DOE/DR/20717--5-Vol.4

DOE/OR/20717--5 Vol. 4

DE83 000174

The BRECKINRIDGE PROJECT

Initial Effort

REPORT V

VOLUME 4

MASTER

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

PREPARED FOR
UNITED STATES DEPARTMENT OF ENERGY
UNDER COOPERATIVE AGREEMENT
NO. DE-FC05-800R20717

DISCLAIMER

The following pages are an exact representation of what is in the original document folder.

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

REPORT V
VOLUME 4

INTRODUCTION

Report V, Volume 4 provides descriptions, data, and drawings pertaining to Instrument and Plant Air Systems (Plant 36), Telecommunication Systems (Plant 37), Inert Gas Systems (Plant 38), Purge and Flush Oil Systems (Plant 39), Site Development and Roads (Plant 40), Buildings (Plant 41), Solid Waste Management (Plant 42), and Landfill (Plant 44).

Instrument and Plant Air Systems (Plant 36) includes all equipment and piping necessary to supply instrument and utility air to the process plants and offsite facilities.

Telecommunication Systems (Plant 37) includes the equipment and wiring for: communication throughout the facility; communication between plant data processing systems and offsite computing facilities; communication with transportation carriers.

Inert Gas Systems (Plant 38) provides high purity and low purity nitrogen streams for plant startup and normal operation.

Purge and Flush Oil Systems (Plant 39) provides purge and flush oils to various plants.

Site Development and Roads (Plant 40) provides site leveling, the addition of roads, fencing, and drainage, and the placement of fills, pilings, footings, and foundations for plants.

Buildings (Plant 41) provides buildings for equipment and for personnel, including utilities, lighting, sanitary facilities, heating, air conditioning, and ventilation.

Solid Waste Management (Plant 42) identifies, characterizes, segregates, and transports the various types of solid wastes to either Landfill (Plant 44) or outside disposal sites.

Landfill (Plant 44) provides disposal of both nonhazardous and hazardous solid wastes.

The following information is included (as applicable) for each of the eight plants described in this volume:

- A description of the plant's design, including utility balance 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

REPORT V
VOLUME 4

TABLE OF CONTENTS

PLANT 36 INSTRUMENT AND PLANT AIR SYSTEMS

1.0 INTRODUCTION

The system includes all equipment and piping necessary to supply instrument and utility air to the process plants and offsite facilities. Distribution piping is sized according to the estimated requirement for each plant, based on velocity only.

2.0 PLANT DESIGN

2.1 Design Basis

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

- Pressure = 100 psig
- Temperature = 100°F
- Dew point = -40°F
- Ambient air summer dry bulb temperature, 96°F
- Ambient air summer wet bulb temperature, 78°F
- Ambient air winter temperature, -10°F
- Ambient air extreme temperatures, -16°F and 108°F

The system consists of three packaged air compressors, two operating and one spare, to supply the requirement of 8,000 inlet scfm. Auxiliary equipment such as filters, knockout drums, air dryer packages, filters and air coolers are included.

2.2 Plant Description

2.2.1 Air Compressor Unit

The compressors supply 4,000 scfm each, at 125 psig discharge pressure. The three compressor packages include the following:

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

2.2.2 Knockout Drum

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

2.2.3 Air Dryer Package

Two air dryer packages are provided. One package is a complete spare. Each dryer package provides for the full design flow of 8,000 inlet scfm and for 150 psig. A filter, included in the air dryer package, guards against dessicant breakthrough.

2.2.4 Distribution System

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

2.2.5 Controls

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

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

2.2.6 Noise

Noise emission by the air compressor is an accordance with OSHA standards.

2.3 Utility Balance

Electricity, kW

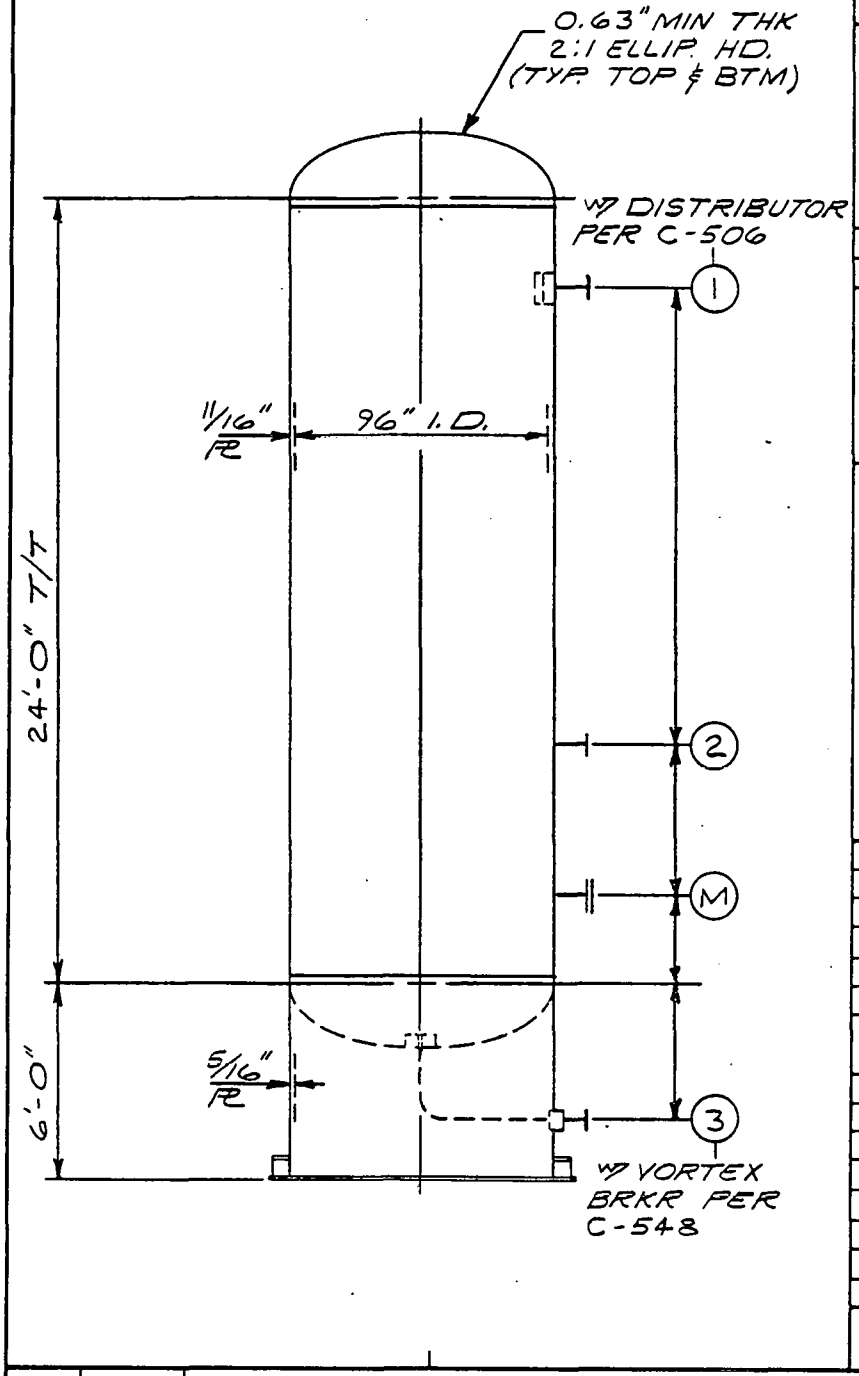
Condition	Consumed
Operating	1,526

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
36	INSTRUMENT AIR AND PLANT AIR SYSTEM	000000 NA
36C-101A	AIR K.O. DRUM	000000 NA
36C-101B	AIR K.O. DRUM	000000 NA
36K-101A	PLANT AIR COMPRESSOR PACKAGE	000000 NA
36K-101B	PLANT AIR COMPRESSOR PACKAGE	000000 NA
36K-101C	PLANT AIR COMPRESSOR PACKAGE	000000 NA
36V-102A	AIR DRYER PACKAGE	000000 NA
36V-102B	AIR DRYER PACKAGE	000000 NA

4.1 Data Sheets for Columns and Pressure Vessels

36-DS-C-001: Knock-out Drum - Plant Air Supply (36C-101 A, B)



CODE	ASME Sec VIII Div I-80	
SPEC.	14222-C1	
OPER. COND.	PRESS.	125 PSIG
	TEMP.	100°F
DES. COND.	PRESS.	155 PSIG
	TEMP.	300°F

MATERIALS	
SHELL & HDS	A-516-70
SKIRT	A-36
FORGING	A-181
PIPING	A-106-B
STRUCTURAL	
BOLTS	

C.A. ~~OR CLAD~~	1/8"
PWHT	No

TESTS/EXAM.					
X-RAY	Spot	JOINT EFF.	85%		
UT	MT	PT	CV @	°F.	
HARDNESS MAX. BHN					
WELD SAMPLING					
CODE HYDRO	POSITION Horiz				
	PRESS @ TOP 232			PSIG	

NOZZLES & MANWAYS	MK	NO.	SIZE	RATING	SERVICE
	1	1		150#	
	2	1		150#	
	3	1		150#	
	M	1	20"	150#	

LADDER & PTFM CLIPS	REQD.	✓	NO
PIPE SUPPORT CLIPS	REQD.		NO
INSUL. SUPPORT CLIPS	REQD.	✓	NO
INSUL. THICKNESS	2 IN.		
PAINTING			
VESSEL CAPACITY	1341 CU. FT.		
VESSEL WEIGHT EMPTY	27.6 KIPS		
VESSEL WEIGHT TEST	111 KIPS		

OPERATING WT = 32 K.

REF. DWGS.

NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
0	12/20/80	Issued For Phase Zero	NN	[illegible]		[illegible]	HNH

BECHTEL

THE BRECKINRIDGE PROJECT

KNOCK-OUT DRUM — PLANT AIR SUPPLY
36C-101 A/B

JOB NO. 14222

DRAWING NO.	REV.
36-05-C-001	0

FORM 875, 4/79

4.2 Data Sheets for Package Units

36-SP-A-01: Air Dryer Package (36V-102 A, B)

THE BRECKINRIDGE PROJECT

PLANT #36

INSTRUMENT & PLANT AIR

SPECIAL EQUIPMENT DUTY SPECIFICATION

#36-SP-A-01

AIR DRYER PACKAGE 36V-102 A, B
Air dryer
Model NR-2 Dual Tower Connection Dryer

Service Conditions:

Gas to be dried:	Air
Flow rate:	8,000 SCFM
Dryer cycle:	8 hours
Absorption:	4 hours
Reactivation:	
Heating:	2.75 hours
Cooling:	1.25 hours
Inlet pressure:	125 PSIG
Inlet temperature:	100°F
Due point at operating pressure:	-40°F
Pressure loss:	4 PSI

Design Data:

Pressure vessels ASME code:	150 PSIG
Electrical construction:	4 (NEMA)
Power circuit:	460-3-60 Volt-Phase-CPS
Control circuit:	110-1-60 Volt-Phase-CPS

Utilities:

Reactivation heat:	
Electric (connected load):	215 KW
Reactivation blower	40 HP

Equipment:

Dual tower absorptive dryer:	NR-2 (Model)
Connection Size - Inlet and outlet:	10"
Method of control:	Automatic

FORM H-292 7-66

1	1/6/81	ISSUED FOR PHASE ZERO	[illegible]		HNH

ASFI THE BRECKINRIDGE PROJECT AECI
U.S.DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717
DUTY SPECIFICATION
INSTRUMENT & PLANT AIR

JOB NO. 14222
SPECIFICATION 36-SP-A-01
REV 0

Desiccant:

Silica Gel:	3775 lbs/tower
Overall dimensions (Approx.):	LxWxH 16'-11"x8'-9"x11'-9"
Shipping weight (Approx.):	25,000 lbs

Manufacturer: Kemp

After Filter:

Model GP-146-650

Manufacturer: Dollinger

Prices by: Thorpe Equipment Co.
David Snyder
Proposal No. A-1298

FORM 293

4.3 Data Sheets for Compressors and Drivers

36-DS-K-101: Instrument and Plant Air (36V-101 A, B, C)

EQUIP. NO. 36V-101 A, B, C

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT DATE 11-7-80 REVISION
FOR BRECKINRIDGE J.O. 14222 UNIT PLANT 36
SITE BRECKINRIDGE COUNTY KENTUCKY SERIAL NO.
SERVICE INSTRUMENT & PLANT AIR NO. REQUIRED 3
MANUFACTURER INGERSOLL-RAND Co. MODEL C11-40 M2 DRIVER I.D. MOTOR
NOTE ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

Equip Nos. 36V-101 A,B&C

	NORMAL	RATED	OTHER CONDITIONS A	B	C	D
○ GAS HANDLED (ALSO SEE PAGE ____)						
○ ~~MMSCFD~~/SCFM (14.7 PSIA & 60°F DRY)		AIR				
○ WEIGHT FLOW, #/MIN (WET) (DRY)		3500				
INLET CONDITIONS:						
○ PRESSURE (PSIA)		14.1				
○ TEMPERATURE (°F)		96				
○ RELATIVE HUMIDITY (%)						
○ MOLECULAR WEIGHT (M)		28.97				
☐ C_p/C_v (K_1) OR (K_{Avg})		1.4				
☐ COMPRESSIBILITY (Z_1) OR (Z_{Avg})		1				
☐ INLET VOLUME, (CFM-WET)		4,120				
DISCHARGE CONDITIONS:						
○ PRESSURE (PSIA)		138.9				
☐ 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)		924				
☐ SPEED (RPM)		3565				
☐ ESTIMATED SURGE, ICFM (AT SPEED ABOVE)						
☐ POLYTROPIC HEAD (FT)						
☐ POLYTROPIC EFFICIENCY (%)						
○ GUARANTEE POINT						
☐ 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: REFER TO ENGLISH STANDARD CONTROL INSTRUMENTATION INCLUDING LOCAL PANEL FOR REMOTE APPLICATIONS

No.	DATE	REVISIONS	BY	CHK'D	DESIGN SUPV	ENG'R	PROJ ENGR	APPR
						CWJ		HNH
0	12/12/80	ISSUED FOR PHASE 0	JMV			JMV		

SCALE | DESIGNED | DRAWN | CHIEF ENGR

ORIGIN | BECHTEL | CENTRIFUGAL COMPRESSOR DATA SHEET | JOB No. | DRAWING No. DS-36-K-101 | 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	(SEE INLET CONDITIONS (SHEET 2 OF)						
OXYGEN	32.000							
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. 28.966								

LOCATION:
○ INDOOR ○ HEATED ● UNDER ROOF
● OUTDOOR ● UNHEATED ○ PARTIAL SIDES
○ GRADE ○ MEZZANINE ○ _____
○ ELECTRICAL AREA CLASS I GR. 2 DIV. 2
○ WINTERIZATION REQD. ○ TROPICALIZATION REQD.

SITE DATA:
○ ELEVATION 400 FT. BAROMETER 14.4 PSIA
○ RANGE OF AMBIENT TEMPS.:

	DRY BULB	WET BULB
SITE RATED °F		
NORMAL °F		
MAXIMUM °F	96°F	78°F
MINIMUM °F	-10	

UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER _____

NOISE SPECIFICATIONS:
○ APPLICABLE TO MACHINE:
SEE SPECIFICATION _____
○ APPLICABLE TO NEIGHBORHOOD
SEE SPECIFICATION _____
ACCOUSTIC HOUSING: ○ YES ○ NO
● COMPLETE UNIT 85 dBA

APPLICABLE SPECIFICATIONS:
API 617 CENTRIFUGAL COMPR. FOR GEN. REFINERY SERVICES
API STANDARDS 672
(JUNE 1979) AS MODIFIED
BY PURCHASER SHALL APPLY

PAINTING:
● MANUFACTURER'S STD. SUBJECT TO REVIEW
○ 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. 3600 RPM TRIP 3650 RPM
MAX. TIP SPEEDS: 1ST 1468 / 2ND 1442 FPS @ RATED SPEED
_____ FPS @ MAX. CONT. SPEED

☐ **LATERAL CRITICAL SPEEDS:**
FIRST CRITICAL NONE WITHIN 20% OF OPERATING SPEED RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
SECOND CRITICAL N.A. RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
THIRD CRITICAL N.A. RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
FOURTH CRITICAL N.A RPM
DAMPED _____ UNDAMPED _____
MODE SHAPE _____
LATERAL CRITICAL SPEED — BASIS.
☐ DAMPED UNBALANCE RESPONSE ANALYSIS
☐ SHOP TEST
☐ OTHER TYPE ANALYSIS

☐ **TORSIONAL CRITICAL SPEEDS:**
FIRST CRITICAL N.A RPM
SECOND CRITICAL _____ RPM
THIRD CRITICAL _____ RPM
FOURTH CRITICAL _____ RPM

☐ **VIBRATION:**
ALLOWABLE TEST LEVEL 1.0 MILS (PEAK TO PEAK)

☐ **ROTATION, VIEWED FROM DRIVEN END:**

☐ **CASING:**
MODEL C 11-40 M2
CASING SPLIT VERTICAL
MATERIAL CI - ANNEALED, ASTM A48-CI-30B
THICKNESS (IN.) — CORR. ALLOW (IN.) —
MAX. WORK PRESS 150 PSIG MAX DESIGN PRESS 200 PSIG
TEST PRESS (PSIG) HELIUM — HYDRO 225
MAX OPER TEMP 140 F MIN. OPER TEMP _____ F
MAX NO. OF IMPELLERS FOR CASING TWO (2)
MAX CASING CAPACITY (ICFM) 4500 @ 125 PSIG
RADIOGRAPH QUALITY ○ YES _____ ● NO _____
CASING SPLIT SEALING GASKETS

☐ **DIAPHRAGMS:**
MATERIAL NONE

☐ **IMPELLERS:**
NO. 2 DIAMETERS 10.11" (1ST STG.) & 7.31" (2ND STG.)
NO. VANES EA. IMPELLER _____

TYPE (OPEN, ENCLOSED, ETC.) OPEN - BACKWARD LEANING
TYPE FABRICATION CASTINGS - MACHINED
MATERIAL 17-4 PH STAINLESS STEEL
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:** (BULL GEAR)
MATERIAL ALLOY STEEL AISI-4340
DIA. @ IMPELLERS (IN.) 25.77 DIA. @ COUPLING (IN.) 2.3625
SHAFT END: ☐ TAPERED ● CYLINDRICAL
MAX. YIELD STRENGTH (PSI) —

☐ **BALANCE PISTON:**
MATERIAL NONE AREA — (IN.²)
FIXATION METHOD —

SHAFT SLEEVES:
○ AT INTERSTG. CLOSE CLEAR. PTS. ☐ MATL. NONE
○ AT SHAFT SEALS — ☐ MATL. —

☐ **LABYRINTHS:**
INTERSTAGE
TYPE NONE MATERIAL —
BALANCE PISTON
TYPE NONE MATERIAL —

SHAFT SEALS:
● TYPE FLOATING CARBON RING
○ SEAL SYSTEM TYPE _____
○ SETTLING OUT PRESSURE _____
● INNER OIL LEAKAGE GUAR. (GAL/DAY/SEAL) NONE
○ TYPE BUFFER GAS AIR
● BUFFER GAS FLOW (PER SEAL). (TOTAL
NORMAL > 10CFM @/MIN @ 100 PSI Δ P —
MAX — @/MIN @ — PSI Δ P —
● BUFFER GAS REQUIRED FOR:
● START-UP
☐ AIR RUN-IN
☐ OTHER _____
● BUFFER GAS CONTROL SYSTEM SUPPLIED BY PURCHASER

☐ **BEARING HOUSING CONSTRUCTION:**
TYPE (SEPARATE, INTEGRAL) SEPARATE SPLIT N.A
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 3-LOBE FIXED-TILTED PAD SPAN (IN.) 2.125
AREA (IN²) — LOADING (PSI) ACT — ALLOW —
CENTER PIVOT N.A.
OFFSET PIVOT N.A.
%
PAD MATERIAL CARBON STEEL AISI-1020C
TYPE BABBITT HIGH TEMP. - ASTM B23 GRADE 2
BABBITT THICKNESS —

☐ **THRUST BEARING:**
LOCATION COMP. CASE TYPE 3-LOBE FIXED TILTED PAD
MFR L.R. AREA (IN²) —
LOADING (PSI) ACTUAL — ALLOWABLE —
GAS LOADING (LB) — CPLG SLIP LOAD (LB) N.A.
CPLG COEFF FRICT N.A. CPLG GEAR PITCH DIA (IN.) N.A.
BAL PISTON COMPENSATING LOAD N.A. LB
CENTER PIVOT N.A.
OFFSET PIVOT N.A.
%
PAD MATERIAL CARBON STEEL AISI-1020C
TYPE BABBITT HIGH TEMP. - ASTM B23 GRADE 2
BABBITT THICKNESS —

☐ **MAIN CONNECTIONS:**

	SIZE	ANSI RATING	FACING	POSITION	FLANGE VEL. FPS
INLET	10	150#	R.F.	END HORIZ.	—
DISCHARGE	3	150#	R.F.	"	—
BY-PASS	2	150#	R.F.	END VERT.	—

☑ **OTHER CONNECTIONS:**

SERVICE	NO	SIZE	TYPE
LUBE-OIL INLET (COOLER)	1	2"	NPT
LUBE-OIL OUTLET "	1	2"	NPT
SEAL-OIL INLET	—		
SEAL-OIL OUTLET	—		
CASING DRAINS	2	1/2"	NPT
STAGE DRAINS	2	1/2"	NPT
VENTS	2	1/8"	NPT
COOLING WATER (AIR COOLERS)	4	2	150# FSA RF
PRESSURE (GAUGE)	2	1/2"	NPT
TEMPERATURE (GAUGE)	2	1/2"	NPT
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	300	1500	125	625	75	375
VERTICAL	750	750	315	315	190	190
HORIZ. 90°	600	750	250	315	150	190
	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:
○ TYPE PROXIMITER PROBES ☑ MODEL TYPE 190
○ MFR BENTLY-NEVADA
○ NO. AT EACH SHAFT BEARING 2 TOTAL NO 4
○ OSCILLATOR-DETECTORS SUPPLIED BY —
○ MFR BENTLY-NEVADA ☑ MODEL 211S
○ MONITOR SUPPLIED BY SELLER
☑ LOCATION COMP. PANEL ENCLOSURE —
☑ MFR. BENTLY-NEV. ☑ MODEL —
☑ SCALE RANGE 2-2 ○ ALARM ☑ SET @ 2.7 MILS
☑ SHUTDOWN ☑ SET @ 1.0 MILS ○ TIME DELAY — SEC

AXIAL POSITION DETECTOR:
○ TYPE NONE REQ'D ☐ 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.

R&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	SIER-BATH	
MODEL	SERIES "F"	
LUBRICATION	GREASE	
MOUNT CPLG. HALVES	BY SELLER	
SPACER REQD.	✓	
LIMITED END FLOAT REQD.	✓	
IDLING ADAPTOR REQD.	—	
CPLG. RATING (HP/100 RPM)	196	
KEYED (1) OR (2); OR HYDR. FIT	(1)	

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. 5700 GEAR _____ DRIVER 5090 BASE 1600

ROTORS. COMPR. 36 DRIVER _____ GEAR _____

GEAR ~~COMPR~~ UPPER CASE 1090

L.O. CONSOLE _____ S.O. CONSOLE _____

MAX. FOR MAINTENANCE (IDENTIFY) 1100 - INTERCOOLER

TOTAL SHIPPING WEIGHT 13,500

☐ **SPACE REQUIREMENTS (FT & IN.):**

	L	W	H
COMPLETE UNIT	12'5"	5'6"	6'0
L.O. CONSOLE			
S.O. CONSOLE.			

MISCELLANEOUS:

- ☐ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION FOUR (4)
- ○ 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:

	DRIVERS		HEATING	
STEAM				
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	4160	460	120/208	120
HERTZ	60	60	60	60
PHASE	3	3	3	1

COOLING WATER:

TEMP. INLET 85 F — MAX RETURN 115 F
PRESS NORM 50 PSIG — DESIGN 75 PSIG
MIN RETURN 35 PSIG — MAX ALLOW ΔP 15 PSI
WATER SOURCE CWS

INSTRUMENT AIR:

MAX PRESS ____ PSIG — MIN PRESS ____ PSIG

☐ TOTAL UTILITY CONSUMPTION:

COOLING WATER	255 GPM
STEAM, NORMAL	— #/HR
STEAM, MAX	— #/HR
INSTRUMENT AIR	____ SCFM
HP (DRIVER)	____ HP
HP (AUXILIARIES)	____ HP

REMARKS:

DRIVER
IND. MOTOR
1000 HP - 3600 RPM
4160 V, 3ϕ 60 ~

EQUIPMENT FURNISHED

1. COMPRESSOR
2. ELECT. MOTOR DRIVER
3. COMMON BASE PLATE UNDER COMP. & DRIVER
4. COUPLING & GUARD
5. INTERCOOLER
6. AFTER COOLER
7. VIBRATION MONITOR
8. DUAL CONTROL
9. CONTROL PANEL
10. INLET AIR FILTER/SILENCER
11. INLET THROTTLE VALVE
12. BLOWOFF VALVE
13. BLOWOFF SILENCER
14. DISCHARGE CHECK VALVE
15. AUTOMATIC CONDENSATE TRAPS
16. COOLING WATER MANIFOLD
17. PIPING FOR IN-PLACE AIR COOLER RECIRCULATION

R&C Form 187 (5/80) Sheet 6 of 6

5.0 DRAWINGS

Due to the nature of Instrument and Plant Air Systems (Plant 36), no drawings are included in this section.

PLANT 37 TELECOMMUNICATION SYSTEMS

1.0 INTRODUCTION

Plant 37 includes the equipment and wiring for communication throughout the plant and to offsite locations linking plant data processing systems with offsite computing facilities, and for communication with transportation carriers.

The following subsystems are included in Plant 37:

- Interconnecting cables, standby emergency power and grounding
- Computer remote access
- Facsimile
- Fire alarm
- Public address paging
- Medical emergency and life-signs telemetry
- Intraplant party paging
- Land mobile radio
- Land mobile radio telephone
- Maritime mobile radio
- Radio paging
- Security system
- Telephone, telephone PABX
- Telex

The communication requirements for the three phases of plant development, mobilization, construction, and operation vary. The requirements for each phase are discussed in the following sections.

PLANT 37 TELECOMMUNICATION SYSTEMS

2.0 PLANT DESIGN

2.1 Design Basis

Plant 37, in serving the telecommunications requirements for the initial phases of mobilization and construction, is designed with sufficient flexibility to allow for conversion to final plant operation

Master communications central control and monitoring of all subsystems are provided for the plant operation phase.

Reliability, a prime factor in the design of the plant, is achieved through the use of solid-state components, factory burn-in of assemblies, redundant assemblies, alternative traffic flow routing and, where possible, automatic operation.

Maintainability is achieved through modular organization of hardware assemblies, automatic fault detection and alarm systems, standardization of components and procurement sources and a spare inventory based upon mean-time-between-failure (MTBF) data and repair cycle time.

Flexibility is achieved through the usage of central electronic switching, shelterized (transportable) facilities, commonality of subassemblies where possible and a system capacity adequate for all three phases of the development.

2.2 Plant Description

Table 1 summarizes by plant operational phase the telecommunications equipment installed.

TABLE 1

TELECOMMUNICATIONS INSTALLATION

	Plant Status Phase		
Telecommunication Type or System	Mobilization	Construction	Operation
Battery Plant		X	X
Cable plant, outside (for interconnections, grounding, etc.)		X	X
Computer remote access terminal	X	X	X
Facsimile	X	X	
Fire alarm and public address paging system, administration building			X
Medical life-signs telemetry		X	X
Paging, intraplant party			X
Radio, land mobile, local	X	X	X
Radio, land mobile, radio telephone		X	X
Radio, land mobile to railroad operations		X	X
Radio, maritime mobile		X	X
Radio, paging		X	X
Security system		X	X
Telephone (before plant completion, locally available services are used during the mobilization phase)	X	X	X
Telephone PABX		X	X
Telex	X	X	X

2.2.1 Battery Plant

The battery plant supplies standby emergency power to the telephone, security, land mobile radio and maritime mobile radio systems. It is maintained in readiness by dual battery chargers.

2.2.2 Outside Cable Plant

The outside cable layout consists of all direct buried telephone cables and computer cables connecting the jobsite system 34 CPU with all work stations.

2.2.3 Computer Remote Access Terminal

The terminal is used for gathering data between the jobsite, the Bechtel design office in Houston, and the Ashland Synthetic Fuels, Inc. (ASFI) home office in Kentucky. Computer data terminal circuits for 1200/2400/4800 baud rates are provided.

