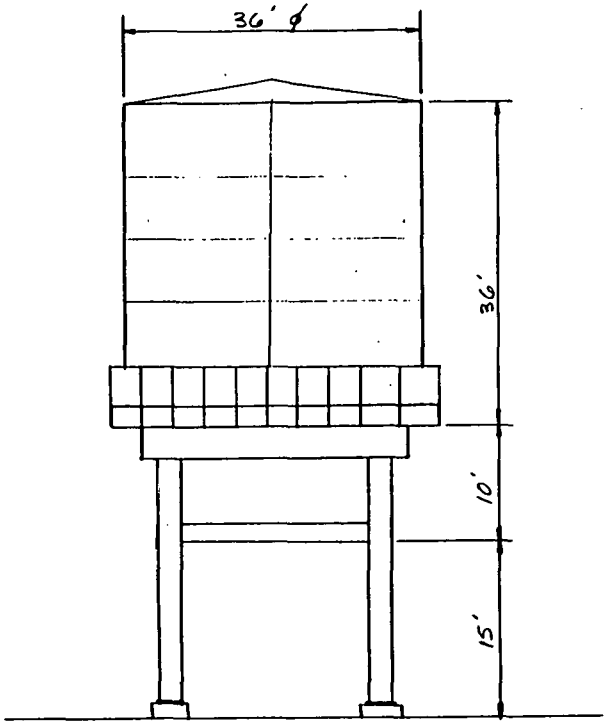
PAINTING	ZINC RICH EPOXY PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	CONCRETE

ROOF APPURTENANCES

VENT NOZZLE	YES
RIM VENTS	
MANHOLE – 20"	YES
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	
CIRCUMFERENTIAL STAIRS	
PLATFORMS	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	
VENT FILTERS	2
AIR SLIDES	YES



NOTES: FLANGES 150# F.F.
ALL PIPE SCH. 40
SILO MT'L - C.S. 3/8" R

ITEM NO: 31-D-118

FLY ASH STORAGE SILO

1	9/29/82	ADDED AIR SLIDE PER DOE COMMENT	AA	AA					
0	7/14/82	ISSUE FOR PHASE ZERO	AE	AA					HUK

BECHTEL

BRECKINRIDGE PROJECT
31-POWER PLANT

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-A-14	1

R&C S.F. Form 173 (4/77)

4.3 Data Sheets for Exchangers

31-DS-E-1: Cooling Water (31E-103 A, B)

31-DS-E-2: Suspect Condensate (31E-104 A, B, C)

31-DS-E-3: Suspect Condensate (31E-105 A, B, C)

31-DS-E-6: Circ. Cooling Water (31E-108 A, B, C)

SURFACE CONDENSER DATA SHEET

Customer	BRECKINRIDGE					
Project Location	KENTUCKY			Manufacturer		
Plant	# 31	Cond. No.	31-E-103A &	Req. No.		
Service Of Unit	COOLING WATER		31-E-103B	Item No.	31-E-103A & 103B	
Size		Horizontal		No. Required	2	
Surf (Eff/Gross)	25930 / 26090	ft²				

PERFORMANCE

Fluid Allocation		Shellside		Tubeside	
Fluid Circulated		Wet Steam			
Total Fluid Entering	lb/h	267500			
		Design	Normal	Design	Normal
Water	lb/h			11 x 10⁶	11 x 10⁶
Steam	lb/h, MW	267500	267500		
Steam Condensed	lb/h	267500	267500		
Density, Liq.	lb/ft³				
Viscosity, Liq. (Vap.)	cP				
Therm. Cond., Liq. (Vap.)	Btu/h-ft² °F				
Specific Heat, Liq. (Vap.)	Btu/lb °F				
Latent Heat, Vap.	Btu/lb				
Temperature In/Out	°F	120.6 / 120.6	120.6 / 120.6	90 / 112.9	85 / 107.9
Operating Press.	IN. Hga.	3.5	3.5		
No. Passes		One	One	TWO	TWO
Velocity Allow/Calc.	ft/sec	— / —	— / —	7.0 / 7.0	7.0 / 7.0
Press. Drop, Allow/Calc.	psi	/	/	/ 7.0	/ 7.0
Cleanliness Factor				85%	
Heat Exchanged	252 x10⁶	Btu/h,MTD			°F
Transfer Rate, Service		Clean			Btu/h-ft². °F

CONSTRUCTION

Tubes	Hotwell: lb
Main Condensing Sections:	Type: Capacity: 2800 GALLONS
No.: 6050 OD: 3/4 in. Thk: 18 BWG	Material:
Length, effective: ft. Overall: 44 ft	Thickness.
Material: 70-10 Cu-Ni Tube Pitch: in	Tube sheets
Gas Removal Sections: IN ABOVE	Number and size:
No.: OD: in. Thk.: BWG	Material: MUNTZ Thickness: in.
Length, effective: ft Overall: ft	
Material: Tube Pitch: in	Tube support plates
Impingement Sections: IN ABOVE	Number:
No.: OD. in. Thk: BWG	Material: C.S. Thickness: in.
Length, effective: ft Overall: ft	
Material: 90-10 Cu-Ni Tube Pitch: in	Steam inlet neck and exhaust connection
Tube – Tubesheet Joint: ROLLED	Material
Water boxes & Covers	Thickness: Number of sections:
Material (Water box): C.S. ASTM A-285 GRADE C	Connection to:shell – (flanged) or (welded) Turbine – (flanged) or (Welded):
Material (Covers):	Height – top of water box flange to turbine Exhaust Including
Divided or non-divided: DIVIDED	expansion joint (if any):
Design pressure: 80 psig Temperature 150 °F	Provision for vertical expansion (condenser hung);
Nozzles Number and Size – Inlet: Outlet: 2X6"	(spring supports)(expansion joint):
Shell:	Spring supports Type:
Material: C.S. ASTM A-285 GRADE C	Expansion joint Type:
Thickness: 3/8 in Number of sections: 1	Material:
Provision for tube expansion	Height: Ends – (Flanged) (Welded)
Number and size of venting connections: 1 X 4"	
Design pressure 15 psig Temperature 150 °F And Full Vacuum	PLANT 31

REV.		DATE		BY	CH	PE	CLIENT	JOB NO.	DRWG. NO.	REV.
	△									
	△	11/25/80	ISSUED FOR PHASE ZERO	AK	~~GK~~	U.K	MWH	14222	DS-E-1	0

FORM 908 (11/79)

SHEET 1 OF 2

SURFACE CONDENSER DATA SHEET (CONTINUED)

55	Steam Jet Air Ejector(s)	31-H-101A & 31-H-101B (ONE FOR EACH CONDENSER)				
56	Total number of Ejector Units:	TWO				
57	Size and type:		No. of elements:	ONE	No. of stages:	ONE
58		Surface Inter-and After-Condensers	NONE			
59	Operating Conditions and Performance					
60	Design capacity – 100 per cent –					
61	Suction pressure:	3.5	in. Hg. abs	Suction temperature:	120.6	°F
62	Dry air leakage:	25	SCFM corresponding to:			lb per h
63	Non-condensible gases other than air leakage:	AMMONIA				lb per h
64	Associated saturated water vapor:		lb per h	Total gas-vapor mixture:		lb per h
65	Design capacity each element:	25 SCFM.				per cent
66	Number of elements operating for 100% capacity:	ONE				
67	Curve(s) of approximate capacity vs. suction pressure:					
68	Steam conditions –					
69	Maximum initial pressure:	150	psig	Total temp:	366	°F
70	Minimum operating pressure (at nozzles):	30	psig	Total temp:	366	°F
71	Steam Consumption (100 per cent design capacity):				1000 (EJECTOR)	lb per h
72	Inter/After Condenser Data					
73	Surface sq ft:	Inter-Condenser		After-Condenser		
74	Heat Exchanged Btu/h	Inter-Condenser		After-Condenser		
75	Tubes. No:	OD	in Thk	BWG:	Length (Effective-overall) ft	
76	Tube-Tubesheet Joint:					
77	Cooling Water (condensate) (raw water):					
78	Minimum flow required at:		per cent design capacity:			lb/h
79	Maximum design flow:		lb/h			
80	Pressure drop allowable/calculated		psig			
81	Shell/Water boxes – Design pressure	/	psig	Design Temperature	/	°F
82	Materials:					
83	Suction chambers:			Condenser shells:		
84	Diffusers:			Water chambers:		
85	Steam nozzles:			Tube sheets:		
86	Steam chests (nozzle heads):			Tubes:		
87	Fittings and Accessories included					
88	Air leakage meter:					
89	Other:					
90	Hogging Ejectors	NONE				
91	(Steam) ~~(Air) (Water)~~ Operated.	Number per condenser		Size		
92	Operating Conditions and Performance					
93	Capacity:	lb per h	dry air at		in. Hg abs	Suction Pressure
94	Steam consumption:	lb per h	at		psig	°F
95	Maximum design steam conditions:				psig	°F
96	Consumption: Air	SCFM at	psig	Water	lb/hr at	psig
97						
98	Fittings and accessories included:					
99	Priming Ejector(s)	NONE				
100	(Steam) (Air) (Water) Operated.			Size		
101	Operating Conditions and Performance					
102	Capacity:	lb per h	dry air at		in. Hg abs	Suction Pressure
103	Steam consumption:	lb per h	at		psig	°F
104	Maximum design steam conditions:				psig	°F
105	Consumption: Air	SCFM at	psig	Water	lb/h at	psig
106						
107	Approximate weight:					
108	Condenser Dry	lb.	Ejectors: Priming			
109	Flooded	lb.	Hogging			lb.
110			Air			lb.
111						

DATA SHEET 31-0-E-1 REV. C SHEET 2 OF 2

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION	BRECKINRIDGE, KENTUCKY		EXCHANGER MANUFACTURER	
2	PLANT	31 - POWER PLANT	EXCH. NO.	31-E-104 A THRU C	REQ. NO.
3	SERVICE OF UNIT	SUSPECT CONDENSATE			ITEM NO.
4	SIZE	27" x 21'-6"	TYPE	HORIZ. (HORIZ)	CONNECTED IN / SERIES / ✓ PARALLEL
5	SURF./UNIT (EFF/GROSS)	976 / 1002	SHELLS/UNIT	1	SURF/SHELL (EFF/GROSS)
6	PERFORMANCE OF ONE UNIT				

	FLUID ALLOCATION	SHELLSIDE		TUBESIDE	
8	FLUID CIRCULATED	SUSPECT CONDENSATE		FILTERED CONDENSATE	
9	TOTAL FLUID ENTERING LB/HR	1647600		769945	
10		IN	OUT	IN	OUT
11	LIQUID				
12	VAPOR LB/HR, MW				
13	NONCOND LB/HR, MW				
14	STEAM				
15	WATER LB/HR	1647600	1647600	769945	769945
16	FLUID VAPORIZED/CONDENSED				
17	GRAVITY, LIQ.	1.00	1.00	1.00	1.00
18	VISCOSITY, LIQ. LB/FT-HR	0.362	0.682	0.871	0.678
19	THERM. COND., LIQ. BTU/HR-FT-°F	0.388	0.395	0.362	0.395
20	SPECIFIC HEAT, LIQ. BTU/LB-°F	1.060	1.006	1.00	1.004
21					
22	TEMPERATURE °F	366.0	216.5	181.0	213.8
23	OPERATING PRESS. (PSIA) (PSIG)	153	143	90	80
24	NO. PASSES/SHELL	2		2	
25	VELOCITY FT/SEC			6.91	
26	PRESS. DROP, ALLOW/CALC. PSI	10 / 12		10 / 5	
27	FOULING RESISTANCE	0.001		0.0005	
28	HEAT EXCHANGED 2.46 X 10⁷	BTU/HR; MTD (CORR) (WTD)		80.16	°F
29	TRANSFER RATE, SERVICE 325	CLEAN 635			BTU/HR. SQ. FT. °F
30	CONSTRUCTION				

			SHELLSIDE	TUBESIDE
31				
32	DESIGN/TEST PRESS. PSIG		200 / 300	150 / 225
33	DESIGN TEMPERATURE °F		370	370
34	CORROSION ALLOWANCE IN		0.125	0.125
35	CONNECTIONS	INLET	4"	8"
36	SIZE	OUTLET	4"	8"
37	RATING		150 # RF	150 # RF

38	TUBES NO. 1160	OD 1 1/4"	THK (MIN/AVG) 14 BWG	LENGTH 19.2'	PITCH 1 9/16"	FLOW → ◁ △ ◇ □				
39	TUBE MATERIAL 90-10 Cu-Ni			TUBE-TUBESHEET JOINT ROLLED						
40	SHELL C.S.	ID 27" OD		SHELL COVER					(INTEG.) (REMOV)	
41	CHANNEL/BONNET			CHANNEL COVER						
42	TUBESHEET-STATIONARY			TUBESHEET FLOATING						
43	FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)						
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)		SPACING				
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS						
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT						
47	GASKETS									
48	CODE REQUIREMENTS ASME VIII	STAMP (YES) (NO)		TEMA CLASS		SPECS				
49	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER						
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED									
51										
52										
53										
54										

PLANT-31

REV.		DATE		BY	CHK	PE	CLIENT	JOB NO.	DRWG. NO.	REV.
	△									
	△									
	△	1/9/81	ISSUE FOR PHASE ZERO	YL	CHK	LHP	HMM	14222	DS-E-2	0

BECHTEL

R&C SFE FORM 138 (8/76)

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION	BRECKINRIDGE, KENTUCKY			EXCHANGER MANUFACTURER		
2	PLANT	31 - POWER PLANT	EXCH. NO.	31-E-105 A THRU C	REQ. NO.		
3	SERVICE OF UNIT	SUSPECT CONDENSATE			ITEM NO.		
4	SIZE	29" x 22'-6"	TYPE	HORIZ.	(HORIZ/~~VERT~~) CONNECTED IN		SERIES ✓PARALLEL
5	SURF./UNIT (EFF/GROSS)	1205 / 1236	SHELLS/UNIT	1	SURF/SHELL (EFF/GROSS)		
6			PERFORMANCE OF ONE UNIT				
7	FLUID ALLOCATION		SHELLSIDE		TUBESIDE		
8	FLUID CIRCULATED		SUSPECT CONDENSATE		FILTERED CONDENSATE		
9	TOTAL FLUID ENTERING	LB/HR	413614		769945		
10			IN	OUT	IN	OUT	
11	LIQUID		—	—	—	—	
12	VAPOR	LB/HR, MW	—	—	—	—	
13	NONCOND	LB/HR, MW	—	—	—	—	
14	STEAM		—	—	—	—	
15	WATER	LB/HR	413614	413614	769945	769945	
16	FLUID VAPORIZED/CONDENSED		—	—	—	—	
17	GRAVITY, LIQ.		1.00	1.00	1.00	1.00	
18	VISCOSITY, LIQ.	LB/FT-HR	0.581	0.724	1.041	0.871	
19	THERM. COND., LIQ.	BTU/HR-FT-°F	0.396	0.394	0.364	0.362	
20	SPECIFIC HEAT, LIQ.	BTU/LB-°F	1.01	1.00	1.00	1.00	
21							
22	TEMPERATURE	°F	256.3	202.0	150.4	181.0	
23	OPERATING PRESS.	(PSIA) (PSIG)	53	43	105	95	
24	NO. PASSES/SHELL		2		2		
25	VELOCITY	FT/SEC			5.82		
26	PRESS. DROP, ALLOW/CALC.	PSI	10 / 8.8		10 / 4.0		
27	FOULING RESISTANCE		0.001		0.0005		
28	HEAT EXCHANGED	2.25 X10⁷	BTU/HR; MTD/(CORR)/(WTD)		62.7		°F
29	TRANSFER RATE, SERVICE	311	CLEAN		582		BTU/HR. SQ. FT. °F
30			CONSTRUCTION				
31			SHELLSIDE	TUBESIDE			
32	DESIGN/TEST PRESS.	PSIG	100 / 150	150 / 225			
33	DESIGN TEMPERATURE	°F	300	300			
34	CORROSION ALLOWANCE	IN	0.125	0.125			
35	CONNECTIONS	INLET	6"	8"			
36	SIZE	OUTLET	6"	8"			
37	RATING		150 # F.F.	150 # F.F.			
38	TUBES NO. 188	OD 1 1/4"	THK (MIN/AVG) 14 BWG	LENGTH 20.1'	PITCH 1 9/16"	FLOW — ◁ △ ◇ □	
39	TUBE MATERIAL	90-10 Cu-Ni		TUBE-TUBESHEET JOINT	ROLLED		
40	SHELL C.S	ID 29" OD		SHELL COVER			(INTEG.) (REMOV)
41	CHANNEL/BONNET			CHANNEL COVER			
42	TUBESHEET-STATIONARY			TUBESHEET FLOATING			
43	FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING		
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS			
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT			
47	GASKETS						
48	CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS	SPECS		
49	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER			
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED						
51							
52							
53							
54							PLANT 31

BECHTEL	REV.	DATE		BY	CHK	PE	FLEET	JOB NO.	DRWG. NO.	REV.
	△							14222	OS-E-3	0
	△									
	△	1/7/81	ISSUE FOR PHASE ZERO	YL	~~GK~~	~~LHP~~	~~HHH~~			

R&C SPE FORM 158 (8/76)

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION	BRECKINRIDGE, KENTUCKY		EXCHANGER MANUFACTURER	
2	PLANT	#31	EXCH. NO. 31-E-108A	REQ. NO.	
3	SERVICE OF UNIT	CIRC. COOLING WATER	THRU 31-E-108C	ITEM NO.	
4	SIZE	25 IN. X 39 FT. 4 IN. TYPE HORIZ.	(HORIZ/VERT) CONNECTED IN	SERIES	✓ PARALLEL
5	SURF./UNIT (EFF/GROSS)	3492 / 3534	SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS)	
6		PERFORMANCE OF ONE UNIT			

	FLUID ALLOCATION	SHELLSIDE		TUBESIDE	
7		IN	OUT	IN	OUT
8	FLUID CIRCULATED	DEMINERALIZED WATER W/ CORR. INHI.		COOLING WATER	
9	TOTAL FLUID ENTERING LB/HR	650,000		1,030,000	
10		IN	OUT	IN	OUT
11	LIQUID	—	—	—	—
12	VAPOR LB/HR, MW	—	—	—	—
13	NONCOND LB/HR, MW	—	—	—	—
14	STEAM	—	—	—	—
15	WATER LB/HR	650,000	650,000	1,030,000	1,030,000
16	FLUID VAPORIZED/CONDENSED	—	—	—	—
17	GRAVITY, LIQ.	1.0	1.0	1.0	1.0
18	VISCOSITY, LIQ. LB/FT-HR	1.49	1.75	1.85	1.63
19	THERM. COND., LIQ. BTU/HR-FT-°F	0.368	0.362	0.360	0.364
20	SPECIFIC HEAT, LIQ. BTU/LB-°F	0.998	0.997	0.997	0.998
21					
22	TEMPERATURE °F	110	95	90	99.5
23	OPERATING PRESS. (PSIA) (PSIG)	80		50	
24	NO. PASSES/SHELL	1		1	
25	VELOCITY FT/SEC			7.0	
26	PRESS. DROP, ALLOW/CALC. PSI	10.0 / 9.0		10.0 / 10.0	
27	FOULING RESISTANCE	0.0005		0.001	
28	HEAT EXCHANGED 9.75 x 10⁶	BTU/HR; MTD (CORR.) (WTD)		7.4	°F
29	TRANSFER RATE, SERVICE 350	CLEAN 628			BTU/HR. SQ. FT. °F
30		CONSTRUCTION			

			SHELLSIDE	TUBESIDE
31				
32	DESIGN/TEST PRESS.	PSIG	100 / 150	80 / 120
33	DESIGN TEMPERATURE	°F	150	150
34	CORROSION ALLOWANCE	IN	0.125	0.125
35	CONNECTIONS	INLET	8	10
36	SIZE	OUTLET	8	10
37	RATING		150# F.F.	150# F.F.

38	TUBES NO. 750	OD 1/2 IN.	THK (MIN/AVG) 18 BWG	LENGTH 36 FT.	PITCH 5/8 IN.	FLOW → ◁ △ ◇ □			
39	TUBE MATERIAL 90-10 Cu-Ni			TUBE-TUBESHEET JOINT ROLLED					
40	SHELL C.S.	ID 25 IN. OD		SHELL COVER				(INTEG.) (REMOV)	
41	CHANNEL/BONNET			CHANNEL COVER					
42	TUBESHEET-STATIONARY			TUBESHEET FLOATING					
43	FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)					
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING				
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS					
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT					
47	GASKETS								
48	CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS	SPECS				
49	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER					
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED								
51									
52									
53									
54									PLANT 31

REV.		DATE		BY	CH	PE	CLIENT	JOB NO.	DRWG. NO.	REV.
	△							14222	DS-E-6	0
	△	11/25/80	ISSUE FOR PHASE ZERO	ASK	GS	WP	HNH			

BECHTEL

R&C SPE FORM 158 (6/76)

4.4 Data Sheets for Fired Heaters

31-DS-F-01: 600 psig Steam/Superheater (31F-104 A, B)

31-SP-A-01: Duty Specification for Boilers

FIRED HEATER DATA SHEET

Customer	ASHLAND SYNTHETIC FUELS INC.	Manufacturer	
Location	KENTUCKY	Equip. No	31-F-104 A.B
Unit	BRECKINRIDGE	Req. No.	2
Number Required	TWO	Item No.	
Total Heat Absorbed mm Btu/h	25.6 EA	Type of Heater	GAS

HEATER PERFORMANCE

Heater Section				
Service				
Fluid Name		STEAM		
Heat Absorption	mm Btu/h	25.6		
Flow Rate	lb/h	157250		
Pressure Drop (Allowable - Clean/Fouled)	psi	15		
Pressure Drop (Calculated - Clean/Fouled)	psi			
Coking Allowance	in			
Average Radiant Flux Density (Allowable)	Btu/h-sq ft			
Average Radiant Flux Density (Calculated)	Btu/h-sq ft			
Maximum Radiant Flux Density	Btu/h-sq ft	10,000		
Average Convection Flux Density	Btu/h-sq ft			
Velocity Limitation	ft/sec			
Maximum Allowable Inside Film Temperature	°F			
Fouling Resistance Inside	h-ft²-°F/Btu			
Inlet Conditions:				
Temperature	°F	489		
Pressure	(psig)	615		
Liquid Flow	lb/h	0.0		
Vapor Flow	lb/h	157250		
Density, Liquid (Vapor) At P&T	lb/cu ft			
Gravity, Liquid	Sp Gr at 60 °F			
Vapor	mol wt	18		
Viscosity, Liquid (Vapor)	cP			
Specific Heat, Liquid (Vapor)	Btu/lb-°F			
Conductivity, Liquid (Vapor)	Btu-ft/h-ft²-°F			
Outlet Conditions:				
Temperature	°F	700		
Pressure	(psig)	600		
Liquid Flow	lb/h	0.0		
Vapor Flow	lb/h	157250		
Density, Liquid (Vapor) At P&T	lb/cu ft	0.95		
Gravity, Liquid	(Sp Gr at 60°F)			
Vapor	mol wt	18		
Viscosity, Liquid (Vapor)	cP			
Specific Heat, Liquid (Vapor)	Btu/lb-°F			
Conductivity, Liquid (Vapor)	Btu-ft/h-ft²-°F			

Remarks and Special Requirements:

Data sheet reference for vaporization curve. _____

REV.							JOB NO. 14888	
							DATA SHEET	REV.
							31-DS-F-01	0
3	1/9/91	ISSUED FOR PHASE 2	HP			HNF		

Form 378A (11/79)

COMBUSTION AND FUEL DATA

51.	Type of Fuel	REFINERY GAS / MEDIUM BTU GAS		
52.	Excess Air %			
53.	Calculated Heat Release mm Btu/h(LHV)			
54.	Calculated Efficiency, Percent (LHV)			
55.	Guaranteed Efficiency, Percent (LHV) See Note			
56.	Radiation Loss, Percent of Heat Release (LHV)			
57.	Flue Gas Temp. Leaving Radiant Section °F			
58.	Flue Gas Temp. Leaving Convection Section °F			
59.	Flue Gas Temp. (Uncorr) Leaving Air Heater °F			
60.	Flue Gas Mass Velocity-Conv. Section lb/sq ft-sec			
61.	Volumetric Heat Release Btu/h-cu ft			
62.	Altitude Above Sea Level ft			
63.	Air Temperature, Combustion °F			
64.	Air Temperature, Draft °F			
65.	Minimum Furnace Draft/Location in H_2O			
66.	Draft at Burners in H_2O			
67.	Note: A Fuel Savings of _____ mm Btu/h Fuel Value $_____ / mm Btu			
68.	Will Offset a $1000 increase in			
69.	Furnace Cost (Erected)			

Fuel Characteristics

70.				
71.	Heating Value HHV	1000-1600 / 250-350 BTU/SCF		
72.	Heating Value LLV			
73.	Specific Gravity			
74.	Molecular Weight			
75.	Viscosity, At _____ °F SSU			
76.	Viscosity, At _____ °F SSU			
77.	Fuel Pressure Available at Burner psig			
78.	Atomizing Steam Pressure psig			
79.	Composition:			
80.	Vanadium ppm			
81.	Sodium ppm			
82.	Salt Content ppm			
83.	Ash % wt			
84.	Sulfur % wt	-0-		
85.	Hydrogen % wt			
86.	Carbon % wt			
87.	Nitrogen % wt/% vol			
88.	Oxygen % wt			
89.	CH_4 % vol			
90.	C_2H_4 % vol			
91.	C_2H_6 % vol			
92.	C_3H_8 % vol			
93.	H_2S % vol			
94.	H_2O % vol			
95.				
96.				
97.				
98.				
99.				
100.				
101.				
102.				
103.				

MECHANICAL DESIGN
COIL DATA

General:

Plot Limitations _____ Minimum Stack Height _____

Tube Length Limitations _____

Coil:

Coil Design:

Heater Section				
Design Basis for Wall Thickness				
Design Life				
Design Pressure	psig	750		
Corrosion Allowance, Tubes	in	1/8		
Weld Stress Relieve				
Weld Inspection Requirements X-ray or Others				
Maximum Wall Temperature (Calculated-Clean)	°F			
Maximum Wall Temperature (Design-Fouled)	°F			
Inside Film Coefficient	Btu/h—°F sq ft			
Overall Heat Transfer Coefficient	Btu/h—°F sq ft			
Corrected Mean Temperature Difference	°F			
Bare Tubes, Total Exposed Surface	sq ft			
Extended Surface Tubes, Total Exposed Surface	sq ft			

Coil Configuration:

Tubes, Vertical or Horizontal				
Number of Flow Passes/Tubes Per Pass				
Effective Tube Length	ft			
Bare Tubes, Number				
Extended Surface Tubes, Number				
Tube Spacing, Center to Center (Staggered) (In Line)	in			
Tube Center to Furnace Wall	in			

Tubes:

Material (ASTM Specification and Grade)		C.S.		
Outside Diameter	in			
Wall Thickness (Minimum) (Average)	in			
Overall Tube Length	ft - in			

Description of Extended Surface:

Type				
Fin or Stud Material				
Fin or Stud Material				
Fin or Stud Dimensions	in			
Fin or Stud Dimensions	in			
Fin or Stud Spacing	per in			
Fin or Stud Spacing	per in			
Maximum Fin or Stud Temperature	°F			
Maximum Fin or Stud Temperature	°F			

Plug-Type Headers:

Location				
Manufacturer and Type				
Nominal Rating				
Welded or Rolled Joint				

MECHANICAL DESIGN
(COIL DATA)

161.	Return Bends:				
162.	Location				
163.	Material (ASTM Specification and Grade)				
164.	Wall Thickness or Schedule				
165.	Crossovers:				
166.	Location (Internal) (External)				
167.	Pipe Material (ASTM Specification and Grade)				
168.	Wall Thickness (Minimum) (Average) in				
169.	Flange Material (ASTM Specification and Grade)				
170.	Flange Size and Rating				
171.	Terminals or Manifolds:				
172.	Location				
173.	(Welded) (Flanged)				
174.	Wall Thickness (Minimum) (Average) in				
175.	Flange Material (ASTM Specification and Grade)				
176.	Flange Size and Rating				
177.	Tube Supports:				
178.	Location (End) (Top) (Bottom)				
179.	Material (ASTM Specification and Grade)				
180.	Web Thickness in				
181.	Insulation, Type and Thickness				
182.	Anchor Type and Material				
183.	Immediate Tube Supports:				
184.	Material (ASTM Specification and Grade)				
185.	Spacing ft				
186.	Coating, Type and Thickness				
187.	Tube Guides:				
188.	Location (Top) (Bottom) (Intermediate)				
189.	Material (ASTM Specification and Grade)				
190.	Coil Terminal Movements and Forces:				
191.	Nozzle Movement in				
192.	Direction				
193.	External Nozzle Load lb				
194.	Direction				
195.	Pipe Load Supported by Heater				
196.	Special Support Brackets Required				
197.	Notes				
198.					
199.					
200.					
201.					
202.					
203.					
204.					
205.					
206.					
207.					
208.					
209.					

MECHANICAL DESIGN
CONSTRUCTION DATA

Settings:
Floor:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Casing: Thickness _____ Material _____ Temperature _____ °F

Exposed Vertical Walls:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Shielded Vertical Walls:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Arch:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Convection Sidewalls:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Breeching:
Refractory: Thickness _____ Hot Face Temp: Calculated _____ °F Design _____ °F
Construction _____
_____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Bridgewall:
Thickness _____ Height _____ Material _____

Notes: _____

MECHANICAL DESIGN
CONSTRUCTION DATA

Flue Gas Duct:
Refractory: Thickness _____ Material _____ Hot Face Temp. Design _____ °F
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Combustion Air Duct:
Lining: Thickness _____ Material _____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____ Temperature _____ °F

Header Boxes:
Location _____ Doors, Bolted-Hinged _____
Refractory: Thickness _____ Material _____
Anchor Type and Material _____
Casing and Door: Thickness _____ Material _____

Plenum Chamber:
Location _____
Lining: Thickness _____ Material _____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Casing: Thickness _____ Material _____

Stack:
Location _____ Number _____
Lining: Thickness _____ Material _____
Extent of Lining _____
Anchor Type and Material _____
Method of Attaching Anchor to Casing _____
Plate: Thickness _____ Material _____ Corrosion Allow. _____
Outside Metal Diameter _____ Stack Length _____ ft Height Above Grade _____ ft

Dampers:
Location _____
Material: Blade _____ Shaft _____
Multiple or Single Leaf _____
Description of Provision for Operation From Grade _____

Notes _____

MECHANICAL DESIGN
CONSTRUCTION DATA

309. Miscellaneous:

310. Platforms:
311. Type of Flooring _____
312. Radiant Section, Width and Location _____
313. _____
314. Convection Section, Width and Location _____
315. _____
316. _____
317. Stairs, Width and Location _____
318. Ladders, Location _____
319. _____
320. Doors:
321. Radiant, Access, Size and Location _____
322. Convection/Stack, Access, Size and Location _____
323. Observation, Size and Location _____
324. Tube Removal, Size and Location _____
325. Explosion, Size and Location _____

	Number	Size
326. Instrument Connections:		
327. Draft		
328. Temperature		
329. Flue Gas Sample		
330. Smothering Steam		
331. Drains		

332. Painting and Galvanizing Requirements _____
333. _____
334. _____
335. Auxiliary Equipment:
336. Burners:
337. Manufacturer and Type _____ Quantity _____
338. Design and Size _____ Location and Orientation _____
339. Heat Release mm Btu/h Per Burner at Design Excess Air and Draft:
340. Minimum _____ Normal _____ Maximum _____
341. Design Draft Loss Across Burners, in H_2O _____
342. Burner Pilot:
343. Heat Release (Capacity), mBtu/h _____ Fuel _____
344. Type of Ignition _____
345. Special Requirements (Flame Detection Devices) Etc. _____
346. _____
347. Sootblowers

348. Number			
349. Type			
350. Spacing and Arrangement			
351. (Drawing Reference)			
352. Orientation			
353. Blowing Medium			
354. Blowing Medium Conditions			
355. Materials of Construction			
356. Type Driver			
357. Control System Type			

358. _____
359. _____
360. _____
361. _____
362. _____

MECHANICAL DESIGN
CONSTRUCTION DATA

364. Painters Trolley and Rail Included _____
365. Extent of Tube Handling Facilities _____
366. Thermocouples, Number and Location _____
367. _____
368. Thermowells, Number and Location _____
369. _____

370. Air Heater

		Air Side Conditions	Flue Gas-Heating Fluid Side Conditions
371.	Duty ..... mmBtu/h		
372.	Quantity ..... lb/h		
373.	Entering		
374.	Leaving		
375.	Temperature		
376.	Entering ..... °F		
377.	Leaving ..... °F		
378.	Pressure Drop		
379.	Allowable ..... In H_2O		
380.	Calculated ..... In H_2O		

381. Sootblower _____
382. Water Wash Facilities _____

383. Materials of Construction _____
384. _____
385. Cold Air Bypass Description _____
386. _____

387. Fans:

		F. D.	I. D.
388.	Quantity ..... lb/h		
389.	Temperature ..... °F		
390.	Static Pressure ..... in		
391.	RPM		
392.	BHP		
393.	Type		
394.	Arrangement		
395.	Damper Control		

396. Drives:
397. Electric Motor

398.	Installed HP		
399.	Voltage		
400.	RPM		

401. Turbine

402.	Installed HP		
403.	Normal HP		
404.	Water Rate ..... lb/BHP		
405.	Steam Condition		
406.	Inlet		
407.	Outlet		

408. Damper Actuators _____
409. Type-Size _____

DUTY SPECIFICATION FOR BOILERS

The plant will utilize four non-reheat boilers with the following waterside conditions:

	MCR	Normal
Main Steam Flow-PPH/Boiler	400,000	300,000
Main Steam Temperature-F	755	755
Main Steam Pressure-PSIG	930	930
Final Feedwater Temperature	295	295

Peak capacity shall be 440,000 PPH/Boiler.

As shown in the above design, main steam temperature of 755F must be maintained at and above 300,000 PPH/Boiler. The flue gas temperature leaving the air preheater shall be 320F.

The boilers will burn the following combinations of fuels:

Fuel 1	Sulfur Plant Tail Gas and Middlings
Fuel 2	Sulfur Plant Tail Gas and Coal
Fuel 3	Middlings only
Fuel 4	Coal only

Fuel analyses are shown attached in Table I and Table II. Ignition will be by natural gas (1,000 BTU/SCF).

Ash characteristics for the coal are presented in Table III. The coal blend will be 50% Illinois No. 6, 35% Kentucky No. 9, and 15% Kentucky No. 11.

Budget pricing for the boilers includes the following accessories:

a. Pressure parts and piping within the boiler and termination at boiler superheater outlet.

b. Structural steel for the boiler including hanger rods and miscellaneous framing steel integral with boiler.

c. Necessary boiler refractories, inner casing, buckstays (complete with all necessary tube ties and fastenings), roof, and outer casing of the boiler settings.

d. Necessary insulation, casing and lagging material for outdoor installation.

e. Stairs, platforms and walkways.

f. Economizer section for feedwater.

g. Burners and burner safety controls.

h. Boiler safety valves.

i. Steam soot blowers.

j. Feeders.

k. All flue gas and air ductwork including bracing, dampers, supports and expansion joints up to rear boiler column.

l. Pulverizers and electric motor drives.

m. FD fan(s) with drive motor(s).

n. ID fan(s) with drive motor(s).

o. PA fan(s) with drive motor(s).

p. Regenerative air heater(s).

q. Steam air heater(s).

r. Furnace safeguard supervisory system (FSSS).

s. Price change, if any, for supplying mechanical drive turbines in lieu of motor drives for the fans and pulverizers.

TABLE I

BOILER FEED CHARACTERISTICS

	MIDDLINGS		RAW COAL BLEND	
PROXIMATE ANALYSIS	AS RECEIVED, %	DRY BASIS, %	AS RECEIVED, %	DRY BASIS,%
Volative Matter	34.7	39.9	34.5	40.2
Fixed Carbon	34.9	40.1	34.7	40.3
Ash	17.4	20.0 (Max.)	16.8	19.5
Total Moisture	13.0	--	14.0	--
TOTAL	100.0	100.0	100.0	100.0
ULTIMATE ANALYSIS	AS RECEIVED, %	DRY BASIS, %	AS RECEIVED, %	DRY BASIS,%
Carbon	52.62	60.49	56.32	65.50
Hydrogen	3.75	4.31	4.02	4.67
Nitrogen	1.02	1.17	1.08	1.26
Oxygen	6.90	7.93	7.39	8.59
Sulfur	5.22	6.00 (Max.)	2.66	3.09
Chloride	0.09	0.10	0.08	0.09
Ash	17.40	20.00(Max.)	14.45	16.80
Moisture	13.00	--	14.00	--
TOTAL	100.00	100.00	100.00	100.00
HHV, BTU/LB		11,200.00		11,700.00

SIZE FRACTIONS, %	MIDDLINGS	RAW COAL
3" x 3/8"	53	3" x 0"
3/8" x 28 M	47	
28 M x 0	--	
TOTAL	100	
Hardgrove Index	45-50 (assumed)	55 (assumed)

FORM 293

TABLE II

SULFUR PLANT TAIL GAS DATA*

COMPONENT	MOLS/HR	LB/HR
H_2O (Vapor)	1,001.53	18,044
CO_2	1,591.50	70,042
N_2	2,177.45	60,997
CO	24.44	629
H_2S	42.35	1,443
SO_2	21.18	1,357
COS	11.48	690
CS_2	2.65	202
H_2	28.05	57
S (as S liquid)	1.81	58
TOTAL	4,900.44	153,519

Temperature: 320°F

Pressure (at Boiler Battery Limits): 1 PSIG

HHV: 10.2 BTU/SCF

*Preliminary Estimate.

TABLE III

ASH ANALYSIS AND ASH FUSION DATA

SLAG ASH ANALYSIS (1)	WT% ILLINOIS #6 (2)	WT% KENTUCKY #9	WT% KENTUCKY #11
P_2O_5	0.2	0.10	0.17
SiO_2	45.1	47.96	40.30
Fe_2O_3	17.6	25.59	28.31
Al_2O_3	19.9	17.51	17.14
TiO_2	1.1	0.89	0.97
CaO	4.0	1.00	1.33
MgO	0.9	0.95	0.60
SO_3	5.6	0.71	0.36
K_2O	1.4	2.19	2.22
Na_2O	1.1	1.60	0.52
Undertermined	3.1	1.50	8.08
TOTAL	100.1	100.00	100.00

TYPICAL ASH FUSION DATA FOR ILLINOIS #6 (AT REDUCING ATMOSPHERE) (3)

1)	Initial Deformation Temperature, °F.	1,971
2)	Softening Temperature, °F.	2,030
3)	Hemispherical Temperature, °F.	2,149
4)	Fluid Temperature, °F.	2,255

(1) Analyses from EPRI Report AF-1122 & 6/4/79 Memo to C.D. Hoertz, et al; from H.N. Hicks "Washability Data for TVA's Paradise Preparation Plant".

(2) Average of Two Analyses.

(3) From EPRI Report AF-233, Table II.

FORM 293

4.5 Data Sheets for Pumps and Drivers

31-DS-G-1: Treated Boiler Feedwater Pump (31G-101 A, B, C)

31-DS-G-2: Demineralizer Feed Pumps (31G-102 A, B, C)

31-DS-G-3: Deaerator Feed Pumps (31G-103 A, B, C)

31-DS-GT-1: Deaerator Feed Pump (31GT-103)

31-DS-G-4: 900 psig System Boiler Feedwater Pumps (31G-104 A, B, C, D)

31-DS-GT-2: 900 psig System Boiler Feed Pumps (31GT-104 A, B)

31-DS-G-5: Suspect Condensate Pumps (31G-105 A, B, C)

31-DS-G-6: Hotwell Condensate Pumps (31G-106 A, B, C, 107A, B, C)

31-DS-G-7: Cooling Water Pumps (31G-108 A, B, C)

31-DS-G-8: 150 psig System Boiler Feedwater Pumps (31G-109 A, B, C)

31-DS-GT-3: 150 psig System Boiler Feed Pump (31-GT-109)

31-DS-G-9: 600 psig System Boiler Feedwater Pumps (31G-110 A, B, C)

4.5 Data Sheets for Pumps and Drivers (continued)

31-DS-GT-4: 600 psig System Boiler Feed Pump (31GT-110)

31-DS-G-10: Condenser Vacuum Pumps (31G-111 A, B)

31-DS-G-11: Steam Air Heater Feed Pumps (31G-112 A, B, 113 A, B, 114 A, B, 115 A, B)

31-DS-G-12: Condensate Flash Drum Drain Pumps (31G-116 A, B, C)

31-DS-G-13: Blowdown Drum Drain Pumps (31G-117 A, B, C)

31-DS-G-14: Atmospheric Blowoff Drain Pumps (31G-118 A, B, C, D)

31-DS-G-15: Sodium Softener Booster Pumps (31G-119 A, B, C)

31-DS-G-16: Sodium Softener Regeneration Brine (31G-120 A, B)

31-DS-G-17: Conveyor Recirc. Pumps (31G-121 A, B)

31-DS-G-18: Continuous Recirc. Pumps (31G-122 A, B)

31-DS-G-19: Dewatering Area Seal Water Booster Pumps (31G-123 A, B)

31-DS-G-20: Dewatering Area Sump Pumps (31G-124 A, B)

31-DS-G-21: Sludge Return Pumps (31G-125 A, B)

31-DS-G-22: Boiler Area Ash Sump Pumps (31G-126 A, B, 127 A, B, 128 A, B, 129 A, B)

31-DS-G-23: Boiler Area Seal Water Booster Pumps (31G-130 A, B, 131 A, B, 132 A, B, 133 A, B)

31-DS-G-24: Ash Sluice Water Booster Pumps (31G-134 A, B, C, 135 A, B, C, 136 A, B, C, 137 A, B, C)

31-DS-G-25: Bottom Ash Handling Pumps (31G-138 A, B, 139 A, B, 140 A, B, 141 A, B)

31-DS-G-26: Fire Water Booster Pump (31G-142)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-101 A,B,C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/10/80 REVISION 0

PPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
..OTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY.
UNIT 31 - POWER PLANT SERVICE TREATED BOILER FEED WATER PUMP
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 31-GP-101A,B,C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D — ITEM NO. — PROVIDED BY — MTD BY —
PUMP MFR PEERLESS PUMP * SIZE AND TYPE * 4AD9 1/2 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID SODIUM ZEOLITE SOFTENED WATER. U.S. GPM at PT. NOR. ---- RATED 800
DISCH. PRESS., PSIG 121
PT. F. NOR. 80 MAX. 90 SUCT. PRESS., PSIG MAX. 13 RATED 13
SP. GR. at PT. 0.9966 DIFF. PRESS., PSI 108
VAP. PRESS. at PT. PSIA 0.5069 DIFF. HEAD, FT 250
VIS. at PT. Sse — CP 0.88 NPSHA, FT 108
CORR/EROS. CAUSED BY — HYD. HP 50

PERFORMANCE

PROPOSAL CURVE NO. 3111041 B
RPM 3500 NPSHR (WATER)
EFF. 78 BHP RATED 65
MAX. BHP RATED IMP 70
MAX. HEAD RATED IMP 270 FT
MIN. CONTINUOUS GPM 240
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	6	150	FF	SIDE
DISCHARGE	4	150	FF	SIDE

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ■ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR. ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ● WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ②
CAST STEEL / BRONZE
BASEPLATE: ☐ STEEL FABRICATED

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-101 A, BC

HP 75 RPM 3000 FRAME 365TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL CLASS B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A.

APPROX. WT. PUMP & BASE 370
MOTOR 690 TURBINE -

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL DATA FROM PEERLESS CATALOG.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		DRN	CHD	PE	CHECK
0	12/11/80	ISSUE FOR PHASE ZERO		[illegible]	[illegible]	[illegible]

JOB NO. 14222 DRAWING NO. 31-DS-G-1 REV. 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-102A,B,C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/10/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BIRECKINRIDGE PROJECT SITE BIRECKINRIDGE COUNTY KENTUCKY
UNIT 31 - POWER PLANT SERVICE DEMINERALIZED FEED PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 31-GP-103A,B PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D — ITEM NO. — PROVIDED BY — MTD BY —
PUMP MFR * PEERLESS PUMP SIZE AND TYPE * 6AD14 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID SODIUM ZEOLITE SOFTENED WATER — U.S. GPM at PT. NOR. — RATED 1500
DISCH. PRESS., PSIG 70
PT. F. NOR. 30 MAX. 30 — SUCT. PRESS., PSIG MAX. 13 RATED 13
SP. GR. at PT. 0.9966 — DIFF. PRESS., PSI 57
VAP. PRESS. at PT, PSIA 0.5069 — DIFF. HEAD, FT 132
VIS. at PT, Sse — CP 0.86 NPSHA, FT 63
CORR/EROS. CAUSED BY — HYD. HP 50

PERFORMANCE

PROPOSAL CURVE NO. 3111014 *
RPM 1750 NPSHR (WATER) 13
EFF. 83 BHP RATED 58
MAX. BHP RATED IMP 64
MAX. HEAD RATED IMP 165
MIN. CONTINUOUS GPM 450
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	8	150	F.F.	SIDE
DISCHARGE	6	150	F.F.	SIDE

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ■ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ● WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ●
CAST STEEL / BRONZE
BASEPLATE ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-102 A, B, C

HP 75 RPM 1800 FRAME 365TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE INSUL CLASS B FULL LOAD AMPS
ENC. TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 923
MOTOR 690 TURBINE —

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL DATA FROM PEERLESS PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		DEN	GND	PE	PENG	JOB NO.	DRAWING NO.
2	12/10/80	ISSUE FOR PHASE ZERO		GB	WP	HUH	14222	31-DS-G-2 0
							SHEET 1 OF 1	

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-103A THRU C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 - POWER PLANT SERVICE DEAERATOR FEED PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 2 ITEM NO. 31-GP-103B&C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D 1 ITEM NO. 31-GT-103A PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PUMP MFR * SIZE AND TYPE * STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID DEMINERALIZED WATER
U.S. GPM at PT, NOR. 1350 RATED 1450
DISCH. PRESS., PSIG 109
PT, F, NOR. 118 MAX. 120
SUCT. PRESS., PSIG MAX. 18 RATED 10
SP. GR. at PT 0.99
DIFF. PRESS., PSI 91
VAP. PRESS. at PT, PSIA 1.6
DIFF. HEAD, FT 210
VIS. at PT, Ssu 2.715 cP 0.58
NPSHA, FT 24 (AT LOWER LIQUID LEVEL)
CORR/EROS. CAUSED BY O_2
HYD. HP

PERFORMANCE

PROPOSAL CURVE NO. 5X9SB-1
RPM 3550 NPSHR (WATER) 30
EFF. 80.2% BHP RATED 98
MAX. BHP RATED IMP 98
MAX. HEAD RATED IMP 270 FT.
MIN. CONTINUOUS GPM 750
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	8"	125	FLANG	SIDE
DISCHARGE	5"	125	FLANG	SIDE

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD: TYPE VOLUTE ■ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 250 PSIG 250 °F ☐ HYDRO TEST 375 PSIG
-CONNECT: ■ VENT ■ DRAIN ■ GAGE
IMPELLER DIA.: ■ RATED 8 1/4" ■ MAX. 8 1/4" ☐ TYPE: 56B3B
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ BY VENDOR
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ◉ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
◉ NPSH REQ'D. ◉ WIT. NPSH
◉ SHOP INSPECTION
◉ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ A216WCB / BRONZE
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
◉ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ◉ PIPE
◉ EXTERNAL SEAL FLUSH FLUID PUMP. WATER ☐ GPM BY VENDOR ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-103B&C

HP 125 RPM 3550 FRAME 404TS VOLTS/PHASE/CYCLES 460/3/60
MFR WESTINGHOUSE EC BEARINGS BALL LUBE BY VENDOR
TYPE INSUL B FULL LOAD AMPS 143
ENC WPII TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.15

TURBINE DRIVER

REFERENCE DATA SHT 31-DS-GT-1

APPROX. WT. PUMP & BASE 690
MOTOR 1145 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED INGERSOL-RAND COMPANY
*TYPICAL DATA FROM 5X9SB PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHK	PE	QE	JOB NO.	DRAWING NO.	REV.
1	12-17-80	ISSUED FOR PHASE ZERO	YL	[illegible]	[illegible]	[illegible]	14222	31-DS-G-3	0

SHEET 1 OF 1

GENERAL PURPOSE STEAM TURBINE DATA SHEET

JOB NO. 14222-000 ITEM NO. 31-GT-103
PURCHASE ORDER NO. _____
REQUISITION NO. _____

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE SUMP DRIVE
MANUFACTURER _____

UNIT PLANT 31 - POWER PLANT
SERIAL NO. _____ NO. REQUIRED ONE
DRIVEN EQUIPMENT DEAERATOR FEED PUMP
MODEL _____

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	100	3600	
NORMAL	100	3600	

STEAM CONDITIONS

	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG IN HG ABS		50	

MAX. EXHAUST CASING PRESSURE _____ PSIG
COOLING WATER IN _____ PSIG _____ °F OUT _____ △P (6H)
● WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP _____ DOWN _____
SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

☐ NO. HAND VALVES, AVAIL _____ FURNISHED _____
ROTATION, FACING GOVERNOR END ○ CW ● CCW

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ____ ○ MECH ● HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS _____ % MINUS _____ %
● HAND SPEED CHANGER (30a)
● ELECTRICAL HAZARD _____ CLASS _____ GR _____ DIV (6i)
● REMOTE TRIP SIGNAL _____ (30m)
● BASEPLATE ○ SOLEPLATE BY _____ (19a)
○ EXTENDED FOR GEAR ● FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED _____ (15d)
● MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (16a-d)
● INSULATION ● JACKET ● SENTINEL WARNING VALVE

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS _____ (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ _____ PSIG EXH CASE ☐ _____ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE DRG NO. _____ SEC. DRG NO. _____

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED	23.9		
NORMAL	23.9		

☐ NORMAL EXHAUST TEMPERATURE _____ °F
☐ COOLING WATER REQ'D _____ GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES _____

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ● HORIZ SUPPORT ■ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ● HORIZ ☐ NO. STAGES _____
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA. _____
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ● HYDR
INTERSTAGE GLAND SEALS ● CARBON ○ LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ☐ LABYRINTH NO. RINGS/BOX _____
BEARINGS, RADIAL _____ THRUST _____

○ LUBE SYSTEM
● RING OILED ○ PURCHASERS SYSTEM OTHER _____
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

MATERIALS (25a)

☐ HIGH-PRESS. CASING ASTM 216WCB EXH CASING ASTM 216WCB
☐ NOZZLES STEEL WHEELS _____
☐ SHAFT ALLOY STL UNDERPACKING _____
☐ GOV VALVE TRIM NIRESIST

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	2"	600 #	R.F.	SIDE
EXHAUST	4"	150#	R.F.	SIDE

☐ RPM MAX. CONT _____ TRIP _____ 1ST CRITICAL _____ (17a)
☐ CASING DESIGN INLET 700 PSIG 750 °F EXH 100 PSIG
☐ MAX. ALLOWABLE RPM _____ WEIGHT _____ LB

GEAR FURNISHED BY N/A (23a-f)
TYPE _____ RATIO _____
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

R&C - Form 50 (8/73)

NO.	DATE		DES	CHD	PE	CHECK	JOB NO.	DRAWING NO	REV.
							14222	31-D5-GT-1	0
0	12/8/80	ISSUED FOR PHASE ZERO		JB	UP	HWH			

BECHTEL

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-104A THRU D
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31 - POWER PLANT SERVICE 900 PSIG SYSTEM BOILER FEEDWATER PUMPS
NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 2 ITEM NO. 31-GP-104C&D PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D 2 ITEM NO. 31-GT-104A&B PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PUMP MFR * SIZE AND TYPE * STAGES 7 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID BOILER FEED WATER
U.S. GPM at PT. NOR. 1050 RATED 1270
DISCH. PRESS., PSIG 1216
PT. F. NOR. 295 MAX. 295
SUCT. PRESS., PSIG MAX. 55 RATED 55
SP. GR. at PT. 0.921
DIFF. PRESS., PSI 1061
VAP. PRESS. at PT. PSIA 62.1
DIFF. HEAD, FT 2450
VIS. at PT. Ssu 0.926 cP 0.184
NPSHA, FT 36
CORR/EROS. CAUSED BY NONE
HYD. HP 757

PERFORMANCE

PROPOSAL CURVE NO. SHMTA-H
RPM 3560 NPSHR (WATER) 25FT
EFF. 77.3% BHP RATED 973
MAX. BHP RATED IMP 1050
MAX. HEAD RATED IMP 3500 FT
MIN. CONTINUOUS GPM 650
ROTATION (VIEWED FROM CPLG END) CW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	8"	300	FLANG	SIDE
DISCHARGE	6"	900	FLANG	SIDE

CASE-MOUNT: ☒ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 200 PSIG 400 °F; ☐ HYDRO TEST 1300 PSIG
-CONNECT: ■ VENT ■ DRAIN ■ GAGE
IMPELLER DIA.: ☒ RATED 10 1/4" ☒ MAX. 10 1/4" ☐ TRIM:
MOUNT: ■ BETWEEN BRGS. ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ BY VENDOR
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ A216 WCB / 12% CHROME
BASEPLATE: ☐

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

AUXILIARY PIPING

● C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING: ● PIPE
☐ TOTAL COOLING WATER REQ'D, GPM BY VENDOR ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ● PIPE
● EXTERNAL SEAL FLUSH FLUID DEMINERWATER 85°F ☐ GPM BY VENDOR ■ PSIG 50
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

MOTOR DRIVER 31-GP-104C&D

HP 1250 RPM 3560 FRAME 6809H VOLTS/PHASE/CYCLES 4160/3/60
MFR WESTINGHOUSE E.C. BEARINGS JOURNAL LUBE FORCED
TYPE INSUL B FULL LOAD AMPS
ENC WPII TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

REFERENCE DATA SHT 31-DS-GT-2

APPROX. WT. PUMP & BASE 7525
MOTOR 6515 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. INGERSOL-RAND COMPANY
* TYPICAL DATA FROM SHMTA3J PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHD	PE	ENGR
0	12-17-80	ISSUED FOR PHASE ZERO	YL	[illegible]	[illegible]	[illegible]

JOB NO. 14222 | DRAWING NO. 31-DS-G-4 | REV. 0
SHEET 1 OF 1

GENERAL PURPOSE STEAM TURBINE DATA SHEET

31-GT-104A

JOB NO. 14222-000 ITEM NO. 31-GT-104 3
PURCHASE ORDER NO. _____
REQUISITION NO. _____

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY KENTUCKY
SERVICE PUMP DRIVE
MANUFACTURER _____

UNIT PLANT 31 - POWER PLANT
SERIAL NO. _____ NO. REQUIRED TWO
DRIVEN EQUIPMENT 900 PSIG SYSTEM BOILER FEED PUMPS
MODEL _____

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	1000	3600	
NORMAL	350	3600	

STEAM CONDITIONS	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG IN HG ABS		50	

MAX. EXHAUST CASING PRESSURE 100 PSIG
COOLING WATER IN 30 PSIG 95 °F OUT ____ ΔP (6H)
● WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP. _____ DOWN _____
SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

☐ NO. HAND VALVES, AVAIL _____ FURNISHED _____
ROTATION, FACING GOVERNOR END ○ CW ○ CCW

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED	21.4		
NORMAL	21.4		

☐ NORMAL EXHAUST TEMPERATURE _____ °F
☐ COOLING WATER REQ'D _____ GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES _____

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ● HORIZ SUPPORT ☐ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ● HORIZ ☐ NO. STAGES _____
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA. _____
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ○ HYDR
INTERSTAGE GLAND SEALS ○ CARBON ● LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ● LABYRINTH NO. RINGS/BOX ____
BEARINGS, RADIAL _____ THRUST _____

● LUBE SYSTEM
○ RING OILED ○ PURCHASERS SYSTEM OTHER _____
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ____ ○ MECH ● HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS _____ % MINUS _____ %
● HAND SPEED CHANGER (30a)
○ ELECTRICAL HAZARD _____ CLASS _____ GR _____ DIV (6j)
● REMOTE TRIP SIGNAL _____ (30m)
● BASEPLATE ○ SOLEPLATE BY _____ (19a)
○ EXTENDED FOR GEAR ● FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED _____ (15d)
● MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (18a-d)
● INSULATION ● JACKET ● SENTINEL WARNING VALVE

MATERIALS (25a)

● HIGH-PRESS. CASING ASTM A216 WCB EXH CASING ASTM A216 WCB
● NOZZLES STEEL WHEELS _____
● SHAFT HOT ROLLED ALLOY STEEL UNDERPACKING _____
● GOV VALVE TRIM D-2 Ni RESIST.

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	3"	600#	R.F	SIDE
EXHAUST	6"	150#	R.F	SIDE

☐ RPM MAX. CONT ____ TRIP ____ 1ST CRITICAL _____ (17a)
● CASING DESIGN INLET 700 PSIG 750 °F EXH 100 PSIG
☐ MAX. ALLOWABLE RPM _____ WEIGHT _____ LB

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS _____ (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ _____ PSIG EXH CASE ☐ _____ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE DRG NO. _____ SEC. DRG NO. _____

GEAR FURNISHED BY N/A (23a-f)
TYPE _____ RATIO _____
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

NO.	DATE		DRN	CHD	PE	ENGR
0	12/8/80	*ISSUED FOR PHASE ZERO				

JOB NO.	DRAWING NO.	
14222	31-DS-GT-2	0

SHEET 1 OF 1

RAC Form 60 (8/73)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-105A,B,C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/09/80 REVISION 0

PPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
OTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31-POWER PLANT SERVICE SUSPECT CONDENSATE PUMP
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 31-GP-105A,B,C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D — ITEM NO. — PROVIDED BY MTD BY
PUMP MFR PEERLESS PUMP * SIZE AND TYPE * 4AD 9 1/2 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID CONDENSATE U.S. GPM at PT. NOR. 900 RATED 1120
DISCH. PRESS., PSIG 117
PT. F. NOR. 202 MAX. SUCT. PRESS., PSIG MAX. 13 RATED 13
SP. GR. at PT 0.9632 DIFF. PRESS., PSI 104
VAP. PRESS. at PT. PSIA 11.53 DIFF. HEAD, FT 250
VIS. at PT. Sss CP 0.32 NPSHA, FT 38.8
CORR/EROS. CAUSED BY HYD. HP 54.61

PERFORMANCE

PROPOSAL CURVE NO. 3111041
RPM 3500 NPSHR (WATER) 18
EFF. 80 BHP RATED 70
MAX. BHP RATED IMP 70
MAX. HEAD RATED IMP 270
MIN. CONTINUOUS GPM 340
ROTATION (VIEWED FROM CPLG END) CCW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	6"	150	FLAT	SIDE
DISCHARGE	4"	150	FLAT	SIDE

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ■ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. — PSIG °F; ☐ HYDRO TEST — PSIG
-CONNECT: ■ VENT ■ DRAIN ■ GAGE
IMPELLER DIA.: ■ RATED 3 1/4 ☐ MAX 9 1/2 ☐ TYPE: DOUBLE SUCTION
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE ☐ RADIAL BALL ☐ THRUST BALL
LUBE: ■ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ■ MFR FAST ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ● DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ■ MFR & MODEL JOHN CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○
CASE ASTM CAST STEEL
IMPELLER - BRONZE
BASEPLATE: ☐ STEEL FABRICATED

AUXILIARY PIPING

○ C.W. PIPE PLAN N/A ○ CU: ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-105A,B,C

HP 75 RPM 3600 FRAME 365TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL CLASS B FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB N/A SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 540
MOTOR 690 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED HYDRAULIC INSTITUTE STANDARDS APPLY

* TYPICAL DATA FROM PEERLESS PUMP CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		DRN	CHD	PE	PROJ MGR
A	12/09/80	ISSUE FOR PHASE ZERO		SR	MH	MJM

JOB NO.	DRAWING NO.	REV.
14222	31-DS-G-5	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-106 A THRU C
PURCHASE ORDER NO. 107A THRU C
REQUISITION NO.
INQUIRY NO.
DATE 12/12/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31
NO. PUMPS REQ'D 6 NO. MOTORS REQ'D 6 ITEM NO. SEE BELOW
NO. TURBINES REQ'D N/A ITEM NO. N/A
PUMP MFR INGERSOLL-RAND * SIZE AND TYPE 3X2X6 ESP *

SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE HOTWELL CONDENSATE PUMPS
PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PROVIDED BY N/A MTD BY N/A
STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID CONDENSATE (HOT WELL)
PT. F. NOR. 120.6 MAX. 120.6
SP. GR. at PT 1.00
VAP. PRESS. at PT, PSIA 1.7
VIS. at PT, Ssu ____ cP 0.55
CORR/EROS. CAUSED BY NONE

U.S. GPM at PT. NOR. 270 RATED 270
DISCH. PRESS., PSIA 56.0
SUCT. PRESS., PSIA MAX. 1.9 RATED 1.7 PSIA
DIFF. PRESS., PSI 54.1
DIFF. HEAD, FT
NPSHA, FT 17
HYD. HP 8.5

PERFORMANCE

PROPOSAL CURVE NO. 6-ESP C (8/26/75)
RPM 3550 NPSHR (WATER) 12
EFF 71% BHP RATED 12
MAX. BHP RATED IMP 15
MAX. HEAD RATED IMP 135
MIN. CONTINUOUS GPM 90
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F	SIDE
DISCHARGE	2	150 #	F.F	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) CANNED
SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
PRESS: ■ MAX. ALLOW. 150 PSIG 180 °F: ☐ HYDRO TEST ____ PSIG
CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 6 1/4" ■ MAX. 6 1/4" ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ■ THRUST IN MOTOR
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ■ MFR & MODEL JOHN CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ● CAST IRON / CAST DUCTILE IRON
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM N/A ☐ PSIG
● SEAL FLUSH PIPE PLAN API 12 ○ C.S. ○ S.S. ● TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS (CANNED TYPE)

PIT OR SUMP DEPTH ● 14'
MIN. SUBMERGENCE REQ'D. ■ 12'
COLUMN PIPE: ■ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ■ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ■ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-106A TO C 31-GP-107A & C)

HP 15 RPM 3600 FRAME 254T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 370
MOTOR 220 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* TYPICAL INFORMATION FROM INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	CHK'D	JOB NO.	DRAWING NO.	REV.
A	12/12/80	ISSUE FOR PHASE ZERO	AL	RS	MP	HWH	14222	31-DS-G-6	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31G-108A THRU C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 11-24-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT — SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31 - POWER PLANT — SERVICE COOLING WATER PUMPS
NO. PUMPS REQ'D 3 — NO. MOTORS REQ'D 3 — ITEM NO. 31GP-108A to C — PROVIDED BY PUMP VENDOR — MTD BY PUMP VENDOR.
NO. TURBINES REQ'D N/A — ITEM NO. — PROVIDED BY — MTD BY
PUMP MFR * — SIZE AND TYPE * — STAGES 1 — SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID DEMINERALIZED WATER W/CORROSION INHIBITER — U.S. GPM at PT. NOR. 1100 — RATED 1300 GPM.
DISCH. PRESS., PSIG 80
PT. F. NOR. 125 MAX 125 — SUCT. PRESS., PSIG MAX. 24 — RATED 24 PSIG
SP. GR. at PT 0.987 — DIFF. PRESS., PSI 56
VAP. PRESS. at PT, PSIA 1.9 — DIFF. HEAD, FT 130
VIS. at PT, Ssu — CP 0.52 — NPSHA, FT 51.7
CORR/EROS. CAUSED BY NONE — HYD. HP 43

PERFORMANCE

PROPOSAL CURVE NO. 6X14SD-D (10-17-73).
RPM 1750 — NPSHR (WATER) 8 FT
EFF. 80% — BHP RATED 54
MAX. BHP RATED IMP 56
MAX. HEAD RATED IMP 155 FT TDH
MIN. CONTINUOUS GPM 325 GPM.
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	10"	150#	F.F	SIDE
DISCHARGE	6"	150#	F.F	SIDE

CASE-MOUNT: ☐ CENTERLINE ■ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ■ AXIAL ☐ RAD: TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 100 PSIG 150 °F: ☐ HYDRO TEST 150 PSIG
-CONNECT: ■ VENT ■ DRAIN ■ GAGE
IMPELLER DIA.: ■ RATED 12 INCH ■ MAX 14 3/8 ☐ TYPE: DOUBLE SUCTION
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL BALL ☐ THRUST BALL
LUBE: ■ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ■ MFR FAST ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ■ MFR & MODEL JOHN CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM ○
CASE ASTM A216WCB
IMPELLER - BRONZE
BASEPLATE: ☐ STEEL FABRICATED

AUXILIARY PIPING

○ C.W. PIPE PLAN N/A ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN API 12 ● C.S. ○ S.S. ○ TUBING ● PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN N/A ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-108 A THRU C

HP 60 — RPM 1800 — FRAME 364TS — VOLTS/PHASE/CYCLES 460/3/60
MFR — BEARINGS BALL — LUBE GREASE
TYPE — INSUL CLASS B — FULL LOAD AMPS
ENC TEFC — TEMP RISE, C 40 — LOCKED ROTOR AMPS
○ VHS ○ VSS — VERT. THRUST CAP., LB. N/A — SERVICE FACTOR 1.0

TURBINE DRIVER

NOT APPLICABLE

APPROX. WT. PUMP & BASE 1140
MOTOR 760 — TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED HYDRAULIC INSTITUTE STANDARDS APPLY

* TYPICAL DATA FROM IR MODEL 6X14SD PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHK	PE	CHK	JOB NO.	DRAWING NO.	REV.
0	11-24-80	ISSUED FOR PHASE ZERO	AR	SM	UP	HNH	14222	31-DS-G-7	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-109ATHRUC
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31 - POWER PLANT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE 150 psig SYSTEM BOILER FEED WATER PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 2 ITEM NO. 31-GP-109B/C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D 1 ITEM NO. 31-GT-109A PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PUMP MFR * SIZE AND TYPE * STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID BOILER FEED WATER
U.S. GPM at PT. NOR. 1300 RATED 1300
DISCH. PRESS., PSIG 1196
PT. F. NOR. 295 MAX. 295
SUCT. PRESS., PSIG MAX. 55 RATED 55
SP. GR. at PT. 0.921
DIFF. PRESS., PSI 141
VAP. PRESS. at PT. PSIA 62.1
DIFF. HEAD, FT. 325
VIS. at PT. Sss 0.926 cp 0.184
NPSHA, FT 36
CORR/EROS. CAUSED BY NONE
HYD. HP 110

PERFORMANCE

PROPOSAL CURVE NO. P-4X10AL-A
RPM 3550 NPSHR (WATER) 20
EFF. 77% BHP RATED 137
MAX. BHP RATED IMP 143
MAX. HEAD RATED IMP 390 FT
MIN. CONTINUOUS GPM 650
ROTATION (VIEWED FROM CPLG END) EIGHT

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	6"	300	FLANG	SIDE
DISCHARGE	4"	300	FLANG	SIDE

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT (TYPE)
-SPLIT: ☐ AXIAL ■ RAD; TYPE VOLUTE ■ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 500 PSIG 500 °F ☐ HYDRO TEST 900 PSIG
-CONNECT: ■ VENT ■ DRAIN ■ GAGE
IMPELLER DIA.: ■ RATED 9 1/2" ■ MAX. 9 1/2" ■ TYPE 4X10AL3A
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST BY VENDOR
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○
ASTM A216 WCB / 12% CHROME
BASEPLATE: ☐

AUXILIARY PIPING

● C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ● PIPE
☐ TOTAL COOLING WATER REQ'D. GPM BY VENDOR ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ● PIPE
● EXTERNAL SEAL FLUSH FLUID DEMIN WATER 85°F ☐ GPM BY VENDOR ☐ PSIG 50
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-109B+C

HP 150 RPM 3550 FRAME 405TS VOLTS/PHASE/CYCLES 460/3/60
MFR WESTINGHOUSE E.C. BEARINGS JOURNAL LUBE FORCED
TYPE INSUL B FULL LOAD AMPS 168
ENC WPII TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.15

TURBINE DRIVER

REFERENCE DATA SHT
31-DS-GT-3

APPROX. WT. PUMP & BASE 1650
MOTOR 1260 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. INGERSOL-RAND COMPANY
* TYPICAL DATA FROM 4X10AL PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHD	PE	PROJ MGR
0	12-17-80	ISSUED FOR PHASE ZERO	YL	SB	WH	WHH

JOB NO. 14222 DRAWING NO. 31-DS-G-8 0
SHEET 1 OF 1

GENERAL PURPOSE STEAM TURBINE DATA SHEET

JOB NO. 14222-000 ITEM NO. 3-GT-109
PURCHASE ORDER NO.
REQUISITION NO.

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE PUMP DRIVE
MANUFACTURER

UNIT PLANT 3-GT POWER PLANT
SERIAL NO. NO. REQUIRED ONE
DRIVEN EQUIPMENT 150 PSIG SYSTEM BOILER FEED PUMP
MODEL

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	140	3600	
NORMAL	120	3600	

STEAM CONDITIONS

	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG		50	

MAX. EXHAUST CASING PRESSURE PSIG
COOLING WATER IN PSIG °F OUT △P (6H)
◉ WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP DOWN
SERVICE ◉ CONTINOUS ○ INTERMITTENT ○ STANDBY

☐ NO. HAND VALVES, AVAIL FURNISHED
ROTATION, FACING GOVERNOR END ○ CW ● CCW

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ○ MECH ◉ HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS % MINUS %
◉ HAND SPEED CHANGER (30a)
◉ ELECTRICAL HAZARD CLASS GR DIV (6j)
◉ REMOTE TRIP SIGNAL (30m)
◉ BASEPLATE ○ SOLEPLATE BY (19a)
○ EXTENDED FOR GEAR ◉ FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED (15d)
◉ MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (16a-d)
◉ INSULATION ◉ JACKET ● SENTINEL WARNING VALVE

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ PSIG EXH CASE ☐ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE DRG NO. SEC. DRG NO.

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED	28.9		
NORMAL	28.9		

☐ NORMAL EXHAUST TEMPERATURE °F
☐ COOLING WATER REQ'D GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ◉ HORIZ SUPPORT ☐ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ◉ HORIZ ☐ NO. STAGES
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA.
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ◉ HYDR
INTERSTAGE GLAND SEALS ○ CARBON ● LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ☐ LABYRINTH NO. RINGS/BOX
BEARINGS, RADIAL THRUST

○ LUBE SYSTEM
◉ RING OILED ○ PURCHASERS SYSTEM OTHER
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

MATERIALS (25a)

☐ HIGH-PRESS. CASING ASTM A216 WCB EXH CASING ASTM A216 WCB
☐ NOZZLES STEEL WHEELS
☐ SHAFT ALLOY STL UNDERPACKING
☐ GOV VALVE TRIM NI-RESIST

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	2"	600#	R.F	SIDE
EXHAUST	4"	150#	R.F	SIDE

☐ RPM MAX. CONT TRIP 1ST CRITICAL (17a)
☐ CASING DESIGN INLET 700 PSIG 750 °F EXH PSIG
☐ MAX. ALLOWABLE RPM WEIGHT LB

GEAR FURNISHED BY N/A (23a-f)
TYPE RATIO
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

NO.	DATE		BEN	CED	PE	CLIENT	JOB NO.	DRAWING NO.	REV.
0	12/18/80	ISSUED FOR PHASE ZERO		[illegible]	MP	MNH	14222	31-DS-GT-3	0
							SHEET 1 OF 1		

R&C Form 50 (8/73)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-110A THRU C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-30 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31 - BOILER PLANT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE 600psig SYSTEM BOILER FEEDWATER PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 31-GP-110B&C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D 1 ITEM NO. 31-GT-110A PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PUMP MFR * SIZE AND TYPE * STAGES 6 SERIAL NO.

OPERATING CONDITIONS. EACH PUMP

LIQUID BOILER FEED WATER
U.S. GPM at PT. NOR. 510 RATED 510
DISCH. PRESS., PSIG 753.4
PT. F. NOR. 235 MAX 275
SUCT. PRESS., PSIG MAX. 55 RATED 55
SP. GR. at PT 0.921
DIFF. PRESS., PSI 698.4
VAP. PRESS. at PT. PSIA 62.1
DIFF. HEAD, FT 1612.5
VIS. at PT. Ssu 0.136 CP 0.13
NPSHA, FT 36
CORR/EROS. CAUSED BY NONE
HYD. HP 219

PERFORMANCE

PROPOSAL CURVE NO. 3CNTA-S
RPM 3560 NPSHR (WATER) 15
EFF. 73% BHP RATED 300
MAX. BHP RATED IMP 337.5
MAX. HEAD RATED IMP 1800 FT
MIN. CONTINUOUS GPM 220
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	6"	300	FLANG	SIDE
DISCHARGE	4"	600	FLANG	SIDE

CASE-MOUNT: ☒ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT (TYPE)
-SPLIT: ☒ AXIAL ☐ RAD: TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 600 PSIG 400 °F ☐ HYDRO TEST 1200 PSIG
-CONNECT: ☒ VENT ☒ DRAIN ☒ GAGE
IMPELLER DIA.: ☐ RATED 8 3/8" ☒ MAX. 8 3/8" ☐ TYPE: 3CNTB-L
MOUNT: ☒ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL BY
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER VENDOR
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ A216 WCB / 12% CHROME
BASEPLATE: ☐

AUXILIARY PIPING

● C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ● PIPE
☐ TOTAL COOLING WATER REQ'D. GPM BY VENDOR ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ● PIPE
● EXTERNAL SEAL FLUSH FLUID DEMIN. WATER 65°F ☐ GPM BY VENDOR ☒ PSIG 30
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-110B&C

HP 350 RPM 3560 FRAME 5009H VOLTS/PHASE/CYCLES 4000/3/50
MFR WESTINGHOUSE E.C. BEARINGS JOURNAL LUBE FORCED
TYPE INSUL B FULL LOAD AMPS 90
ENC WPII TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

REFERENCE DATA SHEET 31-DS-GT-4

APPROX. WT. PUMP & BASE 3250
MOTOR 3150 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. INGERSOL-RAND COMPANY
→ TYPICAL DATA FROM 3CNTA-6 PUMP

FORM NO 130 (REVISED SEPT 72)

NO.	DATE							JOB NO.	DRAWING NO.	V.
A	12-17-30	ISSUED FOR PHASE ZERO	YL	9A	WR	MWH		14222	31-DS-G-9	0
NO.	DATE		BY	CHD	PE	QA/QC		SHEET 1 OF 1		

GENERAL PURPOSE STEAM TURBINE DATA SHEET

JOB NO. 14222-000 ITEM NO. 31-GT-110.
PURCHASE ORDER NO. _____
REQUISITION NO. _____

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE COUNTY KENTUCKY
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE PUMP DRIVE
MANUFACTURER _____

UNIT PLANT 31 - POWER PLANT
SERIAL NO. _____ NO. REQUIRED ONE
DRIVEN EQUIPMENT COOLING SYSTEM BOILER FEED PUMP
MODEL _____

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	300	3600	
NORMAL	220	3600	

STEAM CONDITIONS	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG		50	

MAX. EXHAUST CASING PRESSURE _____ PSIG
COOLING WATER IN _____ PSIG 95 °F OUT _____ ΔP (6H)
○ WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP _____ DOWN _____
SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

☐ NO. HAND VALVES, AVAIL _____ FURNISHED _____
ROTATION, FACING GOVERNOR END ○ CW ● CCW

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED	26.2		
NORMAL	26.2		

☐ NORMAL EXHAUST TEMPERATURE _____ °F
☐ COOLING WATER REQ'D _____ GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES _____

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ◉ HORIZ SUPPORT ☐ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ◉ HORIZ ☐ NO. STAGES _____
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA. _____
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ◉ HYDR
INTERSTAGE GLAND SEALS ○ CARBON ● LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ☐ LABYRINTH NO. RINGS/BOX _____
BEARINGS, RADIAL _____ THRUST _____

● LUBE SYSTEM
○ RING OILED ○ PURCHASERS SYSTEM OTHER _____
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ___ ○ MECH ◉ HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS _____ % MINUS _____ %
◉ HAND SPEED CHANGER (30a)
◉ ELECTRICAL HAZARD _____ CLASS _____ GR _____ DIV (6j)
◉ REMOTE TRIP SIGNAL _____ (30m)
◉ BASEPLATE ○ SOLEPLATE BY _____ (19a)
○ EXTENDED FOR GEAR ● FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED _____ (15d)
● MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (16a-d)
● INSULATION ● JACKET ● SENTINEL WARNING VALVE

MATERIALS (25a)

ASTM
☐ HIGH-PRESS. CASING 216 WCB EXH CASING A216 GR WCB
☐ NOZZLES STEEL WHEELS _____
☐ SHAFT ALLOY STL. UNDERPACKING _____
☐ GOV VALVE TRIM N-RESIST

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	2"	600#	R.F.	SIDE
EXHAUST	4"	150#	R.F.	SIDE

☐ RPM MAX. CONT _____ TRIP _____ 1ST CRITICAL _____ (17a)
☐ CASING DESIGN INLET 700 PSIG 750 °F EXH 100 PSIG
☐ MAX. ALLOWABLE RPM _____ WEIGHT _____ LB

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS _____ (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ _____ PSIG EXH CASE ☐ _____ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE DRG NO. _____ SEC. DRG NO. _____

GEAR FURNISHED BY N/A (23a-f)
TYPE _____ RATIO _____
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

NO.	DATE		DRN	CHD	PE	PROJ MGT	JOB NO.	DRAWING NO.	REV.
0	12/8/80	ISSUED FOR PHASE ZERO		9B.	HP	HNH	14222	31-DS-GT-4	0
							SHEET 1 OF 1		

R&C Form 50 (8/73)

VACUUM PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-111A & 111B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/11/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE — SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 — SERVICE CONDENSER VACUUM PUMPS
NO. PUMPS REQ'D 2 — NO. MOTORS REQ'D 2 — ITEM NO. 31-GP-111A&B — PROVIDED BY VENDOR — MTD BY VENDOR
NO. TURBINES REQ'D N/A — ITEM NO. — PROVIDED BY — MTD BY
PUMP MFR NASH * — SIZE AND TYPE NASH AT-1004E — STAGES — SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID STEAM AND NON-CONDENSIBLE GASES — U.S. STD / AT — PT. NOR. — RATED 10
DISCH. PRESS., PSIA 15
PT. F. NOR. 120.6 — MAX. 120.6 — SUCT. PRESS., MAX. 3.5" Hga — RATED 1.0" Hga
SP. GR. at PT 1.0 (AIR=1.0) — DIFF. PRESS., PSI N/A.
VAP. PRESS. at PT, PSIA N/A. — DIFF. HEAD, FT N/A
VIS. at PT, Ssu N/A — cP — NPSHA, FT N/A.
CORR/EROS. CAUSED BY NONE — HYD. HP N/A.

PERFORMANCE

PROPOSAL CURVE NO. EN1162-37
RPM 600 — NPSHR (WATER) N/A
EFF. N/A — BHP RATED 35
MAX. BHP RATED IMP 65 (HOGGING)
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	4"	150 #	F.F.	SIDE
DISCHARGE	4"	150 #	F.F.	SIDE

CASE-MOUNT: ☐ CENTERLINE ☒ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☒ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☒ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ● WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

☒ CASE/TRIM CLASS ●
CAST IRON / CAST IRON
BASEPLATE: ☐ STEEL FABRICATED

AUXILIARY PIPING

● C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM 75GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ● TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID CONDENSATE ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-111A & 111B

HP 75 — RPM 1800 — FRAME 365TS — VOLTS/PHASE/CYCLES 460/3/60
MFR — BEARINGS BALL — LUBE GREASE
TYPE HORIZONTAL — INSUL B — FULL LOAD AMPS
ENC TEFC — TEMP RISE, C 80 — LOCKED ROTOR AMPS
○ VHS ○ VSS — VERT. THRUST CAP., LB — SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE GEAR+MOTOR 7000 lbs
MOTOR — TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* TYPICAL INFORMATION FROM NASH CATALOG, PAGE A-115

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	CL	JOB NO.	DRAWING NO.	
0	12/11/80	ISSUE FOR PHASE ZERO	AK	GS	UP	MM	14222	31-DS-G-10	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-112 A & B
PURCHASE ORDER NO. -113 A & B
REQUISITION NO. -114 A & B
INQUIRY NO. -115 A & B
DATE 12-4-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 - POWER PLANT SERVICE STEAM AIR HEATER DRAIN PUMPS
NO. PUMPS REQ'D 8 NO. MOTORS REQ'D 8 ITEM NO. PROVIDED BY MTD BY
NO. TURBINES REQ'D N/A ITEM NO. PROVIDED BY MTD BY
PUMP MFR * SIZE AND TYPE 2 x 1½ x 6 - VO * STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID HOT CONDENSATE U.S. GPM at PT. NOR. 20 RATED 20 GPM
DRAINS W/O CORROSIVES DISCH. PRESS., PSIG 100 MAX.
PT. F. NOR. 298 MAX. 298 SUCT. PRESS., PSIG MAX. 50 RATED 50 PSIG
SP. GR. at PT 1.03 DIFF. PRESS., PSI 50
VAP. PRESS. at PT, PSIA 65 DIFF. HEAD, FT 115
VIS. at PT, Ssu CP 0.18 NPSHA, FT 8 FT.
CORR/EROS. CAUSED BY HYD. HP

PERFORMANCE

PROPOSAL CURVE NO. 6VOC-A (8-26-71)
RPM 3550 NPSHR (WATER) 4 FT.
EFF. 30% BHP RATED 2
MAX. BHP RATED IMP 3
MAX. HEAD RATED IMP 132 FT TDH
MIN. CONTINUOUS GPM 6 GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	2"	150 #	F.F.	SIDE
DISCHARGE	1½"	150 #	F.F.	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) INLINE
-SPLIT: ■ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 300 PSIG 450 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 5½" ■ MAX. 6¼" ■ TYPE: SINGLE SUCTION
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL BALL ☐ THRUST BALL
LUBE: ■ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR NOT AVAILABLE ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ■ MFR & MODEL JOHN CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

CASE/TRIM ○
CASE ASTM 216 WCB
IMPELLER - BRONZE
BASEPLATE: ☐ NONE

AUXILIARY PIPING

○ C.W. PIPE PLAN N/A ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN API 12 ● C.S. ○ S.S. ○ TUBING ● PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN N/A ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-112 THRU 115 A&B

HP 3 RPM 3600 FRAME 182T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. N/A SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP 85
MOTOR 75 TURBINE N/A

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED HYDRAULIC INSTITUTE STANDARDS APPLY

* TYPICAL DATA FROM I-R CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHK	PE	PROJ ENG	JOB NO.	DRAWING NO.	REV.
0	12-4-80	ISSUED FOR PHASE ZERO	AK	GB	LHP	MWH	14222	31-DS-G-11	0

BECHTEL

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-116 A THRU C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/15/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 SERVICE CONDENSATE FLASH DRUM DRAIN PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. SEE ABOVE PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR INGERSOLL-RAND * SIZE AND TYPE 3x1½x6 ESP * STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID DRAIN CONDENSATE U.S. GPM at PT. NOR. 110 RATED 110
DISCH. PRESS., PSIG 100
PT. F. NOR. 298 MAX. 298 SUCT. PRESS., PSIG MAX. RATED 53 PSIG
SP. GR. at PT 0.97 DIFF. PRESS., PSI 47
VAP. PRESS. at PT, PSIA 65 DIFF. HEAD, FT
VIS. at PT. Ssu CP 0.19 NPSHA, FT 18
CORR/EROS. CAUSED BY NONE HYD. HP 3.0

PERFORMANCE

PROPOSAL CURVE NO. 6ESP-B (9-26-75)
RPM 3500 NPSHR (WATER) 13
EFF 62% BHP RATED 5
MAX. BHP RATED IMP 10
MAX. HEAD RATED IMP 135 FT.
MIN. CONTINUOUS GPM 40
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F.	SIDE
DISCHARGE	1½	150 #	F.F.	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) CANNED
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 150 PSIG 350 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 5 3/4" ■ MAX. 6 1/4" ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL JACK CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS 316 STAINLESS / 316 STAINLESS STEEL
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM N/A ☐ PSIG
● SEAL FLUSH PIPE PLAN API 12 ○ C.S. ○ S.S. ● TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS (CANNED TYPE)

PIT OR SUMP DEPTH ● 12'
MIN. SUBMERGENCE REQ'D. ■ 10'
COLUMN PIPE: ■ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ■ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ■ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-116 A THRU C)

HP 10 RPM 3600 FRAME 213T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 360
MOTOR 130 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* TYPICAL INFORMATION FROM INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	CLIENT	JOB NO.	DRAWING NO.	
							14222	31-DS-G-12	0
0	12/19/80	ISSUE FOR PHASE ZERO	AK	GB	MP	KWW			
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-117A THRU C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/15/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 SERVICE BLOWDOWN DRUM DRAIN PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. SEE ABOVE PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR INGERSOLL-RAND * SIZE AND TYPE 3 X 1 1/2 X 6 ESP* STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID CONCENTRATED BOILER BLOWDOWN U.S. GPM at PT. NOR. 125 RATED 125
DISCH. PRESS., PSIG 100
PT. F. NOR. 298 MAX. 298 SUCT PRESS., PSIG MAX. RATED 53 PSIG
SP. GR. at PT 0.97 DIFF. PRESS., PSI 47
VAP. PRESS. at PT. PSIA 65 DIFF. HEAD, FT
VIS. at PT. Ssu CP 0.19 NPSHA, FT 19
CORR/EROS. CAUSED BY NONE HYD. HP 3.4

PERFORMANCE

PROPOSAL CURVE NO. 6 ESP-B (8-26-75)
RPM 3500 NPSHR (WATER) 14
EFF. 65% BHP RATED 5 1/2
MAX. BHP RATED IMP 10
MAX. HEAD RATED IMP 135 FT.
MIN. CONTINUOUS GPM 42
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F.	SIDE
DISCHARGE	1 1/2	150 #	F.F.	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) CANNED
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 150 PSIG 350 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA: ■ RATED 5 3/4 ■ MAX. 6 1/4 " ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL JACK CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS 316 STAINLESS STEEL / 316 STAINLESS STEEL
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
● SEAL FLUSH PIPE PLAN API 12 ○ C.S. ○ S.S. ● TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS (CANNED TYP

PIT OR SUMP DEPTH ● 12'
MIN. SUBMERGENCE REQ'D. ■ 10'
COLUMN PIPE: ● FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ■ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ■ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-117A THRU C)

HP 10 RPM 3600 FRAME 213T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 360
MOTOR 130 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	CLIENT	JOB NO.	DRAWING NO.	REV.
0	12/15/80	ISSUE FOR PHASE ZERO	AK	GB	WP	HWH	14222	31-DS-G-13	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-118 A THRU D
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/15/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31
NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. SEE ABOVE
NO. TURBINES REQ'D N/A ITEM NO. N/A
PUMP MFR INGERSOLL-RAND* SIZE AND TYPE 3x1½x6 ESP* STAGES SERIAL NO.

SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE ATMOSPHERIC BLOWOFF DRAIN PUMPS
PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
PROVIDED BY N/A MTD BY N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID CONDENSATE DRAINS
U.S. GPM at PT. NOR. 100 RATED 100
DISCH. PRESS., PSIG 45
PT. F. NOR. 212 MAX. 212
SUCT. PRESS., PSIG MAX. RATED 3 PSIG
SP. GR. at PT 0.98
DIFF. PRESS., PSI 42
VAP. PRESS. at PT. PSIA 14.7
DIFF. HEAD, FT
VIS. at PT. Ssu CP 0.29 NPSHA, FT 17'
CORR/EROS. CAUSED BY NONE HYD. HP 2.5

PERFORMANCE

PROPOSAL CURVE NO. 6ESP-3 (E-10175)
RPM 3500 NPSHR (WATER) 12
EFF 60 % BHP RATED 5
MAX. BHP RATED IMP 10
MAX. HEAD RATED IMP 135 FT
MIN. CONTINUOUS GPM 35
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F.	SIDE
DISCHARGE	1½	150 #	F.F.	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) CANNED
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 150 PSIG 350 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 5½" ■ MAX 6¼" ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL JACK CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

CASE/TRIM CLASS ●
316 STAINLESS STEEL / 316 STAINLESS STEEL
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN API 12 ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS

PIT OR SUMP DEPTH ● 12'
MIN. SUBMERGENCE REQ'D. ● 10'
COLUMN PIPE: ■ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ■ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ■ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-118 A THRU D)

HP 10 RPM 3600 FRAME 213T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 360
MOTOR 130 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	PROJ ENG	JOB NO.	DRAWING NO	V
0	12/15/80	ISSUE FOR PHASE ZERO	AK	GB	WP	HNM	14222	31-DS-G-14	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-1194,B,C
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/9/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31 - POWER PLANT SERVICE SODIUM SOFTENER BOOSTER PUMPS
NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 31-GP-1194,B,C PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D — ITEM NO. — PROVIDED BY — MTD BY —
PUMP MFR PEERLESS PUMP SIZE AND TYPE 4AD8 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 300 RATED 800
DISCH. PRESS., PSIG 50
PT. F, NOR. 80 MAX. 80 SUCT. PRESS., PSIG MAX. 13 RATED 13
SP. GR. at PT. 0.9766 DIFF. PRESS., PSI 37
VAP. PRESS. at PT, PSIA 0.5069 DIFF. HEAD, FT 100
VIS. at PT, Ssu — CP 0.88 NPSHA, FT 60
CORR/EROS. CAUSED BY HYD. HP 17

PERFORMANCE

PROPOSAL CURVE NO. 3111039 ✓
RPM 3500 NPSHR (WATER) 20
EFF. 75 BHP RATED 23
MAX. BHP RATED IMP 30
MAX. HEAD RATED IMP 135
MIN. CONTINUOUS GPM 240
ROTATION (VIEWED FROM CPLG END) CCW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	6"	150	FLAT	SIDE
DISCHARGE	4".	150	FLAT	SIDE

CASE-MOUNT: ☐ CENTERLINE ☑ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☑ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☑ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 80 PSIG 100 °F; ☑ HYDRO TEST 50 PSIG
-CONNECT: ☑ VENT ☑ DRAIN ☑ GAGE
IMPELLER DIA.: ☑ RATED 6" ☑ MAX. 6" ☑ TYPE: Double Suction
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☑ RADIAL BALL ☑ THRUST BALL
LUBE: ■ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ● DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ● WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
● NPSH REQ'D. ● WIT. NPSH
● SHOP INSPECTION
● DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ●
CAST STEEL
IMPELLER - BRONZE
BASEPLATE: ☑ STEEL FABRICATED

AUXILIARY PIPING

○ C.W. PIPE PLAN — ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN — ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN — ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-119A, B, C

HP 25 RPM 3500 FRAME 284TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A.

APPROX. WT. PUMP & BASE 502
MOTOR 330 TURBINE —

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. HYDRAULIC INSTITUTE STANDARDS APPLY

✓ TYPICAL DATA FROM PEERLESS PUMP CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		DRN	CHD	PE	QENG
0	12/9/80	ISSUE FOR PHASE ZERO				

JOB NO.	DRAWING NO.	REV.
14222	31-DS-G-15	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-120 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/9/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31- POWER PLANT SERVICE SODIUM SOFTENER REGENERATION BRINE
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 31-GP-120A,B PROVIDED BY PUMP VENDOR MTO BY
NO. TURBINES REQ'D — ITEM NO. — PROVIDED BY — MTO BY —
PUMP MFR INGERSOLL-RAND SIZE AND TYPE 3X7A/W STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID SALT WATER U.S GPM at PT NOR. 300 RATED 300
DISCH. PRESS., PSIG 60
PT. F, NOR. 70 MAX. 90 SUCT. PRESS., PSIG MAX. 3 RATED 3
SP. GR. at PT 1.1734 DIFF. PRESS., PSI 57
VAP. PRESS. at PT, PSIA 0.10 DIFF HEAD, FT 135
VIS. at PT, Ssu CP NPSHA, FT 23
CORR/EROS. CAUSED BY SALT WATER HYD. HP 10

PERFORMANCE

PROPOSAL CURVE NO. 3X7A/W
RPM 3500 NPSHR (WATER) 10
EFF. 65 BHP RATED 15
MAX. BHP RATED IMP 16
MAX. HEAD RATED IMP 165
MIN. CONTINUOUS GPM 90
ROTATION (VIEWED FROM CPLG END) CCW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	4	150	FLAT	SIDE
DISCHARGE	3	150	FLAT	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☑ VERT. (TYPE) SUPPORT FLANGE BELOW DISCHARGE
-SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. ____ PSIG ____ °F: ☐ HYDRO TEST ____ PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ____ ☐ MAX. ____ ☐ TYPE: ____
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC. ____
BEARINGS-TYPE: ☐ RADIAL ____ ☐ THRUST ____
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ ____
COUPLING: ☐ MFR ____ ☐ MODEL ____
DRIVER HALF MTD BY: ◉ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ____ ☐ SIZE/NO. OF RINGS ____
MECH. SEAL: ☐ MFR & MODEL ____ API CLASS. CODE ____
☐ MFR CODE ____

SHOP TESTS

○ NON-WIT. PERF. ◉ WIT. PERF.
○ NON-WIT. HYDRO ◉ WIT. HYDRO
◉ NPSH REQ'D. ◉ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER ____

MATERIALS

API CASE/TRIM CLASS ____
ENCASED BRONZE/SIX FREE IRON
BASEPLATE: ☐ STEEL FABRICATED

AUXILIARY PIPING

○ C.W. PIPE PLAN ____ ○ CU. ○ S.S.; ○ TUBING: ○ PIPE ____
☐ TOTAL COOLING WATER REQ'D. GPM ____ ○ SIGHT F.I. REQ'D ____
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ____ ☐ PSIG ____
◉ SEAL FLUSH PIPE PLAN ____ ○ C.S. ○ S.S. ◉ TUBING ○ PIPE ____
◉ EXTERNAL SEAL FLUSH FLUID CLEARWATER ☐ GPM ____ ☐ PSIG ____
○ AUXILIARY SEAL PLAN ____ ○ C.S. ○ S.S. ○ TUBING ○ PIPE ____
○ AUX. SEAL QUENCH FLUID ____

VERTICAL PUMPS

PIT OR SUMP DEPTH ◉ 8'
MIN. SUBMERGENCE REQ'D. ☐ ____
COLUMN PIPE: ◉ FLANGED ☐ THREADED
LINE SHAFT: ◉ OPEN ☐ ENCLOSED
BRGS: ◉ BOWL ____ ◉ LINE SHAFT ____
BRG. LUBE ◉ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ◉ NONE
FLOAT SWITCH ☐ ____
PUMP THRUST, LB ☐ UP ____ ◉ DOWN ____

MOTOR DRIVER 31-GP-120A AND B

HP 20 RPM 3600 FRAME 256T VOLTS/PHASE/CYCLES 460/3/60
MFR ____ BEARINGS GALL LUBE GREASE
TYPE VERTICAL INSUL CLASS B FULL LOAD AMPS ____
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS ____
○ VHS ○ VSS VERT. THRUST CAP., LB. ____ SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 370
MOTOR 230 TURBINE —

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

✓ INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		DRN	CHD	PE	PLNT
A	12/9/80	ISSUE FOR PHASE ZERO				

JOB NO. 14222 DRAWING NO. 31-DS-G-16 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-121 A & B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/17/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT SERVICE CONVEYOR RECIRC. PUMPS
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WORTHINGTON SIZE AND TYPE 4X3X6 D-1000 STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LAGOON WATER
U.S. GPM at PT. NOR. 400 RATED 400
DISCH. PRESS. 200' (86.6 PSI)
PT. F. NOR. 80 MAX. 80
SUCT. PRESS., MAX. 34'(14.7) RATED 32'(13.9PSI)
SP. GR. at PT 1.0
DIFF. PRESS. 168'(72.7 PSI)
VAP. PRESS. at PT. PSIA 13.9
DIFF. HEAD, FT 168'
VIS. at PT. Ssu CP 0.85
NPSHA, FT 40
CORR/EROS. CAUSED BY NONE
HYD. HP 17.0

PERFORMANCE

PROPOSAL CURVE NO. D-4X3X6 A
RPM 3550 NPSHR (WATER) 12
EFF. 72% BHP RATED 24
MAX. BHP RATED IMP 36
MAX. HEAD RATED IMP 196 FT. TDH
MIN. CONTINUOUS GPM 200
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	4	150 #	F.F.	SIDE
DISCHARGE	3	150 #	F.F.	TOP

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 175 PSIG 250 °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 6.5" ■ MAX. 6.5" ■ TYPE: ENCLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
■ MFR CODE CRANE TYPE 9 SEAL W/FLUSH GLAND

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ○ DUCTILE IRON/ IMPELLER - 316 SST
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-121 A & B)

HP 30 RPM 3600 FRAME 286TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZ. INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE
MOTOR 380 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* TYPICAL INFORMATION FROM WORTHINGTON CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	ENG	JOB NO.	DRAWING NO.	REV.
0	12/17/80	ISSUE FOR PHASE ZERO	AK	AP	JP	HH	14222	31-DS-G-17	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-122A & B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/17/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31 - POWER PLANT
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. SEE BELOW
NO. TURBINES REQ'D N/A ITEM NO. N/A
PUMP MFR WORTHINGTON * SIZE AND TYPE 8x6x15 D-1600* STAGES N/A SERIAL NO. N/A

SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE CONTINOUS RECIRC. PUMPS
PROVIDED BY PUMP VENDOR MTO BY PUMP VENDOR
PROVIDED BY N/A MTO BY N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LADDEN WATER
U.S. GPM at PT. NOR. 1600 RATED 1600
DISCH. PRESS. 200' (86.6 PSI)
PT. F. NOR. 80 MAX. 80
SUCT. PRESS. MAX. 34' (14.7PSI) RATED 32' (13.9 PSI)
SP. GR. at PT 1.0
DIFF. PRESS., PSI 72.7
VAP. PRESS. at PT. PSIA 13.9
DIFF. HEAD, FT 168'
VIS. at PT. SSU CP 0.85 NPSHA, FT 40
CORR/EROS. CAUSED BY NONE HYD. HP 67.8

PERFORMANCE

PROPOSAL CURVE NO. D-8x6x15-A
RPM 1770 NPSHR (WATER) 12
EFF 76% BHP RATED 90
MAX. BHP RATED IMP 180
MAX. HEAD RATED IMP 265 FT. TDH
MIN. CONTINUOUS GPM 300
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	8	150 #	F.F.	SIDE
DISCHARGE	6	150 #	F.F.	TOP

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 175 PSIG 250 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 13.60" ■ MAX 15.60" ■ TYPE: ENCLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
■ MFR CODE CRANE TYPE 9 SEAL w/ FLUSH GLAND

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS DUCTILE IRON/ IMPELLER - 316 SST
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-122 A&B)

HP 125 RPM 1800 FRAME 444TS VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE
MOTOR 1307 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM WORTHINGTON CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	
0	12/17/80	ISSUE FOR PHASE ZERO	AK	MM	UP	HH

JOB NO. 14222 DRAWING NO. 31-05-G-18 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-123 A & B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/17/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 - POWER PLANT SERVICE DEWATERING AREA SEAL WATER BSTR PUMP
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WORTHINGTON * SIZE AND TYPE 3x1½x8 D-1000* STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID FILTERED WATER U.S. GPM at PT. NOR. 175 RATED 175
DISCH. PRESS., ■ 250' (108.2 PSI)
PT. F. NOR. 80 MAX. 80 SUCT. PRESS., ■ MAX. 32' (13.9 PSI) RATED 25' (10.8 PSI)
SP GR. at PT 1.0 DIFF. PRESS., PSI 97.4
VAP. PRESS. at PT, PSIA 10.8 DIFF. HEAD, FT 225
VIS. at PT. Ssu ____ cP 0.85 NPSHA, FT 32'
CORR/EROS. CAUSED BY NONE HYD. HP 9.94

PERFORMANCE

PROPOSAL CURVE NO. D-3x1½x8-A
RPM 3550 NPSHR (WATER) 12
EFF. 59 % BHP RATED 18
MAX. BHP RATED IMP 20
MAX. HEAD RATED IMP 310
MIN. CONTINUOUS GPM 90
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F.	SIDE
DISCHARGE	1½	150 #	F.F.	TOP

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 175 PSIG 250 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA: ■ RATED 7.70" ■ MAX. 8.00" ■ TYPE: ENCLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
■ MFR CODE CRANE TYPE 9 SEAL W/FLUSH GLAND

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS DUCTILE IRON / IMPELLER - 316 SST
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ G.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM / ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-123 A & B)

HP 20 RPM 3600 FRAME 256T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE
MOTOR 250 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* TYPICAL INFORMATION FROM WORTHINGTON CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	E/E/MT	JOB NO.	DRAWING NO.	REV.
0	12/17/80	ISSUE FOR PHASE ZERO	KR	AD	MP	MW	14222	31-DS-G-19	0

BECHTEL — SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-124 A & B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/18/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT SERVICE DEWATERING AREA SUMP PUMPS
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WARMAN * SIZE AND TYPE 6S 8VSP - SP * STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH CADDEN U.S. GPM at PT. NOR. 400 RATED 400
WATER DISCH. PRESS., PSIG 75' (32.5 PSI)
PT. F. NOR. 80 MAX. 80 SUCT. PRESS., PSIG MAX. 37'(16 PSI) RATED 1' (.45PSI)
SP. GR. at PT 1.1 DIFF. PRESS., PSI 32.1
VAP. PRESS. at PT, PSIA 0.45 DIFF. HEAD, FT 74
VIS. at PT, Ssu CP 0.85 NPSHA, FT 33'
CORR/EROS. CAUSED BY NONE HYD. HP 7.5

PERFORMANCE

PROPOSAL CURVE NO. WPA-6SE41U (JUNE 78)
RPM 1400 NPSHR (WATER) 0.9'
EFF 54 9/10 BHP RATED 14
MAX. BHP RATED IMP 38
MAX. HEAD RATED IMP 110'
MIN. CONTINUOUS GPM 200
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) SIMPLE, BOLTED TO COLUMN
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 11" ■ MAX. 11" ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ③ HARD WEARING ALLOY / IMPELLER - NI-HARD
MOUNTING PLATE: ■ STEEL (COATED)

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ■ THREADED
LINE SHAFT: ■ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ■ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-124 A & B)

HP 20 RPM 1800 FRAME 256T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 950
MOTOR 250 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM WARMAN CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	
0	12/18/80	ISSUE FOR PHASE ZERO	AK	HK	UP	

JOB NO. 14222 DRAWING NO. 31-DS-G-20 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-125 A & B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/18/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31 - POWER PLANT SERVICE SLUDGE RETURN PUMPS
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WARMAN * SIZE AND TYPE 4/3 CAM - CV * STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LADDEN WATER U.S. GPM at PT. NOR. 400 RATED 600
DISCH. PRESS. 75' (32.5 PSI)
PT. F. NOR. 80 MAX. 90 SUCT PRESS. MAX. 38' (16.5 PSI) RATED 2' (0.9 PSI)
SP. GR. at PT 1.1 DIFF. PRESS., PSI 31.6
VAP. PRESS. at PT, PSIA 0.9 DIFF HEAD, FT 73'
VIS. at PT, Ssu CP 0.35 NPSHA, FT 34
CORR/EROS. CAUSED BY NONE HYD. HP 7.4

PERFORMANCE

PROPOSAL CURVE NO. NPA-43A0 IAU (AUG. 78)
RPM 1600 NPSHR (WATER) 5'
EFF. 57% BHP RATED 13
MAX. BHP RATED IMP 25
MAX. HEAD RATED IMP 20'
MIN. CONTINUOUS GPM 200
ROTATION (VIEWED FROM CPLG END).

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	4	150 #	F.F.	SIDE
DISCHARGE	3	150 #	F F.	TOP

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 200 PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 9.64" ■ MAX. 9.64" ■ TYPE: CLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ● CAST GRAY IRON / IMPELLER - Ni-HARD PUMP - METAL LINED
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-125 A & B)

HP 15 RPM 1800 FRAME 254T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 700
MOTOR 230 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM WARMAN CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	
0	12/18/80	ISSUE FOR PHASE ZERO	AR	DRC	LLP	HWH

JOB NO. 14222 DRAWING NO. 31-DS-G-21 REV. 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-126 A&B
PURCHASE ORDER NO. -127 A&B
REQUISITION NO. -128 A&B
INQUIRY NO. -129 A&B
DATE 12/18/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT SERVICE BOILER AREA ASH SUMP PUMPS
NO. PUMPS REQ'D 8 NO. MOTORS REQ'D 8 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WARMAN * SIZE AND TYPE 150-SVSP - SP* STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LADDEN WATER
U.S. GPM at PT. NOR. 435 RATED 435
DISCH. PRESS. 125' (54.1 PSI)
PT. F. NOR. 80 MAX. 80
SUCT. PRESS. MAX 37.7' (16.3 PSI) RATED 1' (.45 PSI)
SP. GR. at PT 1.1
DIFF. PRESS., PSI 53.7
VAP. PRESS. at PT, PSIA 0.45
DIFF. HEAD, FT 124'
VIS. at PT, Ssu ___ CP 0.85 NPSHA, FT 30'
CORR/EROS. CAUSED BY NONE
HYD. HP 15

PERFORMANCE

PROPOSAL CURVE NO. WA-SPEED (SEE NOTE)
RPM 925 NPSHR (WATER) 1.3'
EFF 26 % BHP RATED 53
MAX. BHP RATED IMP 63
MAX. HEAD RATED IMP 143'
MIN. CONTINUOUS GPM 220
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ■ VERT. (TYPE) SIMPLE, BOLTED TO COLUMN
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. ___ PSIG ___ °F; ☐ HYDRO TEST ___ PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA: ■ RATED 14.57" ■ MAX 14.57" ■ TYPE: OPEN
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC. ___
BEARINGS-TYPE: ☐ RADIAL ___ ☐ THRUST ___
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ ___
COUPLING: ☐ MFR ___ ☐ MODEL ___
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ___ ☐ SIZE/NO. OF RINGS ___
MECH. SEAL: ☐ MFR & MODEL ___ API CLASS, CODE ___
☐ MFR CODE ___

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER ___

MATERIALS

■ CASE/TRIM CLASS: HARD WEARING ALLOY/ IMPELLER- NI-HARD
MOUNTING ■ PLATE: STEEL (COATED)

AUXILIARY PIPING

○ C.W. PIPE PLAN ___ ○ CU: ○ S.S.: ○ TUBING: ○ PIPE ___
☐ TOTAL COOLING WATER REQ'D, GPM ___ ○ SIGHT F.I. REQ'D ___
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM: ___ ☐ PSIG ___
○ SEAL FLUSH PIPE PLAN ___ ○ C.S. ○ S.S. ○ TUBING ○ PIPE ___
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ___ ☐ PSIG ___
○ AUXILIARY SEAL PLAN ___ ○ C.S. ○ S.S. ○ TUBING ○ PIPE ___
○ AUX. SEAL QUENCH FLUID ___

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 5.2'
MIN. SUBMERGENCE REQ'D. ☐ 4.9'
COLUMN PIPE: ☐ FLANGED ■ THREADED
LINE SHAFT: ■ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ___ ☐ LINE SHAFT ___
BRG. LUBE ☐ WATER ☐ OIL ■ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐ ___
PUMP THRUST, LB ☐ UP ___ ☐ DOWN ___

MOTOR DRIVER (31-GP-126 THRU 129 A&B)

HP 75 RPM 3600 FRAME 365TS VOLTS/PHASE/CYCLES 460/3/60
MFR ___ BEARINGS BALL LUBE GREASE
TYPE VERTICAL INSUL B FULL LOAD AMPS ___
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS ___
○ VHS ○ VSS VERT. THRUST CAP., LB ___ SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 1910
MOTOR 650 TURBINE ___

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED ___

* TYPICAL INFORMATION FROM WARMAN CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	
0	12/18/80	ISSUE FOR PHASE ZERO	AK	AA	UP	HMM

JOB NO. 14222 DRAWING NO. 31-DS-G-22 REV.
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-130 A & B
PURCHASE ORDER NO. 131 A & B
REQUISITION NO. 132 A & B
INQUIRY NO. 133 A & B
DATE 12/17/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT SERVICE BOILER AREA SEAL WATER BOOSTER PUMPS
NO. PUMPS REQ'D 8 NO. MOTORS REQ'D 8 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WORTHINGTON* SIZE AND TYPE 2XJ10 D-1000* STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS. EACH PUMP

LIQUID FILTERED WATER — U.S. GPM at PT. NOR. 35 RATED 35
DISCH. PRESS. 350' (151.5 PSI)
PT. F. NOR. 80 MAX. 80 SUCT. PRESS. MAX. 250' (108 PSI) RATED 50' (21.7 PSI)
SP. GR. at PT 1.0 DIFF. PRESS., PSI 129.8
VAP. PRESS. at PT, PSIA 21.7 DIFF. HEAD, FT 300
VIS. at PT, Ssu — cP 0.85 NPSHA, FT 32
CORR/EROS. CAUSED BY NONE HYD. HP 2.7

PERFORMANCE

PROPOSAL CURVE NO. D-2XJx10-A
RPM 3550 NPSHR (WATER) 2
EFF. 25% BHP RATED 11
MAX. BHP RATED IMP 30
MAX. HEAD RATED IMP 480
MIN. CONTINUOUS GPM 17.5
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	2	150 #	F.F.	SIDE
DISCHARGE	1	150 #	F.F.	TOP

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 175 PSIG 250 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA: ■ RATED 8.30" ■ MAX 9.90" ■ TYPE: ENCLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
■ MFR CODE CRANE TYPE 9 SEAL w/ FLUSH GLAND

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ● DUCTILE IRON / IMPELLER - 316 STAINLESS STEEL
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-130 THRU 133 A&B)

HP 15 RPM 3600 FRAME 254T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE
MOTOR 230 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM WORTHINGTON CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	ENGR
0	12/17/80	ISSUE FOR PHASE ZERO	AE	BAE	LLP	MWM

JOB NO. 14222 | DRAWING NO. 31-DS-G-23 | REV. 0
SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-134 A THRU C
PURCHASE ORDER NO. -135 A THRU C
REQUISITION NO. -136 A THRU C
INQUIRY NO. -137 A THRU C
DATE 12/17/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31 - POWER PLANT SERVICE ASH SLUICE WATER BOOSTER PUMPS
NO. PUMPS REQ'D 12 NO. MOTORS REQ'D 12 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WORTHINGTON * SIZE AND TYPE 3X2XS D-1000 * STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LADDEN WATER
U.S. GPM at PT. NOR. 200 RATED 200
DISCH. PRESS. 275' (119 PSI)
PT. F. NOR. 80 MAX. 80 SUCT. PRESS., MAX. 200' (86.6) RATED 160' (69.2 PSI)
SP. GR. at PT 1.0 DIFF. PRESS., PSI 49.8
VAP. PRESS. at PT, PSIA 69.2 DIFF. HEAD, FT 115
VIS. at PT, Sss CP 0.85 NPSHA, FT 32
CORR/EROS. CAUSED BY NONE HYD. HP 5.8

PERFORMANCE

PROPOSAL CURVE NO. D-3X2XS-A
RPM 3550 NPSHR (WATER) 8
EFF. 66% BHP RATED 8
MAX. BHP RATED IMP 10
MAX. HEAD RATED IMP 120
MIN. CONTINUOUS GPM 67
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	150 #	F.F.	SIDE
DISCHARGE	1½	150 #	F.F.	TOP

CASE-MOUNT: ■ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
PRESS: ■ MAX. ALLOW. 175 PSIG 250 °F; ☐ HYDRO TEST PSIG
CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 5.20" ■ MAX 5.20" ■ TYPE: ENCLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
■ MFR CODE CRANE TYPE 9 SEAL W/ FLUSH GLAND

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS CAST IRON DUCTILE / IMPELLER - 316 STAINLESS STEEL
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER (31-GP-134 THRU 137-A THRU C)

HP 10 RPM 3600 FRAME 215T VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE
MOTOR 155 TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM WORTHINGTON CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	
							14222	31-DS-G-24	0
0	12/17/80	ISSUE FOR PHASE ZERO	AK	ATK	LHP	RMM			
			BY	CH	PE	ENGR	SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-138 A & B
PURCHASE ORDER NO. -139 A & B
REQUISITION NO. -140 A & B
INQUIRY NO. -141 A & B
DATE 12/18/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT SERVICE BOTTOM ASH HANDLING PUMPS
NO. PUMPS REQ'D 8 NO. MOTORS REQ'D 8 ITEM NO. SEE BELOW PROVIDED BY PUMP VENDOR MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A ITEM NO. N/A PROVIDED BY N/A MTD BY N/A
PUMP MFR WARMAN * SIZE AND TYPE 4/3 DAH- CV * STAGES N/A SERIAL NO. N/A

OPERATING CONDITIONS, EACH PUMP

LIQUID ASH LADDEN WATER U.S. GPM at PT. NOR. 475 RATED 475
DISCH. PRESS., ■ 125' (54.1 PSI)
PT. F. NOR. 80 MAX. 80 SUCT. PRESS., ■ MAX. 20'(8.7 PSI) RATED 10' (4.3 PSI)
SP. GR. at PT 1.2 DIFF. PRESS., PSI 49.8
VAP. PRESS. at PT, PSIA 4.3 DIFF. HEAD, FT 115
VIS. at PT, Ssu ____ CP 0.85 NPSHA, FT 22'
CORR/EROS. CAUSED BY NONE HYD. HP 18

PERFORMANCE

PROPOSAL CURVE NO. WPA-43A01U (FEB 79)
RPM 2000 NPSHR (WATER) 15
EFF. 56 % BHP RATED 32
MAX. BHP RATED IMP 46
MAX. HEAD RATED IMP 20'
MIN. CONTINUOUS GPM 240
ROTATION (VIEWED FROM CPLG END) ____

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	4	150#	F.F.	SIDE
DISCHARGE	3	150 #	F.F.	TOP

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) ____
-SPLIT: ☐ AXIAL ☐ RAD: TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 200 PSIG ____ °F: ☐ HYDRO TEST ____ PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ■ RATED 9.64" ■ MAX 9.64" ■ TYPE: CLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC. ____
BEARINGS-TYPE: ☐ RADIAL ____ ☐ THRUST ____
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ ____
COUPLING: ☐ MFR. ____ ☐ MODEL ____
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ____ ☐ SIZE/NO. OF RINGS ____
MECH. SEAL: ☐ MFR & MODEL ____ API CLASS. CODE ____
☐ MFR CODE ____

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER ____

MATERIALS

■ CASE/TRIM CLASS ■ CAST IRON / IMPELLER - Ni-HARD
PUMP- METAL LINED
BASEPLATE: ■ CAST IRON

AUXILIARY PIPING

○ C.W. PIPE PLAN ____ ○ CU; ○ S.S.; ○ TUBING; ○ PIPE ____
☐ TOTAL COOLING WATER REQ'D, GPM ____ ○ SIGHT F.I. REQ'D ____
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ____ ☐ PSIG ____
○ SEAL FLUSH PIPE PLAN ____ ○ C.S. ○ S.S. ○ TUBING ○ PIPE ____
● EXTERNAL SEAL FLUSH FLUID WATER ☐ GPM ____ ☐ PSIG ____
○ AUXILIARY SEAL PLAN ____ ○ C.S. ○ S.S. ○ TUBING ○ PIPE ____
○ AUX. SEAL QUENCH FLUID ____

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ ____
MIN. SUBMERGENCE REQ'D. ☐ ____
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ____ ☐ LINE SHAFT ____
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐ ____
PUMP THRUST, LB ☐ UP ____ ☐ DOWN ____

MOTOR DRIVER (31-GP-138 THRU 141 A&B)

HP 40 RPM 3600 FRAME 324TS VOLTS/PHASE/CYCLES 460/3/60
MFR ____ BEARINGS BALL LUBE GREASE
TYPE HORIZONTAL INSUL B FULL LOAD AMPS ____
ENC TEFC TEMP RISE, C 80 LOCKED ROTOR AMPS ____
○ VHS ○ VSS VERT. THRUST CAP., LB ____ SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 550
MOTOR 490 TURBINE ____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED ____

* TYPICAL INFORMATION FROM WARMAN CATALOG

FORM NO. 130 (REVISED SEPT '72)

NO.	DATE		BY	CH	PE	
0	12/18/80	ISSUE FOR PHASE ZERO	AK	MM	MP	HWH

BECHTEL

JOB NO.	DRAWING NO.	REV.
14222	31-DS-G-25	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-G-142
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/30/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT — SITE BRECKINRIDGE COUNTY, KENTUCKY
UNIT 31- POWER PLANT. — SERVICE FIRE WATER BOOSTER PUMP
NO. PUMPS REQ'D 1 — NO. MOTORS REQ'D 1 — ITEM NO. SEE BELOW — PROVIDED BY PUMP VENDOR — MTD BY PUMP VENDOR
NO. TURBINES REQ'D N/A — ITEM NO. N/A — PROVIDED BY N/A — MTD BY N/A
PUMP MFR INGERSOLL RAND * — SIZE AND TYPE 2X1½X6 H/HC * — STAGES — SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID FIRE WATER — U.S. GPM at PT. NOR 100 — RATED 100
DISCH. PRESS., PSIG 200
PT. F. NOR. 85F — MAX. 85F — SUCT. PRESS., PSIG MAX. 100 — RATED 100
SP. GR. at PT .998 — DIFF. PRESS., PSI 100
VAP. PRESS. at PT. PSIA 11.5 — DIFF. HEAD, FT
VIS. at PT. Ssu — CP 0.80 — NPSHA, FT 15
CORR/EROS. CAUSED BY NONE — HYD. HP 5.8

PERFORMANCE

PROPOSAL CURVE NO. 6HC-B1 (2/9/72)
RPM 3550 — NPSHR (WATER) 7
EFF. 67% — BHP RATED 3.7
MAX. BHP RATED IMP 10
MAX. HEAD RATED IMP 160
MIN. CONTINUOUS GPM 0
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	2	150 #	F.F.	SIDE
DISCHARGE	1½	150 #	F.F	TOP

CASE-MOUNT: ☐ CENTERLINE ■ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ■ MAX. ALLOW. 125 PSIG 250 °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ■ DRAIN ☐ GAGE
IMPELLER DIA: ■ RATED 5½" ■ MAX. 6⅛" ■ TYPE: CLOSED
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ● PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ■ MFR & MODEL JOHN CRANE API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

■ CASE/TRIM CLASS ○
204 / IMPELLER 165 *
CASING RING 673 *
BASEPLATE ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM N/A ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID N/A ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN N/A ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID N/A

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL, ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER 31-GP-142

HP 10 — RPM 3600 — FRAME 21ST — VOLTS/PHASE/CYCLES 460/3/60
MFR — BEARINGS BALL — LUBE GREASE
TYPE HORIZONTAL — INSUL CLASS B — FULL LOAD AMPS
ENC TEFC — TEMP RISE, C 80 — LOCKED ROTOR AMPS
○ VHS ○ VSS — VERT. THRUST CAP., LB. — SERVICE FACTOR 1.0

TURBINE DRIVER

N/A

APPROX. WT. PUMP & BASE 130
MOTOR 145 — TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* TYPICAL INFORMATION FROM INGERSOLL-RAND CATALOG

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CHK	PE	CHK	JOB NO.	DRAWING NO.	
0	12/30/80	ISSUE FOR PHASE ZERO	AK	GB	WP	MWR	14222	31-DS-G-26	0
							SHEET 1 OF 1		

4.6 Data Sheets for Compressors and Drivers

31-DS-K-1: Transport Air Blowers (31K-103 A, B, C, D, E, F, G, H)

31-DS-K-2: Seal Air Booster Blowers (31K-104 A, B, C, D, E, F, G, H)

31-DS-K-3: Aeration Blowers (Silo) (31K-105 A, B)

31-DS-K-4: Truck Chute Exhaust Fans (31K-106 A, B)

31-DS-KT-1: Induced Draft Fans (31KT-101 A, B, C, D)

31-DS-KT-2: Forced Draft Fans (31KT-102 A, B, C, D)

BLOWER **DATA SHEET**

JOB NO. 14222 ITEM NO. 31-K-103 A THRU 103

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE 12/22/80 REVISION 0

FOR BRECKINRIDGE PROJECT

UNIT 31- POWER PLANT

SITE BRECKINRIDGE COUNTY, KENTUCKY

SERVICE TRANSPORT AIR BLOWERS

Quantity Per Boiler	-	2-100% Capacity
Type	-	Positive Displacement
Capacity, CFM	-	1750
Discharge Pressure, psig	-	15
Motor, hp	-	200

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY				JOB NO.	DRAWING NO.	REV.
0	12/22/80	ISSUE FOR PHASE ZERO	AR	[illegible]	UP	[illegible]	14222	31-DS-K-1	0
NO.	DATE		BY	CH	PE	[illegible]	SHEET 1 OF 1		

BLOWER **DATA SHEET**

JOB NO. 14222 ITEM NO 31-K-104A THRU

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE 12/22/80 REVISION 0

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY

UNIT 31 - POWER PLANT SERVICE SEAL AIR BOOSTER BLOWERS

Quantity Per Boiler	-	2-100% Capacity
Type	-	Centrifugal
Capacity, CFM	-	36
Discharge Pressure, psig	-	17
Motor, hp	-	2

FORM NO 130 (REVISED SEPT 73)

NO.	DATE		BY				JOB NO.	DRAWING NO.	
0	12/22/80	ISSUE FOR PHASE ZERO	AR				14222	31-DS-K-2	0
NO.	DATE		BY	CH	PE		SHEET 1 OF 1		

BLOWER **DATA SHEET**

JOB NO. 14222 ITEM NO. 31-K-105A&B

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE 12/22/80 REVISION 0

FOR BRECKINRIDGE PROJECT

UNIT 31- POWER PLANT

SITE BRECKINRIDGE COUNTY, KENTUCKY

SERVICE AERATION BLOWERS (SILO)

Quantity	-	2-100% Capacity
Type	-	Centrifugal
Capacity, CFM	-	3,000
Discharge Pressure, psig	-	11
Motor, hp	-	200

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE		JOB NO.	DRAWING NO.	REV.
0	12/22/80	ISSUE FOR PHASE ZERO	AR	[illegible]	WP	[illegible]	14222	31-DS-K-3	0

SHEET 1 OF 1

BLOWER **DATA SHEET**

JOB NO. 14222 ITEM NO 31-K-106A & B
PURCHASE ORDER NO
REQUISITION NO.
INQUIRY NO.
DATE 12/22/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31 - POWER PLANT

SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE TRUCK CHUTE EXHAUST FAN

Quantity	-	2-100% Capacity
Type	-	Centrifugal
Capacity, CFM	-	400
Discharge Pressure, in. water	-	19.6
Motor, hp	-	5

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	
0	12/22/80	ISSUE FOR PHASE ZERO	AK		WP	

JOB NO. 14222 | DRAWING NO. 31-05-K-4 | REV. 0
SHEET 1 OF 1

GENERAL PURPOSE STEAM TURBINE DATA SHEET

31-KT-101A
31-KT-101B
31-KT-101C

JOB NO. 14222-000 ITEM NO. 31-KT-101D
PURCHASE ORDER NO. _____
REQUISITION NO. _____

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE FAN DRIVE
MANUFACTURER _____

UNIT PLANT 31 - POWER PLANT
SERIAL NO. _____ NO. REQUIRED TWO
DRIVEN EQUIPMENT INDUCED DRAFT FAN
MODEL _____

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	600	3600	
NORMAL	450	3600	

STEAM CONDITIONS	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG		50	

MAX. EXHAUST CASING PRESSURE 100 PSIG
COOLING WATER IN 80 PSIG 95 °F OUT _____ ΔP (6H)
● WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP _____ DOWN _____
SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

☐ NO. HAND VALVES, AVAIL _____ FURNISHED _____
ROTATION, FACING GOVERNOR END ○ CW ○ CCW

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ____ ○ MECH ● HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS _____% MINUS _____%
● HAND SPEED CHANGER (30a)
○ ELECTRICAL HAZARD _____ CLASS _____ GR _____ DIV (6i)
● REMOTE TRIP SIGNAL _____ (30m)
● BASEPLATE ○ SOLEPLATE BY _____ (19a)
● EXTENDED FOR GEAR ○ FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED _____ (15d)
● MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (16a-d)
● INSULATION ● JACKET ● SENTINEL WARNING VALVE

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS _____ (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ _____ PSIG EXH CASE ☐ _____ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE DRG NO. _____ SEC. DRG NO. _____

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED	19.8		
NORMAL	22.8		

☐ NORMAL EXHAUST TEMPERATURE _____ °F
☐ COOLING WATER REQ'D _____ GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES _____

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ● HORIZ SUPPORT ☐ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ● HORIZ ☐ NO. STAGES _____
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA. _____
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ○ HYDR
INTERSTAGE GLAND SEALS ○ CARBON ● LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ☒ LABYRINTH NO. RINGS/BOX ____
BEARINGS, RADIAL _____ THRUST _____

● LUBE SYSTEM
○ RING OILED ○ PURCHASERS SYSTEM OTHER _____
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

MATERIALS (25a)

☒ HIGH-PRESS. CASING	ASTM A216 WCB	EXH CASING	ASTM A216 WCB
☒ NOZZLES	Steel	WHEELS	
☒ SHAFT	Hot Rolled Alloy Steel	UNDERPACKING	
☒ GOV VALVE TRIM	D-2 Ni Resist		

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	3"	600#	R.F	SIDE
EXHAUST	6"	150#	R.F	SIDE

☒ RPM MAX. CONT _____ TRIP _____ 1ST CRITICAL _____ (17a)
☒ CASING DESIGN INLET 700 PSIG 750 °F EXH 100 PSIG
☒ MAX. ALLOWABLE RPM _____ WEIGHT _____ LB

GEAR FURNISHED BY TURBINE SUPPLIER (23a-f)
TYPE VARIABLE SPEED RATIO _____
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

R&C Form 50 (8/73)

NO.	DATE		DR'N	CK'D	P.E.	CL'T'N	JOB NO.	DRAWING NO.	REV.
0	12/8/80	ISSUED FOR PHASE ZERO		JB.	HH	HWH	14222	31-DS-KT-1	0

SHEET 1 OF 1

GENERAL PURPOSE STEAM TURBINE DATA SHEET

31-KT-102A
31-KT-102B
31-KT-102C
31-KT-102D

JOB NO. 4222-000 ITEM NO. 31-KT-102D
PURCHASE ORDER NO.
REQUISITION NO.

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE FAN DRIVE
MANUFACTURER

UNIT PLANT 31 - POWER PLANT
SERIAL NO. NO. REQUIRED FOUR
DRIVEN EQUIPMENT FORCED DRAFT FAN
MODEL

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHER: ☐ BY MANUFACTURER
PARAGRAPH NUMBERS WITHIN ( ) REFER TO APPLICABLE PARTS OF STANDARD API 611

OPERATING CONDITIONS

	HORSEPOWER	SPEED, RPM	
RATED	500	3600	
NORMAL	375	3600	

PERFORMANCE AT NORMAL STEAM CONDITIONS

CONDITION	STEAM RATES	HAND VALVE POSITION	
	LB/HP/HR	NO. OPEN	NO. CLOSED
RATED			
NORMAL	22.2		

STEAM CONDITIONS

	MAX.	NORMAL	MIN.
INLET PSIG		600	
TEMP °F		700	
EXHAUST PSIG IN HG ABS		30	

☐ NORMAL EXHAUST TEMPERATURE ____ °F
☐ COOLING WATER REQ'D ____ GPM
☐ POTENTIAL MAX. HP WITH NEW NOZZLES ____

MAX. EXHAUST CASING PRESSURE 100 PSIG
COOLING WATER IN ____ PSIG ____ °F OUT ____ ΔP (6H)
● WINTERIZATION
○ DRIVEN EQUIP. THRUST LB UP ____ DOWN ____
SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

CONSTRUCTION FEATURES

TURBINE TYPE ○ VERT ● HORIZ SUPPORT ☐ CL ☐ FOOT (7)
CASING SPLIT ○ VERT ● HORIZ ☐ NO. STAGES ____
SINGLE STAGE ☐ 2 ROW ☐ 3 ROW ☐ REENTRY ☐ WHEEL DIA. ____
TRIP VALVE ○ INTEGRAL ○ SEPARATE ○ MECH ○ HYDR
INTERSTAGE GLAND SEALS ○ CARBON ● LABYRINTH (15b)
END GLAND SEAL ☐ CARBON ☐ LABYRINTH NO. RINGS/BOX ____
BEARINGS, RADIAL ____ THRUST ____

☐ NO. HAND VALVES, AVAIL. ____ FURNISHED ____
ROTATION, FACING GOVERNOR END ○ CW ● CCW

● LUBE SYSTEM
○ RING OILED ○ PURCHASERS SYSTEM OTHER ____
○ CORROSION RESISTANT OIL DRAIN LINES (12g)

ACCESSORIES

NEMA OIL
GOVERNOR TYPE CLASS ____ ○ MECH ○ HYDR ○ RELAY (30h-i)
ADJUSTABLE SPEED RANGE PLUS ____ % MINUS ____ %
● HAND SPEED CHANGER (30a)
○ ELECTRICAL HAZARD ____ CLASS ____ GR ____ DIV (6i)
● REMOTE TRIP SIGNAL ____ (30m)
● BASEPLATE ○ SOLEPLATE BY ____ (19a)
● EXTENDED FOR GEAR ○ FOR DRIVEN MACHINE
○ GLAND CONDENSER MOUNTED ____ (15d)
● MOUNT COUPLING HALF ● TAPER SHAFT ○ STRAIGHT (16a-d)
● INSULATION ● JACKET ● SENTINEL WARNING VALVE

MATERIALS

ASTM (25a)
☐ HIGH-PRESS. CASING A216 WCB EXH CASING A216 WCB
☐ NOZZLES STEEL WHEELS ____
☐ SHAFT 17-4 PH SOLID ALLOY UNDERPACKING ____
☐ GOV VALVE TRIM NITRIDE

CONNECTIONS	SIZE	USASI RATING	FACING	POSITION
INLET	3"	600#	R.F	SIDE
EXHAUST	6"	150#	R.F	SIDE

TESTS AND INSPECTION

R = REQUIRED W = WITNESSED
INSPECTION ○ SURFACE PARTS ____ (31c)
○ NO-LOAD RUN ○ DISASSEMBLY AFTER TEST
HYDRO INLET ☐ ____ PSIG EXH CASE ☐ ____ PSIG
○ PERFORMANCE ○ AUX EQUIP.
○ GOV RESPONSE TO CONTROL SIGNAL
○ OUTLINE ORG NO. ____ SEC. ORG NO. ____

☐ RPM MAX. CONT ____ TRIP ____ 1ST CRITICAL ____ (17a)
☐ CASING DESIGN INLET 700 PSIG 750 °F EXH 100 PSIG
☐ MAX. ALLOWABLE RPM ____ WEIGHT ____ LB

GEAR FURNISHED BY TURBINE SUPPLIER (23a-f)
TYPE FIXED SPEED RATIO ____
NOTE: FOR ADDITIONAL GEAR INFORMATION USE DATA SHEET FROM API STD 613

REMARKS:

NO.	DATE		DES	CHD	PE	CHK'D	JOB NO.	DRAWING NO.	
0	12/9/90	ISSUED FOR PHASE ZERO		98	LP	HNH	4222	31-DS-KT-2	0
							SHEET 1 OF 1		

Form 50 (8/73) R&C

4.7 Data Sheets for Electrical Generating Equipment

31-DS-P-1: Synchronous Generator (31P-101 A, B)

31-DS-PT-1: Single Automatic Extraction Condensing (31PT-101 A, B)

SYNCHRONOUS GENERATOR DATA SHEET SPECIAL	GENERATOR NUMBER	31-P-101A	31-P-101B
	SERVICE	Essential Service	Essential Service
	P.O. NUMBER		

Generator Rating at 30 psig H_2 pressure

1. KW	26,800	26,800
2. Manufacturer		
3. Frame		
4. Power Factor	.85	.85
5. KVA	31,530	31,530
6. RPM	3,600	3,600
7. No. of Poles	2	2
8. Phase	3	3
9. Cycles	60	60
10. Voltage	13,800	13,800
11. Full Load Amperes	1,319	1,319
12. Connection	Wye	Wye
13. SCR	.58	.58
Generator Constants at 31.5 MVA Base		
14. Xd	1.7	1.7
15. X'dv	.25	.25
16. X"dv	0.16	0.16
Exciter		
17. KW	90	90
18. Volts	250	250
19. Type	STATIC EXCITATION	

IRM 1828 (3/77)

RCC SF

NO.	DATE	REVISIONS	BY	CH'K	APP'D
					HWH
0	12/24/80	Issued for Phase Zero			

ORIGIN

BECHTEL

BRECKINRIDGE PROJECT
PLANT 31

JOB No. 14222

DRAWING NO. 31-DS-P-1

REV 0

SHEET 1 OF 1

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET

31-PT-101A
31-PT-101B

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT
FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY KENTUCKY
SERVICE ELECTRIC GENERATOR DRIVE
MANUFACTURER

UNIT PLANT 31- POWER PLANT
MODEL NO.
TYPE SINGLE AUTOMATIC EXTRACTION CONDENSING
NO. REQUIRED 2 SERIAL NO.

NOTE: ○ Indicates information to be completed by PURCHASER ☐ by MANUFACTURER

OPERATING CONDITIONS

INDICATE GUARANTEE POINT BY *

	POWER, KW	SPEED, RPM	STEAM RATE LB/Hp – HR
■ Rated			
☐ Normal	26200	3600	VARIABLE
☐			

■ Steam Rates Based on Output Shaft of: ■ Turb. ☐ Gear
Exhaust Enthalpy @ Rated Point 1029 BTU/LB

SPEEDS:
Criticals: 1st ____ RPM 2nd ____ RPM Trip ____ RPM
Max. Continuous 3600 RPM

STEAM CONDITIONS:

● INLET STEAM
Rated (Normal) 900 PSIG 750 °FTT
Maximum ____ PSIG ____ °FTT
Minimum ____ PSIG ____ °FTT

● EXHAUST STEAM:
Rated (Normal) 3.5 /In. HgA 120 °FTT
Maximum 5.0 /In. HgA 134 °FTT
Minimum 2.0 /In. HgA 101 °FTT

● EXTRACTION STEAM ✓ Controlled ___ Uncontrolled
Rated (Normal) 600 PSIG 665 °FTT
Maximum ____ PSIG ____ °FTT
Minimum ____ PSIG ____ °FTT
Flow (lb/hr) 57800 Normal ____ Max ZERO Min

○ ADMISSION STEAM ___ Controlled ___ Uncontrolled
Rated (Normal) ____ PSIG ____ °FTT
Maximum ____ PSIG ____ °FTT
Minimum ____ PSIG ____ °FTT
Flow (lb/hr) ____ Normal ____ Max ____ Min

■ Max Throttle Flow 325300 lb/hr
■ Max. Flow to Condenser 267500 lb/hr @ 3.5 In. HgA
■ Max. Exhaust Temp in Operation 140 °F
☐ Max BHP Required @ Min/Inlet Max Exh ____ Bhp

DUTY:
● Continuous ○ Intermittent ○ Auto Start

LOCATION:
○ Indoor ○ Heated ○ Under Roof
● Outdoor ● Unheated ○ Partial Sides
○ Grade ● Mezzanine
● Winterization Req'd ○ Tropicalization Req'd

SITE DATA
○ Elevation ____ Ft. ○ Bar ____ PSIA/In.HgA
○ Temperature ____ °F Summer ____ °F Winter
○ Relative Humidity ____ % Design Wet Bulb ____ °F

UNUSUAL CONDITIONS
○ Dust ○ Fumes
○ Other

CONSTRUCTION FEATURES

TURBINE TYPE:
● Horizontal ○ Vertical ☐ Single-Valve ■ Multi-Valve
☐ No. Stages: ____ Impulse ____ Reaction
☐ Overspeed Trip Device ____ Mech ✓ Elect ✓ Hyd
● Casing Split: ✓ Horizontal ____ Vertical
☐ Rotor: ✓ Solid ____ Built-Up ____ Combination
☐ Rotation (Facing Gov. End.): ____ CW ____ CCW
☐ Exhaust Flow ____ Single ____ Double

GOVERNOR TYPE:
● Electronic ■ Hydraulic ○ Oil Relay ○ Direct Acting
○ NEMA Class
○ Governor MFR ☐ Model
☐ Synch. Motor ____ HP ■ Oil Cooler ■ Oil Heater
☐ Power Cylinder ○ Governor Purge Required
○ Stn. Stl. Pins & Bushings in Gov-Linkage
○ Isochronous Control ● Speed Droop Control
☐ Speed Changer ___ Manual ___ Pneumatic ___ Electronic
☐ Speed Range ____ RPM @ ____ PSIG/mA to ____ RPM @ ____ PSIG/mA

VALVES:

	Cam Lift	Bar Lift	Grid Valve
☐ No. Auto Gov Valves	—	—	—
☐ No. Auto Extr Valves	—	—	—
☐ No. Auto Adm Valves	—	—	—

■ Separate Trip & Throttle Valve ✓ Hyd ___ Mech
✓ Remote Trip ___ Manual Actuation
___ Spring Support Req'd ✓ Manual Excersiser
● Extraction Non-Return Valve ✓ Hyd ___ Mech
✓ Remote Trip ✓ Manual Actuation
○ Admission Stop Valve ___ Hyd ___ Mech
___ Remote Trip ___ Manual Actuation
○ Auto Valves arranged to close on Trip ✓ Yes ___ No

BLADES (BUCKETS):
☐ Max Tip Speed ____ FPS
☐ Final Stage Blade Length ____ in Max Length ____ in
☐ Nozzle Ring ____ % Admission ____ Welded ____ Removable
☐ Blade Root ____ Dovetail ____ "T" ____ Fir Tree
☐ Shrouds: ____ Welded ____ Riveted ____ Wire Oamo

No.	DATE	REVISIONS	BY	CHK'D	DESIGN SUPV	ENG'R	PROJ ENGR	APPR
2								
1								
0		ISSUED FOR PHASE ZERO				SB	HP	HNH

SCALE NONE | DESIGNED | DRAWN | CHIEF ENGR
ORIGIN
JOB No. 4222
DRAWING No. 31-DS-PT-1 REV. 0

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET

"A" SIZE A&C Form 8 (5/80) SHEET 1 OF 7

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

CONSTRUCTION FEATURES

BEARING HOUSING CONSTRUCTION:

☐ Type (Separate, Integral) _____ Split _____

☐ Material _____

RADIAL BEARINGS:

☐ Type _____ Brg. Span (In.) _____

☐ Area (In^2) _____ Loading (PSI): Act. _____ Allow. _____

THRUST BEARING:

☐ Location _____ Type _____

☐ MFR _____ Area (In^2) _____

☐ Loading PSI Act. _____ Allow. _____

PACKING TYPE:

☐ Interstage Gland Seals LABYRINTH

☐ End-Gland Seals LABYRINTH No. Per Box _____

☐ ΔP Per Seal _____ PSI ☐ Material _____

● Insulation CALCIUM SILICATE Jacket Material ALUMINUM

☐ Total Expected Leakage _____ Lb/Hr. _____

☐ Labyrinth Type _____ Stationary _____ Rotating

GLAND SEALING SYSTEM ○ See Separate Data Sheet Attached

● Gland ~~Condenser~~ SPRAY TANK w/Mounting Feet Req'd.

○ Steam Ejector Req'd. _____ PSIG _____ °FTT

○ Vacuum Device Req'd. ○ Compound Press. Gauge Req'd.

○ Auto. Pressure Control Valve (Motive Steam) (Sealing Steam)

● Gld. Cond. Drain: ✓ Loop Seal ___ Vertical Leg

___ Other _____

☐ Minimum Cond. Drain Height _____ In.

● Relief Valve on Sealing Steam Header

CAPABILITIES:

☐ Max. Steam Thru Inlet Valve _____ lb/hr*

☐ Max. Steam Thru Exhaust Valve _____ lb/hr*

☐ Steam Inlet Parts:

Max. Allow Press. _____ PSIG Temp _____ °F

☐ Exhaust End Casing:

Max. Allow. Pressure _____ PSIG/In. HgA

Max. Allow. Temperature _____ °F

Max. Expected Temp. During No-Load Run-in _____ °F

☐ Sentinel Warning Valve Set @ _____ PSIG

☐ Hydrostatic Test Pressure:

Steam Inlet Parts _____ PSIG

Exhaust End _____ PSIG/In. HgA

☐ Future Potential Maximum Horsepower _____ BHP*

* With Minor Modifications

TURBINE MATERIALS:

☐ High Press. Casing _____

☐ Exhaust Casing _____ ☐ Mid Casing _____

☐ Nozzles _____ ☐ Blades _____

☐ Wheel _____ ☐ Shaft _____

☐ Steam Chest _____

☐ Diaphrams _____

☐ Nozzle Rings _____

☐ Shrouds _____

☐ Gov. Valve Trim _____

☐ Labyrinth Seals _____

Shaft Materials under Seals _____

___ Applied By ___ Spraying ___ Placing ___ Sleeves

MAIN CONNECTIONS:

	SIZE	ANSI RATING	FACING	POSITION
☐ Inlet				
☐ Exhaust				
☐ Extraction				
☐ Admission				

ALLOWABLE PIPING FORCES AND MOMENTS:

	INLET FORCE MOM'T		EXHAUST FORCE MOM'T		EXTR./ADM. FORCE MOM'T	
	LB	FT LB	LB	FT LB	LB	FT LB
☐ Parallel to Shaft						
☐ Vertical						
☐ Horiz 90°						

OTHER CONNECTIONS:

SERVICE	NO.	SIZE	ANSI RATING	FACING
☐ Lube Oil Inlet				
☐ Lube Oil Outlet				
☐ Gland Condenser Conn				
☐ Staging Drains				
☐ Steam Ring Drain				
☐ T&T Valve H.P. Stem Leakoff				
☐ T&T Valve L.P. Stem Leakoff				
☐ T&T Valve Above Seat Drain				
☐ T&T Valve Below Seat Drain				
☐ Cooling Water Conn.				
☐ Purge for Brg Housing				
☐ Exhaust Case				

BASEPLATES & SOLEPLATES:

○ Baseplate By _____

○ Decked with Non-Skid Deck Plate ○ Open Construction

○ Drip Rim _____ With Open Drain _____

● Under Turbine Only ___ Other AND GENERATOR

● Soleplate By VENDOR

● Horiz. Adjusting Screws for Equipment BY VENDOR.

● Furnish SS Shims

○ Foundation Bolts Furn. By: _____ Vendor ✓ Purchaser

■ Leveling (Chock) Blocks Req'd.

REFERENCE SPECIFICATION:

API 612 SPECIAL PURPOSE STEAM TURBINE N/A

Form 8 (5/80) SHEET 2 OF 7 R&C

DATA SHEET NO. 3605-PT-1 REV. 0 SHEET 2 OF 7

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

UTILITIES

COOLING WATER:

	NORM	MAX	DESIGN
● Supply Pressure, PSIG	80	100	100
● Supply Temp., °F	90	95	95
● Pressure Drop, PSI			

○ Max. Temperature Rise Allowed _____ °F

□ Quantity Required

____ GPM For _____

____ GPM For _____

AUXILIARY STEAM SUPPLY:

○ Supply Pressure, PSIG

Normal ____ Max ____ Min ____

○ Temperature ____ °F Nor ____ Max ____ Min ____

□ Quantity Required

____ Lbs/Hr For _____

____ Lbs/Hr For _____

INSTRUMENT AIR SUPPLY:

● Pressure PSIG ____ Max. ____ Min.

AUXILIARY MOTORS:

● 460 Volts 3 Phase 60 Hertz

INSTRUMENTATION

Gauge Readout In ■ English □ SI □ Dual □ Other _____

NOTE: □ SUPPLIED BY VENDOR ○ SUPPLIED BY PURCHASER Δ LOCATED ON A MACHINE MOUNTED INSTRUMENT BOARD

PRESSURE GAGE REQUIREMENTS:

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	FUNCTION	LOCALLY MOUNTED	LOCAL PANEL
Lube Oil Pump Discharge	■ ○ Δ	□ ○	1st Stage Steam	■ ○ Δ	□ ○
Lube Oil Filter ΔP	■ ○ Δ	□ ○	Steam Chest	■ ○ Δ	□ ○
Lube Oil Supply	■ ○ Δ	□ ○	Exhaust Steam	■ ○ Δ	□ ○
Gov. Control Oil	■ ○ Δ	□ ○	Extraction Steam	■ ○ Δ	□ ○
Gov. Control Oil ΔP	■ ○ Δ	□ ○	Steam Ejector	□ ○ Δ	□ ○
Coupling Oil ΔP	□ ○ Δ	□ ○	Steam Seal	■ ○ Δ	□ ○
Main Steam Inlet	■ ○ Δ	□ ○		□ ○ Δ	□ ○

TEMPERATURE GAGE REQUIREMENTS:

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	FUNCTION	LOCALLY MOUNTED	LOCAL PANEL
Lube Oil Discharge From Each ____	■ ○ Δ	□ ○	Cooler Oil Inlet & Outlet ____	■ ○ Δ	□ ○
Turbine Journal Bearing ____	■ ○ Δ	□ ○	Steam Inlet ____	■ ○ Δ	□ ○
Turbine Thrust Bearing ____	■ ○ Δ	□ ○	Steam Exhaust ____	■ ○ Δ	□ ○
Gear Journal Bearing ____	■ ○ Δ	□ ○	____	□ ○ Δ	□ ○

ALARM & SHUTDOWN FUNCTIONS

FUNCTION	PRE ALARM	TRIP	FUNCTION	PRE ALARM	TRIP
■ ○ Low Lube Oil Pressure Ea. Level			■ ○ Turbine Vibration		
■ ○ Hi Oil Filter ΔP			■ ○ Turbine Axial Position		
■ ○ Aux Lube Oil Pump Start			■ ○ Trip & Throttle Valve Position		
■ ○ Hi Oil Cooler Outlet Temp.			■ ○ HI Turb. Steam Seal Leakage		
■ ○ Low Control Oil Pressure			■ ○ HI Turb. Exh. Pressure		
□ ○			■ ○ HI Turb. Ext. Pressure		
□ ○			■ ○ Turb. Overspeed Trip Operation		

MISCELLANEOUS INSTRUMENTATION:

■ ○ Turbine Speed Pick-Up Devices □ Electronic □ Other _____

■ ○ Turbine Speed Indicators

■ ○ Turbine Speed Indicators Located On □ Local Panel ■ Main Board Type ■ Digital □ Dial Gauge

■ ○ Remote Hand Speed Changer

□ ○ Alarm Horn & Acknowledgement Switch on Panel (Local) (Main)

□ ○ _____

□ ○ _____

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

COUPLING:

● Mount 1/2 Coupling ● Type MANUFACT. STD.
☐ MFR
☐ Spacer Req'd
● Coupling Furnished by MANUFACT.
☐ Keyed (1) or (2), or Hydr. Fit
☐ Cplg. Coeff. Frict ____ Cplg. Gear Pitch Dia. ____ In.
Turbine Shaft. ____ Taper ✓ Cylindrical
Generator Shaft: ____ Taper ✓ Cylindrical
Coupling Guard: ✓ Mfr. Std. ____ Other
☐ Lubrication Req'd. ____ Yes ✓ No

COMPOSITE TORSIONAL ANALYSIS:

○ Required ○ By

LATERAL CRITICAL SPEED ANALYSIS:

○ Required ○ By

SHOP INSPECTION AND TESTS:

	REQ'D	WITNESS
○ Shop Inspection	○	○
○ Hydrostatic (Piping, Casing, Condenser)	○	○
○ Blade Shaker (Static) — Rows	○	○
○ Rotor Balance: ___ Vacuum Pit ___ Std.	○	○
○ Rotor Thermal Stability	○	○
○ Mechanical Run: ___w/Job Cplg. 1/2	○	○
○ Run Spare Rotor: ___w/Job Cplg. 1/2	○	○
○ Performance Test: ___Part Load ___Full Load	○	○
○ Functional Test: ___T & T Valve	○	○
___Turning-Gear	○	○
___Gland Condenser	○	○
___Sealing System	○	○
___Lube Oil System	○	○
○ Governor Stability	○	○
○ Turb. Run at Overspeed and Trip	○	○
○ Use Shop Lube System	○	○
○ Use Job Lube System	○	○
○ Use Job Vib & Axial Disp. Probes,	○	○
○ Oscillator-Demodulators & Monitor	○	○
○ Use Shop Vibration Probes, etc.	○	○
○ X–Y–Y' Plot	○	○
○ Check Brg. & Seals after Test	○	○
○ Noise Level Test	○	○
○ Preparation for Shipment	○	○
○ FM Tape Recording (Vibration)	○	○
○ Cleanliness Inspection (Para. 4.2.6)	○	○
○ Hardness Tests (Para. 4.2.7)	○	○

OIL REQUIREMENTS:

	CONTROL OIL	LUBE OIL
☐ Max. Quantity, GPM		
☐ Pressure, PSIG		
☐ Temperature, °F		
Total Heat Reject BTU/Hr		

Oil Required for ____ T&T Valve ____ Hyd Non-Return Valve
☐ Oil Viscosity ____ SSU @ 100°F

VIBRATION DETECTORS:

● Type PROXIMITY ☐ Model SERIES 7000
● Mfr. BENTLY NEVADA
● No. at Each Shaft Bearing TWO Total No. ____
○ Oscillator Demodulators Supplied by
○ Mfr. ____ ☐ Model ____
● Monitor Supplied by VENDOR No. Channels ____
○ Location CONTROL RM. Enclosure ____
○ Mfr. B-N ☐ Model ____
☐ Scale Range ____ ○ Alarm ☐ Set @ ____ Mils
○ Shutdown ☐ Set @ ____ Mils ○ Time Delay ____ Sec.

AXIAL MOVEMENT DETECTORS:

● Type PROXIMITY ☐ Model SERIES 7000
● Mfr. BENTLY-NEVADA No. Required ONE
○ Oscillator Demodulators Supplied by
○ Mfr. ____ ☐ Model ____
● Monitor Supplied by VENDOR No. Channels ____
○ Location CONTROL RM. Enclosure ____
○ Mfr. B-N ☐ Model ____
☐ Scale Range ____ ○ Alarm ☐ Set @ ____ Mils
○ Shutdown ☐ Set @ ____ Mils ○ Time Delay ____ Sec.

KAYPHAZOR SENSOR:

● Type PROXIMITY ☐ Model SERIES 7000
● Mfr. BENTLY NEVADA ○ No. Required ONE
● Location TURBINE FRONT.
○ Oscillator Demodulators Supplied by
○ Mfr. ____ ☐ Model ____
● Monitor Supplied by VENDOR No. Channels ____
● Location CONTROL RM. Enclosure ____
● Mfr. B-N ☐ Model ____

BEARING TEMPERATURE DEVICES:

○ Thermistors
○ Type ___ Pos. Temp. Coeff. ___ Neg. Temp. Coeff.
○ Temp. Switch & Indicator By ___ Purch. ___ Mfr.
○ Thermocouples
○ Selector Switch & Indicator By ___ Purch. ___ Mfr.
● Resistance Temp. Detectors
○ Resistance Mat'l PLATINUM. ☐ 100 OHMS
○ Selector Switch & Indicator By: ___ Purch. ___ Mfr.
● LOCATION – JOURNAL BRG
No.: ___ Ea. Pad ___ Every Other Pad ___ Per Brg.
___Other
● LOCATION – THRUST BRG:
No. (Act): ___ Ea. Pad ___ Every Other Pad ___ Per Brg.
___Other
No. (Inact.): ___ Ea. Pad ___ Every Other Pad ___ Per Brg.
___Other
☐ Max. Bearing Temps.:
____ °F for Alarm ____ °F for Shutdown

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

BLOW OUT DISC

INSTRUMENTATION

EXHAUST ~~RELIEF VALVE~~ REQUIREMENTS:

- Max. Set Pressure 5 PSIG Exhaust
- Steam Flow 34 VENDOR. Lb/Hr
- Supplied By ____ Purchaser ✓ Vendor

EXTRACTION RELIEF VALVE REQUIREMENTS:

- Max. Set Pressure 650 PSIG Extraction
- Steam Flow 34 VENDOR Lb/hr
- Supplied By ____ Purchaser ✓ Vendor

AREA CLASSIFICATION

Class ____ Group ____ Division ____

MOTOR CONTROL & INSTRUMENT VOLTAGE

120 Volts 1 Phase 60 Cycles

ALARM & SHUTDOWN VOLTAGE

____ Volts ____ Phase ____ Cycles or ____ DC

Solenoid Voltage ____

LOCAL CONTROL PANEL:

Furnished By: ■ Vendor ☐ Purchaser ☐ Others ____

☐ Free Standing ■ Weatherproof ☐ Totally Enclosed ☐ Extra Cutouts

☐ Vibration Isolators ■ Strip Heaters ☐ Purge Connections ☐ With Doors

☐ Annunciator — Furnished By: ☐ Vendor ☐ Purchaser ☐ Others

☐ Annunciator located on ☐ Local Panel ■ Main Control Board

☐ Customer connections brought out to terminal boxes by vendor

Remarks: ____

INSTRUMENT SUPPLIERS:

Pressure Gages:	MFR.		Size & Type	
Temperature Gages:	MFR.		Size & Type	
Level Gages:	MFR.		Size & Type	
Diff. Pressure Gages:	MFR.		Size & Type	
Pressure Switches:	MFR.		Size & Type	
Diff. Pressure Switches:	MFR.		Size & Type	
Temperature Switches:	MFR.		Size & Type	
Level Switches:	MFR.		Size & Type	
Control Valves:	MFR.		Size & Type	
Pressure Relief Valves:	MFR.		Size & Type	
Thermal Relief Valves:	MFR.		Size & Type	
Sight Flow Indicators:	MFR.		Size & Type	
Pneu. Pressure Transmitters:	MFR.		Size & Type	
Vibration Equipment:	MFR.		Size & Type	
Tachometer:	MFR.		Size & Type	
Solenoid Valves:	MFR.		Size & Type	
Annunciator:	MFR.		Model & No. Points	
Thermocouples:	MFR.		Size & Type	
Resistance Temp. Detectors:	MFR.		Size & Type	
Thermowells:	MFR.		Size & Type	
	MFR.		Size & Type	
	MFR.		Size & Type	
	MFR.		Size & Type	

SWITCHES:

Enclosures ○ Explosion Proof ● Weatherproof ○ Other ____

Alarm Contacts shall: ☐ Open ☐ Close to Sound Alarm and be Normally ☐ Energized ☐ De-Energized

Shutdown Contacts shall: ☐ Open ☐ Close to Trip and be Normally ☐ Energized ☐ De-Energized

Note: Normal Condition is when Turbine is in Operation

MISCELLANEOUS:

Pre-Alarm and Shutdown Switches shall be separate.

Purchasers Electrical and Instrument Connections within the confines of the Baseplate and Console shall be:

■ Brought out to Terminal Boxes ☐ Made directly by the Purchaser

Comments Regarding Instrumentation: ____

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

GEAR ○ Separate Data Sheet Attached

○ Special Purpose Gear Required
○ Gear Furnished By _____

OIL SYSTEM

Furnished By ● Turbine Mfr. ☐ Others
○ Separate for Turbine Only
● Common with Driven Equipment
Turbine Mfr. to Supply:
○ Stainless Steel Oil Supply Header Piping
● Oil Drain Header Piping
○ Stainless Steel ● Carbon Steel

EMERGENCY TURNING GEAR

● Turning Gear Required ○ Quick Start Required
☐ Mfr. _____ ☐ Model _____
☐ Ratio _____
☐ Motor: ✓ Electric ____HP ____ Volts ○ AC ○ DC
____ Pneumatic ____ PSIG ____°F ____ SCFM
____ Auto Engage ✓ Manual Engage

PAINTING

● Manufacturer's Standard
○ Other _____

SHIPMENT

● Domestic ○ Export
● Export Boxing Required ● Outdoor Storage over 6 months
○ Water Proof Boxing Required
○ Spare Rotor Assembly Packaged for
○ Horizontal Storage ○ Vertical Storage

WEIGHTS:

☐ Turbine _____ lb.
☐ Rotor _____ lb.
☐ Turb. Upper 1/2 Casing _____ lb.
☐ Maximum for Maintenance (Identify) _____
_____ lb.
☐ Total Shipping Weight _____ lb.

SPACE REQUIREMENTS:

☐ Complete Unit: L_____in. W_____in. H_____in.
☐ Control Panel: L_____in. W_____in. H_____in.