The facilities for long distance transmission are required on a 24-hour basis during all courses of the project development. The quality of transmission for the circuits is consistent with the requirements for interconnection with international circuits.

2.2.4 Facsimile Terminal

The requirements of the facsimile terminal are for transmitting drawings, graphics and pictorial information between the three locations.

2.2.5 Fire Alarm and Public Address (PA) System

The system is integrated with the telephone and switching network. It serves only the administration building.

2.2.6 Medical Emergency System and Life-signs Telemetry

These are provided in the ambulance, first-aid stations and the medical building.

2.2.7 Intraplant Page System

This multichannel page party system is installed in all control rooms, operating equipment rooms, storage, shipping and receiving areas, flare areas, process areas and substations.

The permanent installation for direct dial telephone also includes the following operational areas:

- Administration building and central control room
- Laboratories
- Fire station
- First aid unit
- Security office
- Distributed system control room
- Operating equipment room
- Substations
- Cooling tower
- Flare areas
- Utility plants
- Process areas
- Shipping and receiving areas
- Maintenance shop
- Warehouse

- Cafeterias
- Change house
- Gate houses
- Operators shelters
- Switch gear buildings
- Garages

2.2.8 Land Mobile Radio

The land mobile radio system includes communication between mobile units and hand held portable radios as well as with the base stations. It includes or supplements other systems serving the vehicle mobile units, plant operations and maintenance, fire and safety, security, the medical emergency system, and communication with railroad operations.

2.2.9 Local Area Mobile Radio Telephone Service

The radio telephone service is used on an urgent basis to provide automatically switched mobile radio telephone communications between site offices, residences and vehicles.

2.2.10 Maritime Mobile

The marine radio system operates between base and barges and towboats.

2.2.11 Radio Paging System

Pocket pager units are used for communication by the radio base station to selected personnel during the three phases.

2.2.12 Security System

This system consists of status and alarm reporting systems connected by multipair cables and is supplemented by land mobile radio and by video monitoring systems.

2.2.13 Telephone Service

The telephone facilities provide dial switching service to fill the mobilization task force requirements, and later are expanded to encompass the needs during the construction and operational phases. The telephone service also allows for long distance calls to any other place in the country. Teleconferencing channels are included.

2.2.14 Telephone Switching System

The PABX system switches all interplant communications. In addition, the system switches construction and operation computer data traffic and telex and facsimile traffic. It also interconnects direct dial-up capability to the radio paging system.

2.2.15 Telex Service

The telex facilities are used to transmit message text between jobsite, engineering design offices and other office locations as required.

3.0 EQUIPMENT LIST

Due to the nature of Telecommunication Systems (Plant 37), an equipment list is not required.

4.0 Data Sheets and Sketches

Due to the nature of Telecommunication Systems (Plant 37), data sheets are not required.

5.0 DRAWINGS

Due to the nature of Telecommunication Systems (Plant 37), no drawings are required.

PLANT 38 INERT GAS SYSTEMS

1.0 INTRODUCTION

Two nitrogen streams that are produced in the Oxygen Plant (Plant 15) are used as inert gas for plant startup as well as normal operation. The equipment of the Inert Gas System (Plant 38) is physically located within the Plant 15 battery limits.

The high purity (99.99%) nitrogen stream is used for:

- General plant purging
- Bag house blanketing in Coal Drying and Pulverizing (Plant 1)
- Gas and liquid driers in Gas Plant (Plant 7)
- Gas driers in Cryrogenic Hydrogen Purification (Plant 8)

The low purity (97%) nitrogen stream is used for the air slides in the Plant 1 coal bunkers.

Process Flow Diagram 38-D-B-1 depicts the inert gas system.

PLANT 38 INERT GAS SYSTEMS

2.0 PLANT DESIGN

2.1 Design Basis

2.1.1 High-Purity Nitrogen Stream

Purity: 99.99%

Pressure at:

B.L. of Plant 15	100 psig
User B.L.	90 psig

Supplied by Nitrogen Compressor (15K-55) for:

General plant purging	1,200 scfm
Bag house in Plant 1	120 scfm

Supplied by Nitrogen Compressor* (38K-101) for:

Gas drier (Alumina) in Plant 7	12,000 scfm
Liquid drier (Alumina) in Plant 7	5,200 scfm
Gas drier (mol sieves) in Plant 8	11,000 scfm

2.1.2 Low-Purity Nitrogen Stream

Purity: 97%

Supplied by Nitrogen Blower (38K-103) for:

Plant 1 air slides at 5 psig	7,060 scfm**

* The rated capacity of the compressor is 13,200 scfm. Only one of the three drier systems will be on cooling cycle at one time so that the compressor will not be overloaded.

** The original estimated nitrogen requirement for the air slides of the coal bunkers in Plant 1 was 4,600 scfm and the compressor was rated at 5,060 scfm. The revised nitrogen requirement which has not been incorporated onto the flow diagram is 7,060 scfm. The rated capacity of the compressor should be further revised during the detailed process design stage. The effect of this correction on the capital estimate will not be significant.

2.2 Plant Description

Two nitrogen streams are produced in the Oxygen Plant (Plant 15) in addition to the primary product, oxygen which is used in the partial oxidation gasifier in the Gasification and Purification (Plant 12). One of the nitrogen streams is a high purity product and the other is a waste stream of about 97% purity.

Plant 15 includes a Compressor (15K-55) from which high purity nitrogen is available at 100 psig; such nitrogen is supplied for general plant purging in the complex, and also for purging the bag house filters in Coal Drying and Pulverizing (Plant 1). Equipment to vaporize nitrogen in suitable quantities, at 100 psig, is also available in Plant 15.

Located in Plant 15, but bearing Plant 38 designations, are two additional compressor systems.

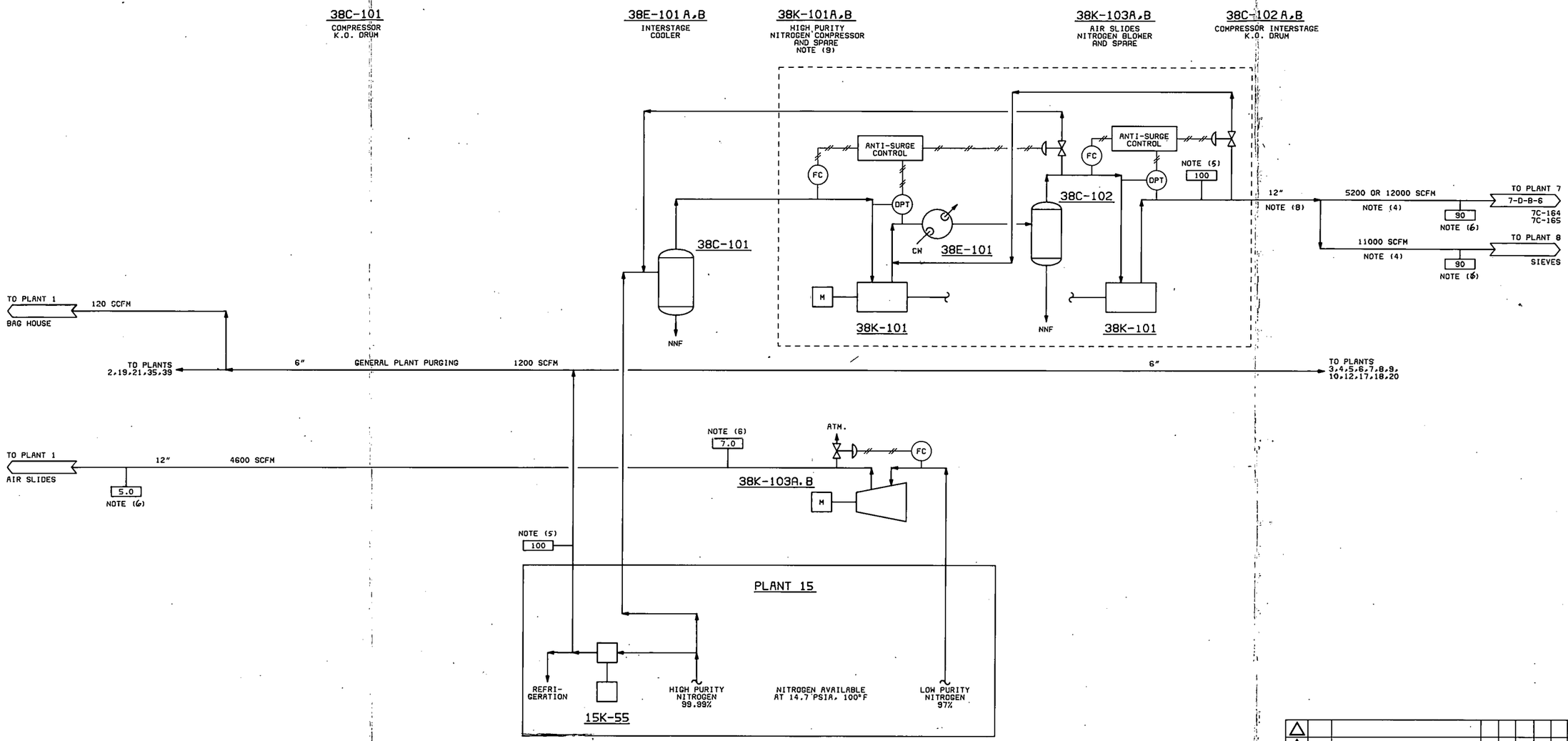
One such system consists of a compressor package unit with two compressors (38K-101 A and B), one operating and one spare, which supply high purity nitrogen at 100 psig for regeneration of the dryers in the Gas Plant (Plant 7) and Cryogenic Hydrogen Purification (Plant 8). Operation of these units is sequenced to regenerate one bed at a time so that the size of the compressor system is minimized.

Another such system, a Blower and spare (38K-101 A and B) supplies low purity nitrogen at 5 psig to air slides in Plant 1 coal bunkers.

2.3 Utility Balance

Electricity, kW

Condition	Consumed
Operating	1,386



NOTES:

1. EQUIPMENT ON THIS PFD TO BE LOCATED WITHIN PLANT 15 AREA.
2. SCFM AT 60°F AND 14.7 PSIA.
3. NNF = NORMALLY NO FLOW.
4. ASSUME THAT DRIERS AND SIEVE REGENERATION CYCLES CAN BE SYNCHRONIZED SO THAT LOADS DO NOT OVERLAP, I.E. ONLY ONE FLOW RATE AT A TIME.
5. PRESSURE(PSIG) AT PLANT 15 BATTERY LIMIT.
6. PRESSURE(PSIG) AT USEH BATTERY LIMIT.
7. LINE SIZES SHOWN ARE APPROXIMATE, FOR PHASE 0 ESTIMATING PURPOSES.
8. NEED FOR AN AFTERCOOLER TO BE DETERMINED IN PHASE 1.
9. COMPRESSORS 38K-101A,B PROVIDED AS A PACKAGE UNIT INCLUDING INTERCOOLERS, K-O DRUMS AND ANTISURGE CONTROL.

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	BI APP'L	ASFI APP'L
1	1/22/81	ISSUED FOR PHASE 0	BJS	LKM	LS		Will	
0	12/19/80	ISSUED FOR REVIEW/APPROVAL	BJS	LKM	LS			

DESIGNED | DRAWN

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80GR20017

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY | PHASE ZERO | KENTUCKY

PROCESS FLOW DIAGRAM PLANT 38 INERT GAS SYSTEM

JOB NO.	DRAWING NO.	REV.
14222	38-D-B-1	1

BECHTEL HOUSTON

22 X 34 "D" SIZE

KCL71B 01/19/81 MJ

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
38	INERT GAS SYSTEM	000000 NA
38C-101A	COMP K-101A K.O. DRUM	000000 NA
38C-101B	COMP K-101B K.O. DRUM	000000 NA
38C-102A	COMP K-101A INTERSTAGE K.O. DRUM	000000 NA
38C-102B	COMP K-101B INTERSTAGE K.O. DRUM	000000 NA
38E-101A	COMPRESSOR K-101A INTERSTAGE COOLER	000000 NA
38E-101B	COMPRESSOR K-101B INTERSTAGE COOLER	000000 NA
38K-101A	NITROGEN COMPRESSOR	000000 NA
38K-101B	NITROGEN COMPRESSOR	000000 NA
38K-103A	NITROGEN BLOWER	000000 NA
38K-103B	NITROGEN BLOWER	000000 NA

4.1 Data Sheets for Compressors and Drivers

38-DS-K-01: Nitrogen (38K-101 A, B)

38-DS-K-03: Fan/Blower (38K-103 A, B)

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT DATE _____ REVISION 0

FOR ASHLAND SYNTHETIC FUELS INC UNIT BRECKINRIDGE

SITE KENTUCKY SERIAL NO. _____

SERVICE NITROGEN NO. REQUIRED 2

MANUFACTURER INGERSOLL RAND MODEL 5C150M4 CENTAC DRIVER MOTOR

NOTE ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER 38-K-101 A,B

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	NORMAL	RATED	OTHER CONDITIONS A	B	C	D
● GAS HANDLED (ALSO SEE PAGE 2) NITROGEN						
● MMSCFD (SCFM) 14.7 PSIA & 60°F DRY)	12000	13200				
● WEIGHT FLOW, #/MIN (WET) (DRY) (LB/HR)	53,113	58,425				
INLET CONDITIONS:						
● PRESSURE (PSIA)	14.4	14.4				
● TEMPERATURE (°F)	AMB	AMB (91)				
● RELATIVE HUMIDITY (%)	0.	0.				
● MOLECULAR WEIGHT (M)	28.016	28.016				
☐ 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)		14,800				
DISCHARGE CONDITIONS:						
● PRESSURE (PSIA)		139.4	(4 STAGE)			
☐ TEMPERATURE (°F)	100	100				
☐ C_p/C_v (K_2) OR (K_{AVG})	1.4	1.4				
☐ COMPRESSIBILITY (Z_2) OR (Z_{AVG})	1.0	1.0				
☐ BHP REQUIRED (ALL LOSSES INCL)		3120				
☐ SPEED (RPM)		3565				
☐ ESTIMATED SURGE, ICFM (AT SPEED ABOVE)						
☐ POLYTROPIC HEAD (FT)						
☐ POLYTROPIC EFFICIENCY (%)						
● GUARANTEE POINT		13200 SCFM @ 125 PSIG				
☐ 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: (1) THE COMPRESSOR WILL OPERATE INTERMITTENTLY AT LOWER FLOWRATES AND MAXIMUM TURNDOWN IS IMPORTANT.

No.	DATE	REVISIONS	BY	CHK'D	DESIGN SUPV	ENG'R	PROJ ENGR	APPR
1	10/7/81	ADDED NOTE ON TURNDOWN & C.W.					ALP	MWL
0	12/31/80	ISSUED FOR PHASE ZERO	JMV/MH				AHP	HVH

SCALE _____ DESIGNED _____ DRAWN _____ CHIEF ENGR _____

ORIGIN

BECHTEL

CENTRIFUGAL COMPRESSOR DATA SHEET

JOB No. 14222

DRAWING No. 38-DS-K-01 REV. 1

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	0.005%						
NITROGEN	28.016	99.99%						
WATER VAPOR	18.016							
CARBON MONOXIDE	28.010							
CARBON DIOXIDE	44.010	0.005%						
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	108	
MINIMUM °F	-16	

UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER _____

NOISE SPECIFICATIONS:
○ APPLICABLE TO MACHINE:
SEE SPECIFICATION _____
◉ APPLICABLE TO NEIGHBORHOOD
SEE SPECIFICATION OSHA
ACOUSTIC HOUSING: ○ YES ◉ NO
Complete Unit Encl.

APPLICABLE SPECIFICATIONS:
API 617 CENTRIFUGAL COMPR. FOR GEN. REFINERY SERVICES
API STANDARDS 672 (JUNE 1973)
AS MODIFIED by PURCHASER

PAINTING:
◉ MANUFACTURER'S STD. (SUBJ. TO REVIEW)
○ OTHERS _____

SHIPMENT:
◉ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQD.
◉ OUTDOOR STORAGE OVER 6 MONTHS

REMARKS: _____

Form 187 (5/80) Sheet 2 of 6 REC

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 (PEAK TO PEAK) _____ MILS

☐ **ROTATION, VIEWED FROM DRIVEN END:**

☐ **CASING:**
MODEL 5L 150 M14
CASING SPLIT VERTICAL
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: _____

RAC 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:

● TYPE PROXIMITOR PROBE ● MODEL TYPE 180

○ MFR B-V

○ NO. AT EACH SHAFT BEARING _____ TOTAL NO _____

○ OSCILLATOR-DETECTORS SUPPLIED BY _____

○ MFR B-V ☐ MODEL _____

○ MONITOR SUPPLIED BY _____

● LOCATION CONT. PANEL ENCLOSURE _____

○ MFR. B.V. ☐ MODEL _____

☐ SCALE RANGE 0-2 ○ ALARM ☐ SET @ 2.7 MILS

○ SHUTDOWN ☐ SET @ 4.0 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.

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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	X	○	○
HYDROSTATIC	X	○	○
HELIUM LEAK	○	○	○
MECHANICAL RUN	X	○	○
MECH RUN SPARE ROTOR	○	○	○
FIT IN SPARE ROTOR	○	○	○
PERFORMANCE TEST (GAS) (AIR)	X	○	○
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	X	○	○
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. 96,000 GEAR 10" DRIVER 10" 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 7'-0"	W 10'-3"	H 10'-3"
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:

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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	4160			
HERTZ	60			
PHASE	3			

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: (1)

COOLING WATER 759 GPM
STEAM, NORMAL ____ #/HR
STEAM, MAX ____ #/HR
INSTRUMENT AIR ____ SCFM
HP (DRIVER) ____ HP
HP (AUXILIARIES) ____ HP

REMARKS:

EQUIPMENT INCLUDED

- I.R. COMPRESSOR - MODEL SC 150 M4 CENTAC
- 3500 HP WP II TYPE INDUCTION MOTOR
- INLET THROTTLE VALVE
- BYPASS VALVE
- NEMA IV CONTROL PANEL (MOUNTED)
- AUTO DUAL CONTROL REGULATION
- LUBE OIL HEATERS
- DUAL OIL FILTERS AND COOLERS WITH TRANSFER VALVE
- SS OIL PIPING
- INTERSTAGE PRESSURE AND TEMPERATURE GAUGES
- HIGH AIR TEMPERATURE SWITCH
- LOW OIL PRESSURE SWITCH
- TIGHT CLOSURE FEATURE (REVERSE ROTATION PROTECTION)
- SPACER COUPLING AND GUARD
- INTERCOOLERS AND MOISTURE SEPARATORS (MOUNTED)
- AFTER COOLERS AND MOISTURE SEPARATORS (MOUNTED)
- VIBRATION MONITOR (EACH PINION).
- SS IMPELLERS
- [illegible] LABYRINTH
- MECH RUN AND PERFORMANCE TEST (1 POINT)
- [illegible] REQUIREMENTS

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POWER: VOLTS _____
CYCLES _____ PHASES _____
STEAM P.S.I.G. AT THROTTLE _____
EXHAUST _____

FAN OR BLOWER DATA SHEET

SPECIFICATION NO. _____
B. M. NO. _____

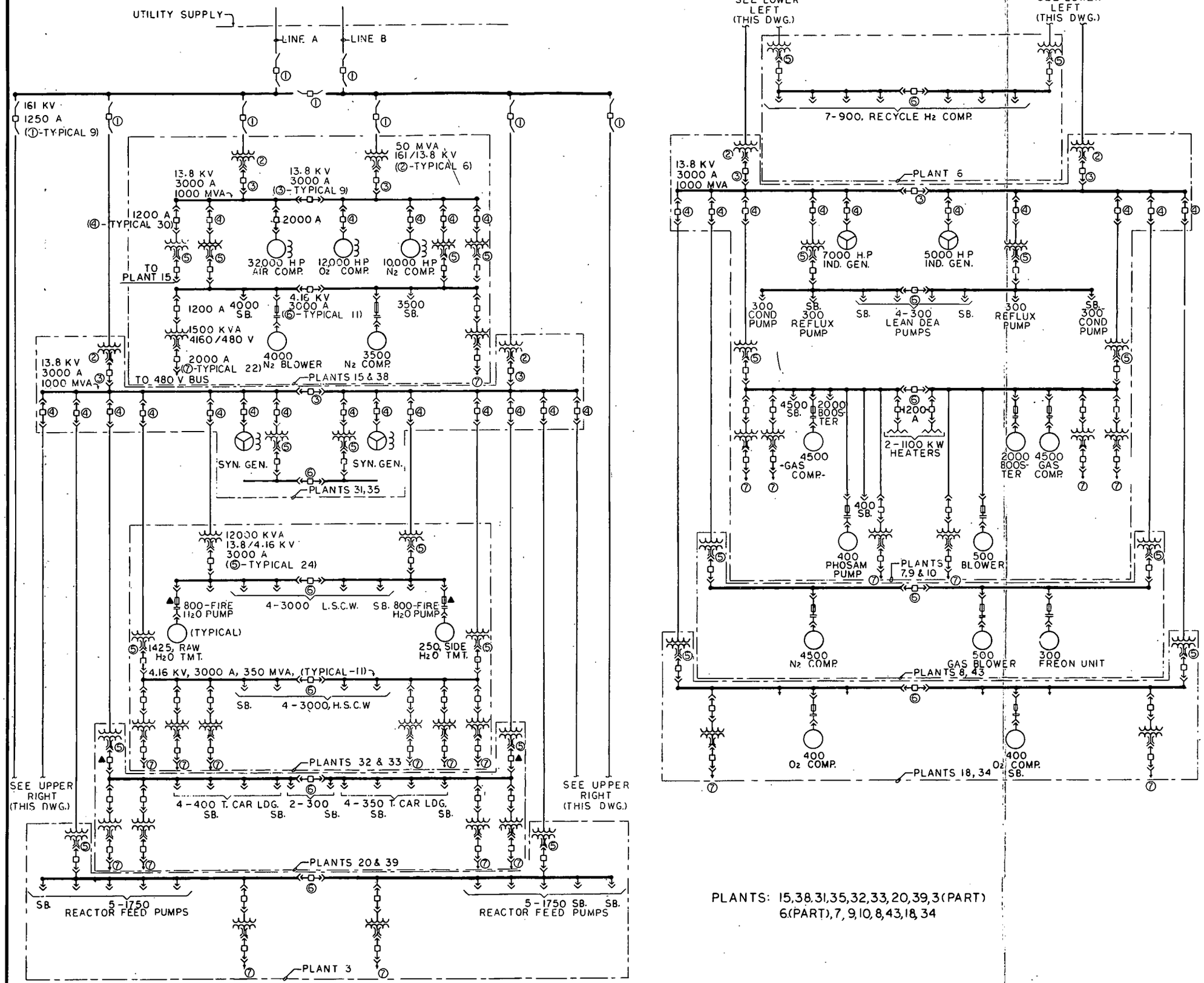
INSTRUCTIONS TO BIDDERS - FILL IN EVERY SPACE TO MAKE BID COMPLETE

A. GAS CHARACTERISTICS SERVICE	FLOWSHEET NO	
	PLANT EQUIP. NO.	38-K-103 A/B
1 GAS		NITROGEN
2 S P. GR. (AIR = 1.0)		
3 POUNDS PER HOUR		22397
4. STD. C.F.M. @ 60°F & 14.7 PSIA		5060
5. FLOW TEMP. °F		100
6. CFM AT FLOW TEMP.		5247
B PRESSURES		
1 SUCTION (PSIA)		14.4
2. DIFFERENTIAL (PSI)		7.6
3. DISCHARGE (PSIA)		22
C. OPERATION		
1. EFFICIENCY AT RATING		
2. B H P AT RATING		198
3. BID IMPELLER DIAM		
4. MAX BHP FOR BID IMP DIA		
5. R P M. OF FAN OR BLOWER		1175
6. R P M OF DRIVER		
7. TIP SPEED		
8. OUTLET VELOCITY		
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW		
10 NUMBER OF STAGES		
D. CONSTRUCTION & MATERIAL		
1. CASE: MATERIAL		C.I.
CONSTRUCTION: HORIZ. OR VERT SPLIT		VERT
2. IMPELLER		D.I.
3 SHAFT MATERIAL		ALOI STEEL
4. SHAFT DIAMETER		—
5. FLEXIBLE COUPLING		YES
6. COUPLING GUARD		—
7. BASE PLATE		-
8. CLASS (FANS)		
9. ARRANGEMENT (FANS)		
10. INLET SCREEN		
11. CLEAN-OUT REQUIRED		
12. VARIABLE INLET VANES REQ'D.		
MANUFACTURER		ROOTS-DRESSER
MFR'S TYPE & SIZE		1225 RGS

E. BEARINGS & LUBRICATION SERVICE	FLOWSHEET NO.	
	PLANT EQUIP. NO.	38K-103 A/B
1 THRUST (S.A.E. NO. ON FINAL DATA SHEET)		
2 RADIAL (S A E. NO. ON FINAL DATA SHEET)		
3 — GREASE PCKD. / FLOOD OILNG. / RING OILNG.		
THRUST	A / B / C	
RADIAL	A / B / C	
4 TYPE OF CLOSURES:		
5 METHOD OF SEALING		
6 VISIBLE LUBRICATORS: TYPE		
7 VISIBLE LUBRICATORS: CAPACITY		
8 BEARINGS WATER COOLED		
9 LUBRICATING OIL PUMP		
10 LUBRICATING OIL COOLER		
F. CONNECTIONS		
1A INLET: SIZE		
1B INLET: RATING		
1C. INLET: FACING		
2A. DISCHARGE SIZE		
2B. DISCHARGE RATING		
2C. DISCHARGE FACING		
2D DISCHARGE LOCATION		
G. TESTING STATE EXTRA COST IF ANY FOR EACH		
1 DYNAMIC BALANCING OF IMPELLERS		YES
2. WITNESSED PERFORMANCE TEST		YES
3. INSPECTION		YES
4 RUNNING TEST WITH ACTUAL DRIVER		YES
H. MISCELLANEOUS		
1 PRICE EACH F.O.B. F.A.S.		
2 WEIGHT POUNDS NET		9200 est
2A WEIGHT BOXED FOR SHIPMENT		—
3 SHIPMENT FROM RCPT OF ORDER WEEKS		
4. DRIVER H.P.		250
5. TYPE OF DRIVER: MOTOR		MOTOR
6 DRIVER COUPLED.		COUPLED
7. PERFORMANCE CURVE MANUFACTURERS NO.		
7A. PERFORMANCE CURVE FOREIGN PRINT NO		
8. OUTLINE DRAWING MANUFACTURERS NO.		
8A OUTLINE DRAWING FOREIGN PRINT NO.		
9. CROSS SECTION DWG. MANUFACTURERS NO.		
9A. CROSS SECTION DWG. FOREIGN PRINT NO.		
10 M'FR'S SERIAL NO. ON FINAL DATA SHEET		
PRICE INCLUDES MOTOR BLOWER, SILENCER		

BECHTEL HOUSTON	REV	DATE						DATE		JOB. NO. 14222	REV.
	0	11/29/60	ISSUED FOR PHASE ZERO	HP	JJO	AJP		HHH		DWG. NO 38-DS-K 03	0

FORM H-280 8/58


UTILITY SUPPLY
LINE A
LINE B
161 KV
1250 A
(①-TYPICAL 9)
13.8 KV
3000 A
1000 MVA
13.8 KV
3000 A
(③-TYPICAL 9)
50 MVA
161/13.8 KV
(②-TYPICAL 6)
1200 A
(④-TYPICAL 30)
2000 A
32,000 H.P
AIR COMP.
12,000 H.P
O2 COMP.
10,000 H.P
N2 COMP.
TO
PLANT 15
1200 A
4000
SB.
4.16 KV
3000 A
(⑥-TYPICAL 11)
3500
SB.
1500 KVA
4160/480 V
2000 A
(⑦-TYPICAL 22)
4000
N2 BLOWER
3500
N2 COMP.
13.8 KV
3000 A
1000 MVA
TO 480 V BUS
PLANTS 15 & 38
SYN. GEN.
SYN. GEN.
PLANTS 31, 35
12000 KVA
13.8/4.16 KV
3000 A
(⑤-TYPICAL 24)
4-3000 L.S.C.W.
SB.
800-FIRE
H2O PUMP
(TYPICAL)
800-FIRE
H2O PUMP
1425, RAW
H2O TMT.
250, SIDE
H2O TMT.
4.16 KV, 3000 A, 350 MVA, (TYPICAL-11)
SB.
4-3000, H.S.C.W
PLANTS 32 & 33
4-400 T. CAR LDG.
SB.
2-300
SB.
4-350 T. CAR LDG.
SB.
SEE UPPER
RIGHT
(THIS DWG.)
SEE UPPER
RIGHT
(THIS DWG.)
PLANTS 20 & 39
SB.
5-1750
REACTOR FEED PUMPS
5-1750 SB.
SB.
REACTOR FEED PUMPS
PLANT 3
SEE LOWER
LEFT
(THIS DWG.)
SEE LOWER
LEFT
(THIS DWG.)
7-900, RECYCLE H2 COMP.
13.8 KV
3000 A
1000 MVA
PLANT 6
7000 H.P
IND. GEN.
5000 H.P
IND. GEN.
300
COND
PUMP
SB.
300
REFLUX
PUMP
SB.
4-300
LEAN DEA
PUMPS
SB.
300
REFLUX
PUMP
SB.
300
COND
PUMP
4500
SB.
2000
BOOS-
TER
4500
-GAS
COMP-
1200
A
2-1100 KW
HEATERS
2000
BOOS-
TER
4500
GAS
COMP.
400
SB.
400
PHOSAM
PUMP
PLANTS
7,9 & 10
500
BLOWER
4500
N2 COMP
500
GAS BLOWER
300
FREON UNIT
PLANTS 8, 43
400
O2 COMP.
400
O2 COMP.
SB.
PLANTS 18, 34
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
ISSUED FOR PHASE ZERO
ISSUED FOR REVIEW/APPROVAL
T4/RAO
RAO
BRECKINRIDGE PROJECT
ELECTRICAL ONE LINE DIAGRAM
14222
30E-P-003
1

PLANT 39 PURGE AND FLUSH OIL SYSTEMS

1.0 INTRODUCTION

Plant 39 includes the following:

- Pump and instrument flush oil systems
- Pump warming systems for slurry pumps
- Emergency flush oil systems
- Neutral oil system
- Glycol system for cooling rotating equipment

Process flow requirements and major equipment for these systems are presented in Drawing 39-D-B-1.