MISCELLANEOUS:

● Provisions for Field Balancing
○ Vendor's Review and Comment on Purchaser's Piping and Foundation Drawings are Required
○ Shaft Grounding Devices
○ "Y" Type Strainer
○ Water Washing Connections
○ Optical Alignment Flats
● Insulation (Lagging) Required
○ Jacket Required
○ Axial Alignment Key
○ Blade Diagrams ____ Campbell ____ Goodman
____ Soderberg ____ Other _____
○ Metric/English ____ Drawings ____ External Flanges
____ Internal Bolting and Threads

SKETCH:

REMARKS: _____

Form 8 (5/80) SHEET 6 OF 7

R&C

DATA SHEET NO 3-05-PT-1 REV. 0 SHEET 6 OF 7

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

GLAND STEAM CONDENSER NOT APPLICABLE, TURBINES SUPPLIED WITH SPRAY TANK

OPERATING CONDITIONS

	SHELL SIDE	TUBE SIDE
○ Fluid		
□ Total Flow LBS/HR		
□ Specific Gravity	@ °F	@ °F
□ Thermal Cond. BTU/HR x SQ FT x °F	@ °F	@ °F
□ Specific Heat – BTU/LB x °F	@ °F	@ °F
□ Viscosity – SSU	@ °F	@ °F
□ Operating Temperatures, °F	IN OUT	IN OUT
Inlet Pressure, PSIG		
Inlet Velocity, FT/SEC		
○ Pressure Drop, PSI	ALLOW. CALC.	ALLOW. CALC.
□ Design Temperature, °F		
Pressure, PSIG	MIN. TEST	MIN. TEST
Foul Resistance, SQ FT x HR x °F/BTU		
○ Min Corrosion Allowance, In		
□ Number of Passes Per shell		

CONSTRUCTION DETAILS

- □ Total Area (1), Sq. Ft. _____
- □ LMTD _____
- □ Corrected MTD _____
- □ Transfer Rate, Clean _____
- □ Transfer Rate, Service _____
- □ Cross Baffles, Type _____
- ○ Code Requirements (2) _____ ASME; TEMA _____
- □ Weights Ea. Bundle _____ Lbs., Bundle & Shell _____ Lbs., Full of Water _____ Lbs.

- □ Shell, No. x ID. _____ x _____ IN
- □ Tubes, No. Per Shell _____
  - □ O.D. x Length _____ IN. x _____ IN.
  - □ Gauge, BWG _____ Avg., Min. Wall
  - □ Tube Pitch _____ IN. △ □ ◇
- □ Removable Tube Bundle □ YES □ NO
  - ○ Code Stamp □ YES □ NO

□ NOZZLE SIZES

	SHELL SIDE			TUBE SIDE		
	NO.	SIZE	RATING & FACING	NO.	SIZE	RATING & FACING
INLET						
OUTLET						
DRAIN						
VENT						

○ MATERIALS

- Tubes _____
- Tube Sheets _____
- Shell _____
- Shell Flanges _____
- Baffles _____
- Channel _____
- Channel Flanges _____
- Channel Nozzle Flanges _____

REMARKS: _____

(1) OUTSIDE TUBE AREA EXCLUDING AREA IN TUBE SHEETS

(2) UNITS EXEMPT FROM CODE STAMP SHALL HAVE LONGETUDINAL WELD SEAMS SPOT EXAMINED PER PARA UW-52 OF ASME CODE.

DATA SHEET NO. 31-05-PT-1 REV. 0 SHEET 7 OF 7

4.8 Data Sheets for Material Handling Equipment

31-DS-T-1: Coal Gallery Belt Conveyors and Trippers (31T-101 A, B)

31-DS-T-2: Coal Dust Collectors (31T-102 A, B, C, D, E)

31-DS-T-3: Coal Silo (31T-103 A, B, C, D, E, F, G, H, I, J, K, L)

31-DS-T-4: Pulverizer Feeders (31T-104 A, B, C, D, E, F, G, H, I, J, K, L)

31-DS-T-5: Coal Surge Bin (31T-105)

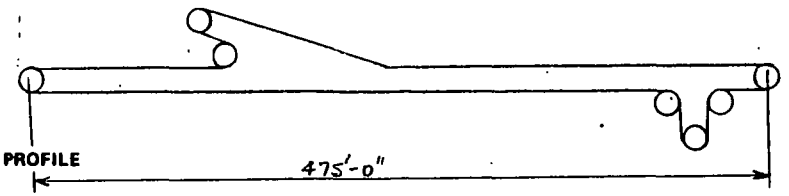
CONVEYOR DATA SHEET

MATERIAL:
Size COAL Weight 50 lbs/cf Temp. — to — F. ∠ of Repose 35°
Characteristics: LUMPY, AVERAGE FLOWING, ABRASIVE

CAPACITY AND POWER REQUIREMENTS –

Normal Capacity	150 STPH	Design Capacity	200 STPH
% of Max. Rated Capacity	66 %	Surcharge ∠	20 °
Calc. Power @ Design Cap.	– HP	Belt Speed	400 fpm

Conveyor Item No. 31-T-101 A&B
No. Req'd 2 (A&B)



DRIVE			BELT BF GOODRICH FIRE RETARDANT OR EQUAL Width - 24"	
MOTOR: Mfctr - GE OR EQUAL			RMA Grade	–
Type/Speed	TEFC/1750 RPM		Plies & Fabric	–
HP/Start. Torque	50/–		Taped Lgth w/o TU	–
REDUCER: Mfctr - FOOTE-JONES OR EQUAL			TU/Splice Allowances	–
Type	DOUBLE REDUCTION PARALLEL SHAFT		Max T1/Rated Tension	–
Size	–		Cover Thickness	Top: – Bottom: –
Ratio & Output Spd	–		Breaker Strip	–
Mech./Thermal HP	–		Weight per Ft.	–
			Type of Splice	–
			IDLERS: Mfctr - HEWITT-ROBINS OR EQUAL	

COUPLINGS	Hi Speed	Lo Speed
Manufacturer	ATH. STD.	FALK
Size & HP	–	–
Bore	–	–
V-BELTS—No. & Size	NONE	
Motor Sheave PD		
Driven Sheave PD		

Type	No. Req.	Series No.	Spacing
° Carrying	–		
° Impact	–		
° Carr. Train.	–		
Return	–		
Ret. Train.	–		

Lubrication: GREASE

HOLDBACK: Mfctr -		TAKE-UP	
Type & Torque Cap.		Type & Travel	GRAVITY TYPE
Location		TU Weight req'd	–

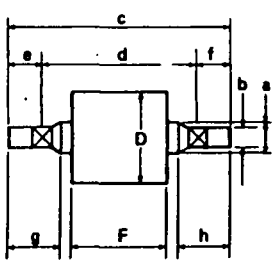
ACCESSORIES:
- ☑ Belt Cleaner — Type SCRAPPER
- ☑ Tripper — One (Two) Three Way — MOTOR propelled — ☑ with Bin Seal
- ☐ Belt Scale — Type —
- ☑ Return Belt Plow at Tail Pulley
- ☐ Tramp Iron Protection
  - ☐ Magnetic Head Pulley Electric/Permanent
  - ☐ Suspended Magnet
  - ☑ Pierced Belt Detector

SAFETY DEVICES:
- ☑ Sequence Start/Stop Control (E)
- ☑ Overload Protection (E) (M)
- ☑ Zero Speed Switch (M)
- ☑ Belt Alignment Switches (M)
- ☐ Emergency Stop Switch (E)
- ☑ Plugged Chute Detector (J)
- ☑ EMERGENCY PULL CORD SWITCH
- ☑ LIMIT SWITCHES
- ☐ _____
- ☐ _____

E – Electrical M – Mechanical J – Instrument

REMARKS:
1. TRAVELLING TRIPPERS ARE EQUIPPED WITH 2 INDEPENDENT ELECTRIC MOTOR DRIVES, 2HP, 460V/3 PHASE/60 HERTZ, 1800 RPM EACH.
2. FLUID COUPLING IS PROVIDED BETWEEN CONVEYOR MOTOR DRIVE & REDUCER AND GEARED COUPLING IS PROVIDED BETWEEN REDUCER & BELT DRIVE PULLEY.

PULLEYS & SHAFTS (Inches) —



Loc.	Face	D	F	a	b	c	d	e	f	g	h
①											
②											
③											
④⑤											
⑥											

Lagging:

BEARINGS: Mfctr -

Type	Series No.	Seal Type

Remarks:

No	DATE	REVISIONS	BY	CHKD	DES SUPV	ENGR	PROJ ENGR	APPR
6	1/1/80	ISSUE PHASE 0	AA	AA			LLP	HWH
SCALE		DESIGNED		DRAWN			CHIEF ENGR	

BECHTEL

BRECKINRIDGE PROJECT
PLANT 31
COAL GALLERY
BELT CONVEYORS & TRIPPERS DATA

JOB No.	DRAWING No.	REV
14222	31-DS-T-1	0

R&C ENG. FORM 238 (4/70)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 31-T-102A THR
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 1/7/81 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT
UNIT 31- POWER PLANT
SITE BRECKINRIDGE COUNTY, KENTUCKY
SERVICE COAL DUST

DUST COLLECTORS

Number of Dust Collectors Required - 5

Each Dust Collector Consists of:

Bag House - 1

Vent Fan - 1 - 4600 CFM @ 10" w.g. Sp
15 Hp

NO.	DATE		BY
0	1/7/81	ISSUE FOR PHASE ZERO	AA AA WP

JOB NO. 14222 | DRAWING NO. 31-DS-T-2 | REV. 0
SHEET 1 OF 1

TANK DATA

TANK NO.	31-T-103 A THRU T-103 L
SIZE, DIA. X HEIGHT (OVER ALL)	
CAPACITY ~~(42 GAL. BBLS)~~ Ft^3/TONS	7150/160
ROOF TYPE	FLAT
BOTTOM TYPE	CONICAL
FILLING RATE-~~BPH~~ TPH	200
EMPTYING RATE-~~BPH~~ TPH	9
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	AMBIENT
CORROSION ALLOWANCE	
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN ~~SPECIFIC GRAVITY~~ DENSITY, LBS/FT^3	45
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	12
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	
CO_2 INJECTION CONNECTION	4 - 2"
POKE HOLES	4 - 10"
VENT (DUST COLLECTION)	1 - 2'-0" X 1'-0"

GENERAL

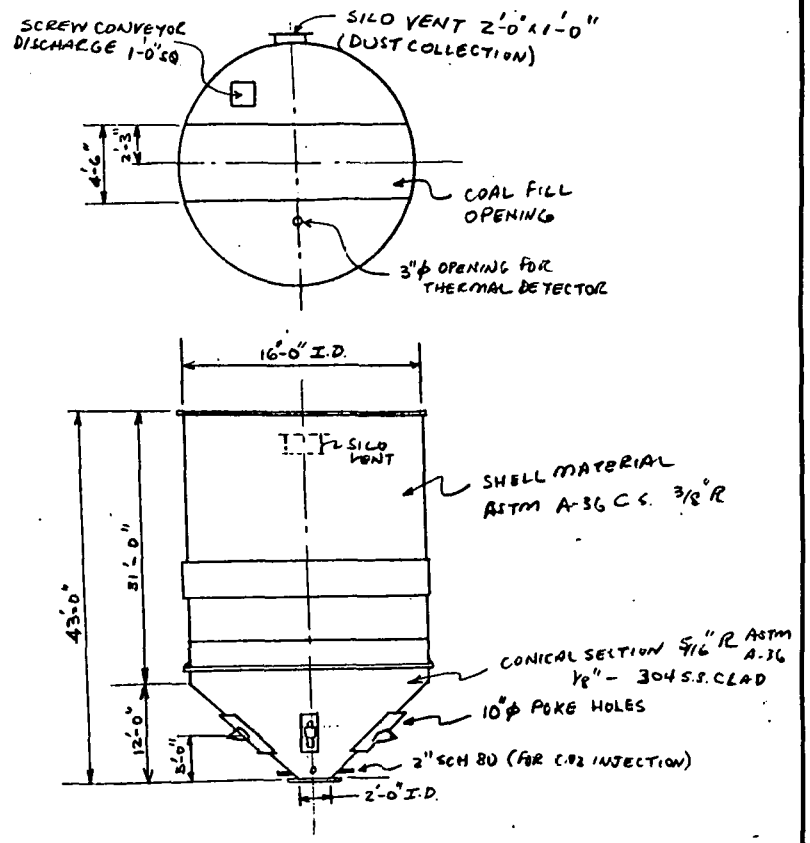
PAINTING	INORGANIC ZINC PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	
COAL FILL OPENING	1-4'-0" X 16'

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	
CIRCUMFERENTIAL STAIRS	
PLATFORM	
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



ITEM NO. 31-T-103A THRU L

COAL SILO

4	7/16	ISSUED FOR PHASE 2 REV	AK	AK					MP		
NO.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR.	CONST.	PROJ. ENGR.	CONST.			

SCALE | DESIGNED | DRAWN

BECHTEL

BRECKINRIDGE PROJECT
PLANT 31

TANK DATA &
LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-T-3	0

R&C S.F. Form 173 (4/77)

PULVERIZER FEEDER **DATA SHEET**

JOB NO. 14222 ITEM NO. 31-T-104A THRU L

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:

☐ BY MANUFACTURER

PURCHASE ORDER NO

REQUISITION NO.

INQUIRY NO.

DATE 12/18/80 REVISION 0

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY

UNIT 31 - POWER PLANT SERVICE COAL

Type	-	Gravimetric
Manufacturer	-	Stock Equipment Co. (or equal)
Feeder Capacity	-	Maximum-40,000 lbs/hr Minimum- 4,000 lbs/hr
Drive	-	Electric Motor 5 HP, 480 V, 3 phase, 60 hertz
No. Required	-	12

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE		JOB NO.	DRAWING NO.	REV.
0	12/18/80	ISSUE FOR PHASE ZERO					14222	31-DS-T-4	0

SHEET 1 OF 1

TANK DATA

TANK NO.	31-T-105
SIZE, DIA. X HEIGHT	
CAPACITY ~~142 GAL. BBLS~~ TONS	100
ROOF TYPE	FLAT
BOTTOM TYPE	
FILLING RATE-~~BPH~~ TPH	200
EMPTYING RATE-~~BPH~~ TPH	200
BEARING PLATES	
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	AMBIENT
CORROSION ALLOWANCE	
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN ~~SPECIFIC GRAVITY~~ DENSITY, LB/FT³	45
TOTAL NET WORKING CAP. – MBBLS	
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	

SHELL APPURTENANCES

SUCTION NOZZLE	
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

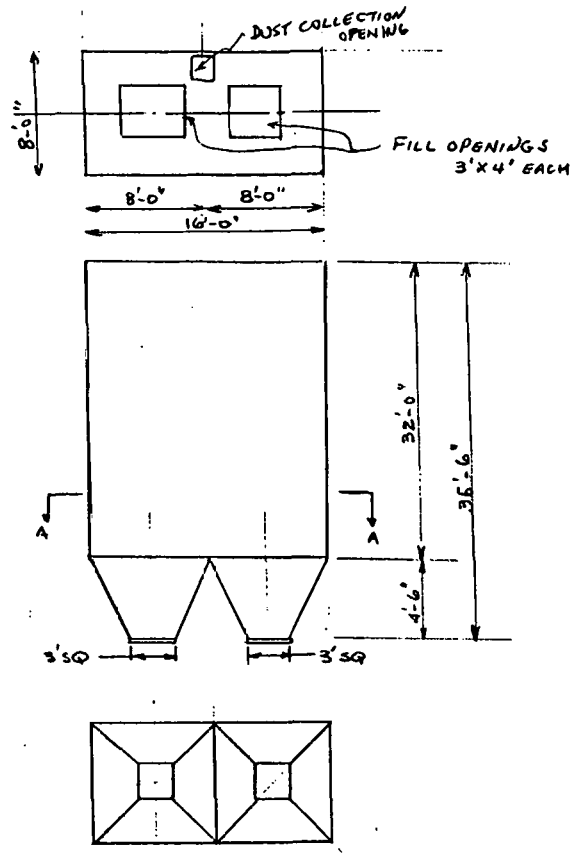
PAINTING	INORGANIC ZINC PRIMER
BOTTOM PLATE COATING	
WINDGIRDERS	
TANK STRAPPING	
SPECIFICATIONS	
FOUNDATION	

ROOF APPURTENANCES

VENT NOZZLE	
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	
COAL FILL OPENINGS	2- 3'X4'

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	
CIRCUMFERENTIAL STAIRS	
PLATFORM	
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	



SECT. A-A

NOTES.

1. ALL STEEL PLATE IS 5/8" "COR-TEN" EXCEPT BIN ROOF WHICH IS ASTM A-36".
2. CORTEN STEEL WILL NOT BE PAINTED.
3. LOAD CELLS WILL BE USED FOR LEVEL INDICATION

ITEM NO 31-T-105.

COAL SURGE BIN

6	11/81	ISSUED FOR PHASE ZERO	MM	AM		MP	
5							
4							
3							
2							
1							
No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR	CHIEF ENGR	APPD

BECHTEL

BRECKINRIDGE PROJECT
PLANT 31

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	31-DS-T-5	

R&C S.F. Form 173 (4/77)

4.9 Package Units

31-DS-V-1: Anion Beds Regeneration Assembly (31V-101)

31-DS-V-2: Cation Beds Regeneration Assembly (31V-102)

31-DS-V-3: Suspect Condensate Filter Regeneration Assembly (31V-103)

PACKAGE UNIT DATA SHEET

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

JOB NO. 14222 ITEM NO. 31-V-101
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-80 REVISION 0

FOR BRECKINRIDGE PROJECT
UNIT 31 - POWER PLANT
SITE BRECKINRIDGE COUNTY KENTUCKY
SERVICE ANION BEDS REGENERATION ASSEMBLY

Anion Beds Regeneration Assembly Equipment

- Two (2) positive displacement diaphragm pumps for caustic feed (one service, one spare)
- Flow measurement orifices, flow controllers and flow control valves for normal service, backwash, regeneration, slow rinse and fast rinse operations
- Control panel
- Skid for the above

FORM NO 130 (REVISED SEPT 78)

NO.	DATE		BY	CH	PE	RIC	JOB NO.	DRAWING NO.	REV.
0	12/19/80	ISSUE FOR PHASE ZERO	AK	[illegible]	MP	[illegible]	14222	31-DS-V-1	0
							SHEET 1 OF 1		

PACKAGE UNIT DATA SHEET

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

JOB NO. 14222 ITEM NO. 31-V-102
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-17-80 REVISION 0

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT 31- POWER PLANT SERVICE CATION BEDS REGENERATION ASSEMBLY

Cation Beds Regeneration Assembly Equipment

- Two (2) positive displacement diaphragm pumps for acid feed (one service, one spare)
- Flow measurement orifices, flow controllers and flow control valves for normal service, backwash, regeneration, slow rinse and fast rinse operations
- Control panel
- Skid for the above

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	ENG	JOB NO.	DRAWING NO.	REV.
0	12/17/80	ISSUE FOR PHASE ZERO	AK	[illegible]	[illegible]	[illegible]	14222	31-05-V-2	0

SHEET 1 OF 1

PACKAGE UNIT DATA SHEET

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

NOTE: □ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:

□ BY MANUFACTURER

JOB NO 14222 ITEM NO. 31-V-103

PURCHASE ORDER NO.

REQUISITION NO.

INQUIRY NO.

DATE 12-17-80 REVISION 0

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KENTUCKY

UNIT 31- POWER PLANT SERVICE SUSPECT COND. FILTER REGEN. ASS

Suspect Condensate Filter Regeneration Assembly Equipment

- One (1) 2,000 gallon precoat tank
- One (1) mixer
- Two (2) 900 gpm precoat/holding pumps (one active, one spare)
- One (1) control panel
- One (1) loading platform
- One (1) skid for the above

FORM NO 130 (REVISED SEPT 72)

NO.	DATE		BY	CH	PE	ENGR	JOB NO.	DRAWING NO.	REV.
0	12/17/80	ISSUE FOR PHASE ZERO	AK	[illegible]	[illegible]	[illegible]	14222	31-DS-V-3	0
							SHEET 1 OF 1		

4.10 Processing Equipment

31-DS-Y-2: Flue Gas Conditioning (31Y-105 A, B, C, D)

PRECIPITATOR DATA SHEET

31-Y-105 A
31-Y-105 B
31-Y-105 C
31-Y-105 D

JOB NO. 14222-000 ITEM NO. 31-Y-105 D
PURCHASE ORDER NO.
REQUISITION NO.

APPLICABLE TO: O PROPOSALS O PURCHASE O AS BUILT
FOR BRECKINRIDGE PROJECT
SITE [illegible] COUNTY, KENTUCKY
SERVICE COAL FIRED GENERATING
MANUFACTURER
UNIT PLANT 31 - POWER PLANT
SERIAL NO. NO. REQUIRED (4) FOUR
DRIVEN EQUIPMENT N/A
MODEL

Type	Cold Side Rigid Frame
Precipitator flue gas flow ACFM	Max flow 185,600
Precipitator flue gas inlet temperature F	320
Collection Efficiency %	99.79
Design inlet loading grains/ACFM	4.48
Number of chambers	1
Width of each precipitator, ft.	40
Depth of each precipitator inlet flange to outlet flange, ft.	87
Number of gas passages	25
Height of each passage, ft.	30
Width of each passage, in.	12
Design Pressure, positive "wg"	TBD
Design Pressure, negative "wg"	TBD
Total number of hoppers	4
Ductwork	
a. Material	CS
b. Thickness	3/8" min.
c. Pressure, positive "wg"	TBD
d. Pressure, negative "wg"	TBD
e. Temperature F	
f. Flue Gas Velocity, ft/sec	60 ft/sec.
Thermal Insulation	
a. Type	
b. Thickness	
1. Precipitator Roof	TBD
2. Precipitator Casing	TBD
3. Precipitator Hoppers	TBD
4. Ductwork	TBD
c. Lagging	
1. Type	TBD
2. Thickness	TBD
Collecting Electrodes	
a. Total Area, sq. ft. (this shall be defined as the total flat projected area required for "A" in the Deutsch-Anderson equation for the performance guarantee)	TBD

REMARKS:

R&C Form 50 (8/73)

NO.	DATE						JOB NO.	DRAWING NO.	REV
0	12/9/80	ISSUED FOR PHASE ZERO	DAT		UP	HWW	14222	31-DS-Y-2	0
NO.	DATE						SHEET 1 OF 2		

PRECIPITATOR DATA SHEET

31-4-105 A
31-4-105 B
31-4-105 C
31-4-105 D

JOB NO. 14222-000 ITEM NO. 31-4-105 D
PURCHASE ORDER NO.
REQUISITION NO.

APPLICABLE TO: O PROPOSALS O PURCHASE O AS BUILT
FOR BRECKINRIDGE PROJECT
SITE BRECKINRIDGE COUNTY KENTUCKY
SERVICE FLUE GAS CONDITIONING
MANUFACTURER

UNIT PLANT 31- POWER PLANT
SERIAL NO. NO. REQUIRED (4) FOUR
DRIVEN EQUIPMENT N/A
MODEL

Effective Collecting Plate Areas, sq. ft.	TBD
b. SCA, sq. ft./1000 ACF	400
Sectionalization	
a. Total Number of T/R Sets	8
b. Total Number of Bus Sectioning	8
c Fields	4

REMARKS:

Form 60 (8/73) R&C

NO.	DATE		DRN	CHD	PE	ENGR	JOB NO.	DRAWING NO.	
0	12/9/80	ISSUED FOR PHASE ZERO	DLS		WP	HWH	14222	31-DS-Y-2	0

SHEET 2 OF 2

4.11 Data Sheets for Water and Waste Treatment Equipment

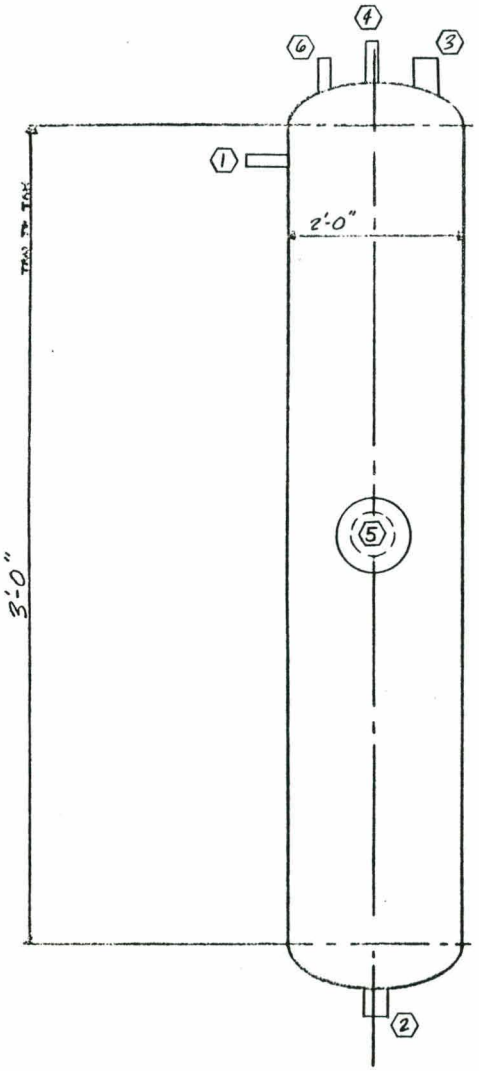
31-DS-Z-1: Cooling Water Chemical Feed Tank (31Z-101)

31-DS-Z-2: Suspect Condensate Filters (31Z-102 A, B, C)

31-DS-Z-3: Sodium Zeolite Softener Vessels (31Z-103 A, B, C)

31-DS-Z-4: Demineralizer Cation Units (31Z-104 A, B, C, D)

31-DS-Z-5: Demineralizer Anion Units (31Z-105 A, B, C, D)



THICKNESS = 0.375"

COOLING WATER CHEMICAL FEED TANK 31-Z-101

NOZZLE NO.	FLUID	FLOW LB/HR	DENSITY LB/CU FT	OPER °F	DESIGN °F	PRESS PSIG OPER	PRESS PSIG DESIGN
1	DILUTION WATER INLET						
2	SOLUTION OUTLET						
3	CHEMICAL INLET						

VAPOR PRESS @ MAX. ANT. °F PSIA

PROCESS CORROSION INHIBITED DEMINERALIZED WATER

CONTAMINANTS NONE

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA516 GR. 60	1/16" MIN.	
INT'LS	WELD-IN	NONE	TOTAL	
	REMOVABLE	NONE	TOTAL	

MECHANICAL DESIGN REQ'M

PRESS MARGIN: MIN SPEC ___ + ___ = 100 PSI

MIN. DESIGN PRESS AT TOP 100 PSIG (MARG. OPER.)

SYSTEM PSV SET AT ___ PSIG LOCATED N/A

MIN. DESIGN TEMP 150 °F @ PSIA

EXTERNAL PRESS DESIGN: FOR

VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___

SADDLES (C-527) ___

HEIGHT ___ MIN. ABV GRADE FIREPROOFING ___

TYPE: LL DATA FOR:

RESIDENCE

LCH
HLL
LAN
HLL
LAL
LLL
LCL

LG L2

① 12"
② 24"
③ 31"
④ 48"

① STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDIT CODE 28P
② REFER TO DWG'S J-L-W501 & 6702
③ SURGE, ETC.
④ [illegible]

POST WELD HEAT TREATMENT FOR N/A (OTHER THAN CODE)

SPECIAL REQUIREMENTS

CODE: ASME VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.) CYCLIC

INSULATION: NONE THK.

NOZZLES INSTRUMENT PROCESS

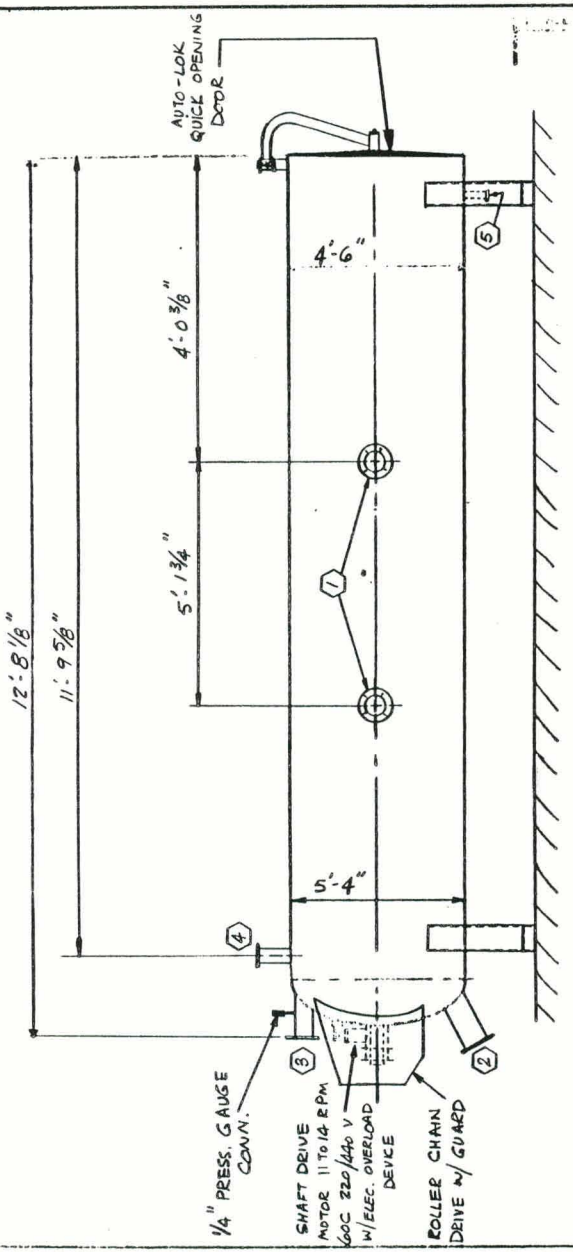
NOZZLE NO	SERVICE	NO. REQ'D	NOZ SIZE	RATING (FACING)	INT'L TYPE OR NOTE	NOZZLE NO.	SERVICE	NO. REQ'D	NOZ SIZE	RATING (FACING)	INT'L TYPE OR NOTE
J-6											
J-5											
J-4											
J-3											
J-2											
J-1	PSV	N/A									
9											
8											
7											
6	SPARE	1	3/4" NOM.	S.W.							
5	HAND ACCESS	1	12" NOM.	150 FF		A-1	MANWAY				
4	VENT CONN.	1	1" NOM.	S.W.							
3	CHEMICAL INLET	1	2" NOM.	150 FF							
2	SOLUTION OUTLET	1	2" NOM.	150 FF							
1	DILUTION WATER INLET	1	2" NOM.	150 FF							

REV	DATE	ISSUED FOR	PROCESS	INSTR	UNIT	CHECKED
A	11/4/80	DESIGN BASIS - ISSUE FOR PHASE ZERO	KGR		UP	ASFI HWH

JOB NO.	VESSEL DESIGN DATA SHEET		VESSEL NO.	REV.
14222	SERVICE COOLING WATER CHEMICAL FEED TANK UNIT BRECKNRIDGE - PLANT 31	31	DS-Z-1	0

(ENTER "B" ON PROCESS MASTER ONLY)

FORM 4660 REV. 12-67



FILTERS TO BE PRECOAT LEAF TYPE (UNITED STATES FILTER AUTOJET 900 OR EQUAL)

ITEM NUMBERS
31-Z-102A
31-Z-102B
31-Z-102C

	FLUID	FLOW RATE	DENSITY	TEMP °F		PRESS PSIG	
1	SUSPECT CONDENSATE	435700	60.1	202	212/	117	130
2	FILTERED CONDENSATE	435700	60.1	202	212/	117	130

VESSEL PRESS & MAX. ALL. °F = PSIA
ADDITIONAL CONTAMINANTS OIL, GREASE

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA516 GR 60	1/8"	ONE HEAD REQ'D
INT'LS	WELD-IN	A285GRC	1/8" TOTAL	
	REMOVABLE	STAINLESS	N/A TOTAL	

MECHANICAL DESIGN DATA

PRESS MARGIN: MIN SPEC ___ + ___ = 20 PSI
MIN. DESIGN PRESS AT TOP 150 PSIG (MARC OPER.)
SYSTEM PSV SET AT N/A PSIG LOCATED
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___
SADDLES (C-527) ___
HEIGHT ___ MIN. ABV GRADE FIREPROOFING ___

TANK DATA FOR:
(1) SYD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONCRETE OVER 28"
(2) REFER TO DWG'S J-L-6701 & 6702
(3) SOURCE, ETC.

POST WELD HEAT TREATMENT PER BY VENDOR ___ (OTHER THAN CODE)

SPECIAL REQUIREMENTS
CODE: ASME VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.)

INSULATION: YES THK 2"

NOZZLE NO.	SERVICE	NO. REQ'D	NOZ SIZE	FLANGE RATING	FACING	NOZZLE TYPE OR NOTE	USER NO.	SERVICE	NO. REQ'D	NOZ SIZE	FLANGE RATING	NOZZLE TYPE OR NOTE
J-6												
J-5												
J-4												
J-3												
J-2												
J-1	PSV											
9												
8												
7												
6												
5	BOTTOM SLUICE	1	1"	SCH 40	150	FF						
4	AIR VENT	1	2"	SCH 40	150	FF						
3	SPRAY HEADER	1	4"	SCH 40	150	FF						
2	DRAIN	1	10"	SCH 40	150	FF						
1	FILL NOZZLE	2	4"	SCH 40	150	FF	1-1	MANWAY	N/A			

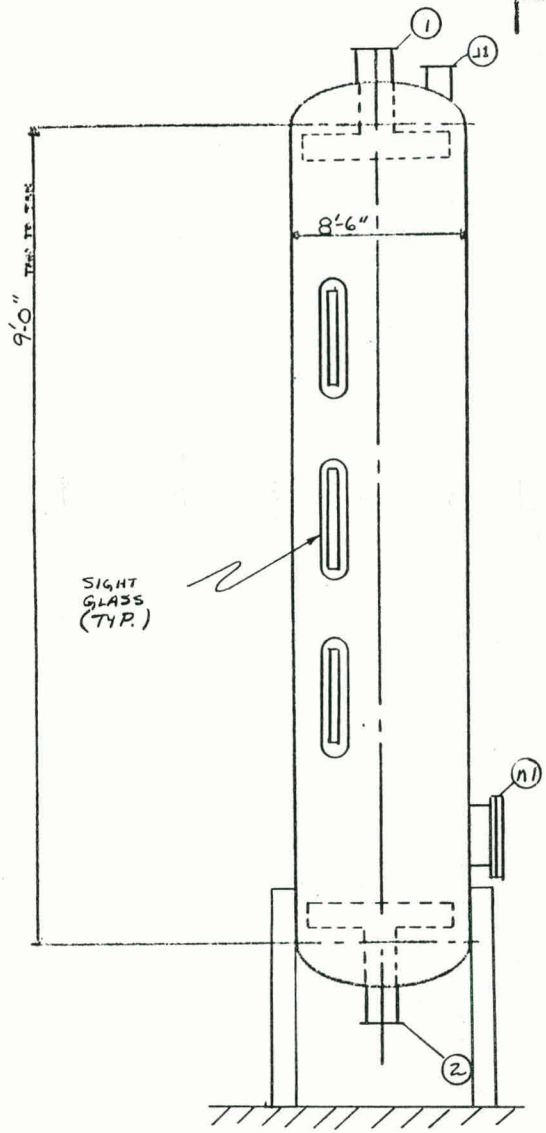
REV.	DATE	DESIGN BASIS - ISSUED FOR	BY	CHK'D
0	11/14/80	PHASE ZERO	AK 9/12	ASFI HWM
		ISSUED FOR		

JOB NO 14222

VESSEL DESIGN DATA SHEET
SERVICE SUSPECT CONDENSATE FILTERS
UNIT - 31 - POWER PLANT - BRECKINRIDGE PROJECT

VESSEL NO.	REV.
31-1 2	0

(ENTER "B" ON PROCESS MASTER ONLY)



NOTE: EACH SODIUM ZEOLITE VESSEL SUPPLIED WITH 215 CUBIC FEET OF RESIN

ITEM NUMBERS
31-Z-103A
31-Z-103B
31-Z-103C

FORM 4660 REV. 12-67

PROCESS INFORMATION

NOZ. NO.	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F NORM	TEMP °F MAX	PRESS PSIG NORM	PRESS PSIG MAX
1	FILTERED WATER	380580	62.2	85		60	80
2	SOFTENED WATER	380580	62.2	85		50	80

VAPOR PRESS @ MAX. ABS. °F = PSIA
PROCESS CONTAMINANTS: DILUTE BRINE (NACL) REGENERATION FLUID

METALLURGY

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA-516 GR 60	1/8" MIN.	RUBBER LINING
INT'LS	WELD-IN		TOTAL	
	REMOVABLE	MONEL	N/A TOTAL	DISTRIBUTION & COLLECTION SPARGERS

POST WELD HEAT TREATMENT FOR BY VENDOR (OTHER THAN CRUDE)

MECHANICAL DESIGN REQ'MTS

PRESS MARGIN: MIN SPEC ___ + ___ : 20 PSI
MIN. DESIGN PRESS AT TOP 100 PSIG (MARG + OPER.)
SYSTEM PSV SET AT 100 PSIG LOCATED TOP
MIN. DESIGN TEMP -20°F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___
SADDLES (C-527) ___
WEIGHT ___ MIN. ABV GRADE FIREPROOFING ___

SPECIAL REQUIREMENTS
CODE: ASME VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.)
CONTINUOUS

INSULATION: N/A THK.

NOZZLES & MANHOLES

NOZ. NO.	SERVICE	NO. REQ'D	NOZ. SIZE	RATING & FACING	INT'L TYPE OR DETAIL	MAN-WAY NO.	SERVICE	NO. REQ'D	NOZ. SIZE	RATING & FACING	INT'L TYP OR DETAIL
J-6											
J-5											
J-4											
J-3											
J-2											
J-1	PSV	1		150FF							
9											
8											
7											
6											
5											
4											
3											
2	OUTLET	1	6"	150 FF							
1	INLET	1	6"	150FF		M-1	MANWAY	1	20	150FF	

REV	DATE	
A	4/29/80	DESIGN BASIS - ISSUE FOR PHASE ZERO

ASFI HHH VP

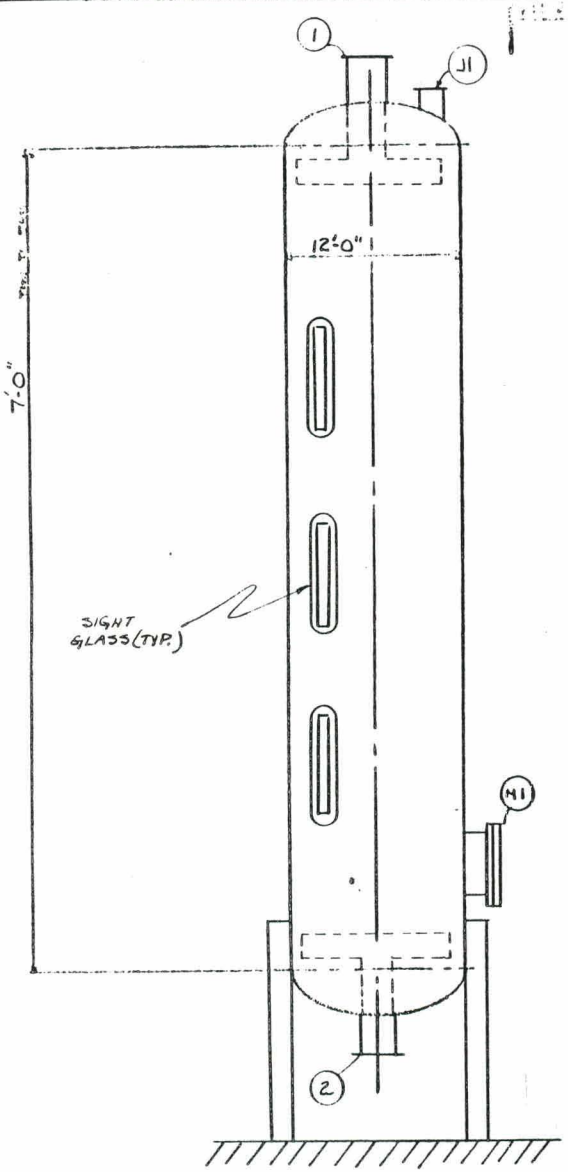
JOB NO. 14222

VESSEL DESIGN DATA SHEET

SERVICE - SODIUM ZEOLITE SOFTENER VESSELS
UNIT - PLANT 31 POWER PLANT - BRECKINRIDGE

PROCESS | VESSEL NO. 31-DS-Z-3 | REV. 0

(ENTER "B" ON PROCESS MASTER ONLY)



NOTE: EACH CATION VESSEL SUPPLIED WITH 215 CUBIC FEET OF RESIN.

ITEM NUMBERS:
31-Z-104A
31-Z-104B
31-Z-104C
31-Z-104D

	FLUID					PRESS PSIG	
						NORM	MAX
1	SOFTENED WATER	478410	61.7	118		70	80
2	DECATIONIZED WATER	478410	61.7	118		60	80

VAPOR PRESS @ MAX. AMB. °F = PSIA

PROCESS CONTAMINANTS: DILUTE ACID (H_2SO_4) REGENERATION FLUID

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA-516 GR 60	1/8" MIN.	RUBBER LINING
INT'LS	WELD-IN		NONE	
	REMOVABLE	STAINLESS STEEL	N/A NONE	DISTRIBUTION & COLLECTION SPARGERS

POST WELD HEAT TREATMENT FOR _____ (OTHER THAN SHELL)

PRESS MARGIN: MIN SPEC ____ + ____ = 20 PSI

MIN. DESIGN PRESS AT TOP 100 PSIG (MARGIN OVER.)

SYSTEM PSV SET AT 100 PSIG LOCATED TOP

MIN. DESIGN TEMP -20 °F @ 14.7 PSIA

EXTERNAL PRESS DESIGN: FOR

VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___

SADDLES (C-527) ___

WEIGHT ____ MIN. ABV GRADE FIREPROOFING ____

INSULATION: N/A THK.

SPECIAL REQUIREMENTS

CODE: ASME VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.) CONTINUOUS

NOZZLE NO.	SERVICE	NO. REQ'D	NOZZ SIZE	RATING (FACING)	INT'L TYPE OR NOTE	NOZZLE NO.	SERVICE	NO. REQ'D	NOZZ SIZE	RATING (FACING)
J-6										
J-5										
J-4										
J-3										
J-2										
J-1	PSV	1		150FF						
9										
8										
7										
6										
5										
4										
3										
2	OUTLET	1	8"	150FF						
1	INLET	1	8"	150FF		M-1	MANWAY	1	20	150FF

NO.	DATE	BY	CHK	APP'D	REVISION
A	12/19/80				DESIGN BASIS - ISSUE FOR PHASE ZERO

ISSUED FOR

JOB NO. 14222

VESSEL DESIGN DATA SHEET

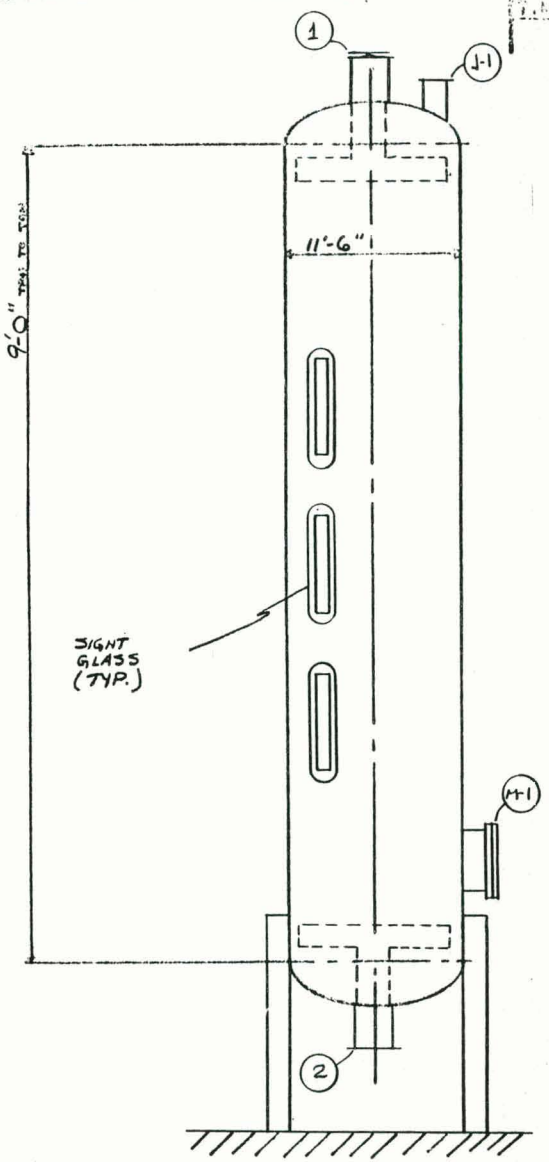
SERVICE DEMINERALIZER CATION UNITS

UNIT 31 - POWER PLANT - BRECKINRIDGE PROJECT

VESSEL NO. 31-Z-104 REV. 0

(ENTER "B" ON PROCESS MASTER ONLY)

FORM 4680 REV. 12-66



NOTE: EACH ANION VESSEL SUPPLIED WITH 410 CUBIC FEET OF RESIN

ITEM NUMBERS
31-Z-105A
31-Z-105B
31-Z-105C
31-Z-105D

PROCESS INFORMATION

LOC. ON DWG.	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F NORM	TEMP °F MAX	PRESS PSIG NORM	PRESS PSIG MAX
(1)	DECATIONIZED WATER	478410	61.7	118		50	80
(2)	DEMINERALIZED WATER	478410	61.7	118		40	80

VAPOR PRESS @ MAX. AMB. °F = PSIA
PROCESS CONTAMINANTS DILUTE CAUSTIC ($NaOH$) REGENERATION FLUID

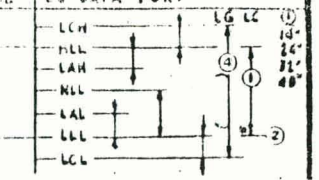
METALLURGY

COMPONENT		TYP. MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS		SA-516 GR 60	1/8" MIN.	RUBBER LINING
INT'LS	WELD-IN		TOTAL	
	REMOVABLE	STAINLESS STL	N/A TOTAL	DISTRIBUTION & COLLECTION SPARGERS

MECHANICAL DESIGN REQ'M.

PRESS MARGIN: MIN SPEC ___ + ___ = 20 PSI
MIN. DESIGN PRESS AT TOP 100 PSIG (MARG + OPER.)
SYSTEM PSV SET AT 100 PSIG LOCATED TOP
MIN. DESIGN TEMP -20 °F @ 14.7 PSIA
EXTERNAL PRESS DESIGN: FOR
VESSEL SUPPORT DATA: SKIRT ___ LEGS ✓ LUGS ___
SADDLES (C-527) ___
HEIGHT ___ MIN. ABV. GRADE FIREPROOFING ___

TIME / LL DATA FOR: RESIDENCE



(1) STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDIT OVER 40"
(2) REFER TO DWG'S J-L-6701 & 6702
(3) SURGE, ETC.
(4) LG WILL BE HIGHEST STD. SIZE TO [illegible]

POST WELD HEAT TREATMENT FOR BY VENDOR (OTHER THAN ENDS)

SPECIAL REQUIREMENTS

CODE: ASME VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.) CONTINUOUS

INSULATION: N/A THK.

NOZZLES & INSTRUMENT CONNECTIONS

NOZ'L NO.	SERVICE	NO. REQ'D	EST SIZE	RATING (FACING)	INT'L TYPE OR NOTE	NOZZ NO.	SERVICE	NO. REQ'D	EST. SIZE	RATING (FACING)	INT'L TYPE OR NOTE
J-6											
J-5											
J-4											
J-3											
J-2											
J-1	PSV	1		150 FF							
9											
8											
7											
6											
5											
4											
3											
2	OUTLET	1	8"	150 FF							
1	INLET	1	8"	150 FF		M-1	MANWAY	1	20"	150 FF	

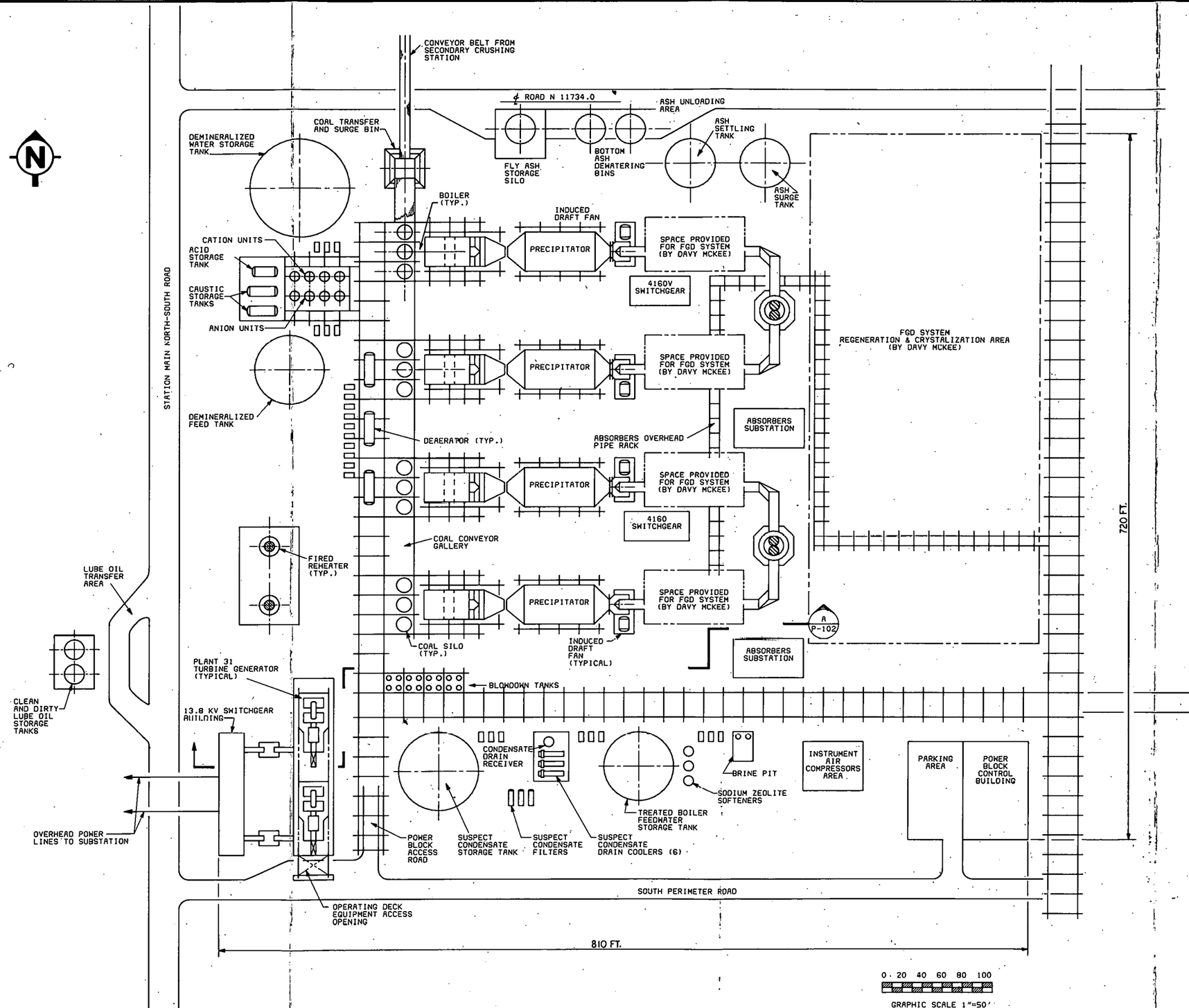
REV	DATE	DESCRIPTION	PROCESS	INSTRU.	UNIT	PROJECT
A	4/12/80	DESIGN BASIS - ISSUE FOR PHASE ZERO	9/6			
		ISSUED FOR				

ASF HWH WP

JOB NO.	VESSEL DESIGN DATA SHEET	VESSEL NO.	REV.
14222	SERVICE DEMINERALIZER ANION UNITS UNIT 31 - POWER PLANT - BRECKINRIDGE PROJECT	31-DS-Z-5	0

(ENTER "B" ON PROCESS MASTER ONLY)

PERMAGRAPH REV. 12-64



NOTES

1. ALL DIMENSIONS ARE ESTIMATED AND USED ONLY FOR CONCEPTUAL DESIGN.

NO.	DATE	REVISIONS	BY	CH'K	ENGR'G	PROJ'N	ELEC. ENGR'G	MECH. ENGR'G
1	2/20/81	ISSUED FOR PHASE ZERO	CAD	LM	LBS	MTP		
0	12/10/80	ISSUED FOR CLIENT REVIEW	CAD	RB	LBS	MTP		

DESIGNED SANTIESTEBAN DRAWN BECKLES/JK

ASHLAND SYNTHETIC FUEL, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717

BRECKINRIDGE PROJECT

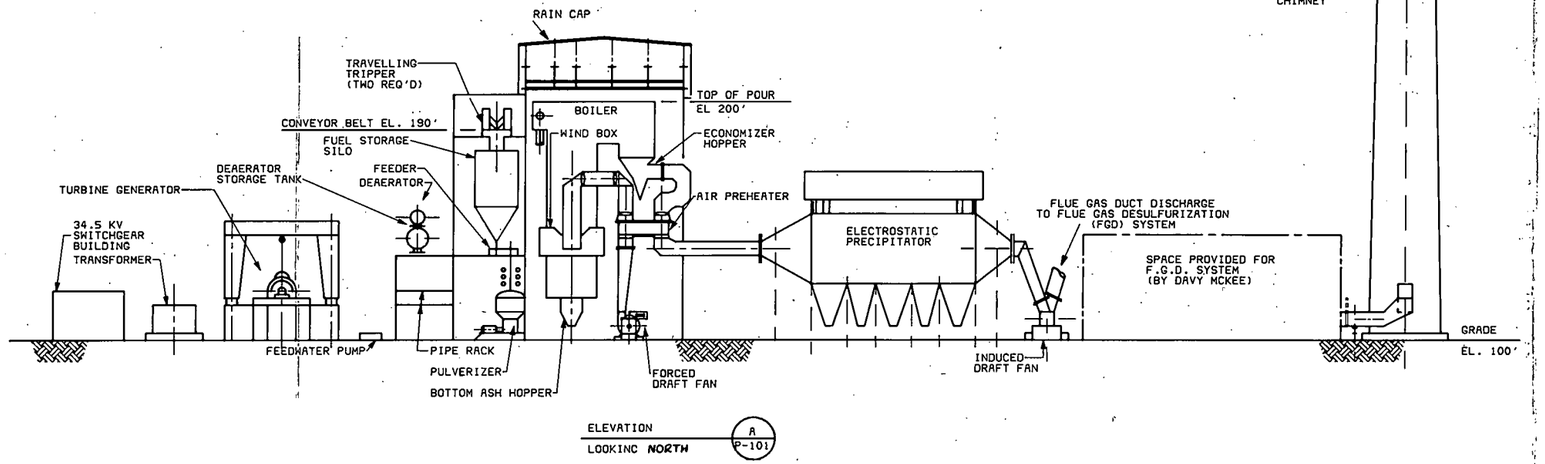
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PLANT 31 GENERAL ARRANGEMENT PLAN

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-D-A-1	1

MPE01A 02/03/81 JK/SOR



ELEVATION LOOKING NORTH (A / P-101)

0 30 60 90

GRAPHIC SCALE 1"-30'

NOTES

1. ALL DIMENSIONS ARE ESTIMATED AND USED ONLY FOR CONCEPTUAL DESIGN.
2. NOT ALL DUCT SUPPORT STRUCTURES ARE SHOWN

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	B1 APPR.	ASST APPR.
1	9/20/81	ISSUE FOR PHASE ZERO.	CAD	LM	MS	VP		
0	12/10/80	ISSUE FOR CLIENT REVIEW	CAD	RB	LBS	WTP		

DESIGNED SANTIESTEBAN DRAWN BECKELS/SG

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

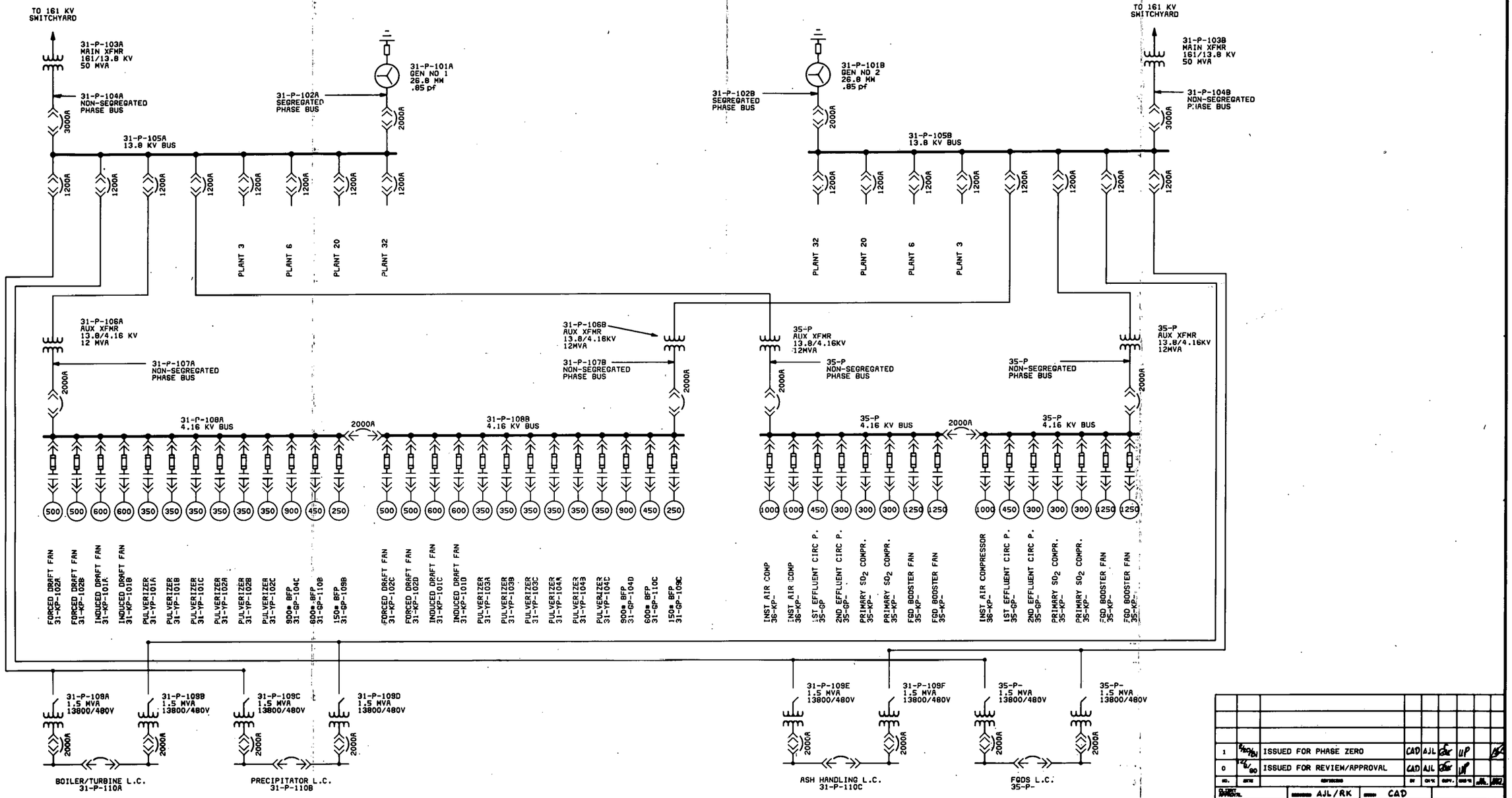
BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PLANT 31
GENERAL ARRANGEMENT
SECTION

JOB NO.	DRAWING NO.	REV.
14222	31-D-A-2	1

BECHTEL HOUSTON



NO.	DATE	DESCRIPTION	BY	CHK	ENGR	MGR	
1	5/30/80	ISSUED FOR PHASE ZERO	CAD	AJL			
0	12/5/80	ISSUED FOR REVIEW/APPROVAL	CAD	AJL			

CLIENT APPROVAL | DESIGNED AJL/RK | DRAWN CAD

ASHLAND SYNTHETIC FUEL, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY COOPERATIVE AGREEMENT NO. DE-FC05-80ET01117

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

POWER BLOCK MAIN ONE LINE DIAGRAM

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	31-D-P-1	1

M0201A 02/11/81 LLH

PLANT 32 WATER SYSTEMS: RAW, POTABLE, COOLING

1.0 INTRODUCTION

Plant 32 includes the river water treating and the cooling tower systems. A project-wide comprehensive water management plan has been developed based on total reuse of waters within the project, resulting in a zero discharge to public waters during normal operation. A schematic flow diagram for the overall water management plan is presented in Figure 1. The water management plan and its objectives are covered in detail in Report VII and will not be discussed here further. It is important to note that Plant 32 is virtually inseparable from Sewers and Wastewater Treatment (Plant 34). Practically all of the treated effluent from the wastewater system is used as makeup in Plant 32. The wastewater system is described in the process description for Plant 34.

The main elements of Plant 32 are:

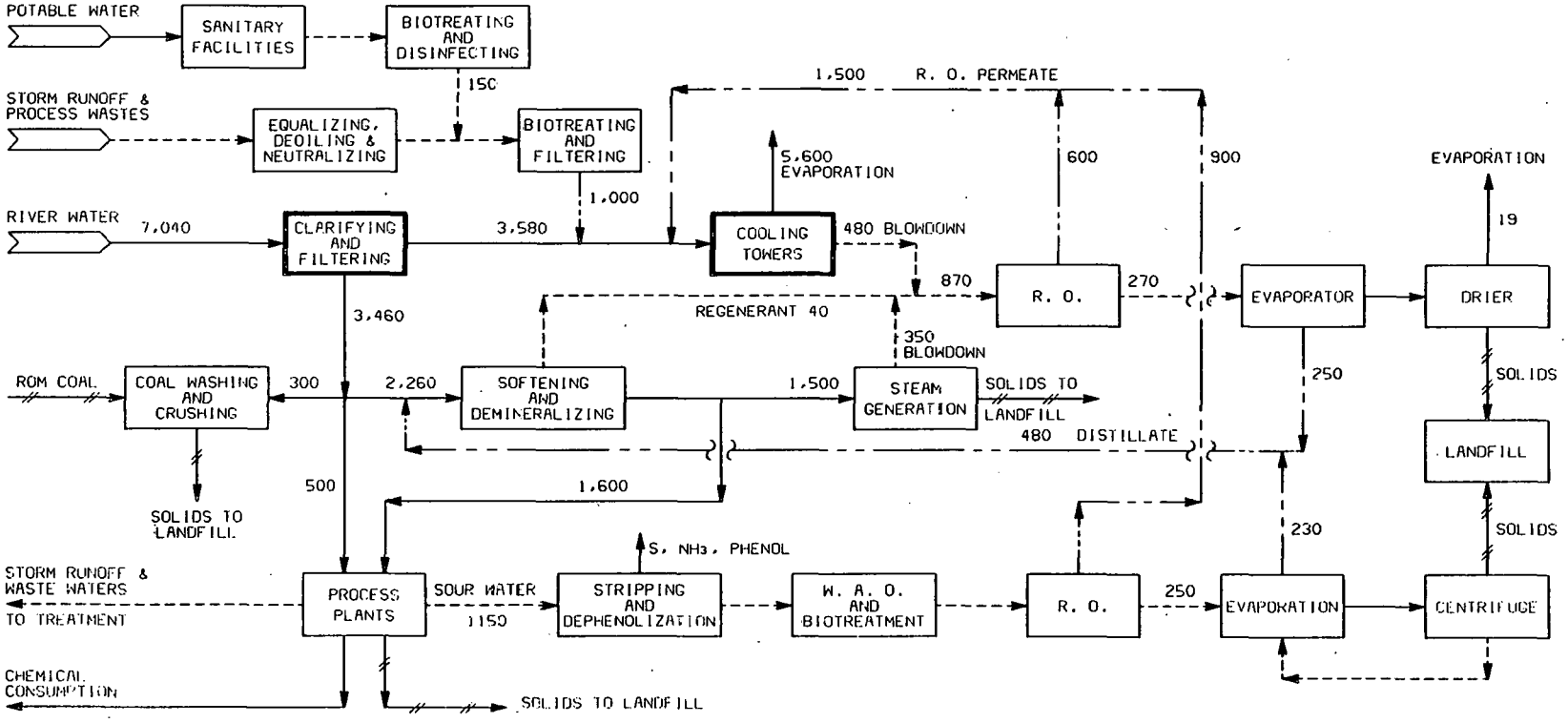
- River water treatment
- Cooling water system
- Cooling tower sidestream treatment

Clarified filtered river water from Plant 32 is used as makeup to the Plant 31 boiler feedwater treatment system.

As illustrated on water management Flowsheets 50-D-B-14 and 50-D-B-15 in Report VII, updating of the overall water balance for the Phase Zero design has generated flow rate numbers that are not always consistent with those originally set as individual system design bases within Plants 32 and 34. The changes are, by and large, compensating and do not have a significant impact on overall costs. Further refinements can be expected as more data become available from the pilot plant and additional optimization studies are performed. Accordingly, revisions to individual system design bases to make them consistent with the updated overall water balance have been deferred until the next phase of the work.

Figure 1

SCHEMATIC FLOW DIAGRAM
WATER MANAGEMENT PLAN



LEGEND

- FRESH WATER OR CONDENSATE
- WASTE WATER
- TREATED RE-USABLE WASTEWATER
- SOLID MOVEMENT

NOTE:

FLOW RATES (IN GPM) ARE APPROXIMATE, AND ONLY FOR ILLUSTRATION PURPOSES. THEY DO NOT MATCH RATES ON INDIVIDUAL PFD'S.

PLANT 32

PLANT 32 WATER SYSTEMS

2.0 PLANT DESIGN

2.1 River Water Treatment

2.1.1 Design Basis

The principal source of fresh water for the plant is the Ohio River. The river water treatment system prepares the river water for some of its direct-end uses (cooling, firefighting, housekeeping) and for secondary water treatment processes (boiler feedwater, process water). Water used for drinking, food preparation and sanitary facilities is obtained from onsite wells or plant river water that is treated in a package potable water treating plant.

The treatment of river water consists of screening, cold lime softening, sedimentation/clarification, pH adjustment and filtration. The process flow is illustrated on Flowsheet 32-D-B-4. The system is designed to treat up to 10,000 GPM of river water. Normal flow rate through the system will vary between about 5,700 and 7,000 GPM depending on rainfall. Rain runoff from building roofs and uncontaminated plant areas as well as certain treated process wastewaters will be used to supplement river water.

The cold lime softening and sedimentation operation is performed in a reactor/clarifier. Conventional cold lime softening is used to reduce the content of calcium and magnesium and, to a lesser degree, that of silica. Dolomitic lime is used in the softening process to raise the pH of the water thereby precipitating calcium and magnesium present as carbonate hardness. It is expected that some of the silica will also coprecipitate as a magnesium-silicate complex. Soda ash is also added to precipitate calcium present as noncarbonate hardness. Sodium aluminate and a polymer are added to aid settling of the suspended solids including the chemical precipitate generated by the softening reactions.

The pH of the softened effluent is lowered with sulfuric acid to prevent post-precipitation in the filter media downstream of the softener. Sulfuric, rather than hydrochloric, acid is used to minimize chloride buildup in the cooling water system.

About 600 GPM of the clarified river water is filtered using four anthracite filters and pumped as makeup to boiler feedwater treatment in Plant 31. Sand is not used in these filters in order to avoid dissolution of silica which would be undesirable in boiler feedwater. The balance of the clarified river water is filtered using five anthracite/garnet dual media filters. This water flows to the utility/fire water storage pond where it is blended with clean or cleaned-up storm runoff. Filter backwash water is recycled to the reactor/clarifier.

Sludge resulting from the clarification/softening process (clarifier underflow) is combined with similar sludge from the Plant 34 coal storage pile runoff treatment facility and is dewatered using rotary vacuum filters. Conditioning of this sludge prior to filtration may be necessary but no conditioning is included in the present design. The need for conditioning will be studied in the next design phase.

The river water intake is designed for a flow of 10,000 GPM. The design velocity through a pair of traveling screens is two feet per second. Six 2500 GPM pumps (four operating and two spares) are used to pump water from the river to the reactor/clarifier.

The water analysis used for the system design is presented in Table 1.

The reactor/clarifiers are designed for a surface loading of 750 GPD/ft^2. Four 80-foot diameter units are provided for processing 10,000 GPM of river water.

TABLE 1

DESIGN RIVER WATER ANALYSIS

Parameter	Before Treatment	After Treatment
Temperature (°F)	85	85
pH Range	6.9-7.6	6.5-7.5
Suspended Solids (mg/l)	472	1
Total Dissolved Solids (mg/l)	220	--
Sodium (as $CaCO_3$)	52	52
Calcium (as $CaCO_3$)	113	35
Magnesium (as $CaCO_3$)	50	40
Methyl Alkalinity (as $CaCO_3$)	87	50
Sulfate	97	115
Chloride (as $CaCO_3$)	42	42
Silica (as SiO_2)	6	4
Carbon Dioxide, Free	3	1

The anthracite filter design loading is 4 GPM/ft^2. Four vertical downflow pressure filters are provided. Three filters process 600 GPM while one is being backwashed. The backwash utilizes air scour.

The dual-media filter design loading is 12 GPM/ft^2 forward flow. Four horizontal downward flow pressure filters filter 9,400 GPM while one is being backwashed. Backwash utilizes air scour.

Vacuum filters are provided to dewater sludges withdrawn from the river water and coal storage pile runoff treatment systems. The filter system design basis is 165 GPM of sludge containing 4.2 wt% solids. The unit loading on the vacuum filters is 10 lb/hr/ft^2 (total filter area). The filter cake is expected to have a moisture content of 60%. Two filters will be used, one operating and one spare. Filtrate is returned to the reactor/clarifier for reuse.

2.1.2 Process Description

Ohio river water is screened to protect the lift pumps and Reactor/Clarifiers (32Z-107 A through D). Water from the river intake structure is pumped directly to 32Z-107 A through D. Controlled quantities of slaked dolomitic lime, soda ash, sodium aluminate and a polymer are added, in liquid form, to the reactor/clarifier. Lime is slaked on site. Aqueous solutions of the other chemicals are prepared on site and the chemicals are fed from day tanks. The clarifier effluent passes through a Neutralizing Basin (32D-138) where sulfuric acid is added to lower the pH to approximately 7.0.

About 600 GPM is pumped through Anthracite Filters (32Z-110 A through D) to the Zeolite softener feed tank. The balance of the reactor/clarifier effluent is pumped through 9,400 GPM capacity dual Media Filters (32Z-111 A through E) to the utility water/fire water storage pond. Effluent from

the coal storage pile runoff treatment facility and clean storm runoff from uncontaminated plant areas are also routed to this utility water/fire water storage pond.

The filters are backwashed with water from the utility water/fire water storage pond. The backwash water, containing the filtered solids, is returned to the reactor/clarifier. Reactor/clarifier underflow containing an estimated 4.2 wt% of solids is sent to the 32D-136 sump, from which it is pumped to two rotary Vacuum Filters (32Z-108 A and B) for dewatering. Sludge produced from treating coal storage pile storm runoff is dewatered with clarifier/reactor underflow. A conveyor system delivers the filter cake to cake Storage Bin (32D-139) from where it is periodically loaded onto trucks that transport it to a landfill.

2.2 Cooling Water System

2.2.1 Design Basis

Two conventional, open circulating cooling water systems with mechanical induced-draft cooling towers are provided. One system - circulating water with a relatively low dissolved solids content - serves the Oxygen Plant (Plant 15) and Steam Generation and Boiler Feedwater Treating (Plant 31). The other system, which circulates water with relatively high dissolved solid content (4,000 ppm TDS) serves the other process plants.

The Low Solids Cooling Tower (32E-101) is designed to provide the 1,507 MM Btu/hr cooling requirement of Plants 15 and 31. This duty includes the condensing load of the turbogenerator turbines in Plant 31 and the condensing load of the compressor turbines in Plant 15.

The High Solids Cooling Tower (32E-102) is designed to supply the 1,290 MM Btu/hr cooling requirement of the process plants.

An objective during the cooling water system design was to maximize the use of treated process wastewater for cooling tower makeup. Treated river water is used to supplement the treated process wastewater.

The cooling water distribution system, as well as individual plant uses and return water temperatures are presented on Flowsheet 32-D-B-1. The cooling tower system is illustrated on Flowsheet 32-D-B-2. Refer to Flowsheet 32-D-B-3 for a preservation of the side stream water treatment for the high solids system.

The cooling tower capacities are as follows:

	Low Solids Cooling Tower	High Solids Cooling Tower
Duty, mm Btu/hr	1,507	1,290
Inlet Temperature °F	109	102
Outlet Temperature °F	85	85
Circulation Rate, GPM	124,000	150,000
Windage Loss, % circulation	0.015	0.015
Cycles of Concentration	3	3

Both cooling water systems are designed for a supply water temperature of 85°.

The climatic conditions used for the cooling tower designs are:

- Atmospheric pressure: 14.4 psia
- Air Temperatures
  - Inlet Temperature: -10°F to 96°F
  - Wet Bulb Temperature: 78°F (maximum)

2.2.2 Process Description

Cooling Tower Makeup. The makeup water to the cooling towers is a variable mix of treated river water and treated process water (refer to water management Flowsheet 50-D-B-14).

- Low Solids Cooling Tower - The makeup to the Low Solids Cooling Tower (32E -101) is treated river water plus treated wastewater. The total makeup requirement to this tower is 4,520 GPM. Treated process water will consist of 2,050 GPM (dry weather) and 3,300 GPM (wet weather)

- High Solids Cooling Tower - The makeup to the High Solids Cooling Tower (32E-102) is composed of all blowdown from the low solids cooling tower (approximately 1,500 GPM), plus treated river water as needed to make up the total requirement of 3,132 GPM

Cooling Water Requirements. The cooling water requirements are as follows:

- Low Solids Cooling Water System - The design cooling requirements for the plants served by the Low Solids Cooling Tower (32E-101) are summarized in Table 2. The total cooling duty is 1,507 MM Btu/hr which includes a contingency allowance of 18.8%

- High Solids Cooling Water System - The design cooling loads for the High Solids Cooling Tower (32E-102) are summarized in Table 3. The total cooling duty is 1,335 MM Btu/hr which includes a contingency allowance of 11.1%

TABLE 2

COOLING WATER REQUIREMENTS

LOW SOLIDS COOLING TOWER

	Duty MM Btu/hr	Flow GPM	Outlet Temperature °F
Plant 15 - Oxygen Plant	831	71,600	108.2
Plant 31 - Steam Generation (and Boiler Feedwater Treating)	393	29,100	112.0
Contingency	283	23,300	109.3
Total	1,507	124,000	
Average Outlet Temperature °F			109.3

HIGH SOLIDS COOLING TOWER

Plant 1 - Coal Drying and Pulverizing	1.6	105	110
Plant 2 - Coal Slurry Preparation	26.2	2,100	110
Plant 3 - H-Coal® Preheating and Reaction	0.1	10	115
Plant 5 - H-Coal® Recycle Slurry Prep.	32.1	2,140	115
Plant 7 - Gas Plant	407.2	56,172	99.5
Plant 8 - Cryogenic Hyd. Purification	50.0	5,000	105
Plant 9 - Sour Water and Ammonia	198.4	19,835	105
Plant 12 - Gasification and Purification	402.5	36,761	106.9
Plant 17 - Distillate Separation	25.0	4,760	95.5
Plant 18 - Naphtha Reforming	8.5	569	115
Plant 20 - Tankage	1.5	100	115
Plant 26 - Coal Receiving and Storage	3.0	200	115
Plant 35 - Stack Gas Scrubbing	31.0	5,640	96.0
Contingency	147.8	16,608	102.8
Total	1,334.9	150,000	
Average Outlet Temperature °F			102.8

Cooling Water Additives. The cooling water treatment requires the use of the following additives.

- Chlorine - Chlorine is added intermittently to the cooling water system for bacteria and algae control. A sidestream of the low solids cooling water supply is used to carry the chlorine to the tower basins. Separate chlorinators are used at each tower, providing 992 lb/day of chlorine for the Low Solids Cooling Tower (32E-101) and 1,200 lb/day of chlorine for the High Solids Cooling Tower (32E-102).

  Chloride content of the low solids circulating cooling water is estimated to range from 90 to 120 ppm with an expected level of 115 ppm. Concentrations for the high solids system are from 360 to 700 ppm with the expected level of 680 ppm.

  Liquid chlorine from cylinders is vaporized in an evaporator and fed to the chlorinator. The chlorine is introduced into the cooling water system via a water ejector which aspirates the chlorine and dissolves it in the water. The water is continuously circulated through the ejector but the chlorine is introduced intermittently. The operation is timer-controlled. Dosage control is by periodic wet analysis of the cooling water.

- Inhibitor - A chromate-based corrosion inhibitor is used in both circulating cooling water systems. It is introduced into the low solids system at about 0.07 lb per 1,000 gallons of makeup water and is carried over to the high solids system in the blowdown from the former which constitutes the bulk of the makeup to the high solids system. Control is by automatic corrosivity control.

- Acid - Sulfuric acid is added to both circulating water systems to control pH.

- Dispersing Agent - A dispersing agent to minimize fouling (mineral deposits on surfaces) is required in both cooling water systems. The low solids system requires 0.02 lb per 1,000 gallons of makeup water, and the high solids system requires 0.052 lb per 1,000 gallons of makeup water. The agents are added as an aqueous solution via metering pumps.

Alternative Drive for Circulating Water Pumps. For reliability, certain cooling water circulation pumps will be run off alternate power with utility backup. During emergencies that result in partial loss of cooling water circulation, water will be preferentially diverted from non-critical to critical users such that Steam Generation and Boiler Feedwater Treating (Plant 31) will receive 100% of its normal requirement, the Oxygen Plant (Plant 15) will receive 25%, and those plants serviced by the high solids cooling water system will receive 25%. This will allow continuous operation of critical systems throughout the plant so that if the emergency condition is severe enough, an orderly shutdown can be undertaken.

2.3 Cooling Tower Sidestream Treatment

2.3.1 Design Basis

A sidestream from the high solids cooling water system is treated to remove suspended solids and dissolved solids from the circulating cooling water. This permits operating the tower at high cycles of concentration, thus reducing the cooling tower makeup and blowdown rates.

A sidestream of the hot water return is treated in a lime softening unit. The softener effluent is filtered with a set of five parallel gravity sand filters and pumped to the high solids cooling tower. A portion of the treated sidestream is stored and used to back wash the filters. The softener underflow sludge is dewatered using vacuum filters.

The sidestream design flow rate was established at a conservative 7,100 GPM in view of the limited specific water analysis. This flow and treatment should permit operation of the high solids tower at a concentration ratio of three with an ample safety margin in spite of the data shortcomings. The high solids cooling tower has an evaporation rate of 2,610 GPM, a makeup rate of 3,132 GPM and a blowdown rate of 478 GPM.

The sidestream water treatment for the high solids cooling water system, including the lime softener underflow (sludge) dewatering scheme, is illustrated on Process Flow Diagram 32-D-B-3.

2.3.2 Process Description

A sidestream flow of 7,100 GPM is diverted from the high solids cooling water tower return header and fed to the Reactor Clarifier (32Z-103) along with recycle streams from the Vacuum Filters (32Z-104 A, B and C) and Sidestream Gravity Filter Backwash Sump (32D-102). The sidestream treatment involves a partial softening of the high solids cooling water. The reactor clarifier precipitates calcium and silica and partially removes suspended solids. Dolomitic lime is added to raise the pH and cause precipitation of calcium carbonates. Soda ash is added to effect further precipitation of calcium and magnesium.

Additionally, silica is coprecipitated with magnesium hydroxide as a magnesium silicate complex. Sodium aluminate and polymer are added as coagulants, allowing colloidal particles to agglomerate and settle out.

The overflow from 32Z-103 is gravity fed to the Sidestream Gravity Filters (32Z-102 A through E). A system of five gravity sand filters operating in parallel is used. Each filter normally handles 1,436 GPM (5.6 GPM/ft^2). When any of the filters is in the backwash mode, the load on each of the four remaining operating filters increases to 1,795 GPM (7.1 GPM/ft^2). The filtered water is collected and pumped to the high solids cooling tower. A portion of the filtered water is routed to the Backwash Water Storage Tank (32D-103) at an average rate of 89 GPM which is the average backwash rate for the plant. Estimated filter backwash frequency is once per day. Estimated filter backwash time is 20 minutes. For a perfectly staggered system, a backwash would occur about once every five hours.

The filters automatically backwash on differential pressure mode but automatic controls limit backwashing to one filter at a time. The design allows two filters to backwash end to end, with a third backwash occurring an hour later. Each filter requires 2,545 GPM of backwash water for ten minutes (10 GPM/ft^2). Filter backwash water is collected in the below-grade Sump (32D-102) and pumped back to the reactor clarifier at as steady rate as possible for reuse. The sump accommodates two backwashes end to end and three additional backwashes in one hour intervals. Two 150 GPM sump pumps operate "on/off" on high and low level controls, providing flows up to 300 GPM.

An agitating system in the sump keeps the solid particles suspended.

The underflow (sludge) containing about 5% solids by weight is drawn from the bottom of the Reactor/Clarifier (32Z-103) into a below grade Sludge Surge Pit (32D-124). The tank is sized for two hours sludge retention time and is equipped with a water jet sludge breaker. Abrasion-resistant progressing cavity pumps transport the sludge to the Vacuum Filters (32Z-104 A, B and C). Three filters are provided, two operating and one spare. The filter design basis is ten pounds of solids filtered each hour per square foot of filter material (10 lb/hr/ft^2). Filtrate is pumped back to 32Z-103. A filter cake, estimated to contain 48% solids by weight, is discharged onto the Sludge Cake Conveyor (32T-101) and transported to the elevated Sludge Cake Storage Bin (32D-125). The 1,200 ft^3 storage bin is sized to contain one day's production of sludge cake. Trucks transport the waste solids to landfill.

2.4 Catalysts, Packings and Chemicals

Packings

	Initial Inventory	Estimated Life
Gravels and Anthracite	12,700 ft^3	3 years

Chemicals (Breakdown by System)

River Water Treatment

	Initial Inventory (pounds)	Consumption (dry basis) Average (6,350 GPM)	Design (10,000 GPM)
Dolomitic lime	150,000	6,480 lb/day	10,200 lb/day
Soda ash	250,000	12,700 lb/day	20,000 lb/day
Sodium aluminate	7,000	1,320 lb/day	2,080 lb/day
Polymer	30,000	610 lb/day	960 lb/day
Sulfuric acid	190	170 lb/day	270 lb/day (max.)

Cooling Water

		Design (average) Consumption (dry basis)
Chlorine	65,700	2,192 lb/day
Inhibitor	10,800	360 lb/day
Sulfuric acid	960	320 lb/day
Dispersing agent	10,800	360 lb/day

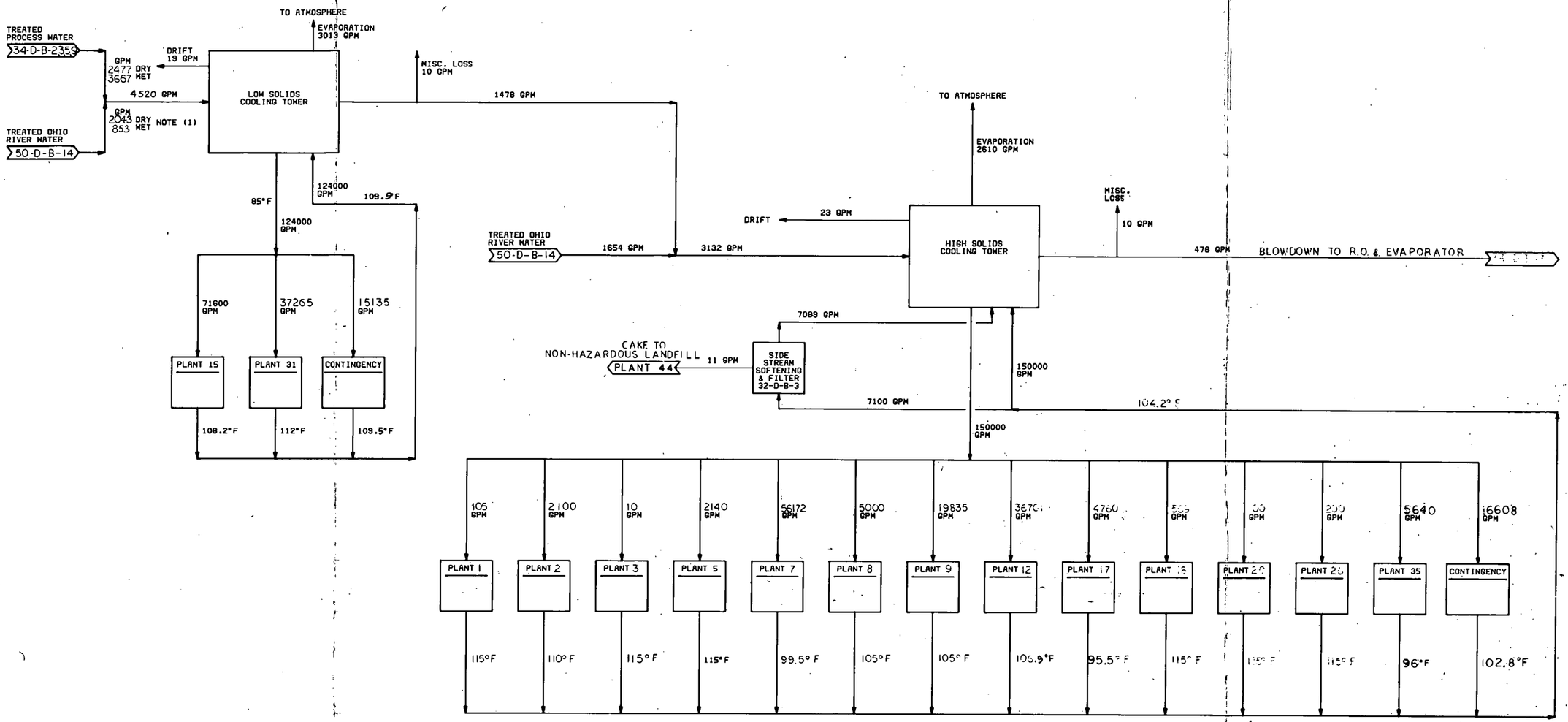
Cooling Water Sidestream

		Design (average) Consumption (dry basis)
Dolomitic lime	240,000	15,550 lb/day
Soda ash	100,000	4,470 lb/day
Sodium aluminate	25,000	820 lb/day
Polymer	2,600	85 lb/day

2.5 Utility Balance

System	Electric Power Consumption (Operating)
River Water Treatment	980 kW
Cooling Water	13,311
Cooling Water Sidestream	229
Total	14,520 kW

(No other utilities required).



NOTE:

1. DRY = DRY WEATHER
   MET = MET WEATHER

NO.	DATE	REVISIONS	BY	CHK.	ENGR.	OI APPR.	AEFI APPR.
2	10/6/81	REVISED LSCT MAKEUP RATE			LKM	VS	WWL
1	2/17/81	ISSUED FOR PHASE 0			LKM	NSG	WWL WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			LKM	NSG	

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PROCESS FLOW DIAGRAM COOLING WATER SYSTEM PLANT 32

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	32-D-B-1	2

KCL56C 01/26/81 MJ

22 X 34 "D" SIZE

D-112 DAY TANK FOR INHIBITOR

D-111 DAY TANK FOR DISPERSING ACID

D-113 DAY TANK FOR ACID

K-101 COOLING TOWER FANS (LSCT)

E-101 LOW SOLIDS COOLING TOWER DUTY:1507 MMBTU/HR

E-111A,B CHLORINATOR UNIT

H-101 CHLORINE EJECTOR (LSCT)

H-102 CHLORINE EJECTOR (HSCT)

D-122 DAY TANK FOR INHIBITOR

D-121 DAY TANK FOR DISPERSING AGENT

D-123 DAY TANK FOR ACID

K-102 COOLING TOWER FANS (HSCT)

E-102 HIGH SOLIDS COOLING TOWER DUTY:1305 MMBTU/HR

D-140 DISPERSING AGENT STORAGE TANK

EVAPORATION 3013

124000 109.3 AR Cl

32-D-B-1 C.W. RETURN

K-101A-K NOTE (3)

MISC. LOSSES 10

19 DRIFT

LOW SOLIDS COOLING TOWER (3 CYCLES)

E-101

1478

FR

AIC CONDUCTIVITY

DRY 2050

WET 3300

4520 FR

TREATED PROCESS WATER

DRY 2470

WET 1220

TREATED OHIO RIVER WATER

LIC

124000 85 C.W. SUPPLY 32-D-B-1

NOTE (1)

G-101A-D

AIC CORROSIVITY AIC pH

FW EMERGENCY MAKE-UP

250

PRV

FI

INHIBITOR

0.067

D-112

G-152A, B

DISPERSING AGENT

0.067

D-111

G-151A, B

SULFURIC ACID

0.01

D-113

NOTE (2)

G-153A, B

H-101

INTER 992

INTER 1200

H-102

NC

E-111A

CHLORINE

NOTE (4)

E-111B

OFF SITE TREATED RIVER WATER FROM UTILITY WATER POND

7100

WATER TREATMENT SEE DWG. NO. 32-D-B-3

11 CAKE TO LANDFILL

7089

FRC

478 TO BLOWDOWN STORAGE/EQUALIZING TANK 34-D-B-5

EVAPORATION 2610

MISC. LOSSES 10

AIC COND.

AR Cl

CW RETURN 32-D-B-1

150000 102.4

142412

K-102A-K NOTE (3)

HIGH SOLIDS COOLING TOWER (6 CYCLES)

E-102

23 DRIFT

1478

1654

FR

NOTE (1)

LIC

G-102A-D

FW EMERGENCY MAKE-UP

CORROSIVITY AIC pH AIC

FR 150000 85 C.W. SUPPLY 32-D-B-1

INHIBITOR

D-122

STANDBY

G-162A, B

FROM TRUCKS

DISPERSING AGENT

D-140

TO D-111

D-121

0.067

G-161A, B

SULFURIC ACID

D-123

NOTE (2)

0.1

G-163A, B

LEGEND:

1. ⟩ = FLOWS IN GPM
2. □ = TEMPERATURES IN °F
3. ALL EQUIPMENT NUMBERS ARE PREFIXED BY 32.
4. ⟨ ⟩ = INTERMITTENT FLOW IN LBS/DAY
5. DRY = DRY WEATHER
   WET = WET WEATHER
6. NC = NORMALLY CLOSED

NOTES:

1. BASINS FOR COOLING TOWERS E-101 AND E-102 TO BE PROVIDED WITH COMPARTMENTS SO CELLS CAN BE TAKEN OUT OF SERVICE FOR REMOVAL OF ACCUMULATED SOLIDS.
2. CHEMICAL DAY TANKS AND INJECTION PUMPS TO BE LOCATED IN A HEATED SHED.
3. FANS K-101A-K AND K-102A-K TO BE PROVIDED WITH TWO FORWARD SPEEDS PLUS ONE REVERSE SPEED FOR DEICING.
4. LINES FOR CHLORINE SYSTEM TO BE STEAM TRACED AND INSULATED.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	DI APPR.	ASST APPR.
2	3/17/81	ISSUED FOR PHASE 0			LKM	NSC		WWD
1	12/8/80	ISSUED FOR REVIEW/APPROVAL			LKM	NSC		

DESIGNED DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

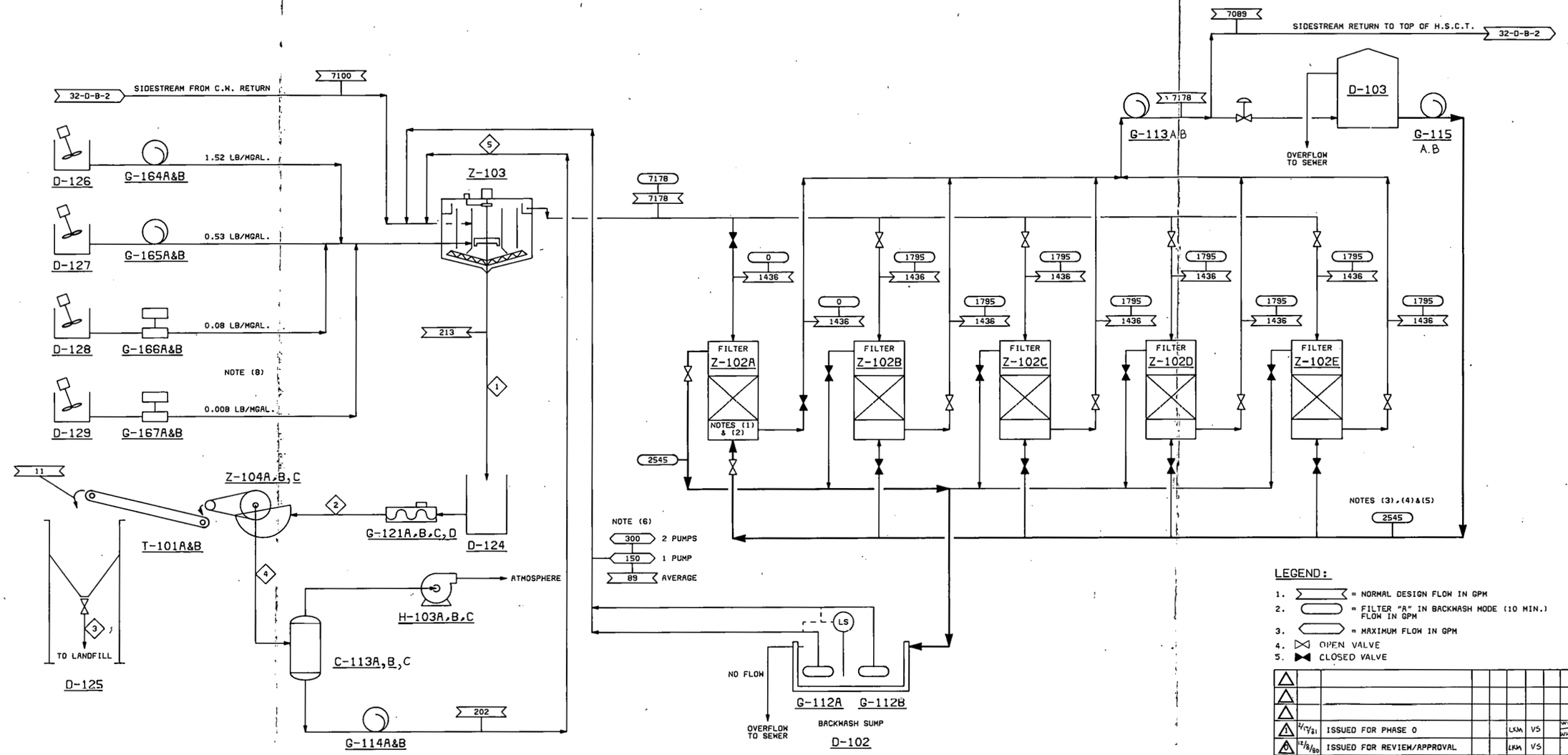
PROCESS FLOW DIAGRAM COOLING WATER SYSTEM PLANT 32

BECHTEL HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	32-D-B-2	1

KCL5SC 01/27/81 MJ

22 X 34 "D" SIZE

D-126 LIME SOLUTION TANK | D-127 SODA ASH SOLUTION TANK | D-128 ALUM SOLUTION TANK | D-129 POLYELECTRIC SOLUTION TANK | D-125 SLUDGE CAKE STORAGE BIN | T-101A&B SLUDGE CAKE CONVEYORS | Z-104A,B,C VACUUM FILTERS | C-113A,B,C VACUUM RECEIVER VESSELS | Z-103 REACTOR CLARIFIER | D-124 SLUDGE SURGE TANK | H-103A,B,C VACUUM PUMPS | Z-102A-E SIDESTREAM GRAVITY FILTERS | D-102 BACKWASH SUMP 30'X30'X10' (CONCRETE) | D-103 BACKWASH WATER STORAGE TANK



LEGEND:

1. = NORMAL DESIGN FLOW IN GPM
2. = FILTER "A" IN BACKWASH MODE (10 MIN.) FLOW IN GPM
3. = MAXIMUM FLOW IN GPM
4. OPEN VALVE
5. CLOSED VALVE

STREAM NO.	1	2	3	4	5
DESCRIPTION / COMPONENT	REACTOR CLARIFIER SLUDGE	REACTOR CLARIFIER SLUDGE	FILTER CAKE	FILTRATE	FILTRATE
WATER (LB/HR)	106,675	106,675	5,500	101,175	101,175
SOLIDS (LB/HR)	5,325	5,325	5,022	303	303
SOLIDS (WT. %)	4.8	4.8	47.8	.3	.3

NOTES:

1. FILTERS ARE AUTOMATIC BACKWASHING GRAVITY FILTERS WITH COMMON BACKWASH STORAGE TANK.
2. FILTERS ARE SIZED FOR 5.6 GPM/FT² FLOW.
3. BACKWASH FLOW IS 10 GPM/FT² FOR 10 MINUTES.
4. BACKWASHING IS CONTROLLED BY PRESSURE DIFFERENTIAL AND OCCURS ABOUT ONCE PER DAY PER FILTER.
5. OVERRIDES ON THE CONTROLS WILL ALLOW TWO BACKWASHES END-TO-END AND A THIRD BACKWASH AFTER 1 HOUR DELAY.
6. AVERAGE BACKWASH FLOW IS BASED ON ONE BACKWASH PER DAY PER FILTER. AFTER 1 BACKWASH, FLOW IS 150 GPM PROVIDED BY 1 PUMP. AFTER END-TO-END BACKWASHES, FLOW IS 300 GPM PROVIDED BY 2 PUMPS.
7. ALL EQUIPMENT NUMBERS ARE PREFIXED BY 32.
8. CHEMICAL DAY TANKS AND INJECTION PUMPS TO BE LOCATED IN A HEATED SHED.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	OI APPR.	ASFI APPD.
1	8/17/81	ISSUED FOR PHASE 0			LKM	VS		WWC WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			LKM	VS		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM SIDESTREAM WATER TREATMENT COOLING WATER SYSTEM PLANT 32

BECHTEL HOUSTON

JOB NO. 14222 | DRAWING NO. 32-D-B-3 | REV. 1

22 X 34 "D" SIZE

KCL61C 01/27/81 MJ

LIME FEED SYSTEM

32Z-105A,B
TRAVELING SCREENS
TWO 2'X6'

32G-168A-F
RAW WATER INTAKE PUMPS
SIX, 2500 GPM, 85 BHP

32D-136
SLUDGE SURGE TANK
4,000 GAL.
CONCRETE

32G-180A,B
VACUUM FILTER FEED
SLUDGE PUMPS (2)
165 GPM, 12 BHP

32D-130A,B
LIME STORAGE HOPPERS
1200 FT³ EACH

32Z-106A,B
LIME SLAKERS
500 LB/HR EACH

32D-131A,B
LIME SLURRY TANKS
500 GAL. EACH

32G-169A-E
LIME FEED PUMPS
3 GPM EACH, 1.5 BHP

POLYMER FEED SYSTEM

32D-132
POLYMER STORAGE TANK
1000 GALLONS

32D-133A,B
POLYMER MIXING TANKS
WITH MIXERS
TWO 200 GAL.

32G-170A,B
POLYMER TRANSFER PUMPS
TWO 2.0 GPM, 3/4 BHP

32G-171A-E
POLYMER FEED PUMPS
2.0 GPM EACH, 3/4 BHP

SODA ASH FEED SYSTEM

32D-134
SODA ASH TANK
800 GAL.

32G-172A-E
SODA ASH FEED PUMPS
2.0 GPM EACH, 3/4 BHP

ALUM FEED SYSTEM

32D-135A,B
ALUM STORAGE TANKS
5,000 GAL. EACH

32G-173A-E
ALUM FEED PUMPS
0.5 GPM EACH, 3/4 BHP

32Z-107A-D
REACTOR/CLARIFIERS (4)
80' DIAM. EACH

32G-174A-D
R/C SLUDGE PUMPS (4)
40 GPM EACH, 10 BHP

32Z-108A,B
VACUUM FILTERS,
10.5'DX10'H,
TANK AND VACUUM PUMPS

32T-102
CAKE CONVEYOR
18"WX200'L

32D-139
CAKE STORAGE BIN
10'X12'X12'

NEUTRALIZATION SYSTEM

32D-137
ACID TANK
100 GAL.

32G-175A,B
ACID FEED PUMPS
0.1 GPM, 1/4 BHP

32Z-109A,B
FLASH MIXERS
5 BHP

32J-101A,B
ACID FEED
CONTROLLERS

32G-181
VACUUM FILTRATE PUMP
150 GPM, 5 BHP

ANTHRACITE FILTER SYSTEM

32G-176A-C
FILTER FEED PUMPS
300 GPM EACH, 13 BHP

32G-177A,B
FILTER BACKWASH PUMPS
750 GPM, 10 BHP

32Z-110A-D
ANTHRACITE FILTERS
8' DIAM. EACH

32K-103A&B
ANTHRACITE FILTER
BACKWASH BLOWER
100 SCFM @ 30 PSI, 15 BHP

32D-138
SURGE TANK
40,000 FT³

DUAL MEDIA FILTER SYSTEM

32G-178A-C
FILTER FEED PUMPS (3)
5,000 GPM EACH, 210 BHP

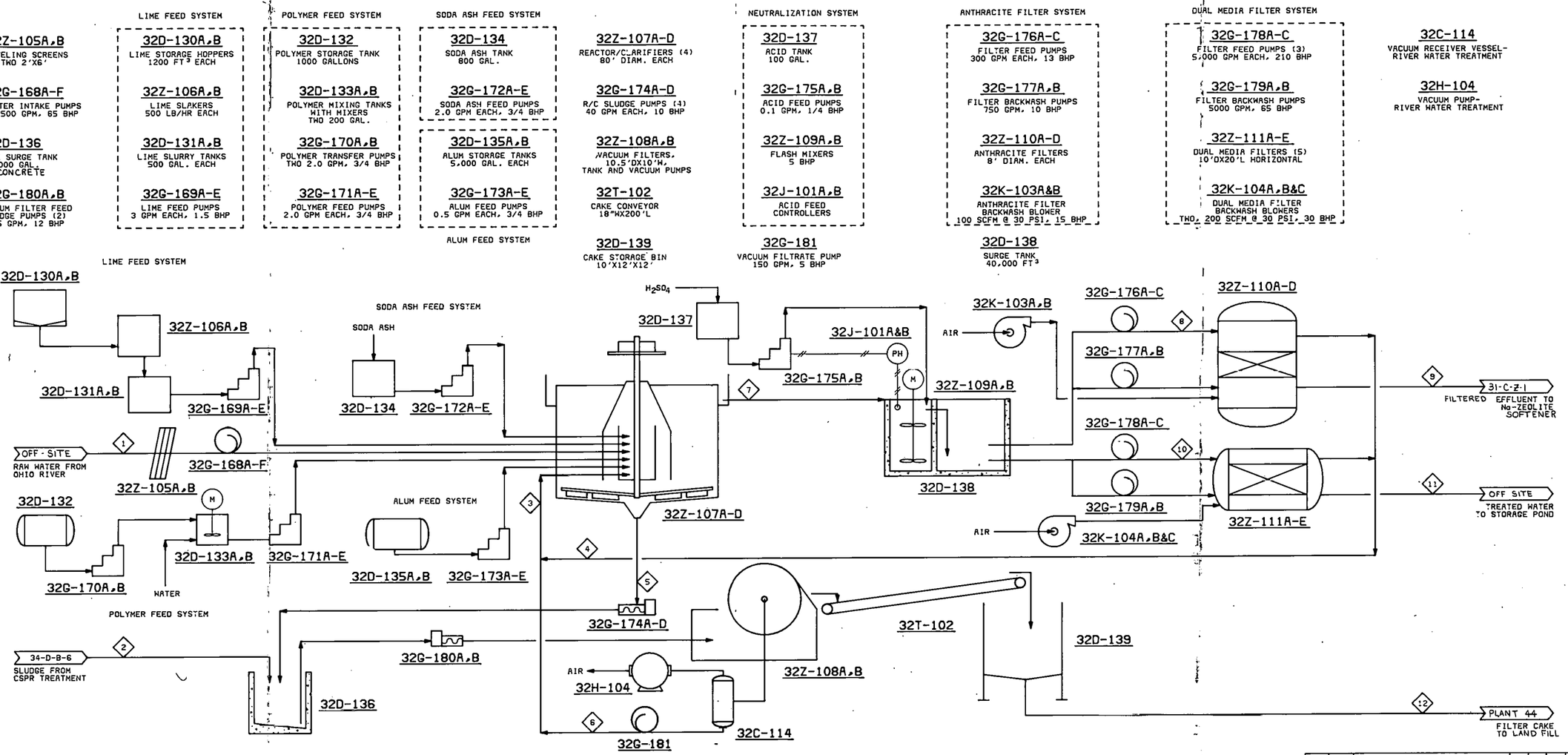
32G-179A,B
FILTER BACKWASH PUMPS
5000 GPM, 65 BHP

32Z-111A-E
DUAL MEDIA FILTERS (5)
10'DX20'L HORIZONTAL

32K-104A,B&C
DUAL MEDIA FILTER
BACKWASH BLOWERS
TWO, 200 SCFM @ 30 PSI, 30 BHP

32C-114
VACUUM RECEIVER VESSEL-
RIVER WATER TREATMENT

32H-104
VACUUM PUMP-
RIVER WATER TREATMENT



STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12
DESCRIPTION / COMPONENT	RAW WATER	SLUDGE FROM CSPR	COMBINED RECYCLE	FILTER BACKWASH	R/C UNDERFLOW	FILTRATE	R/C OVERFLOW	ANTHRACITE FILTER INFLUENT	Na-ZEOLITE FEED	DUAL MEDIA FILTER INFLUENT	TREATED H_2O TO PLANT USE	FILTER CAKE
FLOW (GPM)	10,000	<55	<350	<200	100	<150	10,200	600	600	9400	9400	15
pH		6-9					10.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	
Ca (MG/L C CO)	113						11	11	11	11	11	
Mg (MG/L C CO)	50						5	5	5	5	5	
SS (MG/L)	250	2%			5%	5000	23	23	1	23	1	40%
TDS (MG/L)	294	1,200					280	280	280	280	280	
SiO_2 (MG/L)	6.3						3	3	3	3	3	
Cl (MG/L)	30						30	30	30	30	30	
ALK. (MG/L)	87						9	9	9	9	9	
SO_4 (MG/L)	93						93	93	93	93	93	

KCL66A 02/12/81 RS

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	GI APPR.	ASPT APPR.
1	2/17/81	ISSUED FOR PHASE ZERO			VS LCM	BTK		WWL WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			VS LCM	BTK		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80DR20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM
PLANT 32 - WATER TREATMENT
RIVER WATER TREATMENT

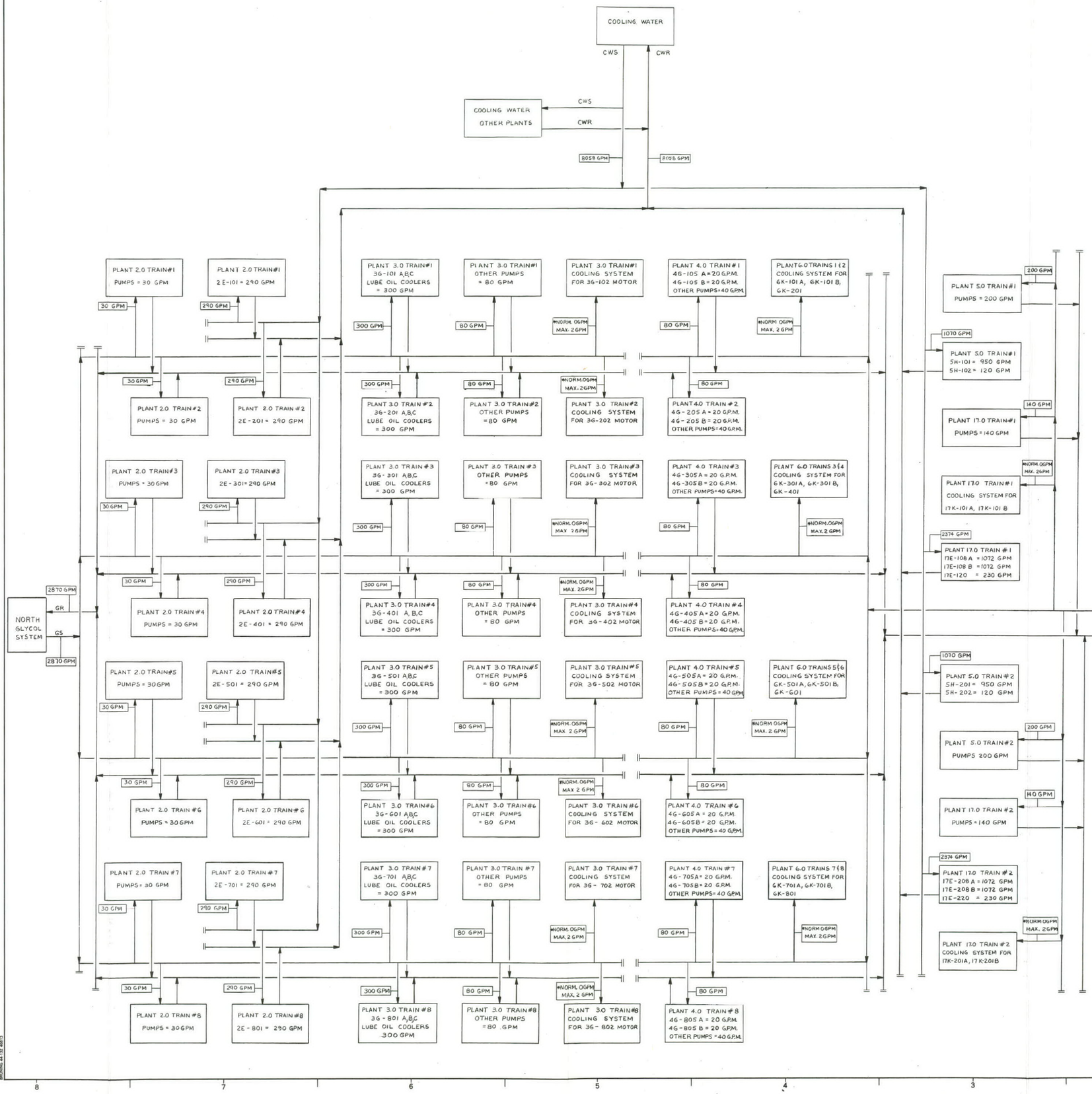
BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	32-D-B-4	1

22 X 34 "D" SIZE

NOTES:

1. IT IS ASSUMED THAT GLYCOL FLOWS TO ALL PUMPS, INCLUDING SPARES, AT ALL TIMES.
2. MAKE-UP REQUIREMENTS FOR INDEPENDENT CLOSED LOOP SYSTEMS WITH SPECIFIC TEMPERATURE OR FAIL-SAFE REQUIREMENT. FLOWS ARE A RESULT OF LEAKAGE OR OTHER ABNORMAL CONDITIONS. ANNUAL GLYCOL CONSUMPTION NEGLIGIBLE.



NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENGR.	HRI APPR.	ASPT APPR.
1	1-2081	FOR DOE	CCF				TK	HWH

DESIGNED CCF DRAWN V.N. SCALE

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80XR20717

BRECKINRIDGE PROJECT

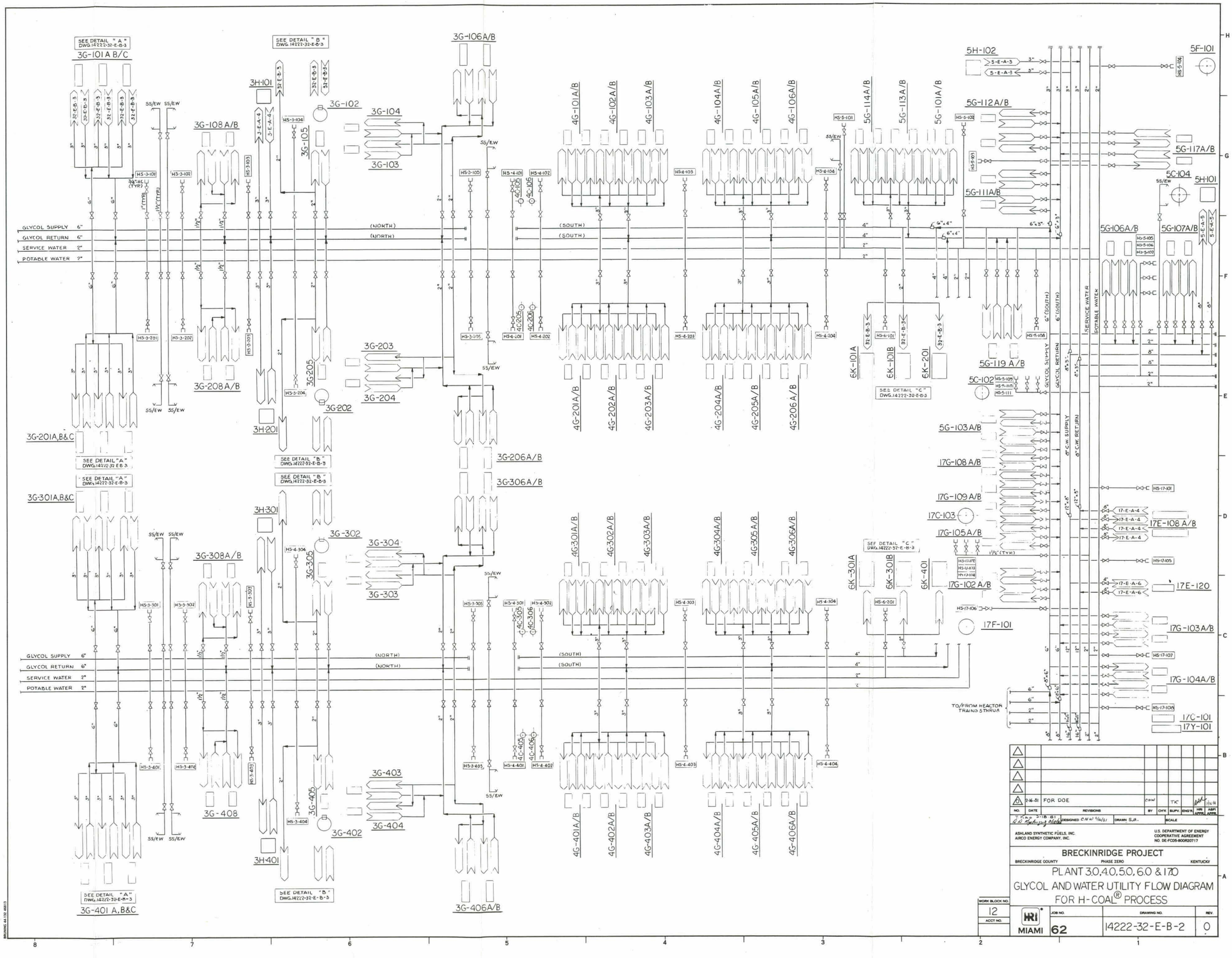
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PLANTS 2.0, 3.0, 4.0, 5.0, 6.0 & 17.0 GLYCOL AND COOLING WATER BLOCK DIAGRAM FOR H-COAL® PROCESS

WORK BLOCK NO. 12
ACCT NO.

HRI MIAMI | JOB NO. 62 | DRAWING NO. 14222-32-E-B-1 | REV. 0

BRUNING 44.152 46513



NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENG'R	HRI APPR.	ASPT APPR.
1	2-16-81	FOR DOE	CNW		TC			

DESIGNED C.N.W. 5/14/81 — DRAWN S.J.A. — SCALE

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

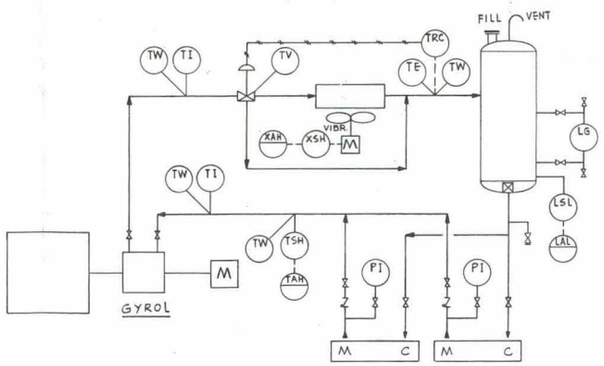
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PLANT 3.0, 4.0, 5.0, 6.0 & 17.0
GLYCOL AND WATER UTILITY FLOW DIAGRAM
FOR H-COAL® PROCESS

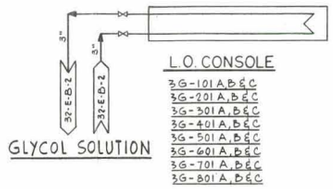
WORK BLOCK NO.		JOB NO.	DRAWING NO.	REV.
12	HRI MIAMI	62	14222-32-E-B-2	0
ACCT NO.				

BRUNING 44-112-40813

GYROL FLUID AIR COOLER GYROL FLUID DRUM



GYROL FLUID CIRC. PUMP

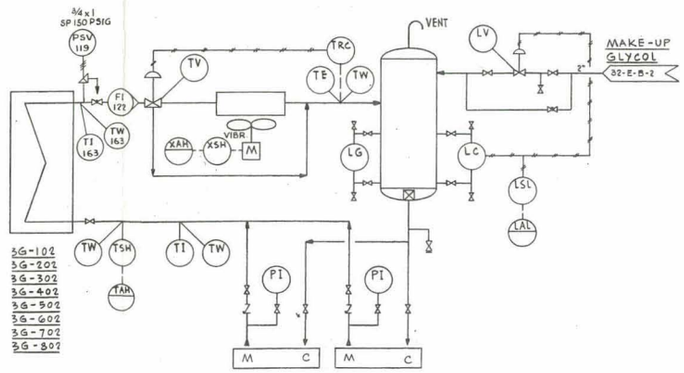


L.O. CONSOLE

3G-101 A,B & C
3G-201 A,B & C
3G-301 A,B & C
3G-401 A,B & C
3G-501 A,B & C
3G-601 A,B & C
3G-701 A,B & C
3G-801 A,B & C

DETAIL "A"
GLYCOL & GYROL FLUID COOLING SYSTEM
(24 REQ'D.)

GLYCOL SOLUTION AIR COOLER GLYCOL SOLUTION DRUM

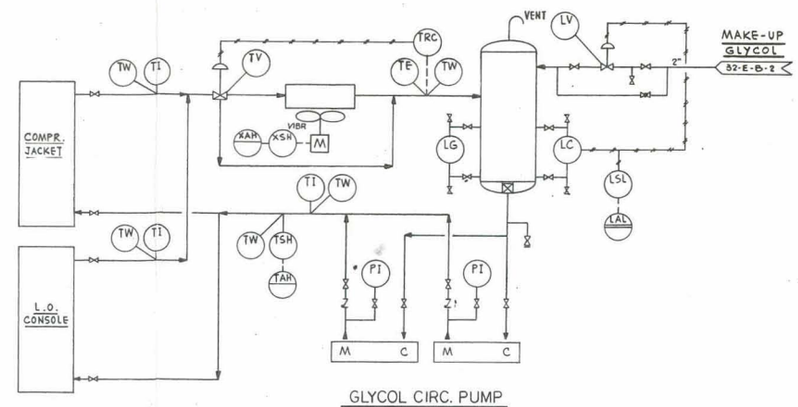


3G-102
3G-202
3G-302
3G-402
3G-502
3G-602
3G-702
3G-802

GLYCOL CIRC. PUMP

DETAIL "B"
GLYCOL COOLING SYSTEM
(8 REQ'D.)

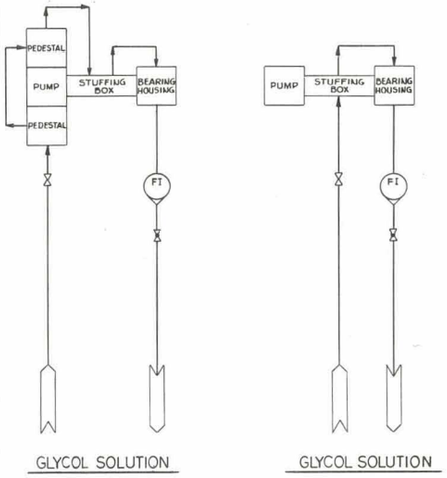
GLYCOL SOLUTION AIR COOLER GLYCOL SOLUTION DRUM



GLYCOL CIRC. PUMP

GK-101 A,B & GK-201
GK-301 A,B & GK-401
GK-501 A,B & GK-601
GK-701 A,B & GK-801

DETAIL "C"
GLYCOL COOLING SYSTEM
(12 REQ'D.)



DETAIL "D"
PEDESTAL, SEAL & BEARING HOUSING COOLING

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENGR.	HRI APPR.	ABPI APPR.
2	2-17-81	FOR DOE	CNW		TC		DMF	HUH

T. K. 2-18-81 DESIGNED C.N.W. 2/17/81 DRAWN S.M. SCALE

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PLANT 3.0, 4.0, 5.0, 6.0 & 17.0 DETAILS FOR GLYCOL & WATER FOR H-COAL® PROCESS

WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV.
12	62	14222-32-E-B-3	0
ACCT NO.			

HRI MIAMI

BRUNING 44-132 46613

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32	WATER SYSTEM	000000 NA
32C-113B	VACUUM RECEIVER VESSELS	000000 NA
32C-113C	VACUUM RECEIVER VESSELS	000000 NA
32D-102	BACKWASH SUMP	000000 NA
32D-103	BACKWASH WATER STORAGE TANK	000000 NA
32D-111	HOLDING TANK FOR DISPERSING AGENT L.S.C.T	000000 NA
32D-112	HOLDING TK FOR INHIBITOR (CHROMATE) L.S.C.T.	000000
32D-113	HOLDING TANK FOR ACID L.S.C.T	000000
32D-121	HOLDING TANK FOR DISPERSING AGNT H.S.C.T.	000000
32D-122	HOLDING TANK FOR INHIBITOR (CHROMATE)	000000
32D-123	HOLDING TANK FOR SULFURIC ACID	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32D-124	SLUDGE SURGE TANK -	000000 NA
32D-125	CAKE STORAGE BIN -	000000 NA
32D-126	LIME SOLUTION TANK -	000000 NA
32D-127	SODA ASH SOLUTION TANK -	000000 NA
32D-128	ALUM SOLUTION TANK -	000000 NA
32D-129	POLYELECTROLYTE SOLUTION TANK -	000000 NA
32D-132	POLYMER STORAGE TANK -	000000 NA
32D-133A	POLYMER MIXING TANK -	000000 NA
32D-133B	POLYMER MIXING TANK -	000000 NA
32D-134	SODA ASH SURGE TANK -	000000 NA
32D-135A	ALUM STORAGE TANK -	000000 NA

JOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32D-135B	ALUM STORAGE TANK	000000 NA
32D-136	SLUDGE SURGE TANK	000000 NA
32D-137	ACID TANK	000000 NA
32D-138	SURGE TANK	000000 NA
32D-139	CAKE STORAGE BIN	000000 NA
32D-140	DISPERSING AGENT STORAGE TANK	000000 NA
32E-101	LOW SOLIDS COOLING TOWER (L.S.C.T.)	000000
32E-102	HIGH SOLIDS COOLING TOWER (H.S.C.T.)	000000
32E-111A	CHLORINATOR L.S.C.T.	000000
32E-111B	CHLORINATOR L.S.C.T.	000000 NA
32G-101A	L.S. CIRCULATING PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-101B	L.S. CIRCULATING PUMP	000000
32G-101C	L.S. CIRCULATING PUMP	000000
32G-101D	L.S. CIRCULATING PUMP	000000
32G-102A	H.S. CIRCULATING PUMP	000000
32G-102B	H.S. CIRCULATING PUMP	000000
32G-102C	H.S. CIRCULATING PUMP	000000
32G-102D	H.S. CIRCULATING PUMP	000000
32G-112A	BACKWASH SUMP PUMP	000000 NA
32G-112B	BACKWASH SUMP PUMP	000000 NA
32G-113A	C.W. SIDESTREAM RETURN PUMP	000000 NA
32G-113B	C.W. SIDESTREAM RETURN PUMP	000000 NA

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-114A	RECYCLE WATER PUMP TO LIME SOFTENER -	000000 NA
32G-114B	RECYCLE WATER PUMP TO LIME SOFTENER -	000000 NA
32G-115A	BACKWASH WATER SUPPLY PUMP -	000000 NA
32G-115B	BACKWASH WATER SUPPLY PUMP -	000000 NA
32G-121A	SLUDGE FEED PUMP -	000000 NA
32G-121B	SLUDGE FEED PUMP -	000000 NA
32G-121C	SLUDGE FEED PUMP -	000000 NA
32G-121D	SLUDGE FEED PUMP -	000000 NA
32G-151A	RECIPROCATING PUMP FOR DISPERSING AGENT LSCT -	000000 NA
32G-151B	RECIPROCATING PUMP FOR DISPERSING AGENT L.S.C.T -	000000 NA
32G-152A	RECIPROCATING PUMP FOR INHIBITOR L.S.C.T. -	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-152B	RECIPROCATING PUMP FOR INHIBITOR L.S.C.T. -	000000 NA
32G-153A	RECIPROCATING PUMP FOR ACID L.S.C.T. -	000000 NA
32G-153B	RECIPROCATING PUMP FOR ACID L.S.C.T. -	000000 NA
32G-161A	RECIPROCATING PUMP FOR DISPERSING AGENT H.S.C.T -	000000 NA
32G-161B	RECIPROCATING PUMP FOR DISPERSING AGENT H.S.C.T -	000000 NA
32G-162A	RECIPROCATING PUMP FOR INHIBITOR H.S.C.T. -	000000
32G-162B	RECIPROCATING PUMP FOR INHIBITOR H.S.C.T. -	000000 NA
32G-163A	RECIPROCATING PUMP FOR H.S.C.T. -	000000 NA
32G-163B	RECIPROCATING PUMP FOR H.S.C.T. -	000000 NA
32G-164A	LIME FEED PUMP -	000000 NA
32G-164B	LIME FEED PUMP -	000000 NA

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-165A	SODA ASH FEED PUMP -	000000 NA
32G-165B	SODA ASH FEED PUMP -	000000 NA
32G-166A	ALUM FEED PUMP -	000000 NA
32G-166B	ALUM FEED PUMP -	000000 NA
32G-167A	POLYELECTROLYTE FEED PUMP -	000000 NA
32G-167B	POLYELECTROLYTE FEED PUMP -	000000 NA
32G-168A	RAW WATER INTAKE PUMP -	000000 NA
32G-168B	RAW WATER INTAKE PUMP -	000000 NA
32G-168C	RAW WATER INTAKE PUMP -	000000 NA
32G-168D	RAW WATER INTAKE PUMP -	000000 NA
32G-168E	RAW WATER INTAKE PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-168F	RAW WATER INTAKE PUMP	000000
	-	NA
32G-169A	LIME SLURRY FEED PUMP	000000
	-	NA
32G-169B	LIME SLURRY FEED PUMP	000000
	-	NA
32G-169C	LIME SLURRY FEED PUMP	000000
	-	NA
32G-169D	LIME SLURRY FEED PUMP	000000
	-	NA
32G-169E	LIME SLURRY FEED PUMP	000000
	-	NA
32G-170A	POLYMER TRANSFER PUMP	000000
	-	NA
32G-170B	POLYMER TRANSFER PUMP	000000
	-	NA
32G-171A	POLYMER FEED PUMP	000000
	-	NA
32G-171B	POLYMER FEED PUMP	000000
	-	NA
32G-171C	POLYMER FEED PUMP	000000
	-	NA

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-171D	POLYMER FEED PUMP	000000
	-	NA
32G-171E	POLYMER FEED PUMP	000000
	-	NA
32G-172A	SODA ASH FEED PUMP	000000
	-	NA
32G-172B	SODA ASH FEED PUMP	000000
	-	NA
32G-172C	SODA ASH FEED PUMP	000000
	-	NA
32G-172D	SODA ASH FEED PUMP	000000
	-	NA
32G-172E	SODA ASH FEED PUMP	000000
	-	NA
32G-173A	ALUM FEED PUMP	000000
	-	NA
32G-173B	ALUM FEED PUMP	000000
	-	NA
32G-173C	ALUM FEED PUMP	000000
	-	NA
32G-173D	ALUM FEED PUMP	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-173E	ALUM FEED PUMP	000000 NA
32G-174A	REACTOR/CLARIFIER SLUDGE PUMP	000000 NA
32G-174B	REACTOR/CLARIFIER SLUDGE PUMP	000000 NA
32G-174C	REACTOR/CLARIFIER SLUDGE PUMP	000000 NA
32G-174D	REACTOR/CLARIFIER SLUDGE PUMP	000000 NA
32G-175A	ACID FEED PUMP	000000 NA
32G-175B	ACID FEED PUMP	000000 NA
32G-176A	FILTER FEED PUMP	000000 NA
32G-176B	FILTER FEED PUMP	000000 NA
32G-176C	FILTER FEED PUMP	000000 NA
32G-177A	FILTER BACKWASH PUMP	000000 NA

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32G-177B	FILTER BACKWASH PUMP	000000 NA
32G-178A	FILTER FEED PUMP	000000 NA
32G-178B	FILTER FEED PUMP	000000 NA
32G-178C	FILTER FEED PUMP	000000 NA
32G-179A	FILTER BACKWASH PUMP	000000 NA
32G-179B	FILTER BACKWASH PUMP	000000 NA
32G-180A	VACUUM FILTER FEED PUMP	000000 NA
32G-180B	VACUUM FILTER FEED PUMP	000000 NA
32G-181	VACUUM FILTRATE PUMP	000000 NA
32G-182A	UTILITY WATER PUMP	000000 NA
32G-182B	UTILITY WATER PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32H-101	CHLORINE EJECTOR LSCT	000000
	-	NA
32H-102	CHLORINE EJECTOR HSCT	000000
	-	NA
32H-103A	VACUUM PUMP	000000
	-	NA
32H-103B	VACUUM PUMP	000000
	-	NA
32H-103C	VACUUM PUMP	000000
	-	NA
32J-101A	ACID FEED CONTROLLER	000000
	-	NA
32J-101B	ACID FEED CONTROLLER	000000
	-	NA
32K-103A	AIR BLOWER	000000
	-	NA
32K-103B	AIR BLOWER	000000
	-	NA
32K-104A	AIR BLOWER	000000
	-	NA
32K-104B	AIR BLOWER	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32K-104C	AIR BLOWER	000000
	-	NA
32T-101A	CAKE CONVEYOR	000000
	-	NA
32T-101B	CAKE CONVEYOR	000000
	-	NA
32T-102	FILTER CAKE CONVEYOR	000000
	-	NA
32Z-102A	SIDESTREAM FILTER	000000
	-	NA
32Z-102B	SIDESTREAM FILTER	000000
	-	NA
32Z-102C	SIDESTREAM FILTER	000000
	-	NA
32Z-102D	SIDESTREAM FILTER	000000
	-	NA
32Z-102E	SIDESTREAM FILTER	000000
	-	NA
32Z-103	LIME SOFTENER	000000
	-	NA
32Z-104A	VACUUM FILTER	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32Z-104B	VACUUM FILTER	000000
	-	NA
32Z-104C	VACUUM FILTER	000000
	-	NA
32Z-105A	TRAVELING SCREEN	000000
	-	NA
32Z-105B	TRAVELING SCREEN	000000
	-	NA
32Z-107A	REACTOR/CLARIFIER	000000
	-	NA
32Z-107B	REACTOR/CLARIFIER	000000
	-	NA
32Z-107C	REACTOR/CLARIFIER	000000
	-	NA
32Z-107D	REACTOR/CLARIFIER	000000
	-	NA
32Z-108A	VACUUM FILTER SYSTEM	000000
	-	NA
32Z-108B	VACUUM FILTER SYSTEM	000000
	-	NA
32Z-109A	FLASH MIXER	000000
	-	NA

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32Z-109B	FLASH MIXER	000000 NA
32Z-110A	ANTHRACITE FILTER	000000 NA
32Z-110B	ANTHRACITE FILTER	000000 NA
32Z-110C	ANTHRACITE FILTER	000000 NA
32Z-110D	ANTHRACITE FILTER	000000 NA
32Z-111A	DUAL MEDIA FILTER	000000 NA
32Z-111B	DUAL MEDIA FILTER	000000 NA
32Z-111C	DUAL MEDIA FILTER	000000 NA
32Z-111D	DUAL MEDIA FILTER	000000 NA
32Z-111E	DUAL MEDIA FILTER	000000 NA
32Z-164	LIME SLURRY FEED SYSTEM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
32Z-165	SODA ASH FEED SYSTEM	000000 NA
32Z-166A	RIVER WATER LIME SLURRY FEED SYSTEM	000000 NA
32Z-166B	RIVER WATER LIME SLURRY FEED SYSTEM	000000 NA
		000000

4.1 Data Sheets for Tanks

32-DS-D-03: Backwash Water Storage Tank (32D-103)

32-DS-D-140: Dispersing Agent Storage Tank (32D-140)

TANK DATA

BACKWASH WATER STORAGE TANK	
TANK NO.	32D-103
SIZE, DIA. X HEIGHT	22'x22'
CAPACITY (42 GAL. BBLS)	1489
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	✓
EMPTYING RATE-BPH	✓
BEARING PLATES	YES
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	102
CORROSION ALLOWANCE	1/8
DESIGN METAL TEMP. – °F MIN./MAX.	125
DESIGN SPECIFIC GRAVITY	1.0
TOTAL NET WORKING CAP. – MBBLS	1.489
MINIMUM NO. OF TANKS	
GAS BLANKET – MIN./MAX. IN. WATER	ATM
VISCOSITY, CP	0.65
MATERIALS OF CONSTRUCTION	CS

SHELL APPURTENANCES

SUCTION NOZZLE	/
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	✓
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

PAINTING (BECHTEL STD.)	X-502
BOTTOM PLATE COATING	YES
WINDGIRDERS	
TANK STRAPPING	NO
SPECIFICATIONS D-501 + API 650	
FOUNDATION CONCRETE RINGWALL	

ROOF APPURTENANCES

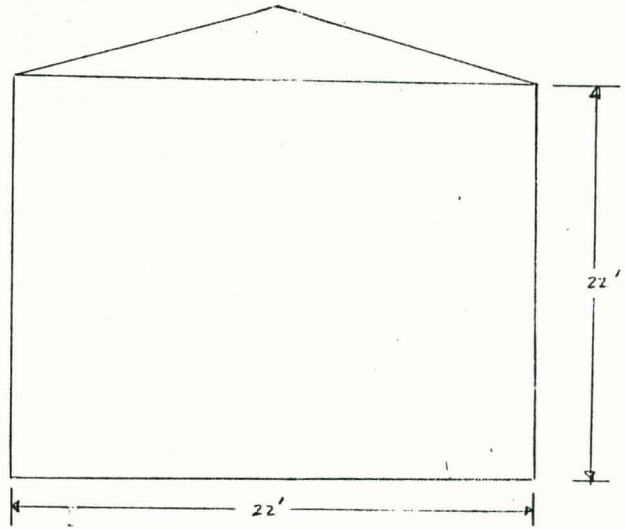
VENT NOZZLE	✓
RIM VENTS	
MANHOLE – 20"	
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	20"
GAUGE HATCH NOZZLE	✓
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	✓
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM (ROOF ACCESS)	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	YES
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	NO
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	✓
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	✓
OPEN VENT (MUSHROOM)	
INSULATION	NONE
SAMPLE COOLER	
~~CENTER PIN FOR~~ PAINTER'S TROLLEY	YES

GENERAL NOTES

1. CONSTRUCTION IS TO BE PER API-650 + BECHTEL SPEC. 14222-D-1.
2. CORROSION ALLOWANCE SHALL BE ADDED TO ROOF, BOTTOM, SHELL CALCULATED THICKNESS.



No.	DATE	REVISIONS	BY	CHKD	PROJ. ENGR	ENGR	PROJ. ENGR	APPD
△								
△								
△								
△								
△	12/15/76	ISSUE FOR PIPE FLEX	JP			SKA		HNH
△	10-13-76							

SCALE | DESIGNED | DRAWN | CHKD ENGR

BECHTEL

BACKWASH WATER STORAGE TANK

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	32-DS-D-03	0

R&C S.F. Form 173 (4/77)

TANK DATA

DISPERSANT	
TANK NO.	32D-140
SIZE, DIA. X HEIGHT	10"x15'
CAPACITY (42 GAL. BBLS)	210
ROOF TYPE	CONE
BOTTOM TYPE	FLAT
FILLING RATE-BPH	✓
EMPTYING RATE-BPH	✓
BEARING PLATES	YES
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	100
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	
DESIGN SPECIFIC GRAVITY	1.23
TOTAL NET WORKING CAP. – MBBLS	0.195
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	ATM
VISCOSITY cps	19.1
MATERIALS OF CONSTRUCTION	
304 L STAINLESS	

SHELL APPURTENANCES

SUCTION NOZZLE	✓
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	✓
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – 1" COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

PAINTING (BECHTEL STD)	X-502
BOTTOM PLATE COATING	YES
WINDGIRDERS	
TANK STRAPPING	NO
SPECIFICATIONS	
FOUNDATION CONCRETE RING WALL	

ROOF APPURTENANCES

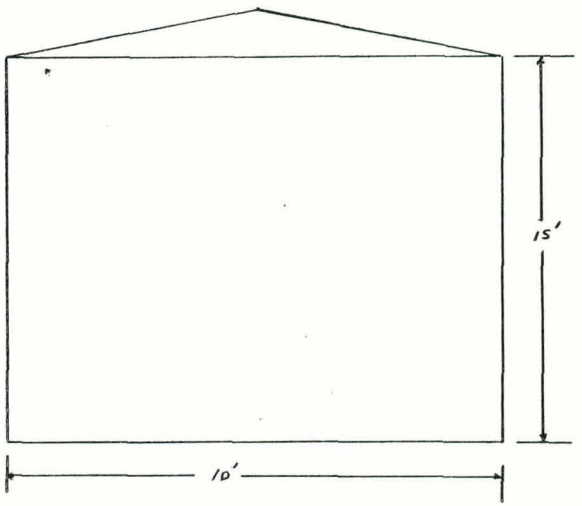
VENT NOZZLE	✓
RIM VENTS	
MANHOLE – 20"	20"
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	✓
ROOF DRAIN, FLEX. PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	✓
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	YES
CIRCUMFERENTIAL STAIRS	
PLATFORM (ROOF ACCESS)	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	YES
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	NO
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	✓
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	✓
OPEN VENT (MUSHROOM)	
INSULATION	
SAMPLE COOLER	
CENTER PIN FOR PAINTER'S TROLLEY	

GENERAL NOTES:

1. CONSTRUCTION IS TO BE PER API-650 & BECHTEL SPEC 14222-D-1.
2. CORROSION ALLOWANCE SHALL BE ADDED TO ROOF, BOTTOM, AND SHELL CALCULATED THICKNESS.



No.	Date	Revisions	By	Chkd	Design Engr	Engr	Proj. Engr	Appd
1	12/3/82	ISSUE FOR PHASE ZERO						

Scale | Designed | Drawn | Engr Engr

BECHTEL

DISPERSING AGENT STORAGE TANK
32 D – 140

TANK DATA &
LIST OF APPURTENANCES

Job No.	Drawing No.	Rev
14222	32-DS-D-140	0

R&C S.F. Form 173 (4-77)

4.2 Data Sheets for Exchangers

32-DS-E-01: Low Solids Cooling Tower (32E-101)

32-DS-E-02: High Solids Cooling Tower (32E-102)

COOLING TOWER DATA SHEET

Customer _____ Manufacturer _____

Location _____ Equip. No. E-101

Unit LOW SOLIDS COOLING TOWER SC No. _____

Number Required 1 Item No. _____

GENERAL

Selection _____

Tower Model _____

Type INDUCED DRAFT

DESIGN & OPERATING CONDITIONS

*Circulating Water Flow,	lb/h	62,000,000 (124,000 gpm)
*Hot (inlet) Water Temp.	°F	Δ 109.3
*Cold (outlet) Water Temp	°F	85
*Wet Bulb Temp., Inlet	°F	
Ambient	°F	78
Tower Pump Head,	ft	
Total Fan B.H.P., (Driver Output)		
Drift Loss, % of circulating flow		0.015
Evaporation Loss (at design).	GPM	Δ 3013
*Design Wind Load,	lbs/sq ft	
	ML/hr	
*Design Seismic Load,	%G	
*Tower Site (ground level, roof, etc)		
*Elevation Above Sea Level,	ft	
*Tower Exposure		

STRUCTURAL DETAILS

Number of Cells.		~~8~~ 11
Fans per Cell.		1
Total Number of Fans		~~8~~ 11
Nominal Cell Dimen. LxW,	ft	40' x 55'
Overall Tower Dimension, LxW	ft	440 x 55'
Height-Basin Curb to Fan Deck,	ft	50'
Fan Stack Height,	ft	
Overall Tower Height,	ft	65
Inside Basin Dimensions,	ft	55 x 440
*Column Extensions, Perimeter, below		
basin curb,	ft	
Internal, below curb,	ft	
Anchorage		
Hot Water Inlet-Number		
Nom. Diameter,	in	
Description		

1)

REV.									
	Δ								JOB NO. 14222
	Δ								DATA SHEET REV.
	Δ								
	Δ	~~0~~ 1	PHASE ZERO	DD	GMK		HWH		32-DS-E-01 0

FORM 160 (11/79)

SHEET 1 OF 1

COOLING TOWER DATA SHEET

Customer _____ Manufacturer _____

Location _____ Equip. No. E-102

Unit HIGH SOLIDS COOLING TOWER SC No. _____

Number Required 1 Item No. _____

GENERAL

Selection	
Tower Model	
Type	INDUCED DRAFT

DESIGN & OPERATING CONDITIONS

*Circulating Water Flow,	lb/h	Δ 75,000,000 (150,000 gpm)
*Hot (inlet) Water Temp.	°F	102
*Cold (outlet) Water Temp	°F	85
*Wet Bulb Temp., Inlet	°F	
Ambient	°F	78
Tower Pump Head,	ft	
Total Fan B.H.P., (Driver Output)		
Drift Loss, % of circulating flow		0.015
Evaporation Loss (at design).	GPM	Δ 2550
*Design Wind Load,	lbs/sq ft	
	ML/hr	
*Design Seismic Load,	%G	
*Tower Site (ground level, roof, etc)		
*Elevation Above Sea Level,	ft	
*Tower Exposure		

STRUCTURAL DETAILS

Number of Cells.		~~10~~ 11
Fans per Cell.		1
Total Number of Fans		~~10~~ 11
Nominal Cell Dimen. LxW,	ft	40 x 55'
Overall Tower Dimension, LxW.	ft	440 x 55'
Height-Basin Curb to Fan Deck,	ft	50'-0"
Fan Stack Height,	ft	
Overall Tower Height,	ft	65'
Inside Basin Dimensions,	ft	55' x 440'
*Column Extensions, Perimeter, below		
basin curb,	ft	
Internal, below curb,	ft	
Anchorage		
Hot Water Inlet-Number		
Nom. Diameter,	in	
Description		

1) No Basin or Pumps.

2) Number of Cells M 6716 - 4 - 11
Motor 200 HP
55' Wide x 440' Long
75 Wide x 440' x 65' Tall

REV.							JOB NO. 14222	
	Δ						DATA SHEET	REV.
	Δ							
	Δ	~~10~~ 11	Phase 2 Rev	MD		HNH	32-DS-E-02	0

FORM 160 (11/79)

SHEET 1 OF 21

4.3 Data Sheets for Pumps and Drivers

32-DS-G-01: Low Solids Cooling Water (32G-101 A, B, C, D)

32-DS-G-02: High Solids Cooling Tower (32G-102 A, B, C, D)

32-DS-G-12: Backwash Sump Pump (32G-112 A, B)

32-DS-G-13: Cooling Water Sidestream Return (32G-113 A, B)

32-DS-G-14: Recycle Water to Lime Softener (32G-114 A, B)

32-DS-G-68: Raw Water Intake Pumps (32G-168 A, B, C, D, E, F)

32-DS-G-82: Utility Water Pump (32G-182 A, B)

32-DS-G-115: Backwash Water Supply (32G-115 A, B)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-101 A, B, C, D,
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR THE BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT LOW SOLIDS COOLING WATER SERVICE COOLING WATER
NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO 32G-101 A,B,C,D PROVIDED BY VENDOR MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR BYRON JACKSON SIZE AND TYPE 64KXH-1 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 42000 RATED 46000
DISCH. PRESS., PSIG 70
PT. F, NOR. 85 MAX. 115 SUCT. PRESS., PSIG MAX. ① RATED 0
SP. GR. at PT 1.0 DIFF. PRESS., PSI 70
VAP. PRESS. at PT. PSIA 0.6 DIFF. HEAD, FT 162
VIS. at PT. Ssu CP 0.8 NPSHA, FT FLOODED
CORR/EROS. CAUSED BY HYD. HP 1881.8

PERFORMANCE

PROPOSAL CURVE NO. 2638
RPM 500 NPSHR (WATER) —
EFF. 80 BHP RATED 1352
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	—			
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○
C.I. BOWL
BRZ. FITTED
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH 10'
MIN. SUBMERGENCE REQ'D 5'
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 3000 RPM 516 FRAME VOLTS/PHASE/CYCLES 4160/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC WP-2 VERT. TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE 40,000# MOTOR 25,000# TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. ① VENDOR TO ADVISE THE MIN DEPTH OF SUCTION BASIN REQUIRED ② TO BE SUITABLE FOR PARALLEL OPERATION

FORM NO 130 (REVISED SEPT 72)

NO.	DATE							JOB NO.	DRAWING NO.	REV.
	12/3/80	ISSUE FOR PHASE 0	HR	JPH	[illegible]	MJH		14225	32-DS-G-01	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-102 A, B, C, D
PURCHASE ORDER NO
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR THE BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KENTUCKY
UNIT HIGH SOLIDS COOLING TOWER SERVICE COOLING WATER
NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. 32G-102 A,B,C,D PROVIDED BY VENDOR MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR BYRON JACKSON SIZE AND TYPE 64KXH-4 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 48000 RATED 52,000
DISCH. PRESS., PSIG 70
PT. F. NOR. 85 MAX. 115 SUCT. PRESS., PSIG MAX. (1) RATED 0
SP. GR. at PT 1.0 DIFF. PRESS., PSI 70
VAP. PRESS. at PT, PSIA 0.6 DIFF. HEAD, FT 162
VIS. at PT. Ssu CP 0.8 NPSHA, FT FLOODED
CORR/EROS. CAUSED BY HYD. HP 2127.2

PERFORMANCE

PROPOSAL CURVE NO. 2638
RPM 500 NPSHR (WATER) —
EFF 84 BHP RATED 2537
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	—			
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ☒ WIT. PERF.
○ NON-WIT. HYDRO ☒ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
☒ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.: ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 10'
MIN. SUBMERGENCE REQ'D. ☐ 5'
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 3000 RPM 510 FRAME VOLTS/PHASE/CYCLES 4160/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC WP-2-Vert. TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE 40,000# (TOTAL 65,000#) MOTOR 25,000# TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. (1) VENDOR TO ADVISE THE MIN. DEPTH OF SUCTION BASIN REQUIRED (2) TO BE SUITABLE FOR PARALLEL OPERATION

FORM NO 130 (REVISED SEPT 72)

NO.	DATE					JOB NO.	DRAWING NO.	REV.
	12/3/80	ISSUE FOR PHASE 0	JWJ		HWH	14225	32-DS-G-02	0

BECHTEL

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-112 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE, KY.
UNIT PLANT 32 SERVICE BACKWASH SUMP PUMP
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 32-G-112 A,B PROVIDED BY MTO BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTO BY
PUMP MFR SIZE AND TYPE STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT, NOR. 150 RATED 165
DISCH. PRESS., PSIG 25
PT, F, NOR. 102 MAX. SUCT. PRESS., PSIG MAX. 0 RATED 0
SP. GR. at PT 1.0 DIFF. PRESS., PSI 25
VAP. PRESS. at PT, PSIA 1.0 DIFF. HEAD, FT 58
VIS. at PT, Ssu CP .8 NPSHA, FT FLOODED (SUMP PUMP)
CORR/EROS. CAUSED BY — HYD. HP 2.4

PERFORMANCE

PROPOSAL CURVE NO.
RPM NPSHR (WATER)
EFF. 50 BHP RATED 4.8
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ I2
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 10'
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 7½ RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						
0	12/30/80	ISSUE FOR PHASE 2 & 3	BO	[illegible]	DWP	HWH	

JOB NO.	DRAWING NO.	REV.
14222	32-DS-G-12	0
SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-113 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE, KY.
UNIT PLANT 32 SERVICE COOLING WATER SIDESTREAM RETURN
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 32-G-113AB PROVIDED BY MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR SIZE AND TYPE STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 7178 RATED 7896
DISCH. PRESS., PSIG 39
PT. F. NOR. 102 MAX. SUCT. PRESS., PSIG MAX. 6.5 RATED 6.5
SP. GR. at PT. 1.0 DIFF. PRESS., PSI 32.5
VAP. PRESS. at PT. PSIA 1.0 DIFF. HEAD, FT. 75
VIS. at PT. Ssu CP .8 NPSHA, FT. 46
CORR/EROS. CAUSED BY — HYD. HP 150

PERFORMANCE

PROPOSAL CURVE NO.
RPM NPSHR (WATER)
EFF. 75 BHP RATED 200
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ S1
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 300 RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC. TEFC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						
0	12/30/80	ISSUE FOR PHASE ZERO	DJ	MLP		HBJH	

BECHTEL

JOB NO.	DRAWING NO.	REV
14222	32-DS-G-13	0
SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-114 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE KY.
UNIT PLANT 32 SERVICE RECYCLE WATER TO LIME SOFTENER
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 32-G-114A,B PROVIDED BY MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR SIZE AND TYPE STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 202 RATED 222
DISCH. PRESS., PSIG 21
PT. F. NOR. 102 MAX. SUCT. PRESS., PSIG MAX. 2.6 RATED 2.6
SP. GR. at PT 1.0 DIFF. PRESS., PSI 18.4
VAP. PRESS. at PT, PSIA 1.0 DIFF. HEAD, FT 42.5
VIS. at PT, Ssu CP 1.8 NPSHA, FT 14
CORR/EROS. CAUSED BY HYD. HP 2.38

PERFORMANCE

PROPOSAL CURVE NO.
RPM NPSHR (WATER)
EFF 60 BHP RATED 4.0
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL -☐RAD; TYPE VOLUTE ☐SGL ☐DBL - ☐DIFFUSER
-PRESS: ☐MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐RATED ☐MAX. ☐TYPE:
MOUNT: ☐ BETWEEN BRGS ☐OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐RADIAL ☐THRUST
LUBE: ☐-RING OIL ☐FLOOD ☐OIL MIST ☐FLINGER ☐PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○NON-WIT. PERF. ○WIT. PERF.
○NON-WIT. HYDRO ○WIT. HYDRO
○NPSH REQ'D. ○WIT. NPSH
○SHOP INSPECTION
○DISMANT. & INSP. AFTER TEST
○OTHER

MATERIALS

API CASE/TRIM CLASS○ S1
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○PACKING COOLING INJECTION REQ'D: ☐TOTAL GPM ☐ PSIG
○SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐BOWL ☐LINE SHAFT
BRG. LUBE ☐WATER ☐OIL ☐GREASE
FLOAT & ROD ○C.S. ○S.S. ○BRZ ○NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐UP ☐DOWN

MOTOR DRIVER

HP 7½ RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
○VHS ○VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	12/30/80	ISSUE FOR PHASE ZERO	DD	JMV	OMP	HWH	14222	32-05-G-14	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-168 A THRU F
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE, KY.
UNIT PLANT 32 SERVICE RAW WATER INTAKE PUMPS
NO. PUMPS REQ'D 6 NO. MOTORS REQ'D 6 ITEM NO. 32-G-168 A THRU F PROVIDED BY MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR BYRON JACKSON SIZE AND TYPE 17 MQL STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID RIVER WATER U.S. GPM at PT. NOR. RATED 2500
DISCH. PRESS., PSIG 52
PT. F. NOR. 60 MAX. 80 SUCT. PRESS., PSIG MAX. — RATED 0
SP. GR. at PT 1.0 DIFF. PRESS., PSI 52
VAP. PRESS. at PT, PSIA 1.0 DIFF. HEAD, FT 120
VIS. at PT. Ssu CP .8 NPSHA, FT SUBM.
CORR/EROS. CAUSED BY — HYD. HP 75.8

PERFORMANCE

PROPOSAL CURVE NO. —
RPM 1770 NPSHR (WATER) —
EFF. 82 BHP RATED 92
MAX. BHP RATED IMP 98
MAX. HEAD RATED IMP —
MIN. CONTINUOUS GPM —
ROTATION (VIEWED FROM CPLG END) —

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) SUMP
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ I-2
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 40'
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 100 RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE VERT INSUL FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE 2000
MOTOR 1000 TURBINE —

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	12/29/80	ISSUE FOR PHASE ZERO	DL	JHV	ARP	HNW	14222	32-DS-G-68	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32G-182A, B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION B

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY, KY
UNIT PLANT 32 SERVICE UTILITY WATER PUMP
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR BYRON JACKSON SIZE AND TYPE 20" HQ-H-9 STAGES 4 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 6553 RATED 6800
DISCH. PRESS., PSIG 114
PT. F. NOR. AMB MAX. SUCT. PRESS., PSIG MAX. RATED 7
SP. GR. at PT .992 DIFF. PRESS., PSI 107
VAP. PRESS. at PT. PSIA .7 DIFF. HEAD, FT 248
VIS. at PT. Ssu CP .52 NPSHA, FT 47 (FLOODED)
CORR/EROS. CAUSED BY HYD. HP 425

PERFORMANCE

PROPOSAL CURVE NO.
RPM 1200 NPSHR (WATER)
EFF. 83 BHP RATED 511
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE	16"	300#		

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) SUMP
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR BJ ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ✓ ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○
C.S. / CAST IRON
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ ~~3'~~ 13 1/2"
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 600 RPM 1200 FRAME VOLTS/PHASE/CYCLES 4160/3/60
MFR BEARINGS LUBE
TYPE VERT INSUL FULL LOAD AMPS
ENC. WPII TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT, PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	1/14/81	ISSUED FOR PHASE ZERO	JM	HKN LOWP		HWH	14222	32-DS-G-82	0
							SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 32-G-115 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE REVISION

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:
☐ BY MANUFACTURER

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE KY.
UNIT PLANT 32 SERVICE BACKWASH WATER SUPPLY
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 32-G-115 AB PROVIDED BY MTD BY
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR SIZE AND TYPE STAGES SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT, NOR. 2545 RATED 2800
DISCH. PRESS., PSIG 19
PT, F, NOR. 102 MAX. SUCT. PRESS., PSIG MAX. 10 RATED 0.9
SP. GR. at PT 1.0 DIFF. PRESS., PSI 18.1
VAP. PRESS. at PT, PSIA 1.0 DIFF. HEAD, FT 41.8
VIS. at PT, Ssu CP .8 NPSHA, FT 33
CORR/EROS. CAUSED BY — HYD. HP 29.6

PERFORMANCE

PROPOSAL CURVE NO.
RPM NPSHR (WATER)
EFF. 70 BHP RATED 42.2
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE				

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED ☐ MAX. ☐ TYPE:
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ○ S1
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 60 RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE							JOB NO.	DRAWING NO.	REV
0	12/30/80	ISSUE FOR PHASE ZERO		DWP			HNH	14222	32-DS-G-115	0
NO.	DATE							SHEET 1 OF 1		

4.4 Duty Specifications for Miscellaneous Equipment

32-SP-A-01: River Water Treatment

32-SP-A-02: Reactor Clarifier System

32-SP-A-03: Sidestream Water Treatment

32-SP-A-04: Sidestream Sludge Dewatering

32-SP-A-05: Chemical Treating Systems for Cooling Water Towers

32-SP-A-06: Sidestream Filters

32-SP-A-07: Solids Handling Equipment

32-SP-A-08: River Water Treatment

32-SP-A-09: Sidestream Water Treatment

THE BRECKINRIDGE PROJECT

PLANT #32

RIVER WATER TREATMENT

EQUIPMENT DUTY SPECIFICATIONS

Lime Slurry Feed System

FOR INSTALLATION COSTS CONSIDER TWO UNITS PER ATTACHED SKETCH 32 Z-166 A & B

Lime feed assembly including:

- Two (2) 1200 Ft^3 lime storage hoppers (32D-130 A,B)
- Two (2) 500 gal. capacity lime slurry tanks (32D-131 A,B)
- Two (2) 500 LB/HR lime slakers (32Z-106 A,B)
- Five (5) variable speed, low shear, positive displacement progressing cavity lime slurry feed pumps, rated 3GPM, four operating and one spare; chromed steel rotor, rubber stator (32G-169 A-E)

32-G-174 A - D

Reactor/Clarifier Sludge Pumps — Four (4) progressing cavity pumps rated 100 GPM, variable speed, lime sludge viscosity, cast iron casing, high carbon, high chrome tool steel rotor plated with heavy chrome for abrasion resistance.