The oils consumed in Plant 39 are either produced onsite (distillate flush oil, heavy distillate and vacuum distillate) or purchased (neutral oil). These oils are stored in intermediate product tankage in Tankage (Plant 20). Distillate flush oil and vacuum distillate flush oil are filtered in Plant 20 and transferred to use points by means of the Interconnecting Piping (Plant 21).

Plant 39 includes various drums, pumps, heaters, coolers and filters physically located in the battery limits of the following plants:

- Coal Slurry Preparation (Plant 2)
- H-Coal Preheating and Reaction (Plant 3)
- H-Coal Primary Separation (Plant 4)
- H-Coal Recycle Slurry Preparation (Plant 5)

- H-Coal Recycle Hydrogen Compression (Plant 6)
- Gasification and Purification (Plant 12)
- H-Coal Distillate Separation (Plant 17)

The equipment is not included in the individual plants since in many cases, several plants are supplied by one Plant 39 system.

PLANT 39 PURGE AND FLUSH OIL SYSTEM

2.0 PLANT DESIGN

2.1 Design Basis

The design basis and a brief description for each system is detailed in the following paragraphs. For clarity the titles of the plants referred to in this plant description are listed in the introduction.

2.1.1 Pump and Instrument Flush Oil Systems

Two separate pump seal oil systems are provided to supply slurry pump inboard seal flush, lantern ring flush, instrument purges and ebullating pump flush. One system uses distillate flush oil obtained from a main tower sidedraw in Plant 17. The distillate flush oil is used for seal flush oil to slurry pumps in Plants 2, 3, 5 and 12, as well as for special flushes in Plants 3 and 12. The second system is supplied with vacuum distillate from the vacuum tower in Plant 5. Vacuum distillate flushes are used in Plant 5 for services requiring flush oil with low volatility.

Distillate flush oil from Plant 17 is stored in the Tanks (20D-114 A and B) and filtered in the precoat Filter Package (20V-104). This equipment is located in Tankage (Plant 20). The 2 x 50,000-barrel tanks provide a six-day storage capacity. Distillate flush oil is used in the applications outlined in Table 1.

Distillate flush oil piping located downstream of the filtration step is light wall stainless steel to avoid plugging small valves used for metering flushes and to ensure a perfectly clean supply of flush for the ebullating and charge pump requirements. The flush oil header design pressure is 250 psig so that only the high-pressure users require independent charge drums and pumps.

TABLE 1

PLANT 17 DISTILLATE FLUSH OIL USAGE

Inboard Seal Flushes	lb/hr
Plant 2	17,500
Plant 3	191,520
Plant 4	7,000
Plant 5	20,000
Plant 12	12,000
Subtotal	248,020
Instrument Purging to Plants 2, 3, 5, and 17	20,550
Total Requirement	268,570

TABLE 2

PLANT 5 VACUUM DISTILLATE FLUSH OIL USAGE

Inboard Seal Flushes	lb/hr
Plant 5	10,000
Plant 12	4,000
Total	14,000

Vacuum distillate flush oil from Plant 5 is stored in the Tank (20D-127) and filtered in the precoat Filter Package (20V-103). This equipment is located in Tankage (Plant 20). The 10,000-barrel tank provides a ten-day storage capacity. Vacuum distillate flush oil is used in the applications described in Table 2.

Vacuum distillate flush oil piping downstream of the filtration step is light wall stainless steel to ensure a clean supply of flush oil. Vacuum distillate flush oil is used in applications where the lower boiling distillate flush oil would vaporize in the pump casing leading to cavitation.

2.1.2 Pump Warming Systems for Slurry Pumps

Hot slurry pumps are designed with replaceable casing liners. These liners are made of abrasion-resistant materials subject to cracking upon rapid heating. In order to permit controlled heating of these pumps and to maintain spare pumps in a hot standby condition, pump warming systems are provided.

Plot plan considerations suggested the use of three systems in order to minimize the cost of distribution piping. One system serves the hot slurry pumps in Trains 1, 2, 3 and 4 of Plant 4, as well as Train 1 of Plant 5. Another system serves the hot slurry pumps in Trains 5, 6, 7 and 9 of Plant 4, as well as Train 2 of Plant 5; and the third system serves all the hot slurry pumps in Plant 12.

The systems are designed to supply 10 GPM of 500°F oil to each standby slurry pump. Heavy distillate is used as the circulating fluid. Contaminated or degraded heavy distillate is pumped to the fractionator preflash drum in H-Coal Distillate Separation (Plant 17). All slurry pumps normally operating at 600°F or higher are tied into the

warming system. Electrical heating is used to offset heat losses and maintain the circulating oil at 500°F.

2.1.3 Emergency Flush Oil System

Two separate pumping systems are provided to supply heavy distillate (fractionator bottoms) produced in Plant 17. A low flow rate system is provided for various nonemergency intermittent uses. The principal operation served by the low flow rate system is the catalyst addition and withdrawal system in H-Coal Preheating and Reaction (Plant 3). A second system is provided for various emergency or upset conditions requiring high flow rates.

Heavy distillate from Plant 17 is stored in a 50,000-barrel Tank (20D-119). This tank is heated to maintain the oil viscosity at a level suitable for pumping. A low flow pumping system transfers heavy distillate to process units for use in adding and removing catalyst from the Plant 3 reactors and for flushing various control valves and pressuresafety valves. This system is also used for supplying oil to the pump warming system and to various slurry blowdown drums. An inventory of heavy distillate is kept in these slurry blowdown drums to dilute high melting point slurry discharged from safety valves. The dilution simplifies the pumping and handling of material.

A second high flow rate pumping system is provided for emergency uses. This system pumps from the same tank as the low flow rate system and is arranged to supply up to 2,400 GPM for various emergency situations. The more critical of these situations are:

- Supplying distillate oil for controlling Plant 3 temperature excursions by direct injection into the high-pressure system (quenching)
- Supplying distillate oil for flushing slurry out of various drums and lines in Plants 2, 3, 4, 5 and 12 prior to shutdown for repair or during localized power outages

- Supplying distillate oil for diluting vacuum bottoms from Plant 5. The diluted vacuum bottoms are pumped to storage when vacuum bottoms production exceeds the Plant 12 gasification capacity

None of the low flow or high flow applications require a clean distillate oil, accordingly, filtration and stainless piping are not used in these systems.

2.1.4 Neutral Oil System

Neutral oil is required for proprietary applications in H-Coal Preheating and Reaction (Plant 3). A pumping system is provided to transfer neutral oil to day tanks located in Plant 3. Purchased neutral oil is unloaded from tank cars to the Tank (20D-125) in Tankage (Plant 20). The 10,000-barrel tank provides a 30-day storage capacity. The 100 SSU viscosity oil is pumped once a day to 8 x 3,000-gallon day tanks located inside the Plant 3 battery limits.

Neutral oil is also used in closed loop pressurization and cooling systems for the slurry pump shaft seals. In some cases these systems have been included in the vendor package for the pump and in others data sheets have been developed for the individual components. A standardized procurement approach will be developed during the detailed mechanical design work.

2.1.5 Glycol Systems

Glycol solution of 50 wt% is used for cooling of slurry pump pedestal, seal housing and bearing casing. Two systems, north and south, are provided to accommodate plot plan requirements. Each system consists of a horizontal holding drum, circulating pumps, glycol solution coolers and required piping to and from the slurry pump. The north system serves all slurry pumps in Plants 2, 3 and 4 and the compressor

lube oil cooler in Plant 6. The south system serves Plants 5, 12 and 17. There is no provision for supplemental glycol storage. The glycol solution is brought to the plant site in 55-gallon drums and unloaded directly into the holding drums.

2.2 Utility Balance

Electricity, kW

Condition	Consumed
Operating	400

INBOARD SEAL FLUSH OIL-LOW EFV SERVICES (HIGH VOLATILITY)

FRACTIONATOR LOWER SIDE DRAW-DISTILLATE FLUSH OIL

2500 LB/HR TO 29-102A,B COAL SLURRY BOOSTER PUMP

NOTE (3) TO PLANT 2 — TO OTHER 7 TRAINS

NOTE (3) TO PLANT 3 — TO OTHER 7 TRAINS

19800 LB/HR TO 39-101A,B,C SLURRY CHARGE PUMPS

7560 LB/HR

39C-112

39E-110

39C-103

39G-106A,B,C

TO 39-102 TO EBULLATING PUMP

15850 LB/HR TO PLANT 5

3770 LB/HR — 1885 LB/HR TRAIN 2 — TO 50-113A,B ATM. STRIPPER FEED PUMP

4000 LB/HR TO PLANT 12 — TO OTHER 7 PUMPS

TO 129-101 GASIFIER FEED PUMP

3770 LB/HR — 1885 LB/HR TRAIN 2 — TO 50-101A,B HYDROCLONE OVERFLOW ATM. FLASH DRUM FEED PUMP

20,550 LB/HR

20V-104 PRECOAT FILTERS PACKAGE UNIT

4540 LB/HR — 1885 LB/HR TRAIN 2 — TO 50-114A,B HYDROCLONES FEED PUMP

228450 LB/HR

3770 LB/HR — 1885 LB/HR TRAIN 2 — TO 50-117A,B VAC. TOWER STARTUP HEATER

TO PLANTS 2,3,5,4,12,17 INSTRUMENT PURGING

20D-114A,B

DISTILLATE FLUSH OIL PLANT 17

20E-112A,B

20G-114A,B,C

PUMP AND INSTRUMENT FLUSH OIL SYSTEMS

INBOARD SEAL FLUSH OIL-HIGH EFV SERVICE (LOW VOLATILITY)

VACUUM TOWER SIDE DRAW- VACUUM DISTILLATE

4000 LB/HR TO PLANT 12 — TO 129-025A GASIFIER BOOSTER PUMP — TO OTHER 3 BOOSTER PUMPS

23000 LB/HR TO PLANT 5

3830 LB/HR TO 50-103A,B VACUUM TOWER SURGE DRUM FEED PUMP — 3830 LB/HR TO TRAIN 2

3830 LB/HR TO 50-106A,B VACUUM TOWER BOTTOMS PUMP — 3830 LB/HR TO TRAIN 2

3830 LB/HR TO 50-111A,B, HYDROCLONE OVERFLOW VACUUM FLASH DRUM BOTTOMS PUMP — 3850 LB/HR TO TRAIN 2

VACUUM DISTILLATE PLANT 5

20D-127

20V-103 PRECOAT FILTERS PACKAGE UNIT

20G-128A,B,C

20E-114

EMERGENCY FLUSH OIL SYSTEMS

LOW RATE APPLICATIONS & LINE FLUSHING — TO 3C-109 FOR CATALYST TRANSFER & LINE FLUSHING — TO OTHER 7 TRAINS

100 PSIG

HIGH PRESSURE QUENCH OIL 3000 PSIG — TO OTHER 7 TRAINS — TO 3F-102 SLURRY HEATER — TO 3C-101

39G-111A,B 600 GPM

LOW PRESSURE QUENCH OIL — TO OTHER 7 TRAINS — TO 39-101A,B SLURRY CHARGE PUMPS

PC

PLANT 12 — TO 12C-001 &12C-002 GASIFIER CHARGE — TO 129-101 GASIFIER FEED PUMP — TO OTHER 7 PUMPS

PLANT 4 — TO OTHER 7 TRAINS — TO 4C-106

PLANT 5 — TO TRAIN 2 — HYDOCLONES — TO 5C-107 UNDERFLOW DRUM — TO 5C-109 ATM. FLASH DRUM — TO 5C-110 VACUUM FLASH DRUM — TO 5C-102 ATM. STRIPPER — TO 5C-104 VACUUM TOWER — TO 5C-113 START UP DRUM

PLANT 2 — TO OTHER 7 TRAINS — TO 29-102A SLURRY BOOSTER PUMP

PLANT 5 MIXER — TO 20D-111A,B VACUUM TOWER BOTTOMS

VACUUM BOTTOMS FROM PLANT 5

20G-119A,B

20D-119

HEAVY FLUSH OIL PLANT 17

20E-111

20G-129A,B,C 1200 GPM

120 PSI

20G-133 JOCKY PUMP 120 GPM

GLYCOL SYSTEM FOR COOLING ROTATING EQUIPMENT

FROM 55GAL. DRUMS GLYCOL

NORTH SYSTEM PLANTS 2,3,4,6

SOUTH SYSTEM PLANTS 5,12,17,6

SIMILAR TO NORTH SYSTEM

39E-111

39C-104

FROM ALL SLURRY PUMPS

TO ALL SLURRY PUMPS PLANTS 2,3,4 AND COMP. LUBE OIL COOLER PLANT 6

39G-107A,B

PUMP WARMING SYSTEMS FOR SLURRY PUMPS

39C-003

WEST SYSTEM TO PLANTS 4 & 5

39E-003A&B — TO ALL SLURRY PUMPS — FROM

39G-003A,B

TO PLANT 17 FRACTIONATOR PREFLASH DRUM

39C-004

EAST SYSTEM TO PLANTS 4 & 5

39E-004A&B — TO ALL SLURRY PUMPS — FROM

39G-004A,B

TO PLANT 17 FRACTIONATOR PREFLASH DRUM

39C-107

TO PLANT 12

39E-114 — TO ALL SLURRY PUMPS — FROM

39G-110A,B

TO PLANT 17 FRACTIONATOR PREFLASH DRUM

HEAVY FLUSH OIL PLANT 17

20D-119

20G-119A,B

20E-111

NEUTRAL OIL SYSTEM

39C-001 & 39C-002

39E-001 & 39E-002

PLANT 12

39E-005 & 39E-006

12G-025A,B,C,D

39G-001A,B 39G-002A,B

39Y-001A,B & 39Y-002A,B

PLANT 3

39C-101

39C-113

20D-125

39E-109

NEUTRAL OIL FROM TANK

TO OTHER 7 TRAINS

TO 39-102 EBULLATING PUMP

20G-125A,B

39G-102A,B,C (2 RUNNING, 1 SPARE)

NOTES

1. FLOW RATES SHOWN ARE FOR ORDER OF MAGNITUDE ONLY NEW FLOW RATES WILL BE ISSUED AT A LATER DATE.
2. PLANT 39 EQUIPMENT FOR PLANTS 2,4,5 (NEUTRAL OIL SYSTEM) TO BE PROVIDED BY PUMP MANUFACTURER
3. DISTILLATE FLUSH OIL DESIGNED TO FEED 7 TRAINS SIMULTANEOUSLY IN PLANT 2 AND PLANT 3

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	ENG'G	SI APPR.	ASFI APPR.
2	10/13/81	REV. LINE ROUTING; ADDED EQP.NOS.			CKM			WWL
1	6/11/81	ISSUED FOR PHASE 0			LDA	NSG		WWL MHD
0	12/ /80	ISSUED FOR CLIENT REVIEW/APPROVAL			LDA	AHS		

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

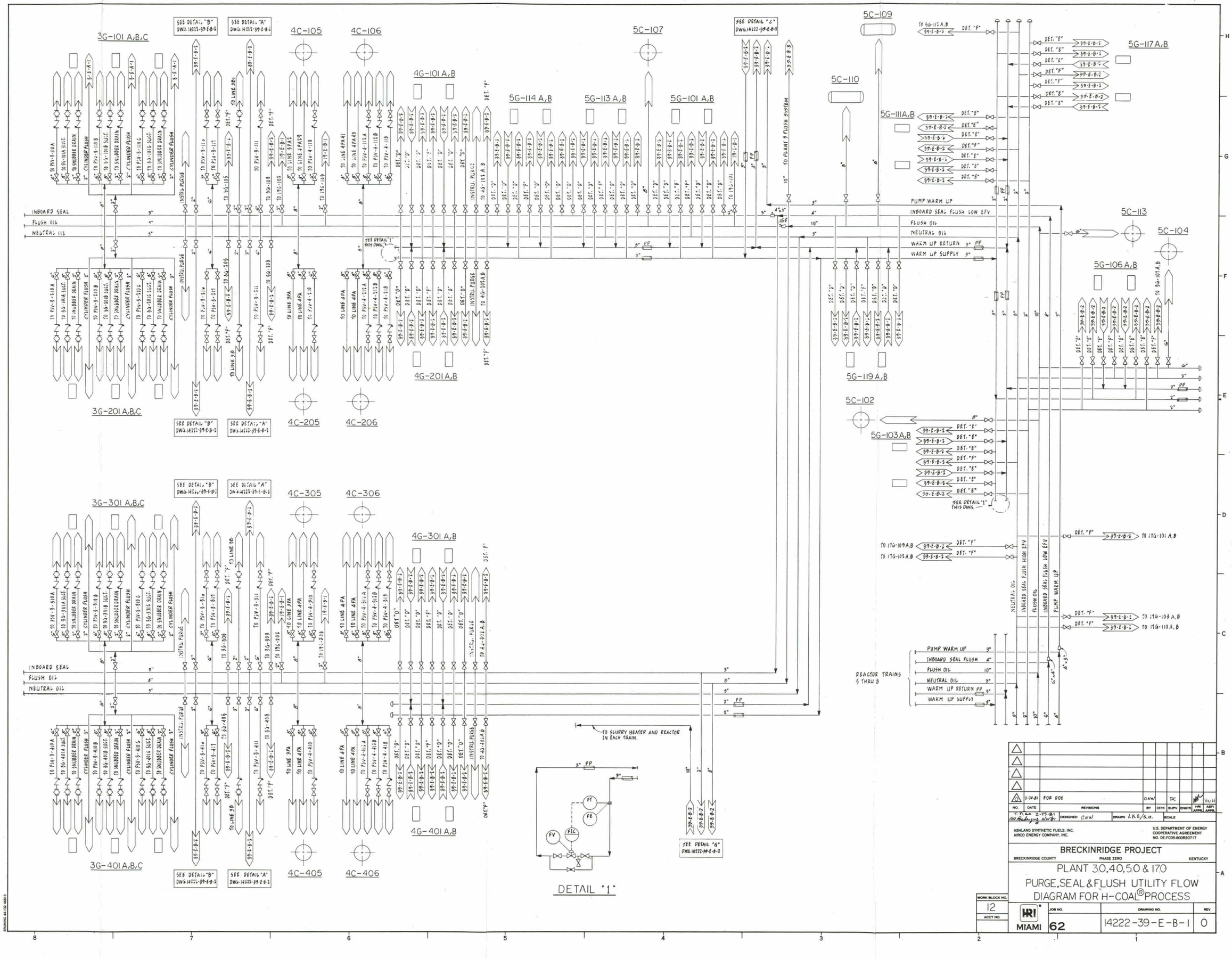
PROCESS FLOW DIAGRAM PLANT 39 - PURGE AND FLUSH OIL SYSTEMS

BECHTEL HOUSTON

JOB NO. 14222 — DRAWING NO. 39-D-B-1 — REV. 2

22 X 34 "D" SIZE

KCL75A 02/11/81 MHB



NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENGR.	HRI APPR.	ASPT. APPR.
1	2-24-81	FOR DOE	CNW		TRC			

T. K. Ko 2-25-81 — DESIGNED C.N.W. — DRAWN K.O./S.M. — 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 30, 40, 50 & 170
PURGE, SEAL & FLUSH UTILITY FLOW DIAGRAM FOR H-COAL® PROCESS

WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV.
12	62	14222-39-E-B-1	0

ACCT NO.

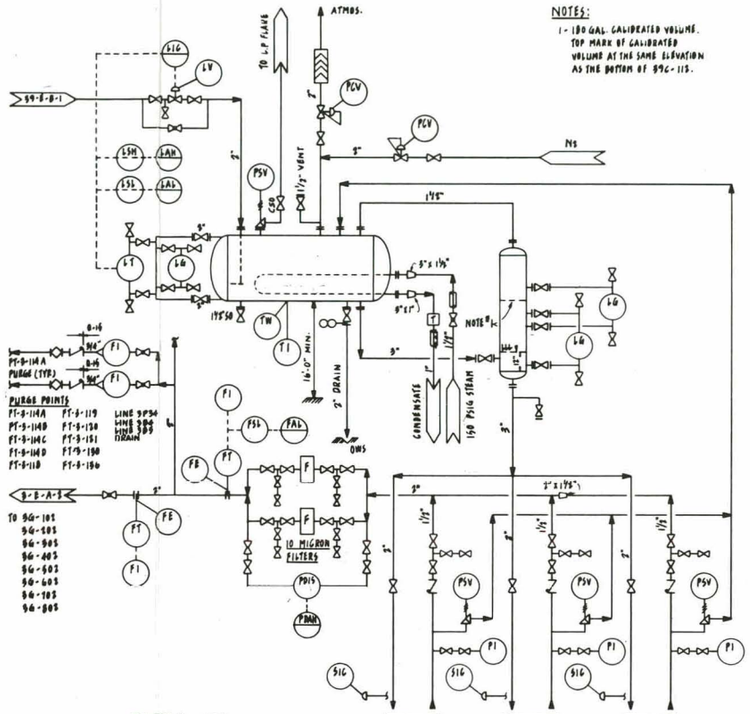
HRI MIAMI

BRUNING 44-132-4613

39C-112
PLANT 3.0 FLUSH OIL
STORAGE DRUM
6'-0" Ø X 16'-0"
DESIGN: 50 PSIG/FULL VAC. AT 650°F
INSULATION 2"

39C-103
PLANT 3.0 FLUSH OIL
RATE CHECK DRUM
2'-6" Ø X 10'-0"
DESIGN: 50 PSIG/FULL VAC. AT 650°F
INSULATION 2"

NOTES:
1 - 180 GAL. CALIBRATED VOLUME. TOP MARK OF CALIBRATED VOLUME AT THE SAME ELEVATION AS THE BOTTOM OF 39G-115.



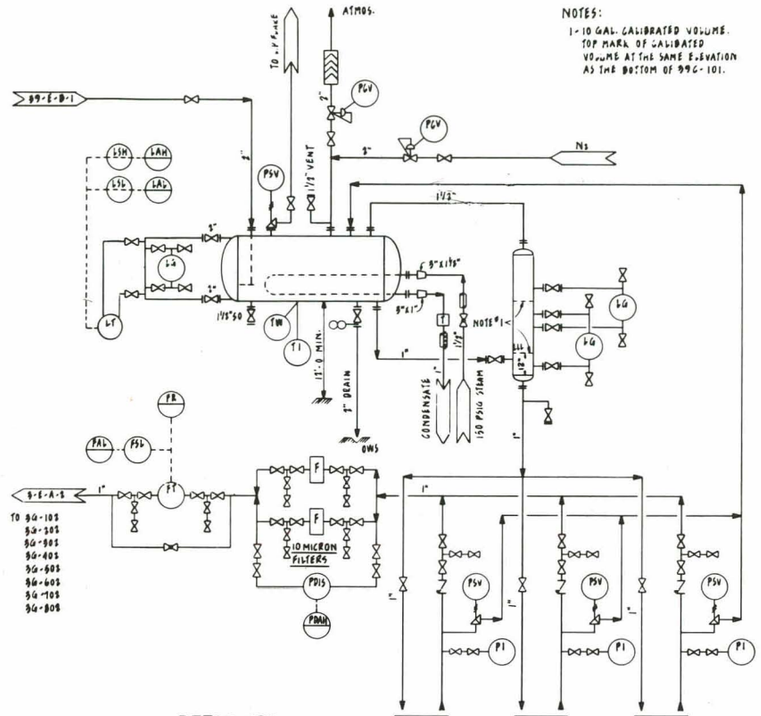
DETAIL "A"
PROCESS DERIVED FLUSH FOR EBULLATING PUMP AUXILIARY SEAL & HIGH PRESSURE PURGE OIL (8 REQ'D)

39G-106A
39G-106B
39G-106C SPARE
HIGH PRESSURE FLUSH OIL PUMPS

39C-101
EBULLATING PUMP
SEAL OIL DRUM
6'-0"Ø X 16'-0"
DESIGN: 50 PSIG/FULL VAC. AT 650°F
INSULATION 2"

39C-113
EBULLATING PUMP SEAL OIL
RATE CHECK DRUM
6'Ø X 11'-6"
DESIGN: 50 PSIG/FULL VAC. AT 650°F
INSULATION 2"

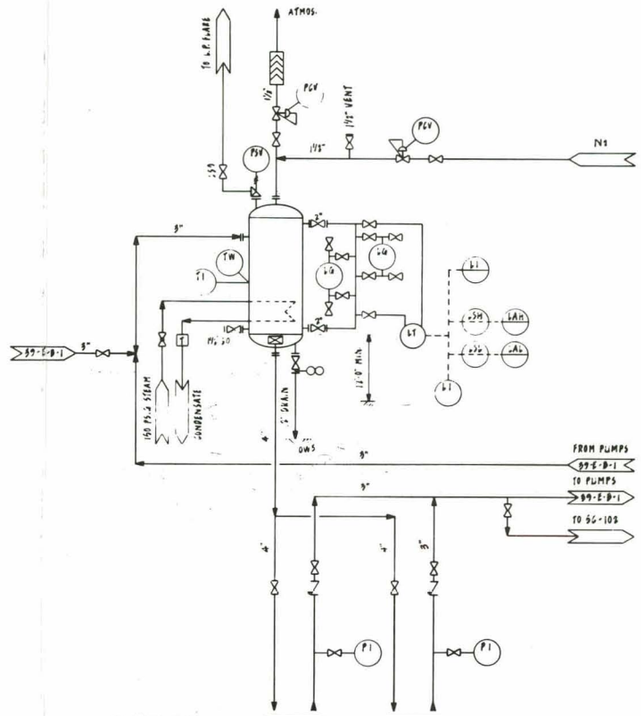
NOTES:
1 - 10 GAL. CALIBRATED VOLUME. TOP MARK OF CALIBRATED VOLUME AT THE SAME ELEVATION AS THE BOTTOM OF 39G-101.



DETAIL "B"
NEUTRAL OIL FLUSH FOR EBULLATING PUMP MOTOR (8 REQ'D)

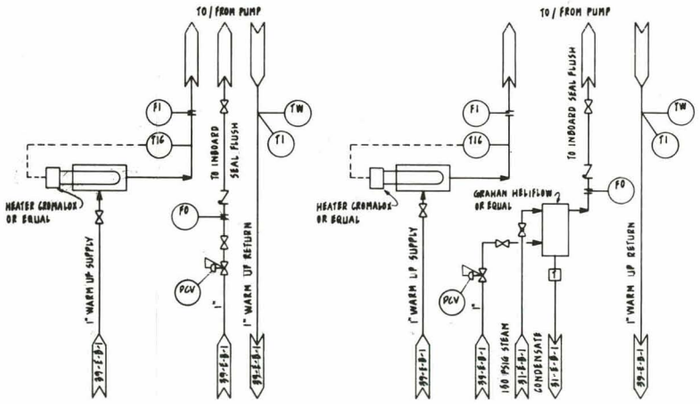
39G-102A
39G-102B
39G-102C SPARE
EBULLATING PUMP SEAL OIL SUPPLY PUMPS
(MANUAL STROKE ADJUSTMENT)

39C-003 & 39C-004
SLURRY PUMP WARNING
SYSTEM DRUM
4'-0" Ø X 12'-0"
DESIGN: 50 PSIG/FULL VAC. AT 650°F



DETAIL "C"
WARM UP FOR PUMPS (2 REQ'D)

39G-003A & 39G-004A
PUMP WARNING SYSTEM CIRCULATION PUMPS
SPARE



NOTES:
1 - OPERATING PUMP: WARM UP SUPPLY AND RETURN NOT IN SERVICE.
2 - SPARE PUMP: INBOARD SEAL FLUSH NOT IN SERVICE.
3 - WHEN PUMP IS AT AMBIENT TEMPERATURE DO NOT USE HEATER. PUT HEATER IN SERVICE WHEN PUMP TEMPERATURE APPROACHES 600°F BY SETTING "TIC" AT 600°F.