32-G-180 A, B

Vacuum Filter Feed Pumps — Two (2) progressing cavity pumps, rated at 165 GPM cast iron casing, high carbon, high chrome tool steel rotor plated with heavy chrome for abrasion resistance

32-G-181

Vacuum Filtrate Pump — Vacuum filtrate pump rated at 150 GPM

Prices per:
Bill Shaud
Datum Company
2441 Bartlett
Houston, Texas 77098 713/529-3688

FORM H-292 7-66

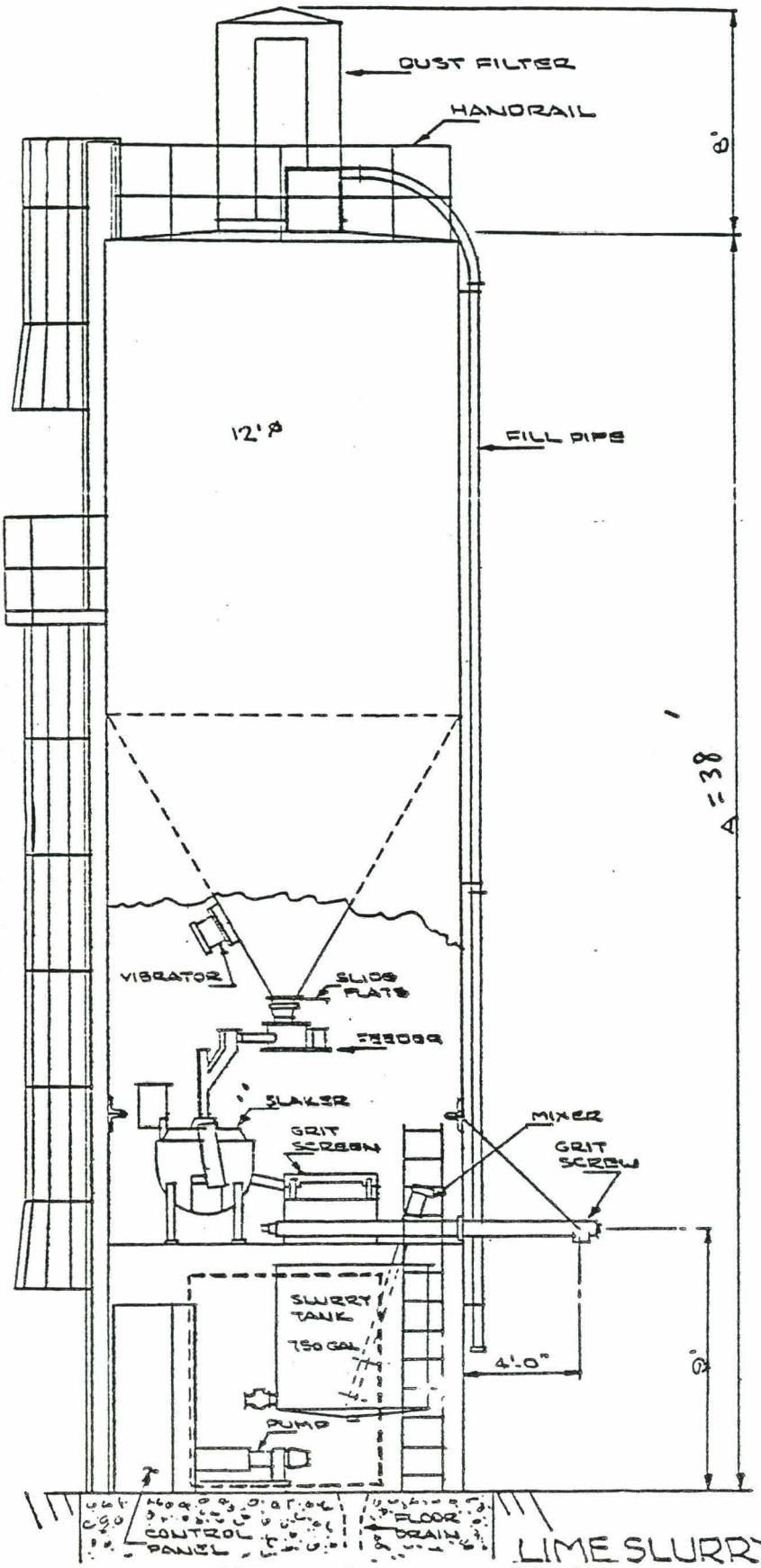
12/29/80	ISSUED FOR PHASE 0	RJ	HWP	HNH

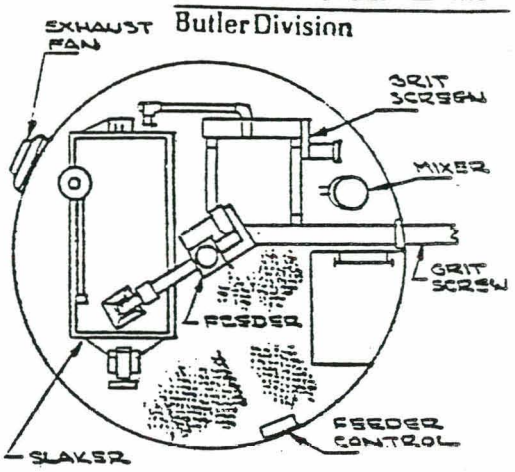
ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO.DE-FC05-800R20717
DUTY SPECIFICATION
MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0

JOB NO. 14222

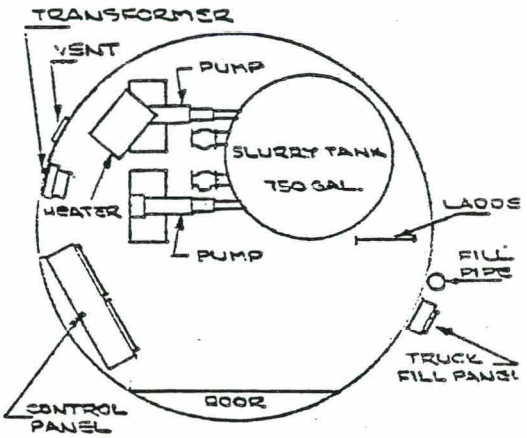
SPECIFICATION	REV
32-SP-A-01	0

PORTEC inc.
Butler Division

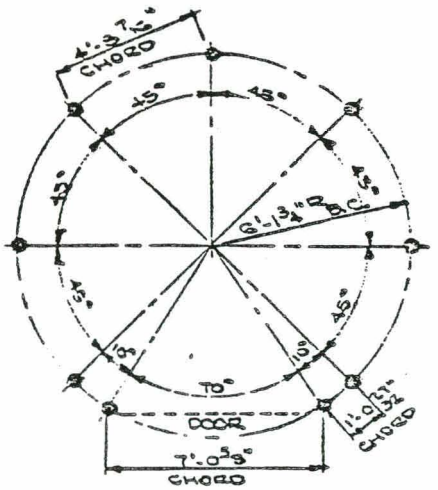




SLAKER LEVEL



GRADE LEVEL



(9) ANCHORS, PROJECT 1" ABOVE SLAB, 4" THREAD.

ANCHOR BOLT LAYOUT

LIME SLURRY STATION, QL

LIME SLURRY FEED SYSTEM

EST. WT. = 25,000 #

PORTEC inc. BUTLER DIV.

32-SP-A-01 SHEET 2 OF 2

THE BRECKINRIDGE PROJECT

PLANT #32

EQUIPMENT DUTY SPECIFICATIONS

32Z-103

Lime Softener
(Graver Reactivator
84' Diameter or Equivalent)

Graver Water Division
Datum Company
2441 Bartlett
Houston, Texas 77098
713/529-3688

One reactor clarifier system to treat 7300 to 7600 gpm of cooling water including:

- An 84' diameter tank arranged to provide a rapid mixing and recirculation zone
- Slow mixing and floc formation zone
- Sedimentation zone
- Influent conduit
- Four chemical injection ports
- Sludge drawoff with backwash
- Scraper and mixer drivers
- Annular effluent weir

To include:

- Sodium Aluminate Feed System

  Solution Tank 32-D-128
  Feed Pump 32-G-166

- Polymer Feed System

  Solution Tank 32-D-129
  Feed Pump 32-G-167

32Z-164

Lime Slurry Feed System

Lime Feed Assembly including:

- Storage Hopper (3510 Cu. Ft.)
- Slaker
- Slurrying Tank (32D-126)
- Feed Pump (32-G-164)

Sized to feed 16,200#/day of dolomitic lime

FORM H-292 7-66

11/29/80	ISSUE FOR PHASE 0				HNH

ASFI THE BRECKINRIDGE PROJECT AECI

U.S. DOE COOPERATIVE AGREEMENT NO.DE-FC05-800R20717
PROJECT SPECIFICATION
MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0

JOB NO. 14222

SPECIFICATION	REV
32-SP-A-02	0

32Z-165

Soda Ash Feed System

Soda Ash Bulk System

- Storage Tank (2152 Cu. Ft.)
- Mixing Tank (32-D-127)
- Sized to feed 4469#/day of 98% soda ash
- Feed pump (32-G-165)

FORM 293

SPECIFICATION NO. _____ REV. _____ SHEET 2 OF 2

SIDESTREAM WATER TREATMENT

DUTY SPECIFICATIONS

PLANT #32

32-E-111 A, B ⚠

CHLORINATOR

One chlorinator rated at 10,000 #/day to intermittently service two cooling towers with circulating rates of 124,000 GPM and 150,000 GPM

One evaporator rated to supply 10,000 #/day including a pressure reducing valve

To include a one cylinder scale, two timers and 15 cylinder fittings

32-H-101

CHLORINE EJECTOR

One ejector to provide 372 #/hour of chlorine to low solids cooling tower with the motive fluid being cooling water at 85°F and 74.7 PSIG

32-H-102

CHLORINE EJECTOR

One ejector to provide 450 #/hour of chlorine to high solids cooling tower with the motive fluid being cooling water at 85°F and 74.7 PSIG

PRICES: Per Mr. Hayes of Wallace & Tiernan

PHONE: 680-0760

FORM H-292 7-66

1	01/13/81	REISSUE FOR PHASE 0	HKN own'		HNH
0	12/28/80	ISSUE FOR PHASE 0	[illegible]		

ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO.DE-FC05-800R20717
DUTY SPECIFICATION
MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0

JOB NO. 14222

SPECIFICATION	REV
32-SP-A-03	1

THE BRECKINRIDGE PROJECT

PLANT #32

SIDESTREAM SLUDGE DEWATERING

EQUIPMENT DUTY SPECIFICATIONS

32G-121 A - D

Filter Feed Pumps

Four (4) progressing cavity pumps, one for each vacuum filter and a common spare, rated at 175 GPM with differential of 40 psi; cast iron casing, high carbon, high chrome tool steel rotor heavily chrome plated for abrasion resistance

Prices per:

Bill Shaud
Datum Company
2441 Bartlett
Houston, Texas 77098

713/529-3688

FORM H-292 7-66

△					
△					
△					
△	12/30/80	ISSUED FOR PHASE 0	EHS	AZP	HNH

ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717
DUTY SPECIFICATION
MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0

JOB NO. 14222

SPECIFICATION	REV
32-SP-A-04	0

SHEET 1 OF 1

THE BRECKINRIDGE PROJECT

PLANT #32

CHEMICAL TREATING SYSTEMS FOR COOLING WATER TOWERS

EQUIPMENT DUTY SPECIFICATIONS

Low Solids Cooling Tower

Sulfuric Acid Feed System

32-D-113	Neptune Model A250, 250 gal. capacity specifically designed for sulfuric acid, including suction piping, gauge glass and desiccant breather
32-G-153 A,B	Two Neptune chemical pump, Model 538-S-N4, 26.5 GPH capacity

Zinc Chromate (Inhibitor) Feed System

32-D-112	500 gal. carbon steel tank with accessories
32-G-152 A,B	Two Neptune Model 532-S-N3 chemical pumps with 18 GPH capacity

Dispersant Feed System

32-D-111	250 gal. 304 stainless steel tank including accessories
32-G-151 A,B	Two Neptune chemical pumps, Model 525-S-N3, stainless steel, rated at 7 GPH

FORM H-292 7-66

12/29/80	ISSUED FOR PHASE 0			HNH
ASFI	THE BRECKINRIDGE PROJECT	AECI	JOB NO. 14222	
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717			SPECIFICATION	REV
DUTY SPECIFICATION MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0			32-SP-A-05	0

High Solids Cooling Tower

Sulfuric Acid Feed System

32-D-123	Neptune Model A250, 250 gal. capacity specifically designed for sulfuric acid, including suction piping, gauge glass and desiccant breather
32-G-163 A,B	Two chemical pumps rated at 180 GPH each

Zinc Chromate (Inhibitor) Feed System

32-D-122	500 gal. carbon steel tank with accessories
32-G-162 A,B	Two Neptune Model 532-S-N3 chemical pumps with 18 GPH capacity

Dispersant Feed System

32-D-121	400 gal., 304 stainless steel tank with accessories
32-G-161 A,B	Two Neptune chemical pump, Model 525-S-N3 rated at 7 GPH

ESTIMATED PRICES PER:

Philip Farrell
Datum Company
2441 Bartlett
Houston, Texas 77098

713/529-3688

FORM 293

THE BRECKINRIDGE PROJECT

PLANT #32

SIDESTREAM FILTERS

EQUIPMENT DUTY SPECIFICATIONS

32-Z-102 A-E	Five (5) 18' diameter sand, gravel and charcoal gravity filters to filter a 7200 GPM sidestream flow of cooling water at 102°F including two inlet and two outlet nozzles, backwash blowers, controls for automatic backwashing at a set pressure differential and overriding controls to allow only one backwash at a time.

PRICE: Per Philip J. Farrell
Datum Company
2441 Bartlett
Houston, Texas 77098

FORM H-292 7-66

12/29/80	ISSUE FOR PHASE 0				HNH

ASFI THE BRECKINRIDGE PROJECT AECI

U.S. DOE COOPERATIVE AGREEMENT NO.DE-FC05-800R20717

PROJECT SPECIFICATION

MAJOR EQUIPMENT DATA SHEETS FOR PHASE 0

JOB NO. 14222

SPECIFICATION 32-SP-A-06

REV 0

THE BRECKINRIDGE PROJECT

PLANT #32

SOLIDS HANDLING EQUIPMENT

DUTY SPECIFICATION

32-Z-105 A-B Traveling Screens	Two (2) screens, 2' wide by 6' deep, 10,000 GPM flow at 2 ft/sec, stainless steel screen wire and panel frame with corten frame and chains

Prices per:
Jim Coulson
Fairfield Service Company
340 N. Boone Avenue
Marion, OH 43302
614/387-3335

32-D-125 Cake Storage Bin	One (1) storage bin 1200 ft^3, 10'x11'x11', sloping bottom, 18 inch diameter bottom slide valve, rubber lined carbon steel

Prices per:
Mike Hoage
Smith Tank & Equipment
Tyler, Texas
214/597-5541

32-D-139 Cake Storage Bin	One (1) 1400 ft^3 bin, 10'x12'x12', inclined bottom, rubber lined carbon steel

Prices per:
Mike Hoage
(same as above)

32-T-101 A, B Sludge Conveyor System	One (1) conveyor belt system consisting of a 18" wide x 200' long enclosed conveyor belt and a 18" wide x 100' long enclosed conveyor belt, motors and controls
32-T-102 Filter Cake Conveyor	One (1) conveyor belt system consisting of a 18" wide x 200' long enclosed conveyor belt, motor and controls

FORM H-292 7-66

12/31/80	ISSUED FOR PHASE 0	[illegible]		HNH

ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO.DE-FC05-800R20717
PROJECT SPECIFICATION
SOLIDS HANDLING EQUIPMENT

JOB NO. 14222
SPECIFICATION 32-SP-A-07
REV 0

THE BRECKINRIDGE PROJECT

PLANT #32

RIVER WATER TREATMENT

EQUIPMENT DUTY SPECIFICATION

Alum Feed System:

- Two (2) 5,000 Gallons fiberglass storage tanks.
  32D-135 A & B.
- Five (5) Alum Feed Pumps, variable speed, low shear, positive displacement, progressive cavity type.

  Rated 0.5 gpm, 3/4 BHP.

  Four operating + one spare.

  32G-173A-E.

Soda Ash Feed System:

- One (1) 800 gallon tank, 12 gauge, 304 SS, dish bottom tank.

  32D-134.

- Five, variable speed, low shear positive displacement, progressive cavity pumps.

  Rated 2.0 gpm, 3/4 BHP.

  Four operating + one spare.

  32G-172A-E.

Polymer Feed System:

- One polymer storage tank 1,000 gallon capacity, 6 feet deep x 6 feet diameter.

  32D-132

- Two variable speed, low shear, positive displacement, progressive cavity pumps.

  Rated 2.0 gpm, 3/4 BHP.

  32G-170 A & B.

FORM H-292 7-66

2/20/81	ISSUED FOR PHASE ZERO				
ASFI	THE BRECKINRIDGE PROJECT	AECI	JOB NO. 14222		
U.S.DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717			SPECIFICATION		REV
DUTY SPECIFICATION			32-SP-A-08		0
MAJOR EQUIPMENT DATA SHEETS FOR PHASE ZERO					

- Two tanks, 200 gallon capacity with mixers and motors, 16 gauge, type 304 stainless steel sloped bottom tank.

  32D-133 A, B.

- Five pumps, variable speed, low shear, positive displacement, progressive cavity type.

  Rated 2.0 gpm, 3.4 BHP.

  Four operating + one spare.

  32G-171 A-E.

32Z-107 A-D

Reactor/Clarifiers

- Four reactor/clarifier systems consisting of an 80' diameter tank arranged to provide a rapid mixing and recirculation zone, a slow mixing and floc formation zone, and a sedimentation zone. Provided will be a raw water influent conduit, four chemicals injection ports, sludge drawoff with back-flush, scraper and mixer drivers, and an annular effluent weir.

32G-174 A-D

Reactor/ Clarifier Sludge Pumps

(Moyno Model SWG 10 or equivalent)

Robbins & MYers, Inc.
Moyno Pump Div.
Springfield, Ohio 45501

- Four pumps, progressive cavity type rated 15-100 gpm, 10 BHP.
- Materials - cast iron casing, high carbon, High chrome tool steel rotor plated with heavy chrome for abrasion resistance.

32D-136

Sludge Surge Tnak

- One tank, 4,000 gallons, inclined bottom.

  Material - concrete.

32G-180 A, B

Vacuum Filter Feed Pump

(Moyno Model SGW 12 or equivalent)

- Two pumps progressing cavity type.

  (1 + 1 spare) 165 gpm, 12 BHP.

- Materials - cast iron casing, high carbon, high chrome tool steel rotor plated with heavy chrome for abrasion resistance.

FORM 293

32Z-108 A,B

Vacuum Filter System

- Two vacuum drum filters (1 + 1 spare) Each Drum 10.5' diameter x 10' wide.

Eimocomet Drum Filter
Envirotech Corp.

Webtrol Vacuum Filter
Dorr-Oliver, Inc.

- System to include filter drum,
  Tank (32C-114).
  Piping and controls.
  Vacuum pump (32H-104).
  Vacuum filtrate pump, 150 gpm 5 BHP. (32G-181).
  Material - corrosion resistant

32T-102

Filter Cake Conveyor

- One Conveyor belt system consisting of a 18" wide x 200' long enclosed conveyor belt, motor and controls.

32D-102

Cake Storage Bin

- One bin, 1,400 ft^3 capacity, 10'x12'x12', rubber lined, inclined bottom, one day cake storage capacity.

  Material - rubber lined carbon steel.

32D-137

Acid Tank

- One, 100 gallon tank, H_2SO_4 acid resistant.

32G-175 A, B

Acid Feed Pumps

- Two pumps, positive displacement type rated 0-0.1 gpm, ¼ BHP.

(Calgon Model 2MIA or eq.)

32Z-109 A, B

Flash Mixer

- Two flash mixers 5 BHP.

32J-101 A, B

Acid Feed Contollers

- Two units capable of controlling a ¼ HP motor.

32D-138

Surge Tank

- One tank 300,000 gallon (40,000 ft^3), concrete, measuring 50 ft^2 x 16 ft. deep, with two flash mixing compartments each 2,500 gallons capacity, 5 ft^2 x 16 ft. deep.

32Z-110 A-D

Anthracite filters

- Four pressure filters, vertical-type, 8' diameter anthracite, automatic air assisted backwash, rubber lined carbon steel vessels. Al piping, values, and appurtenances shall be provided for automatic backwash from an external source.

32G-176 A-C
Filter Backwash Pumps

- Three pumps, centrifugal, each rated 300 gpm 13 BHP.

32G-1777 A, B

Filter Backwash Pumps

- Two pumps, centrifugal.
  (1 + 1 spare).
  Rated 750 gpm, 10 BHP.

  P = 15 psi.

32K-103 A, B

Air Blowers

- Two air blowers, 15 BHP, 100 SCFM @ 30 psig.

32Z-111 A-E

Dual Media Filter

- Five pressure filters horizontal type 10' diameter x 20' long dual media anthracite/garnet, automatic air assisted backwash, rubber.

  All piping, values, appurtenances provided for automatic backwash from external source.

32G-178 A, B, C

Filter Feed Pumps

- Three centrifugal pumps.

  (2 + 1 spare) each rate at 5,000 gpm, 210 BHP.

32G-179 A, B

Filter Backwash pumps

- Two centrifugal pumps

  (1 + 1 spare).

  Rated at 5,000 gpm, 65 BHP.

32K-104 A, B, C

Air Blowers

- Three air blowers 50 BHP, 400 SCFM @ 30 psig.

FORM 293

THE BRECKINRIDGE PROJECT

PLANT #32

EQUIPMENT DUTY SPECIFICATIONS

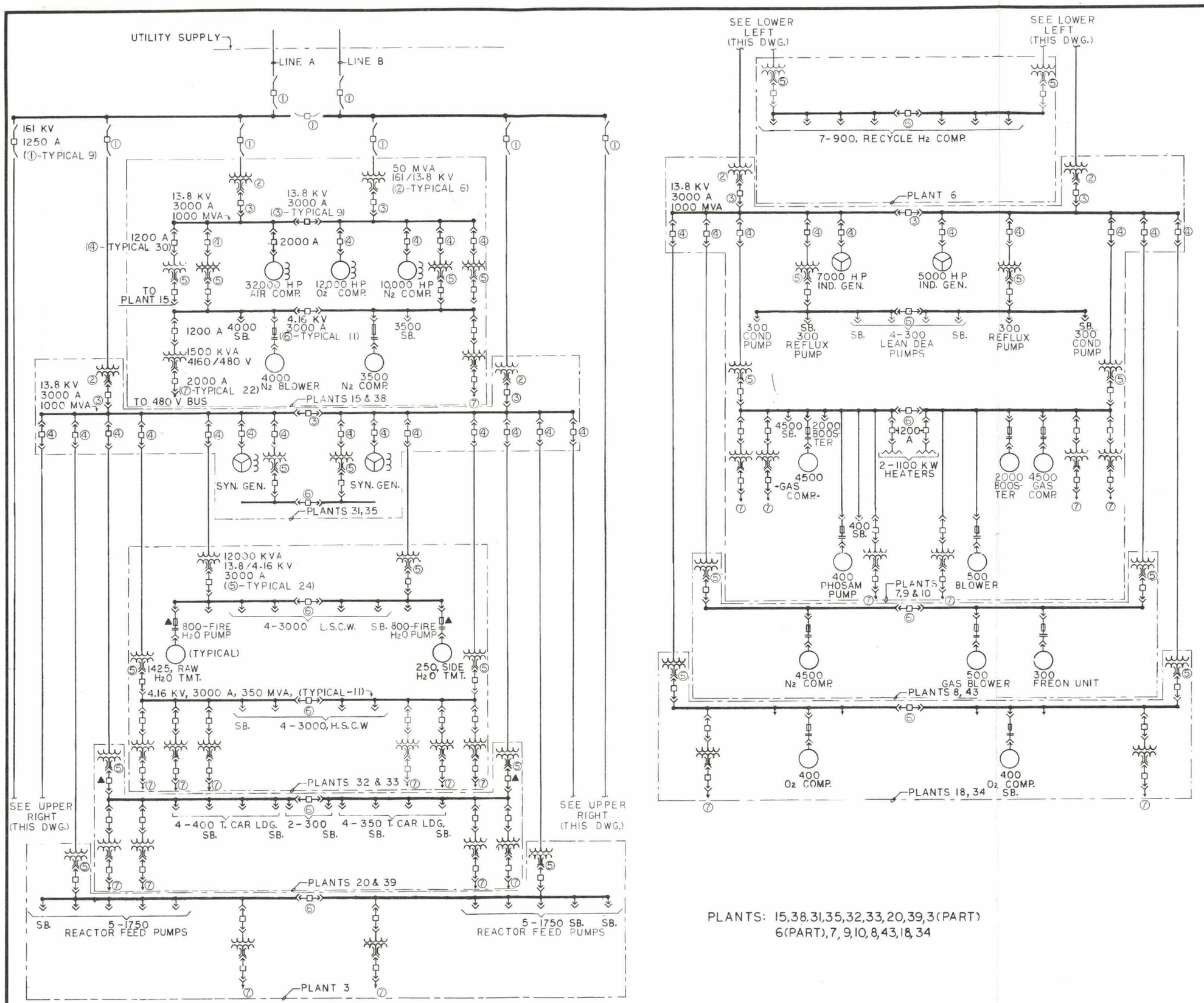
SIDESTREAM WATER TREATMENT

Vacuum Filtration System

32Z-104 A,B,C	Three vacuum drum filters (two operating and one spare) each includes filter drum, tank, vacuum pump and control. Each filter drum 8' diameter x 10' wide, approx. 250 ft^2 corrosion resistant materials.
	Vacuum pumps - 32H-101 A,B,C.
	Vacuum receiving - 32C-113 A,B,C. vessels.

FORM H-292 7-66

2/23/81	ISSUED FOR PHASE ZERO		JPM	HP IS	HNH
	ASFI THE BRECKINRIDGE PROJECT AECI U.S.DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717 EQUIPMENT DUTY SPECIFICATION MAJOR EQUIPMENT DATA SHEETS FOR PHASE ZERO		JOB NO. 14222 SPECIFICATION 32-SP-A-09		REV 0



LEGEND

- SF6 BREAKER
- VACUUM CKT. BKR.
- E2 CONTROLLER
- TRANSFORMER
- MOTOR
- IND. GENERATOR
- SYN. GENERATOR
- SYN. MOTOR
- HEATER
- BUS DUCT
- SB. STANDBY

NOTE: ALL TIE BREAKERS ARE N. O. (MANUAL)

WHEN UTILITY SOURCE IS LOST, FEEDER BREAKERS MARED ▲ WILL OPEN TO NON-ESSENTIAL LOADS

PLANTS: 15,38,31,35,32,33,20,39,3(PART) 6(PART),7, 9,10,8,43,18, 34

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	SUPV'R	ADMIN APPR'L
3	JAN. 16/81	ISSUED FOR PHASE ZERO	RAO	TTG	LH	WB	WB
2	DEC. 1/80	ISSUED FOR REVIEW/APPROVAL	RAO	AJ	GA	LH	

DESIGNED T4/RAO DRAWN RAO

ASHLAND SYNTHETIC FUELS, INC.
AMOCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC01-80ET51017

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

ELECTRICAL ONE LINE DIAGRAM

HOUSTON

JOB NO. 14222

DRAWING NO. 30E-P-003

REV. 1

24 X 36 "D" SIZE

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

H | G | F | E | D | C | B | A

PLANT 33 FIRE SYSTEMS

1.0 INTRODUCTION

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 filling rack
- Smothering steam for compressor buildings and fired heaters
- Halogen system for computer room and laboratory
- Nitrogen system for sulfur storage tanks

Separate fire control systems for the liquids loading and coal unloading docks are covered under River Facilities (Plant 22).

PLANT 33 FIRE SYSTEMS

2.0 PLANT DESIGN

2.1 Plant Description

2.1.1 Supply Source

Fire water is supplied from two sources: the main pond and the fire water tank. Each source is capable of supplying 60,000 barrels, or 150% of the total requirements of the system for four hours.

2.1.2 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.

2.1.3 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.

2.1.4 Fire Hydrants, Fixed Monitors, and Firehose 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 fog/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 firehose stations, with hose lines stored on reels preconnected to the fire water system.

The requirements are:

- 6-inch hydrants 249 units
- 4-inch hydrants with 3 inch monitor 126 units
- 1-1/2-inch hose on reels 50 units

2.1.5 Deluge System

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

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

2.1.6 Foam Systems

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

- One 1,000-gallon system for light slop and heavy slop tanks
- One 3,000-gallon system for gasoline reformate, phenols and raw heavy naphtha 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.

2.1.7 Halogen System

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

2.1.8 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.

2.1.9 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.

2.1.10 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.

2.1.11 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.

2.1.12 Miscellaneous

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

2.2 Utility Balance

Electricty, kW

Condition	Consumed	Generated
Operating	45	-

THE BRECKINRIDGE PROJECT

_____R EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
33	FIRE SYSTEMS	000000 NA
33D-101	FIRE WATER TANK	000000 NA
33G-101	FIRE WATER MAIN PUMP	000000 NA
33G-102	FIRE WATER MAIN PUMP	000000 NA
33G-103	FIRE WATER MAIN PUMP	000000 NA
33G-104	FIRE WATER MAIN PUMP	000000 NA
33G-105A	FIRE WATER JOCKEY PUMP	000000 NA
33G-105B	FIRE WATER JOCKEY PUMP	000000 NA
33V-101	FOAM TO LIGHT & HEAVY SLOP TANKS	000000 NA
33V-102	FOAM TO GAS. REF.,PHENOL & RAW HEAVY NAPTHA	000000 NA

4.1 Data Sheets for Tanks

33-DS-D-01: Fire Water (33D-101)

TANK DATA

FIRE WATER STORAGE	
TANK NO.	33-D-101
SIZE, DIA. X HEIGHT	105 x 40
CAPACITY (42 GAL. BBLS)	55000
ROOF TYPE (SUPPORTED	CONE)
BOTTOM TYPE	FLAT
FILLING RATE-BPH	
EMPTYING RATE-BPH	
BEARING PLATES	YES
DRAW-OFF SUMP	
WATER DRAW CONN.	
STORAGE TEMP. °F	100
CORROSION ALLOWANCE	1/8"
DESIGN METAL TEMP. – °F MIN./MAX.	125
DESIGN SPECIFIC GRAVITY	1.0
TOTAL NET WORKING CAP. – MBBLS	55
MINIMUM NO. OF TANKS	1
GAS BLANKET – MIN./MAX. IN. WATER	ATM
MATERIAL	C. STEEL
EPOXY PHENOLIC LINING	

SHELL APPURTENANCES

SUCTION NOZZLE	YES
SUCTION NOZZLE W/1" COUPLING	
FILL NOZZLE	YES
FILL NOZZLE W/1" COUPLING	
STEAM NOZZLE – DOUBLE FLANGED	
CONDENSATE NOZZLE – DOUBLE FLGD.	
ROOF DRAIN NOZZLE – DOUBLE FLGD.	
FOAM CHAMBER	
FOAM TROUGHS	
MANHOLES – 20" OR 24" DIA.	24"
MIXER NOZZLE	
MIXER NOZZLE – W/BLIND FLG. (MH)	
FLUSH TYPE CLEANOUT, 3' X 4'	
SAMPLE CONNECTION – ' COUPLING	
TEMP. GAUGE CONN. – 1" COUPLING	
PRESSURE GAUGE CONN.	
TEMP. CONTROLLER CONN. – 1" CPLG.	
SUCTION NOZZLE – DBL. FLG. W/1" CPLG.	
SPECIAL CONNECTIONS	
HIGH & LOW LEVEL ALARMS	
LEVEL GAUGE CONNS.	
HIGH & LOW PRESS. ALARMS	

GENERAL

PAINTING (BECHTEL STD.)	X-502
BOTTOM PLATE COATING	YES
WINDGIRDERS	
TANK STRAPPING	NO
SPECIFICATIONS D-501 & API-650	
FOUNDATION CRUSHED STONE RINGWALL	

ROOF APPURTENANCES

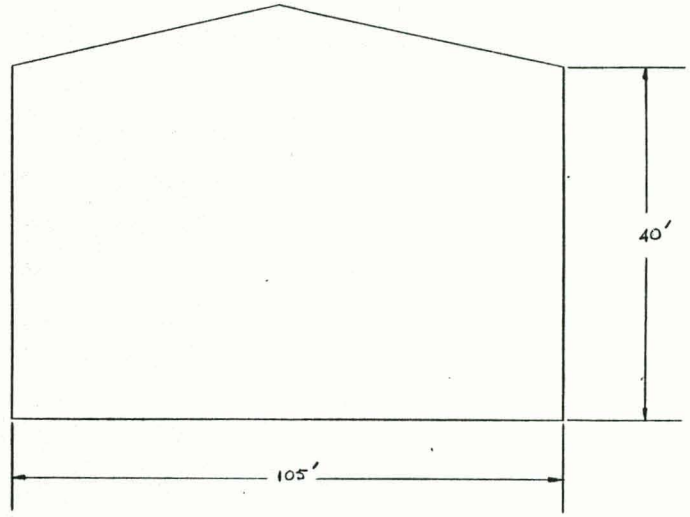
VENT NOZZLE	YES
RIM VENTS	
MANHOLE – 20"	20"
MANHOLE – COMB. EMER. RELIEF	
PONTOON MANHOLE – 20"	
GAUGE HATCH NOZZLE	YES
ROOF DRAIN, FLEX, PIPE	
BLANKET GAS INLET – 2" FLG.	
GAS BLANKET PC 2" FLG. NOZZLE	
AUTOMATIC BLEEDER VENT	
AUTO. GAUGE FLOAT WELL & COVER	
AUTO. GAUGE INSPECT. OPEN. & COVER	
LEVEL GAUGE CONNS.	YES
AVERAGING TEMP. BULB CONN.	
AUTO. GAUGE FLOAT STILLING WELL	

MISCELLANEOUS APPURTENANCES

LADDER W/CAGE	
CIRCUMFERENTIAL STAIRS	YES
PLATFORM (ROOF ACCESS)	YES
ROLLING LADDER W/SELF-LEVEL TRDS.	
GROUNDING LUGS	YES
MIXER SUPPORT LUGS	
LEVEL GAUGE SUPPORTS	YES
FOAM LINE SUPPORTS	
INSULATION SUPPORTS	NO
CATHODIC PROTECTION	
AUTO. LEVEL GAUGE	
AUTO. LEVEL GAUGE, REMOTE	
AUTO. LEVEL GAUGE, REMOTE PRESS.	
TARGET LEVEL GAUGE	YES
TARGET LEVEL GAUGE, W/ALARM	
TARGET LEV. GA., W/LIQ. SEAL, ALARM	
TEMPERATURE GAUGE	
FOAM GENERATOR	
TANK HEATER (INSTALL BY	
HEATER MANIFOLDS (INSTALL BY	
PRESSURE VACUUM RELIEF VALVE	
OPEN VENT (WITH RETURN BEND)	YES
OPEN VENT (MUSHROOM)	
INSULATION	NO
SAMPLE COOLER	
[redacted] PAINTER'S TROLLEY	YES

GENERAL NOTES:

1. CONSTRUCTIONS IS TO BE PER API-650 & BECHTEL SPEC. 14222-D-1
2. CORROSION ALLOWANCE SHALL BE ADDED TO ROOF, BOTTOM, SHELL CALCULATED THICKNESS AS WELL AS ROOF SUPPORT MEMBERS.



No.	DATE	REVISIONS	BY	CHKD	DESIGN SUPV.	ENGR	PROJ ENGR	APPD
0	12/1/80	ISSUED FOR PHASE ZERO	HP			AKP		HWH

SCALE | DESIGNED | DRAWN | CHIEF ENGR

BECHTEL

FIRE WATER

TANK DATA & LIST OF APPURTENANCES

JOB No.	DRAWING No.	REV.
14222	33-DS-D-01	0

R&C S.F. Form 173 (4/77)

4.2 Data Sheets for Pumps and Drivers

33-DS-G-01: Fire Water Main Pump (33G-101)

33-DS-G-02: Fire Water Main Pump (33G-102)

33-DS-G-03: Fire Water Main Pump (33G-103)

33-DS-G-04: Fire Water Main Pump (33G-104)

33-DS-G-05: Fire Water Jockey Pump (33G-105 A, B)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 33-G-101
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-18-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR ASHLAND SYNTHETIC FUELS INC. SITE KENTUCKY
UNIT BRECKINRIDGE SERVICE FIRE WATER MAIN PUMP
NO. PUMPS REQ'D 1 NO. MOTORS REQ'D 1 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
DUAL-DRIVE NO. TURBINES REQ'D 1 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
PUMP MFR PEERLESS SIZE AND TYPE 18HXB-4-VERTICAL STAGES 4 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID FIRE WATER
U.S. GPM at PT. NOR. 3182 RATED 3500
DISCH. PRESS., PSIG 192.5
PT. F. NOR. 80 MAX. 100
SUCT. PRESS., PSIG MAX. RATED 0.5
SP. GR. at PT 1.0
DIFF. PRESS., PSI 192
VAP. PRESS. at PT. PSIA 0.0
DIFF. HEAD, FT 444
VIS. at PT. Ssu CP 0.7
NPSHA, FT 34.
CORR/EROS. CAUSED BY OPERATING CONDITIONS
HYD. HP 392

PERFORMANCE

PROPOSAL CURVE NO. 28468 52
RPM 1760 NPSHR (WATER) 23
EFF. 78 BHP RATED 503
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	12"	250	FF	SIDE
DISCHARGE				BOTTOM

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) 18 HXB
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☒ RATED 10 3/4" X 11 1/4" ☒ MAX. 13 X 13 3/8 ☐ TYPE: ENCL.
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR PEERLESS ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ⑧ I-2
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 10
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☒ THREADED
LINE SHAFT: ☒ OPEN ☐ ENCLOSED
BRGS: ☒ BOWL BRZ ☒ LINE SHAFT BRZ
BRG. LUBE ☒ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 600 RPM 1800 FRAME VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

COPPUS RLH-28

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.
NOTE: PUMP TO BE CAPABLE OF PRODUCING 150% RATED CAPACITY AT 65% RATED PRESSURE AND A SHUT-OFF HEAD NOT MORE THAN 120% OF RATED PRESSURE

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	12/18/80	ISSUED FOR PHASE ZERO	HP	JRC	MJ	HNH	14222	33-DS-G-01	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 33-G-102
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-18-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR ASHLAND SYNTHETIC FUELS INC. SITE KENTUCKY
UNIT BRECKINRIDGE SERVICE FIRE WATER MAIN PUMP
NO. PUMPS REQ'D 1 NO. MOTORS REQ'D ITEM NO. PROVIDED BY MTD BY
DIESEL ENGY REQ'D 1 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
PUMP MFR PEERLESS SIZE AND TYPE 18HXB-4-VERT. STAGES 4 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID FIRE WATER
U.S. GPM at PT, NOR. 3182 RATED 3500
DISCH. PRESS., PSIG 192.5
PT, F, NOR. 80 MAX. 100
SUCT. PRESS., PSIG MAX. RATED 0.5
SP. GR. at PT 1.0
DIFF. PRESS., PSI 192
VAP. PRESS. at PT, PSIA 0.0
DIFF. HEAD, FT 444
VIS. at PT, Ssu CP 0.7
NPSHA, FT 34
CORR/EROS. CAUSED BY OPERATING CONDITIONS
HYD. HP 392

PERFORMANCE

PROPOSAL CURVE NO. 2846852
RPM 1760 NPSHR (WATER) 23
EFF. 78 BHP RATED 503
MAX. BHP RATED IMP
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	12"	250	FF	SIDE
DISCHARGE				BOTTOM

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) 18 HXB
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☒ RATED 10 3/4" X 11 1/4" ☒ MAX. 13 V 13 3/8 ☐ TYPE: ENCL.
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL ☐ THRUST
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR. PEERLESS ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ● E-2
BASEPLATE. ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 10
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
DRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

N/A

HP RPM FRAME VOLTS/PHASE/CYCLES
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

DIESEL ~~TURBINE~~ DRIVER

CUMMINS VT 1710 F

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED
NOTE: PUMP TO BE CAPABLE OF PRODUCING 150% RATED CAPACITY AT 65% RATED PRESSURE AND A SHUT-OFF HEAD NOT MORE THAN 120% OF RATED PRESSURE.

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						
0	12/13/80	ISSUED FOR PHASE ZERO	HP			HWH	

BECHTEL

JOB NO.	DRAWING NO.	RE
14222	33-DS-G-02	0

SHEET 1 OF 1

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 33-G-103
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12-18-80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR ASHLAND SYNTHETIC FUELS INC. SITE KENTUCKY
UNIT BRECKINRIDGE SERVICE FIRE WATER MAIN PUMP
NO. PUMPS REQ'D 1 NO. MOTORS REQ'D 1 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
DUAL-DRIVE NO. TURBINES REQ'D 1 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
PUMP MFR PEERLESS SIZE AND TYPE HORIZONTAL 10 LKV 23 STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID FIRE WATER U.S. GPM at PT. NOR. 3182 RATED 3500
DISCH. PRESS., PSIG 173 ~~192.5~~
PT. F. NOR. 80 MAX. 100 SUCT. PRESS., PSIG MAX. RATED -0.5
SP. GR. at PT 1.0 DIFF. PRESS., PSI 173.5 ~~193~~
VAP. PRESS. at PT, PSIA 0.0 DIFF. HEAD, FT 445
VIS. at PT, Ssu CP 0.7 NPSHA, FT 32.
CORR/EROS. CAUSED BY OPERATING CONDITIONS HYD. HP 394

PERFORMANCE

PROPOSAL CURVE NO 28317T8
RPM 1760 NPSHR (WATER)
EFF. 82 BHP RATED 480.5
MAX. BHP RATED IMP 503
MAX. HEAD RATED IMP 450 @ 5.0
MIN. CONTINUOUS GPM 1250
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	12	125	FF	SIDE
DISCHARGE	10	125	FF	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☒ RATED 20" ☐ MAX. 20" ☐ TYPE ENCL
MOUNT: ☒ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☒ RADIAL BALL ☒ THRUST BALL
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR FALK ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ASBESTOS ☐ SIZE/NO. OF RINGS 12
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ● I-2
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

HP 600 RPM 1800 FRAME VOLTS/PHASE/CYCLES 4160/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC WP-II TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

COPPUS RLH-28

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.
NOTE: PUMP TO BE CAPABLE OF PRODUCING 150% RATED CAPACITY AT 65% RATED PRESSURE AND A SHUT-OFF HEAD NOT MORE THAN 120% OF RATED PRESSURE.

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	12/18/80	ISSUED FOR PHASE ZERO	HP	[illegible]	MH	MWH	14222	33-DS-G-03	
							SHEET 1 OF 1		

FORM NO 130 (REVISED SEPT 72)

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 33-G-104
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 12/18/80 REVISION 0

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR ASHLAND SYNTHETIC FUELS INC SITE KENTUCKY
UNIT BRECKINRIDGE SERVICE FIRE WATER MAIN PUMP
NO. PUMPS REQ'D 1 NO. MOTORS REQ'D ITEM NO. PROVIDED BY MTD BY
Diesel Eng 1
NO. ~~MOTORS~~ REQ'D ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
PUMP MFR PEERLESS SIZE AND TYPE HORIZONTAL 18AX20G STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID FIRE WATER U.S. GPM at PT. NOR. 3182 RATED 3500
DISCH. PRESS., PSIG 173 ~~182.5~~
PT. F. NOR. 80 MAX 100 SUCT. PRESS., PSIG MAX. RATED -0.5
SP. GR. at PT 1.0 DIFF. PRESS., PSI 173.5 ~~182~~
VAP. PRESS. at PT. PSIA 0.9 DIFF. HEAD, FT 445
VIS. at PT. Ssu ___ cP 0.7 NPSHA, FT 32.
CORR/EROS. CAUSED BY OPERATING CONDITIONS HYD. HP 354

PERFORMANCE

PROPOSAL CURVE NO. 288 1778
RPM 1760 NPSHR (WATER)
EFF. 82 BHP RATED 431.8
MAX. BHP RATED IMP 503
MAX. HEAD RATED IMP 450 @ 5.0
MIN. CONTINUOUS GPM 1250
ROTATION (VIEWED FROM CPLG END) CW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	12	125	FF	SIDE
DISCHARGE	10	250	FF	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F: ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☒ RATED 20 ☒ MAX. 20 ☐ TYPE: ENCL.
MOUNT: ☒ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☒ RADIAL BALL ☒ THRUST BALL
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☒ MFR FALK ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ASBESTOS ☐ SIZE/NO. OF RINGS 10
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS C-2
BASEPLATE: ☒ FAB STEEL

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU: ○ S.S.; ○ TUBING: ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☐ THREADED
LINE SHAFT: ☐ OPEN ☐ ENCLOSED
BRGS: ☐ BOWL ☐ LINE SHAFT
BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☐ DOWN

MOTOR DRIVER

N/A

HP RPM FRAME VOLTS/PHASE/CYCLES
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEMP RISE, C LOCKED ROTOR AMPS
○ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR

TURBINE DRIVER

CUMMINS VT-1710F

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.
NOTE: PUMP TO BE CAPABLE OF PRODUCING 150% RATED CAPACITY AT 65% RATED PRESSURE AND A SHUT-OFF HEAD NOT MORE THAN 120% OF RATED PRESSURE

FORM NO 130 (REVISED SEPT 72)

NO.	DATE							JOB NO.	DRAWING NO.	REV.
0	12/19/80	ISSUED FOR PHASE ZERO	HP				HWH	14222	33-DSG-04	0
								SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 33-G-105 A,B
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 11-20-1980 REVISION A

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;
☐ BY MANUFACTURER

FOR ASHLAND SYNTHETIC FUELS INC SITE KENTUCKY
UNIT BRECKINRIDGE SERVICE FIRE WATER JOCKEY PUMP
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR PEERLESS SIZE AND TYPE VERTICAL 4X4X10C STAGES 5 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID WATER U.S. GPM at PT. NOR. 250 RATED 275
DISCH. PRESS., PSIG 192.5
PT. F. NOR. 80 MAX. 100 SUCT. PRESS., PSIG MAX. RATED 0.5
SP. GR. at PT. 1.0 DIFF. PRESS., PSI 192
VAP. PRESS. at PT. PSIA 0.0 DIFF. HEAD, FT 444
VIS. at PT. Ssu 0.7 CP NPSHA, FT 34
CORR/EROS. CAUSED BY OPERATING CONDITIONS HYD. HP 31

PERFORMANCE

PROPOSAL CURVE NO. 43060-12
RPM 3462 NPSHR (WATER) —
EFF. 71% BHP RATED 43.7
MAX. BHP RATED IMP. 49
MAX. HEAD RATED IMP
MIN. CONTINUOUS GPM
ROTATION (VIEWED FROM CPLG END)

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION				
DISCHARGE	4"	250	FF	SIDE

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) 7 LB
-SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. PSIG °F; ☐ HYDRO TEST PSIG
-CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED 5 3/32 X 5 5/16 ☐ MAX. 5 5/16 ☐ TYPE: ENCL.
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL A1/A ☐ THRUST D.A.
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☒ MFR PEERLESS ☐ MODEL
DRIVER HALF MTD BY: ○ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL API CLASS. CODE
☐ MFR CODE

SHOP TESTS

○ NON-WIT. PERF. ○ WIT. PERF.
○ NON-WIT. HYDRO ○ WIT. HYDRO
○ NPSH REQ'D. ○ WIT. NPSH
○ SHOP INSPECTION
○ DISMANT. & INSP. AFTER TEST
○ OTHER

MATERIALS

API CASE/TRIM CLASS ● E-2
BASEPLATE: ☐

AUXILIARY PIPING

○ C.W. PIPE PLAN ○ CU; ○ S.S.; ○ TUBING; ○ PIPE
☐ TOTAL COOLING WATER REQ'D, GPM ○ SIGHT F.I. REQ'D
○ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG
○ SEAL FLUSH PIPE PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
○ AUXILIARY SEAL PLAN ○ C.S. ○ S.S. ○ TUBING ○ PIPE
○ AUX. SEAL QUENCH FLUID

VERTICAL PUMPS

PIT OR SUMP DEPTH ○ 10
MIN. SUBMERGENCE REQ'D. ☐
COLUMN PIPE: ☐ FLANGED ☒ THREADED
LINE SHAFT: ☒ OPEN ☐ ENCLOSED
BRGS: ☒ BOWL BRZ ☒ LINE SHAFT BRE
BRG. LUBE ☒ WATER ☐ OIL ☐ GREASE
FLOAT & ROD ○ C.S. ○ S.S. ○ BRZ ○ NONE
FLOAT SWITCH ☐
PUMP THRUST, LB ☐ UP ☒ DOWN 1110

MOTOR DRIVER

HP 50 RPM 3600 FRAME — VOLTS/PHASE/CYCLES 460/3/60
MFR BEARINGS LUBE
TYPE INSUL FULL LOAD AMPS
ENC TEFC TEMP RISE, C LOCKED ROTOR AMPS
☒ VHS ○ VSS VERT. THRUST CAP., LB. SERVICE FACTOR 1.15

TURBINE DRIVER

APPROX. WT. PUMP & BASE
MOTOR TURBINE

FORM NO 130 (REVISED SEPT 72)

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

NO.	DATE						
0	12/18/80	ISSUED FOR PHASE ZERO	HP				
			1				

BECHTEL

JOB NO.	DRAWING NO.	REV.
14222	33-DS-G-05	0
SHEET 1 OF 1		

4.3 Duty Specifications for Package Units

33-SP-A-01: Foam Subsurface Injection System (33V-101)

33-SP-A-02: Foam Subsurface Injection System (33V-102)

BRECKINRIDGE PROJECT

PLANT 33 - FIRE SYSTEMS

FOAM SUBSURFACE INJECTION SYSTEM

ITEM NO.: 33-V-101

One skid-mounted balanced pressure proportioning system complete for subsurface foam injection, consisting of:

- Foam storage drum, 3,000 gals. capacity, (carbon steel)

- Foam proportioner, skid mounted capacity: 300 - 2,200 GPM solution

- Foam Maker nozzles (550 GPM cap.)

- Skid for foam maker nozzles

Price obtained from:
Arthur Dooley & Sons

FORM H-292 7-66

1	12/28/80	ISSUED FOR PHASE ZERO	HP ARP		HNH.

ASFI THE BRECKINRIDGE PROJECT AECI

U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717

DUTY SPECIFICATION

FOAM BALANCED PRESSURE PROPORTIONING SYSTEM

JOB NO. 14222

SPECIFICATION	REV
33-SP-A-01	0

BRECKINRIDGE PROJECT

PLANT 33 - FIRE SYSTEMS

FOAM SUBSURFACE INJECTION SYSTEM

ITEM NO. : 33-V-102

One skid-mounted balanced pressure proportioning system complete for subsurface foam injection, consisting of:

- Foam storage drum, 1,000 gals capacity, carbon steel.
- Foam proportioner, skid-mounted capacity 300 - 1,400 GPM solution.
- Foam maker nozzles (550 GPM cap)
- Skid for foam maker nozzles.

Price obtained from:
Arthur Dooley & Sons

FORM H-292 7-66

12/28/80	ISSUED FOR PHASE ZERO	HP		HNH

ASFI THE BRECKINRIDGE PROJECT AECI

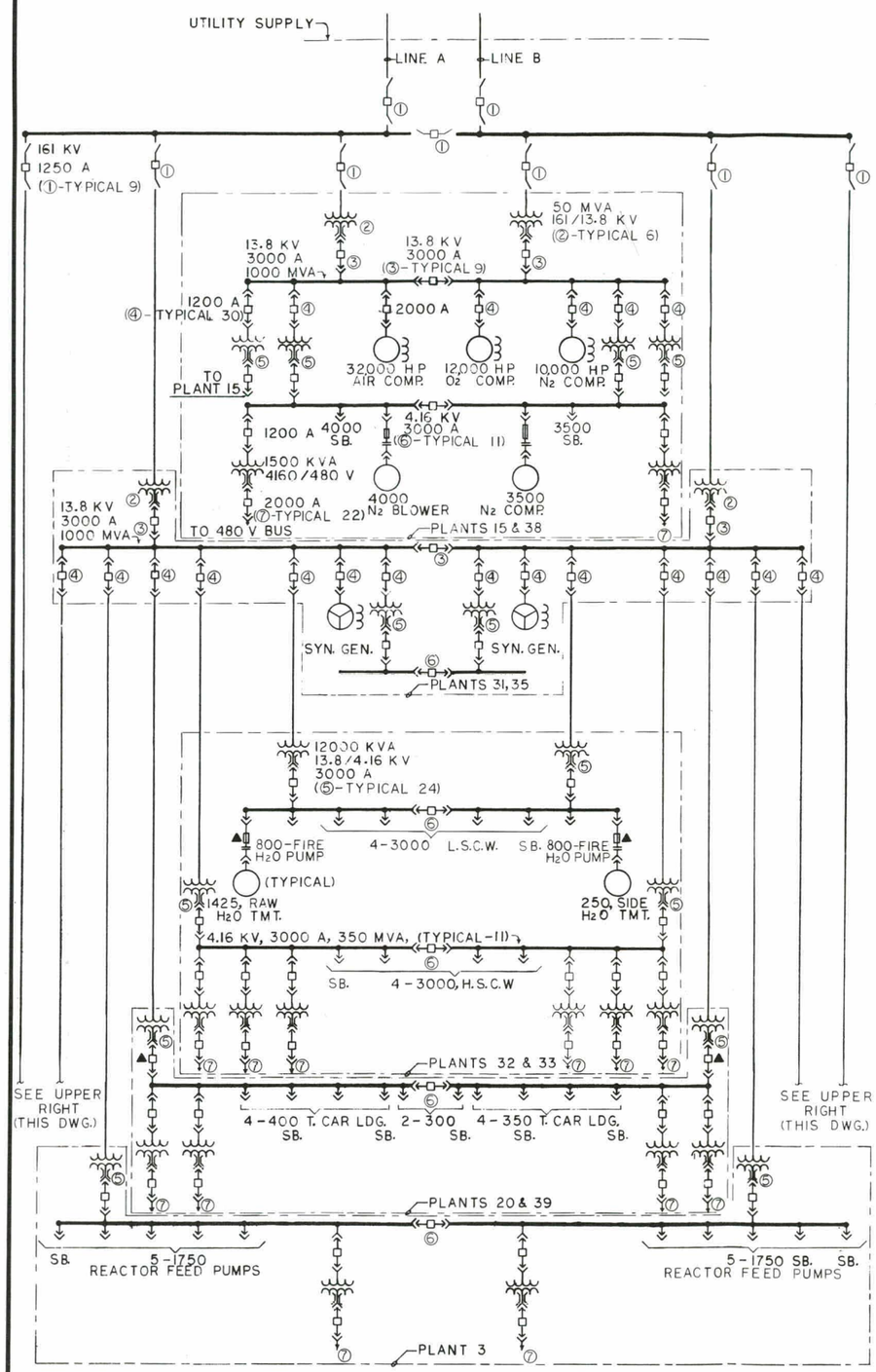
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717

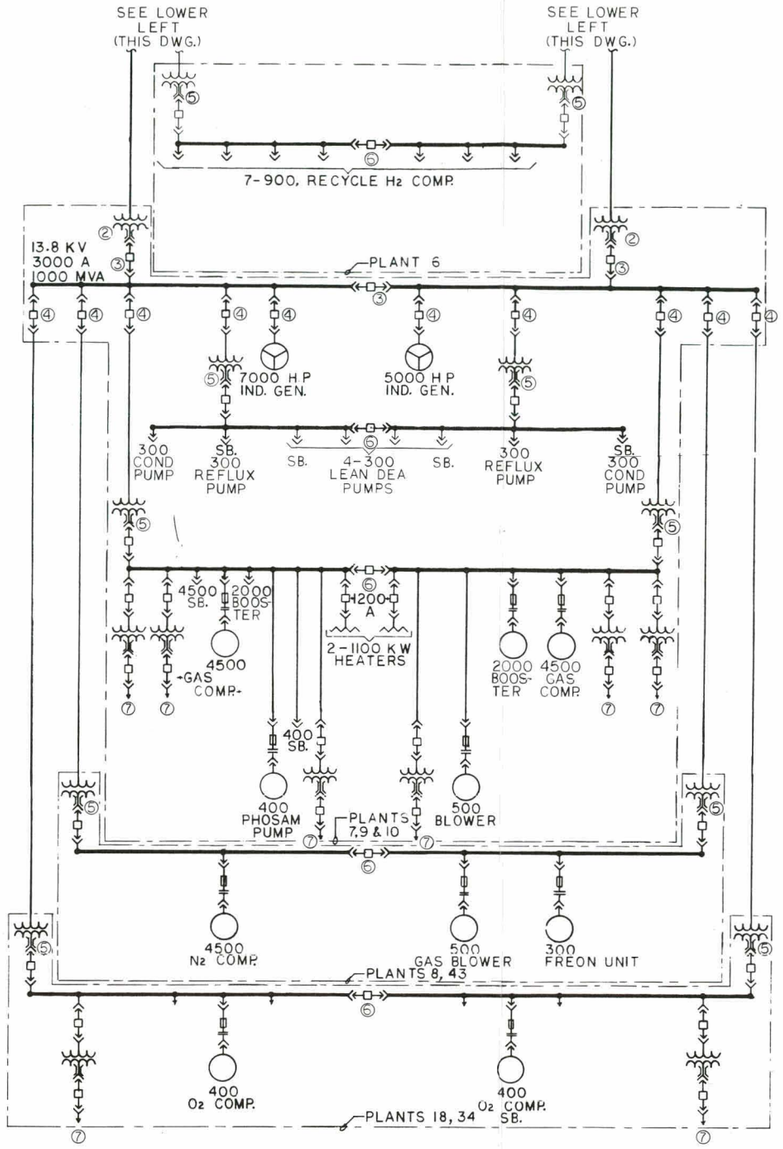
DUTY SPECIFICATION

FOAM BALANCED PRESSURE PROPORTIONING SYSTEM

JOB NO. 14222

SPECIFICATION	REV
33-SP-A-02	0





LEGEND

- SF6 BREAKER
- VACUUM CKT. BKR.
- E2 CONTROLLER
- TRANSFORMER
- MOTOR
- IND. GENERATOR
- SYN. GENERATOR
- SYN. MOTOR
- HEATER
- BUS DUCT
- SB. STANDBY

NOTE: ALL TIE BREAKERS ARE N. O. (MANUAL)

WHEN UTILITY SOURCE IS LOST, FFEDER BREAKERS MARED ▲ WILL OPEN TO NON-ESSENTIAL LOADS

PLANTS: 15,38,31,35,32,33,20,39,3(PART) 6(PART),7, 9,10,8,43,18,34

NO.	DATE	REVISIONS	BY	CHK'D	APP'D
3	Jan. 16/80	ISSUED FOR PHASE ZERO	RAO	TLS	WHB
2	Dec. 3/80	ISSUED FOR REVIEW/APPROVAL	RAO	LA	WS

DESIGNED T4/RAO DRAWN RAO

ASHLAND SYNTHETIC FUELS, INC.
ASHLAND SYNFUELS COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER10717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

ELECTRICAL ONE LINE DIAGRAM

HOUSTON | JOB NO. 14222 | DRAWING NO. 30E-P-003 | REV. 1

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 — 24 X 44

PLANT 34 SEWERS AND WASTEWATER TREATMENT

1.0 INTRODUCTION

Wastewater Treatment (Plant 34) and Water Systems (Plant 32) are closely related and constitute the overall Project Water Management System, with the purpose of minimizing river water consumption and eliminating effluent discharge to public waters during normal plant operation. This goal is achieved by segregating wastewater streams, on the basis of their compatibility, and then treating them to a degree necessary to make them suitable for reuse in lieu of fresh river water. Eventually, most of the water used in the project goes to the atmosphere in the form of harmless water vapor. A very small fraction of the water is consumed as moisture associated with solid wastes that are disposed of in two landfill operations.

The various sources of wastewater, routing, type of treatment, and the ultimate destination are shown on Flowsheets 50-D-B-14 and 50-D-B-15 in Report VII. Individual systems described in this section include:

- Coal Storage Pile Runoff Treatment
- Oily Wastewater Treatment
- Deoiled Wastewater Treatment
- Sour Water System
- Stripped/Dephenolated Wastewater Treatment
- Reverse Osmosis for Process Wastewater
- Brine Concentration and Drying for Process Wastewater
- Reverse Osmosis, Brine Concentration and Evaporation Wastewater from Boiler Feedwater Treating and Boiler/Cooling Tower Blowdown
- Sanitary Sewage Treatment

The systems are all included in Plant 34 with the exception of the sour water system which is included in Plant 9. A portion of this section describes how the dilute and sour water systems are integrated with Plant 34 wastewater treatment facilities. More detailed information regarding the design and operation of the sour water stripping, ammonia recovery, and phenol extraction units is presented in the Plant 9 process description.

As illustrated on Flowsheets 50-D-B-14 and 50-D-B-15, and in Report VII, updating of the overall water balance for the Phase Zero design has generated flowrate numbers that are not always consistent with those originally set as individual system design bases within Plants 32 and 34. These changes are, to a great degree, compensating, and do not have a significant impact on overall costs. Further refinements can be expected as more data becomes available from the pilot plant and additional optimization studies are performed. Accordingly, revisions to individual system design bases to make them consistent with the updated overall water balances have been deferred until the next phase of the work.

The wastewater systems described in this report represent the base case for the inital effort of the Breckinridge Project. Although the treatment involved in this base case is very acceptable from an environmental standpoint, it is not cost effective. Studies have therefore been initiated to evaluate the technical feasibility and economic benefits associated with other wastewater management scenarios for the project. The alternates being considered are arranged in a hierarchy of selected wastes based on their presumed acceptability as potential discharge streams. The acceptability assessment will consider the type and degree of contamination expected, the availability of proven treatment technology for each contaminant, and conventional disposal practices for similar wastes in allied industries. Common to all alternates under study is the inclusion, in the combined discharge, of those waste streams which require little or no treatment to satisfy the effluent discharge limitations. Such wastes will include boiler blowdown, cooling tower blowdown and other relatively innocuous streams.

2.0 PLANT DESIGN

2.1 Coal Storage Pile Runoff Treatment

As a matter of general water management policy, all rain runoff from developed areas is utilized within the complex. Runoff from uncontaminated areas, such as from building roofs, is routed without treatment to the utility/firewater storage pond. Runoff from potentially contaminated areas, including the coal storage areas, is treated before being sent to the utility firewater storage pond.

2.1.1 Design Basis

The design of the Coal Storage Pile Runoff Treatment System is based on published* data regarding runoff from Kentucky and Illinois coals. These data were used to synthesize a design runoff from a blend of Kentucky and Illinois coals mixed in about the same ratios as the design coal feed. The characteristics of the design runoff are summarized as follows:

Parameter	Range	Design
pH	5.9 - 7.5	6.0
Total suspended solids	442 - 2,044	1,800
Total dissolved solids	180 - 1,020	800
Sulfate	55 - 525	320
Iron	1.5 - 17.7	15
Total organic carbon	185 - 700	500
Biochemical oxygen demand	5	5
Chemical oxygen demand	406 - 2,430	2,000

The design is based on the premise that the water will be acidic and therefore bicarbonate alkalinity is insignificant and hardness is entirely noncarbonate. Thus, only soda ash (Na_2CO_3) is being

*EPA Source Assessment - Water Pollutants from Coal Storage Areas, EPA-600/2-78-004m, May 1978.

specified. Soda ash will raise the pH and precipitate calcium and magnesium as the carbonates. If it is determined later that the runoff contains appreciable bicarbonate alkalinity, lime addition may be required.

Design basis for clarifier:

- Water flow 500 GPM
- Surface flooding 700 GPD/ft^2
- Underflow solids concentration 2% (wt)

One 35 ft. diameter clarifier will be used.

Design basis for filters:

- Water flow 500 GPM
- Filtration flux rate 10 GPM/ft^2
- Backwash flux rate 15 GPM/ft^2

Two 5.5 ft. diameter filter units will be used. During backwash, one filter at a flux of 20 GPM/ft^2 will be in service which is considered adequate for short duration.

2.1.2 Process Description

The Coal Storage Pile (CSP) Runoff Treatment System is shown on Flowsheet 34-D-B-6 and consists of clarification, neutralization and filtration.

The runoff from the "live" and "dead" coal storage piles is routed to a storm surge pond which acts as a flow and composition equalizer and a feed "tank" for the CSP runoff treatment equipment. Additionally, some of the heavier suspended solids are expected to settle out at this point.

From the surge pond the runoff is pumped at a constant 500 gpm rate to the Reactor/Clarifier (34Z-102) where it is neutralized with soda ash and clarified with the aid of a polyelectrolyte. Settled solids are withdrawn as sludge from the bottom of the 34Z-102 and pumped to the sludge dewatering facilities at the river water treatment plant as shown on Flowsheet 32-D-B-4. Reactor/Clarifier effluent is pumped through two downflow, pressure-type, dual media filters for residual suspended solids removal. A controlled portion of the filtered water is stored in the Filter Backwash Makeup Tank (34D-103). Periodically the filters are backwashed using filtered water stored in tank 34D-103 and aided by compressed air for scouring the media. Filter backwash water, laden with suspended solids, is returned to 34Z-102 inlet for reuse.

The surge pond will be dredged periodically and the recovered material, principally coal fines, will be blended with the feed to Coal Washing (Plant 27).

The 7 million gallon surge pond size is based on a 10-year frequency storm lasting 48 hours and producing a total of 5 inches of rainfall. (Reference: U.S. Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States, repaginated and reprinted January 1963). This storm would result in an estimated 7 million gallons of water which would be processed at the 500 GPM design rate in about 10 days. Provisions will be made for overflow to the river in the instance that storm runoff exceeds the design basis 10-year storm.

2.2 Oily Wastewater Treatment

The Oily Wastewater Treatment System is illustrated on Flowsheet 34-D-B-2 and consists of API gravity separation followed by dissolved air flotation (DAF). Sludges generated by the API separator and DAF units are disposed of by incineration as shown on Flowsheet 42-D-B-1.

Oil-contaminated wastewaters from throughout the plant, including contaminated surface runoff, are collected by an underground sewer system and routed to the wastewater treatment area. Major sources of this wastewater are:

- Contaminated process area runoff
- Runoff from the tank farm area
- Runoff from truck and railroad loading and unloading areas
- Water draws from oil storage tanks
- Settled water from slop oil tanks
- Vessel and pump drains
- Pump cooling water
- Laboratory sink drains
- Leachate from land fill operations
- Condensate collected in process drains

Normally, oily waste waters flow directly to the API separator. When design flow rates to the API separator are exceeded - as would normally occur during and shortly after a rainfall - excess flow is diverted to an oily water surge pond. When direct flow to the API separator falls below design, surge water is pumped from the pond. Slow speed non-emulsifying pumps are used to transfer water from the pond to the API separators.

In the API separator, unemulsified oil (lighter than water) is floated to the surface and skimmed off while the heavier oils and oil-coated solids settle to the bottom. Skimmed oil is pumped to a slop oil tank prior to reuse in Tankage (Plant 20) while settled sludges are removed from the API separator and collected in a local sump prior to being incinerated.

Separator effluent is pumped to the Flash Mix Tank (34D-111) where it is pH adjusted using either sulfuric acid or caustic soda and dosed with

polyelectrolyte flocculants. Effluent from the flash mix tank flows to the Flocculation Tank (34D-112) where gentle agitation speeds the coagulation of solids.

From the flocculation tank, the wastewater flows by gravity to two parallel DAF units. In these units, additional suspended solids and fine oil droplets are removed by attachment to rising air bubbles. The air bubbles are created by introducing a recycle stream, which has been saturated with air under pressure, into the DAF tanks. Effluent from the DAF units flow by force of gravity to the biological treatment system for biological oxygen demand (BOD) removal, while both skimmed and settled sludges are pumped to a local sump for transfer to incineration in Plant 42.

2.2.1 Design Basis

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

Influent Characteristics	
Flow (maximum)	1,950 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 oily water treatment system is divided into six component systems or packages. Design criteria for each are as follows:

- Oil Separator System

- Maximum wastewater flow	1,950 GPM
- Maximum horizontal velocity	2.5 ft/min
- Surface loading	1,100 gpd/ft^2
- Specific gravity of oil	20°API
- Water temperature	70°F

- Mixer/Flocculator System

- Wastewater flow	1,950 GPM
- Flash mixer detention time	1 minute
- Flocculator detention time	15 minutes
- Mean velocity gradient	40 ft/sec-ft
- Rotor tip speed	1.5 ft/sec

- Dissolved Air Flotation (DAF) System

- Wastewater flow	1,950 GPM
- Recycle rate	50% of forward flow
- Loading rate	2 GPM/ft^2
- Detention time	25 minutes
- Air saturation tank detention time	2 minutes
- Operating pressure	30 psig
- Air requirement	1 scf/100 gallons

- Polymer Feed System

- Maximum dose	5 mg/l
- Total waste flow	1,950 GPM
- Stock solution strength	1%

- Acid Feed System

- Maximum dose	20 mg/l
- Total waste flow	1,950 GPM
- Stock H_2SO_4 solution	1%

- Caustic Soda Feed System

- Maximum dose	20 mg/l
- Total waste flow	1,950 GPM
- Stock NaOH solution	30%

2.2.2 Process Description

The process is shown on Flowsheet 34-D-B-2.

The oily wastewater, on its way to the API Separator (34Z-113) always flows through a specially designed concrete Static Flow Splitter Box (34D-106). The box utilizes a combination of weirs, baffles and orifices to permit excess flows to be diverted to the oily storm surge pond with a minimum of oil carry-over. The pond has a working volume of 25 million gallons. It is equipped with baffles and floating booms located near the inlet end to retain free surface oil within a relatively small area. Floating oil skimmers and vacuum-equipped trucks will be used to skim off this oil before emptying the pond. The emergency overflow to the river will be located at the opposite end of this pond, under a baffle, to ensure no loss of oil to the river.

During oily pond workoff, the Archimedian Screw Lift Pumps (34G-110 A or B) will be used to lift water out of the pond into the sewer main, downstream of the splitter box. These pumps minimize agitation - and thus emulsification - of the oily water and can pump at variable rates as a function of liquid level in the pump sump.

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 then flows on through the two 5 x 11 x 120-foot channels where the finer oil droplets float out and the fine solids (sludge) settle 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 (34G-115) 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 (34G-112) to slop tankage in

Plant 20. Bottom sludge is pumped by the API Separator Sludge Pump (34G-116) to a concrete sump where float and bottom sludges from the DAF units are also collected. This sludge may contain some oil but its recovery is uneconomical. Thus, it is pumped by the Oily Sludge Sump Pump (34G-121) to the incinerator feed tank in Plant 42.

The API separator effluent is pumped by the API Separator Effluent Pump (34G-117) through the Flash Mix Tank (34D-111) and Flocculation Tank (34D-112) to the DAF units. Acid or caustic soda are metered to the flash mix tank to automatically adjust the pH. Alum and polymer are also metered to the flash mix tank at a rate commensurate with the wastewater rate. These chemicals form a dense floc into which some of the small, dispersed oil droplets and suspended solid particles (found in the feed to the DAF units) are trapped. This floc is built up in the flocculation tank by means of a slow-speed mixer-agitator.

The floc containing oily water now enters the twin DAF units, where the oil-coated alum-polymer floc is removed with the aid of small air bubbles. The feed is equally split and fed to the central portion of the circular DAF Flotators (34Z-115 A and B). A portion (50%) of the clarified effluent from each flotator and compressed air are held for about 30 seconds in vessels 34C-101 A or B to dissolve the air in the water. The air-saturated water is depressurized and immediately blended with raw feed to the flotators. There is an independent air saturator for each flotator. The microscopic air bubbles that are thereby formed attach themselves or are trapped in the oil coated floc and rapidly buoy it to the surface of the flotators. The resulting material, known as "float," is skimmed off with slowly revolving scrapers into a hopper from which the float flows by gravity to a sludge collection sump. Some solids settle to the bottom of the flotators. These are removed periodically by bottom sludge pumps and added to the oily sludge sump along with other sludges.

2.3 Deoiled Wastewater Treatment

Effluent from the Oily Water Treatment System (API separator followed by dissolved air flotation) is sent to the next stage of wastewater treatment. This treatment stage, Deoiled Wastewater Treatment, consists of a pure oxygen-activated sludge treatment to remove biodegradable organics, followed by dual media filtration to remove suspended solids. The process is shown on Flowsheet 34-D-B-3.

The pure, oxygen-activated, sludge system consists of three aeration basins, each with two Marox aerators (a total of six), three clarifiers, and one sludge thickener. Effluent from oily water treatment is fed into the aeration basins, in which organic contaminants are contacted with recycled microorganisms and oxygen. The organisms use the biodegradable organic matter as a source of energy and as food for cell growth. The suspension of organisms and wastewater is passed through a clarifier where most solids settle out. The bulk of these settled solids (sludge) is recycled to the front of the aeration basins. The remainder (net production in the basin) of the sludge is removed to maintain a constant microorganism concentration in the basin and thickened to 3% solids in the sludge thickener. The concentrated sludge is sent to the Zimpro wet oxidation unit. Thickener overflow is recycled to the front of the aeration basin.

Effluent from the clarifier is filtered to remove last traces of suspended solids. Anthracite/garnet dual media pressure type filters are used. The filter feed is first chlorinated to prevent biological growth in the filters, and a polymer is added to improve filter performance. The filtered effluent is routed to the low solids cooling tower makeup system.

2.3.1 Design Basis

Oxygen Activated Sludge System. The oxygen activated sludge system employs Marox rotating active diffusers to diffuse pure oxygen into

wastewater in an open aeration basin. The equipment for the required wastewater capacity consists of three Aeration Basins (34Z-116 A, B, and C), six Marox aerators (34K-104 A through F), three Clarifiers (34Z-117 A through C), and one Sludge Thickener (34Z-118).

- Aeration basins and aerators (34Z-116 A, B and C and 34K-104 A through F)

  - Basic data:

Wastewater flow	1,950 GPM
Food to microorganism ratio (F/M)	0.2 lb BOD/MLSS-Day
MLSS	300 mg/l
Detention time	8.4 Hrs
BOD reduction	90%
COD reduction	85%
Oxygen requirement	1.2 lb/1 lb BOD reduction

NOTE:

MLSS - Mixed liquor suspended solids are total solids in aeration basins and includes micro-organisms plus other suspended solids.

Mixed liquor volatile suspended solids are that fraction of MLSS which volatilizes upon burning and represents a measure of the micro-organism content of the MLSS.

  - Unit Description:

Three concrete aeration basins, 80 feet (length) x 30 feet (width) x 18 feet (depth), supplied with oxygen by six Marox rotating active diffusers (two in each basin); each aerator has oxygen transfer capacity of 1500 lb/day oxygen obtained from the Oxygen Plant (Plant 15) at required pressure.

- Clarifier (34Z-117 A, B, and C)

  - Basic Data:

Water flow	4,000 GPM (including sludge recycle)
MLSS in underflow	1%
Surface loading	700 gpd/ft^2
Sludge recycle	50% of incoming

  - Unit Description:

    Three 60-foot diameter circular clarifiers, with sludge scrapers and draw-off, and annular effluent weirs; two 1,000 GPM, 40 bhp, centrifugal sludge recycle pumps (one is a spare).

- Sludge Thickener, 34Z-118

  - Basic Data:

Waste sludge flow	12 GPM
Surface loading	20 gpd/ft.^{2}
Percent MLSS in underflow	3%

  - Unit Description:

    One 10-foot diameter sludge thickener with two 5 GPM, 1/4 bhp, progressing cavity sludge pumps (one is a spare).

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 (34D-114), four anthracite/garnet, dual media, pressure type Filters (34Z-120 A through D), a polymer feed system, and a chlorine feeder.

- Filter Feed Tank (34D-114)

  - Basic Data: Wastewater flow of 1950 GPM, four hours holding capacity.

  - Unit Description: One 70 foot long x 60 foot wide x 15 foot deep concrete basin.

- Chlorine Feeder (34Z-119)

  - Basic Data:

Wastewater flow	1950 GPM
Chlorine dosage	10 mg/l

  - Unit Description: One chlorine feeder rated at 10 lb Cl/hr.

- Polymer Feed System

  34D-115 Polymer Storage Tank
  34D-116 Polymer Mixing Tank
  34D-117 Polymer Feed Tank
  34G-124 Polymer Feed Pumps

  - Basic Data:

Wastewater flow	1950 GPM
Polymer dosage	2 mg/l
Raw polymer storage capacity	2 weeks
Stock solution storage capacity	8 hours
Stock solution concentration	1%

  - Unit Description: One 100 gallon (11 cubic feet) liquid polymer storage tank, one 200 gallon (25 cubic feet) capacity solution tank with slow speed mixer, and one 200 gallon capacity solution.

feed tank. Polymer feed pump is positive displacement, progressive cavity type, rated at 1 GPM.

- Dual Media Filter System (34Z-120 A through D)
  - Basic Data:

Wastewater flow	1950 GPM
Filtration flux	12 gpm/ft^2
Backwash flux	15 gpm/ft^2

  - Unit Description: Four 8 foot diameter, dual media, vertical type, downflow pressure filters with automatic air-assisted backwash. Backwash air provided by a fully spared 150 scfm @ 30 psig blower driven by a 25 bhp motor. Three, 100 GPM, 50 bhp, centrifugal feed pumps (one is a spare) and two, 750 GPM, 10 bhp centrifugal backwash pumps (one is a spare).

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

	Incoming Feed	Filtered Effluent
Flow (GPM)	1950	1950
pH	6-8	6-8
COD (ppm)	480	72
BOD (ppm)	210	21
SS (ppm)	38	1

2.3.2 Process Description

The process is shown on Flowsheet 34-D-B-3.

Wastewater from the Oily Wastewater Treatment System flows directly from the Flotators (32Z-115 A and B) to the Aeration Basins (34Z-116 A, B and C). Weirs regulate the split from the two flotators to the three basins. Recycled sludge from Clarifiers (34Z-117 A, B and C), thickener overflow from the Sludge Thickener (34Z-118) and backwash from the Media Filters (34Z-120 A, B, C and D) 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 recycling of microorganisms in the concentrated sludge.