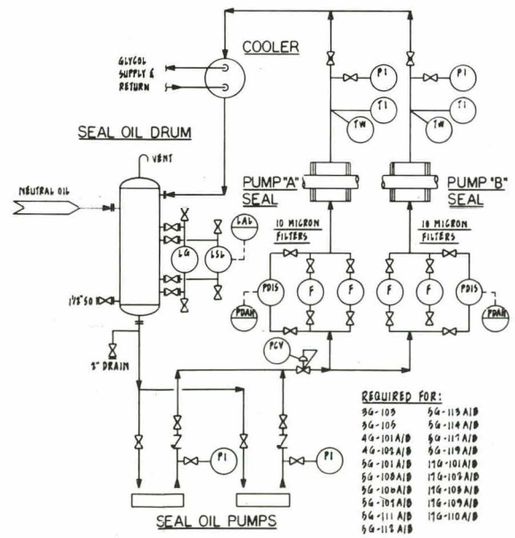
REQUIRED FOR:
9G-101 A/B
9G-101 A/B
9G-115 A/B
9G-114 A/B
9G-119 A/B

DETAIL "D"
WARM UP & INBOARD SEAL FLUSH FOR PUMPS

NOTES:
1 - OPERATING PUMP: WARM UP SUPPLY AND RETURN NOT IN SERVICE.
2 - SPARE PUMP: INBOARD SEAL FLUSH NOT IN SERVICE.
3 - WHEN PUMP IS AT AMBIENT TEMPERATURE DO NOT USE HEATER. PUT HEATER IN SERVICE WHEN PUMP TEMPERATURE APPROACHES 600°F BY SETTING "TIC" AT 600°F.

REQUIRED FOR:
9G-103 A/B
9G-106 A/B
9G-111 A/B
9G-117 A/B

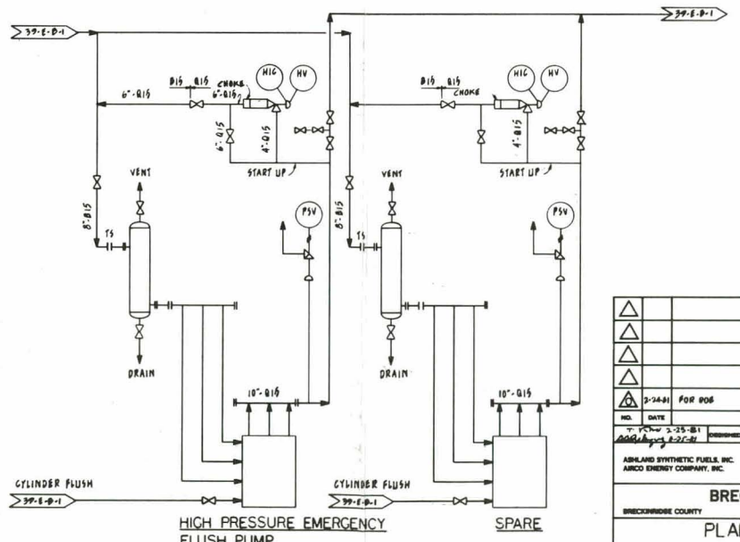
DETAIL "E"
WARM UP & INBOARD SEAL FLUSH FOR PUMPS



REQUIRED FOR:

9G-103	9G-113 A/B
9G-106	9G-114 A/B
9G-101 A/B	9G-117 A/B
9G-105 A/B	9G-119 A/B
9G-101 A/B	17G-101 A/B
9G-108 A/B	17G-105 A/B
9G-100 A/B	17G-108 A/B
9G-103 A/B	17G-109 A/B
9G-111 A/B	17G-110 A/B
9G-115 A/B	

DETAIL "F"
PUMP SEAL COOLING & PRESSURIZATION



HIGH PRESSURE EMERGENCY FLUSH PUMP
SPARE

DETAIL "G"
HIGH PRESSURE EMERGENCY FLUSH

NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENGR.	HRI ACCT.	ASHLAND ACCT.
4	3-26-81	FOR BDS	CAW	TVC				
3	2-25-81	PER CCN 2-25-81	CAW					
2	12-7-81	PER CCN 12-7-81	CAW					
1	8-21-81	PER CCN 8-21-81	CAW					

DESIGNED C.A.W. DRAWN J.K.D./S.A. SCALE

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-800R80717

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

PLANT 3.0, 4.0, 5.0 & 17.0
DETAILS FOR PURGE, SEAL & FLUSH
FOR H-COAL® PROCESS

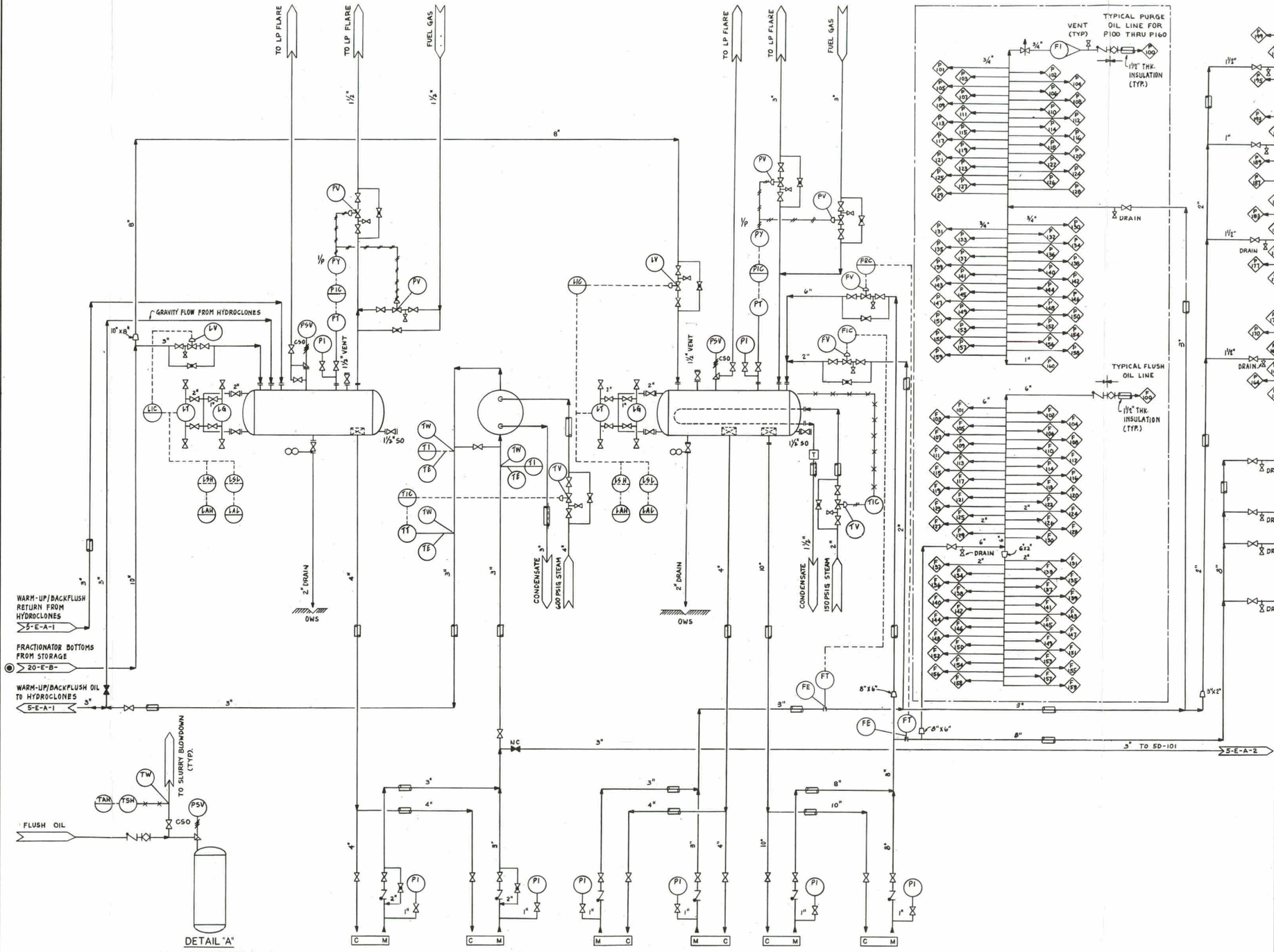
WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV.
12	62	14222-39-E-B-2	0
ACCT NO.	HRI MIAMI		

HYDROCLONES WARM-UP/BACKFLUSH OIL DRUM
5'-0"Ø X 13'-6" TT
INSULATION: 3"

600 PSIG STEAM/WARM-UP -BACKFLUSH OIL EXCHANGER
INSULATION: SS-3" TS-3½"

PURGE/FLUSH OIL DRUM
12'-0"Ø X 24'-0" TT
INSULATION: 2"

PURGE & FLUSH OIL FOR HYDROCLONES



DETAIL "A"

DETAIL SHOWN FOR PSV LOCATED ON VESSEL.
CAN BE USED FOR PSV LOCATED ON LINE ALSO.

WARM-UP/BACKFLUSH OIL PUMP
CAPACITY: 100 GPM

SPARE

PURGE OIL PUMP
CAPACITY: 100 GPM

SPARE

FLUSH OIL PUMPS
CAPACITY: 750 GPM EACH

NOTES:

1. MATCH PURGE OIL OR FLUSH OIL STREAM NUMBER WITH NUMBER ON PLANT 5.0 ENGINEERING FLOW DIAGRAMS FOR DETERMINING DESTINATION.
2. SEE DETAIL "A" FOR TYPICAL INSTRUMENTATION ON PRESSURE SAFETY VALVE DISCHARGE LINE TO FLARE FOR LINE FLUSHING WHEN SAFETY VALVE OPENS. IN THIS PHASE A HIGH TEMPERATURE ALARM IS SHOWN AND THE LINE IS FLUSHED MANUALLY.
3. ALL CHECK AND PLUG VALVES SHOWN ON PURGE AND FLUSH LINES SHOULD BE LOCATED AS CLOSE AS POSSIBLE TO LINES TO BE PURGED OR FLUSHED RESPECTIVELY.

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R	HRI APPR.	ABPP APPR.
1	8/9/81	FOR DOE	CCF		TK			

K. Kho 5/5/81 Checked by Date | DESIGNED CCF | DRAWN V.N. / J.K.O. | SCALE

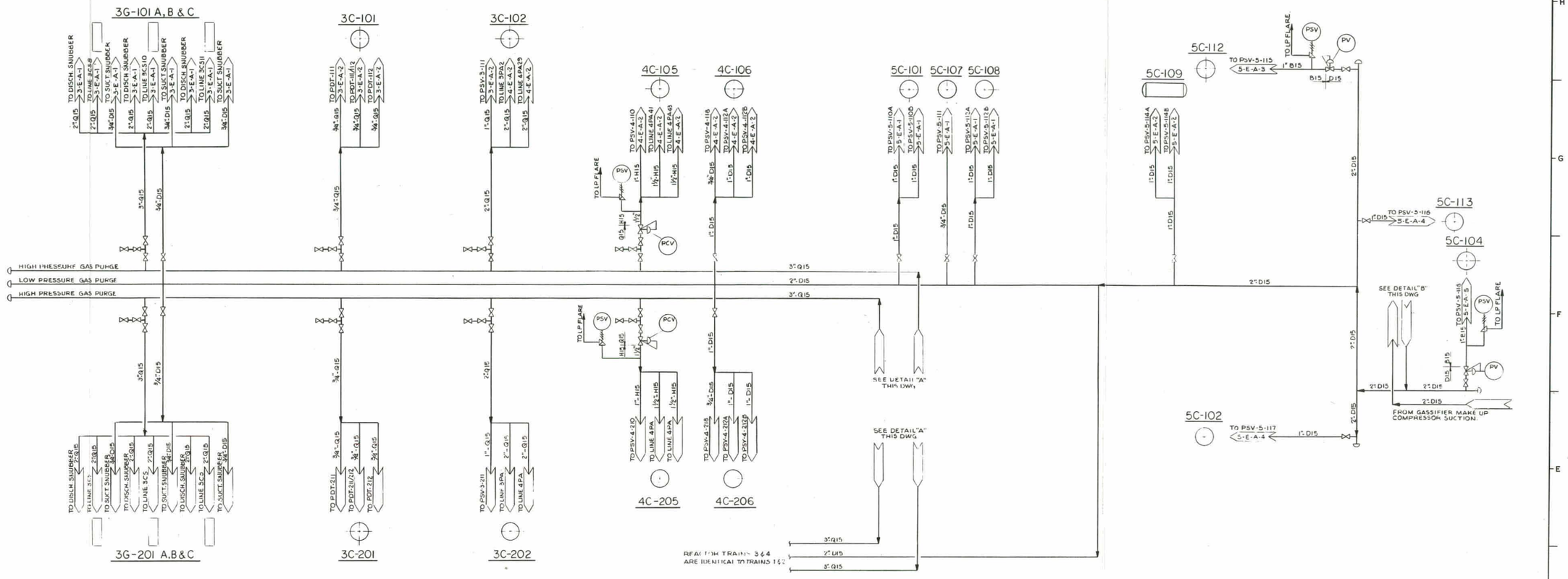
ASHLAND SYNTHETIC FUELS, INC.
AIRCO ENERGY COMPANY, INC.

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

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

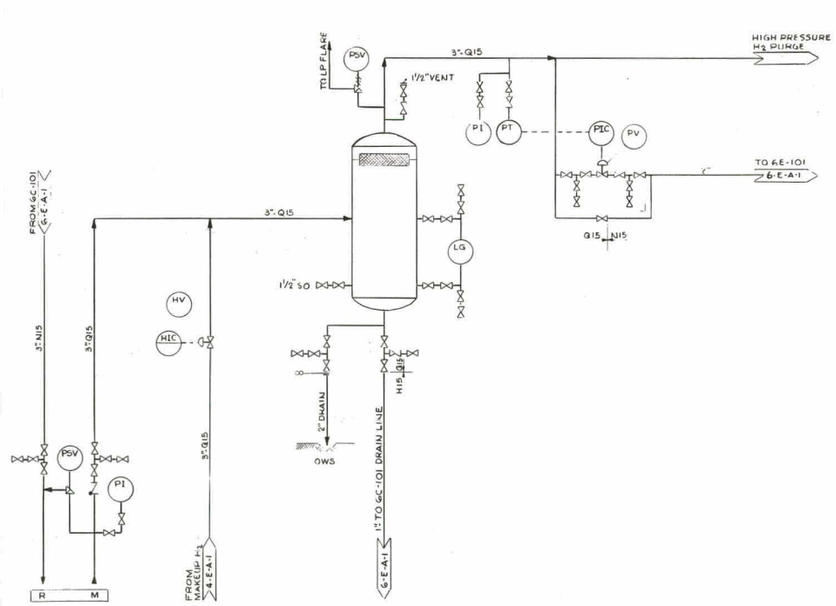
HYDROCLONES WARM-UP/BACKFLUSH, PURGE & FLUSH OIL FOR RECYCLE SLURRY PREPARATION FOR H-COAL® PROCESS

WORK BLOCK NO.	JOB NO.	DRAWING NO.	REV'D
12	62	14222-39-E-B-3	0
ACCT NO.	HRI MIAMI		



HIGH PRESSURE PURGE GAS DRUM

3'-6"Ø x 9'-0"

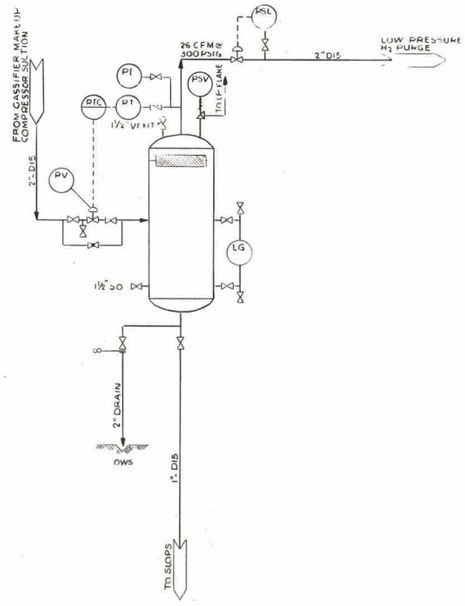


HIGH PRESSURE PURGE GAS COMPRESSOR

RATED CAP 45 ACFM
RATED ΔP 150 PSI

LOW PRESSURE PURGE GAS DRUM

5'-6"Ø x 14'-0"



DETAIL "A"

HIGH PRESSURE PURGE GAS

(8 - REQ'D)

DETAIL "B"

LOW PRESSURE PURGE GAS

(2 - REQ'D)

DETAIL "C"

TYPICAL PURGE POINT DETAIL

NOTES:

1. REACTOR TRAINS 1 THRU 4 AND PLANT 5 TRAIN 1 SHOWN. REACTOR TRAINS 5 THRU 8 AND PLANT 5 TRAIN 2 ARE IDENTICAL TO THEM.

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R	HR APPR.	ASP'T APPR.
1								
2								
3								
4								
5	2-24-81	FOR DOE	CNW		TVC		DM	HLH

TRACING 3-25-81 | DESIGNED CNW | DRAWN S.M. | 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 30,40 & 50
PURGE GAS UTILITY FLOW DIAGRAM FOR H-COAL® PROCESS

WORK BLOCK NO. 12 | ACCT NO.

MIAMI | JOB NO. 62 | DRAWING NO. 14222-39-E-B-4 | REV. 0

BROWNE 44-132 4813

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39	PURGE & FLUSH OIL SYSTEM	000000 NA
39C-001	PLANT 12 NEUTRAL OIL CIRCULATING DRUM	000000 NA
39C-101	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-201	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-301	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-401	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-501	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-601	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-701	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-801	PLANT 3 NEUTRAL OIL SURGE DRUM	000000 NA
39C-002	PLANT 12 NEUTRAL OIL CIRCULATING DRUM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39C-003	PLT 4 & 5 HEAVY FLUSH OIL CIRC DRUM - WEST	000000 NA
39C-103	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-203	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-303	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-403	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-503	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-603	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-703	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-803	EBULLTG PMPS DIST. FLUSH OIL PROVG DRUM	000000 NA
39C-004	PLT 4 & 5 HEAVY FLUSH OIL CIRC DRUM - EAST	000000 NA
39C-104	GLYCOL HOLDING TANK	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39C-204	GLYCOL HOLDING TANK	000000 NA
39C-107	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-207	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-307	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-407	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-507	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-607	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-707	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-807	PUMP HEATING OIL HOLDING VESSEL	000000 NA
39C-112	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-212	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39C-312	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-412	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-512	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-612	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-712	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-812	PLANT 3 DIST. FLUSH OIL HOLDING DRUM	000000 NA
39C-113	PLANT 3 NEUTRAL OIL PROVING DRUM	000000 NA
39C-213	PLANT 3 NEUTRAL OIL PROVING DRUM	000000 NA
39C-313	PLANT 3 NEUTRAL OIL PROVING DRUM	000000 NA
39C-413	PLANT 3 NEUTRAL OIL PROVING DRUM	000000 NA
39C-513	PLANT 3 NEUTRAL OIL PROVING DRUM	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39C-613	PLANT 3 NEUTRAL OIL PROVING DRUM -	000000 NA
39C-713	PLANT 3 NEUTRAL OIL PROVING DRUM -	000000 NA
39C-813	PLANT 3 NEUTRAL OIL PROVING DRUM -	000000 NA
39E-001	PLANT 12 CIRCULATING OIL AIR COOLER -	000000 NA
39E-002	PLANT 12 CIRCULATING OIL AIR COOLER -	000000 NA
39E-003A	PLT 4 & 5 CIRC DRUM C-003 HEATER -	000000 NA
39E-003B	PLT 4 & 5 CIRC DRUM C-003 HEATER -	000000 NA
39E-004A	PLT 12 CIRC DRUM C-004 HEATER -	000000 NA
39E-004B	PLT 12 CIRC DRUM C-004 HEATER -	000000 NA
39E-005	PLT 12 CIRC DRUM C-001 HEATER -	000000 NA
39E-006	PLT 12 CIRC DRUM C-002 HEATER -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39E-111	GLYCOL COOLER	000000 NA
39E-211	GLYCOL COOLER	000000 NA
39E-114	HEATER FOR 39C-107	000000 NA
39E-214	HEATER FOR 39C-207	000000 NA
39E-314	HEATER FOR 39C-307	000000 NA
39E-414	HEATER FOR 39C-407	000000 NA
39E-514	HEATER FOR 39C-507	000000 NA
39E-614	HEATER FOR 39C-607	000000 NA
39E-714	HEATER FOR 39C-707	000000 NA
39E-814	HEATER FOR 39C-807	000000 NA
39G-001A	PLT. '12 NEUTRAL OIL CIRC. DRUM PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-001B	PLT. 12 NEUTRAL OIL CIRC. DRUM PUMP	000000 NA
39G-002A	PLT. 12 NEUTRAL OIL CIRC. DRUM PUMP	000000 NA
39G-002B	PLT. 12 NEUTRAL OIL CIRC. DRUM PUMP	000000 NA
39G-102A	NEUTRAL OIL PUMP	000000 NA
39G-102B	NEUTRAL OIL PUMP	000000 NA
39G-102C	NEUTRAL OIL PUMP	000000 NA
39G-202A	NEUTRAL OIL PUMP	000000 NA
39G-202B	NEUTRAL OIL PUMP	000000 NA
39G-202C	NEUTRAL OIL PUMP	000000 NA
39G-302A	NEUTRAL OIL PUMP	000000 NA
39G-302B	NEUTRAL OIL PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-302C	NEUTRAL OIL PUMP	000000
	-	NA
39G-402A	NEUTRAL OIL PUMP	000000
	-	NA
39G-402B	NEUTRAL OIL PUMP	000000
	-	NA
39G-402C	NEUTRAL OIL PUMP	000000
	-	NA
39G-502A	NEUTRAL OIL PUMP	000000
	-	NA
39G-502B	NEUTRAL OIL PUMP	000000
	-	NA
39G-502C	NEUTRAL OIL PUMP	000000
	-	NA
39G-602A	NEUTRAL OIL PUMP	000000
	-	NA
39G-602B	NEUTRAL OIL PUMP	000000
	-	NA
39G-602C	NEUTRAL OIL PUMP	000000
	-	NA
39G-702A	NEUTRAL OIL PUMP	000000
	-	NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-702B	NEUTRAL OIL PUMP -	000000 NA
39G-702C	NEUTRAL OIL PUMP -	000000 NA
39G-802A	NEUTRAL OIL PUMP -	000000 NA
39G-802B	NEUTRAL OIL PUMP -	000000 NA
39G-802C	NEUTRAL OIL PUMP -	000000 NA
39G-003A	PLT. 4 & 5 HEAVY FLUSH OIL CIRC. DRUM PUMP -	000000 NA
39G-003B	PLT. 4 & 5 HEAVY FLUSH OIL CIRC. DRUM PUMP -	000000 NA
39G-106A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-106B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-106C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-206A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-206B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-206C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-306A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-306B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-306C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-406A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-406B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-406C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-506A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-506B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-506C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-606A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-606B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-606C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-706A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-706B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-706C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-806A	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-806B	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-806C	EBULLATING PUMPS FLUSH OIL PUMP -	000000 NA
39G-107A	GLYCOL SOLUTION PUMP -	000000 NA
39G-107B	GLYCOL SOLUTION PUMP -	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-207A	GLYCOL SOLUTION PUMP	000000 NA
39G-207B	GLYCOL SOLUTION PUMP	000000 NA
39G-110A	HEATING OIL PUMP	000000 NA
39G-110B	HEATING OIL PUMP	000000 NA
39G-210A	HEATING OIL PUMP	000000 NA
39G-210B	HEATING OIL PUMP	000000 NA
39G-310A	HEATING OIL PUMP	000000 NA
39G-310B	HEATING OIL PUMP	000000 NA
39G-410A	HEATING OIL PUMP	000000 NA
39G-410B	HEATING OIL PUMP	000000 NA
39G-510A	HEATING OIL PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39G-510B	HEATING OIL PUMP	000000 NA
39G-610A	HEATING OIL PUMP	000000 NA
39G-610B	HEATING OIL PUMP	000000 NA
39G-710A	HEATING OIL PUMP	000000 NA
39G-710B	HEATING OIL PUMP	000000 NA
39G-810A	HEATING OIL PUMP	000000 NA
39G-810B	HEATING OIL PUMP	000000 NA
39G-111A	PLANT 3 EMER. HEAVY FLUSH OIL PUMP	000000 NA
39G-111B	PLANT 3 EMER. HEAVY FLUSH OIL PUMP	000000 NA
39Y-001A	PLANT 12 NEUTRAL OIL FILTER	000000 NA
39Y-001B	PLANT 12 NEUTRAL OIL FILTER	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
39Y-002A	PLANT 12 NEUTRAL OIL FILTER	000000 NA
39Y-002B	PLANT 12 NEUTRAL OIL FILTER	000000 NA
39F-101A - L	SLURRY PUMP HEATERS	000000 NA
39F-201A - L	SLURRY PUMP HEATERS	000000 NA

4.1 Data Sheets for Columns and Pressure Vessels

39-DS-C-01: Neutral Oil for Plant 12 Feed Booster Pumps Drum (39C-001, 002)

Ebullating Pump Seal Oil Tank (39C-101, 201, 301, 401, 501, 601, 701, 801)

Slurry Pump Warning System Drum (39C-003, 004)

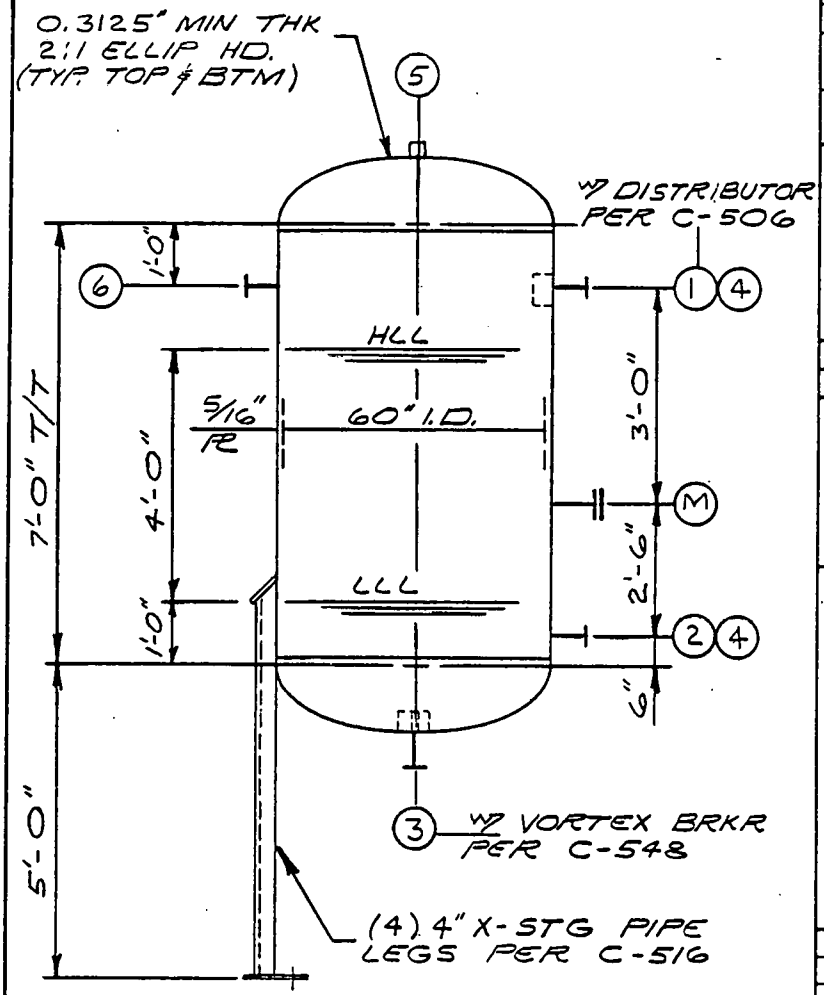
Plant 3 Flush Oil Rate Check Tank (39C-103, 203, 303, 403, 503, 603, 703, 803)

39-DS-C-03: Glycol Holding Drum (39C-104, 204)

39-DS-C-02: Heavy Flush Oil for Plant 12 Slurry Pumps Drum (39C-107, 207, 307, 407, 507, 607, 707, 807)

Plant 3 Flush Oil Storage Tank (39C-112, 212, 312, 412, 512, 612, 712, 812)

Ebullating Pump Seal Oil Rate Check Tank (39C-113, 213, 313, 413, 513, 613, 713, 813)



CODE	ASME SEC VIII DIV I-80	
SPEC.	14222-C1	
OPER. COND.	PRESS.	2.4 PSIG
	TEMP.	180 °F
DES. COND.	PRESS.	50 PSIG
	TEMP.	300 °F

MATERIALS	
SHELL & HDS	SA-516-70
SKIRT	
FORGING	A-181-II
PIPING	A-106-B
STRUCTURAL	
BOLTS	
BASE PL & CAP	A-283-C

C.A. ~~OR CLAD~~	1/8"
PWHT	NO

TESTS/EXAM.					
X-RAY	SPOT		JOINT EFF.	85%	
UT	MT	PT	CV @	°F.	
HARDNESS MAX. BHN					
WELD SAMPLING					
CODE	POSITION	HORIZ			
HYDRO	PRESS @ TOP	75	PSIG		

NOZZLES & MANWAYS				
MK	NO.	SIZE	RATING	SERVICE
1	1	2"	300#	FILL
2	1	2"	300#	PUMP SUCTION
3	1	2"	300#	DRAIN
4	2	2"	300#	LEVEL GAUGE
5	1	1½"	6000#	VENT
6	1	2"	300#	LIQ. RET.
M	1	18"	150#	MANWAY

LADDER & PTFM CLIPS	REQD.	NO
PIPE SUPPORT CLIPS	REQD.	NO
INSUL. SUPPORT CLIPS	REQD.	✓ NO
INSUL. THICKNESS		1½ IN.
PAINTING		
VESSEL CAPACITY		170 CU. FT.
VESSEL WEIGHT EMPTY		3.5 KIPS
VESSEL WEIGHT TEST		14.1 KIPS

LIQ. DEN: = 53.6 #/CU FT

REF. DWGS.

NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
1	1/15/81	REISSUE FOR PHASE ZERO - INDICATED Nº OF VESSEL REQUIRED & CHANGE EQUIP. Nº.		HP			
0	1/05/81	Issued For Phase Zero	NN HP				

FORM 875, 4/79

BECHTEL

THE BRECKINRIDGE PROJECT

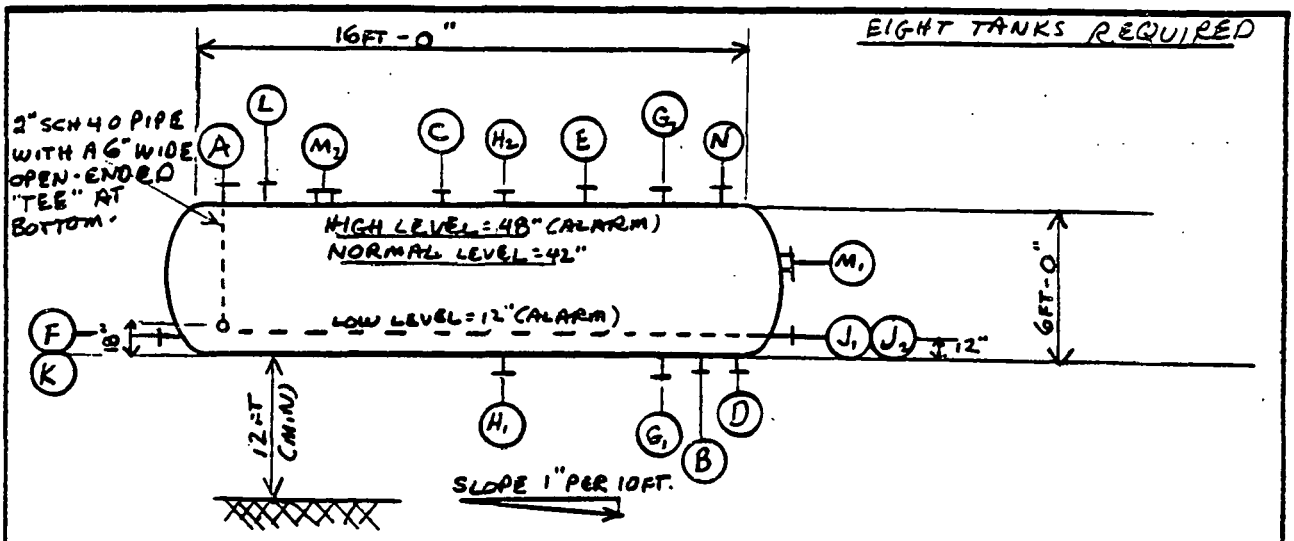
JOB NO. 14222

NEUTRAL OIL FOR PLANT 12 FEED & BOOSTER PUMPS DRUM 39C-001&002 (2 REQ'D)

DRAWING NO. 39-DS-C-01

REV. 1

EIGHT TANKS REQUIRED



NOZZLES

SERVICE	MARK	SIZE	RAT'G	FAC'G
LIQUID INLET	A	2"		
LIQUID OUTLET	B	1"		
GAS BLANKET & VENT	C	2"		
DRAIN	D	2"		
RELIEF VALVE	E	4"		
STEAM-OUT	F	2"		
LEVEL TRANS. BRIDLE	G_1-G_2	2"		
LEVEL GAUGE BRIDLE	H_1-H_2	2"		
STEAM COIL	J_1-J_2	3"		
TEMP. INDICATOR	K	1"		
PUMP PSV INLET	L	1½"		
RATE CHECK VENT PIPE	N	1½"		
MANWAY	M_1-M_2	24"		

DESIGN DATA

PRESSURE	OPERATING	0.5	PSIG
	DESIGN	FV & 50	PSIG
TEMPERATURE	OPERATING	100	°F
	DESIGN	650	°F
MATERIAL	SHELL & HEADS	CS	
	INTERNALS	316 SS	
CORROSION ALLOWANCE	SHELL & HEADS	1/8	IN
	INTERNALS	—	IN

(1) PROVIDE AN INTERNAL 3" SCH 40 STEAM COIL (150# STEAM) IN THE FORM OF A U-TUBE RUNNING ALONG THE LENGTH OF THE VESSEL.

(2) INSULATE THE VESSEL FOR HEAT CONSERVATION.

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
4				3				2				1	BF 1-14-81		HNH

CLIENT & PLANT:
ASHLAND SYNTHETIC FUELS, INC
BRECKINRIDGE PROJECT

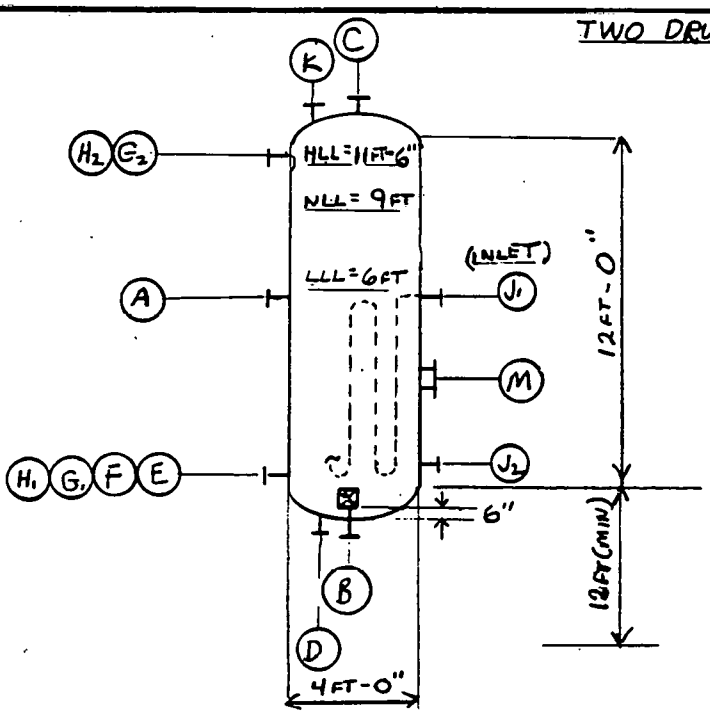
AREA & UNIT: 39.0
FLUSH & PURGE

TITLE:
EBULLATING PUMP SEAL OIL TANK
39C-101 THRU 39C-801

HRI ENGINEERING, INC.

JOB NO.	DRAWING NUMBER	ISSUE
62	HRI	1

TWO DRUMS REQUIRED



NOZZLES

SERVICE	MARK	SIZE	RAT'G	FAC'G
OIL RETURN & MAKE-UP	A	3"		
OIL OUTLET	B	4"		
GAS BLANKET & VENT	C	1½"		
DRAIN	D	2"		
STEAM-OUT	E	1½"		
TEMP. INDICATOR	F	1"		
LEVEL TRANS. BRIDLE	G_1-G_2	2"		
LEVEL GAUGE BRIDLE	H_1-H_2	2"		
STEAM COIL	J_1-J_2	2"		
RELIEF VALVE	K			
MANWAY	M	24"		

DESIGN DATA

PRESSURE	OPERATING	0.5	PSIG
	DESIGN	FV & 50	PSIG
TEMPERATURE	OPERATING	300	°F
	DESIGN	650	°F
MATERIAL	SHELL & HEADS	CS	
	INTERNALS	316 SS	
CORROSION ALLOWANCE	SHELL & HEADS	1/8	IN
	INTERNALS	—	IN

1. DO NOT INSULATE
2. PROVIDE AN INTERNAL 2" STEAM COIL (150PSIG STEAM) IN A VERTICAL SERPENTINE ARRANGEMENT WITH 50 SQ FT. COIL SURFACE.

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
4				3				2				1	BL 1-28-81		HNT

CLIENT & PLANT: ASHLAND SYNTHETIC FUELS, INC. BRECKINRIDGE PROJECT

TITLE: SLURRY PUMP WARMING SYSTEM DRUM: 39C-003 AND 39C-004

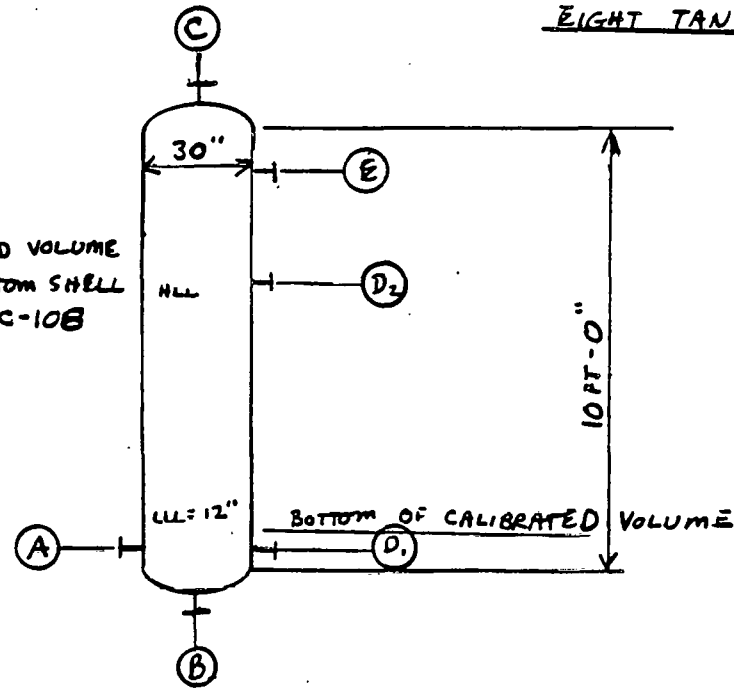
AREA & UNIT: 39.0

FLUSH & PURGE

HRI ENGINEERING, INC.

JOB NO. 62 | HRI DRAWING NUMBER | ISSUE 1

EIGHT TANKS REQUIRED



NOZZLES

SERVICE	MARK	SIZE	RAT'G	FAC'G
LIQUID INLET	A	3"		
LIQUID OUTLET	B	3"		
VENT TO 39C-108	C	1½"		
LEVEL GAUGE BRIDLE	D_1-D_2	2"		
HAND HOLE	E	6"		

DESIGN DATA

PRESSURE	OPERATING	0-5	PSIG
	DESIGN	FV & 50	PSIG
TEMPERATURE	OPERATING	130	°F
	DESIGN	650	°F
MATERIAL	SHELL & HEADS	CS	
	INTERNALS		
CORROSION ALLOWANCE	SHELL & HEADS	1/8	IN
	INTERNALS		IN

(1) LEVEL GAUGE TO INDICATE A CALIBRATED VOLUME OF 180 GALLONS, STARTING AT LOW LIQUID LEVEL.

(2) VESSEL TO BE INSULATED FOR HEAT CONSERVATION.

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
4				3				2	BK 1-15-84			1	BK 7/12/81		HN-1

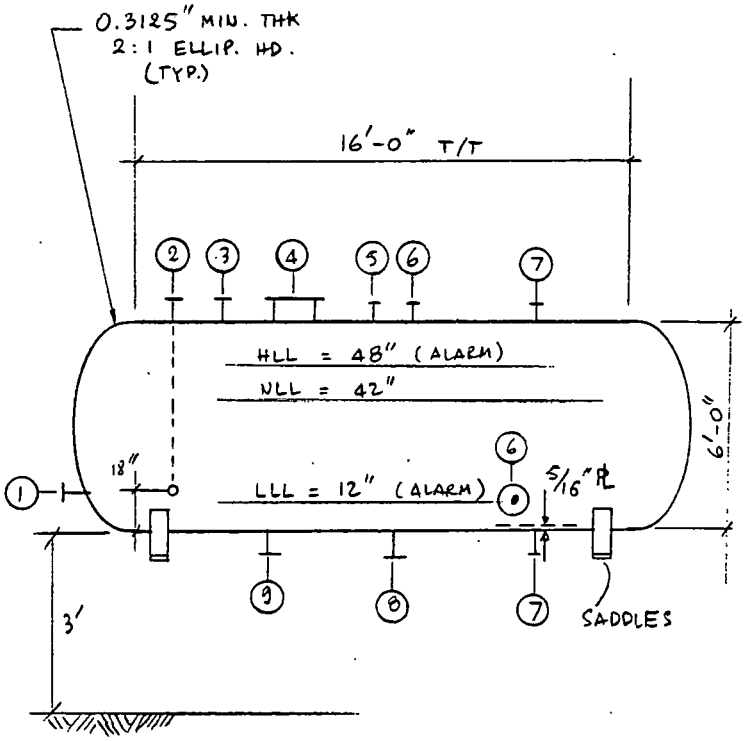
CLIENT & PLANT: ASHLAND SYNTHETIC FUELS, INC. BRECKINRIDGE PROJECT

TITLE: PLANT 3.0 FLUSH OIL RATE CHECK TANK 39C-103 THRU 803 (8 REQUIRED)

AREA & UNIT: 39.0 FLUSH & PURGE

HRI ENGINEERING, INC.

JOB NO. 62 | HRI DRAWING NUMBER | ISSUE 2



CODE	ASME SECT VIII, DIV I - 80	
SPEC.	14222 - C-1	
OPER. COND.	PRESS.	0 PSIG
	TEMP.	70 F
DES. COND.	PRESS.	50 PSIG
	TEMP.	205 F

MATERIALS	
SHELL & HDS	SA - 516 - 70
SKIRT	
FORGING	A - 181 - II
PIPING	A - 106 - B
STRUCTURAL	
BOLTS	
BASE PL & CAP	A - 283 - C

C.A. [redacted]	1/8"
PWHT	NO

TESTS/EXAM.					
X-RAY	SPOT	JOINT EFF.	85%		
UT	MT	PT	CV @	°F.	
HARDNESS MAX. BHN					
WELD SAMPLING					
CODE HYDRO	POSITION	HORIZ.			
	PRESS @ TOP	75	PSIG		

NOZZLES & MANWAYS				
MK	NO.	SIZE	RATING	SERVICE
1	1	1"	150	TEMP. IND
2	1	3"	150	LIQUID INLET
3	1	2"	150	RECIR.
4	1	20"	150	MANHOLE
5	1	2"	150	VENT
6	2	2"	150	LEVEL GAUGE
7	2	2"	150	LEVEL TRANS.
8	1	2"	150	DRAIN
9	1	3"	150	PUMP SUCTION

LADDER & PTFM CLIPS	REQD.	✓	NO	
PIPE SUPPORT CLIPS	REQD.	✓	NO	
INSUL. SUPPORT CLIPS	REQD.		NO	✓
INSUL. THICKNESS	N/A IN.			
PAINTING				
VESSEL CAPACITY	358 CU. FT.			
VESSEL WEIGHT EMPTY	7.6 KIPS			
VESSEL WEIGHT TEST	22.4 KIPS			
LIQ. DENSITY : 71.4 #/FT³				

REF. DWGS.	

NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
0	1/16/81	ISSUED FOR PHASE ZERO.	HP			[illegible]	HW H

BECHTEL

THE BRECKINRIDGE PROJECT

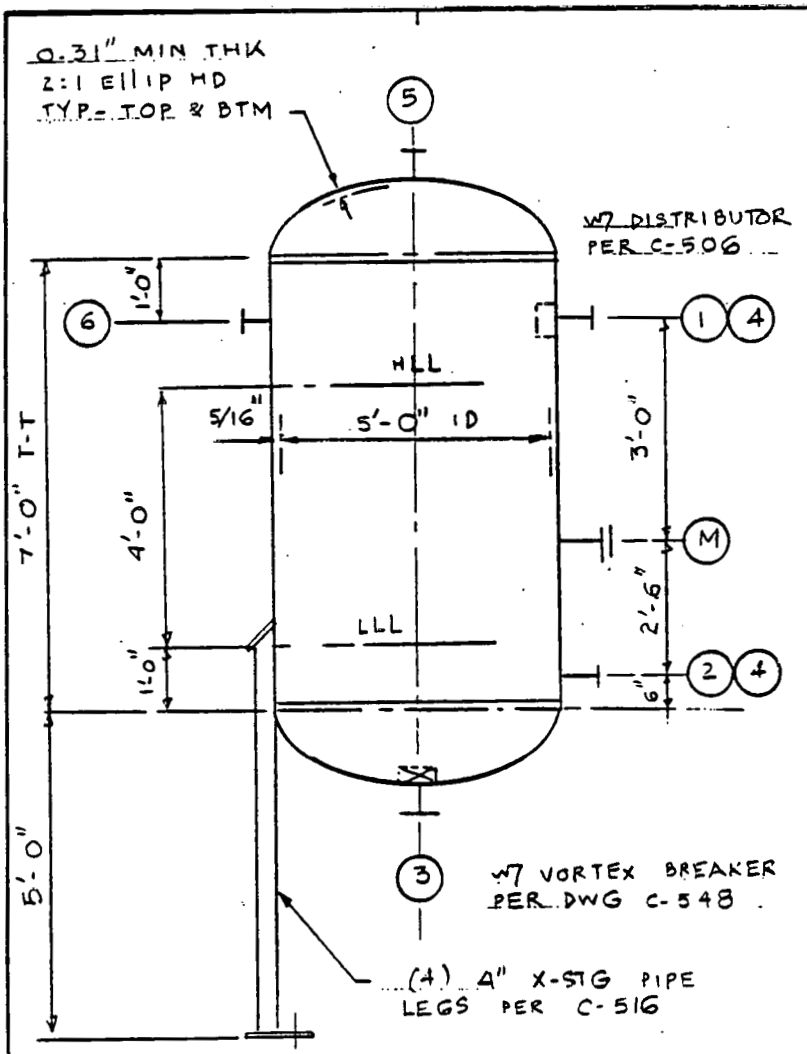
GLYCOL HOLDING DRUM 39-C-104, 204 (2 REQ'D)

JOB NO. 14222

DRAWING NO. 39-DS-C-03

REV. 0

FORM 875, 4/79



CODE	ASME SECT VIII DIV 1, 80		
SPEC.	14222 - C1		
OPER. COND.	PRESS.	2.4 PSIG	
	TEMP.	180 °F	
DES. COND.	PRESS.	50 PSIG	
	TEMP.	300 °F	
MATERIALS	SHELL & HDS	SA-516-70	
	SKIRT		
	FORGING	A-181 II	
	PIPING & LEGS	A-106 B	
	STRUCTURAL		
	BOLTS		
C.A. ~~0~~		1/8"	
PWHT	NOT REQ'D		
TESTS/EXAM.	X-RAY	SPOT	JOINT EFF. 85%
	UT	MT	PT	CV @ °F.
	HARDNESS MAX. BHN		
	WELD SAMPLING		
	CODE HYDRO	POSITION HORIZ	
		PRESS @ TOP 75 PSIG	

NOZZLES & MANWAYS	MK	NO.	SIZE	RATING	SERVICE
	1	1	2"	300 #	FILL
	2	1	2"	"	PUMP SUCTION
	3	1	2"	"	DRAIN
	4	2	2"	"	LEVEL GAUGE
	5	1	1½"	6000 #	VENT
	6	1	2"	300 #	LIQ. RETURN
	M	1	18"	150 #	MANWAY

LADDER & PTFM CLIPS	REQD.	✓	NO	
PIPE SUPPORT CLIPS	REQD.		NO	
INSUL. SUPPORT CLIPS	REQD.	✓	NO	
INSUL. THICKNESS	1½		IN.	
PAINTING				
VESSEL CAPACITY	170		CU. FT.	
VESSEL WEIGHT EMPTY	3.5		KIPS	
VESSEL WEIGHT TEST	12.1		KIPS	

OPER. WT = 13.3 K

REF. DWGS.

NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
1	1/15/81	REISSUED FOR PHASE ZERO - INDICATE NUMBER OF VESSEL REQUIRED	HP			[illegible]	HNH
0	1/05/81	ISSUED FOR PHASE ZERO	NNHP	NN		[illegible]	

BECHTEL

THE BRECKINRIDGE PROJECT

JOB NO. 14222

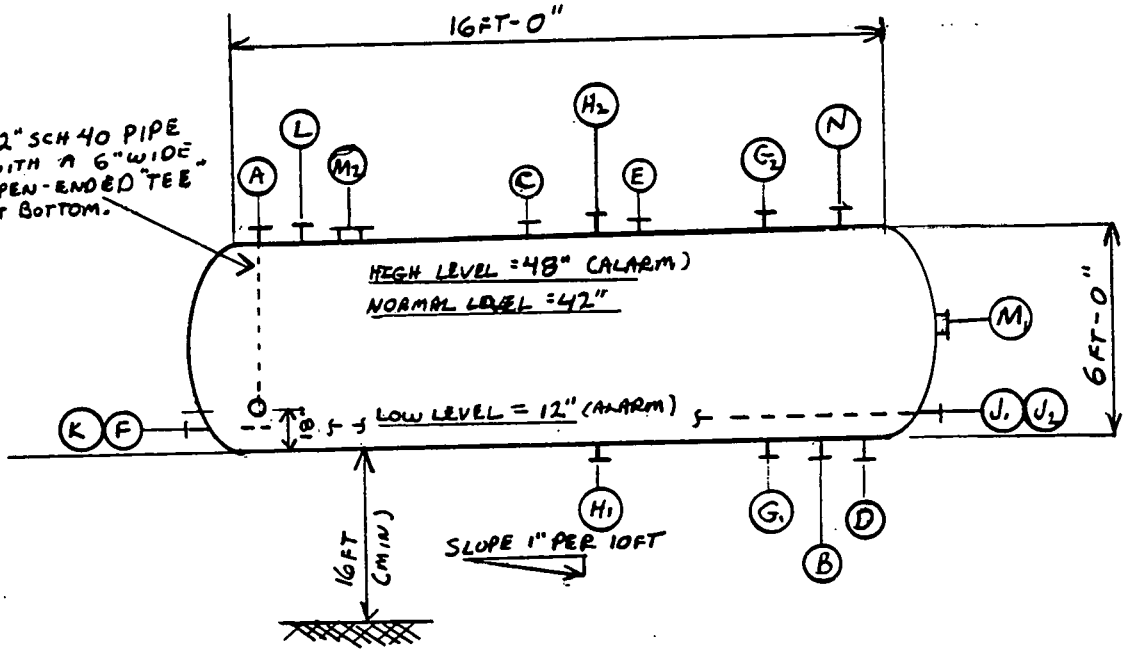
HEAVY FLUSH OIL FOR PLT 12 SLURRY PUMPS DRUM 39C-107-807 (3 REQ'D)

DRAWING NO. 39-DS-C-02

REV. 1

FORM 875, 4/79

EIGHT TANKS REQUIRED



NOZZLES

SERVICE	MARK	SIZE	RAT'G	FAC'G
LIQUID INLET	A	2"		
LIQUID OUTLET	B	3"		
GAS BLANKET & VENT	C	2"		
DRAIN	D	2"		
RELIEF VALVE	E	4"		
STEAM-OUT	F	2"		
LEVEL TRANS. BRIDLE	G_1-G_2	2"		
LEVEL GAUGE BRIDLE	H_1-H_2	2"		
STEAM COIL	J_1-J_2	3"		
TEMP. INDICATOR	K	1"		
PUMP PSV INLET	L	1½"		
RATE CHECK VENT PIPE	N	1½"		
MANWAY	M_1-M_2	24"		

DESIGN DATA

PRESSURE	OPERATING 0.5	PSIG
	DESIGN FV & 50	PSIG
TEMPERATURE	OPERATING 130	°F
	DESIGN 316 SS	°F
MATERIAL	SHELL & HEADS CS	
	INTERNALS	
CORROSION ALLOWANCE	SHELL & HEADS 1/8	IN
	INTERNALS —	IN

(1) PROVIDE AN INTERNAL 3" SCH 40 STEAM COIL (150PSIG STEAM) IN THE FORM OF A U-TUBE RUNNING ALONG THE LENGTH OF THE VESSEL.

(2) INSULATE THE VESSEL FOR HEAT CONSERVATION.

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
4				3			

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
2	BK 1-15-81			1	BK 11/18/81		HNT

CLIENT & PLANT: ASHLAND SYNTHETIC FUELS, INC.
BRECKINRIDGE PROJECT

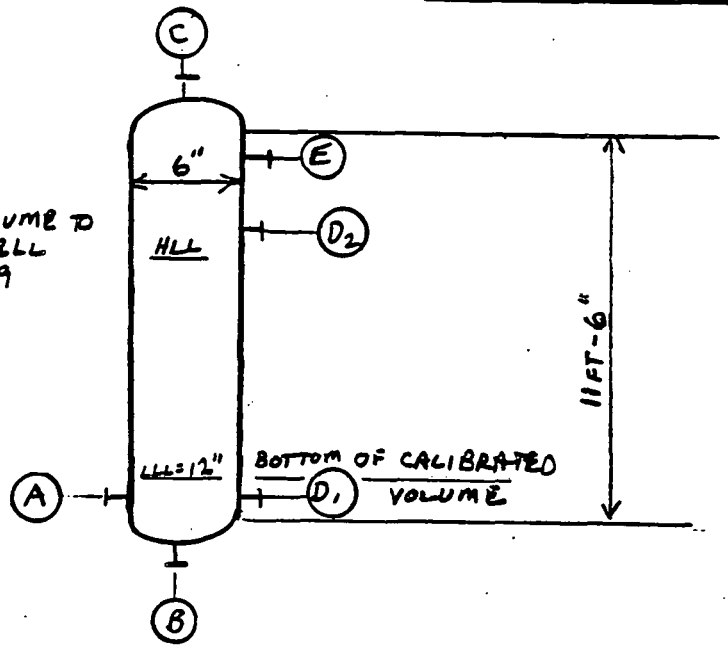
AREA & UNIT: 39.0
FLUSH & PURGE

TITLE: PLANT 3.0 FLUSH OIL STORAGE TANK
39C-112 THRU 812 (8 REQUIRED)

HRI ENGINEERING, INC.

JOB NO.	HRI DRAWING NUMBER	ISSUE
62		2

EIGHT REQUIRED



TOP OF CALIBRATED VOLUME TO BE AT THE BOTTOM SHELL ELEVATION OF 39C-109

NOZZLES

SERVICE	MARK	SIZE	RAT'G	FAC'G
LIQUID INLET	A	1"		
LIQUID OUTLET	B	1"		
VENT TO 39C-109	C	1½"		
LEVEL GAUGE BRIDLE	D_1-D_2	2"		
HANDHOLE	E	6"		

DESIGN DATA

PRESSURE	OPERATING	0.5	PSIG
	DESIGN FV &	50	PSIG
TEMPERATURE	OPERATING	100	°F
	DESIGN	650	°F
MATERIAL	SHELL & HEADS	CS	
	INTERNALS		
CORROSION ALLOWANCE	SHELL & HEADS	1/8	IN
	INTERNALS		IN

(1) LEVEL GAUGE TO BE MARKED FOR A CALIBRATED VOLUME OF 10 GALLONS, STARTING AT LOW LIQUID LEVEL.