Oxygen, wastewater and recycled sludge (microorganisms) are intimately mixed with the use of the Marox Aerator (34K-104 A through F). 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 (34D-114).

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 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. The clarity of the overflow is inconsequential since it is recycled to the aeration basins.

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 and permits the use of unfiltered water for filter backwash without disruption to 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 destroy any remaining microorganism thereby preventing further biodegradation which would result under uncontrolled conditions, producing material that would be difficult to filter. A polymer is also added at a controlled rate to render the suspended solids more easily filterable. The exact rates and types of polymer will be established later.

Effluent from the filter is combined and directed to the cooling tower.

The suspended solids concentration in the unfiltered material is expected to be very low. Therefore, unfiltered material will be used to backwash the filters. This method avoids the need to accumulate filtered material for backwashing, thereby saving investment costs.

During backwashing, water is pumped through the filter in the reverse direction of filtration. In these filters, the backwash direction is upward. The rate of backwash is higher than that for filtration and high enough to almost float the filter media. Compressed air is added to the backwash water to help float the filter media and help scour and purge the collected solids out of the media. Air scouring results in more effective cleaning thereby extending the filter cycle time.

2.4 Sour Water System

The H-Coal process produces significant quantities of ammonia, carbon dioxide, hydrogen sulfide and hydrogen chloride. These gases are all present in the main process stream in H-Coal Primary Separation (Plant 4). As this main stream is cooled, precautions must be taken to avoid equipment-fouling with salts of ammonium carbonate, sulfide and chloride. Accordingly, wash water is injected to dissolve any salts that may have formed. The wash water also dissolves soluble organics such as phenols and fatty acids in the gas. The resultant water is termed "sour water". To minimize quantities of waste water to be treated, weak sour waters are used as makeup water to the wash water systems in Plant 4. This discussion of the Sour Water System focusses on the gathering of the various weak sour water streams and treatment of this combined stream prior to use as wash water makeup, as well as the handling of the concentrated sour water that results from the water wash. Although they are the source of the major process wastewater stream, none of the sour water facilities described in this section are actually part of Plant 34, but are part of Sour Water Treating (Plant 9).

Conventional refinery experience with very similar operations indicate that salt content of wash waters should not exceed 10% by weight. Normal refinery services do not encounter soluble organics which when dissolved in water tend to reduce the solubility of salts. Laboratory data has shown that dissolved organics can vary from 1 to 3% in sour waters.

To allow water to dissolve both organics and salts, a design limit of 8% salt has been set for the sour water from Plant 4. Operational experience from the pilot plant at Cattletsburg will be used to confirm this design limit. Obviously lower design salt concentrations will result in increased flows and increased sour water treatment costs.

The Sour Water System is depicted on Flowsheet 34-D-B-1. Sources of weak sour solutions are as follows:

Plant No.	Water	Rate (GPM)
2	Process steam condensate	53
5	Process steam condensate	42
17	Process steam condensate	130
7	Dilute sour water	93
18	Dilute sour water	1
12	Grey water	550
20	Separated water from slop oil tank	1
20	Water in 20% caustic solution	48
3 and 4	Water from H-Coal yields	232
9	Water from neutralization	1
	Total	1,157

Disposition of the water is as follows:

Plant No.	Water	Rate(GPM)
34	Stripped and dephenolized sour water	1,153
10	Water lost to acid gases	2
31	Water lost in desalter emulsion	2
	Total	1,157

Process condensate is obtained from three plants as follows:

(1) Fractionator Overhead Receivers (17C-106 and 17C-206)

(2) Scrubber Overhead Receivers (2C-101 and 2C-801)

(3) Vacuum Tower Overhead Separators (5C-114 and 5C-214) and Hydroclone Vacuum Jet Condensate Drums (5C-111 and 5C-211)

The condensate is pumped from each source to a desalter water feed header.

There is more process steam condensate than required for the desalter. Therefore, part of the header flow goes to the desalter, and the excess goes directly to the Plant 4 Wash Water Receivers (4C-110 and 4C-810). Water separated from oil in the slop oil tanks in Plant 20 is also pumped to the desalter and enters the desalter feed header after the split between the desalter and Plant 4 wash water to assure that all of this oily water enters the desalter. The desalter effects good separation between water and oil. Desalted oil flows to the Plant 17 fractionator feed preheater exchangers while the deoiled water is taken to the Plant 4 wash water receivers.

Also pumped to the Plant 4 wash water receivers is dilute sour water from Plant 20 Dilute Sour Water Tanks (20D-116 A and B), which in turn receive water from the following sources:

(1) Filtered Grey Water Tank (42D-104) in Plant 42

(2) Sour Water Flash Drum (7C-105) in Plant 7

(3) Hydrotreater Separator in Plant 18

The composite water stream in the wash water receivers is used as wash waters for six condensers in Plant 4. These condensers operate at three pressure levels - two at 60 psig, two at 725 psig, and two at 2975 psig. Condensate from each condenser consisting of wash water, hydrocarbon and some additional water condensed from the gas, is collected in respective pressure level receivers and then flashed into the Sour Water Surge Drums (4C-109 and 4C-809). Resultant flashed gases are sent to Plant 17 while the sour waters are pumped to the concentrated sour water tank in Plant 20.

After oil skimming in the concentrated sour water tanks, the water is pumped to Plant 9 for stripping and dephenolization. Caustic soda is added in the stripping tower after essentially all the free ammonia, hydrogen sulfide and carbon dioxide has been removed. The caustic reacts with fixed ammonia salts, such as ammonium chloride, and releases ammonia vapors which are completely stripped out before the water exits the bottom of the stripper. Stripped and dephenolated process wastewater from Plant 9 is then routed to Plant 34 for further treatment.

2.5 Stripped/Dephenolated Wastewater Treatment

Following treatment in Plant 9, 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.

The treatment systems for this waste stream consists of wet oxidation and biophysical treatment (powdered activated carbon/activated sludge, PACT) to remove the organic matter, followed by reverse osmosis (RO) to separate out inorganic salts. The separated inorganic salts in the form of a concentrated solution are sent to an evaporator where additional fresh water is recovered. This section concerns the wet oxidation and biophysical treatment. The process is shown on Flowsheet 34-D-B-4.

2.5.1 Design Basis - Wet Oxidation & PACT Systems

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

- Basic Data:

Item	Design Basis
Reactor Feeds (Total)	
- Waste Water	1,060 GPM with 40,000 mg/l COD
- 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

- System Description:

  Three identical trains are provided, each includes two feed pumps, two heat exchangers, a reactor, a gas-liquid separator, a gas scrubber and controls. Each train is sized to process 400 GPM of feed.

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	1,100 GPM
BOD of Feed	2,700 mg/l
BOD Reduction Required	95%

- Expected Operation:

Item	Requirement
O_2	1.2 lb/lb BOD reduction
Feed/Recycle Sludge Ratio	0.3 lb/lb
MLSS in Aeration Basin	4,500 mg/l
PAC in Aeration Basin	20,000 mg/l
Clarifier Loading	700 GPD/f^2
Clarifier Underflow Concentration	5% solids

- System Description:

  Aeration Basins. Five 30 ft (width) x 160 ft (length) x 18 ft (depth) concrete tanks with 6 Marox aerators in each tank on a walkway bridge. Each aerator is sized to deliver 1,500 lb O_2/day.

Clarifiers. Three 50 ft diameter circular clarifiers include sludge scrapers and two 1,000 GPM centrifugal sludge pumps.

PAC Feed System. Two storage hoppers, 10 ft diameter x 10 ft high, one 400 gallon slurry tank with mixer and two 10 GPM slurry feed pumps make up the PAC Feed System.

2.5.2 Process Description

The Wet Air Oxidation/PAC Activated Sludge Treatment Process is shown on Flowsheet 34-D-B-4.

Stripped-extracted sour water streams are collected in the Equalization Tank (34D-118) and then sent to the Zimpro wet oxidation unit where dissolved and suspended organics are oxidized. Three identical parallel trains are used. In the Zimpro process, wastewater 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 hot reactor effluent is passed through a waste heat boiler generating about 50,000 lb/hr of 150 psig steam. The partially cooled effluent is then passed through the feed preheater for further 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.

In addition to the stripped-extracted sour water, the Zimpro wet oxidation system will receive 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 inert solids in the reactor; regenerated carbon is then returned to the PAC activated sludge system.

The effluent from the Zimpro system is 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 Zimpro effluent, together with returning sludge (PAC and MLSS mixture) and regenerated PAC is fed into five Aeration Basins (34Z-123 A through E) equipped with a total of 30 pure oxygen aeration systems of the Marox rotating active diffusers type. Organics in the Zimpro system effluent are biologically degraded in the aeration basins. The effluent overflows from the aeration basins into three Clarifiers (34Z-124 A, B and C) where spent PAC and waste sludge settle out. The clarifier overflow drains to the Filter Feed Tank (34D-121). 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.

2.6 Reverse Osmosis System for Process Wastewater

The reverse osmosis system is used to separate an aqueous salt solution into two portions - one more dilute than the starting solution and the

other more concentrated. The separation is effected via special non-porous membranes which permit the solvent (water) to pass through the membrane more easily than the solute (salt). Pressure is used as the driving force. In simplicity, it is analagous to filtration where the membrane is the filter medium, the weak solution is the filtrate and the concentrated solution is the filter cake. However, flow is molecular through spaces in the molecular structure of the membrane rather than through physical openings in the filter medium. As such, the feed water must be absolutely free of suspended solids. Preparation of the feed for reverse osmosis therefore consists of filtration followed by chemical treatment to protect the membrane and avoid solids formation on the membrane.

2.6.1 Design Basis

Pretreatment System. The RO pretreatment system includes two chemical injection systems (chlorine and polymer), a media filter system, and a cartridge filter system.

- Basic Data: The chemical injection systems to supply a chlorine dose of up to 10 ppmw and polymer dose of 2 ppmw.

  Media filters for a wastewater rate of 1100 GPM; filter flux at 12 GPM/ft^2; backwash flux at 15 GPM/ft^2; and air scouring flow at 3 scfm/ft^2.

  Cartridge filters for a wastewater flow of 1100 GPM at a 40 psi maximum pressure drop.

- System Description: The chemical injection systems contain one chlorine gas feeder rated at 5.5 lb/hr. One polymer feed system consists of one 100 gallon polymer storage tank, one 100 gallon polymer solution tank with slow speed mixer, one 100 gallon polymer feed tank and two 1 GPM positive displacement polymer feed pumps.

  The media filter system consists of two 1100 GPM centrifugal feed pumps, two 750 GPM centrifugal backwash pumps, two 8 foot diameter dual media pressure filters (anthracite/garnet) and one 150 scfm air blower and control system.

The cartridge filter system consists of two 1100 GPM cartridge filter feed pumps and four 10-micron cartridge filter units designed for 350 GPM of flow each at a maximum pressure drop of 40 psi.

Reverse Osmosis (RO) System. The RO system includes three chemical injection systems (sodium bisulfite, sulfuric acid, and polyphosphate) and three trains of RO modules. The RO system including pumps, membrane elements, piping and controls will be provided as a package unit.

- Basic Data: The chemical systems provide for a feed pH adjustment to 5 to 6, up to 5 mg/l $NaHSO_3$ dose, and up to 10 mg/l polyphosphate dose. There is a minimum two week storage capacity of all chemicals.

  The RO system total flow is 1100 GPM into three completely independent, identical trains, each train sized for 360 GPM feed. Each train is designed for minimum 75% water recovery with minimum 95% salt rejection. The RO system is based on poly thin film membrane elements (ether/amide) with 5000 GPD capacity.

- System Description: The chemical systems contain one pH control system consisting of a 60 gallon acid storage tank and two 0.25 GPM metering acid feed pumps; one sodium bisulfite injection system consisting of one 500 gallon storage tank, two 200 gallon mixing/feed tanks with slow speed mixers and two metering feed pumps rated at 0.5 GPM and one polyphosphate injection system consisting of one 500 gallon storage tank, two 200 gallon mixing/feed tanks with slow speed mixers and two metering pumps rated at 0.5 GPM.

  Three 360 GPM RO trains are used. Each train consists of two high-pressure feed pumps, 108 membranes in a parallel/series array arrangement, permeate and concentrate collection systems, and control systems. There will be one spare high pressure pump manifold which can be used in any one of the trains. Each train includes two stages of 12 and 6 pressure vessels. Each pressure vessel includes six 8 inches x 40 inches poly thin film composite membrane spiral wound elements (ether/amide).

2.6.2 Process Description

The process is shown on Flowsheet 34-D-B-9.

The effluent from the PAC activated sludge system is pumped from the Filter Feed Tank (34D-121) and through the Filter (34Z-126 A and B). The flow is equally split between the two filters. When one filter is on backwash, the entire load is carried by the other filter. In transit from the tank to the filters, the wastewater is dosed with chlorine and polymer. The dosage rates are predetermined and proportional to the wastewater rate. The chlorine destroys any remaining microorganisms thus preventing any further unwanted biological reactions. The polymer is used as a filtration aid.

The effluent from the two media filters is pumped through the four Cartridge Filters (34Z-127A-D). When a cartridge is loaded with solids as indicated by a high pressure drop, it is isolated and the cartridges replaced. During this period, the remaining three cartridge filters carry the entire load.

When the media filters are loaded with solids as indicated by a high pressure drop, the filters are isolated and cleaned by backflushing to remove deposited solids. Air is added to the backwash water for more effective cleaning. Backwash water is supplied by Filter Backwash Pump (34G-132A or B) and air is supplied with Blower (34K-106 A or B). For better staggering of the cycle, the filters may be backwashed on a time basis rather than pressure drop basis.

The backwash water is derived from the main line and loaded backwash is discharged to the PAC activated sludge system where the solids ultimately will leave the system with clarifier underflow.

The effluent from the cartridge filters is pH adjusted to 5 to 6 using sulfuric acid. Only acid is deemed necessary since the prior treatment of the wastewater is expected to maintain a pH above 6. Following pH adjustment, the wastewater is dosed with a predetermined amount of sodium bisulfite and a polyphosphate solution. The former is to neutralize any residual chlorine from the filtration step; the latter is to disperse concentrated dissolved solids that would tend to precipitate on the membrane.

The chemically-conditioned RO feed is pressurized to the operating pressure (400-600 psig) by high-pressure pumps (34G-134A through G) and fed into the RO membrane units (34Z-128 A, B and C) which are arranged in a parallel-series array resembling an inverted pyramid. Relatively pure water permeates through the membranes, while the brine flowing through units becomes more concentrated. A number of parallel units and stages in series are designed to meet the flow and concentration requirements.

The permeate (clean water) from the RO system is sent as makeup to the Low Solid Cooling Tower (32E-101) basin, while the concentrated brine is sent to the brine evaporation system.

2.7 Brine Concentration and Drying for Process Wastewater

A brine concentration and drying system is used to process stripped and dephenolized wastewater which has been treated by reverse osmosis per Flowsheet 34D-B-9. It is anticipated that a definite salt slurry can be produced in the evaporator and that the salt crystals will be large enough to permit recovery of relatively dry salt using a conventional continuous centrifuge.

The process is shown on Flowsheet 34D-B-8.

2.7.1 Design Basis

Vapor Recompression Evaporation. The basic data and a unit description are as follows:

- Basic Data:

Influent Flow:	275 GPM
Influent TDS:	20,000 mg/l
Water recovery	91.5 of feed
Evaporation losses	0.5% of feed

- Unit Description (each): Two 225,000 GPD skid-mounted modules are provided, each module containing one plate type feed/product exchanger; one plate type trim heater; one plate type scavenge exchanger; one evaporator body with 35 vertical leaves and internal product tank; one centrifugal brine recirculation pump rated at 5,200 GPM capacity @ 60-ft head; one deaeration tank with packing; one scavenge vapor compressor @ 355 ICFM; one steam compressor @ 355 ICFM; motor control center; and instrumentation module.

Brine Crystallizer. The basic data for the brine crystallizer is as follows:

Influent flow:	20 GPM
Influent TDS:	250,000 mg/l
Product size:	20-200 mesh
Magma-consistency:	33g crystals/liter of slurry
Production capacity:	35 TPD NaCl

2.7.2 Process Description

Concentrated stripped and dephenolized water from Reverse Osmosis units (34Z-128 A, B and C) flows to the VRE Feed Tank (34D-140), which provides a design surge capacity of 9 hours. Wastewater is pumped as required to the Vapor Recompressor Evaporators (34V-114 A and B) through a series of

feed preheaters. The feed is nearly saturated. It is next deaerated in 34D-141 and injected into the body of the evaporator.

Brine in the body of the evaporator is continuously circulated by Brine Recirculation Pumps (34G-154 A and B) through the respective heaters in the evaporators. Water is evaporated from the brine. The vapors are compressed by Vapor Compressors (34K-113 A and B) to a pressure sufficient to raise the saturation temperature about 8 degrees above the boiling temperature of the brine. The hot vapors condense on the steam side of the heaters providing heat of vaporization for the brine. The condensate is collected and constitutes the recovered water.

Brine is continuously drawn from the evaporator and pumped to the Brine Crystallizer (34V-115). The crystallizer is essentially identical to the evaporator except that it uses steam instead of compressed vapors as heating medium. Also, it does not have any feed preheating as the size does not make it economical. Generated vapors are condensed and collected for recycle to the boiler feedwater storage tank. Noncondensibles are removed from the system by Vacuum Pump (34G-160).

Slurry is continuously drawn from the crystallizer and pumped to the Solid Bowl Centrifuge (34Y-111), which separates the liquid from the solid phase. Granular salt product is continuously discharged from one end of the solid bowl centrifuge while the filtrate with some solids is discharged from the other end. The filtrate is received in the Mother Liquor Tank (34D-142) and pumped back to the crystallizer.

Salt is stored in the Salt Storage Bin (34D-144) prior to disposal.

2.8 Reverse Osmosis, Brine Concentration and Drying of Wastewater from BFW Treating and Boiler/Cooling Tower Blowdown

The brine concentration and drying systems are designed to process high total dissolved solids (TDS) wastewaters and produce land-disposal solids and water for reuse in the plant.

Wastewater containing dissolved salts is evaporated using vapor recompression evaporators. The resultant condensate is reusable water. The concentrated salts are processed in a spray dryer to produce dry solids for easier disposal.

There are two types of feedwater to the evaporator: (1) high TDS, and (2) low TDS. The former (high TDS) is fed directly to the evaporator. The latter (low TDS) is first concentrated using reverse osmosis. The permeate (dilute portion) is recycled to the Low Solids Cooling Tower (32E-101) while the concentrate is fed to the evaporator. The wastewater must be treated before reverse osmosis. The pretreatment consists of filtration and chemical treatment to assure no solids formation in the reverse osmosis units.

The process is shown on Flowsheet 34-D-B-5.

2.8.1 Design Basis

Feed streams to this section include 480 GPM of cooling tower blowdown, 340 GPM of boiler blowdown, 30 GPM of sodium/zeolite regenerant, and 45 GPM of demineralizer regenerant. The regenerant streams will bypass the reverse osmosis system and be fed directly to the evaporator system.

The reverse osmosis, brine concentration and drying systems are composed mostly of packaged units with surge tanks and pumps interspersed between the package units. The design basis and capacity of the individual packages are as follows:

Polymer Feed System (34V-105). The polymer is added to improve filterability of the low TDS wastewater.

- Basic Data:

Maximum Dosage	5 mg/l
Stock Solution	1% (wt)

- Unit Description: The system includes a 250 gallon capacity solution tank with slow-speed mixer, low level actuated fill valve and associated piping. The polymer feed pump is a screw-type pump with varidrive, 3-30 GPH range.

Chlorination System (34V-106). Chlorine is added to the low TDS wastewater to destroy any microorganism which may cause problems with filtration.

- Basic Data:

Maximum chlorine dosage	10 mg/l
Influent flow	820 GPM

- Unit Description: Manually-controlled V-notch chlorinator, 7.5-150 lb/day capacity with pressure and vacuum relief valves, rotometer, variable orifice control valve and injector and diaphragm check valve. Injection water pump is a 10 GPM multi-stage centrifugal pump.

Media Filter System (34V-107). The basic data and a unit description of the media filter system are as follows.

- Basic Data:

Influent flow:	820 GPM
Feed TSS:	50 mg/l
Effluent TSS:	5 mg/l
Filter loading:	12 GPM/ft^2

- Unit Description: Two 84 inch diameter dual-media, vertical down flow pressure filters with automatic air-assisted backwash cycle are provided. Backwash air is provided by a 100 sfcm @ 30 psi, blower.

Sulfuric Acid Feed System (34V-108). Sulfuric acid is added to the reverse osmosis feed for pH adjustment.

- Basic Data:

Maximum dose:	200 mg/l
Influent flow:	812 GPM
Stock solution:	66°Be

- Unit Description: The system contains a 50-gallon capacity day tank with high/low level-actuated fill valve. The feed pump is a diaphragm-type metering pump with pneumatic stroke positioner (set by pH controller), 1/20 GPH range.

Sodium Bisulfite Feed System (34V-109). Sodium bisulfide is used to react with any free chlorine in the reverse osmosis feed.

- Basic Data:

Maximum dose:	10 mg/l
Influent flow:	812 GPM
Stock solution	30%

- Unit Description: The system includes a 30 gallon capacity solution tank with high/low level-actuated fill valve. The feed pump is a diaphragm type metering pump with pneumatic stroke positioner, 0 - 2 GPH range.

Sodium Hexametaphosphate Feed System (34V-110). Sodium hexametaphosphate is used to assure no precipitation in the reverse osmosis unit.

- Basic Data:

Maximum dose:	20 mg/l
Influent flow:	812 GPM
Stock solution	25%

- Unit Description: A 50-gallon capacity solution tank with high/low level-actuated fill valve is provided. The feed pump is a diaphragm type metering pump with a pneumatic stroke positioner, 0.6-11 GPH range.

Reverse Osmosis System (34V-111 A and B). The basic data and a unit description for the reverse osmosis system are as follows:

- Basic Data:

Influent flow:	812 GPM
Influent TDS:	3200 mg/l
Product recovery:	75%
Salt rejection:	95%
Loading:	5000 GPD per membrane element

- Unit Description (each): Two 48-element cartridge filters with 10 micron polyporpylene elements are provided along with two multi-stage centrifugal pumps, 220 GPM capacity @ 540 psi; one 2-stage RO unit with 16 first-stage vessels containing 6 - 8 inch diameter by 40 inches long poly ether/amide elements; eight 2nd stage vessels containing 6 - 18 inch diameter elements; plus required piping, controls and instrumentation.

Vapor Recompression Evaporation System (34V-112 A and B). The basic data and a unit description for the vapor recompression evaporation system are as follows.

- Basic Data:

Influent flow:	278 GPM
Influent TDS:	14,060 mg/l
Water recovery:	92.5% of feed
Evaporation loss:	0.5%

- Unit Description (each): Two 225,000 GPD skid-mounted modules are provided, each module contains one plate type feed/product exchanger; one plate type trim heater; one plate type scavenge exchanger; one evaporator body with 35 vertical leaves and internal product tank; one centrifugal brine recirculation pump rated at 5,200 GPM @ 60-ft head; brine deaeration tank with packing; one scavenge vapor compressor, 355 ICFM; one steam compressor, 37,350 ICFM; motor control center; and instrumentation module.

Spray Dryer System (34V-113). The basic data and a unit description for the spray dryer system are as follows:

- Basic Data:

Influent flow:	20 GPM
Evaporative capacity:	10,000 lb/hr
Hot gas inlet temperature:	800°F
Dry solids moisture content:	3%

- Unit Description: The system contains a spray tower with top-mounted feed atomizer wheel in the gas inlet section, anda 60° conical bottom section six feet diameter by 19 ft 9 in., a product cyclone with 9.68 ft^2 inlet area and rotary valve bottom discharge. Fabric filter collector with 6,750 sq ft filter area and 99% collection efficiency is included. An induced-draft fan is provided which has a capacity of 20,000 ICFM at 6-inches of water column static pressure with an outlet temperature of 220°F.

2.8.2 Process Description

The process is shown on Flowsheet 34-D-B-5. Cooling tower blowdown and boiler blowdown is collected in the Blowdown Storage/ Equalization Tank (34D-130) providing eight hours of surge capacity. The combined blowdown stream is pumped to two parallel Dual-Media Filters (34Z-130 A and B). Chlorine and polymer is added to the filter feed to control biological

growth and promote flocculation of suspended solids for better capture in the filter beds. Filtered water flows to a surge tank upstream of the RO system. Spent backwash from the filters is returned to High Solids Cooling Tower (32E-102) side stream softener.

The RO system is used to concentrate the dissolved solids in the filtered blowdown stream by a factor of about four. Liquid from the RO feed tank is pumped through ten-micron Cartridge Filter Units (34Z-131 A through D) prior to entering the suction side of the high-pressure RO feed pumps. Sulfuric acid (pH reduction), sodium bisulfite (dechlorination) and sodium hexamethaphosphate (anti-precipitant) is added to condition the RO feed. Four multi-stage centrifugal pumps feed the two-stage RO modules. Each module handles about 420 GPM of feed and consists of 16 pressure vessels in the first stage and 8 in the second stage. Water recovery in permeate is about 75 percent and the concentrate streams total about 200 GPM. Recovered water (permeate) is routed to the Low Solids Cooling Tower (32E-101) as partial makeup.

Sodium zeolite waste and demineralizer waste are combined with the RO concentrate in the Feed Tank (34D-136) upstream of the two Vapor Recompression Evaporators (34E-104 A and B). The two 225,000 GPD evaporator units further concentrate the wastes to a brine slurry by evaporation and recover a high quality distillate water product. The wastewater feed is pumped through three plate-type titanium heat exchangers to preheat the steam above its boiling point. Dissolved CO_2 and oxygen are released in deaerators and the hot waste stream discharges into the evaporator sump. Brine is circulated to the top of the heat transfer leaves and spread in a thin film. As water evaporates from the brine film, the vapor is compressed by the Vapor Compressor (34K-110) to raise its saturation temperature 6 to 8°F above the brine boiling point. The compressed vapor is introduced into the internal section of the heat

transfer leaves and condenses, providing the heat required for evaporation. The condensate is collected and pumped out through the feed/product exchanger and to the condensate storage tank in Steam Generation and Boiler Feedwater Treating (Plant 31). Concentrated brine from the recirculation line is sent to the spray dryer feed tank. Water recovery is about 92 percent.

Concentrated brine from the two evaporators is pumped from the common, agitated Spray Dryer Feed Tank (34D-138) to a Spray Dryer Tower (34Y-107) and introduced into a hot air stream (combustion products) by an atomizing wheel. The hot air contacting the droplets evaporates the water leaving dry solid particles which are collected in a product cyclone. Residual particulates in the cyclone exhaust go through an induced draft fan and into the Fabric Filter Collector (34Y-109). Collected particulates are periodically discharged to the products solids line for disposal. The solids are conveyed to a storage hopper from which they are loaded onto trucks or conveyors for transport to land disposal or sale.

2.9 Sanitary Sewage Treatment

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, generally between the railroad tracks and the river bank. 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. It is simple to operate and maintain and has great flexibility of operation. It can be operated either in the "step aeration," "contact stabilization" or "extended aeration" mode depending on conditions in the plant and operator preference. The package unit is capable of handling considerable variations in incoming flow and waste "strength" without causing upsets or off-test effluent.

The settled effluent from the treatment plant is chlorinated and pumped to the inlet of the aeration basins of the deoiled wastewater treatment system for additional treatment. Ultimately, the treated sanitary wastewater is used as a partial makeup to the Low Solids Cooling Tower (32E-101).

2.9.1 Design Basis

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. Should this peak flow rate last more than one hour, an aerated surge tank may have to be installed ahead of the treatment plant. This will be studied in the next phase of the project.

2.9.2 Process Description

The process is shown on Flowsheet 34D-13-7.

34V-101 Sanitary Sewage Treatment Package. The package consists of two above-ground concentric circular tanks, the outer one being divided into three compartments to form an aeration tank, an aerobic digester, and an effluent chlorine contact tank; and the inner one forming the settling tank.

Sewage is pumped from the Lift Sump (34D-104) into the inner tank, Aeration Basin (34Z-104). 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 (34K-102) is dispersed by special diffusers mounted circumferentially around the wall of the compartment.

Digested sewage overflows the aerator into the Clarifier (34Z-106) where suspended solids settle to the bottom and clarified water overflows circumferential weir into the Chlorine Contact Tank (34Z-111). The clarifier is sized for a minimum of four hour 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 Aerobic Digester (34Z-105). The air lifts are cyclic, being operated via a timer.

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 (34Z-112), 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 3K-102 blower. Aerobic treatment prevents generation of bad odor by the sludge. 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.

A Comminitor (34Z-108) is provided on the main sewage inlet line to the aerator to continuously screen and reduce (size) of all entering matter to 1/4 inch and less for proper operation of the aerator.

2.10 Catalysts, Packings, and Chemicals

Chemicals	Initial Inventory (pounds)	Consumption Rate (lb/day)
20 wt% Caustic Solution (as 100%)	1,400	1,400
Sulfuric Acid (as 100%)	1,540	2,510
Soda Ash (as 98%)	140	20
8.25% Sodium Aluminate (as 100%)	900	2,600
1% Polymer Solution (as 100%)	179	383
Chlorine	14,300	473
30% Sodium Bisulfite Solution (as 100%)	2,380	2,730
25% SHMP Solution (Sodium Hexametaphosphate)	1,875	2,325
Powdered Activated Carbon	60,000	1,000

2.11 Utility Balance

Electricity, kW

Condition	Consumed	Generated
Operating	7,294	--

Steam, lb/hr

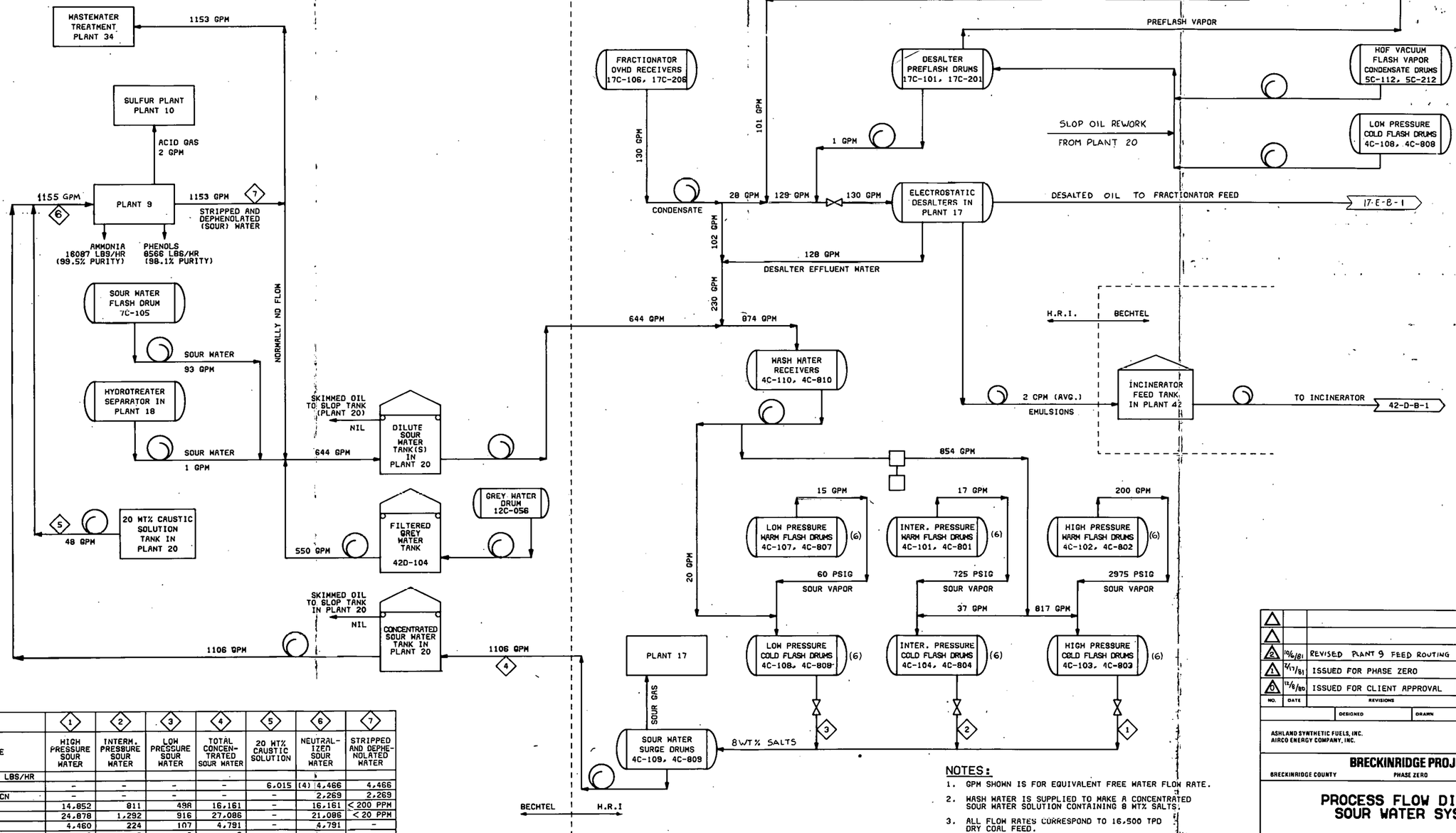
Level	Consumed	Generated	Imported (Exported)
50 psig	-	50,000	(50,000)

Condensate returned: 5,560 lb/hr

Condensate Received: 185,820 lb/hr

Water, GPM

Boiler Feed Water: 111



STREAM NO.	1	2	3	4	5	6	7
STREAM NAME	HIGH PRESSURE SOUR WATER	INTERM. PRESSURE SOUR WATER	LOW PRESSURE SOUR WATER	TOTAL CONCEN-TRATED SOUR WATER	20 WT% CAUSTIC SOLUTION	NEUTRAL-IZED SOUR WATER	STRIPPED AND DEPHE-NOLATED WATER
COMPONENT, LBS/HR							
NAOH	-	-	-	-	6,015	(4) 4,466	4,466
NACL & NACN	-	-	-	-	-	2,269	2,269
NH3	14,852	811	498	16,161	-	16,161	< 200 PPM
H2S	24,878	1,292	916	27,086	-	21,086	< 20 PPM
CO2	4,460	224	107	4,791	-	4,791	-
HCN	3	0	0	3	-	-	-
HCL	1,300	69	45	(5) 1,414	-	-	-
PHENOLICS	8,176	431	281	8,888	-	8,888	127
OTHER ORGANICS	8,176	431	281	8,888	-	8,888	8,090
H2O	508,557	26,790	17,512	552,859	24,060	577,616	576,616
TOTAL LBS/HR	570,402	30,048	19,640	620,090	30,075	650,165	591,568

NOTES:

1. GPM SHOWN IS FOR EQUIVALENT FREE WATER FLOW RATE.
2. WASH WATER IS SUPPLIED TO MAKE A CONCENTRATED SOUR WATER SOLUTION CONTAINING 8 WT% SALTS.
3. ALL FLOW RATES CORRESPOND TO 16,500 TPD DRY COAL FEED.
4. THIS NaOH RATE IS DESIGNED TO NEUTRALIZE PHENOLICS AND POSSIBLE ORGANIC ACIDS, AND TO SPRING AMMONIA.
5. HCl RATE CORRESPONDS TO 0.1 WT% CHLORINE IN COAL FEED.
6. WATER FLOWING FROM THESE DRUMS IS PRODUCED BY CHEMICAL REACTIONS IN THE LIQUEFACTION SECTION.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	BI APPR.	ASFI APPR.
2	10/6/81	REVISED PLANT 9 FEED ROUTING			LKM	VS		WWL
1	7/17/81	ISSUED FOR PHASE ZERO			VS LKM	TZW		WWL WHO
0	12/8/80	ISSUED FOR CLIENT APPROVAL			VS LKM	TZW		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM SOUR WATER SYSTEM

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	34-D-B-1	2

KCLSSD 02/11/81 RS

22 X 34 "D" SIZE

34G-112A&B OIL TRANSFER PUMPS

34E-111 SKIMMED OIL COLLECTION & DEWATERING TANK HEATER 2.0 MM BTU/HR

34D-106 FLOW SPLITTER SUMP 20'X8'X12' DEEP

34G-110A&B SCREW LIFT PUMPS 100-1,100 GPM, 10 BHP

34Q-101 SURGE POND LIFT PUMP SUMP

34Y-101 ALUM MIXER 3/4 BHP

34D-105 ALUM DAY TANK

34D-108 SKIMMED OIL COLLECTION & DEWATERING TANK 500 BBL, 12'ØX24'HEIGHT

34G-115A&B SKIMMED OIL PUMPS 50 GPM, 1 BHP

34G-116A&B API SLUDGE PUMPS 10 GPM, 1 BHP

34G-111A&B ALUM FEED PUMPS

34Z-114 OIL SKIMMING EQUIPMENT FOR API SEPARATOR

34Z-113 API SEPARATOR 2-CHANNEL, EA. 5'DEEP X11'WIDEX120'LONG

34Y-102 POLYMER MIXER 3/4 BHP

34D-107 POLYMER SOLUTION TANK 60"ØX72"DEEP

34G-117A,B&C API SEPARATOR EFFLUENT PUMPS 1,000 GPM, 20 BHP

34G-113A&B POLYMER FEED PUMPS 0-3 GPM, 3/4 BHP

34G-114A&B CAUSTIC SODA FEED PUMPS 0-1 GPM, 3/4 BHP

34Y-103 FLASH MIXER 100 RPM, 2 BHP

34D-111 FLASH MIXER TANK 5'ØX11'DEEP

34D-109 CAUSTIC SODA DAY TANK 60"ØX72"DEEP

34Y-104 FLOCCULATION MIXER 7'DIA., 1 BHP

34D-112 FLOCCULATION TANK 25'ØX10'DEEP

34G-118A&B ACID FEED PUMPS 0-0.5 GPM, 1/4 BHP

34G-121A&B OILY SLUDGE SUMP PUMPS 25 GPM, 3 BHP

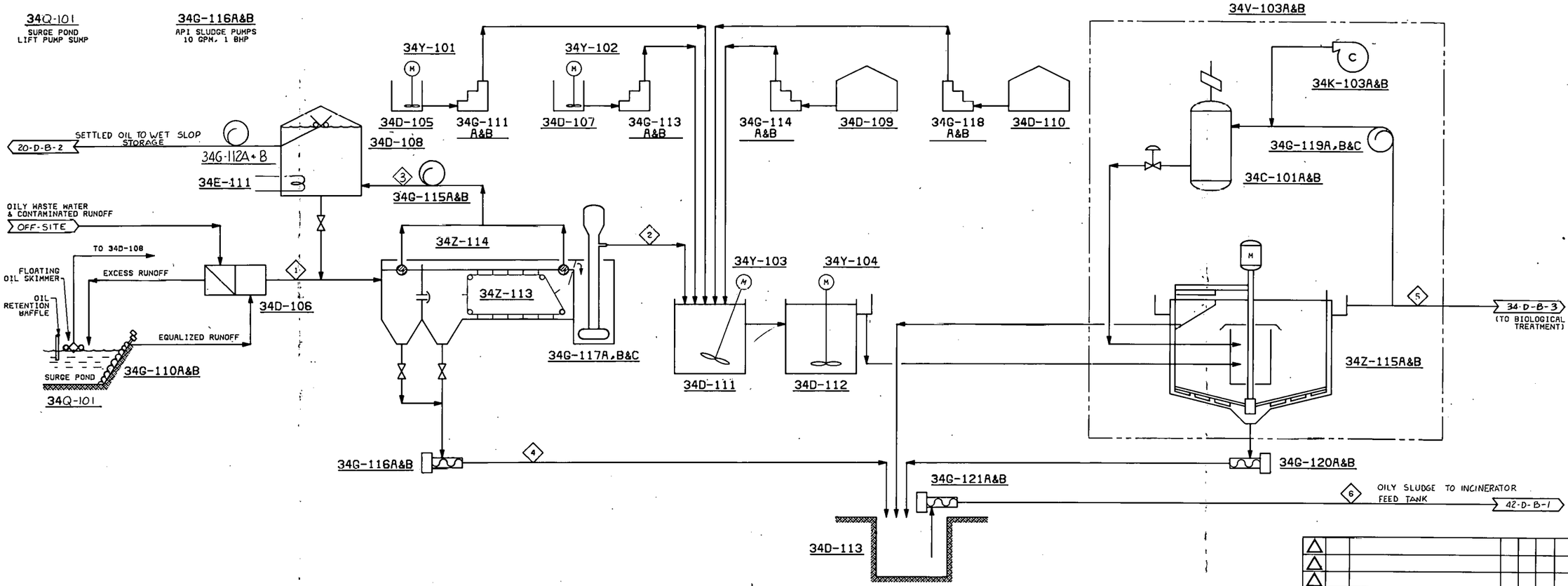
34D-113 OILY SLUDGE SUMP 8'X8'X10'DEEP

34D-110 ACID DAY TANK 60"ØX72"DEEP

34G-120A&B DAF BOTTOM SLUDGE PUMPS 15 GPM, 1/2 BHP

34V-103A&B DISSOLVED AIR FLOTATION SYSTEMS

- **34K-103A&B** AIR COMPRESSORS 10 SCFM AT 50 PSIG, 2-1/2 BHP
- **34Z-115A&B** FLOTATORS 30.5'ØX7'DEEP
- **34G-119A,B&C** RECYCLE PRESSURIZING PUMPS 500 GPM, 25 BHP
- **34C-101A&B** AIR SOLUTION VESSELS (1,000 GAL)



STREAM NO.	1	2	3	4	5	6
DESCRIPTION / COMPONENT	INFLUENT	API SEPARATOR EFFLUENT	SKIMMED OIL	API SEPARATOR SLUDGE	DAF EFFLUENT	DAF SLUDGES
FLOW (GPM)	1,950	1,937	50	10	1,922	15
pH	6-8	6-8		6-8	6-8	6-8
OIL (MG/L)	350	175	20%	NIL	26	2%
TSS (MG/L)	150	75	NIL	1.5%	38	4,800
COD (MG/L)	1,200	800			480	
BOD (MG/L)	500	350			210	

NO.	DATE	REVISIONS	BY	CHK	ENGR	OT APPR	ASST APPR
1	2/11/81	ISSUED FOR PHASE ZERO		VS LKM	BTK		WWL WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL		VS LKM	BTK		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34- SEWERS AND WWT OILY WATER TREATMENT SYSTEM

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	34-D-B-2	1

22 X 34 "D" SIZE

KCL818 02/12/81 RS

34K-104 A-F	34G-122 A,B	34Z-117 A,B,C	34G-123 A,B	34Z-118	34Z-119	34D-114	34G-125 A-C
MAROX AERATORS 10 HP-EACH	SLUDGE PUMPS 1000 GPM-40 BHP EACH	CLARIFIERS 60'ø EACH	SLUDGE PUMPS (THICKENER) 5 GPM-1/2 HP EACH	SLUDGE THICKENER 10'ø	CHLORINE FEEDER 10 LBS CL2/HR	FILTER FEED TANK 60X70X15 FT³	FILTER FEED PUMPS 1000 GPM-50 HP EACH

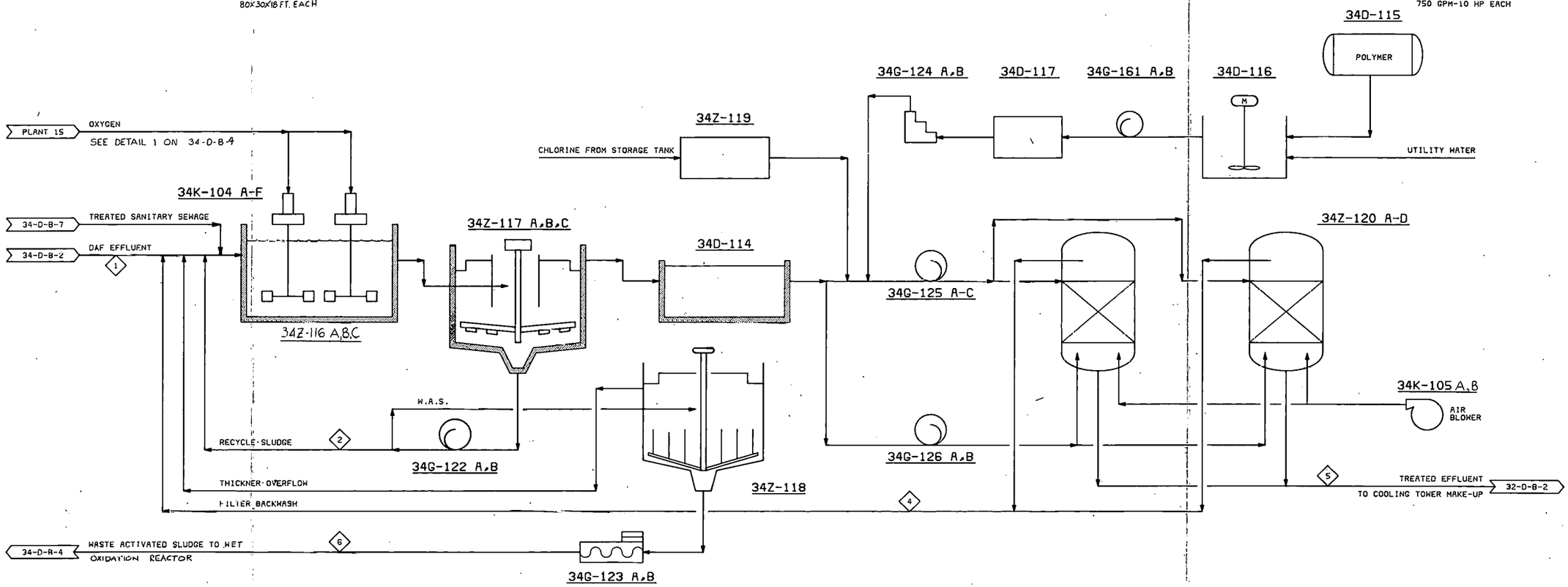
34Z-116 A,B,C
AERATION BASINS
80X30X18 FT. EACH

POLYMER FEED SYSTEM

34G-124 A,B	34G-161 A,B	34D-117	34D-116	34D-115
POLYMER FEED PUMPS 1 GPM-3/4 HP EACH	POLYMER TRANSFER PUMPS 10 GPM-1/2 HP EACH	POLYMER FEED TANK 200 GAL.	POLYMER MIXING TANK 200 GAL.	POLYMER STORAGE TANK 100 GAL.

34Z-120 A-D	34K-105 A,B
MEDIA FILTERS 8 FT. DIA. EACH	FILTER BACKWASH AIR BLOWERS

34G-126 A,B
FILTER BACKWASH PUMPS
750 GPM-10 HP EACH



STREAM NO.	1	2	3	4	5	6
DESCRIPTION / COMPONENT	API-DAF EFFLUENT	CLARIFIER UNDERFLOW	CLARIFIER EFFLUENT	SPENT BACKWASH	TREATED EFFLUENT	WASTE SLUDGE
FLOW (GPM)	<1950	1000	1950	750	1950	4.9
PH	6-8					
COD (MG/L)	480		72		72	15,000
BOD (MG/L)	210		21		21	7,500
SS (MG/L)	38	10,000			<1	30,000
TDS (MG/L)						

KCL 68B 02/12/81 RS

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	BI APPR.	ASFI APPR.
1	2/17/81	ISSUED FOR PHASE ZERO			VS LKM	BTK		WWD WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			VS LKM	BTK		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - SEWERS AND WWT DEOILED WASTEWATER TREATMENT

BECHTEL HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	34-D-B-3	1

22 X 34 "D" SIZE

34D-118
EQUALIZATION TANK
36,334 BBL

34K-114AB
OXYGEN SUPPLY
COMPRESSOR

WET OXIDATION SYSTEM

34Z-121A,B,C
SEE NOTE (1)

PAC FEED SYSTEM

34D-119A,B
PAC STORAGE
785 FT³ EACH

34G-127A,B
PAC FEED PUMPS
10 GPM, 3/4 HP

34D-120
PAC SLURRY TANK
400 GAL.

34Z-122A,B
PAC FEEDERS
2000 LBS PAC/HR

PAC - ACTIVATED SLUDGE SYSTEM

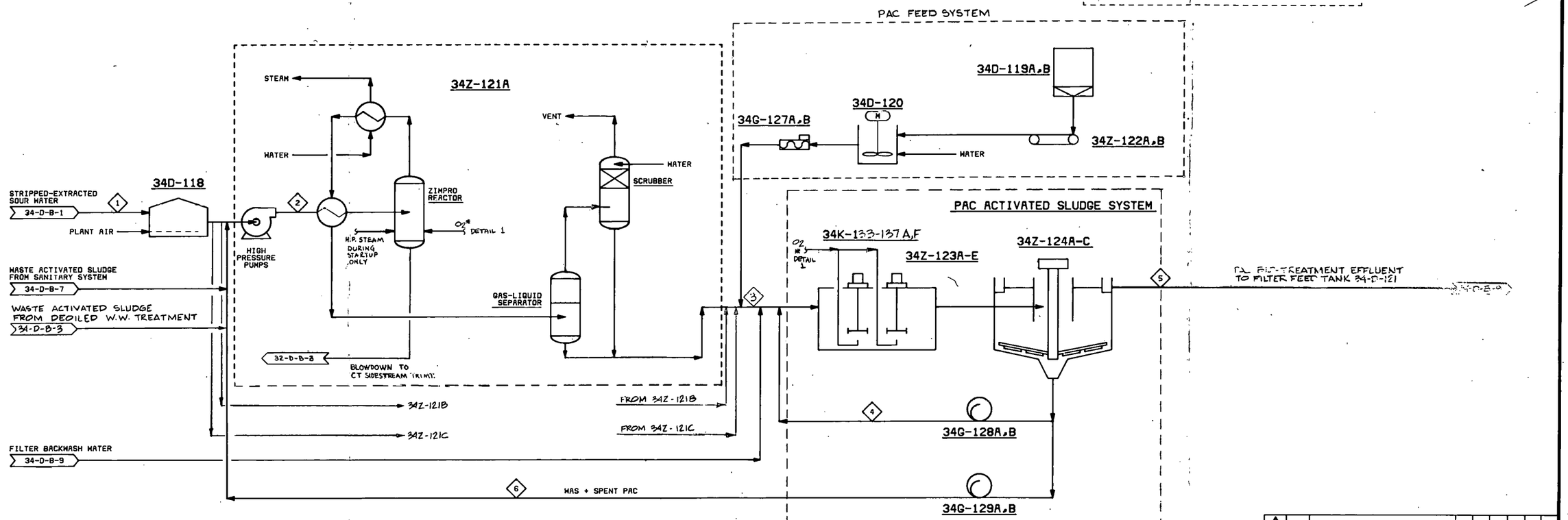
34Z-123A-E
AERATION BASINS
30X160X18 FT³, EACH

34G-128A,B
SLUDGE RECYCLE PUMPS
1100 GPM, 40 HP EACH

34K-133-137A,F
AERATORS
30 UNITS
10 HP EACH

34G-129A,B
WASTE SLUDGE PUMPS
60 GPM, 2 HP EACH

34Z-124A-C
CLARIFIERS
50 FT DIAMETER EACH



STREAM NO.	1	2	3	4	5	6
DESCRIPTION / COMPONENT	STRIPPED SOUR WATER	INFLUENT TO	EFFLUENT FROM	CLARIFIER UNDER-FLOW	CLARIFIER EFFLUENT	SPENT PAC + AS
FLOW, GPM	1060	1124	1124	~1100	~1100	59
pH	6-8					
COD, MG/L	39,600	37,700	5,700		300	5000
BOD, MG/L	19,000	18,000	2,700		150	2500
SS, MG/L	<28			50,000	~50	50,000
TDS, MG/L	-					
NaCl, MG/L	~4,100	~4,100	~4,100		~4,100	
NH₃, MG/L	92					
H₂S, MG/L	23					
PHENOLICS, MG/L	158					
OTHER ORGANICS, MG/L	15,200					
PAC						

NOTE:

1. 34Z-121 - WET OXIDATION SYSTEM (THREE IDENTICAL TRAINS); (HIGH PRESSURE PUMP, REACTOR, HEAT EXCHANGERS, GAS-LIQUID SEPARATOR, SCRUBBER, COMPRESSOR, AND CONTROL)

DESIGN BASIS
1124 GPM, 21,000#/HR COD,
85% COD REDUCTION,
21,000#/HR O_2 CONSUMPTION,
OXIDATION AT 500-500°F, 1500 PSI.

LEGEND:

1. PAC = POWDERED ACTIVATED CARBON
2. AS = ACTIVATED SLUDGE
3. WAS = WASTE ACTIVATED SLUDGE

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R.	BI APP'R.	ASST APP'L.
3								
2	10/6/81	ADDED STARTUP STEAM TO REACTOR			LKM	VS		WWD
1	2/9/81	ISSUED FOR PHASE ZERO			[illegible]	[illegible]		WWD WWD
0	12/9/80	ISSUED FOR REVIEW/APPROVAL			[illegible]	[illegible]		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - SEWER & WWT STRIPPED - EXTRACTED SOUR WATER TREATMENT (WET AIR OXIDATION/PAC ACTIVATED SLUDGE)

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	34-D-B-4	2

KCL 80C 02/11/81 RS

22 X 34 "D" SIZE

34V-105

34D-131 POLYMER SOLUTION TANK 35'-9"Ø X 40'-H 250 GAL. CAP.

34G-141 POLYMER FEED PUMP 3-30 GPM, 1/2 HP

34Y-105 POLYMER TANK MIXER 360 RPM, 1/2 HP

POLYMER FEED SYSTEM

34V-106

34Z-129 V-NOTCH CHLORINATOR WITH DIAPHRAGM INJECTOR 7.5-150 LB/D CP.

34G-142 INJECTION WATER PUMP 10 GPM CAP. @ 125 PSI 2-1/2 HP

CHLORINATION SYSTEM

34V-107

34Z-130A&B DUAL-MEDIA FILTERS Ø4'-ØX54'-TT

34K-108 FILTER BACKWASH AIR BLOWER 100 SCFM @ 30 PSI 15 HP

MEDIA FILTER SYSTEM

34D-130 BLOWDOWN STORAGE/ EQUALIZATION TANK 45'-9"Ø X 40'-H 492,000 GAL. CAP. CONE ROOF

34G-140A&B FILTER FEED PUMPS 450 GPM CAP. @ 50 PSI 18.7 BHP

34G-143 FILTER BACKWASH PUMP 600 GPM CAP. @ 15 PSI 7.1 BHP

34D-132 R.O. FEED TANK 36'-3"Ø X 32'-H 246,000 GAL. CONE ROOF

34G-144A&B R.O. L.P. FEED PUMPS 450 GPM CAP. @ 30 PSI 11.2 BHP

34V-108

34D-133 SULFURIC ACID TANK 22.5"Ø X 40"H 50 GAL. CAP.

34G-145 H₂SO₄ FEED PUMP 1-20 GPH @ 125 PSI, 1/4 HP

SULFURIC ACID FEED SYSTEM

34V-109

34D-134 NaHSO₃ SOL'N. TANK 22.5"Ø X 22-1/4"H 30 GAL. CAP.

34G-146 NaHSO₃ FEED PUMP 0.2-3.7 GPH @ 125 PSI, 1/4 HP

SODIUM BISULFITE FEED SYSTEM

34V-110

34D-135 SHMP SOL'N. TANK 22.5"Ø X 40"H 50 GAL. CAP.

34G-147 SHMP FEED PUMP 0.5-11 GPH @ 125 PSI, 1/4 HP

SODIUM HEXAMETAPHOSPHATE FEED SYSTEM

34V-111A&B

34Z-131A,B,C,D CARTRIDGE FILTER UNITS 40-10W SMPP ELEMENTS

34G-148A,B,C,D R.O. H.P. FEED PUMPS 220 GPM CAP @ 540 PSI 150 BHP

34Z-132A&B R.O MODULES 2-STAGE UNITS 16-1ST STAGE VESSELS W/6-8"Ø X 40"L ELEMENTS POLY ETHER/AMIDE MEMBRANES

REVERSE OSMOSIS SYSTEMS

34D-136 VRE FEED TANK 34'-6"Ø X 24'-H 168,000 GAL. CAP. CONE ROOF

34G-149A&B VRE FEED PUMPS 175 GPM CAP. @135 PSI 22.5 BHP

34V-112A&B

34E-101A&B FEED/PRODUCT EXCHANGER

34G-150 A&B BRINE RECIRC. PUMP 5200 GPM CAP @ 26 PSI 85 BHP

34E-104A&B EVAPORATOR BODY 225,000 GPD CAP.

34D-137A&B DEAERATOR TANK

34K-110A&B VAPOR COMPRESSOR 37,350 ICFM CAP. @ 3.8 PSI 755 BHP

34G-151A&B DISTILLATE PUMP 170 GPM CAP. @ 65 PSI 15 BHP

VAPOR RECOMPRESSION EVAPORATOR SYSTEMS

34D-138 SPRAY DRYER FEED TANK 17'-6"Ø X 16'-H 28,750 GAL. CAP.

34Y-106 FEED TANK AGITATOR 15 HP

34G-152 A&B DRYER FEED PUMP 20 GPM CAP. @ 135 PSI 5 BHP

34D-139 SOLIDS STORAGE BIN 8'-ØX10'-H W/ CONICAL BOTTOM

34V-113

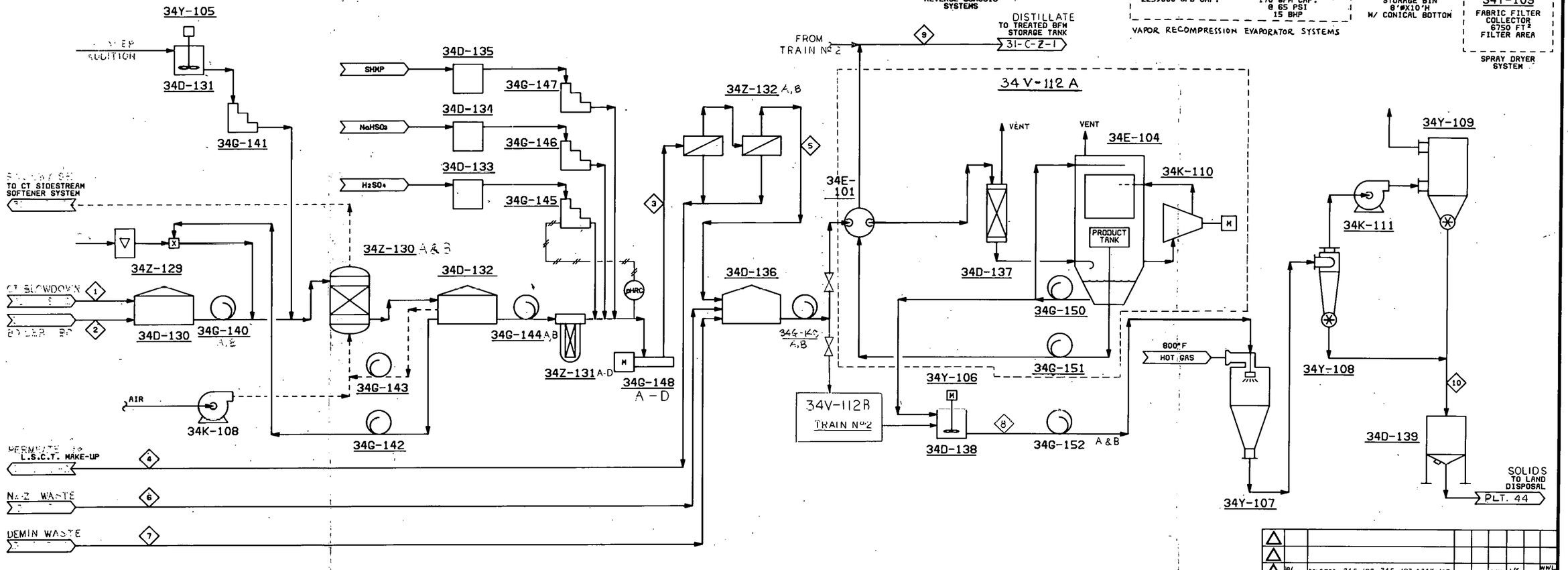
34Y-107 SPRAY DRYER W/ ATOMIZER 10,000 LB/HR EVAP. CAP.

34Y-108 PRODUCT CYCLONE W/ ROTARY VALVE 6'-ØX19'-9"H

34K-111 INDUCED DRAFT FAN 20,000 SCFM CAP. S.P.=6"H.C 25 BHP

34Y-109 FABRIC FILTER COLLECTOR 6750 FT² FILTER AREA

SPRAY DRYER SYSTEM



STREAM NO.	◇1	◇2	◇3	◇4	◇5	◇6	◇7	◇8	◇9	◇10
DESCRIPTION / COMPONENT	CT BLOWDOWN	BOILER BLOWDOWN	R.O. FEED	R.O. PERMEATE	R.O. CONCENTRATE	Na-ZEOLITE WASTE	DEMIN. WASTE	VRE CONC. BRINE	VRE DISTILLATE	DRIED SOLIDS
FLOW, GPM	480	340	812	609	203	30	45	18.8	257	
TDS, MG/L	4,000	1,500	3,123	208	11,867	20,000	20,000	166,230	≤10	} 1,953 LB/HR
TSS MG/L	50	50	<1	-	-	-	-	41,560	TRACE	
CALCIUM (AS CaCO₃) MG/L	753	-	441	29	1,676	3,500	-	23,675	<1.2	
MAGNESIUM (AS CaCO₃) MG/L	458	-	268	18	1,018	2,400	-	14,800	<0.8	
SODIUM MG/L	-	600	251	17	954	5,508	3,883	28,315	<1.3	
SULFATE (AS CaCO₃) MG/L	1,340	460	1,125	75	4,275	-	16,813	86,345	<4.1	
CHLORIDE MG/L	000	150	1,116	74	1,241	9,492	-	59,206	<2.7	
SILICA (AS SiO₂) MG/L	67	30	51	3	194	-	-	2,100	<0.1	
pH	6-8	9-11	4-5							
TEMPERATURE, °F	~85	~120	~95	~90	~90	70	70	209	110	200
PRESSURE, PSIA										

NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENG'R.	BI APPR.	ASFI APPR.
2	10/6/81	DELETED 34E-102, 34E-103 & 34K-109			LKM	VS		WWL
1	2/17/81	ISSUED FOR PHASE 0			VS LKM	GTK		WWL WWD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			VS LKM	GTK		

DESIGNED DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - BRINE CONCENTRATION, EVAPORATION AND RESIDUE DRYING

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	34-D-B-5	2

KCL79A 02/04/81 MJ

22 X 34 "D" SIZE

POLYMER FEED SYSTEM

34Z-101
POLYMER MIXER
3/4 HP
350 RPM

34D-101
POLYMER SOLUTION TANK
64"HIGHX52"DIA.
400 GAL. NOM. CAP.

34G-102
POLYMER FEED PUMP
0-0.5 GPM
3/4 HP

34G-101A&B
SURGE BASIN LIFT PUMPS
250 GPM
2.5 BHP

SODA ASH FEED SYSTEM

34D-102
SODA ASH TANK
200 GAL.

34G-103
SODA ASH FEED PUMP
0-0.1 GPM
1/4 HP

34J-101
FEED PUMP CONTROLLER

34G-104A&B
SLUDGE PUMPS
50 GPM
1.0 BHP

34Z-102
REACTOR CLARIFIER
35-FT. DIA.

34G-105A&B
CLARIFIED EFFLUENT PUMPS
250 GPM
10 BHP

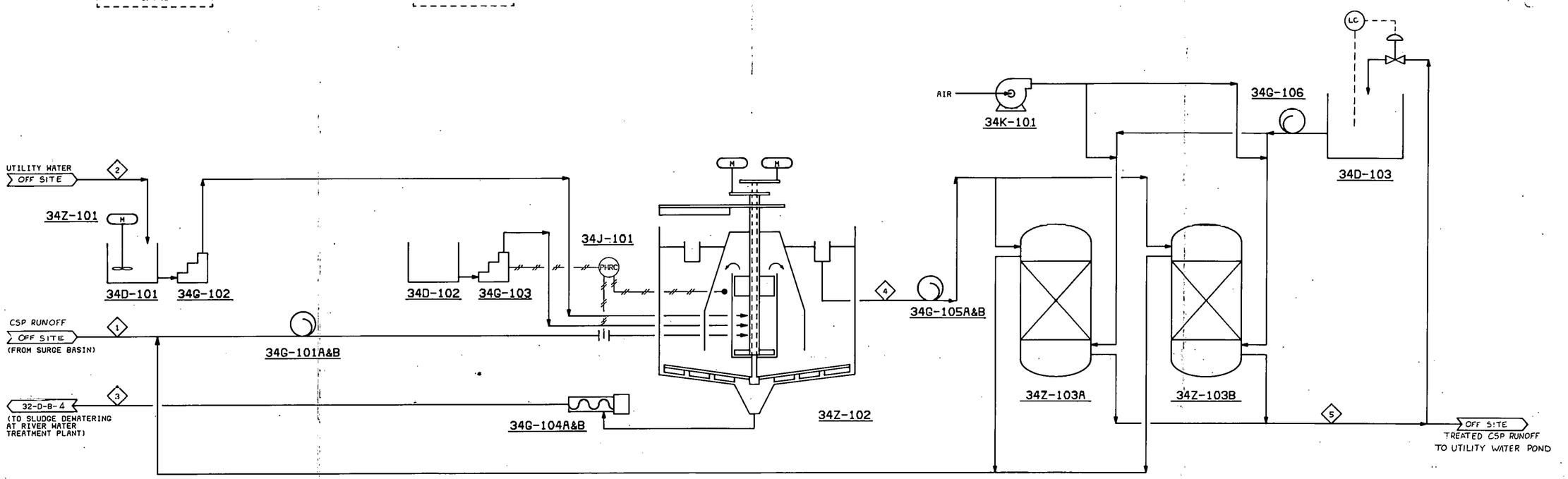
MEDIA FILTER SYSTEM

34Z-103A&B
MEDIA FILTERS
TWO, 66" DIA.

34G-106
FILTER BACKWASH PUMP
712 GPM
5 BHP

34K-101
FILTER BACKWASH AIR BLOWER
100 SCFM @ 30 PSIG
15 BHP

34D-103
FILTER BACKWASH MAKE-UP TANK
6FT. HIGH X 7.5 FT. DIA.



STREAM NO.	1	2	3	4	5
DESCRIPTION / DESIGN PARAMETER	IMPOUNDED CSP RUNOFF	UTILITY WATER	SLUDGE	CLARIFIED EFFLUENT	FILTERED EFFLUENT
FLOW (GPM)	500	0.3	55	445	445
pH	3.0-7.6	7.0	6-9	6-9	6-9
TSS (MG/L)	<2,300	-	2%	100	<5
TDS (MG/L)	1,200	-	1,200	1,200	1,200
TCC (MG/L)	<700				
IRON (Fe, MG/L)	18				

NOTE:
CSP - COAL STORAGE PILE

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENGR.	BI APPR.	ASFI APPR.
3								
2	10/7/81	INCREASED CAP. OF 34G-104 A&B			LKM	VS		WPL
1	2/17/81	ISSUED FOR PHASE ZERO			VS LKM	OTK		WWL WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL			VS LKM	BTK		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80DR20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY, PHASE ZERO, KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - SEWERS AND WWT CSP RUNOFF TREATMENT

BECHTEL HOUSTON

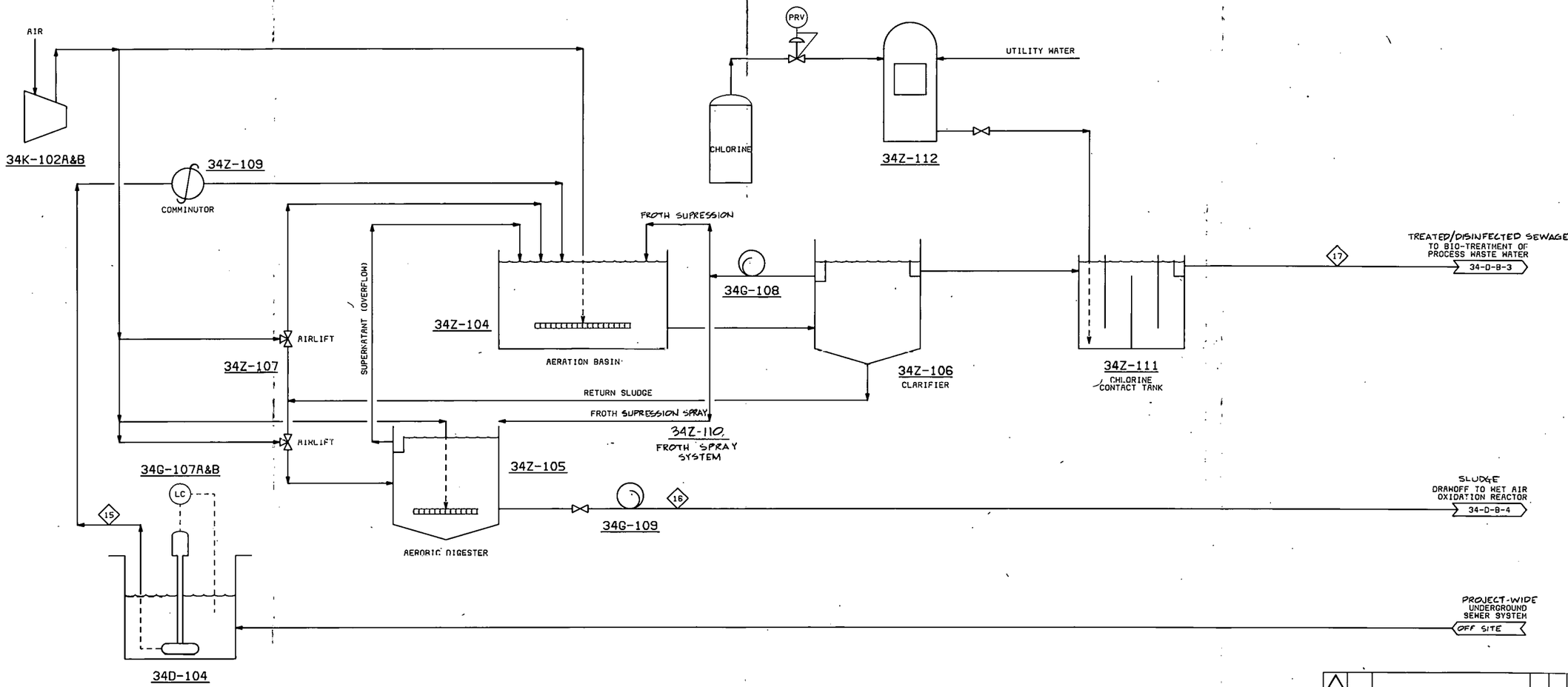
JOB NO.	DRAWING NO.	REV.
14222	34-D-B-6	2

22 X 34 "D" SIZE

KCL64A 02/12/81 RS

34 V-101 SANITARY SEWAGE TREATMENT PACKAGE PLANT

34K-102A&B AIR BLOWERS | 34Z-109 COMMINUTOR | 34Z-107 AIRLIFT SYSTEM | 34Z-104 AERATION COMPARTMENT | 34Z-105 AEROBIC DIGESTER | 34G-109 DIGESTED SLUDGE DRAWOFF PUMP | 34Z-110 FROTH SPRAY SYSTEM | 34G-108 FROTH SPRAY FEED PUMP | 34Z-112 CHLORINATOR | 34Z-106 CLARIFIER | 34Z-111 CHLORINE CONTACT TANK | 34G-107 A, B LIFT PUMPS | 34D-104 SEWAGE LIFT SUMP



STREAM NO.	15	16	17
DESCRIPTION / COMPONENT	RAW SEWAGE	DIGESTED SLUDGE	TREATED SANITARY SEWAGE
FLOW (AVE.) (GPM)	106	2	104
FLOW (MAX.) (GPM)	400	5	200
TSS (MG/L)	175	15,000	30
BOD (MG/L)	180	500	25

KCL70B 02/12/91 RS

NOTES:

1. THE SANITARY SEWAGE TREATMENT PACKAGE IS COMPOSED OF THE FOLLOWING ITEMS:
   - A - COMMINUTOR
   - B - AERATION BASIN
   - C - CLARIFIER
   - D - CHLORINE CONTACT TANK
   - E - AEROBIC DIGESTER
   - F - FROTH SPRAY SYSTEM
   - G - ELECTRICAL CONTROL SYSTEM

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	DI APPR.	ASST APPR.
1	2/17/88	ISSUD FOR PHASE ZERO			LEM	VS		WWD WHD
0	12/6/80	ISSUED FOR REVIEW/APPROVAL			LEM	VS		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - SEWERS AND WWT SANITARY SEWAGE TREATMENT

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	34-D-B-7	1

22 X 34 "D" SIZE

34D-140
VRE FEED TANK
52'-7"ØX24'H
150,000 GAL. CAP.
CONE ROOF

34G-153A&B
VRE FEED PUMPS
175 GPM CAP.
@ 135 PSI
22.5 BHP

34D-144A&B
SALT STORAGE BINS
500 FT³ CAP.
8'ØX12'H
W/ CONICAL BOTTOM

34V-114A&B

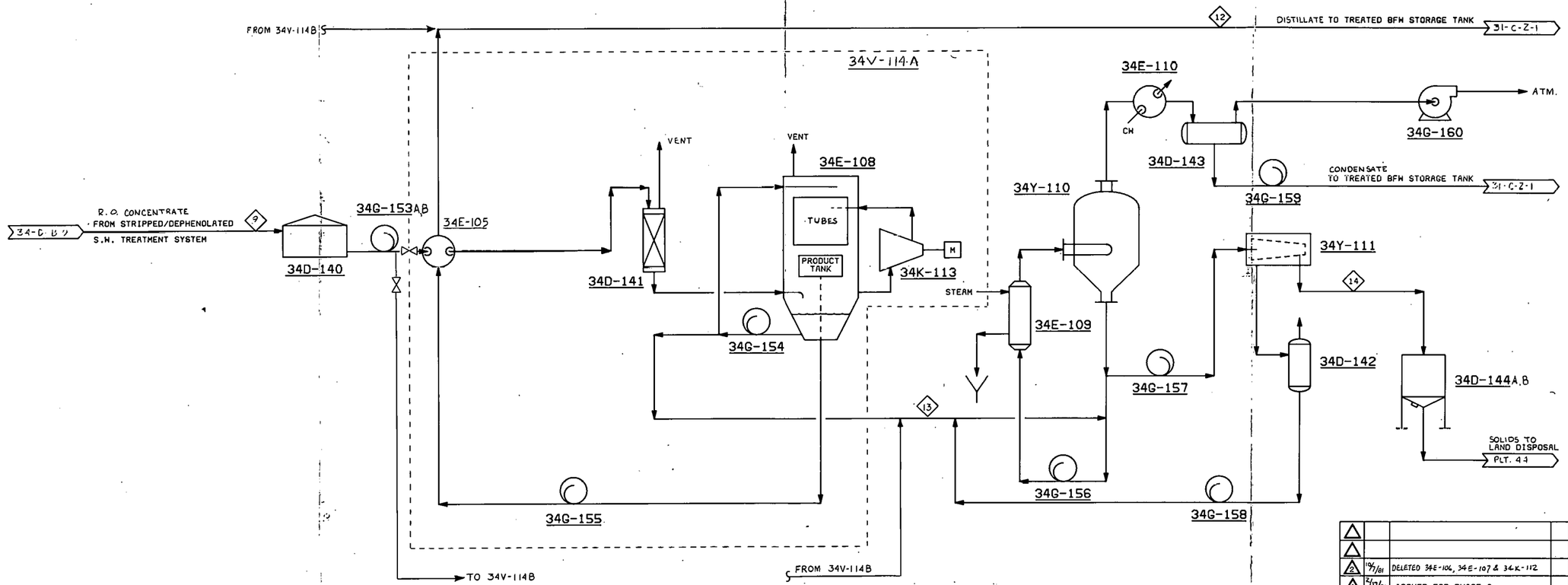
34E-105A&B FEED/PRODUCT EXCHANGER	**34E-108A&B** EVAPORATOR BODY 225,000 GPD CAP.	**34D-141 A&B** DEAERATOR TANK
34G-155A&B DISTILLATE PUMP 170 GPM CAP. @ 65 PSI, 15 BHP	**34G-154A&B** BRINE RECIRC. PUMP 5200 GPM CAP. @ 26 PSI, 85 BHP	**34K-113A&B** VAPOR COMPRESSOR 37,350 ICFM CAP. 03.8 PSI, 755 BHP

VAPOR RECOMPRESSION EVAPORATOR SYSTEMS

34V-115

34Y-110 CRYSTALLIZER 10'ØX36'H 35 TPD CAP.	**34G-156** MAGMA RECIRC. PUMP 5200 GPM CAP. @ 26 PSI, 90 BHP	**34G-159** 25 GPM CAP. @ 45 PSI, 1.2 BHP	**34D-142** MOTHER LIQUOR TANK 1500 GAL. CAP. 5'-8"ØX8'T-T
34E-109 SLURRY HEATER 300 FT² HTA	**34G-157** CENTRIFUGE FEED PUMP 175 GPM CAP. @ 45 PSI, 10 BHP	**34G-160** VACUUM PUMP 75 ICFM, P.R.=4.7 4.7 BHP	**34D-143** CONDENSATE ACCUMULATOR 500 GAL. CAP. 3'ØX9'-6"T-T
34E-110 OVERHEAD CONDENSER 750 FT² HTA	**34G-158** M.L. PUMP 175 GPM CAP. @ 45 PSI, 10 BHP	**34Y-111** SOLID-BOWL CENTRIFUGE 24"ØBOWL 3000 RPM, 150 HP	

BRINE CRYSTALLIZER SYSTEM



STREAM NO.		9	12	13	14
DESCRIPTION / COMPONENT		SOUR WATER R.O. CONC.	VRE DISTILLATE	CRYSTALLIZER FEED	NaCl SOLIDS
FLOW,	GPM	275	250	20	~5
TDS,	MG/L	20,000	≤10	285,200	2,520 LB/HR (10% MOISTURE)
TSS	MG/L	-	TRACE	-	
CALCIUM (AS CaCO₃)	MG/L	-	-	-	
MAGNESIUM (AS CaCO₃)	MG/L	-	-	-	
SODIUM	MG/L	7,868	≤4	112,203	
SULFATE (AS CaCO₃)	MG/L	-	-	-	
CHLORIDE	MG/L	12,132	≤6	172,997	
SILICA (AS SiO₂)	MG/L	-	-	-	
pH					
TEMPERATURE, °F		80	110	209	165
PRESSURE, PSIA					

KCL87A 02/05/81 MJ

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'G	SI APPR.	ASST APPR.
2	9/1/81	DELETED 34E-106, 34E-107 & 34K-112		LKM	VS			WWL
1	2/11/81	ISSUED FOR PHASE 0		VS LKM	BTK			WWL WHD
0	12/8/80	ISSUED FOR REVIEW/APPROVAL		VS LKM	BTK			
		DESIGNED		DRAWN				

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY (SUPPORTIVE AGREEMENT NO. DE-FC05-800R20717)

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PROCESS FLOW DIAGRAM PLANT 34 - BRINE CONCENTRATION, EVAPORATION AND RESIDUE DRYING (PROCESS WATER)

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	34-D-B-8	2

22 X 34 "D" SIZE

MEDIA FILTER SYSTEM

34D-121
FILTER FEED TANK
40X60X15FT
CONCRETE

34Z-126A,B
MEDIA FILTERS
8 FT DIAMETER EACH

34G-131A,B
FILTER FEED PUMPS
1100 GPM, 50 HP EACH

34G-132A,B
FILTER
BACKWASH PUMPS
750 GPM, 10 HP EACH

34K-106A,B
FILTER
BACKWASH BLOWERS

34Z-125
CHLORINE FEEDER
5.5 LBS Cl2/HR

POLYMER FEED SYSTEM

34D-122
POLYMER
STORAGE TANK
100 GAL.