(2) INSULATE FOR HEAT CONSERVATION

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
4				3			

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
2				1	BK 1-15-81		HNA

CLIENT & PLANT:
ASHLAND SYNTHETIC FUELS, INC.
BRECKINRIDGE PROJECT

TITLE:
EBULLATING PUMP SEAL OIL RATE CHECK TANK 39C-113 THRU 39C-813

AREA & UNIT: 39.0

FLUSH & PURGE

HRI ENGINEERING, INC.

JOB NO.	HRI DRAWING NUMBER	ISSUE
62		1

4.2 Data Sheets for Exchangers

39-DS-E-03: Neutral Oil from Plant 12 (39E-001, 002)

39-DS-E-01: Neutral Oil Holding Drum (39E-005, 006)

39-DS-E-02: Heavy Flush Oil Holding Drum (39E-114, 214, 314, 414, 514, 614, 714, 814)

AIR-COOLED HEAT EXCHANGER SPECIFICATION SHEET

1	Customer and Plant Location	ASFI , BRECKINRIDGE COUNTY , KENTUCKY			Manufacturer:		
2	Plant	BRECKINRIDGE	Exch. No.	39-E-001, 002	Req. No.	2	△1
3	Service	NEUTRAL OIL FROM PLT 12 BOOSTER PUMPS SEALS			Item No.		
4	Size & Type	3-18 6 *			(Induced)(Forced) Draft	No. of Bays 1 *	
5	Surface per Unit-Finned Tube		ft²		Bare Tube	551	ft²
6	Heat Exchanged	211725.0	Btu/h		MTD, Eff.	52.76	°F
7	Transfer Rate-Finned Tube	—	;Bare Tube, Service	7.26	Clean		Btu/h-ft²°F

PERFORMANCE DATA—TUBE SIDE

9	Fluid Name	NEUTRAL OIL			Lethal Service(Yes)(No)		IN	OUT
10	Total Fluid Entering			lb/h	Density, Liquid	lb/ft³	56.16	57.72
11		IN	OUT		Specific Heat Capacity	Btu/lb °F	.45	.45
12	Temperature	°F	180	130	Cond.(Liq.)([redacted])	Btu/h-ft °F	.075	.075
13	Liquid	lb/h	9410	9410	(Pour)(Freeze)Point	°F		
14	Vapor	lb/h, mol. wt.	—	—	Bubble Point	°F		
15	Noncond.	lb/h, mol. wt.	—	—	Latent Heat	Btu/lb		
16	Steam	lb/h	—	—	Inlet Pressure	(psig)([redacted])	30. (MAX 276)	
17	Water	lb/h	—	—	Pressure Drop, Allow./Calc.	psi	10. / 8. CALC.	
18	Viscosity(Liq.)([redacted])	cP	20	18	Fouling Resist., Inside	h-ft² °F/Btu	0.0015	

PERFORMANCE DATA—AIR SIDE

20	Air Quantity, Total	29700	([redacted])(std.ft³/min)	Altitude above Sea Level	420	ft.
21	Air Quantity/Fan	63142	act. ft³/min	Temperature In(Design Dry Bulb)	96	°F
22	Actual Static Pressure	0.29	in. water	Temperature Out	102.6	°F
23	Face Velocity	600 std. ft/min	Mass Velocity(Net Free Area)	lb/h-ft²	Minimum Design Ambient	°F

DESIGN—MATERIALS—CONSTRUCTION

25	Design Pressure	300 psig	Test Pressure	psig	Design Temperature	230 °F		
26	TUBE BUNDLE		HEADER, Type	PLUG	TUBE, Material	C.S		
27	Size	3-18 6 *	Material	C.S. SA 516-70	SA 214	~~(Seamless)~~(Welded)		
28	No./Bay	1 No. Tube Rows 6	No. Passes*	12 Slope in./ft	OD 1 in.	Min. Thick. .110 in.		
29	Arrangement		Plug Material		No./Bundle	117	Length	18 ft.
30	Bundles	1 In Parallel In Series	Gasket Material		Pitch	1 3/4 in.△		
31	Bays	1 In Parallel In Series	Corrosion Allowance	1/8 in.	FIN, Type	—		
32	Bundle Frame		No., Size Inlet Nozzle	in.	Material	—		
33	MISCELLANEOUS		No., Size Outlet Nozzle	in.	OD in.	Stock Thick.	in.	
34	Struct. Mount.(Grade)(Piperack)	c/c	Special Nozzles	in.	No./in.	Fin Design Temp.	°F	
35	Surface Preparation		Rating & Facing		Code-ASME VIII, Div. 1		Stamp(Yes)([redacted])	
36	Louvers	(Auto) Manual	TI	PI 661	SPECS.			
37	Vibration Switches		Chem. Cleaning					

MECHANICAL EQUIPMENT

39	FAN, Mfr. & Model			DRIVER, Type	ELECTRIC MOTOR		SPEED REDUCER, Type	V BELT
40	No./Bay	2	rev/min	Mfr.			Mfr. & Model	
41	Dia.	8 ft	No. Blades 4 MIN	No./Bay	2	hp/Driver 7.5	No./Bay	2 TOTAL ALL BAYS
42	Pitch	~~Adj.~~ Auto	Angle	rev/min			AGMA Rating hp	Ratio /1
43	Material, Blade		Hub	Enclosure	TEFC		Support(Structure)(Pedestal)	
44	hp/Fan, Des.	5.66	Minimum Amb.	Volt;Phase;Cycle				
45	Control Action on Air Failure-Fan Pitch (Minimum)(Maximum)(Lockup);					Louvers (Open)(Close)(Lockup)		
46	Degree Control of Outlet Process Temperature (Maximum Cooling)(±			°F)				
47	Recirculation (None) (Internal) (External Over Side) (External Over End)					Steam Coil (Yes)(No)		
48	NOTES: *Give tube count of each pass when irregular.							
49	ONE ROW TWO PASSES							
50	* ITEMS 39-E-001, 002 COMBINED TOGETHER							
51	UNIT IN BARE TUBE, NOT FINNED.							
52								
53								
54								
55								
56	Plot Area		Weight—Bundle		lb Shipping			lb

REV.	△	DATE					JOB NO.	DRWG. NO.	REV.
	△1	1/15/81	REISSUED FOR PHASE ZERO - CHANGE EQUIP NUMBER	HP	DLP	HMM	14222	39-DS-E-03	1
	△	12/[illegible]	ISSUED FOR PHASE ZERO	HP	ARP				

FORM 318 (6/78)

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION	ASHLAND SYNTHETIC FUELS INC. KENTUCKY			EXCHANGER MANUFACTURER	DEAN PRODUCTS INC.
2	PLANT	BRECKINRIDGE	EXCH. NO.	39 - E - 005,006	REQ. NO.	2
3	SERVICE OF UNIT	NEUTRAL OIL HOLDING DRUM			ITEM NO.	39 -C- 001 & 002
4	SIZE	12" x 23"	TYPE	PANEL COIL * 301	(HORIZ/VERT) CONNECTED IN	SERIES / PARALLEL
5	SURF./UNIT (EFF/GROSS)	1.9 FT²/EA	SHELLS/UNIT		SURF/SHELL (EFF/GROSS)	N/A
6	PERFORMANCE OF ONE UNIT					

	FLUID ALLOCATION	SHELLSIDE		TUBESIDE	
7	FLUID CIRCULATED			150 # SAT STEAM	
8	TOTAL FLUID ENTERING LB/HR			6	
9		IN	OUT	IN	OUT
10	LIQUID			N/A	
11	VAPOR LB/HR, MW			N/A	
12	NONCOND LB/HR, MW			N/A	
13	STEAM			150 # SAT	
14	WATER				CONDENSATE
15	FLUID VAPORIZED/CONDENSED				CONDENSED
16	GRAVITY, LIQ.				0.8819
17	VISCOSITY, LIQ. (VAP.)			0.016	0.155
18	THERM. COND., LIQ. (VAP.)			—	—
19	SPECIFIC HEAT, LIQ. (VAP.)			0.2	1.
20					
21	TEMPERATURE °F			366	366
22	OPERATING PRESS. (PSIA) (PSIG)			150	150
23	NO. PASSES/SHELL				
24	VELOCITY FT/SEC				
25	PRESS. DROP, ALLOW/CALC. PSI	/		70 /	
26	FOULING RESISTANCE				
27	HEAT EXCHANGED 455 4	BTU/HR; MTD (CORR) (WTD)		236	°F
28	TRANSFER RATE, SERVICE 8 BTU/Hr FT² F	CLEAN			BTU/HR. SQ. FT. °F

	CONSTRUCTION	SHELLSIDE	TUBESIDE
29	DESIGN/TEST PRESS. PSIG	/	190 / 285
30	DESIGN TEMPERATURE °F		408
31	CORROSION ALLOWANCE IN		1/8"
32	CONNECTIONS INLET		1"
33	SIZE OUTLET		1"
34	RATING		150 #

35	TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH *	FLOW → ▽ △ ◇ □
36	TUBE MATERIAL	CARBON STEEL		TUBE-TUBESHEET JOINT		
37	SHELL	ID OD		SHELL COVER		(INTEG.) (REMOV)
38	CHANNEL BONNET			CHANNEL COVER		
39	TUBESHEET-STATIONARY			TUBESHEET FLOATING		
40	FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)		
41	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING	
42	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS		
43	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT		
44	GASKETS					
45	CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS	SPECS	
46	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER		
47	REMARKS: MARK (GR) AND PERCENT (RT) AS REQUIRED					

* PANELCOIL TYPE

NUMBER OF SHEETS REQUIRED : 10 /EA DRUM

	DATE				JOB NO.	DRWG. NO.	REV.
1	1/5/81	REISSUED FOR PHASE ZERO - CORRECT WT OF EQUIP. & PRICING	HP DWP	MM	14222	39-DSE 01	1
0	12/15/80	ISSUED FOR PHASE ZERO	HP HP				

INC. TYPE FORM 138 (6/78)

HEAT EXCHANGER SPECIFICATION SHEET

CUSTOMER AND PROJECT LOCATION	ASHLAND SYNTHETIC FUELS INC. KENTUCKY				EXCHANGER MANUFACTURER	DEAN PRODUCTS INC.		
PLANT	BRECKINRIDGE	EXCH. NO.	39-E-114-814	REQ. NO.	8			
SERVICE OF UNIT	HEAVY FLUSH OIL HOLDING DRUM			ITEM NO.	39-C-107-807			
SIZE	12" x 23"	TYPE	PANELCOIL #301	(HORIZ/VERT)	CONNECTED IN		SERIES	PARALLEL
SURF./UNIT (EFF/GROSS)	1.9 FT² /EA	SHELLS/UNIT			SURF/SHELL (EFF/GROSS)	N/A		

PERFORMANCE OF ONE UNIT

FLUID ALLOCATION	SHELLSIDE		TUBESIDE	
FLUID CIRCULATED			190 # SAT. STEAM	
TOTAL FLUID ENTERING LB/HR			C	
	IN	OUT	IN	OUT
LIQUID			N/A	
VAPOR LB/HR, MW			N/A	
NONCOND LB/HR, MW			N/A	
STEAM			150 # SAT	
WATER				CONDENSATE
FLUID VAPORIZED/CONDENSED				CONDENSED
GRAVITY, LIQ.				0.8819
VISCOSITY, LIQ. (VAP.)			0.016	0.155
THERM. COND., LIQ. (VAP.)			—	—
SPECIFIC HEAT, LIQ. (VAP.)			0.2	1.
TEMPERATURE °F			366	366
OPERATING PRESS. (PSIA) (PSIG)			150	150
NO. PASSES/SHELL				
VELOCITY FT/SEC				
PRESS. DROP, ALLOW/CALC. PSI	/		70. /	
FOULING RESISTANCE				

HEAT EXCHANGED	4551	BTU/HR; MTD (CORR) (WTD)	236	°F
TRANSFER RATE, SERVICE	8. BTU/HR FT² F	CLEAN		BTU/HR. SQ. FT. °F

CONSTRUCTION

		SHELLSIDE	TUBESIDE
DESIGN/TEST PRESS. PSIG		/	190 / 285
DESIGN TEMPERATURE °F			408
CORROSION ALLOWANCE IN			1/8"
CONNECTIONS	INLET		1"
SIZE	OUTLET		1"
RATING			150 #

TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH	* FLOW → ◁ △ ◇ □
TUBE MATERIAL	CARBON STEEL		TUBE-TUBESHEET JOINT		
SHELL	ID	OD	SHELL COVER		(INTEG / REMOV)
CHANNEL BONNET			CHANNEL COVER		
TUBESHEET-STATIONARY			TUBESHEET FLOATING		
FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)		
BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING	
BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS		
INSUL. PRK SHELL	CHAN.		EXPANSION JOINT		
GASKETS					
CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS	SPECS	
WEIGHT EACH SHELL	BUNDLE		FULL OF WATER		

REMARKS, MARK (SR) AND PERCENT (RT) AS REQUIRED

* PANELCOIL TYPE :

NUMBER OF SHEETS REQUIRED : 10/EA DRUM

	DATE						JOB NO.	DRWG. NO.	REV.
2	1/15/81	REISSUED FOR PHASE ZERO - CORRECT TOTAL PRICE	HP	owp		HNH	16222	39-DSE02	1
1	12/15/80	ISSUED FOR PHASE ZERO	HP	ALP					

HEC GEC FORM 155 (6/78)

4.3 Data Sheets for Fired Heaters

Slurry Pump Heater (39F-101 A, B, C, D, E, F, G, H, I, J, K, L, 201 A, B, C, D, E, F, G, H, I, J, K, L)

ASHLAND SYNTHETIC FUELS, INC.
BRECKINRIDGE PROJECT
PLANT 39.0

24 IDENTICAL UNITS REQUIRED

ITEMS 39F-101 A-L
39F-201 A-L

PROVIDE 24 IDENTICAL TUBULAR ELEMENT ELECTRIC IMMERSION HEATERS, EACH IN ACCORDANCE WITH THIS PROCESS DUTY SPECIFICATION.

FLUID CHARACTERISTICS

SERVICE	NORMAL	DESIGN	
FLUID TO BE HEATED	3.6°API COAL-DERIVED OIL →		
INLET PRESSURE (PSIG)	35	50	
ALLOWABLE PRESS. DROP (PSI)		10	
INLET TEMP. (°F)	300	300	
OUTLET TEMP (°F)	500	500	(750°F MECH. DESIGN)
FLOW RATE (LB/HR)	500	1000	
VISCOSITY (cp) AVG.	2 →		
ABSORPTION (KW)	15	30	
SPECIFIC GRAVITY (IN/OUT)	0.96/0.89 →		

SHEATH MATERIAL	321 SS
FLANGE MATERIAL	316 SS

ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR	ISS	DRAWN	CHKD	APPR
												1	BK 1-21-81		HN

TITLE SLURRY PUMP HEATER
39F-101 A-L THRU 39F-201 A-L

HYDROCARBON RESEARCH INC.

SHT 1 OF 1 | HRI STANDARD NUMBER | ISSUE 1

4.4 Data Sheets for Pumps and Drivers

39-DS-G-01: Neutral Oil to Plant 12 Feed and Booster Pumps (39G-001 A, B, 002 A, B)

Ebullating Pump Seal Oil Supply (39G-102 A, B, C, 202 A, B, C, 302 A, B, C, 402 A, B, C, 502 A, B, C, 602 A, B, C, 702 A, B, C, 802 A, B, C)

Pump Warming System Circulation (39G-003 A, B, 004 A, B)

High Pressure Flush Oil (39G-106 A, B, C, 206 A, B, C, 306 A, B, C, 406 A, B, C, 506 A, B, C, 606 A, B, C, 706 A, B, C, 806 A, B, C)

39-DS-G-02: Heavy Flush Oil to Plant 12 Slurry Pumps (39G-110 A, B, 210 A, B, 310 A, B, 410 A, B, 510 A, B, 610 A, B, 710 A, B, 810 A, B)

39-DS-G-03: Glycol to Plants 2, 3, 4, 5, 12, 17 (39G-107 A, B, 207 A, B)

39-G-002 A,B

JOB NO. 14222 ITEM NO. 39-G-001 A,B

CENTRIFUGAL PUMP DATA SHEET

PURCHASE ORDER NO.

APPLICABLE TO: PROPOSALS ○ PURCHASE ○ AS BUILT ○

REQUISITION NO.

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER;

INQUIRY NO.

☐ BY MANUFACTURER

DATE 1/15/91 REVISION 1

FOR ASHLAND SYNTHETIC FUELS INC SITE KENTUCKY

UNIT THE BRECKINRIDGE PROJECT SERVICE NEUTRAL OIL TO PUT 12 FEED + BOOSTER PUMPS

NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR

NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY

PUMP MFR SUNFLO / DELAVERAN SIZE AND TYPE P 2AHG STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID NEUTRAL OIL U.S. GPM at PT, NOR. 40 RATED 44

DISCH. PRESS., PSIG 230.

PT, F, NOR. 180 MAX. 180 SUCT. PRESS., PSIG MAX. RATED 0.72

SP. GR. at PT 0.94 DIFF. PRESS., PSI 229.2

VAP. PRESS. at PT, PSIA 0.0 DIFF. HEAD, FT 563.2

VIS. at PT, Ssu 100. CP NPSHA, FT 37.16

CORR/EROS. CAUSED BY HYD. HP 5.88

PERFORMANCE

PROPOSAL CURVE NO.

RPM 7200 NPSHR (WATER) 13

EFF. 45 BHP RATED 15

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-5

316 SS

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 15 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

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.
1	1/15/91	REISSUED FOR PHASE ZERO - INDICATE NO OF PUMPS REQUIRED	HP			HWH	14222	39-DS-G-01	1
0	12/31/90	ISSUED FOR PHASE ZERO	HP	MAP					

SHEET 1 OF 1

EACH OF THE EIGHT AIMP SERVICES CONSISTS OF THREE PUMPS (2 OPERATING + 1 SPARE)

HYDROCARBON RESEARCH INC.

TWENTY-FOUR PUMPS REQUIRED

RECIPROCATING PUMP DATA SHEET

39G-102 A, B & THRU

CLIENT ASHLAND SYNTHETIC FUELS, INC. ITEM NO. 39G-802 A, B, C

PLANT LOCATION BRECKINRIDGE PROJECT JOB NO. 62

SERVICE EBULLIATING PUMP SEAL OIL SUPPLY DATE 1-15-81 BY BK

OPERATING CONDITIONS - EACH PUMP

PRODUCT SPECIAL LUBE OIL 100 °F P.T.

SP GR. @ 60°F 1.09 VIS. 30 cP @ 100 °F

SP GR. HOT @ SUC. COND. 1.0 SP GR. HOT @ DIS. COND. 1.0

NORMAL CAPACITY

COLD @ 60°F 0.5 G. P. M.

HOT @ SUC. COND. 0.5 G. P. M.

HOT @ DIS. COND. ____ G. P. M.

DESIGN CAPACITY

COLD @ 60°F 1.0 G. P. M.

HOT @ SUC. COND. 1.0 G. P. M.

HOT @ DIS. COND. ____ G. P. M.

DISCHARGE PRESSURE 3700 PSIG (PSV SET @ 4000 PSIG)

SUCTION PRESSURE 5 PSIG

NPSH = 15 PSI (AVAIL)

DIFFERENTIAL PRESSURE 3695 PSI

DESIGN HEAD IN FEET ____

STEAM PRESSURE ____

QUALITY ____

EXHAUST PRESSURE ____

MOTOR CHARACTERISTICS ____ VOLTS ____ PHASE ____ CYCLES

GUARANTEED BRAKE HORSE POWER TO BE BASED ON DESIGN CAPACITY AT DISCHARGE CONDITIONS.

PUMP SPECIFICATIONS

PUMP TO BE FURNISHED IN ACCORDANCE WITH SPECIFICATION NO. ____

MANUFACTURER ____

TYPE ____

SIZE ____

MATERIAL FOR LIQUID END

CYLINDER CAST STEEL

CYLINDER LINER ____

PISTON ____

PISTON PACKING ____

PISTON ROD ____

GUIDE ROD ____

PLUNGER 440 STAINLESS STEEL

VALVES ____

VALVE SEATS ____

PACKING BOX TYPE ____

LIQUID END PACKING ____

STEAM END PACKING ____

SIZE SUCTION ____

SIZE DISCHARGE ____

SIZE STEAM ____

SIZE EXHAUST ____

PISTON SPEED ____ FT/MIN. @ SUC. COND.

R. P. M. ____

SUCT. VALVE AREA ____

DISCH VALVE AREA ____

VEL. THRU SUCT VALVES ____ FT/MIN @ SUC. COND.

STALLING PRESSURE ____

H. H. P. 2

GAS CONS. C. F/H. H. P./HR. ____

STEAM CONS. #H. H. P./HR. ____

COOLING WATER REQUIRED ____ °F ____ G. P. M.

LUBRICATOR ____

REVOLUTION COUNTER ____

SPARE PACKING ____

LAGGING ____

EXPORT PACKING ____

SERIAL NO. ____

DIMENSION PRINT NO. ____

WEIGHT ____

PRICE ____

DRIVER ____

REMARKS

PACKING TO BE INSTALLED IN FIELD. THICKNESS OF SUCTION FLANGE TO CONFORM WITH THICKNESS SPECIFIED FOR DISCHARGE FLANGE.

① ALL PUMPS TO BE MOTOR DRIVEN

② MANUAL CAPACITY ADJUSTMENT IS REQUIRED.

ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE
1	1/15/81												

FORM HEA-178 (REV.-11) 3/26/75

HYDROCARBON RESEARCH INC.
CENTRIFUGAL PUMP DATA SHEET

FOUR IDENTICAL PUMPS REQUIRED

396-003 A/B

CLIENT ASHLAND SYNTHETIC FUELS INC. — ITEM NO. 396-004 A/B

PLANT LOCATION BRECKINRIDGE PROJECT — JOB NO. 62

SERVICE PUMP WARMING SYSTEM CIRCULATION — MANUFACTURER — DATE 1-20-81 BY BK

MOTOR DRIVE ALL PUMPS — TURBINE DRIVE

UNIT — SIZE & TYPE — NO. REQ'D 4

OPERATING CONDITIONS, EACH PUMP

LIQUID COAL-DERIVED OIL — U.S. gpm AT PT, NOR 125 RATED 125

3.6 °API — DISCH. PRESS., psig 35

PT, °F 300 — SUCT. PRESS, psig MAX 50 RATED 5

SP GR. AT PT 0.963 — DIFF. PRESS., psi 30

VAP. PRESS, AT PT, psia 0.5 — DIFF HEAD, ft 72

VIS AT PT, SSu ____ cP 3.0 — NPSH AVAIL., ft > 20

CORR/EROS. CAUSED BY THIOPHENIC SULFUR, 1% 100μ SOLIDS — HYD. HP. 2.2

CONSTRUCTION AND MATERIALS

CASING-MOUNTING (CENTERLINE) (FOOT) (BRACKET) (VERTICAL)

SPLIT (AXIAL) (RADIAL)

TYPE (SINGLE VOLUTE) (DOUBLE VOLUTE) (DIFFUSER)

TAPPED OPENINGS (VENT) (DRAIN) (GAGE CONNS)

NOZZLES	SIZE	ASA RATING	FACING	POSITION
SUCTION				
DISCHARGE				

IMPELLER DIAM RATED ____ MAX ____ TYPE ____

MFR'S BEARING NO. RADIAL ____ THRUST ____

LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PR.

COUPLING AND (OSHA) GUARD: MFR ____ DRIVER HALF MTD BY ____

☐ PACKING: MFR AND TYPE ____ SIZE ____ NO. OF RINGS ____

☒ MECH SEAL: MFR AND MODEL ____ API CLASS CODE BSTXX(1)

FOR VERTICAL PUMPS: SHAFT THRUST (UP) (DOWN) ____ lb.

BASEPLATE: ____

PERFORMANCE

PROPOSAL CURVE NO. ____

NPSH REQ'D (WATER), ft. ____

NO. OF STAGES ____ RPM 1750

DES EFF 62 BHP 3.6

MAX BHP RATED IMP. ____

MAX HEAD RATED IMP, ft ____

MIN CONTINUOUS gpm (BY MFR) ____

ROTATION FACING COUPLING END ____

WATER COOLING ____

BEARINGS ____

STUFF. BOX ____

PEDESTAL ____

GLAND ____

TOTAL WATER REQ'D, gpm ____

PACKING COOLING ____

FLUSHING ____

SEAL FLUSHING PLAN NO. ____

AUX PIPING BY MFR.

COOLING WATER ☐ TUBING ☐ PIPE

SEAL FLUSH ☐ TUBING ☐ PIPE

MATERIAL CLASS AND ABBREVIATION (CASE / TRIM) *

I-1	I-2	S-1	S-3	S-4	S-5	S-6	S-9
CI / CI	CI / BRZ.	STL. / CI	STL. / NI RESIST	STL. / STL.	STL. / STL. 12%CHR	STL. / 12%CHR	STL. / MONEL

C-6	D-6	A-7	A-8				
12%CHR / 12%CHR	5%CHR / 12%CHR	18-8 SS / 18-8 SS	316 SS / 316 SS				

* NOTE: TABLE BASED ON API-610 (5 TH. EDITION, MARCH, '71) APPENDIX-D.

SHOP TESTS	REQUIRED	WITNESSED
RUNNING PERF		
NPSH		
DISASSEMBLY		
INSPECTION		

HYDROSTATIC ____ PSIG

MAX. ALLOW. CASE WP ____ PSIG ____ F

WEIGHTS: PUMP ____ BASE ____

MOTOR ____ TURBINE ____

MOTOR DRIVER BY ____

ITEM NO. ____ MTD BY ____

HP 5 RPM ____ FRAME ____

MFR: ____

TYPE ____ INSUL ____

ENC. ____ TEMP. RISE C ____

VOLTS/PHASE/CYCLES ____

BEARINGS ____ LUBE ____

FULL LOAD AMPS ____

S.F. ____

TURBINE DRIVER BY ____

ITEM NO. ____ MTD BY ____

HP ____ RPM ____ MAT'L ____

MFR AND TYPE ____

INLET STEAM, psig ____ TEMP F ____

EXHAUST, psig ____ CW REQ'D; gpm ____

STEAM RATE, FL ____ lb/BHP/HR

BEARINGS ____ LUBE ____

NOZZLES	SIZE	ASA RATING	FACING	POSITION
INLET				
EXHAUST				

MFR. FINAL DATA (AS BUILT)

ACTUAL IMPELLER DIAM ____

TEST CURVE NO. ____

OUTLINE DWG. NO. ____

PUMP SECT. DWG. NO. ____

SEAL DIAM. DWG. NO. ____

PUMP SERIAL NO. ____

WR CLEARANCE DIAM. ____

(MECH SEAL)(PACKING) SHIPPED

☐ INSTALLED ☐ BOXED SEPARATELY

API STD 610 GOVERNS UNLESS OTHERWISE STATED ____

EXCEPTIONS (ITEMIZE) (1) SEAL TO BE ALL METAL BELLOWS WITH TUNGSTEN CARBIDE ROTATING/STATIONARY SEAL FACES AND GRAFOIL SECONDARY SEAL RING.

ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE
1	1-20-81	HWM											

FORM MEA-177 (REV-2) 6/9/75

EACH OF THE EIGHT PUMP SERVICES CONSISTS OF THREE PUMPS (2 OPERATING + 1 SPARE)

HYDROCARBON RESEARCH INC.

RECIPROCATING PUMP DATA SHEET

TWENTY-FOUR PUMPS REQUIRED

39G-106A/B/C THRU

CLIENT ASHLAND SYNTHETIC FUELS, INC. ITEM NO. 39G-806A/B/C

PLANT LOCATION BRECKINRIDGE PROJECT JOB NO. 62

SERVICE HIGH PRESSURE FLUSH OIL DATE 1-12-81 BY BK

OPERATING CONDITIONS - EACH PUMP

PRODUCT COAL-DERIVED OIL 130 °F P.T.

SP GR. @ 60°F 1.02 VIS. 10 CP. @ 130 °F

SP GR. HOT @ SUC. COND. 0.99 SP GR. HOT @ DIS. COND. 0.99

NORMAL CAPACITY

COLD @ 60°F 8.2 G. P. M.