34D-123
POLYMER
MIXING TANK
100 GAL.

34D-124
POLYMER FEED TANK
100 GAL.

34G-130A,B
POLYMER FEED PUMPS
1 GPM, 3/4 HP

CARTRIDGE FILTER SYSTEM

34Z-127A-D
CARTRIDGE FILTERS
250 GPM EACH

34G-133A,B
CARTRIDGE FILTER PUMPS
1100 GPM, 90 HP EACH

34V-104A,B,C
2 STAGE R.O. SYSTEM
SEE NOTE (1)

34G-134A-G
R.O. FEED PUMPS
180 GPM, 90 HP EACH
600 PSI

34Z-128A,B,C
R.O. MEMBRANE UNITS
3 TRAINS
360 GPM EACH

NaHSO3 FEED SYSTEM

34D-125
NaHSO3
STORAGE TANK
500 GAL.

34D-126A,B
NaHSO3
SOLUTION TANKS
200 GAL. EACH

34G-135
NaHSO3
TRANSFER PUMP
5 GPM, 1/4 HP

34G-136A,B
NaHSO3
FEED PUMPS
1 GPM, 1/4 HP

POLYPHOSPHATE FEED SYSTEM

34D-127
POLYPHOSPHATE
STORAGE TANK
500 GAL. EACH

34D-128A,B
POLYPHOSPHATE
MIXING TANKS
200 GAL. EACH

34G-137
POLYPHOSPHATE
TRANSFER PUMPS
5 GPM, 1/4 HP

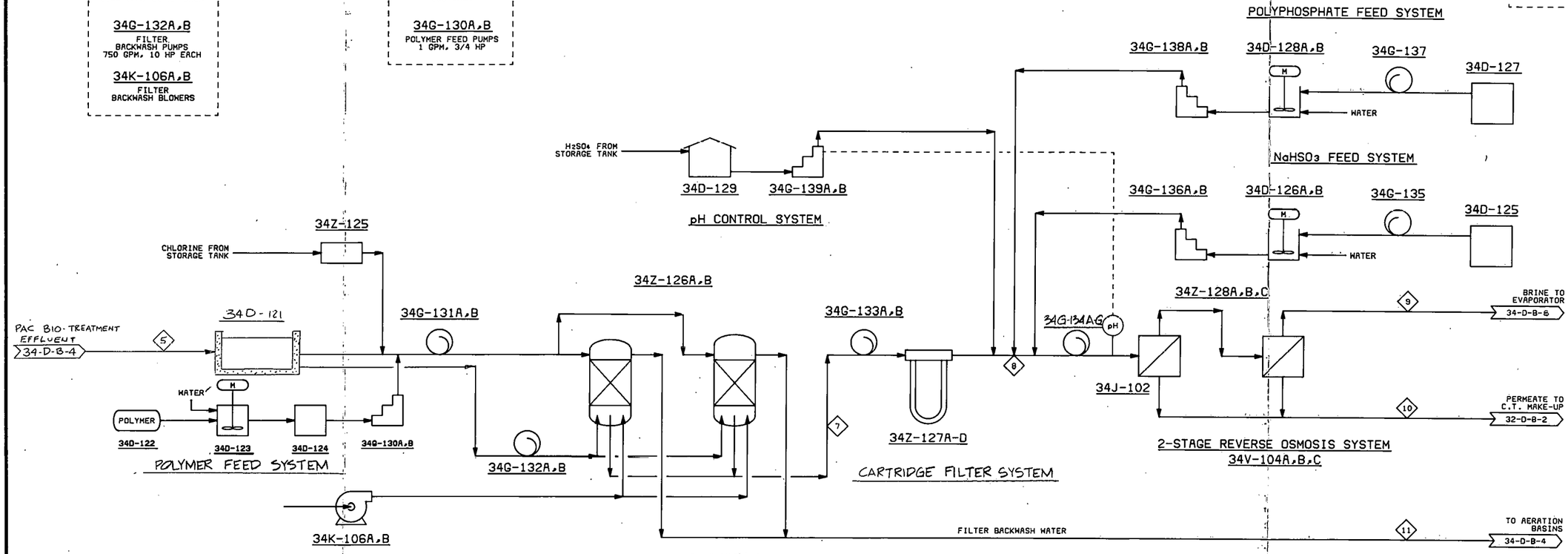
34G-138A,B
POLYPHOSPHATE
FEED PUMPS
1 GPM, 1/4 HP

pH CONTROL SYSTEM

34D-129
ACID FEED TANK
60 GAL.

34G-139A,B
ACID FEED PUMPS
0.25 GPM, 1/4 HP

34J-102
pH CONTROLLER



STREAM NO.	5	7	8	9	10	11
DESCRIPTION / COMPONENT	CLARIFIER EFFLUENT	FILTERED WATER	FLOW TO R.O.	BRINE FROM R.O.	PERMEATE FROM R.O.	FILTER BACKWASH
FLOW (GPM)	~1100	1100	1100	275	825	25
pH			5-6	5-6	5-6	
COD, MG/L	300					
BOD, MG/L	150					
SS, MG/L	~50	<1	0	0	0	
TDS, MG/L						
N C , MG/L	~4100	~4100	~4100	~16,000	~200	
NH , MG/L						
H S, MG/L						
PHENOLICS, MG/L						
OTHER ORGANICS, MG/L						
PAC						

NOTE:

1. 34V-104A,B,C - 2-STAGE R.O. SYSTEM
   6 FEED PUMPS - 180 GPM, 90 HP EACH, 600 PSI
   3 TRAINS OF R.O. MEMBRANE UNITS, 360 GPM EACH

DESIGN BASIS
- 1100 GPM FEED
- 95% SALT REJECTION
- 75% WATER RECOVERY

LEGEND:
1. PAC = POWDERED ACTIVATED CARBON
2. RO = REVERSE OSMOSIS

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	BI APP'L	ASFE APP'L
1	5/17/81	ISSUED FOR PHASE ZERO			VS LKM	BTK		UNAL WHD
0	12/8/80	DESIGN BASIS & EQUIPMENT TAKEOFF			VS LKM	BTK		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

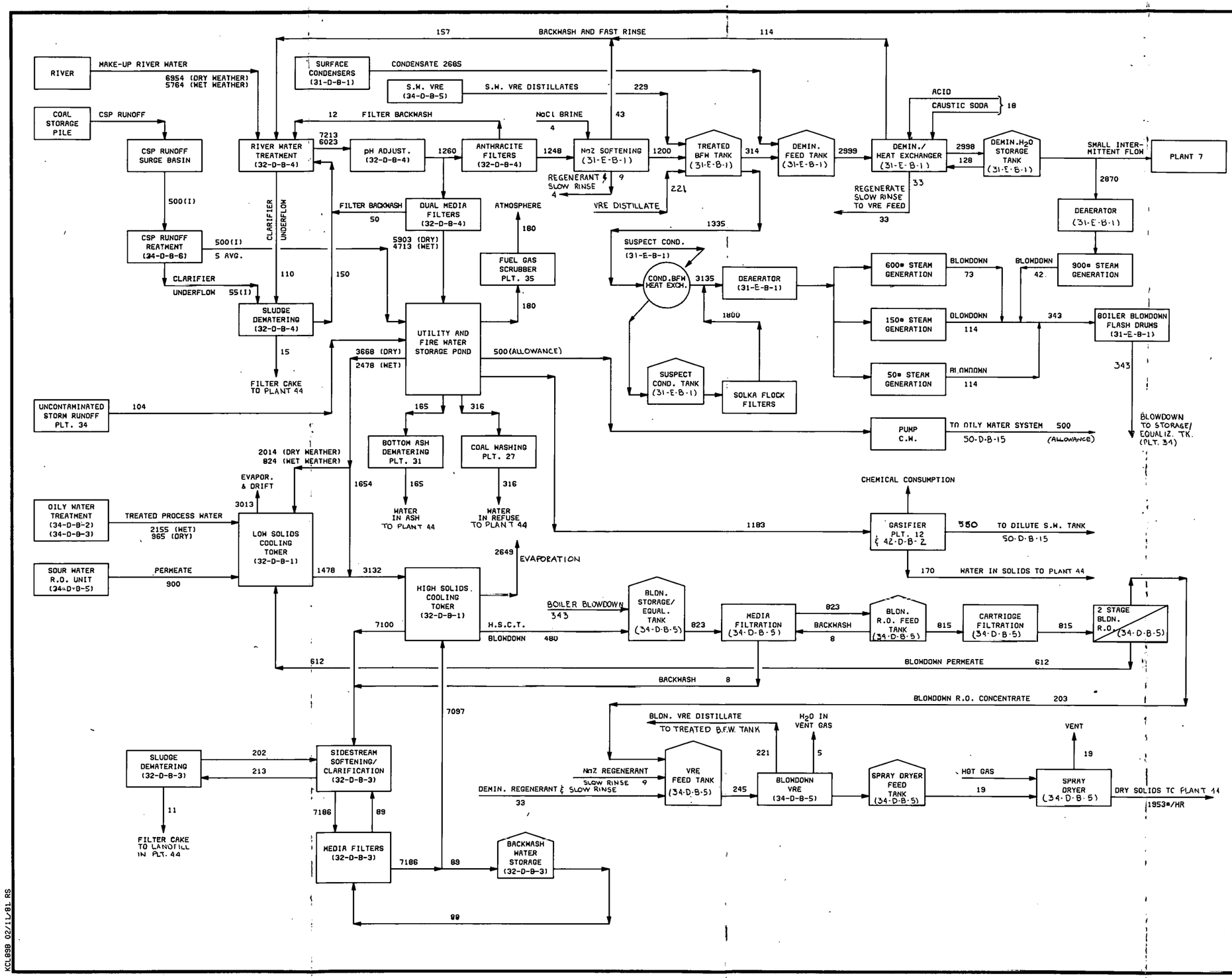
PROCESS FLOW DIAGRAM
PLANT 34 - SEWERS & WWT STRIPPED-EXTRACTED SOUR WATER TREATMENT (FILTRATION/REVERSE OSMOSIS)

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	34-D-B-9	1

KCL94A 02/06/81 RS

22 X 34 "D" SIZE



NOTES:

1. ALL RATES, UNLESS OTHERWISE SHOWN, ARE IN GPM.
2. RATES, UNLESS OTHERWISE SHOWN, REPRESENT WATER.
3. RATES SHOWN ARE NORMAL/AVERAGE.
4. BACKWASH, REGENERANT & RINSE RATES ARE ANUALIZED AVERAGES.

LEGEND:

(I) - INTERMITTENT FLOW
R.O. - REVERSE OSMOSIS
VRE - VAPOR RECOMPRESSION EVAPORATOR
CSP - COAL STORAGE PILE
SW - SOUR WATER

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	CHG'R	BY APPR.	ASFI APPR.
1	2/17/81	ISSUED FOR PHASE ZERO			LKM	VS		ANL WHC
0	12/8/80	ISSUED FOR CLIENT REVIEW			LKM	VS		

DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80DR20717

BRECKINRIDGE PROJECT

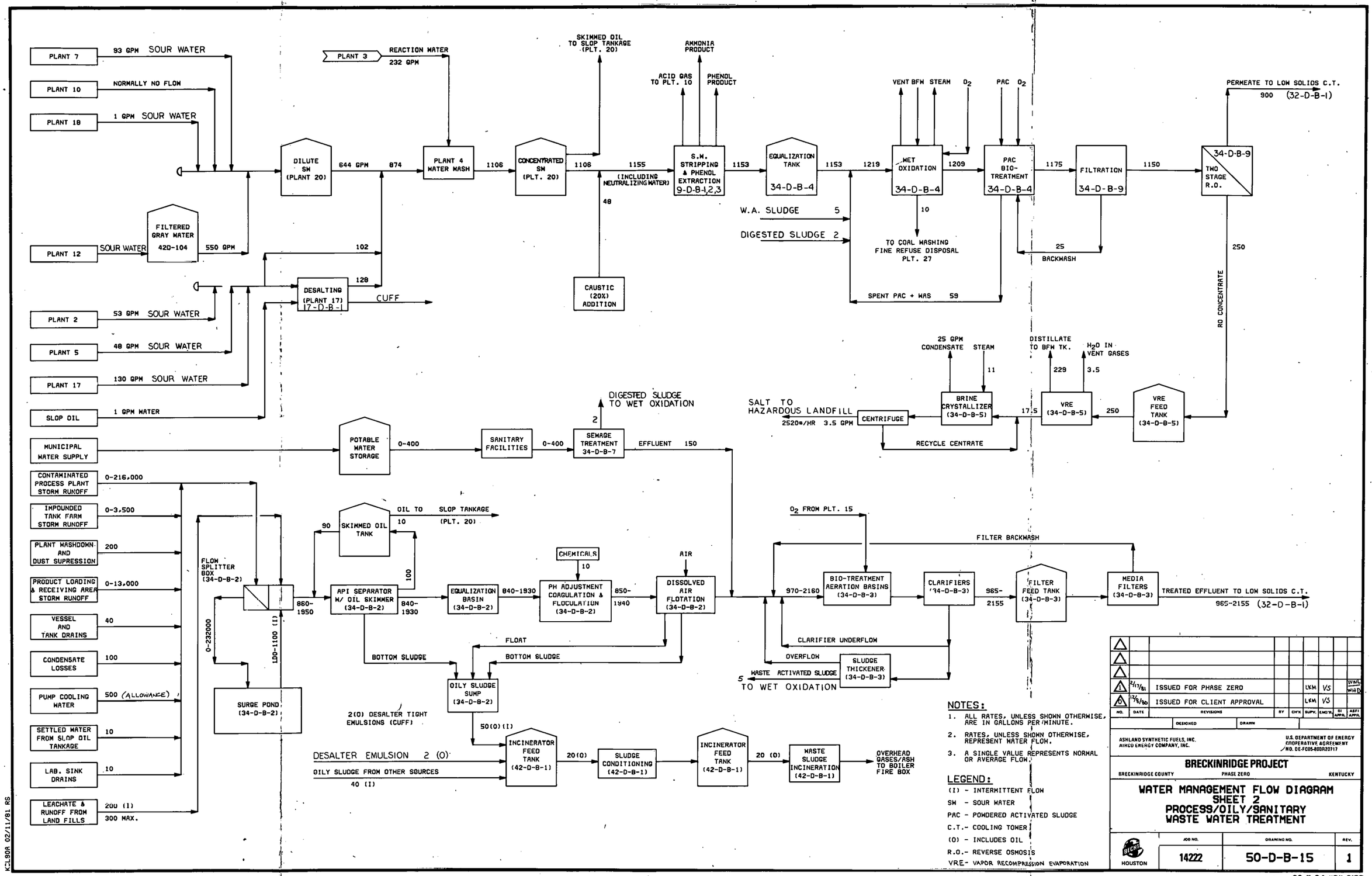
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

WATER MANAGEMENT FLOW DIAGRAM SHEET 1 - WATER TREATMENT & BLOWDOWN DISPOSAL

BECHTEL HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	50-D-B-14	1

22 X 34 "D" SIZE

KCL898 02/11/81 RS



NOTES:

1. ALL RATES, UNLESS SHOWN OTHERWISE, ARE IN GALLONS PER MINUTE.
2. RATES, UNLESS SHOWN OTHERWISE, REPRESENT WATER FLOW.
3. A SINGLE VALUE REPRESENTS NORMAL OR AVERAGE FLOW.

LEGEND:

(I) - INTERMITTENT FLOW
SW - SOUR WATER
PAC - POWDERED ACTIVATED SLUDGE
C.T.- COOLING TOWER
(O) - INCLUDES OIL
R.O.- REVERSE OSMOSIS
VRE- VAPOR RECOMPRESSION EVAPORATION

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	BI APPL	ASFI APPL
1	2/17/81	ISSUED FOR PHASE ZERO			LKM	VS		WNL WHD
0	12/16/80	ISSUED FOR CLIENT APPROVAL			LKM	VS		

DESIGNED DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AMOCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80DR20117

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

WATER MANAGEMENT FLOW DIAGRAM SHEET 2 PROCESS/OILY/SANITARY WASTE WATER TREATMENT

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	50-D-B-15	1

KCL90R 02/11/81 RS

22 X 34 "D" SIZE

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34	WASTE WATER TREATMENT SYSTEMS	000000 NA
34D-101	POLYMER SOLUTION TANK	000000 NA
34D-102	SODA ASH SOLUTION TANK	000000 NA
34D-103	FILTER BACKWASH MAKEUP TANK	000000 NA
34D-104	SEWAGE LIFT SUMP	000000 NA
34D-105	ALUM DAY TANK	000000 NA
34D-106	FLOW SPLITTER SUMP OILY WWT	000000
34D-107	POLYMER SOLUTION TANK	000000 NA
34D-108	SKIMMED OIL SETTLING TANK	000000 NA
34D-109	CAUSTIC SODA DAY TANK	000000 NA
34D-110	ACID DAY TANK	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34D-111	FLASH MIX TANK	000000 NA
34D-112	FLOCCULATION TANK	000000 NA
34D-114	FILTER FEED TANK	000000 NA
34D-115	POLYMER STORAGE TANK	000000 NA
34D-116	POLYMER MIXING TANK	000000 NA
34D-117	POLYMER FEED TANK	000000 NA
34D-118	WET OXIDATION FEED/ EQUALIZATION TANK	000000 NA
34D-119A	PAC STORAGE TANK	
34D-119B	PAC STORAGE TANK	
34D-120	PAC SLURRY TANK	000000 NA
34D-121	FILTER FEED TANK	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34D-122	POLY. STO. TK. STRIPPED/ EXTRACTED SOUR W.T. -	000000
34D-123	POLY. MIX. TK. STRIPPED/ EXTRACTED SOUR W.T. -	000000
34D-124	POLYMER FEED TANK -	000000 NA
34D-125	SODIUM BISULFITE STORAGE TANK -	000000 NA
34D-126A	SODIUM BISULFITE SOLUTION TANK -	000000 NA
34D-126B	SODIUM BISULFITE SOLUTION TANK -	000000 NA
34D-127	POLYPHOSPHATE STORAGE TANK -	000000 NA
34D-128A	POLYPHOSPHATE MIXING TANK -	000000 NA
34D-128B	POLYPHOSPHATE MIXING TANK -	000000 NA
34D-129	ACID FEED TANK -	000000 NA
34D-130	BLOWDOWN STORAGE/ EQUALIZATION TANK -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34D-132	R.O. FEED TANK	000000 NA
34D-136	VRE FEED TANK	000000 NA
34D-138	SPRAY TOWER FEED TANK	000000 NA
34D-139	SOLIDS STORAGE BIN	000000 NA
34D-140	VRE FEED TANK	000000 NA
34D-144A	STORAGE BIN	000000 NA
34D-144B	STORAGE BIN	000000 NA
34E-111	SKIMMED OIL TANK 34D-108 HEATER	000000
34G-101A	SURGE BASIN LIFT PUMP	000000 NA
34G-101B	SURGE BASIN LIFT PUMP	000000 NA
34G-102	POLYMER FEED PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-103	SODA ASH FEED PUMP	000000 NA
34G-104A	SLUDGE PUMP	000000 NA
34G-104B	SLUDGE PUMP	000000 NA
34G-105A	CLARIFIED EFFLUENT PUMP	000000 NA
34G-105B	CLARIFIED EFFLUENT PUMP	000000 NA
34G-106	FILTER BACKWASH PUMP	000000 NA
34G-107A	SEWAGE LIFT PUMP	000000 NA
34G-107B	SEWAGE LIFT PUMP	000000 NA
34G-109	DIGESTED SLUDGE DRAWOFF PUMP	000000 NA
34G-110A	SURGE/EQUALIZATION BASIN LIFT PUMP	000000 NA
34G-110B	SURGE/EQUALIZATION BASIN LIFT PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST- 14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-111A	ALUM FEED PUMP -	000000 NA
34G-111B	ALUM FEED PUMP -	000000 NA
34G-112A	OIL TRANSFER PUMP -	000000 NA
34G-112B	OIL TRANSFER PUMP -	000000 34
34G-113A	POLYMER FEED PUMP -	000000
34G-113B	POLYMER FEED PUMP -	000000 NA
34G-114A	CAUSTIC SODA FEED PUMP -	000000 NA
34G-114B	CAUSTIC SODA FEED PUMP -	000000 NA
34G-115A	SKIMMED OIL PUMP -	000000 NA
34G-115B	SKIMMED OIL PUMP -	000000 NA
34G-116A	API SEPARATOR SLUDGE PUMP -	000000 NA

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-116B	API SEPARATOR SLUDGE PUMP	000000 NA
34G-117A	API SEPARATOR EFFLUENT PUMP	000000 NA
34G-117B	API SEPARATOR EFFLUENT PUMP	
34G-117C	API SEPARATOR EFFLUENT PUMP	000000 NA
34G-118A	ACID FEED PUMP	000000
34G-118B	ACID FEED PUMP	000000 NA
34G-119C	PRG PUMP	000000 NA
34G-120A	DAF BOTTOM SLUDGE PUMP	000000 NA
34G-120B	DAF BOTTOM SLUDGE PUMP	000000 NA
34G-121A	OILY SLUDGE SUMP PUMP	000000 NA
34G-121B	OILY SLUDGE SUMP PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-122A	CLARIFIER SLUDGE PUMP	000000 NA
34G-122B	CLARIFIER SLUDGE PUMP	000000 NA
34G-123A	THICKENER SLUDGE PUMP	000000 NA
34G-123B	THICKENER SLUDGE PUMP	000000 NA
34G-124A	POLYMER FEED PUMP	000000 NA
34G-124B	POLYMER FEED PUMP	000000 NA
34G-125A	FILTER FEED PUMP	000000 NA
34G-125B	FILTER FEED PUMP	000000 NA
34G-125C	FILTER FEED PUMP	000000 NA
34G-126A	FILTER BACKWASH PUMP	000000 NA
34G-126B	FILTER BACKWASH PUMP	000000 NA

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-127A	PAC FEED PUMP	000000 NA
34G-127B	PAC FEED PUMP	000000 NA
34G-128A	SLUDGE RECYCLE PUMP	000000 NA
34G-128B	SLUDGE RECYCLE PUMP	000000 NA
34G-129A	WASTE SLUDGE PUMP	000000 NA
34G-129B	WASTE SLUDGE PUMP	000000 NA
34G-130A	POLYMER FEED PUMP	000000 NA
34G-130B	POLYMER FEED PUMP	000000 NA
34G-131A	FILTER FEED PUMP	000000 NA
34G-131B	FILTER FEED PUMP	000000 NA
34G-132A	FILTER BACKWASH PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-132B	FILTER BACKWASH PUMP	000000 NA
34G-133A	CARTRIDGE FILTER PUMP	000000 NA
34G-133B	CARTRIDGE FILTER PUMP	000000 NA
34G-135	SODIUM BISULFITE TRANSFER PUMP	000000 NA
34G-136A	SODIUM BISULFITE FEED PUMP	000000 NA
34G-136B	SODIUM BISULFITE FEED PUMP	000000 NA
34G-137	POLYPHOSPHATE TRANSFER PUMP	000000 NA
34G-138A	POLYPHOSPHATE FEED PUMP	000000 NA
34G-138B	POLYPHOSPHATE FEED PUMP	000000 NA
34G-139A	ACID FEED PUMP	000000 NA
34G-139B	ACID FEED PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-140A	FILTER FEED PUMP -	000000 NA
34G-140B	FILTER FEED PUMP -	000000 NA
34G-143	FILTER BACKWASH PUMP -	000000 NA
34G-144A	R. O. LOW PRESSURE FEED PUMP -	000000 NA
34G-144B	R. O. LOW PRESSURE FEED PUMP -	000000 NA
34G-149A	VRE FEED PUMP -	000000 NA
34G-149B	VRE FEED PUMP -	000000 NA
34G-152A	DRYER FEED PUMP -	000000 NA
34G-152B	DRYER FEED PUMP -	000000 NA
34G-153A	VRE FEED PUMP -	000000 NA
34G-153B	VRE FEED PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34G-161A	POLYMER SOLUTION TRANSFER PUMP	000000 NA
34G-161B	POLYMER SOLUTION TRANSFER PUMP	000000 NA
34K-101	BACKWASH AIR BLOWER	000000 NA
34K-102A	AIR BLOWER	000000 NA
34K-102B	AIR BLOWER	000000 NA
34K-104A	AERATION EQUIPTMENT	000000 NA
34K-104B	AERATION EQUIPTMENT	000000 NA
34K-104C	AERATION EQUIPTMENT	000000 NA
34K-104D	AERATION EQUIPTMENT	000000 NA
34K-104E	AERATION EQUIPTMENT	000000 NA
34K-104F	AERATION EQUIPTMENT	000000 NA

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34K-105A	FILTER BACKWASH AIR BLOWER -	000000 NA
34K-105B	FILTER BACKWASH AIR BLOWER -	000000 NA
34K-106A	FILTER BACKWASH BLOWER -	000000 NA
34K-106B	FILTER BACKWASH BLOWER -	000000 NA
34K-114A	OXYGEN COMPRESSOR -	000000 NA
34K-114B	OXYGEN COMPRESSOR -	000000 NA
34V-101	SANITARY SEWAGE TREATMENT PACKAGE -	000000 NA
34V-103A	DISSOLVED AIR FLOTATION SYSTEM -	000000 NA
34V-103B	DISSOLVED AIR FLOTATION SYSTEM -	000000 NA
34V-104A	REVERSE OSMOSIS SYSTEM -	000000 NA
34V-104B	REVERSE OSMOSIS SYSTEM -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34V-104C	REVERSE OSMOSIS SYSTEM	000000 NA
34V-105	POLYMER FEED SYSTEM	000000 NA
34V-106	CHLORINATION SYSTEM	000000 NA
34V-107	MEDIA FILTER SYSTEM	000000 NA
34V-108	SULFURIC ACID FEED SYSTEM	000000 NA
34V-109	SODIUM BISULFITE FEED SYSTEM	000000 NA
34V-110	SODIUM HEXAMETAPHOSPHATE FEED SYSTEM	000000 NA
34V-111A	REVERSE OSMOSIS SYSTEM	000000 NA
34V-111B	REVERSE OSMOSIS SYSTEM	000000 NA
34V-112A	VAPOR RECOMPRESSION EVAPORATOR SYSTEM	000000 NA
34V-112B	VAPOR RECOMPRESSION EVAPORATOR SYSTEM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34V-113	SPRAY DRYER SYSTEM	000000 NA
34V-114A	VAPOR RECOMPRESSION EVAPORATOR SYSTEM	000000 NA
34V-114B	VAPOR RECOMPRESSION EVAPORATOR SYSTEM	000000 NA
34V-115	BRINE CRYSTALLIZER SYSTEM	000000 NA
34Y-101	ALUM SOLUTION MIXER	000000 NA
34Y-102	POLYMER SOLUTION MIXER	000000 NA
34Y-103	FLASH MIXER	000000 NA
34Y-104	FLOCCULATOR/MIXER	000000 NA
34Y-106	FEED TANK AGITATOR	000000 NA
34Z-101	POLYMER MIXER	000000 NA
34Z-102	REACTOR CLARIFIER	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-103A	MEDIA FILTER	000000
	-	NA
34Z-103B	MEDIA FILTER	000000
	-	NA
34Z-111	CHLORINE CONTACT TANK	000000
	-	NA
34Z-112	CHLORINATOR	000000
	-	NA
34Z-114	MECHANICAL EQUIPMENT FOR API SEPARATOR	000000
	-	NA
34Z-117A	CLARIFIER	000000
	-	NA
34Z-117B	CLARIFIER	000000
	-	NA
34Z-117C	CLARIFIER	000000
	-	NA
34Z-118	SLUDGE THICKENER	000000
	-	NA
34Z-119	CHLORINE FEEDER	000000
	-	NA
34Z-120A	DUAL MEDIA FILTER	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-120B	DUAL MEDIA FILTER	000000 NA
34Z-120C	DUAL MEDIA FILTER	000000 NA
34Z-120D	DUAL MEDIA FILTER	000000 NA
34Z-121A	ZIMPRO WET OXIDATION SYSTEM	000000 NA
34Z-121B	ZIMPRO WET OXIDATION SYSTEM	000000 NA
34Z-121C	ZIMPRO WET OXIDATION SYSTEM	000000 NA
34Z-122A	PAC FEEDER	000000 NA
34Z-122B	PAC FEEDER	000000 NA
34Z-124A	CLARIFIER	000000 NA
34Z-124B	CLARIFIER	000000 NA
34Z-124C	CLARIFIER	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-125	CHLORINE FEEDER/ CONTROLLER	000000 NA
34Z-126A	DUAL MEDIA FILTER	000000 NA
34Z-126B	DUAL MEDIA FILTER	000000 NA
34Z-127A	CARTRIDGE FILTER	000000 NA
34Z-127B	CARTRIDGE FILTER	000000 NA
34Z-127C	CARTRIDGE FILTER	000000 NA
34Z-127D	CARTRIDGE FILTER	000000 NA
34Z-133A	AERATOR	000000 NA
34Z-133B	AERATOR	000000 NA
34Z-133C	AERATOR	000000 NA
34Z-133D	AERATOR	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-133E	AERATOR	000000
	-	NA
34Z-133F	AERATOR	000000
	-	NA
34Z-134A	AERATOR	000000
	-	NA
34Z-134B	AERATOR	000000
	-	NA
34Z-134C	AERATOR	000000
	-	NA
34Z-134D	AERATOR	000000
	-	NA
34Z-134E	AERATOR	000000
	-	NA
34Z-134F	AERATOR	000000
	-	NA
34Z-135A	AERATOR	000000
	-	NA
34Z-135B	AERATOR	000000
	-	NA
34Z-135C	AERATOR	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-135D	AERATOR	000000 NA
34Z-135E	AERATOR	000000 NA
34Z-135F	AERATOR	000000 NA
34Z-136A	AERATOR	000000 NA
34Z-136B	AERATOR	000000 NA
34Z-136C	AERATOR	000000 NA
34Z-136D	AERATOR	000000 NA
34Z-136E	AERATOR	000000 NA
34Z-136F	AERATOR	000000 NA
34Z-137A	AERATOR	000000 NA
34Z-137B	AERATOR	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
34Z-137C	AERATOR	000000
	-	NA
34Z-137D	AERATOR	000000
	-	NA
34Z-137E	AERATOR	000000
	-	NA
34Z-137F	AERATOR	000000
	-	NA

4.1 Data Sheets for Compressors and Drivers

34-DS-K-01: Oxygen (34K-114 A, B)

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT DATE _____ REVISION 0

FOR ASHLAND SYNTHETIC FUELS INC. UNIT BECHTEL 98

SITE KENTUCKY SERIAL NO. _____

SERVICE OXYGEN NO. REQUIRED 1

MANUFACTURER CLARK MODEL 1H4 DRIVER MOTOR

NOTE ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER 34-K-114 A/S

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	NORMAL	RATED	OTHER CONDITIONS A	B	C	D
● GAS HANDLED (ALSO SEE PAGE 2) OXYGEN						
● MMSCFD (SCFM) (14.7 PSIA & 60°F DRY)	4366	4800				
○ WEIGHT FLOW, #/MIN (WET) (DRY)	22083	24278				
INLET CONDITIONS:						
● PRESSURE (PSIA)	14.4	14.4				
● TEMPERATURE (°F)	100	100				
● RELATIVE HUMIDITY (%)	0.	0.				
● MOLECULAR WEIGHT (M)	32.0	32.0				
☐ C_p/C_v (K_1) OR (K_{Avg})	1.4	1.4				
☐ COMPRESSIBILITY (Z_1) OR (Z_{Avg})	1.0	1.0				
☐ INLET VOLUME, (CFM-WET)		4701				
DISCHARGE CONDITIONS:						
● PRESSURE (PSIA)		75				
☐ TEMPERATURE (°F)		100				
☐ C_p/C_v (K_2) OR (K_{Avg})		1.4				
☐ COMPRESSIBILITY (Z_2) OR (Z_{Avg})		1.0				
☐ BHP REQUIRED (ALL LOSSES INCL)		1200				
☐ SPEED (RPM)						
☐ ESTIMATED SURGE, ICFM (AT SPEED ABOVE)						
☐ POLYTROPIC HEAD (FT)						
☐ POLYTROPIC EFFICIENCY (%)						
● GUARANTEE POINT		4800 SCFM @ 75 PSIA				
☐ PERFORMANCE CURVE NO.						

PROCESS CONTROL:

METHOD: ○ BYPASS FROM _____ TO _____

● ANTI-SURGE BYPASS: ○ MANUAL ● AUTO

○ SUCTION THROTTLING FROM _____ TO _____

○ SPEED VARIATION FROM _____ TO _____

○ OTHER _____

SIGNAL: ○ SOURCE _____

○ TYPE _____

○ RANGE: FOR PNEUMATIC CONTROL _____ RPM @ _____ PSIG @ _____ RPM @ _____ PSIG _____

OTHER _____

SERVICE: ● CONTINUOUS ○ INTERMITTENT ○ STAND BY

REMARKS: _____

No.	DATE	REVISIONS	BY	CHK'D
0	1/05/81	ISSUED FOR PHASE ZERO	JMI	

DESIGN SUPV | ENG'R | PROJ ENGR | APPR

SCALE | DESIGNED | DRAWN | CHIEF ENGR

ORIGIN | BECHTEL | CENTRIFUGAL COMPRESSOR DATA SHEET

JOB No. 14231

DRAWING No. 34-DS-K-01 REV. 0

Form 187 (5/80) Sheet 1 of 6

"A" SIZE R&C

CENTRIFUGAL COMPRESSOR DATA SHEET

GAS ANALYSIS ○ MOL % ○	M.W.	NORMAL	RATED	OTHER CONDITIONS A	B	C	D	REMARKS
AIR	28.966							
OXYGEN	32.000	100%						
NITROGEN	28.016							
WATER VAPOR	18.016							
CARBON MONOXIDE	28.010							
CARBON DIOXIDE	44.010							
HYDROGEN SULFIDE	34.076							
HYDROGEN	2.016							
METHANE	16.042							
ETHYLENE	28.052							
ETHANE	30.068							
PROPYLENE	42.078							
PROPANE	44.094							
i - BUTANE	58.120							
n - BUTANE	58.120							
i-- PENTANE	72.146							
n - PENTANE	72.146							
HEXANE PLUS								
TOTAL								
AVG. MOL. WT.								

LOCATION:
○ INDOOR ○ HEATED ◉ UNDER ROOF
◉ OUTDOOR ◉ UNHEATED ○ PARTIAL SIDES
○ GRADE ○ MEZZANINE ○ _____
○ ELECTRICAL AREA CLASS GR. ____ DIV. ____
○ WINTERIZATION REQD. ○ TROPICALIZATION REQD.

SITE DATA:
◉ ELEVATION 415 FT. BAROMETER 14.4 PSIA
◉ RANGE OF AMBIENT TEMPS.:

	DRY BULB	WET BULB
SITE RATED °F	96	
NORMAL °F	96	78
MAXIMUM °F	105	
MINIMUM °F	-16	

UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER _____

NOISE SPECIFICATIONS:
○ APPLICABLE TO MACHINE:
SEE SPECIFICATION _____
◉ APPLICABLE TO NEIGHBORHOOD
SEE SPECIFICATION OSHA
ACCOUSTIC HOUSING: ○ YES ◉ NO

APPLICABLE SPECIFICATIONS:
API 617 CENTRIFUGAL COMPR. FOR GEN. REFINERY SERVICES

PAINTING:
◉ MANUFACTURER'S STD. (SUBJECT TO APPROVALS)
○ OTHERS _____

SHIPMENT:
◉ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQD.
◉ OUTDOOR STORAGE OVER 6 MONTHS

REMARKS: _____

R&C Form 187 (5/80) Sheet 2 of 6

CENTRIFUGAL COMPRESSOR DATA SHEET

CONSTRUCTION FEATURES

☐ **SPEEDS:**
MAX. CONT. _____ RPM TRIP _____ RPM
MAX. TIP SPEEDS: _____ FPS @ RATED SPEED
_____ FPS @ MAX. CONT. SPEED

☐ **LATERAL CRITICAL SPEEDS:**
FIRST CRITICAL _____ RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
SECOND CRITICAL _____ RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
THIRD CRITICAL _____ RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
FOURTH CRITICAL _____ RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
LATERAL CRITICAL SPEED — BASIS.
☐ DAMPED UNBALANCE RESPONSE ANALYSIS
☐ SHOP TEST
☐ OTHER TYPE ANALYSIS

☐ **TORSIONAL CRITICAL SPEEDS:**
FIRST CRITICAL _____ RPM
SECOND CRITICAL _____ RPM
THIRD CRITICAL _____ RPM
FOURTH CRITICAL _____ RPM

☐ **VIBRATION:**
ALLOWABLE TEST LEVEL _____ MILS
(PEAK TO PEAK)

☐ **ROTATION, VIEWED FROM DRIVEN END:**

☐ **CASING:**
MODEL _____
CASING SPLIT _____
MATERIAL _____
THICKNESS (IN.) _____ CORR. ALLOW. (IN.) _____
MAX. WORK PRESS _____ PSIG MAX DESIGN PRESS. _____ PSIG
TEST PRESS (PSIG) HELIUM _____ HYDRO _____
MAX OPER TEMP _____ F MIN. OPER TEMP _____ F
MAX NO. OF IMPELLERS FOR CASING _____
MAX CASING CAPACITY (ICFM) _____
RADIOGRAPH QUALITY ○ YES _____ ○ NO _____
CASING SPLIT SEALING _____

☐ **DIAPHRAGMS:**
MATERIAL _____

☐ **IMPELLERS:**
NO. _____ DIAMETERS _____
NO. VANES EA. IMPELLER _____
TYPE (OPEN, ENCLOSED, ETC.) _____
TYPE FABRICATION _____
MATERIAL _____
MAX. YIELD STRENGTH (PSI) _____
BRINNEL HARDNESS. MAX. _____ MIN. _____
SMALLEST TIP INTERNAL WIDTH (IN.) _____
MAX. MACH NO. @ IMPELLER EYE _____
MAX. IMPELLER HEAD @ RATED SPEED (FT.) _____

☐ **SHAFT:**
MATERIAL _____
DIA. @ IMPELLERS (IN.) _____ DIA. @ COUPLING (IN.) _____
SHAFT END: ☐ TAPERED ☐ CYLINDRICAL
MAX. YIELD STRENGTH (PSI) _____

☐ **BALANCE PISTON:**
MATERIAL _____ AREA _____ (IN.²)
FIXATION METHOD _____

SHAFT SLEEVES:
○ AT INTERSTG. CLOSE CLEAR. PTS. ☐ MATL _____
○ AT SHAFT SEALS _____ ☐ MATL _____

☐ **LABYRINTHS:**
INTERSTAGE
TYPE _____ MATERIAL _____
BALANCE PISTON
TYPE _____ MATERIAL _____

SHAFT SEALS:
☐ TYPE _____
○ SEAL SYSTEM TYPE _____
○ SETTLING OUT PRESSURE _____
☐ INNER OIL LEAKAGE GUAR. (GAL/DAY/SEAL) _____
○ TYPE BUFFER GAS _____
☐ BUFFER GAS FLOW (PER SEAL). _____
NORMAL. _____ #/MIN @ _____ PSI Δ P _____
MAX. _____ #/MIN @ _____ PSI Δ P _____
○ BUFFER GAS REQUIRED FOR:
☐ START-UP
☐ AIR RUN-IN
☐ OTHER _____
☐ BUFFER GAS CONTROL
SYSTEM SUPPLIED BY _____

☐ **BEARING HOUSING CONSTRUCTION:**
TYPE (SEPARATE, INTEGRAL) _____ SPLIT _____
MATERIAL _____

REMARKS: _____

R&C Form 187 (5/80) Sheet 3 of 6

SPECIAL-PURPOSE STEAM TURBINE DATA SHEET (Cont'd)

CONSTRUCTION FEATURES, CONT'D

☐ RADIAL BEARINGS:

TYPE _____ SPAN (IN.) _____

AREA (IN.²) _____ LOADING (PSI) ACT _____ ALLOW _____

CENTER PIVOT _____

OFFSET PIVOT _____

✎ _____

PAD MATERIAL _____

TYPE BABBITT _____

BABBITT THICKNESS _____

☐ THRUST BEARING:

LOCATION _____ TYPE _____

MFR _____ AREA (IN.²) _____

LOADING (PSI) ACTUAL _____ ALLOWABLE _____

GAS LOADING (LB) _____ CPLG SLIP LOAD (LB) _____

CPLG COEFF FRICT _____ CPLG GEAR PITCH DIA (IN.) _____

BAL PISTON COMPENSATING LOAD _____ LB

CENTER PIVOT _____

OFFSET PIVOT _____

✎ _____

PAD MATERIAL _____

TYPE BABBITT _____

BABBITT THICKNESS _____

☐ MAIN CONNECTIONS:

	SIZE	ANSI RATING	FACING	POSITION	FLANGE VEL. FPS
INLET					
DISCHARGE					
_____					
_____					
_____					
_____					

☐ OTHER CONNECTIONS:

SERVICE	NO	SIZE	TYPE
LUBE-OIL INLET			
LUBE-OIL OUTLET			
SEAL-OIL INLET			
SEAL-OIL OUTLET			
CASING DRAINS			
STAGE DRAINS			
VENTS			
COOLING WATER			
PRESSURE			
TEMPERATURE			
PURGE FOR			
BRG HOUSING			
BETWEEN BRG & SEAL			
BETWEEN SEAL & GAS			
SOLVENT INJECTION			

☐ ALLOWABLE PIPING FORCES AND MOMENTS:

	INLET		DISCHARGE			
	FORCE LB	MOMT FT. LB.	FORCE LB	MOMT FT. LB.	FORCE LB	MOMT FT. LB
AXIAL						
VERTICAL						
HORIZ. 90°						
	FORCE LB	MOMT FT. LB.	FORCE LB	MOMT FT. LB.	FORCE LB	MOMT FT. LB.
AXIAL						
VERTICAL						
HORIZ. 90°						

INSTRUMENTATION

PANEL SUPPLIED BY _____

	INDICATOR	ALARM	SHUTDOWN
HIGH GAS DISCHARGE TEMPERATURE (EACH SECTION)	◪	◪	◪
REFERENCE GAS PRESSURE	◪	◪	○
BALANCE DRUM DIFFERENTIAL PRESSURE	◪	◪	○
BUFFER GAS DIFFERENTIAL PRESSURE	◪	◪	○
IMBEDDED TEMPERATURE SENSORS			
RADIAL BEARINGS	◪	◪	○
TYPE _____			
NO. PER BRG _____			
LOCATION _____			
THRUST BEARINGS	◪	◪	○
TYPE _____			
NO. PER BRG _____			
LOCATION _____			

PHASE ANGLE TRANSDUCER NUMBER _____ LOCATION _____

VIBRATION DETECTORS: By Vendor

○ TYPE _____ ☐ MODEL _____

○ MFR _____

○ NO. AT EACH SHAFT BEARING _____ TOTAL NO _____

○ OSCILLATOR-DETECTORS SUPPLIED BY _____

○ MFR _____ ☐ MODEL _____

○ MONITOR SUPPLIED BY _____

○ LOCATION _____ ENCLOSURE _____

○ MFR. _____ ☐ MODEL _____

☐ SCALE RANGE _____ ○ ALARM: ☐ SET @ _____ MILS

○ SHUTDOWN ☐ SET @ _____ MILS ○ TIME DELAY _____ SEC.

AXIAL POSITION DETECTOR:

○ TYPE _____ ☐ MODEL _____

○ MFR _____ ○ NO REQUIRED _____

○ OSCILLATOR-DEMODULATOR SUPPLIED BY _____

○ MFR. _____ ☐ MODEL _____

○ MONITOR SUPPLIED BY _____

○ LOCATION _____ ENCLOSURE _____

○ MFR. _____ ☐ MODEL _____

☐ SCALE RANGE _____ ○ ALARM: ☐ SET @ _____ MILS

○ SHUTDOWN: ☐ SET @ _____ MILS ○ TIME DELAY _____ SEC.

A&C Form 187 (5/80) SHEET 4 OF 6

CENTRIFUGAL COMPRESSOR DATA SHEET (Cont'd)

CONSTRUCTION FEATURES. CONT'D

COUPLINGS:

	DRIVER-COMP OR DRIVER-GEAR	GEAR-COMP
○ MAKE		
□ MODEL		
○ LUBRICATION		
○ MOUNT CPLG. HALVES		
○ SPACER REQD.		
○ LIMITED END FLOAT REQD.		
○ IDLING ADAPTOR REQD.		
□ CPLG. RATING (HP/100 RPM)		
□ KEYED (1) OR (2); OR HYDR. FIT		

SHOP INSPECTION AND TESTS:

	REQD.	WITNESS	OBSERVED
SHOP INSPECTION	●	●	○
HYDROSTATIC	●	●	○
HELIUM LEAK	●	●	○
MECHANICAL RUN	●	●	○
MECH RUN SPARE ROTOR	○	○	○
FIT IN SPARE ROTOR	○	○	○
PERFORMANCE TEST (GAS) (AIR)	●	●	○
COMP WITH DRIVER	●	●	○
COMP LESS DRIVER	○	○	○
USE SHOP LUBE & SEAL SYS.	○	○	○
USE JOB LUBE & SEAL SYS	●	●	○
USE SHOP VIBRATION PROBES. ETC	●	○	●
USE JOB VIB & AXIAL DISP PROBES. OSCILLATOR-DETECTORS & MONITOR	○	○	○
PRESSURE COMP TO FULL OPER. PRESS	○	○	○
DISASSEMBLE-REASSEMBLE COMP AFTER TEST	○	○	○
CHECK BRGS & SEALS AFTER TEST	●	●	○
NOISE LEVEL TEST	●	●	○
RESIDUAL ELECTRICAL/MECH. RUNOUT	○	○	○
_____	○	○	○

BASEPLATE & SOLEPLATES:

SOLEPLATES FOR: ● COMPRESSOR ● GEAR ● DRIVER

BASEPLATE:

- ● COMMON (UNDER COMP., GEAR & DRIVER)
- ○ UNDER COMP ONLY ○ OTHER _____
- ○ DECKED WITH NON-SKID DECK PLATE ○ OPEN CONSTR.
- ○ DRIP RIM ○ WITH OPEN DRAIN
- ○ HORIZ. ADJUSTING SCREWS FOR EQUIPMENT
- ○ SUITABLE FOR POINT SUPPORT
- ○ SUITABLE FOR PERIMETER SUPPORT
- ○ STAINLESS SHIMS THICKNESS _____
- □ GROUTING TYPE _____

□ **WEIGHTS (LB):**

COMPR. _____ GEAR _____ DRIVER _____ BASE _____

ROTORS. COMPR. _____ DRIVER _____ GEAR _____

COMPR. UPPER CASE _____

L.O. CONSOLE _____ S.O. CONSOLE _____

MAX. FOR MAINTENANCE (IDENTIFY) _____

TOTAL SHIPPING WEIGHT _____

□ **SPACE REQUIREMENTS (FT & IN.):**

COMPLETE UNIT L _____ W _____ H _____

L.O. CONSOLE L _____ W _____ H _____

S.O. CONSOLE. L _____ W _____ H _____

MISCELLANEOUS:

- □ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION _____
- ○ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION
- ○ OPTICAL ALIGNMENT FLATS REQUIRED ON COMPRESSOR, GEAR & DRIVER
- ○ PROVISION FOR WATER WASHING BEFORE OPENING CASING BY _____
- ○ TORSIONAL ANALYSIS REPORT REQUIRED

REMARKS:

CENTRIFUGAL COMPRESSOR DATA SHEET

UTILITIES

UTILITY CONDITIONS:

STEAM	DRIVERS		HEATING	
INLET MIN	____ PSIG	____ F	____ PSIG	____ F
NORM	____ PSIG	____ F	____ PSIG	____ F
MAX	____ PSIG	____ F	____ PSIG	____ F
EXHAUST. MIN	____ PSIG	____ F	____ PSIG	____ F
NORM	____ PSIG	____ F	____ PSIG	____ F
MAX	____ PSIG	____ F	____ PSIG	____ F

ELECTRICITY:

	DRIVERS	HEATING	CONTROL	SHUTDOWN
VOLTAGE				
HERTZ				
PHASE				

COOLING WATER:

TEMP. INLET 85 F — MAX RETURN 110 F

PRESS NORM 50 PSIG — DESIGN 75 PSIG

MIN RETURN 30 PSIG — MAX ALLOW ΔP ____ PSI

WATER SOURCE COOLING WATER

INSTRUMENT AIR:

MAX PRESS ____ PSIG — MIN PRESS ____ PSIG

☐ **TOTAL UTILITY CONSUMPTION:**

COOLING WATER ____ GPM

STEAM, NORMAL ____ #/HR

STEAM, MAX ____ #/HR

INSTRUMENT AIR ____ SCFM

HP (DRIVER) ____ HP

HP (AUXILIARIES) ____ HP

REMARKS:

DRIVER

1500 HP, 4160/3/60

WRH CONSTRUCTION

INDUCTION MOTOR

R&C Form 187 (5/80) Sheet 6 of 6

Data Sheet NO. 24-[illegible]-4-04 REV. A SHEET 6 OF 6

4.2 Duty Specifications for Miscellaneous Equipment

34-SP-A-01: Oily Water Treatment System

34-SP-A-02: Deoiled Wastewater Treatment

34-SP-A-03: Stripped/Extracted Sour Water Treatment

34-SP-A-04: Brine Concentration, Evaporation and Residual Drying

34-SP-A-05: Coal Storage Pile Run-Off Treatment

34-SP-A-06: Sanitary Sewage Treatment

THE BRECKINRIDGE PROJECT

PLANT #34 - SEWERS AND WASTE WATER TREATMENT

OILY WATER TREATMENT SYSTEM

34G-110 A & B

Surge/Equalization Basin Lift Pumps
Lakeside Equipment Corp.
1022 E. Devon Ave.
Bartlett, IL 60103

Two screw lift pumps (one spare), each 1100 gpm, nominal capacity (actual range at constant speed 100-1100 gpm), 30 in. screw diameter, 2 flights, with 15 ft. lift; including gear reducer and 7.0 bhp motor wired for 3ϕ service.

34D-105

Alum Day Tank

One 700 gallon nominal capacity carbon steel tank with sloping bottom and reinforced top edge. Tank shall measure 50 inches in diameter x 72 inches deep and have level indicator.

34D-106

Flow Splitter Sump

One concrete sump for routing excess oily runoff to surge pond, 20 ft. x 8 ft. x 12 ft. deep.

34Y-101

Alum Solution Mixer

One 3/4 hp, 350 rpm mixer equipped with propellers with stabilizing ring on the bottom propeller.

34G-111 A & B

Alum Feed Pumps
Wallace and Tiernan

Two chemical metering pumps, diaphragm type, Wallace and Tiernan, series 44 or equivalent, capable of delivery to 5 gpm against a TDH of 20 ft. Stroke length to be adjustable from 0 to 100% while pumps are operating.

34D-107

Polymer Solution Tank
(Calgon Part No. 386997-4
Calgon Corporation
P.O Box 1346
PITTSBURG, PA 15230

One 700-gallon nominal capacity strain-steel tank with sloped bottom and reinforced top edge. The tank shall measure 56"ϕ x 70" WITH LEVEL INDICATOR.

FORM H-292 7-66

1/05/81	ISSUED FOR PHASE ZERO	HP	WS	HMH

ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717
DUTY SPECIFICATION
OILY WATER TREATMENT SYSTEM

JOB NO. 14222
SPECIFICATION 34-SP-A-01
REV 0

34Y-102

Polymer Solution Mixer
(Calgon Cat. No. 3870011)

One 3/4 hp, 350 rpm mixer equipped with propellers with stabilizing ring on the bottom propeller.

34G-113 A,B

Polymer Feed Pumps
(Calgon Model 2L3)

Two 3/4 hp, variable speed, positive displacement, progressive cavity feed pump capable of delivering 0 to 3 gpm.

34D-109

Caustic Soda Day Tank
(Calgon Part No. 386997-4)

One 700 gallon nominal capacity stainless steel tank with sloped bottom and reinforced top edge. The tank shall measure 56 inches in diameter x 72 inches deep.

34G-114 A&B

Caustic Soda Feed Pumps
(Calgon Model 2L2)

Two 3/4 hp, variable speed, positive displacement, progressive cavity feed pump capable of delivering 0 to 1 gpm.

34D-110

Acid Day Tank
(Calgon Part. No. 386997-4)

One 700 gallon nominal capacity stainless steel tank with sloped bottom and reinforced top edge. The tank shall measure 56 inches in diameter x 70 inches deep.

34G-118 A&B

Acid Feed Pumps
(Calgon Model 2M1)

Two ½ hp, variable speed, positive displacement, progressive cavity feed pump capable of delivering 0 to 0.5 gpm.

34Z-113

API Separator
(Project Spec. No. 14222-Y-2)

One concrete API separator system for two channels, each 5 ft. deep x 11 ft. wide x 120 ft. long. Complete with sludge hoppers, handrails, cross-walks, effluent sump and skimmed oil sump.

34Z-114

Mechanical Equipment for
API Separator
Envirex Water Quality
Control Division
P.O. Box 1067
Waukesha, Wis. 53186

Complete set of mechanical equipment for an API Separator, 2 cells, each 5 ft. liquid depth x 11 ft. wide x 120 ft. long. Included shall be chain-type flight collectors for oil skim-pipes with worm-gear drive operators, reaction jets and effluent weir plates.

34G-116 A&B

API Separator Sludge Pumps
(Moyno Pump Model No. 1EOS-1)
Robbins & Myers
Moyno Pump Div.
Springfield, OH 45501

Two positive displacement, progressive cavity sludge pumps, each 10 gpm, 1 bhp.

34G-117 A,B&C

API Separator Effluent Pumps

Three centrifugal-type non-clog wastewater pumps (one spare), each 1000 gpm, 20 bhp, wired for 3Ø service.

34G-115 A&B

Skimmed Oil Pumps
(Moyno Pump Model 1EOS-1)

Two positive displacement, progressive cavity pumps for pumping mixture of liquid hydrocarbons and variable percentage of waste water. Stator to be resistant to aromatic hydrocarbon attack. Each pump capacity 50 gpm, with 1 bhp motor.

34D-108

Skimmed Oil Settling Tank

One API type cone roof, carbon steel tank 500 BBL nominal capacity, 12 ft diameter x 24 ft. high, complete with manways, roof hatch, roof vent/breather valve, inlet and outlet nozzles, water draw and an extra man-way for installing a steam coil heater.

34D-111

Flash Mix Tank

One carbon steel open top tank, 5 ft. diameter x 11 ft.. shell height, complete with steel bridge/walkway on top to support tank mixer, handrails and access ladder.

34Y-103

Flash Mixer
Eimco/Envirotech Corp.
9235 Katy Road
Houston, TX 77024
(713) 464-8386

One Eimco Type VT4 flash mixer, complete with fully enclosed motorized speed reducer, 2 HP motor, two sets of impellers.

34D-112

Flocculation Tank

One Carbon Steel open top tank, 25 ft. diameter x 10 ft. high, complete with steel bridge/walkway on top to support floc building reactor/mixer, with handrails and access ladder.

34Y-104

Flocculator/Mixer
Eimco/Envirotech Corp.
9235 Katy Road
Houston, TX 77024
(713) 464-8386

One Eimco Type VTR-F Turbine Reactor for flocculation, turbine diameter 7 ft., with 1 HP reactor, gear reducer to produce shaft speeds between 1.4 and 5.4 RPM.

34V-103 A&B

Dissolved Air Flotation (DAF) System
Walker Process Corporation
P.O. Box 266
Aurora, Ill. 60506
or
Eimco/Envirotech
669 West Second South
Salt Lake City, Utah 84110

Two units, each consisting of a circular flotator, 50% recycle pressurizing pumps, air saturation vessel, air compressor and pressure release valve.

34Z-115 A&B

Flotator

Two DAF flotators, each 30.5 ft. in diameter x 7 ft. S.W.D. complete with stilling well, float skimming and sludge scraping mechanism, top bridge with handrails, access ladder and variable speed drive.

34G-119 A,B&C

Pressurizing Pumps

Three centrifugal pumps, (500 gpm, 25 bhp) one each to pressurize 500 gpm of clarified effluent from each of two flotators, the third pump serving as a common spare.

34C-101 A&B

Air Solution Vessel

Two vertical steel air saturation vessels, one for each of the two DAF systems, 1,000 gallon capacity, complete with inlet & outlet nozzles, manway and cover, four support legs.

34K-103 A&B

Air Compressor

Two reciprocating air compressors capable of delivering 10 SCFM of air at 50 psig, operated by a 3-phase electric motor (2.5 bhp) complete with air receiving tank.

34G-120 A&B

DAF Bottom Sludge Pumps
(Moyno Pump Model 1-EOS-1)

Two positive displacement, progressive cavity sludge pumps, each 15 gpm, ½ bhp.

34G-121 A&B

Oily Sludge Sump Pumps (Moyno Pump Model 1E05-1)

Two positive displacement, progressive cavity sludge pumps, each 25 gpm, 3 bhp.

34D-113

Oily Sludge Sump

One concrete sump, below grade, 8 ft. square x 10 ft. deep.

34Q-101

Surge Pond Lift Pump Sump

One concrete sump to house two 1100 gpm screw lift pumps, approximately 30 ft. x 6 ft. x 17 ft. deep complete with inlet trash screen, guardrails and pump and motor supports.

34E-111

Skimmed Oil Tank Heater

One horizontal steam heater for the skimmed oil collection and dewatering tank. Duty is 2 MM BTU/hr.

34-G-112 A,B.

OIL TRANSFER PUMPS.

TWO HORIZONTAL PUMPS, CENTRIFUGAL TYPE, 100 GPM, ΔP = 50 PSI, 100 CP VIS.

THE BRECKINRIDGE PROJECT

PLANT #34 - SEWERS AND WASTE WATER TREATMENT

DEOILED WASTE WATER TREATMENT

34Z-116 A, B, C

Aeration Basins	Three, open top, sunken concrete tanks 80 ft. long x 30 ft. wide x 16 ft. deep. Provided with raw water influent conduit, effluent weir and return sludge inlet.

34K-104 A-F

Aeration Equipment Zimpro, Inc. Environmental Control Systems Rothschild, Wisconsin 54474 (715) 359-7211	Marox pure oxygen system. Six Marox rotating active diffusers rated at 1500 lbs oxygen dissolved/day/diffuser. Equipped with a system of D.O. sensors and analyzers with controls. To be supplied with oxygen available at the plant site.

34Z-117 A-C

Clarifiers Eimco, Envirotech 537 W. 6th South Salt Lake City, Utah 84110 (801) 521-2000	Three, 80-ft. diameter, sunken clarifiers with controlled, continuous high-volume sludge removal. Each clarifier mechanism shall include the walkway with handrails, center assembly with drive unit and control assembly, stationary influent column (feed well), sludge discharge column, sludge collection arms with ducts, and sludge drawoff pipes.

34G-122 A, B

Clarifier Sludge Pump Lawrence Pumps, Inc. 371 Market St. Lawrence, Mass. 01843 (617) 682-5248	Two, centrifugal-type, slurry pumps capable of pumping 1 percent solids sludge at 1000 gpm, 40 bhp each. 1 + 1 spare)

34Z-118

Sludge Thickener Eimco, Envirotech 537 W. 6th South Salt Lake City, Utah 84110 (301) 521-2000	One, 10-ft. diameter, sunken sludge thickener. Provided with influent conduit, sludge raking apparatus, sludge drawoff well, peripheral ladder for overflow, and drive mechanism.

FORM H-292 7-66

4					
3					
2					
1	1/9/81	ISSUED FOR PHASE ZERO			HNH

BECHTEL	ASFI THE BRECKINRIDGE PROJECT AECI U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717 DUTY SPECIFICATION DEOILED WATER TREATMENT SYSTEM	JOB NO. 14222 SPECIFICATION	REV
		34-SP-A-02	0

35G-123 A,B

Thickener Sludge Pumps Robbins & Myers, Inc. Moyno Pump Division Springfield, Ohio 45501 (513) 323-6461	Two, positive displacement, progressing cavity sludge pumps capable of pumping sludge of 3 percent solids at 5 gpm, 1/2 bhp each. 1 + 1 spare) Materials: cast iron casing, rotor of high carbon, high chrome tool steel plated with a heavy layer of hard chrome for abrasion resistance. Stator is a one piece molding of Buna-N rubber bonded to its metal housing.

34D-114

Filter Feed Tank	One, sunken, reinforced concrete tank, 468,000 gallon capacity, 70-ft. long x 60-ft. wide x 15-ft. deep.

34Z-119

Chlorine Feeder	One, chlorine feeder rated at 10 lbs chlorine/hr. Chlorine from pressurized supply tank.

34D-115

Polymer Storage Tank (Calgon Cat. No. 3804-001-4) Calgon Corporation Water Management Division P.O. Box 1346 Pittsburgh, Pa. 15230	One, 100 gallon nominal capacity stainless steel tank, with sloped bottom and reinforced top edge.

34D-116/34D-117

Polymer Mixing Tank/Polymer Feed Tank (Calgon Cat. No. 3804-002-2)	Two, 200 gallon nominal capacity stainlesss steel tanks, with sloped bottom and reinforced top edge. Equipped with slow speed mixer and motor.

34G-124 A,B

Polymer Feed Pumps (Calgon Cat. No. 3837230)	Two, 3/4 hp, variable speed, positive displacement, progressive cavity feed pumps, capable of delivering 0.1 - 1.0 gpm.

34Z-120 A-D

Dual Media Filters Baker Filtration Company 5352 Research Drive Huntington Beach, Ca. 92644 (714) 898-3474)	Four, 8 ft. diameter, dual media pressure filter modules, with automatic feed and backwash control, air scouring system, and two chemical feed systems.

34G-125 A,C

Filter Feed Pumps	Three, centrifugal-type pumps, rated at 1000 gpm, 50 bhp. (2 + 1 spare)

34G-126 A,B

Filter Backwash Pumps	Two, centrifugal-type pumps, rated at 750 gpm, 10 bhp. (1 + 1 spare)

34K-105 A,B

Filter Backwash Air Blowers	Two air blowers each capable of delivering 100 SCFM of air at 30 psig, 15 bhp.

34G-161 A,B

Polymer Transfer Pump	Two centrifugal pumps, 10 gpm, ½ HP.

THE BRECKINRIDGE PROJECT

PLANT #34 - SEWERS AND WASTE WATER TREATMENT

STRIPPED/EXTRACTED SOUR WATER TREATMENT

34D-118

Wet Oxidation Feed/
Equalization Tank

One, cone roof steel tank 36,334 bbl capacity.

34Z-121 A, B, C

Zimpro Wet Oxidation System

Zimpro, Inc.
Military Rd.
Rothschild, Wis. 54474

(715) 359-7211

Three identical trains of Zimpro Wet Oxidation package systems, each consisting of two feed pumps, two high pressure pumps, one oxygen compressor, one process heater, one start-up heater, one reactor, one gas-liquid separator, one gas scrubber, and two high pressure purge pumps.

Each train is designed for up to 400 gpm of liquid waste containing 4% COD (dissolved organics), and for 85% COD reduction in the presence of high inorganic salt content, primarily sodium chloride.

The reactor will be operated at 1500 psia and 536°F.

34Z-123 A-E

Aeration Basins

Five, 160 ft. long x 30 ft. wide x 18 ft. deep, sunken concrete basins, each with six walkway bridges for aerators.

34-Z-133 A-F TO 34Z-137 A-F.

Aerators (30 REQ'D)

Thirty, Marox pure oxygen aerators (Marox Rotating Active Diffusers) rated at 1500 lbs O_2/day (10 Hp motor).

FORM H-292 7-66

2					
1					
0	1/22/81	REISSUED FOR PHASE ZERO - CORRECT EQUIP. NO. FROM G-181 A,B TO 181 A,B	HP		HWH
Δ	1/5/81	ISSUED FOR PHASE ZERO	HP	HS	

ASFI THE BRECKINRIDGE PROJECT AECI

U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717

DUTY SPECIFICATION

STRIPPED/EXTRACTED SOUR WATER TREATMENT

JOB NO. 14222

SPECIFICATION	REV
34-SP-A-03	1

34Z-124 A, B, C

Clarifiers

Eimco Envirotech
537 W. 6th South
Salt Lake City, Utah 84110

(801) 521-2000

Three, 50 ft. diameter, circular clarifiers with sludge scrapers, effluent weir, and walkway and handrails.

34-SP-4-03
SHEET 2 OF 6

34G-128 A,B

Sludge Recycle Pumps Lawrence Pumps, Inc. 371 Market St. Lawrence, Mass. 01843 (617) 682-5248	Two, centrifugal-type slurry pumps, each rated at 1100 gpm, 75 bhp.

34G-129 A,B

Waste Sludge Pumps Lawrence Pumps, Inc. 371 Market St. Lawrence, Mass. 01843 (617) 682-5248	Two, centrifugal-type slurry pumps, each rated at 60 gpm, 7.5 bhp.

34D-119 A,B

PAC Storage Tanks	Two, 10 ft. diameter x 10 ft. high powdered carbon storage hoppers.

34Z-122 A,B

PAC Feeder	Two, powdered carbon feeders rated at 2000 lbs/hr.

34D-120

PAC Slurry Tank	One 400 gallon capacity powdered carbon slurrytank with 1 Hp mixer.

34G-127 A,B

PAC Feed Pump	Two, 10 gpm slurry pumps (3/4 Hp.)

34D-121

Filter Feed Tank	One, sunken concrete tank 60 ft. long x 40 ft. wide x 15 ft. deep.

34Z-125

Chlorine Feeder/Controller Capital Controls Co. Advanced Lane Colman, Pa. 18915 (215) 822-2901	One chlorine feeder and control system rated at maximum of 5.5 lbs Cl_2/hr. Chlorine from central supply tank.

34D-122

Polymer Storage Tank

Calgon Corporation
Water Management Division
P.O. Box 1346
Pittsburgh, Pa. 15230

One, 100 gallon nominal capacity stainless steel (No. 16 gauge type 304) tank, with sloped bottom and reinforced top edge.

34D-123/34D-124

Polymer Mixing Tank/Polymer Feed Tank

(Calgon Cat. No. 3804-001-4)

Two, 100 gallon nominal capacity stainless steel tanks, with sloped bottom and reinforced top edge. Equipped with slow speed mixer and motor.

34G-130 A,B

Polymer Feed Pumps

(Calgon Cat. No. 3837230)

Two, 3/4 Hp, variable speed positive displacement, progressive cavity feed pumps capable of delivering 0.1-1.0 gpm.

34Z-126 A,B

Dual Media Filter

Baker Filtration Company
5352 Research Drive
Huntington Beach, CA 92649

(714) 898-3474

Two, 8' diameter, dual media pressure filter modules with automatic feed and backwash control, air scouring system.

34G-131 A,B

Filter Feed Pumps

Two, centrifugal-type pumps rated at 1100 gpm, 50 bhp each. (1 + 1 spare)

34G-132 A,B

Filter Backwash Pumps

Two, centrifugal-type pumps, rated at 750 gpm, 10 bhp each. (1 + 1 spare)

34K-106 A,B

Filter Backwash BLowers

Two centrifugal air blowers, each capable of delivering 100 SCFM @ 30 psig, 15 bhp.

34G-133 A,B

Cartridge Filter Pumps

Two, centrifugal-type pumps rated at 1100 gpm, 90 bhp each. (1 + 1 spare).

GOULDS 3175 S 4x6x18 150 HP

34Z-127 A-D

Cartridge Filters (Cuno Filter Model 14D3, or equivalent) Cuno Engineering Corporation Division of American Machine & Foundary Company 261 Madison Ave. new York, NY 10016	Four, cartridge filter units equipped with mounting legs, drain plugs, vent plug, stainless steel cartridge posts and seal assemblies. Each unit contains 42, 10 micron cartridges rated at 250 gpm.

34D-125

Sodium Bisulfite Storage Tank	One 500 gallon sodium bisulfite storage tank.

34G-135

Sodium Bisulfite Transfer Pump	One 5 gpm metering pump.

34D-126 A,B

Sodium Bisulfite Solution Tanks	Two, 200 gallon nominal capacity, stainless steel tanks with sloped bottom. Equipped with slow speed mixer and motor.

34G-136 A,B

Sodium Bisulfite Feed Pumps	Two, positive displacement progressive cavity-type feed pumps capable of delivering 0.1 - 1.0 gpm, 1/4 Hp.

34D-127

Polyphosphate Storage Tank	One 500 gallon sodium hexametaphosphate storage tank.

34G-137

Polyphosphate Transfer Pump	One 5 gpm metering pump.

34D-128 A,B

Polyphosphate Mixing Tanks	Two, 200 gallon nominal capacity stainless steel tanks with sloped bottom. Equipped with slow speed mixer and motor.

34G-138 A,B

Polyphosphate Feed Pumps	Two, positive displacement, progressive cavity-type feed pumps, capable of delivering 0.1 - 1.0 gpm, 1/4 Hp.

34D-129

Acid Feed Tank	One, 60 gallon (8 cu. ft.) capacity, acid tank.

34G-139 A,B

Acid Feed Pump	Two, positive displacement pumps, rated at 0.25 gpm, 1/4 Hp.

34J-102

pH Controller	One pH control monitor

34V-104 A,B,C

Reverse Osmosis Systems	Three, 360 gpm R. O. trains, each train has two 180 gpm feed pumps @ 600 psi, 150 bhp, eighteen pressure vessels in stage arrangement. Each pressure vessel includes six 8" diameter x 40" long poly thin film (ether/amide) spiral wound R.O. membrane elements.
34G-134 A-G -R.O. Feed Pumps	
34Z-128 A-C -R.O. Membrane Units	
UOP Fluid Systems 2980 N. Harbor Drive San Diego, Ca 92101 (714) 299-9920	Each train is complete with piping valves, controls and instruments mounted on skid. The system also has one spare feed pump manifold to serve any one of the three trains.

THE BRECKINRIDGE PROJECT

PLANT #34 - SEWERS AND WASTE WATER TREATMENT

BRINE CONCENTRATION, EVAPORATION & RESIDUE DRYING

34D-130	
Blowdown Storage/Equalization Tank	One cone-roofed epoxy-lined steel tank, nominal capacity: 492,000 gallons; 45 ft. [illegible] inches diameter by 40 ft. high.
34G-140 A & B	
Filter Feed Pumps (Goulds Pump Company No. 3775, 4 x 5 x 7 or equivalent)	Two horizontal, single-stage centrifugal pumps, 540 gpm capacity (min.) @ 50 psi ΔP, 25 HP @ 70 percent efficiency.
34V-105	
Polymer Feed System (Baker Filtration Company)	One package unit of 250 gallon capacity, including:
34D-131 (Polymer Solution Tank)	One epoxy phenolic coated steel tank of 250 gallon capacity, approx. 35 inches diameter by 60 inches high equipped with solenoid feed valve actuated by high/low level -float switch.
34Y-105 (Polymer Mixer)	One 1/2 HP top-mounted 115/230 V, 360 rpm mixer with 304 SS shaft and marine propeller.
34G-141 (Polymer Feed Pump	One screw-type feed pump with variable speed drive capable of supplying 3 to 30 gph of 1% polymer solution, 1/2 Hp motor drive.
34V-106	
Chlorination System	One package unit of 7.5 to 150 lb/day chlorination capacity, including:
34Z-129 (V-Notch Chlorinator & Injector)	One V-notch chlorinator with V-notch variable orifice, rotometer, pressure regulating-pressure relief valve, vacuum regulating-relief and combination injector and diaphragm check valve.

FORM H-292 7-66

1	1/5/81	ISSUED FOR PHASE ZERO	HP	HK	HNH

ASFI THE BRECKINRIDGE PROJECT AECI

U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC01-80CR30717

DUTY SPECIFICATION

BRINE CONCENTRATION, EVAPORATION & RESIDUE DRYING

JOB NO. 14222

SPECIFICATION 34-SP-A-04 REV 0

SHEET 1 OF 8

34G-142 (Injection Water Pump) (Wallace & Tiernan Series A-741 Chlorinator)	One 9-stage centrifugal pump capable of providing 10 gpm @ 125 psi ΔP, 2.2 bhp

34V-107

Media Filter System (Baker Filtration Company, Model HRD-284 or equivalent)	One package filter unit of 920 gpm filtering capacity at 12 gpm/ft^2, including:
34Z-130 A&B (Dual-Media Filters)	Two vertical downflow dual-media pressure filters, each rubber lined steel vessel is 84 inches diameter by 54 inches shell height.
34K-108 (Backwash Air Blower)	One backwash air blower capable of supplying 100 SCFM at 30 psig discharge pressure with a 15 Hp motor drive. All piping, valves, controls and other appartenances shall be provided for automatic backwash from an external source.

34G-143

Filter Backwash Pump (Goulds No. 3775, 4 x 6 x 11 H or equivalent)	One single-stage horizontal centrifugal pump, 600 gpm capacity (min) @ 15 psi Δ P, 7.5 bhp @ 78 percent efficiency.

34D-132

R.O. Feed Tank	One cone-roofed epoxy-lined steel tank, nominal capacity: 246,000 gallons; 36 feet 3 inches diameter by 32 feet high.

34G-144 A&B

R.O. Low Pressure Feed Pumps (Goulds No. 3775, 3 x 4 - 11 or equivalent)	Two single-stage horizontal centrifugal pumps, 450 gpm capacity (min) @ 30 psi Δ P, 15 HP @ 75 percent efficiency.

34V-108

Sulfuric Acid Feed System (Wallace & Tiernan)	One package unit of 50 gallons capacity, including:
34D-133 (Sulfuric Acid Tank)	One 50 gal polyethylene solution tank with solenoid feed valve actuated by high/low level float switch.
34G-145 (Sulfuric Acid Feed Pump)	One diaphragm type metering pump (Penton head) pneumatic stroke positioner capable of providing 1 to 20 gph of 66° Be sulfuric acid @ 125 psi Δ P, 1/4 Hp motor.

34V-109

Sodium Bisulfite Feed System (Wallace & Tiernan)	One package unit of 30 gallons capacity, including:

34D-134 (Sodium Bisulfite Solution Tank)	One 30 gallon polyethylene solution tank with solenoid feed valve actuated by high/low level float switch.
34G-146 (Sodium Bisulfite Feed Pump)	One diaphragm type meter pump (Kralon head) with pneumatic stroke positioner capable of providing 0.2 to 3.7 gph @ 125 psi Δ P, 1/4 Hp motor.
34V-110	
Sodium Hexametaphosphate Feed System (Wallace & Tiernan)	One package unit of 50 gallon capacity, including:
34D-135 ($NaPO_4$ Solution Tank)	One 50 gallon polyethylene solution tank with solenoid feed valve actuated by high/low level float switch.
34G-147 ($NaPO_4$ Feed Pump)	One diaphragm type metering pump (Kralastic head) with pneumatic stroke position capable of supplying 0.6 to 11 gph of 25 percent $NaPO_4$ solution at 125 psi Δ P, 1/4 Hp motor.
34V-111 A&B	
Reverse Osmosis System (Fluid Systems/UOP)	Two parallel 440 gpm package units, parallel unit each including:
34Z-131 A,B,C,D (Cartridge Filter Units) Cuno CG12S-4 filters	Two cartridge filter vessels each containing 48-10 micron spiral-wound polypropylene elements.
34G-148 A,B,C,D (R.O. High Pressure Feed Pumps) Goulds BP 200-48 pumps	Two 48-stage centrifugal pumps, each capable of delivering 220 gpm @ 540 psi Δ P, 150 bhp @ 46 percent efficiency.
34Z-132 A&B (R.O. Modules) UOP/Roga membrane elements	One 2-stage R.O. modules, each having sixteen 8-7/8 inch diameter by 22 feet long 1st stage vessels containing six 8 inch diameter by 40 inches long poly-ether/amide membrane elements; eight 8-7/8 inch diameter by 22 feet long 2nd stage vessels containing six 8 inch diameter by 40 inches long elements. Modules include piping, valves, controls and instruments mounted on skid.
34D-136	
VCE Feed Tank	One cone-roofed epoxy-lined steel tank, nominal capacity: 168,000 gallns; 34 feet 6 inch diameter by 32 feet high.

34G-149 A&B

VCE Feed Pumps (Goulds No. 3196 MT, 1½ x 3-10 or equivalent)	Two single-stage horizontal centrifugal pumps capable of delivering 175 gpm @ 135 psi Δ P, 20 HP @ 63 percent efficiency.