HOT @ SUC. COND. 8.5 G. P. M.

HOT @ DIS. COND. 8.5 G. P. M.

DESIGN CAPACITY

COLD @ 60°F 9.7 G. P. M.

HOT @ SUC. COND. 10 G. P. M.

HOT @ DIS. COND. 10 G. P. M.

DISCHARGE PRESSURE 3700 PSIG (PSV SET @ 4000 PSIG)

SUCTION PRESSURE 5 PSIG

NPSH = 15 PSI AVAIL.

DIFFERENTIAL PRESSURE 3695 PSI

DESIGN HEAD IN FEET

STEAM PRESSURE

QUALITY

EXHAUST PRESSURE

MOTOR CHARACTERISTICS VOLTS PHASE CYCLES

GUARANTEED BRAKE HORSE POWER TO BE BASED ON DESIGN CAPACITY AT DISCHARGE CONDITIONS.

PUMP SPECIFICATIONS

PUMP TO BE FURNISHED IN ACCORDANCE WITH SPECIFICATION NO.

MANUFACTURER

TYPE

SIZE

MATERIAL FOR LIQUID END

CYLINDER CAST STEEL

CYLINDER LINER —

PISTON

PISTON PACKING

PISTON ROD

GUIDE ROD

PLUNGER 440 STAINLESS STEEL

VALVES

VALVE SEATS

PACKING BOX TYPE

LIQUID END PACKING

STEAM END PACKING

SIZE SUCTION

SIZE DISCHARGE

SIZE STEAM

SIZE EXHAUST

PISTON SPEED FT./MIN. @ SUC. COND.

R. P. M.

SUCT. VALVE AREA

DISCH VALVE AREA

VEL THRU. SUCT VALVES FT/MIN @ SUC. COND.

STALLING PRESSURE

H. H. P. 22

GAS CONS. C. F/H. H. P./HR.

STEAM CONS. #H. H. P./HR.

COOLING WATER REQUIRED °F G. P. M.

LUBRICATOR

REVOLUTION COUNTER

SPARE PACKING

LAGGING

EXPORT PACKING

SERIAL NO.

DIMENSION PRINT NO.

WEIGHT

PRICE

DRIVER

REMARKS

PACKING TO BE INSTALLED IN FIELD. THICKNESS OF SUCTION FLANGE TO CONFORM WITH THICKNESS SPECIFIED FOR DISCHARGE FLANGE.

① ALL PUMPS TO BE MOTOR-DRIVEN

② ANNUAL CAPACITY ADJUSTMENT IS REQUIRED

ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE	ISSUE	DATE
1	1/13/81	2	1/15/81	Hold									

FORM MEA-178 (REV.-1) 3/26/75

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 39G-110A,B TO 810A
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 1/15/81 REVISION 1

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 HEAVY FLUSH OIL TO PLT #12 SLURRY PUMP:
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D 2 ITEM NO. 39G-110A,B PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR SUN FLO SIZE AND TYPE P2 AHG STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID HEAVY FLUSH OIL U.S. GPM at PT. NOR. 40 RATED 44
DISCH. PRESS., PSIG 230.
PT. F, NOR. 130 MAX. 180 SUCT. PRESS., PSIG MAX. RATED 0.83
SP. GR. at PT 1.026 DIFF. PRESS., PSI 229.17
VAP. PRESS. at PT, PSIA 0.0 DIFF. HEAD, FT 515.97
VIS. at PT, Ssu - cP 42.0 NPSHA, FT 34.27
CORR/EROS. CAUSED BY HYD. HP 5.88

PERFORMANCE

PROPOSAL CURVE NO.
RPM 7200 NPSHR (WATER)
EFF. 45 BHP RATED 13.~~65~~
MAX. BHP RATED IMP 15
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 ○
316 SS
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 15 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

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.
1	1/15/81	REISSUED FOR PHASE ZERO. INDICATE NO. OF PUMPS REQ'D	HP		Dup	HNM	14222	39-DSG-02	1
0	12/31/80	ISSUED FOR PHASE ZERO	HP	DM	AH				
NO.	DATE						SHEET 1 OF 1		

CENTRIFUGAL PUMP DATA SHEET

JOB NO. 14222 ITEM NO. 396-1074,B ; 2074,E
PURCHASE ORDER NO.
REQUISITION NO.
INQUIRY NO.
DATE 1/16/81 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 GLYCOL TO PLANTS 2,3,4,5,12,17
NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. PROVIDED BY VENDOR MTD BY VENDOR
NO. TURBINES REQ'D ITEM NO. PROVIDED BY MTD BY
PUMP MFR WILSON SNYDER SIZE AND TYPE 2x3x13"LL" ESNC STAGES 1 SERIAL NO.

OPERATING CONDITIONS, EACH PUMP

LIQUID GLYCOL U.S. GPM at PT. NOR. 200 RATED 220
DISCH. PRESS., PSIG 262.0
PT. F. NOR. 70 MAX. 180 DUCT. PRESS., PSIG MAX. RATED 1.3
SP. GR. at PT 1.145 DIFF. PRESS., PSI 260.7
VAP. PRESS. at PT, PSIA 0.0 DIFF. HEAD, FT 525.9
VIS. at PT. Ssu 68.4 cP NPSHA, FT 31.0
CORR/EROS. CAUSED BY HYD. HP 33.44

PERFORMANCE

PROPOSAL CURVE NO. M-CP606-D7
RPM 3550 NPSHR (WATER) 9
EFF. 49 * BHP RATED 68.7 *
MAX. BHP RATED IMP 81.9 *
MAX. HEAD RATED IMP 627
MIN. CONTINUOUS GPM 50
ROTATION (VIEWED FROM CPLG END) CCW

CONSTRUCTION

NOZZLES	SIZE	RATING	FACING	LOCATION
SUCTION	3	300	RF	END
DISCHARGE	2	300	RF	TOP

CASE-MOUNT: ☒ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE)
-SPLIT: ☐ AXIAL ☒ RAD: TYPE VOLUTE ☒ SGL ☐ DBL ☐ DIFFUSER
-PRESS: ☐ MAX. ALLOW. 500 PSIG 250 °F: ☐ HYDRO TEST 750 PSIG
-CONNECT: ☐ VENT ☒ DRAIN ☐ GAGE
IMPELLER DIA.: ☐ RATED 12½ ☐ MAX. 13 ☐ TYPE: CLOSED
MOUNT: ☐ BETWEEN BRGS ☒ OVERHUNG ☐ WEAR. RG. DIAM./CLRNC.
BEARINGS-TYPE: ☐ RADIAL BALL ☐ THRUST BALL
LUBE: ☒ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐
COUPLING: ☐ MFR THOMAS ☐ MODEL DBZ-C
DRIVER HALF MTD BY: ☒ PUMP MFR ○ DRIVER MFR ○ PURCHASER
PACKING: ☐ MFR & TYPE ☐ SIZE/NO. OF RINGS
MECH. SEAL: ☐ MFR & MODEL DURA PTO API CLASS. CODE
☐ MFR CODE FUSE (F/:) VV

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 ⑥ S-5
BASEPLATE: ☒ STEEL, DRAIN TYPE

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 11 ☒ 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 100 RPM 3600 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

APPROX. WT. PUMP & BASE
MOTOR TURBINE

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED
* CORRECTED FOR VISCOSITY

FORM NO 130 (REVISED SEPT 72)

NO.	DATE						JOB NO.	DRAWING NO.	REV.
0	1/16/81	ISSUED FOR PHASE ZERO	HP	D.W.P.		HNM	14222	39 DSG-03	0

SHEET 1 OF 1

4.5 Data Sheets for Processing Equipment

39-DS-Y-01: Neutral Oil Filters (39Y-001 A, B, 002 A, B)

DESIGN DATA

COMPONENTS	FEED	Filtrate	CAKE
FLOWS			
Total, Lb/Hr	9410		
Total, GPM	20		
Solids, Lb/Hr	9.4		
Liquid, Lb/Hr	9400.6		
Liquid, GPM	19.98		
PROPERTIES			
Pulp Density, Lb/ft^3			
Liquid, Wt%	99.9		
Liquid Density, Lb/ft^3	58.66		
Solids, Wt%	0.1		
PARTICLE SIZE DISTRIBUTION	FILTER TO 5 μ		
TEMPERATURE, °F	180		
Vapor Pr., PSIA Norm / Max	0. / 0.		

CHARACTERISTICS

FILTER TYPE	CARTRIDGE
NO. REQ.	4 ⚠1
FILTERING RATE, GPM / FT^2	
Filt. Area, FT^2 Req / Act	
FILTER MEDIA	
Precoat Material	
Precoat Thickness, in.	
Wash Rate, GPM	
Wash Composition	
Cake Vol., FT^3/Hr @ Lb/FT^3	
Dry Solids, Lb/Hr	
Cake Discharge	
Cake Exposure	
Method of Operation	
Viscosity, Lb/Ft-Hr	

NOZZLES

Noz. no	SERVICE	Normal flow	Design flow	No. Req	Est Size
1	INLET			1	2"
2	OUTLET			1	2"
3					
4					
5					
6					

TIME CYCLE

CYCLES/DAY

Phase	Hrs./Cycle
Filtering	
Washing	
Drying	
Cake Disch.	

[COMBINING TWO SMALLER FILTERS IN 1]

NOTES: VENDOR SUGGESTED TYPE REF-

No.	Date	REVISIONS	Prog.	Proj.	Client
⚠1	11/5/82	REVISED FOR PHASE FILTER - CORRECT NO OF FILTERS	HP	[illegible]	HMA
⚠0	11/30/82	ISSUED FOR PHASE REVIEW	HP	MP	

RM 472

PROCESS DESIGN DATA FILTERS

TAG Nº : 39-Y-001 A,B; 002 A,B

NEUTRAL OIL FILTERS

JOB NO. 14222

DRAWING NO. 39 - DS - Y - 01

Rev. 1

4.6 Duty Specifications for Miscellaneous Equipment

39-SP-A-01: Heavy Flush Oil High Pressure Pumps (39G-111 A, B)
Glycol Heat Exchangers (39E-111, 211)

39-SP-A-02: Electric Heaters (39E-003 A, B)
Electric Heaters (39E-004 A, B)

THE BRECKINRIDGE PROJECT

PLANT 39 - PURGE & FLUSH OIL SYSTEM

39-G-111 A, B	Two heavy flush oil high pressure pumps for delivering 600 GPM rate to plant 3 (8 trains) slurry heaters and H-Coal reactors to control runaway reaction. Suction Pressure: 100 PSIG Discharge Pressure: 3000 PSIG Operating Temperature: 180°F
39E-111, 211	Two air cooled glycol heat exchangers for pedestal, seal housing & bearing casing cooling of all slurry pumps in plants 2, 3, 4, 5, 12 & 17. Rated flow: 220 GPM Design press.: 300 PSIG Design temp.: 205°F

FORM H-292 7-66

1	1/19/81	ISSUED FOR PHASE ZERO	MPowP		

ASFI THE BRECKINRIDGE PROJECT AECI

U.S.DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717

DUTY SPECIFICATION

PURGE & FLUSH OIL SYSTEM

JOB NO. 14222

SPECIFICATION	REV
39-SP-A-01	0

THE BRECKINRIDGE PROJECT

PLANT 39 - PURGE & FLUSH OIL SYSTEM

39E-003 A, B.	Two electric heaters, Indeeco Model 363N250, capapble of delivering 250 KW each with 16 stages of heating. Associated controls for the units are included.
39E-004 A, B.	Two electric heaters, Indeeco Model 363N250, capable of delivering 250 KW each with 16 stages of heating. Associated controls for the units are included.

FORM H-292 7-66

1	1/29/81	ISSUED FOR PHASE ZERO	EF DWP		HNH

ASFI THE BRECKINRIDGE PROJECT AECI

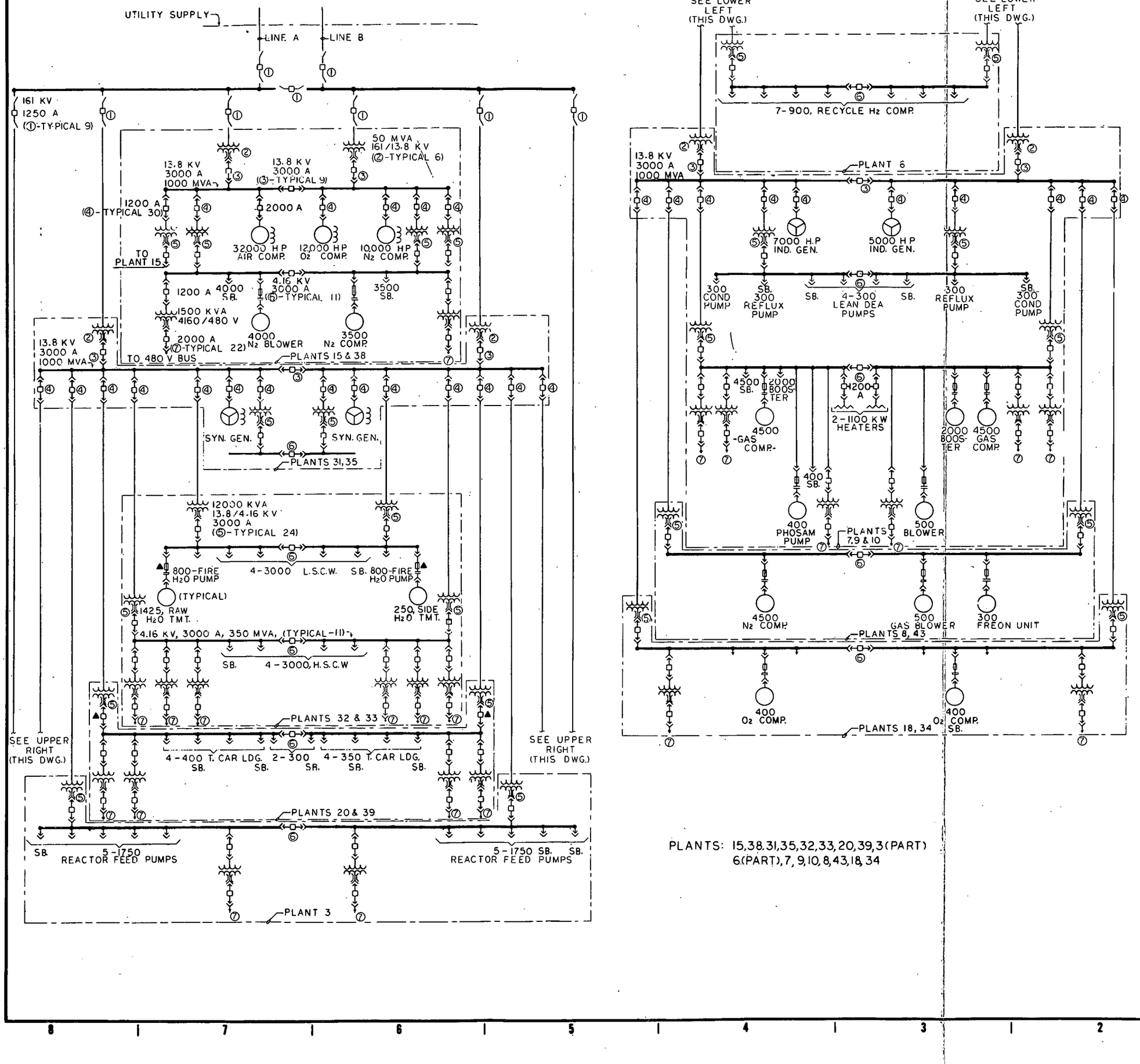
U.S.DOE COOPERATIVE AGREEMENT NO. DE-FC05-800R20717

DUTY SPECIFICATION

PURGE & FLUSH OIL SYSTEM

JOB NO. 14222

SPECIFICATION 39-SP-A-02 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

3	JAN. 16/81	ISSUED FOR PHASE ZERO	RAO	TIG	LH	RAO
2	DEC. 5/80	ISSUED FOR REVIEW/APPROVAL	RAO	JA	DA	JS
NO.	DATE	REVISIONS	BY	CHK'D	CHK'D	APP'D

DESIGNED T4/RAO DRAWN RAO

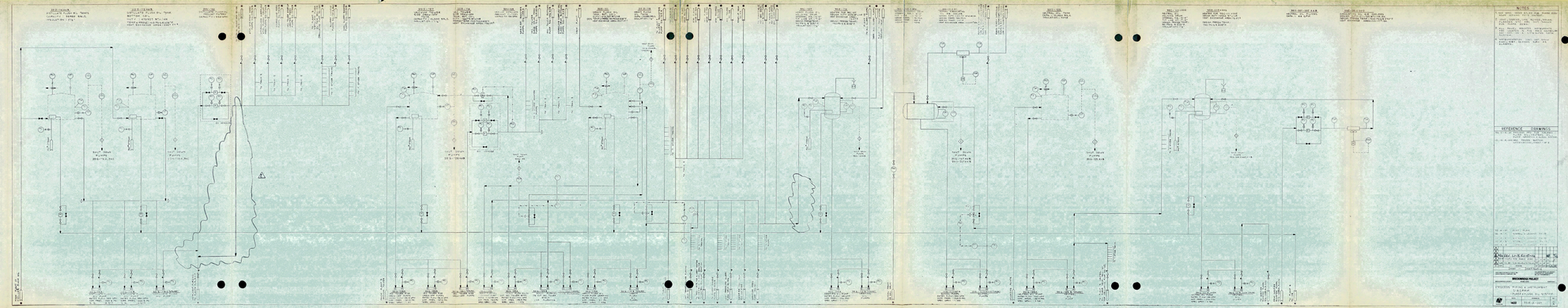
ASHLAND SYNTHETIC FUELS, INC. / ARMCO SYNFUELS COMPANY, INC. — U.S. DEPARTMENT OF ENERGY / SYNTHETIC FUELS CORPORATION / CONTRACT NO. DE-FC05-80ET01017

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

ELECTRICAL ONE LINE DIAGRAM

HOUSTON — JOB NO. 14222 — DRAWING NO. 30E-P-003 — REV. 1



PLANT 40 SITE DEVELOPMENT AND ROADS

1.0 INTRODUCTION

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

The general site is graded to a basic elevation of 415 feet above mean sea level (MSL) and the coal storage area is graded to +420 MSL. Most of the overburden removed in this operation is very low strength silt unsuitable for structural fill. It is stockpiled for other uses.

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

Soil improvement work required for River Facilities (Plant 22) is included in the Plant 22 section of this report.

PLANT 40 SITE DEVELOPMENT AND ROADS

2.0 PLANT DESIGN

2.1 Foundations

The low-strength soil extends below elevation 415 on an average of 10 feet throughout most of the plant site. Based on the soils report, this material is unsuitable for foundation support.

Within plant units, this low-strength silt is completely excavated and stockpiled for other uses. Below the silt is a loose sand that can be strengthened to a satisfactory condition. This strengthening is effected by excavation of approximately 10 feet of the loose sand, and then replacement of the same material in layers with adequate densification of each layer. The low-strength silt that was removed below MSL elevation 415 is replaced with suitable structural fill borrowed elsewhere on the property.

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

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

2.2 Finish Grading and Drainage

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

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

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

2.3 Sewers and Ponds

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

2.4 Dikes for Tank Farm

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

2.5 Roads and Bridges

Plant roads are constructed of asphalt concrete on a crushed limestone base course which is placed on a compacted subgrade. Main plant roads are 24 feet wide with 3 feet wide shoulders. Secondary roads have similar cross sections with widths appropriate to their usage. Employee parking lots are within the scope of Plant 40 and are of construction similar to that of plant roads.

A roadway approach embankment is constructed of structural quality fill for the bridge that is over the existing highway and the new and existing railroad trackage. The fill is obtained on the property as described above for foundations.

Two bridges are constructed on the plant site to provide access and to improve operations. One bridge provides access from the main plant area on the east to the wastewater collection and treatment area and the river facilities on the west. The bridge spans the existing highway and both existing and new railroad tracks. The bridge has a length of approximately 500 feet. It has a reinforced concrete deck supported by steel girders and the foundations are supported on piles.

The other bridge provides east-west access across the existing drainage ditch located to the southeast of the main plant area. The bridge has a total length of approximately 520 feet and is of the same construction as the above bridge. This bridge is designed to carry the solid waste disposal truck traffic.

Both bridges are designed to American Association of State Highway and Transportation Officials (AASHTO) specifications and standards.

2.6 Fencing

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

3.0 EQUIPMENT LIST

Due to the nature of Site Development and roads (Plant 40), and equipment list is not required.

4.0 DATA SHEETS AND SKETCHES

Due to the nature of Site Development and Roads (Plant 40), no data sheets are required.

5.0 DRAWINGS

Due to the nature of Site Development and Roads (Plant 40), no drawings are required.

PLANT 41 BUILDINGS

1.0 INTRODUCTION

Plant 41 includes all buildings for equipment and for personnel.

Both masonry and metal buildings are used, depending upon the function of the building and upon its location with respect to hazards. Buildings which house critical equipment or instrumentation within the process area are of the blast-proof type. For the administration complex a brick veneer exterior is used.

The scope of Plant 41 includes the inherent requirements for each type of building, such as utilities, lighting, sanitary facilities, heating and, if needed, ventilation and air conditioning. Excluded from the scope are furnishings, appliances, interior decoration, landscaping, telecommunications and fire alarms and protection. The latter are covered by Telecommunication Systems (Plant 37) and Fire Systems (Plant 33).

2.0 PLANT DESIGN

2.1 Design Basis

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

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

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

2.2 Plant Description

The five types of buildings are classified as types A, B, C, D or Administrative according to their major construction features. The types and their construction features are shown below. Table 1, at the end of Plant Description, lists all buildings by name or function and shows the type, linear dimensions, area and quantity.

2.2.1 Type A

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

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

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

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

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

2.2.2 Type B

Type B buildings are the plant laboratory, the wet air oxidation laboratory, the reverse osmosis laboratory, the cafeterias, the medical building, and the change house.

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

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

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

2.2.3 Type C

Type C buildings serve a number of diverse functions which are generally plant operations or maintenance related.

These buildings are steel-framed structures sheathed and roofed with prefabricated-building-type metal panels.

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

Office areas are heated and air conditioned with package units.

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

2.2.4 Type D

Type D buildings have masonry walls and structural steel-framed roofs with decking cover.

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

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

2.2.5 Administrative

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

TABLE 1

BUILDING LIST

Description	Number Required	Size (ft)	Area (ft^2)	Type
Distributed System Control Room				
H-Coal	1	70 x 70	4,900	A
Gas Plant	1	70 x 70	4,900	A
Boiler Plant	1	50 x 70	3,500	A
Operating Equipment Rooms				
Tank Farm	1	20 x 26	520	A
Process Plants	11	20 x 26	5,720	A
Wet Air Oxidation Laboratory	1	40 x 40	1,600	B
Reverse Osmosis Laboratory	1	100 x 50	5,000	B
Plant Laboratory	1	100 x 200	20,000	B
Change House (Clean and Dirty Laundry)	1	100 x 200	20,000	B
Cafeteria	1	100 x 200	20,000	B
Cafeteria	1	50 x 100	5,000	B
Medical	1	50 x 100	5,000	B
Ash Handling	1	80 x 150	12,000	C
Operator Shelters				
Coal Pile	2	10 x 20	400	C
Coal Unloading Dock	1	10 x 20	200	C
Barge Loading Dock	1	10 x 20	200	C

TABLE 1

BUILDING LIST

(Continued)

Description	Number Required	Size (ft)	Area (ft^2)	Type
Solid Waste Disposal	1	10 x 20	200	C
Cooling Water Tower	1	10 x 20	200	C
Water Pond	1	10 x 20	200	C
Tank Car Loading	1	10 x 20	200	C
Tank Truck Loading	1	10 x 20	200	C
Gate Houses	4	20 x 20	1,600	C
Guard/Security	1	50 x 100	5,000	C
Switchgear Buildings				
161 kV	2	100 x 30	6,000	C
34.5 kV	2	100 x 30	6,000	C
13.8 kV	2	100 x 30	6,000	C
Process Plant	18	30 x 30	16,200	C
Fire Station	1	60 x 80	4,800	C
Warehouse	1	200 x 400	80,000	C
Maintenance Buildings				
B-1	1	100 x 200	20,000	C
B-2	1	40 x 100	4,000	C
B-3	1	60 x 100	6,000	C
B-4	1	60 x 100	6,000	C
B-5	1	60 x 100	6,000	C
B-6	1	40 x 100	4,000	C

TABLE 1

BUILDING LIST

(Continued)

Description	Number Required	Size (ft)	Area (ft^2)	Type
Garages				
Mobile Equipment	1	40 x 100	4,000	C
General	1	100 x 100	10,000	C
Coal Car Unloading	1	30 x 70	2,100	C
Compressor Shelters				
Plant 6	1	30 x 100	3,000	C
Plant 7	2	60 x 90	10,800	C
Plant 8	1	50 x 25	1,250	C
Plant 12	1	250 x 56	14,000	C
Plant 12 Gas Feed Pump	1	130 x 30	3,900	C
Plant 15	3	53 x 83	13,197	C
Plant 17	1	30 x 30	900	C
Pumps, Chemical Feed, Filter Shelters	15	20 x 30	9,000	C
Transformer Houses	4	50 x 26	5,200	D
Special Cleaning, Foam, Chemicals	1	30 x 40	1,200	D
Administration Building	1	200 x 300	120,000 (2-story)	

2.3 Supporting Functions

2.3.1 Fire Protection

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

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

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

2.3.2 Utilities and Other Services

Drinking water, compressed air and steam are provided where required. Gas is provided to the laboratories. Electric power is provided for general lighting, convenience outlets and air conditioning.

Telephones are provided as shown in Telecommunication Systems (Plant 37).

One ambulance is provided for the medical building and fire trucks for the fire station in Mobile Equipment (Plant 45).

3.0 EQUIPMENT LIST

Due to the nature of Buildings (Plant 41), no equipment list is required.

4.0 DATA SHEETS AND SKETCHES

Due to the nature of Buildings (Plant 41), no data sheets are required.

5.0 DRAWINGS

Due to the nature of Buildings (Plant 41), no drawings are required.

PLANT 42 SOLID WASTE MANAGEMENT

1.0 INTRODUCTION

The project will product an estimated 8,700 tons of a variety of solid wastes each operating day. The overall solid waste management plan is presented on Process Flow Diagram 50-D-B-11 and is fully discussed in Report VII. The plan calls for identifying, characterizing, segregating and transporting the various types of solid wastes to either outside sales or to Landfill (Plant 44) disposal sites.

The major sources, types and estimated quantities of waste solids are:

Source	Type	Approximate Rate TPD
Coal Washing (Plant 27)	Coal refuse	6,690
Gasification and Purification Plant (Plant 12)	Slag, ash, soot	1,524
Steam Generation and Boiler Feedwater Treating Plant (Plant 31)	Bottom ash Fly ash	96 233
Stack Gas Scrubbing (Plant 35)	Sodium sulfate	12
Water System (Plant 32)	Filter cake	24
Sewers and Wastewater Treatment (Plant 34)	Filter cake, sludge, salts	96
Miscellaneous	Plant refuse, floatsam	5
Total solid waste		8,680

Most of the solid wastes produced in process and offsite plants within the complex are dewatered within the battery limits of the source plant. Descriptions of the dewatering facilities are included in the source plant process descriptions. Early project plans included transport of some solids to landfill via pipelines. However as solid waste management

studies evolved truck transport seemed better suited to the multiple sources, destinations and types of solids. The Gasification and Purification Plant (Plant 12) design and estimating work was nearly complete at the time trucks were adopted as the transport mode; consequently, the decision was made to add Plant 12 slag dewatering facilities to Plant 42. Prior to detailed design this Plant 12 equipment will be relocated from Plant 42 to Plant 12 at which time the name of Plant 42 will be changed to incineration. At present Plant 42 includes the following equipment:

- Gasifier slag and ash dewatering equipment
- Waste sludge, emulsion, and oily water incineration units

2.0 PLANT DESIGN

2.1 Design Basis - Waste Sludge Incineration System

2.1.1 System Capacity

Four incinerators are provided to meet a maximum charge rate of the sludge from the complex. However, during normal conditions three will be in operation and one in standby.

Each incinerator is designed to have a heat release rate of 10 million Btu (LHV) per hour. This unit would have a water evaporation capacity of 2,600 to 2,900 pounds per hour. The charge rate will be a function of the characteristics of the sludge feed (ash and combustibles and combustibles heat value). Auxiliary fuel is medium Btu fuel gas.