34V-112 A&B

Vapor Recompression Evaporator System (Resources Conservation Company Model 225T or equivalent)	Two 225,000 gallon per day package units, each including:
34E-101 A&B (Feed/Product Exchanger)	One feed/product aluminum plate-type exchanger, 8.2 x 10^6 Btu/hr design duty.
34E-102 A&B (Trim Heat Exchanger)	One trim aluminum plate type condenser.
34E-103 A&B (Scavenger Heat Exchanger)	One scavenge aluminum plate type condenser.
34E-104 A&B (Evaporator Body) Heat exchangers-American Heat Reclaiming Corp.	One evaporatory body with 35 titanium vertical heat transfer plates (leaves), internal product tank and brine pump.
34D-137 A&B (Deaerator)	One deaerator tank with internal packing and demister.
34G-150 A&B (Brine Recirculation Pump)	One axial-flow impeller pump capable of delivering 5200 gpm @ 26 psi Δ P, 85 bhp.
34G-151A&B (Distillate Pump) Pumps - Allis Chalmers	One horizontal centrifugal pump capable of delivering 170 gpm @ 65 psi Δ P, 15 bhp.
34K-109 A&B (Scavenge Compressor)	One centrifugal compressor rated at 355 ICFM capacity, pressure ratio = 1.32, 14.8 bhp.
34K-110 A&B (Steam Compressor) Compressors - Roots Connerville Dresser Ind.	One centrifugal steam compressor rated at 37,350 ICFM, pressure ratio = 1.26, 755 bhp Unit also includes 12 feet wide x 38 feet long skid with a motor control center and instrumentation console, piping, valves and controls.

34D-138

Spray Tower Feed Tank	One FRP-lined open top steel tank, nominal capacity: 28,750 gallons; 17 feet 6 inches diameter by 16 feet high.

34Y-106

Feed Tank Agitator (Lightnin' Mixer Co.)	One top-mounted 240/480 V, vertical mixer with rubber-lined shaft and marine propeller, 15 Hp motor.

34G-152 A&B

Dryer Feed Pump	20 GPM capacity (min.) at 135 psi Δ P, 5 bhp.

34V-113

Spray Dryer System (Niro Atomizer Rumsay, MD)	One spray dryer package unit of 10,000 lb/hr evaporative capacity, including:
34Y-107 (Spray Dryer)	One 25 feet diameter by 30 feet high spray dryer tower capable of evaporating 10,000 lb/hr of water (800°F hot gas supply) with Niro-type feed atomizer wheel in gas inlet section (50 Hp motor) and 60° conical bottom section (bottom discharge).
34Y-108 (Product Cyclone)	One 6 feet diameter by 19 feet 9 inches high 316SS product cyclone with 8.68 ft^2 inlet area and rotary valve bottom discharge (1 Hp).
34K-111 (Draft Fan)	One induced draft fan rated at 20,000 ICF (220°F, 2 inches W.C.), static pressure = 6 inches W.C., 25 bhp.
34Y-109 (Fabric Filter Collector)	One fabric filter collector rated at 20,000 CFM, 3 fpm filtering velocity, 6750 Ft^2 filter area and 99 percent collection efficiency with mechanical or reverse jet shakers and dust hopper with rotary valve bottom discharge. Unit includes all ducting, piping and controls.

34D-140

VCE Feed Tank	One cone-roofed epoxy coated steel tank, nominal capacity: 150,000 gallons; 32 feet 7 inches diameter by 24 feet high.
34G-153 A&B VCE Feed Pumps (Goulds No. 3196 MT, 1½ x 3-10 or equivalent)	Two single-stage horizontal centrifugal pumps capable of delivering 175 gpm @ 135 psi Δ P, 40 HP @ 63 percent efficiency

34V-114 A&B

Vapor Recompression Evaporator System (Resources Conservation Company Model 225T or equivalent)	Two 225,000 gallon per day package units-each including:
34E-105 A&B(Feed/Product Exchanger)	One feed/product aluminum plate-type exchanger, 8.2 x 10^6Btu/hr design duty.
34E-106 A&B(Trim Heat Exchanger)	One trim aluminum plate type condenser.
34E-107 A&B(Scavenger Heat Exchanger)	One scavenge aluminum plate type condenser.
34E-108 A&B(Evaporator Body) Heat Exchangers-American Heat Reclaiming Corp.	One evaporatory body with 35 titanium vertical heat transfer plates (leaves), internal product tank and brine pump.
34D-141 A&B(Deaerator)	One deaerator tank with internal packing and demister.
34G-154 A&B(Brine Recirculation Pump)	One axial-flow impeller pump capable of delivering 5200 gpm @ 26 psi ΔP, 85 bhp.
34G-155 A&B(Distillate Pump) Pumps-Allis Chalmers	One horizontal centrifugal pump capable of delivering 170 gpm @ 65 psi ΔP, 15 bhp.
34K-112 A&B(Scavenge Compressor)	One centrifugal compressor rated at 355 ICFM capacity, pressure ration = 1.32, 14.8 bhp.
34K-113 A&B(Steam Compressor) Compressors-Roots Connerville Dresser Ind.	One centrifugal steam compressor rated at 37,350 ICFM, pressure ratio = 1.26, 755 bhp.
	Unit also includes 12 feet wide x 38 feet long skid with a motor control center and instrumentation console, piping, valves and controls.

34V-115

Brine Crystallizer System (Swenson Evaporator Company Division of Whiting Corp.)	One forced circulation evaporative crystallizer unit of 35 tons per day capacity, including:
34Y-110(Crystallizer)	One crystallizer body, 10 feet diameter by 36 feet high including 60° conical bottom 12 feet long (-12 to +5 psig).

34E-109(Sluurry Heater)	One vertical shell & tube heat exchanger, 300 Ft^2, one tube pass (1/3/4" OD 16 BWG x 8 Ft. long titanium tubes).
34E-110(Overhead Condenser)	One in-shell condenser, 750 Ft^2, vacuum service.
34G-156(Magma Recirculation Pump)	One axial-flow impeller pump capable of delivering 5200 gpm (slurry) @ 26 psi ΔP, 90 bhp.
34G-157(Centrifuge Feed Pump) 34G-158 (Mother Liquor Pump)	One horizontal centrifugal pump capable of delivering 175 gpm (slurry) @ 45 psi, 10 bhp. (66% efficiency).
34G-159(Condensate Pump)	One horizontal centrifugal pump capable of delivering 25 gpm @ 45 psi, 1.2 bhp @ 55 percent efficiency.
34Y-111(Solid-Bowl Centrifuge)	One 24 inch diameter horizontal solid-bowl (decanter) centrifuge capable of handling 175 gpm liquid and 1.5 tph solids, 3000 rpm bowl speed, 150 Hp motor drive.
34D-142(Mother Liquor Tank)	One 1500 gallon capacity epoxy-coated steel tank, 5 feet 8 inches diameter by 8 feet high (T-T).
34D-143(Condensate Accumulator)	One 500 gallon capacity epoxy-coated steel tank, 3 feet diameter by 9 feet 6 inches long (T-T).
34G-160(Vacuum Pump)	One rotary vacuum pump, 70 ICFM, pressure ratio = 4.8, 4.7 bhp @ 40 percent efficiency. Unit includes piping, valves and controls.
34D-139 Solids Storage Bin	One rubber-lined steel storage bin of 500 ft^3 capacity, 8 Ft. diameter by 10 ft. high with 60° conical bottom and bin vibrator.
34D-144 A&B	Two rubber-lined steel storage bins of 500 Ft^3capacity, 8 Ft. diameter by 10 Ft. high with 60° conical bottom and bin vibrator.

THE BRECKINRIDGE PROJECT

PLANT #64 - SEWERS AND WASTE WATER TREATMENT

COAL STORAGE PILE RUN-OFF TREATMENT

Polymer Feed System

(Calgon Type STS-400 or equivalent)

Calgon Corporation
Water Management Division
P. O. Box 1346
Pittsburgh, PA 15230

One unit, 400 gallon batch capacity Package system, including:

34D-101 Polymer Solution Tank

1. Water Network consisting of a 1" bronze ball valve, solenoid valve, flow control valve and 7' hose assembly.

2. One, 16 gauge, 304 stainless steel, sloped bottom tank with 1½" discharge port and reinforced top edge. The tank shall be a 400 gallon tank, 64" high, 52" diameter, with a solution depth of 48".

34Z-101 Polymer Mixer

3. One 3/4 HP, 115/230 volt, 1 phase 350 RPM mixer. The mixer shaft to be equipped with propellers with stabilizing ring on the bottom prop.

4. An electrical control system for automatic batch preparation and feeding polymer solution.

34G-102 Polymer Feed Pump

5. Feed Pump capable of supplying a 0 to 3 gpm of solution. The pump will be supplied with 3/4 HP DC motor.

34G-101 A & B Surge Basin Lift Pumps

(Flygt 4" Cp3085, impeller 085-434 or equivalent)

Flygt Corporation
120 Glover Avenue
Norwalk, Conn. 06856

Two submersible, centrifugal-type non-clog wastewater pumps, minimum 250 gpm and 2.5 bhp, wired for 3Ø service.

FORM H-292 7-66

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ASFI THE BRECKINRIDGE PROJECT AECI — JOB NO. 14222

U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717 — SPECIFICATION NO.

DUTY SPECIFICATION
COAL STORAGE PILE RUN-OFF TREATMENT

34-SP-A-05 — 0

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ISSUED FOR PHASE ZERO

Soda Ash Feed System

34D-102 Soda Ash Solution Tank (Calgon No. 3804-002-2 or equivalent)	One, 14 guage, stainless steel, sloped bottom tank with 1-½ NPT discharge port, 1-½ NPT overflow and reinforced top edge. Nominal capacity 200 gallons, 38 inch diameter X 46 inches high.
34G-103 Soda Ash Feed Pump (Calgon Model 2MIA or equivalent)	One feed pump capable of supplying 0.01 to 0.1 gpm of solution. Pump will be a variable speed, positive displacement, progressive cavity pump. The pump will be supplied with a helical rotor of chromed steel and a stator of Buna-N synthetic rubber. The pump unit shall include: pump, ½ hp D.C. motor, base, timing belt and pulleys, belt guard, and name plate.
34J-101 Feed Pump Controller	One unit capable of controlling a ½ hp D.C. motor, and processing two remote signals.
34G-104 A&B Sludge Pumps (Moyno Model SWG 8 or equivalent) Robbins & Myers, Inc. Moyno Pump Division Springfield, Ohio 45501 (513) 323-6461	Two, positive displacement, progressive cavity sludge pumps capable of pumping sludge of a least 2 percent solids content at 30 gpm, ½ bhp each.
34Z-102 Reactor Clarifier (Graver REACTIVATOR 35 foot diameter or equivalent) Graver Water Division Ecodyne, Inc. 2720 U.S. Hwy. 22 Union, N.J., 07083 (201) 687-8300	One reactor-clarifier system consisting of a 35 ft. diameter tank, arranged to provide a rapid mixing and recirculation zone, a slow mixing floc formation zone, and a sedimentation zone. Provided will be a raw water influent conduit, two chemical injection ports, sludge drawoff with backflush, scraper and mixer drivers, and an annular effluent weir.
34G-105 A&B Clarified Effluent Pumps	Two centrifugal-type pumps, minimum 250 gpm, 10 bhp, wired for 3Ø service.

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Media Filter System

(Baker HRD-266-DA system or equivalent)	One package unit consisting of:
34Z-103 A&B Media Filters	Two vertical-type 66-inch diameter dual media pressure filters, automatic air-assisted backwash, rubber lined carbon steel vessel.
34K-101 Backwash Air Blower	The backwash air blower shall deliver 100 scfm at 30 psi, and shall be provided with a 15 bhp, 3Ø driver. All piping, valves, and appurtenances shall be provided for automatic backwash from an external source.
34G-106 Filter Backwash Pump	One centrifugal-type pump, 355 gpm, 5 bhp, 3Ø.
34D-103 Filter Backwash Makeup Tank	One steel tank, nominal capacity 1,400 gallons, 6 ft. high X 7.5 ft. diameter.

THE BRECKINRIDGE PROJECT

PLANT #34 - SEWERS AND WASTE WATER TREATMENT

SANITARY SEWAGE TREATMENT

34V- 101 Sanitary Sewage Treatment Package
Model HS-150 Hydro-Robic Treatment Plant or Equivalent
Hydro Systems, Inc.
Portland, Tennessee

One package unit, designed to treat 150,000 gpd of sanitary sewage with a maximum five day BOP loading of 250 pounds per day. The plant shall consist of two above-ground concentric circular tanks, the outer one being divided into three compartments to form an aeration tank, an aerobic digester, and an effluent chlorine contact tank, and the inner one forming the settling tank. Further details and equipment include:

34Z-104 Aeration Compartment
One aeration compartment, 7160 cubic feet volume, nine hour minimum detention time at design flow rate. Included are diffuser assemblies mounted circumferentially around outer edge of inner walls to provide spiral air flow.

34Z-105 Aerobic Digester Compartment
One digester compartment, 3400 cubic feet volume, four hour minimum detention time at design flow rate. Included are circumferential air diffuser assemblies and a hopper bottom clarifier type supernatant drawoff with discharge into the aeration compartment and skimming air-lifts for return of scum to the digester.

34Z-106 Settling Tank
One tank, minimum of four hours detention based on design flow, and a minimum surface area of 226 square feet. Sludge is removed by a rotary mechanical collector with a one half HP, 230/460 volt, three phase, 60 H_z 1750 RPM gear motor driver.

34Z-107 Air Lift System
One assembly for return of activated sludge from settling tank to aeration compartment, one for transport of waste sludge to aerobic digester, one for discharge of scum from settling tank to digester and two for discharging scum from supernatant separator to digester. Airlifts will be controlled by air solenoid valves and a percent-of-time clock.

FORM H-292 7-66

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U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80CR-20717
DUTY SPECIFICATION
SANITARY SEWAGE TREATMENT

JOB NO. 14020
SPECIFICATION 34-SP-A-06 REV C

34Z-108 Electrical Control System

One electrical control system for automatic control of the treatment plant, consisting of across-the-line magnetic starters, program timer, and switches to operate electrical and mechanical devices.

34Z-109 Comminutor

One half HP, 230/460 volt, three phase, 60 H_z motor driver comminutor to continuously reduce and screen organic matter in sewage to one-fourth inches or less particles.

34Z-110 Froth Spray System

One froth spray system, for controlling froth in aeration compartment and aerobic digester, fed by a submersible pump and including spray nozzles, piping and pump well.

34G-108 Froth Spray Feed Pump

One, three fourth HP, 230/460 volt, three phase, 60 H_z heavy duty pump, rated for 30 GPM at 15 feet TDH.

34Z-111 Chlorine Contact Tank

One tank, 3,360 gallons capacity with three dividing baffles to provide over and underflow, and weir box with a 90° V-Notch Weir.

34K-102 A&B Air Blowers

Two V-belt driven, 15 HP, 230/460 volt, three phase, 60 H_z 1750 RPM positive displacement blowers. These include intake filter, silencer, four inch butterfly valve, four inch check valve, four inch flexible connector, and four inch pressure relief valve and anchor belts.

34Z-112 Chlorinator
Regal Model 410-B or Equivalent

One vacuum operated automatic switchover chlorinator with a maximum capacity of 30 pounds per twenty four hours, consisting of chlorinator ejector-diffusor assembly, 25 LF or 3/8" vent and vacuum tubing, ten lead cylinder gaskets and one cylinder wrench.

34D-104 Sewage Lift Sump

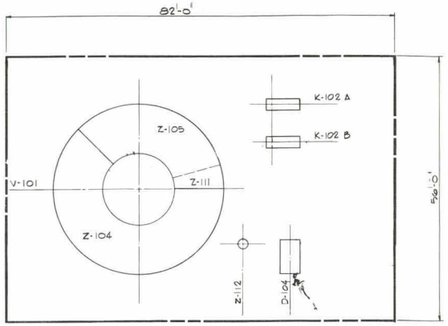
One concrete sewage lift sump 4'x7'x10' deep, covered with a concrete slab and equipped with a C.I. manhole cover.

34G-107 A&B Lift Pumps

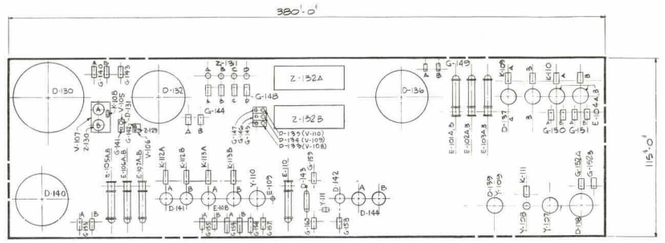
Two submersible centrifugal non-clog sewage pumps, 200 gpm and 7BHP.

34G-109 Digested Sludge Drawoff Pump

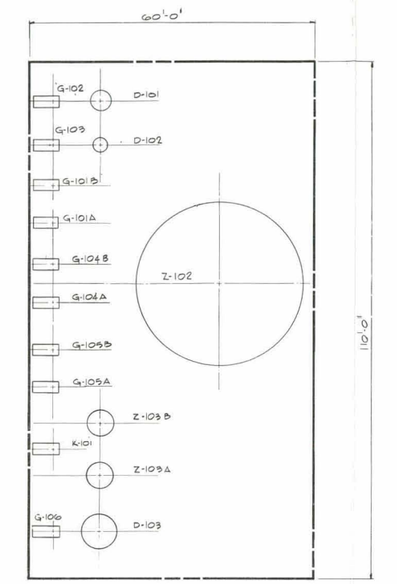
One centrifugal pump, 5 gpm and one-fourth BHP



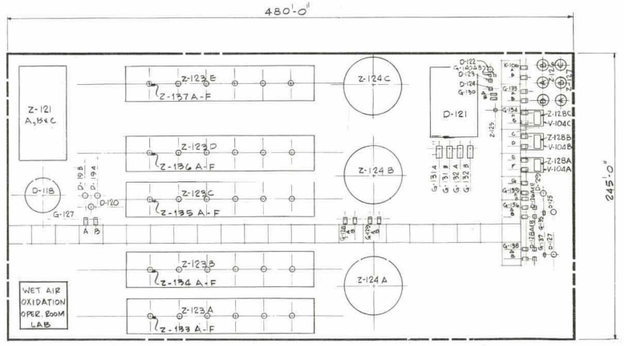
(FF) SANITARY SEWAGE TREATMENT PLANT
SCALE: 1"=10'-0"



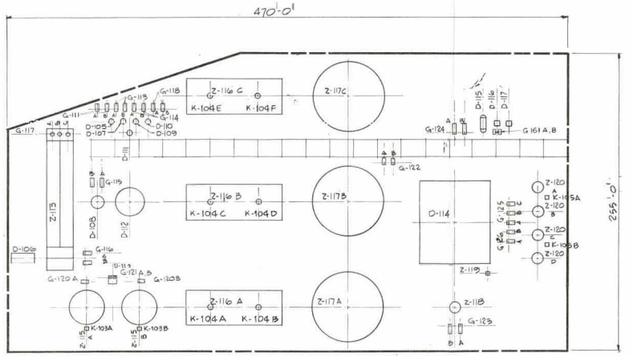
(BB) BRINE CONCENTRATION AND RESIDUE DRYING
SCALE: 1"=30'-0"



(X) COAL STORAGE PILE RUNOFF TREATMENT PLANT
SCALE: 1"=10'-0"



(KK) STRIPPED SOUR WATER TREATMENT PLANT
SCALE: 1"=40'-0"



(MM) OILY WATER AND DEOILED WATER TREATMENT PLANT
SCALE: 1"=40'-0"

ITEM	DESCRIPTION	LOCATION
	(FF) SANITARY SEWAGE TREATMENT	
34D-104	SEWAGE LIFT SUMP	G-6
34G-107 A,B	LIFT PUMPS (NOT SHOWN)	
34G-108	FROTH SPRAY FEED PUMP (NOT SHOWN)	
34G-109	DIGESTED SLUDGE DRAWOFF PUMP (NOT SHOWN)	
34K-102 A,B	AIR BLOWERS	G-6
34V-101	SANITARY SEWAGE TREATMENT PACKAGE	G-7
34Z-104	AERATION COMPARTMENT	G-7
34Z-105	AEROBIC DIGESTER COMPARTMENT	G-7
34Z-106	SETTLING TANK (V-101) (NOT SHOWN)	
34Z-107	AIR LIFT SYSTEM (V-101) (NOT SHOWN)	
34Z-108	ELECTRICAL CONTROL SYSTEM (V-101) (N.S.)	
34Z-109	COMMINUTOR (V-101) (NOT SHOWN)	
34Z-110	FROTH SPRAY SYSTEM (NOT SHOWN)	
34Z-111	CHLORINE CONTACT TANK	G-7
34Z-112	CHLORINATOR	
	(MM) OILY WATER & DEOILED WATER TREATMENT	
34D-105	ALUM SOLUTION DAY TANK	D-4
34D-106	FLOW SPLITTER SUMP	C-6
34D-107	POLYMER SOLUTION TANK	D-6
34D-108	SKIMMED OIL SETTLING TANK	C-6
34D-109	CAUSTIC SODA DAY TANK	D-6
34D-110	ACID DAY TANK	D-6

ITEM	DESCRIPTION	LOCATION
34G-112 A,B	OIL TRANSFER PUMPS	
34G-101 A,B	AIR SOLUTION VESSEL (NOT SHOWN)	
34E-111	SKIMMED OIL TANK HEATER	
34D-111	FLASH MIX TANK	D-4
34D-112	FLOCCULATION TANK	C-4
34D-113	OILY SLUDGE SUMP	C-4
34D-114	FILTER FEED TANK	C-3
34D-116	POLYMER STORAGE TANK	D-3
34D-116/117	POLYMER MIXING AND FEED TANK	D-3
34D-101	SURGE POND LIFT PUMP SUMP (NOT SHOWN)	
34G-110 A,B	SURGE EQUALIZATION BASIN LIFT PUMPS (NOT SHOWN)	
34G-111 A,B	ALUM FEED PUMPS	D-4
34G-112 A,B	POLYMER FEED PUMPS	D-4
34G-142 A,B	CAUSTIC SODA FEED PUMPS	D-4
34G-119 A,B	SKIMMED OIL PUMPS	C-4
34G-116 A,B	API SEPARATOR SLUDGE PUMPS	C-4
34G-117 A,B,C	API SEPARATOR EFFLUENT PUMPS	C-4
34G-118 A,B	ACID FEED PUMPS	D-6
34G-119 A,B,C	PRESSURIZING PUMPS (NOT SHOWN)	
34G-120 A,B	DAF BOTTOM SLUDGE PUMPS	C-4
34G-121 A,B	OILY SLUDGE SUMP PUMPS	C-4
34G-122 A,B	CLARIFIER SLUDGE PUMP	C-3
34G-123 A,B	THICKENER SLUDGE PUMPS	C-3
34G-124 A,B	POLYMER FEED PUMPS	D-3
34G-125 A,B,C	FILTER FEED PUMPS	C-3

ITEM	DESCRIPTION	LOCATION
34G-161 A,B	POLYMER TRANSFER PUMPS	D-3
34V-103 A,B	DISSOLVED AIR FLOTATION SYSTEM	
34Z-111	MECHANICAL EQUIPMENT FOR API SEPARATOR	
34G-126 A,B	FILTER BACKWASH PUMPS	C-3
34K-103 A,B	AIR COMPRESSOR (34V-103 A,B)	C-4
34E-104 A-F	AERATION EQUIPMENT (34Z-116 A-C)	C,D-4
34E-105 A,B	FILTER BACKWASH AIR BLOWER	C-2
34Z-113	API SEPARATOR (34Z-114 OIL SKIMMING EQUIP.)	C-4
34Z-115 A,B	FLOTATOR	C-4
34Z-116 A,C	AERATION BASINS	D,C-4
34Z-117 A,B,C	CLARIFIERS	D,C-3
34Z-118	SLUDGE THICKENER	C-3
34Z-119	CHLORINE FEEDER	C-3
34Z-120 A-D	DUAL MEDIA FILTERS	C-2
	(KK) STRIPPED SOUR WATER TREATMENT	
34D-118	WET OXIDATION FEED/EQUALIZATION TANK	C-7
34D-119 A,B	PAC STORAGE TANKS	C-7
34D-120	PAC SLURRY TANK	C-7
34D-121	FILTER FEED TANK	C-6
34D-122	POLYMER STORAGE TANK	D-6
34D-123	POLYMER MIXING TANK	D-6
34D-124	POLYMER FEED TANK	D-6
34D-126	SODIUM BISULFITE STORAGE TANK	C-6
34D-126 A,B	SODIUM BISULFITE SOLUTION TANK	C-6
34D-127	POLYPHOSPHATE STORAGE TANK	C-6
34D-128 A,B	POLYPHOSPHATE MIXING TANKS	C-6

ITEM	DESCRIPTION	LOCATION
34G-140 A,B	POLYMER TRANSFER PUMPS	
34V-104 A,B,C	REVERSE OSMOSIS SYSTEMS	D-5
34Z-122 A,B	PAC FEEDER (NOT SHOWN)	
34D-128	ACID FEED TANK	C-5
34G-127 A,B	PAC FEED PUMPS	C-7
34G-128 A,B	SLUDGE RECYCLE PUMPS	C-6
34G-129 A,B	WASTE SLUDGE PUMPS	C-6
34G-130 A,B	POLYMER FEED PUMPS	D-6
34G-131 A,B	FILTER FEED PUMPS	C-6
34G-132 A,B	FILTER BACKWASH PUMPS	C-6
34G-133 A,B	CARTRIDGE FILTER PUMPS	C-5
34G-134 A,B	SODIUM BISULFITE TRANSFER PUMP	C-5
34G-135 A,B	SODIUM BISULFITE FEED PUMPS	C-5
34G-137	POLYPHOSPHATE TRANSFER PUMPS	C-5
34G-138 A,B	POLYPHOSPHATE FEED PUMPS	C-5
34G-139 A,B	ACID FEED PUMP	C-6
34K-104 A,B	FILTER BACKWASH BLOWERS	D-5
34Z-113 117	MIXERS	C-7
34Z-121 A,B,C	WET OXIDATION SYSTEM (ZIMPRO)	D-7
34Z-123 A-B	AERATION BASINS	DC-6,7
34Z-124 B,C	CLARIFIERS	D,C-6
34Z-126	CHLORINE FEEDER / CONTROLLER	D-5
34Z-128 A,B	DUAL MEDIA FILTERS	D-5
34Z-127 A-D	CARTRIDGE FILTERS	D-5
34Z-128 B,C	REVERSE OSMOSIS MEMBRANE UNITS (34V-104 A,B,C)	D-5

NOTES

1. HIGH POINT OF FINISHED GRADE IS EL. 100'-0"

REFERENCE DRAWINGS

50E-A-1	OVERALL SITE PLAN
50E-A-4	PLOT PLAN INDEX

ITEM	DESCRIPTION	LOCATION
	(BB) BRINE CONCENTRATION AND RESIDUE DRYING	
34D-130	BLOWDOWN STORAGE/EQUALIZATION TANK	E-7
34D-131	POLYMER SOLUTION TANK (34V-105)	E-7
34D-132	R.O. FEED TANK	E-7
34D-133	SULFURIC ACID TANK (34V-108)	E-6
34D-134	SODIUM BISULFITE SOLUTION TANK (34V-109)	E-6
34D-135	$NaPO_3$ SOLUTION TANK (34V-110)	E-6
34D-136	VCE FEED TANK	E-6
34D-137 A,B	DEAERATORS (34V-112 A & B)	E-6
34D-138	SPRAY TOWER FEED TANK	E-5
34D-139	SOLIDS STORAGE BIN	E-6
34D-140	VCE FEED TANK	E-7
34D-141 A,B	DEAERATORS (34V-114 A & B)	E-7
34D-142	MOTHER LIQUOR TANK (34V-115)	E-6
34D-143	CONDENSATE ACCUMULATOR (34V-115)	E-6
34D-144 A,B	STORAGE BINS	E-6
34E-101 A,B	FEED/PRODUCT EXCHANGER (34V-112 A & B)	E-6
34E-102 A,B	TRIM HEAT EXCHANGER (34V-112 A & B)	E-6
34E-103 A,B	SCAVENGER HEAT EXCHANGER (34V-112 A & B)	E-6
34E-104 A,B	EVAPORATOR BODY (34V-112 A & B)	E-5
34E-106 A,B	FEED/PRODUCT EXCHANGER (34V-114 A & B)	E-7
34E-106 A,B	TRIM HEAT EXCHANGER (34V-114 A & B)	E-7
34E-107 A,B	SCAVENGER HEAT EXCHANGER (34V-114 A & B)	E-7
34E-108 A,B	EVAPORATOR BODY (34V-114 A & B)	E-7
34E-109	SLURRY HEATER (34V-115)	E-7
34E-110	OVERHEAD CONDENSER (34V-115)	E-7
34G-140 A,B	FILTER FEED PUMPS	E-7
34G-141	POLYMER FEED PUMP (34V-105)	E-7
34G-142	INJECTION WATER PUMP (34V-106)	F-7
34G-143	FILTER BACKWASH PUMP	F-7
34G-144 A,B	R.O. LOW PRESSURE FEED PUMPS	E-7
34G-145	SULFURIC ACID FEED PUMP (34V-108)	E-7
34G-146	SODIUM BISULFITE FEED PUMP (34V-109)	E-6
34G-147	$NaPO_3$ FEED PUMP (34V-110)	E-6
34G-148 A-D	R.O. HIGH PRESSURE FEED PUMPS (34V-111 A & B)	E-7
34G-149 A,B	VCE FEED PUMPS	F-6
34G-150 A,B	BRINE RECIRCULATION PUMPS (34V-112 A & B)	E-5
34G-151 A,B	DISTILLATE PUMPS (34V-112 A & B)	E-5
34G-152 A,B	DRYER FEED PUMPS	E-6
34G-153 A,B	VCE FEED PUMPS	E-7
34G-154 A,B	BRINE RECIRCULATION PUMPS (34V-114 A & B)	E-7
34G-155 A,B	DISTILLATE PUMPS	E-7
34G-156	MAGMA RECIRCULATION PUMP (34V-115)	E-7
34G-157	CENTRIFUGE FEED PUMP (34V-115)	E-7
34G-158	MOTHER LIQUOR PUMP (34V-115)	E-6
34G-159	CONDENSATE PUMP (34V-115)	E-6
34G-160	VACUUM PUMP (34V-115)	E-6
34K-108	BACKWASH AIR BLOWER (34V-108)	E-7
34K-109 A,B	SCAVENGE COMPRESSOR (34V-112 A & B)	E-7
34K-110 A,B	STEAM COMPRESSOR (34V-112 A & B)	E-5
34K-111	INDUCED DRAFT FAN (34V-113)	E-5
34K-112 A,B	SCAVENGE COMPRESSOR (34V-114 A & B)	E-7
34K-113 A,B	STEAM COMPRESSOR (34V-114 A & B)	E-7
34V-109	POLYMER FEED SYSTEM	E-7
34V-106	CHLORINATION SYSTEM	E-7
34V-107	MEDIA FILTER SYSTEM	F-7
34V-108	SULFURIC ACID SYSTEM	E-6
34V-109	SODIUM BISULFITE FEED SYSTEM	E-6
34V-110	SODIUM HEXAMETAPHOSPHATE FEED SYSTEM	E-6
34V-111 A,B	REVERSE OSMOSIS SYSTEM	E-7
34V-112 A,B	VAPOR RECOMPRESSION EVAPORATOR SYST.	E-7
34V-113	SPRAY DRYER SYSTEM	E-5
34V-114 A,B	VAPOR RECOMPRESSION EVAPORATOR SYST.	E-7
34V-115	BRINE CRYSTALLIZER SYSTEM	E-7
34Y-105	POLYMER MIXER (NOT SHOWN) (34V-105)	
34Y-106	FEED TANK AGITATOR (NOT SHOWN)	
34Y-107	SPRAY DRYER (34V-113)	E-5
34Y-108	PRODUCT CYCLONE (34V-113)	E-5
34Y-109	FABRIC FILTER COLLECTOR (34V-113)	E-5
34Y-110	CRYSTALLIZER (34V-115)	E-7
34Y-111	SOLID-BOWL CENTRIFUGE (34V-115)	E-6
34Z-129	V-NOTCH CHLORINATION & INJECTOR (34V-106)	E-7
34Z-130 A,B	DUAL MEDIA FILTERS (34V-107)	F-7
34Z-131 A-D	CARTRIDGE FILTERS (34V-111 A & B)	F-7
34Z-132 A,B	R.O. MODULES (34V-111 A & B)	E-6
	(MM) COAL STORAGE PILE RUNOFF TREATMENT	
34D-101	POLYMER SOLUTION TANK	H-4
34D-102	SODA ASH SOLUTION TANK	G-4
34D-103	FILTER BACKWASH MAKEUP TANK	E-4
34G-101 A,B	SURGE BASIN LIFT PUMPS	G-4
34G-102	POLYMER FEED PUMP	H-4
34G-103	SODA ASH FEED PUMP	G-4
34G-104 A,B	SLUDGE PUMPS	G-4
34G-105 A,B	CLARIFIED EFFLUENT PUMPS	F-4
34G-106	FILTER BACKWASH PUMP	E-4
34K-101	BACKWASH AIR BLOWER	F-4
34Z-102	REACTOR CLARIFIER	G-3
34Z-103 A,B	MEDIA FILTERS	F-4

0 10 20 0 10 20 30 40 50 60 0 20 40 60 80
1"=10'-0" 1"=30'-0" 1"=40'-0"
GRAPHIC SCALES

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	ENG'R	DI APP'D	ASST. APP'D
1	12/81	ISSUED FOR PHASE ZERO	DR	JK	JK	HS		
2	1/82	REVISED FOR REVIEW AND APPROVAL	DR	JK	JK	HS		

SCALE: NOTED | DESIGNED TR/JC | DRAWN T. ROBERTSON

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER20717

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

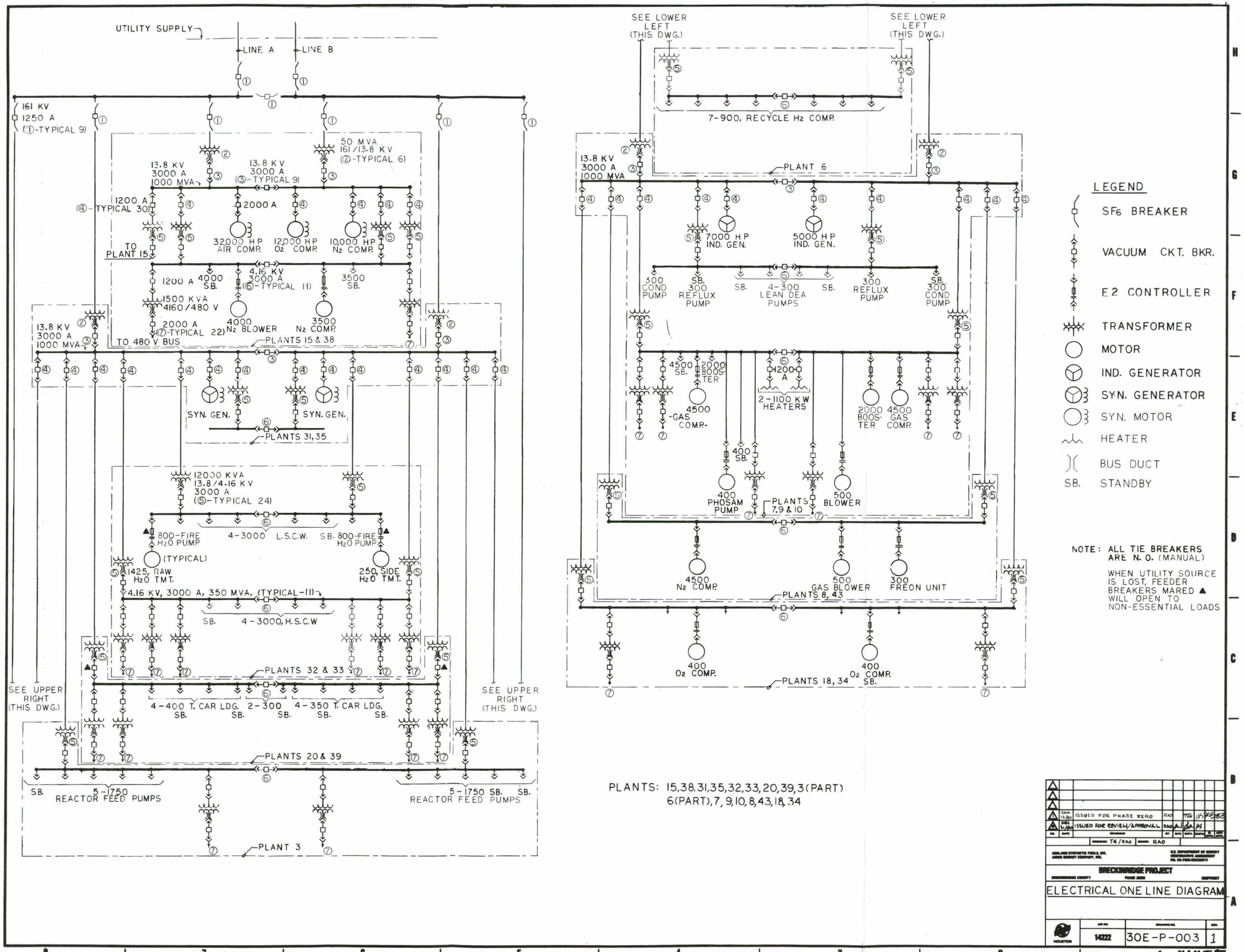
PLOT PLANS PLANT 34
SEWAGE AND WASTEWATER TREATMENT

	JOB NO.	DRAWING NO.	REV.
BECHTEL HOUSTON	14222	34E-A-1	1

34 X 44 "E" SIZE

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

H G F E D C B A



LEGEND

- SF6 BREAKER
- VACUUM CKT. BKR.
- E2 CONTROLLER
- TRANSFORMER
- MOTOR
- IND. GENERATOR
- SYN. GENERATOR
- SYN. MOTOR
- HEATER
- BUS DUCT
- SB. STANDBY

NOTE: ALL TIE BREAKERS ARE N. O. (MANUAL)

WHEN UTILITY SOURCE IS LOST, FEEDER BREAKERS MARED ▲ WILL OPEN TO NON-ESSENTIAL LOADS

PLANTS: 15,38,31,35,32,33,20,39,3(PART) 6(PART),7, 9,10, 8,43, 18, 34

NO.	DATE	REVISIONS	BY	CHK'D	APP'D
3	JAN. 16/81	ISSUED FOR PHASE ZERO	RAO	TG	LV
2	DEC. 1/80	ISSUED FOR REVIEW/APPROVAL	RAO	JA	LV

T4/RAO — RAO

ASHLAND SYNTHETIC FUELS INC. / ASHLAND SYNTHETIC FUELS COMPANY, INC. — U.S. DEPARTMENT OF ENERGY, SYNTHETIC FUELS ADMINISTRATION, NO. DE-FOO1-80ER80017

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

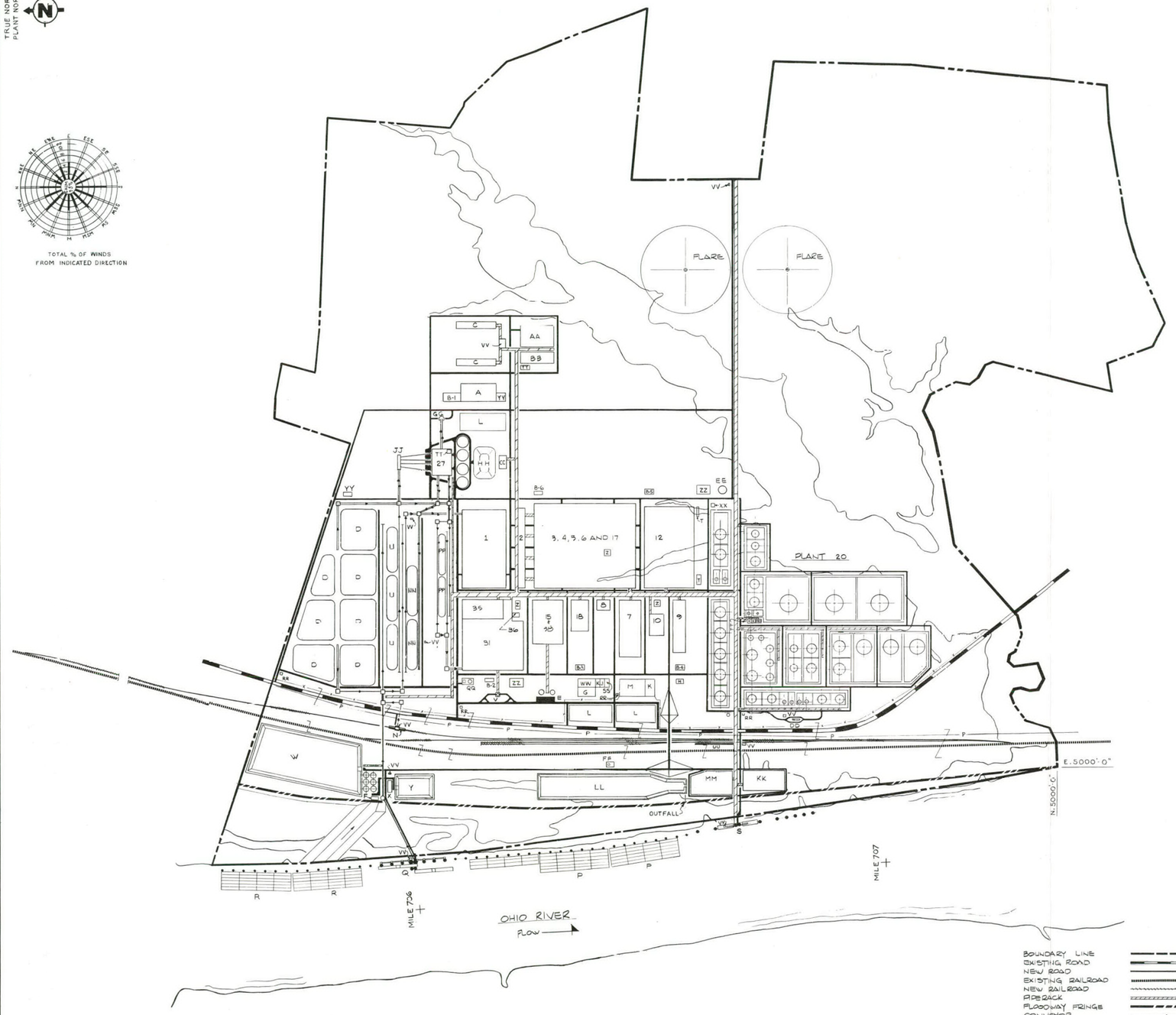
ELECTRICAL ONE LINE DIAGRAM

HOUSTON — JOB NO. 14222 — DRAWING NO. 30E-P-003 — REV. 1

24 X 44

TRUE NORTH 5.0°
PLANT NORTH 0.0°

TOTAL % OF WINDS
FROM INDICATED DIRECTION



LEGEND

1. COAL DRYING AND PULVERIZING
2 COAL SLURRY PREPARATION
3 H-COAL PRE-HEATING AND REACTION
4 H-COAL PRIMARY SEPARATION
5 H-COAL RECYCLE SLURRY PREPARATION
6 H-COAL RECYCLE HYDROGEN CONCENTRATION AND COMPRESSION
7 GAS PLANT
8 CRYOGENIC HYDROGEN PURIFICATION
9 SOUR WATER TREATING
10 SULFUR PLANT
12 GASIFICATION AND PURIFICATION
15 OXYGEN PLANT
17 DISTILLATE SEPARATION
18 NAPHTHA TREATING AND REFORMING
20 TANKAGE
21 INTERCONNECTING PIPING (PIPERACKS)
22 RIVER LOADING FACILITIES
23 RAIL AND TRUCK LOADING
26 COAL RECEIVING AND STORAGE
27 COAL WASHING AND SECONDARY CRUSHING
31 STEAM GENERATION AND B.F.W. TREATING
32 WATER SYSTEM
33 FIRE SYSTEM
34 WASTE WATER TREATMENT PLANTS
35 STACK GAS SCRUBBING
36 INSTRUMENT AIR AND PLANT AIR SYSTEM
38 INERT GAS SYSTEM
39 PURGE AND FLUSH OIL SYSTEM
42 WASTE SLUDGE INCINERATOR.

A WAREHOUSE
B-1 THRU B-6 MAINTENANCE BUILDINGS
C COOLING TOWERS (PLT. 32)
D DEAD COAL (PLT. 26)
E LIQUID OXYGEN AND NITROGEN UNLOADING
F WATER INTAKE
G CHANGE HOUSE
H FIRE STATION
J FIRST AID STATION
K CAFETERIA
L PARKING
M ADMINISTRATION
N RAILROAD COAL UNLOADING (PLT. 26)
P FULL BARGES, 24 BARGE TOW (PLT. 22)
Q COAL UNLOADING DOCK (PLT. 22)
R EMPTY BARGES, 24 BARGE TOW (PLT. 22)
S LIQUID LOADING DOCK (PLT. 22)
T SWITCH GEAR | ZZ SUBSTATION
U RAW COAL (PLT. 26)
V FLY ASH UNLOADING AREA (PLT. 31)
W RAW WATER POND
X CSP RUNOFF TREATING AREA (PLT. 34)
Y COAL STORAGE PILES (CSP) RUNOFF POND (PLT. 34)
Z CONTROL ROOM
AA COOLING TOWER SOFTENING AND FILTRATION (PLT. 32)
BB WASTE WATER CONCENTRATION AND EVAPORATION SYSTEM (PLT. 34)
CC ASH HANDLING. (PLT. 31)
DD TANK TRUCK LOADING (PLT. 23)
EE FIRE WATER TANK (PLT. 33)
FF SANITARY SEWAGE TREATMENT PLANT (PLT. 34)
GG REFUSE BUNKER (PLT. 27)
HH EMERGENCY POND (PLT. 27)
JJ PLANT FEED BUNKER (PLT. 26)
KK POST TREATMENT OF STRIPPED SOUR WATER (PLT. 34)
LL OILY WATER SURGE POND (PLT. 34)
MM OILY WATER TREATMENT (PLT. 34)
NN CLEAN COAL STORAGE (PLT. 26)
PP BOILER FUEL STORAGE (PLT. 26)
QQ SUMP AND TANK FOR INCINERATOR (PLT. 42)
RR GATE HOUSE
SS GUARD/SECURITY HOUSE
TT OPERATING EQUIPMENT ROOM
UU RAIL LOADING (PLT. 23)
VV OPERATOR SHELTER
WW LABORATORY
XX SPECIAL CLEANING
YY GARAGE

NOTES

1. SITE COORDINATES N.5000'-0" E.5000'-0" ARE ESTABLISHED AT THE MOUTH OF TOWN CREEK AT THE INTERSECTION OF THE WATER LINE OF THE OHIO RIVER.
   II REFERENCE: COMMONWEALTH LAND TITLE INSURANCE COMPANY PHILADELPHIA, PENNSYLVANIA FILE No. 6-0552292.
2. HIGH POINT OF FINISHED GRADE ELEVATION 100'-0" EQUALS ELEVATION 415'-0" ABOVE M.S.L.
3. NORMAL WATER ELEVATION OF OHIO RIVER IS EL. 382.3 AT RIVER MILE 709.
4. MEAN HIGHWAY ELEVATION IS EL. 415'-0"
5. TOP OF RAILROAD BALLAST EL. IS 419'-0"

REFERENCE DRAWINGS

50F-A-4 INDEX DRAWING
50E-A-6 CONSTRUCTION REQUIREMENT STUDY

0 200 400 600 800 1000
1"=400'-0"
GRAPHIC SCALE

NO.	DATE	REVISIONS	BY	CHK'D.	SUPV. ENG'R.	SI ASST'S.	ASST. SUPR.
1	12/29/81	ISSUED FOR PHASE ZERO	R.P.	J.K.	J.K.	J.S.	J.S.
2	12-4-80	ISSUED FOR REVIEW AND APPROVAL	R.	J.K.	J.K.	M.P. J.S.	

SCALE 1"=400' | DESIGNED J. KUTLIK | DRAWN T. BURTON

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

OVERALL SITE PLAN

HOUSTON | JOB NO. 14222 | DRAWING NO. 50E-A-1 | REV. 1

34 X 44 "E" SIZE

P&ID LINE WORK STANDARDS

		LINE WIDTH
1.	INSTRUMENTATION	0.010 IN.
2.	GENERAL LINEWORK SYMBOLS & EQUIP	0.022 IN.
3.	PROCESS LINES	0.022 IN.
4.	MAIN PROCESS LINE	0.045 IN.
5.	DRAINS, VENTS & SAFTEY VALVES	0.022 IN.
6.	TEXT, 1/10" HIGH	0.010 IN.
7.	ARROWS FOR LINE WEIGHT 0: ◄ 1: ◄ 3: ◄	
A.	ELECTRICAL SIGNALS — 0.1" LINE, 0.1" SPACE	
B.	PNEUMATIC SIGNALS — 1/8",45° SLASHES AT 0.6" SPACING	
C.	CAPILLARY TUBE — 1/8", TEXT "X" AT 0.6" SPACING	
D.	HYDRAULIC SIGNAL — 1/8" TEXT "L" AT 0.6" SPACING	
E.	ELECTROMAGNETIC RADIATION OR SONIC SIGNAL — 01" DIA. ARCS AT 0.6" SPACING	
F.	OTHER SYSTEMS, BLDG., OUTLINES & EQUIPMENT — 0.5" (NOTE 1), 0.3" LINE, 0.1" SPACE	
G.	CENTER LINE — 0.5" (NOTE 1), 0.8",0.1" LINES, 0.1" SPACE	
H.	FURNISHED BY OTHERS — 0.6" (NOTE 1), 0.9",0.1" LINES, 0.1" SPACE	
I.	UNDERGROUND — 0.4" LINE,0.1" SPACE	
J.	UNDERGROUND (EXISTING) — 0.5",0.1" LINES,0.1" SPACE	
K.	EXISTING	

P&ID SYMBOL SIZES

1.	INSTRUMENT CIRCLE	0.6" DIA.
2.	MISCELLANEOUS EQUIPMENT	0.35" SIDES
3.	TIE-IN POINT BETWEEN NEW & EXISTING	0.40" SIDES
4.	LINE BREAK OR RESUMPTION POINT	0.25" X 1.4"
5.	INSTRUMENTATION TO/FROM	0.25" X 1.2"
6.	GRID NUMBER (A 2)	0.50" X 0.25"
7.	FURNISHED WITH EQUIPMENT	0.2" LINES

STATUS SYMBOLS - LINE VALVES

1. OPEN DURING NORMAL OPERATION (ALL VALVES EXCEPT BUTTERFLY)
2. CLOSED DURINC NORMAL OPERATION
3. NO — OPEN DURING NORMAL OPERATION (BUTTERFLY ONLY)
4. NC — CLOSED DURING NORMAL OPERATION (BUTTERFLY ONLY)
5. LO — LOCKED OPEN; LC — LOCKED CLOCD; CSO - CAR SEALED OPEN; CSC - CAR SEALED CLOSED

MARCH 12/02/80 BM

PROCESS PIPING

1. MAIN PROCESS LINE
2. SECONDARY PROCESS LINE
3. CONCENTRIC REDUCER - INCREASER
4. ECCENTRIC REDUCER - INCREASER
5. WELDED CAP
6. SCREWED CAP
7. HOSE CONNECTION
8. QUICK DISCONNECT
9. REMOVABLE SPOOL
10. FLEXIBLE CONNECTION
11. BLIND FLANGE
12. DU — INSULATING FLANGES (IF) OR DIELECTRIC UNION (DU) (SHOWN)
13. BREATHER CAP
14. LOOP SEAL
15. (1/8) — DOWNWARD SLOPE (1" PER 8' SHOWN)
16. (1/5) — UPWARD SLOPE (1" PER 5' SHOWN)
17. ATM. OR — ATMOSPHERIC VENT
18. H — 0.2" WIDE, 0.8" LONG MAX. — HEAT CONSERVATION
19. P — 0.2" WIDE, 0.8" LONG MAX. — PROCESS CONTROL
20. C — 0.2" WIDE, 0.8" LONG MAX. — COLD INSULATION
21. T — 0.2" WIDE, 0.8" LONG MAX. — STEAM TRACING
22. E — 0.2" WIDE, 0.8" LONG MAX. — ELECTRIC TRACING
23. PP — 0.2" WIDE, 0.8" LONG MAX. — PERSONAL PROTECTION INSULATION
24. JACKETED — 0.2" WIDE, 0.8" LONG MAX.
25. SR — STRESS RELIEVE

LINE VALVES AND CONTROL VALVE BODIES

1. GATE
2. GATE WITH CAVITY VENT ON HIGH PRESSURE SIDE
3. GLOBE
4. ANGLE
5. THREE-WAY
6. FOUR-WAY
7. NEEDLE
8. PLUG (2-WAY)
9. PLUG (3-WAY)
10. PLUG (4-WAY)
11. BALL (2-WAY)
12. BALL (3-WAY)
13. DIAPHRAGM
14. BUTTERFLY
15. ECCENTRIC DISK
16. CHECK (FLOW DIRECTION ⟶ SHOWN)
17. CHECK WITH 1/8 DIA. HOLE DRILLED IN DISC
18. CHECK WITH FUSIBLE LINK
19. FCV — FLOW LIMITING (OR EXCESS FLOW CHECK)
20. STOP CHECK
21. QUICK OPENING
22. BLOWDOWN
23. VALVE PLUGGED
24. VALVE WITH BLIND FLANGE
25. HAND ACTUATOR
26. A — ACTUATOR; E - MAN (SHOWN); A - AIR WRENCH; C - CHAIN; E - EXTENSION STEM; S - SPECIAL TYPE

MISCELLANEOUS

1. SPECTACLE BLIND
2. CIRCULAR OR HAMER BLIND
3. BS — SIMPLEX BASKET STRAINER
4. SS — DUPLEX BASKET STRAINER
5. YS — Y-TYPE STRAINER (SHOWN WITHOUT BLOWOFF VALVE)
6. SU — TEMPORARY STARTUP STRAINER
7. SC — SCREEN TYPE STRAINER
8. F — FILTER
9. XJ — EXPANSION JOINT
10. NSE — FLAME ARRESTER
11. ST — T — TRAP; ST - STEAM TRAP (SHOWN); AT - AIR TRAP; DT - DRAIN TRAP
12. C125-►-S32S — PIPE SPEC. CHANGE
13. EJECTOR OR EDUCTOR
14. EXHAUST HEAD
15. SPRAY NOZZLE OR SPARGER (SHOWN WITH UPWARD FLOW)
16. DESUPERHEATER
17. (S 2) — SAMPLING CONNECTION (NO. INDICATES TYPE)
18. (SC 2) — SAMPLE COOLER (NO. INDICATES TYPE)
19. SO — STEAM OUT
20. W A S — UTILITY STATION (WATER, AIR, STEAM SHOWN)
21. DF — DRINKING FOUNTAIN
22. HEATING COIL

MISCELLANEOUS (CONTINUED)

22. IN-LINE MIXER
23. COLD BOX
24. MODULATING-TYPE BY-PASS RECIRCULATING VALVE (YARWAY)
25. C — ASME BOILER PRESSURE VESSEL CODE LIMITS
26. OWS — DRAIN TO SEWER; OWS - OILY WATER SEWER (SHOWN); SWS - SANITARY WATER SEWER; CS - CHEMICAL SEWER; WS - WATER SEWER (STORM DRAIN)
27. AIR FILTER

CONTROL VALVE FAILURE MODES

1. FO — TWO-WAY (TYPICAL, GLOBE SHOWN); FO - INDICATES FAIL OPEN; FC - INDICATES FAIL CLOSED; FI - INDICATES FAIL (LOCKED) (POSITION DOES NOT CHANGE); FI - INDICATES FAIL INDETERMINATE
2. FO 3-WAY
3. FO 4-WAY

FIRE PROTECTION

1. FIRE HYDRANT
2. FIRE HYDRANT WITH PUMPER CONNECTION
3. FIRE HYDRANT WITH MONITOR (PUMP CONNECTION SHOWN)
4. M — ELEVATED MONITOR
5. 14 — HOSE AND STAND PIPE SYSTEM PER NFPA-14
6. 15 — FIXED SPRAY SYSTEM PER NFPA-15
7. 13 — SPRINKLER SYSTEM PER NFPA-13
8. A — HALON 1301 SYSTEM PER NFPA-12A
9. 12 — CO_2 SYSTEM PER NFPA-12
10. H — HOSE HOUSE
11. DELUGE VALVE — DELUGE VALVE
12. HR — HOSE REEL
13. POST INDICATOR VALVE

NOTES:
(1) MINIMUM LENGTH AND FORMAT FOR LINES.
(2) ALL LINE PATTERNS BASED ON 1.2" REPEAT PATTERN
(3) ALL LINES MUST MEET AT CORNERS, SYMBOLS & EQUIPMENT LINES MAY NOT START WITH A SPACE.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	ELEC. ENGR.	AGR'T APPR.
1	2/26/81	ISSUED FOR PHASE 0	WBC	WBC	BMP	WBC	IWS	
0		ISSUED FOR REVIEW / APPROVAL	BMP	WBC	WBC	IWS		

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FCOS-80OR20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

SYMBOLS & LEGEND
PIPING & INSTRUMENT DIAGRAMS

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	OE-A-1	1

34X44 "E" SIZE

8 7 6 5 4 3 2 1 — H G F E D C B A

EQUIPMENT

1. FILTER
2. MOTOR DRIVEN PUMP, COMPRESSOR OR BLOWER (CENTRIFUGAL SHOWN)
3. HYDRAULIC TURBINE DRIVEN PUMP
4. TURBINE DRIVEN PUMP, COMPRESSOR OR BLOWER
5. TURBOEXPANDER (ELECTRICAL GENERATOR SHOWN)
6. RECIPROCATING AIR COMPRESSOR (INSTRUMENT & SERVICE)
7. SCREEN
8. VERTICAL CENTRIFUGAL OR SUMP PUMP (MOTOR DRIVEN SHOWN)
9. BELT CONVEYOR
10. MIXER
11. EDUCTOR
12. ROLL CRUSHER

HEAT EXCHANGERS

1. FIN TUBE DOUBLE PIPE
2. AIR COOLER
3. AIR COOLER (PITCH CONTROL)
4. REBOILER & CHILLER KETTLE TYPE
5. ELECTRIC HEATER
6. HEATER, COOLER OR CONDENSER
7. SURFACE CONDENSER

VESSELS, TANKS, ETC.

1. PRESSURE VESSELS, VERTICAL (SHOWN) OR HORIZONTAL (TANKS, RECEIVERS, DRYERS, SEPARATORS, ETC.)
2. CLARIFIER
3. CONE ROOF TANK
4. FLOATING TOP TANK
5. FIRED HEATER
6. SUMP
7. GASIFIER

LEGEND FOR ROTATING EQUIPMENT

C - CENTRIFUGAL
P - PROPORTIONING
R - RECIPROCATION
RO - ROTARY
M - MOTOR DRIVEN
T - TURBINE DRIVEN
H - HYDRAULIC TURBINE DRIVEN

DESIGNATIONS

INSTRUMENT TAGGING

COMPLETE TAG NUMBER

PV 12 3 4A B

- PV — ISA FUNCTION
- 12 — PLANT NUMBER
- 3 — TRAIN NUMBER (SINGLE TRAIN IS 1)
- 4 — LOOP NUMBER
- A — MODIFIER, A, B, C ETC.

LOOP NUMBER IS NORMALLY TWO DIGITS, 10 THROUGH 99.
A THIRD SPACE IS FOR SPILLOVER.
PLANT NUMBER IS NOT NORMALLY SHOWN IF IT CARRIES THE SAME NUMBER AS THE DRAWING.

PV 348A FOR EXAMPLE

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	PROJ. MGR.
1	12-14-81	ISSUED FOR PHASE 0	WDC	AHT	HS	HS	EJB
2		ISSUED FOR REVIEW / APPROVAL	WDC	AHT	AEB	HS	

DESIGNED | DRAWN

ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

SYMBOLS & LEGEND
PIPING & INSTRUMENT DIAGRAMS

HOUSTON | JOB NO. 14222 | DRAWING NO. OE-A-2 | REV. 1

34X44 "E" SIZE

MA80BA 12/02/80 BM

GENERAL INSTRUMENTS

1. LOCAL MOUNTED
2. MAIN PANEL MOUNTED
3. BEHIND MAIN PANEL
4. LOCAL PANEL MOUNTED
5. BEHIND LOCAL PANEL
6. COMBINATION 2 SERVICES (NOTE 1, DWG. O-EA-4)

SENSORS - FLOW

1. FE – ORIFICE PLATE
   FO – RESTRICTION ORIFICE
2. ORIFICE PLATE IN QUICK-CHANGE FITTING
3. VENTURI TUBE OR FLOW NOZZLE
4. PITOT OR PITOT-VENTURI TUBE
5. FORWARD-REVERSE PITOT TUBE
6. FLUME
7. WEIR
8. TURBINE OR PROPELLER TYPE
9. ROTAMETER
10. IN-LINE INSTRUMENT (NOTE 2, DWG. O-EA-4)
11. FLOW STRAIGHTENING VANES

SENSORS - LEVEL

1. GAGE GLASS OR FLOAT OR DISPLACEMENT TYPE LEVEL INSTRUMENT
2. DIFFERENTIAL PRESSURE TYPE (NOTE 3, DWG. O-EA-4)
3. (NOTE 3, DWG. O-EA-4) TANK-MOUNTED DIFFERENTIAL PRESSURE TYPE
4. INTERNAL BALL-FLOAT TYPE
5. GAGE BOARD TYPE

SENSORS - PRESSURE

1. DIRECT CONNECTED
2. WITH DIAPHRAGM SEAL, PIPED

SENSOR - ANALYSIS

1. THROUGH-FLOW TYPE
2. NON THROUGH-FLOW TYPE

SENSORS - TEMPERATURE

1. TI – BIMETALLIC THERMOMETER
   TW – THERMOWELL
   TE – SINGLE SENSOR
2. DUAL SENSOR (SHOWN WHEN BOTH ARE USED)
3. FILLED SENSOR

VALVE BODIES & FAILURE MODES

SEE DWG. O-EA-1
(NOTE 4, DWG. O-EA-4)

VALVES - ACTUATORS

1. PNEUMATIC DIAPHRAGM
2. DIAPHRAGM, PRESSURE BALANCED
3. ROTARY MOTOR (SHOWN TYPICALLY WITH ELECTRIC SIGNAL)
4. PNEUMATIC CYLINDER, SINGLE ACTING
5. HYDRAULIC CYLINDER, DOUBLE ACTING
6. PNEUMATIC CYLINDER, DOUBLE ACTING
7. PNEUMATIC CYLINDER, DOUBLE ACTING, WITH PILOT VALVE
8. SINGLE SOLENOID RESET AFTER LATCH
9. ELECTRO-HYDRAULIC (SHOWN) OR PNEUMATIC-HYDRAULIC (SYMBOL P/H)
10. UNCLASSIFIED (TYPE OF ACTUATOR TO BE WRITTEN ADJACENT TO THE SYMBOL)

VALVE BODY WITH ACTUATOR - TYPICAL

(NOTE 4, DWG. O-EA-4)

1. FC

SELF-ACTUATED DEVICES - FLOW

1. FLOW REGULATOR (NOTE 5, DWG. O-EA-4)
2. SIGHT FLOW GLASS

SELF-ACTUATED DEVICES - LEVEL

1. LEVEL REGULATOR WITH MECHANICAL LINKAGE

SELF-ACTUATED DEVICES - PRESSURE

1. PRESSURE REDUCING REGULATOR SELF-CONTAINED
2. PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
3. DIFFERENTIAL PRESSURE REDUCING REGULATOR WITH INTERNAL AND EXTERNAL PRESSURE TAPS
4. BACKPRESSURE REGULATOR SELF-CONTAINED
5. BACKPRESSURE REGULATOR WITH EXTERNAL PRESSURE TAP
6. PRESSURE RELIEF OR SAFETY VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
7. VACUUM RELIEF VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
8. PRESSURE AND VACUUM RELIEF VALVE
9. RUPTURE DISK OR SAFETY HEAD, FOR PRESSURE RELIEF
10. RUPTURE DISK OR SAFETY HEAD, FOR VACUUM RELIEF

SELF-ACTUATED DEVICES - TEMPERATURE

1. TEMPERATURE REGULATOR, FILLED SYSTEM TYPE

HAND ACTUATED DEVICES

1. TWO-WAY HAND CONTROL VALVE IN PROCESS LINE (NOTE 6, DWG. O-EA-4)
2. MANUALLY ADJUSTABLE RESTRICTION ORIFICE IN SIGNAL LINE
3. TWO-WAY HAND ACTUATED SWITCHING VALVE IN PNEUMATIC SIGNAL LINE

MISCELLANEOUS DEVICES

(NOTE 7, DWG. O-EA-4)

TYPICAL SYMBOL

1. SIGNAL RELAY (NOTE 8, DWG. O-EA-4)

RELAY SIGNALS

2. SQUARE ROOT EXTRACTOR
3. VOLTAGE TO PNEUMATIC CONVERTER
4. CURRENT TO PNEUMATIC CONVERTER
5. VOLTAGE TO CURRENT CONVERTER
6. ADD AND SUBTRACT
7. HIGH SELECT
8. LOW SELECT
9. BIAS
10. MULTIPLY
11. DIVIDE

FOR ADDITIONAL RELAY SYMBOLS, SEE ISA S5.1, TABLE 2

12. PURGE DEVICE (MEANS OF REGULATING PURGE MAY BE SHOWN IN PLACE OF THE SYMBOL). PURGE FLUID AND POWER SUPPLIES ARE:
    AIR SUPPLY
    ELECTRICAL SUPPLY
    GAS SUPPLY
    HYDRAULIC FLUID SUPPLY
    NITROGEN SUPPLY
    STEAM SUPPLY
    WATER SUPPLY
14. INTERLOCK
15. "AND" INTERLOCK – EFFECTIVE ONLY IF ALL INPUT EXIST
16. "OR" INTERLOCK – EFFECTIVE IF ONE OR MORE INPUT EXISTS
17. ANALOG CONTROL SIGNAL
18. BURNER CONTROL SIGNAL

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	PROJ. MGR.	DEPT. APPR.
		DESIGNED	DRAWN					
2	12/22/80	ISSUED FOR PHASE 0	VGC	VGC	JAD	JAS		
1	11/24/80	ISSUED FOR REVIEW / APPROVAL	VGC	VGC	JAD	JAS		

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BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

SYMBOLS & LEGEND
PIPING & INSTRUMENT DIAGRAMS

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	OE-A-3	1

34X44 "E" SIZE

M381GA 12/02/80 BM

8 7 6 5 4 3 2 1

H G F E D C B A

FIRST LETTER (NOTE 9)		SUCCEEDING LETTER(S) (NOTE 9)																		
		SENSING DEVICE (NOTE 5)		DISPLAY DEVICE						CONTROL DEVICE (NOTE 5)						MISCELLANEOUS DEVICE				
MEASURED OR INITIATING VARIABLE (NOTE 10)	SYMBOL	PRIMARY ELEMENT	TRANSMITTER	INDICATOR	RECORDER	INTEGRATING INDICATOR	ALARM ANNUNCIATOR (NOTE 15)			CONTROL STATION MAN/AUTO	CONTROLLER	CONTROL VALVE	SELF-ACTUATED VALVE	OTHER FINAL CONTROL ELEMENT (NOTE 16)	SWITCH (NOTE 17)	LOCAL OBSERVATION GLASS	TEST POINT CONNECTION (NOTE 18)	RELAY, COMPUTER (NOTE 5)	USER'S CHOICE (NOTE 13)	UNCLASSIFIED (NOTE 14)
							LOW	HIGH	HIGH & LOW											
TYPICAL SYMBOL	( )	( )E	( )T	( )I	( )R	( )QI	( )AL	( )AH	( )AHL	( )K	( )C	( )V	( )CV	( )Z	( )S	( )Q	( )P	( )Y	( )B ( )N	( )X
ANALYSIS (NOTE 11)	A	AE	AT	AI	AR		AAL	AAH	AAHL	AK	AC	AV		AZ	AS		AP	AY	AB AN	AX
BURNER FLAME	B	BE	BT	BI	BR		BAL				BC	BV			BS	BG	BP	BY	BB BN	BX
CONDUCTIVITY	C	CE	CT	CI	CR		CAL	CAH	CAHL	CK		CV		CZ	CS		CP	CY	CB CN	CX
DENSITY (MASS) OR WEIGHT	D	DE	DT	DI	DR		DAL	DAH	DAHL	DK	DC	DV		DZ	DS		DP	DY	DB DN	DX
VOLTAGE (EMF)	E	EE	ET	EI	ER		EAL	EAH	EAHL	EK	EC			EZ	ES			EY	EB EN	EX
FLOW (NOTE 12)	F	FE	FT	FI	FR	FQI	FAL	FAH	FAHL	FK	FC	FV	FCV	FZ	FS	FG	FP	FY	FB FN	FX
GAGING (DIMENSIONAL)	G	GE	GT	GI	GR		GAL	GAH	GAHL	GK	GC				GS			GY	GB GN	GX
HAND (MANUAL)	H										HC	HV	HCV	HZ	HS		HP	HY		
CURRENT	I	IE	IT	II	IR	IQI	IAL	IAH	IAHL	IK	IC			IZ	IS			IY	IB IN	IX
POWER	J	JE	JT	JI	JR	JQI	JAL	JAH	JAHL	JK	JC			JZ	JS			JY	JB JN	JX
TIME	K		KT	KI		KQI	KAL	KAH	KAHL		KC	KV		KZ	KS			KY	KB KN	KX
LEVEL	L	LE	LT	LI	LR		LAL	LAH	LAHL	LK	LC	LV	LCV	LZ	LS	LG	LP	LY	LB LN	LX
MOISTURE	M	ME	MT	MI	MR		MAL	MAH	MAHL	MK	MC	MV		MZ	MS		MP	MY	MB MN	MX
USER'S CHOICE	O																			
PRESSURE	P	PE	PT	PI	PR		PAL	PAH	PAHL	PK	PC	PV	PCV	PZ	PS		PP	PY	PB PN	PX
PRESSURE DIFFERENTIAL	PU		PDT	PDI	PDR		PDAL	PDAH	PDAHL	PDK	PDC	PDV	PDCV	PDZ	PDS					
QUANTITY OR EVENT	Q		QT	QI	QR	QQI	QAL	QAH	QAHL	QK	QC	QV		QZ	QS			QY	QB QN	QX
SPEED OR FREQUENCY	S		ST	SI	SR	SQI	SAL	SAH	SAHL	SK	SC			SZ	SS			SY	SB SN	SX
TEMPERATURE	T	TE	TT	TI	TR		TAL	TAH	TAHL	TK	TC	TV	TCV	TZ	TS		TP	TY	TB TN	TX
MULTIVARIABLE	U			UI	UR		UAL	UAH	UAHL		UC	UV		UZ	US			UY	UB UN	UX
VISCOSITY	V		VT	VI	VR		VAL	VAH	VAHL	VK	VC	VV		VZ	VS		VP	VY	VB VN	VX
WEIGHT	W	WE	WT	WI	WR	WQI	WAL	WAH	WAHL	WK	WC	WV		WZ	WS			WY	WB WN	WX
UNCLASSIFIED (NOTE 14)	X																			
VIBRATION	Y	YE	YT	YI	YR			YAH							YS		YP	YY	YB YN	YX
POSITION	Z	ZE	ZT	ZI	ZR		ZAL	ZAH	ZAHL		ZC			ZZ	ZS			ZY	ZB ZN	ZX

GENERAL NOTES

1. EXAMPLES OF THE USE OF INDIVIDUAL INSTRUMENT CIRCLES TO DENOTE A SINGLE INSTRUMENT WITH TWO VARIABLES AND/OR TWO FUNCTIONS.

   TWO VARIABLES: FR/PR: A 2 PEN RECORDER, ONE FOR FLOW ONE FOR PRESSURE.

   TWO FUNCTIONS: LY/LC: A DUAL-PILOT LEVEL INSTRUMENT, ONE TRANSMITTER AND ONE CONTROLLER.

   HCV/ZSO: MANUAL CONTROL VALVE WITH POSITION SWITCH.

2. THE TYPE OF FLOW INSTRUMENT MAY BE NAMED OUTSIDE THE INSTRUMENT CIRCLE, E.G. MAGNETIC FLOW METER, DISPLACEMENT METER, MASS FLOW METER, ETC.

3. THE UPPER INSTRUMENT LEAD LINE IS OMITTED IF LEVEL IS MEASURED BY PRESSURE INSTEAD OF DIFFERENTIAL PRESSURE.

4. VALVE BODY PORTS THAT ARE CLOSED IN NORMAL OPERATION ARE BLACKENED. THE OPERATING CONDITION SHOWN FOR ALL VALVE BODIES CORRESPONDS TO FULL-LOAD OR NORMAL OPERATION REGARDLESS OF THE TYPE OF ACTUATOR OR WHETHER THE ACTUATOR IS ENERGIZED OR DE-ENERGIZED DURING THIS MODE OF OPERATION. FOR 3-WAY VALVES, PORT THAT CLOSES DURING UPSETS CONTAINS A DOT.

5. A CONTROL OR SENSING DEVICE OR RELAY HAVING A DISPLAY FUNCTION SHOULD HAVE THE APPROPRIATE DISPLAY LETTERS ADDED AFTER THE MEASURED VARIABLE DESIGNATION. E.G. AIC DESIGNATES ANALYSIS INDICATING CONTROL STATION.

6. A HAND CONTROL VALVE HCV IS A HAND-ACTUATED VALVE THAT EITHER MODULATES A PROCESS STREAM OR IS USED AS AN INSTRUMENT DEVICE.

7. FOR ROOT AND OTHER INSTRUMENT VALVES, SEE INSTRUMENT INSTALLATION DETAILS

8. THE DESCRIPTION DENOTING A RELAY FUNCTION SHOULD BE SHOWN ON THE P&ID EXCEPT WHEN USED WITH DISTINCTIVE SYMBOLS SUCH AS A SOLENOID VALVE.

   A DOUBLE SOLENOID VALVE IS DRAWN WITH TWO SINGLE SOLENOIDS.

9. THE INSTRUMENT LEGEND IS BASED ON ISA STANDARD S5.1-1973 FOR FURTHER DETAILS AND CLARIFICATION, REFER TO ISA STANDARD.

10. ANY FIRST LETTER MAY BE MODIFIED BY THE FOLLOWING LETTERS:

D - DIFFERENTIAL	(PD - PRESSURE DIFFERENTIAL)
J - SCAN	(AJ - SCANNING ANALYZER INDICATOR)
Q - INTEGRATE OR TOTALIZE	(FQI - FLOW INTEGRATING INDICATOR)

11. THE LETTER A IS USED FOR ALL ANALYSIS VARIABLES. THE FOLLOWING TERMS MAY BE PLACED OUTSIDE THE INSTRUMENT CIRCLE OF A LOOP TO DENOTE THE SPECIFIC VARIABLES.

CHR	- CHROMATOGRAPH	NOX	- NITROGEN OXIDES
CL	- CHLORINE	O	- DISSOLVED OXYGEN
CO	- CARBON MONOXIDE	O2	- GASEOUS OXYGEN
COMB	- COMBUSTIBLE	ORP	- OXIDATION REDUCTION
COND	- CONDUCTIVITY	PH	- PH
H	- DISSOLVED HYDROGEN	SIO2	- SILICA
H2	- GASEOUS HYDROGEN	SO2	- SULPHUR DIOXIDE
H2S	- HYDROGEN SULFIDE	TRB	- TURBIDITY
M	- MOISTURE	VIS	- VISCOSITY
N	- NITROGEN		

12. FO - DESIGNATES FLOW RESTRICTION ORIFICE
    FF - DESIGNATES FLOW RATIO
    FFC - DESIGNATES FLOW RATIO CONTROLLER

13. A USER'S CHOICE LETTER B OR N FOR UNLISTED MEANINGS THAT WILL BE USED REPETITIVELY ON A PARTICULAR PROJECT. THE MEANINGS WILL BE DEFINED ONLY ONCE FOR THAT PROJECT AND HAVE ONE MEANING AS THE FIRST LETTER AND ANOTHER SINGLE MEANING AS THE SUCCEEDING LETTER.

14. THE LETTER X IS FOR UNLISTED MEANINGS THAT WILL BE USED ONLY ONCE OR TO A LIMITED EXTENT. IT MAY HAVE ANY NUMBER OF MEANINGS AS A FIRST LETTER AND ANY NUMBER OF MEANINGS AS A SUCCEEDING LETTER. EXCEPT FOR ITS USE WITH DISTINCTIVE SYMBOLS, THE MEANINGS WILL BE DEFINED OUTSIDE THE INSTRUMENT CIRCLE.

15. HIGH-HIGH ALARMS HAVE ( )AHH; LOW-LOW ALARMS HAVE ( )ALL, AND HIGH-LOW ALARMS HAVE ( )AHL IN INSTRUMENT CIRCLE, E.G.

    LAHH - DESIGNATES HIGH-HIGH LEVEL ALARM
    LALL - DESIGNATES LOW-LOW LEVEL ALARM
    LAHL - DESIGNATES HIGH-LOW LEVEL ALARM

16. THE LETTER Z WHICH FOLLOWS A MEASURED VARIABLE REPRESENTS FINAL DEVICES OTHER THAN CONTROL VALVES SUCH AS HYDRAULIC COUPLINGS, VARIABLE SPEED DRIVE, ACTUATOR, ETC.

17. THE LETTERS U, IB, L, LL AND IL ARE ADDED TO THE MEASURED VARIABLES FOR HIGH, HIGH-HIGH, LOW, LOW-LOW AND HIGH-LOW RESPECTIVELY, AS FOR ALARM.

18. A TEST POINT IS A PROCESS CONNECTION TO WHICH NO INSTRUMENT IS PERMANENTLY CONNECTED, BUT WHICH IS INTENDED FOR TEMPORARY, INTERMITTENT, OR FUTURE CONNECTION OF AN INSTRUMENT.

    PP - DESIGNATES PRESSURE POINT
    AP - DESIGNATES ANALYSIS POINT
    TP - DESIGNATES TEMPERATURE POINT
    TH - DESIGNATES THERMOWELL
    HP - DESIGNATES HAND TEST POINT

19. TEXT LOCATIONS AROUND INSTRUMENT "BALLOONS" SHALL BE STANDARDIZED AS SHOWN IN THE SKETCH BELOW.

J1 - ISA CODE (INSTRUMENT TYPE)
J2 - LOOP NUMBER
J3 - VENDOR DESIGNATOR (E.G.●)
J4 - FUNCTION (E.G.√)

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	ENGR.	PROJ. MGR.	PROJ. APPR.
		DESIGNED		DRAWN				
1	12-11	ISSUED FOR PHASE 0	JJC	WJC	JDD	JS		
0		ISSUED FOR REVIEW / APPROVAL						

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SYMBOLS & LEGEND
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HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	0E-A-4	1

34X44 "E" SIZE

M9811A 12/02/86 RH