2.1.2 Feed Streams

Oily and chemical sludges from various operations throughout the complex are incinerated. Typical sources of waste sludges include:

- API separator bottoms
- DAF bottoms and float
- Desalter emulsion cuff
- Storage tank bottom residues
- Oily sewer manhole residues
- Skimmings and dredgings from ponds

2.2 Design Basis - Gasifier Plant Solids Dewatering

Feed Rates, lb/hr	Clarifier Underflow	Gray Water Blowdown
Total flow	204,609	262,452
Water flow	151,383	262,433
Solids flow	53,226	19

Components Design Capacity

Ash vacuum filter system	205,000 lb/hr feed
Ash transfer conveyor	44 TPH
Total slag storage bin capacity	3 hours
Slag conveyor system	62 TPH
Media filters	560 GPM
Cartridge filters	560 GPM
Filtered grey water tank storage capacity	1/2 hour

2.3 Plant Description - Waste Sludge Incineration System

Process Flow Diagram 42-D-B-1 depicts the incineration system for waste sludge.

Sludges and emulsions are pumped to one of two Incinerator Feed Tanks (42D-102 A and B). Miscellaneous sludges that develop as a result of maintenance, housekeeping or special cleanup operations are expected to be delivered to the incineration site by vacuum truck and will be dumped into a below-ground concrete Sump (42D-101). Positive displacement Sludge Pump (42G-102) periodically transfers the contents of the sump to one of the incinerator feed tanks. The tanks are equipped with mixers to produce a homogeneous mixture which minimizes abrupt variations in incinerator feed composition.

The incineration is a batch operation and has built-in flexibility by virtue of the two feed tanks and four incinerators specified. Normally all sludge streams are routed to one of the tanks. The contents, thoroughly mixed, are analyzed for physical, chemical and heating value characteristics. After determining that the sludge is suitable for incineration, a predetermined quantity is transferred to the second tank from which a number of incinerators are charged, depending on the inventory of sludge on hand.

The incinerators are the fluidized bed type, capable of burning miscellaneous sludges, emulsions and suspensions of oil, ash, soot and coal dust in water.

Each incinerator unit includes all necessary associated equipment, such as:

- Sludge Feed Pumps (42G-101 A-F)
- Overbed Air Preheat Burner Combustion Air Blower (42K-101)
- Fluidizing Combustion Air Blower (42K-102)
- Intake Air Filters (42Y-101/102)
- Incinerator Reactor (42C-101)
- Sand Storage Bin (42D-103)
- Bucket Elevator (42T-101)

Combustion gas from each incinerator will go directly into the firebox of the pulverized coal fired steam boilers in the Steam Generation and Boiler Feedwater Treating Plant (Plant 31).

All ash is presumed to be blown into the boiler. If any separate ash facilities (i.e., cyclones) are needed, the collected ash will be quenched and combined with boiler bottom ash.

2.4 Plant Description - Gasifier Plant Solids Dewatering

Process Flow Diagram 42-D-B-2 depicts the gasifier plant solids dewatering system which is included in Plant 42.

The gasifier plant normally produces about 1,500 tons of solid waste per day consisting of slag and soot. About 80% of this waste material is coarse slag and is screened from the rest of the solid waste as it is discharged from the bottom of the gasifiers. The finer solid wastes are transferred as a water slurry to the Clarifiers (12Y-004 A and B). The solids in the underflow from these clarifiers are referred to here as "ash" and the overflow as "grey water". The water has a characteristic gray color derived from the fine ash and soot in suspension.

This section consists of two interrelated systems:

- Ash dewatering and handling
- Grey water treatment and blowdown

2.4.1 Ash Dewatering and Handling System

The solids in the underflow from the Clarifier (12Y-004) in the Gasification and Purification Plant (Plant 12) are dewatered by a vacuum filter system into filter cake which is then delivered to the Dewatered Slag/Soot Bin (42D-105) by the Filter Cake Loading Conveyor (42T-103). The dewatered ash is mixed with coarse slag in the bin before being hauled by truck to landfill disposal.

2.4.2 Grey Water Blowdown Treatment System

A portion of the clarifier overflow, called grey water blowdown, is filtered in the Media Filters (42Z-102) and Cartridge Filters (42Z-103) in series. The treated water is recycled to the hydrocarbon desalting

process in the H-Coal Distillate Separation Plant (Plant 17). The filter backwash containing fine ash is sent back to the clarifier on an intermittent basis.

2.5 Utility Balance

Electricity, kW

Condition	Consumed
Operating	230

42D-101 SUMP 15'X12'X10'

42G-102A,B SLUDGE PUMPS 40 GPM

42G-107A,B INCINERATOR FEED PRETREATMENT DISCHARGE PUMPS

42Y-103A-F FEED TANK MIXERS

42G-108 A-D INCINERATOR FEED TRANSFER PUMPS

42D-102A,B INCINERATOR FEED TANKS 25'ØX24'H

42V-103 INCINERATOR FEED PRETREATMENT SYSTEM (SEE NOTE 1)

42V-101A,B,C,D
WASTE SLUDGE INCINERATOR SYSTEM

42G-101A-X SLUDGE FEED PUMPS PROGRESSIVE CAVITY VARIABLE SPEED

42K-102 A - D FLUIDIZING-COMBUSTION AIR BLOWER

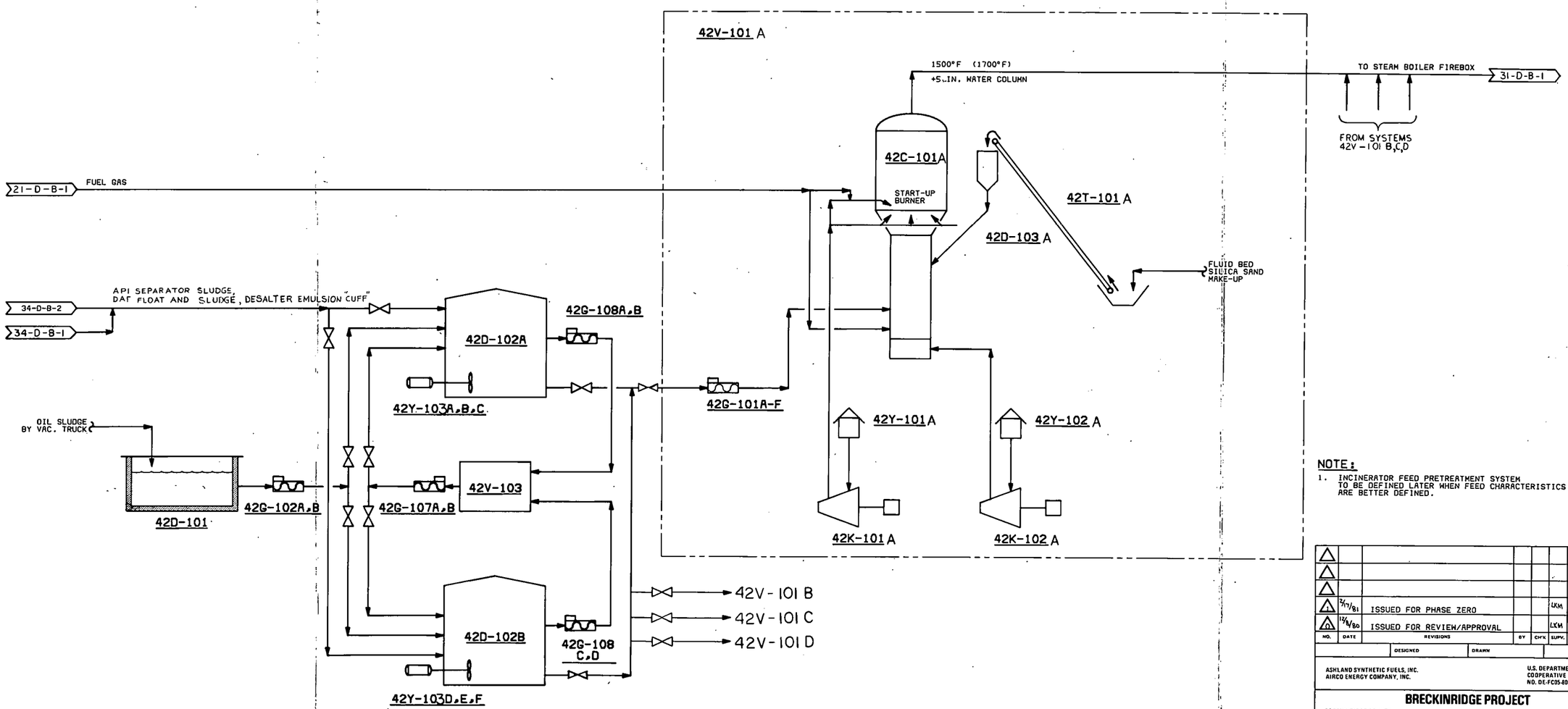
42C-101 A-D INCINERATOR REACTOR

42T-101 A-D BUCKET ELEVATOR

42K-101A-D OVERBED AIR-PREHEAT BURNER COMBUSTION AIR BLOWER

42Y-101/102 A-D INTAKE AIR FILTERS

42D-103 A-D SILICA SAND STORAGE BIN 10 TON CAP.



NOTE:

1. INCINERATOR FEED PRETREATMENT SYSTEM TO BE DEFINED LATER WHEN FEED CHARACTERISTICS ARE BETTER DEFINED.

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R.	BI APPR.	ASFI APPR.
1	3/1/81	ISSUED FOR PHASE ZERO			LKM	VS		WVC WHC
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 PLANT 42 SOLID WASTE MANAGEMENT WASTE SLUDGE INCINERATION SYSTEM

BECHTEL HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	42-D-B-1	1

KCL78A 02/13/81 R6

22 X 34 "D" SIZE

42V-102
GASIFIER SLUDGE VACUUM FILTER SYSTEM

42Z-101A-J
VACUUM FILTERS

42C-102A,B,C
VACUUM FILTRATE ACCUMULATORS

42H-101A,B,C
VACUUM PUMPS

42G-103A,B,C
VACUUM FILTRATE PUMP

42Z-102A,B
MEDIA FILTERS

42Z-103A,B
CARTRIDGE FILTERS

42T-102
FILTER CAKE COLLECTING CONVEYOR

42T-103
FILTER CAKE LOADING CONVEYOR

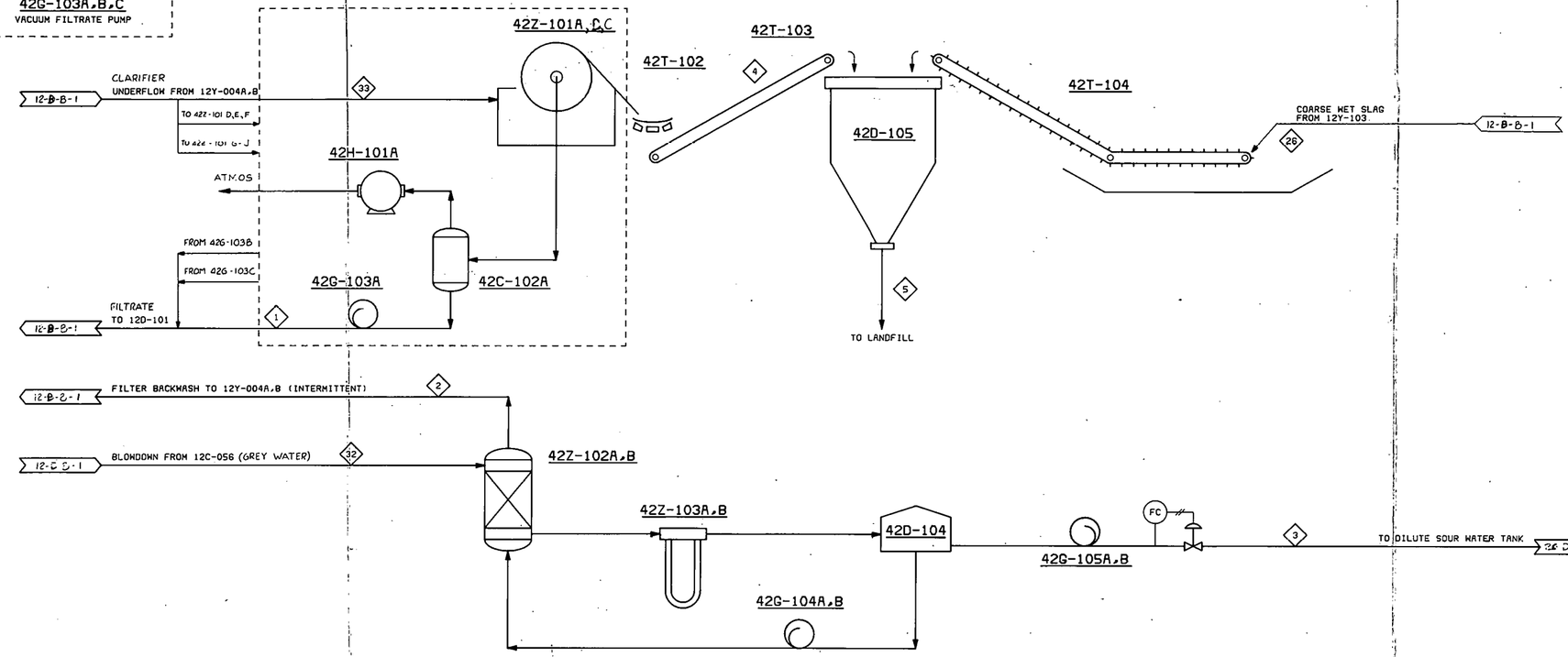
42D-105A,B,C
DEWATERED SLAG/SOOT BIN

42T-104
COARSE SLAG CONVEYOR

42D-104
FILTERED GREY WATER TANK 17,000 GAL.

42G-104A,B
FILTER BACKWASH PUMPS

42G-105A,B
FILTERED GREY WATER PUMP



STREAM NO.	1	2	3	4	5	26	32	33
DESCRIPTION / PARAMETER	VACUUM FILTRATE	FILTER BACKWASH	FILTERED BLOWDOWN TO DILUTE S.M.TK.	FILTER CAKE	SOLIDS TO LANDFILL	COARSE SLAG	QUENCH TANK 12C-056 BLOWDOWN	12Y-004 UNDERFLOW
TOTAL FLOW (GPM)	236	10 (AVE)	5.5				525	406
TOTAL FLOW (LB/HR)	116,300			88,300	212,300	124,000	262,452	204,609
WATER FLOW (LB/HR)	116,300			35,300	85,300	50,000	262,433	151,383
SOLIDS FLOW (LB/HR)				53,000	127,000	74,000	19	53,226

KCL82C 02/10/81 BS

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R	BI APP'L	ASFI APP'L
1	9/17/81	ISSUED FOR PHASE 0		VS LWM	BTK		LWM	
0	12/8/80	ISSUED FOR REVIEW/APPROVAL		VS LWM	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 42 - SOLID WASTE MANAGEMENT
GASIFIER PLANT SOLIDS DEWATERING

BECHTEL HOUSTON

JOB NO.	DRAWING NO.	REV.
14222	42-D-B-2	1

22 X 34 "D" SIZE

THE BRECKINRIDGE PROJECT

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
42	SOLID WASTE TREATMENT	000000 NA
42D-101	SUMP	000000 NA
42D-102A	INCINERATOR FEED TANK	000000 NA
42D-102B	INCINERATOR FEED TANK	000000 NA
42D-104	FILTERED GRAY WATER TANK	000000 NA
42D-105A	DEWATERED SLAG BIN	000000 NA
42D-105B	DEWATERED SLAG BIN	000000 NA
42D-105C	DEWATERED SLAG BIN	000000 NA
42G-102A	SLUDGE TRANSFER PUMP	000000 NA
42G-102B	SLUDGE TRANSFER PUMP	000000 NA
42G-104A	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	
42G-104B	FILTER BACKWASH PUMP	000000 NA
42G-105A	SOUR WATER PUMP	000000 NA
42G-105B	SOUR WATER PUMP	000000 NA
42G-107A	INCINERATOR FEED PRE TREATMENT DISCH PUMP	000000 NA
42G-107B	INCINERATOR FEED PRE-TREATMENT DISCH. PUMP	000000 NA
42G-108A	INCINERATOR FEED TRANS-FER PUMP	000000 NA
42G-108B	INCINERATOR FEED TRANS-FER PUMP	000000 NA
42G-108C	INCINERATOR FEED TRANS-FER PUMP	000000 NA
42G-108D	INCINERATOR FEED TRANS-FER PUMP	000000 NA
42T-102	FILTER CAKE COLLECTING CONVEYOR	000000 NA
42T-103	FILTER CAKE TRANSFER CONVEYOR	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
42T-104	COARSE SLAG CONVEYOR	000000 NA
42V-101A	WATER SLUDGE INCINERATION SYSTEM	000000 NA
42V-101B	WATER SLUDGE INCINERATION SYSTEM	000000 NA
42V-101C	WATER SLUDGE INCINERATION SYSTEM	000000 NA
42V-101D	WATER SLUDGE INCINERATION SYSTEM	000000 NA
42V-102	ASH VACUUM FILTER SYSTEM	000000 NA
42V-103	INCINERATOR FEED PRE TREATMENT SYSTEM	000000 NA
42Y-103A	FEED TANK MIXER	000000 NA
42Y-103B	FEED TANK MIXER	000000 NA
42Y-103C	FEED TANK MIXER	000000 NA
42Y-103D	FEED TANK MIXER	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
42Y-103E	FEED TANK MIXER	000000
	-	NA
42Y-103F	FEED TANK MIXER	000000
	-	NA
42Z-102A	MEDIA FILTER	000000
	-	NA
42Z-102B	MEDIA FILTER	000000
	-	NA
42Z-103A	CARTRIDGE FILTER	000000
	-	NA
42Z-103B	CARTRIDGE FILTER	000000
	-	NA

4.1 Duty Specifications for Miscellaneous Equipment

42-SP-A-01: Waste Sludge Incineration

42-SP-A-02: Gasifier Solids Dewatering

THE BRECKINRIDGE PROJECT

PLANT #42 - SOLID WASTE MANAGEMENT

WASTE SLUDGE INCINERATION

42V-101 A, B, C, D ⚠

Waste Sludge Incineration System

(Dorr-Oliver Fluosolids Combustor or equal)

⚠ Four incinerator units capable of burning miscellaneous sludges and emulsions associated with coal liquefaction, ranging from aromatic oil to emulsions and suspensions of oil, ash and coal dust in water. Material will be pumpable but cannot be atomized.

42C-101 A, B, C, D ⚠ Overhead gas from each incinerator will go directly into the firebox of a pulverized coal slagging steam boiler.

42K-102 A, B, C, D ⚠ Each incinerator must be equipped with a forced draft fan which will result in a positive pressure of [illegible] inches of water at the duct outlet.
(50 HP)

All ash is presumed to be blown into the boiler. If any separate ash facilities (i.e. cyclones) are needed, the collected ash should be quenched and sluiced with water, to be combined with boiler bottom slag elsewhere.

Each incinerator will be designed for a maximum charge rate of one (1) ton per hour of sludge, or a heat release of (10) ten million BTU per hour, LHV basis, whichever is limiting. Auxiliary fuel will be medium BTU fuel gas, 300 BTU per SCF.

Incineration unit to include all necessary associated equipment, such as:

42D-103 A, B, C, D ⚠ Sand Storage Bin

42T-101 A, B, C, D ⚠ Bucket Elevator (3 HP)

42V-101 A, B/102 A, B, C, D ⚠ Intake Air Filters

FORM H-292 7-66

⚠					
⚠					
⚠	1/15/81	REISSUED FOR PHASE ZERO- INCREASE NO OF EQUIPMENT	HP	[illegible]	HNH
⚠	1/5/81	ISSUED FOR PHASE ZERO	HP	HS	

ASFI THE BRECKINRIDGE PROJECT AECI
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-800RC0717
DUTY SPECIFICATION
WASTE SLUDGE INCINERATION

JOB NO. 14822
SPECIFICATION 42-SP-A-01 REV 1

42G-101 A-X (2 sets; 24 total) [1]	Sludge Feed Pumps (2 HP ea.)
42K-101 A, B, C, D [1]	Overbed air-preheat burner combustion air blower. (5HP)

	Indicating and control instrumentation
	Motors, controls and switch gear.
42D-101	One oil sludge sump, below ground, concrete 15 Ft. long x 10 Ft. wide x 12 Ft. deep.
42D-102 A,B	One incinerator feed/mixing tank, 2,000 bbls nominal capacity, API type steel, cone roof tank, 24 Ft. high x 25 Ft. diameter, with three side entry tank mixers, manways, nozzles, etc.
42G-102 A,B	Two sludge transfer pumps progressing cavity type capable of pumping heavy, viscous, dirty oily sludges, 40 gpm @ 50 Ft. discharge head.(2HP ea.)
42Y-103 A,B,C,D,E,F	Three feed tank mixers (5HP ea.)
42V-103	Incinerator feed pretreatment system
42G-107 A,B	Incinerator feed pretreatment discharge pumps
42G-108 A,B,C,D	Incinerator feed transfer pump

THE BRECKINRIDGE PROJECT

PLANT #42 - SOLID WASTE MANAGEMENT

GASIFIER SOLIDS DEWATERING

42V-102	
Ash Vacuum Filter System	Ten, 10' dia. x 10' length vacuum filters. System includes nine working filters and one spare, three vacuum pumps, and three filtrate pumps.
42Z-101 A-J	Ten vacuum drum filters each 10' dia. x 10' long. (REC. 4'x30' BY BRUCE WILSON CO.) (105 FT², C.S.)
42C-102 A, B, C	Three receiving tanks.
42H-101 A, B, C	Three vacuum pumps.
42G-103 A, B, C	Three filtrate pumps each 150 gpm, 30 psia.
42T-102	Horizontal conveyor belt system consisting of 200' long x 30" wide partly enclosed conveyor belt complete with motors, and controls.
Filter Cake Collecting Conveyor	This conveyor is for collecting the filter cake from 10 drum filters. Total rate 44 ton/hr wet cake.
42T-103	
Filter Cake Transfer Conveyor	Conveyor system for delivering 44 ton/hr of vacuum filter cake to tops of 3 elevated storage bins. Estimated total lift is 40 ft.
42D-105 A, B, C	
Dewatered Slag Bins	Three, 15 x 15 x 12 ft. slag storage bins with conical bottom section. 3 hrs. total ash storage capacity and provisions for direct, rapid truck loading.

FORM H-292 7-66

1/3/81	ISSUED FOR PHASE ZERO	HP AIT		HMH
ASFI	THE BRECKINRIDGE PROJECT	ABCI	JOB NO. 14826		
U.S. DOE COOPERATIVE AGREEMENT NO. DE-FC05-80CR-10717			SPECIFICATION		REV
DUTY SPECIFICATION GASIFIER SOLIDS DEWATERING			42-SP-A-02		0

SHEET 1 OF 2

42T-104

Coarse Slag Conveyor System	Conveyor system, 200' long , 36" wide, enclosed complete with motors, and controls. For delivering 100 tons/hr. coarse slag to tops of 3 elevated storage bins 40ft. above ground.

42Z-102 A,B

Media Filters (42G-104 A,B)	Filter system consisting of two 8' diameter vertical pressure filters, two 750 gpm backwash pumps, (42G-104 A,B) two 150 fin air blowers and control.

42Z-103 A,B

Cartridge Filters CUNO FIlter Model ~~19SL3~~ 27 SL3 CUNO Eng. Co (203)237-5541 (REC. BY VENDOR)	Two, cartridge filter units with mounting legs, drain plug, stainless steel cartridge posts and seal assemblies. Each unit to consist of 57 elements, 10 micron cartridges rated at maximum 400 gpm.

42D-104

Filtered Gray Water Tank	One 17,000 gallon tank, cone roof, steel.

42G-105 A,B

Sour Water Pumps	Two, centrifugal-type pumps rated at 350gpm

5.0 DRAWINGS

Due to the nature of Solid Waste Management (Plant 42), no drawings are required.

PLANT 44 LANDFILL

1.0 INTRODUCTION

Presented in this section are conceptual disposal plans for nonhazardous and hazardous solid wastes from the synthetic fuel project planned by Ashland Synthetic Fuels, Inc. and Airco Energy Company, Inc., in Breckinridge County, Kentucky. This work is part of Phase Zero engineering for the Breckinridge Project.

Solid waste quantities and characteristics are taken from Phase Zero process engineering data for the coal liquification and ancillary systems and from similar wastes in other industries. Disposal systems are designed for sites typical of those available in the area and are based on available geotechnical data.

Included in this section are:

- The sources, classification, characteristics, and quantities of the solid wastes
- The nonhazardous waste collection system
- The development of the nonhazardous waste disposal site over the 40-year life of the plant
- The hazardous waste collection system
- The development of the hazardous waste disposal site over the 40-year life of the plant

The objective of the Breckinridge Project is to design, construct, and operate a commercial plant to produce approximately 50,000 barrels per day of hydrocarbon liquid equivalent from coal. Coal will be transported to the site primarily by barge. The coal purchased will most likely be washed although the current design provides for receipt of run-of-mine coal and washing at the plant site. The facility will produce propane,

mixed butanes, light naphtha, reformate, and distillate oil along with by-product pipeline gas, sulfur, and ammonia. Various types of solid waste are generated by the Breckinridge facility and are generally classified as hazardous or nonhazardous according to U.S. EPA definition, when applicable, for purposes of the Phase Zero engineering.

Phase Zero engineering for hazardous and nonhazardous solid waste collection and disposal is presented in this report. It is assumed that the coal will be washed at the facility site. If the coal arrives prewashed, the nonhazardous portion of the solid waste management plan can be greatly reduced in scope.

Most of the waste is nonhazardous, including coal refuse, gasifier ash and slag, boiler ash, water treatment waste, and miscellaneous facility trash and garbage. A small portion is hazardous, including flue gas desulfurization by-product waste, and wastewater treatment filter cake and salts. Approximately 8570 tons per day (TPD) (dry solids) of nonhazardous waste and 130 TPD (dry solids) of hazardous waste are produced. Some nonhazardous waste is mixed with the hazardous waste to improve the disposal properties of the hazardous waste. Consequently, the quantities of dry solids disposed at the nonhazardous and hazardous waste disposal sites are 8450 TPD and 250 TPD respectively.

Solid waste is collected daily to minimize onsite waste storage. All solid waste except miscellaneous plant trash and garbage is stored in elevated bins and hoppers . Most waste is transported to the disposal site in 40- and 85-ton capacity off-road rear-dump haulers. Fly ash is transported in closed concrete mixer trucks. Wheeled, rear-loader containers of 4-cubic-yard capacity are selected to store the miscellaneous plant waste. Rear-loader compactor trucks transport this waste to the disposal site.

The locations of the hazardous and nonhazardous waste disposal sites are shown in Figures 1, 2, and 3. These figures show development of the site for 5-year, 20-year, and 40-year planning periods. Preliminary routes of access roads to the disposal sites and leachate return systems are also shown.

The nonhazardous waste disposal site consists of hollows of the Bull Creek watershed. Site capacity is estimated at 2.5×10^9 cubic feet, based on filling the four main hollows to the drainage divides (an approximate elevation of 600 to 620 feet), beginning at elevations of 415 to 435 feet. The site has just enough capacity for 40 years' disposal of nonhazardous waste at the specified generation rates.

Each hollow is developed separately in stages. The sequence of landfilling for each stage consists of site preparation, material placement in horizontal layers (maintaining a front face slope of 25 percent or less) to the final elevation, and final covering with clay and topsoil and seeding. Starter dikes are provided at the surfaces of the hollows to increase stability of the filled wastes. A clay liner, gravel drainage, and collector piping system which collect and return leachate to the facility for treatment are also provided. Surface runoff is collected in peripheral open channels at the final elevation of each fill and diverted away from the working face area.

The hazardous waste disposal site consists of a hollow of Town Creek and is contiguous to the nonhazardous site. Available capacity, isolation, and proximity to the facility are the main reasons for selecting this site for Phase Zero engineering. The site capacity is significantly larger than 8×10^7 cubic feet necessary for the 40-year planning period. In fact, filling to an elevation of only 580 feet, starting at 440 feet, satisfies that requirement. The landfilling procedure is similar to that described for the nonhazardous wastes. The main

difference at the hazardous site is the compound liner, clay plus synthetic, used to ensure that all leachate produced is collected and returned to the facility. Additionally, an intermediate covering is provided to minimize rainfall percolation and subsequent loss of soluble material. Finally, a clay "cap" is included in the final cover to minimize infiltration into the waste. Surface runoff diversion is also included at this site.

The mobile equipment required for the collection, transportation and disposal of hazardous and nonhazardous wastes is listed in Table 1.

The bulk materials required for the development of the hazardous and nonhazardous waste disposal sites are listed in Table 2.

NOTES

1. FINAL ELEVATIONS OF FILLED HOLLOWS ARE:
   HOLLOW 1 — 620 FEET
   HAZARDOUS HOLLOW — 580 FEET
2. SITE DEVELOPMENT FOR 5 YEAR PERIOD IS:
   HOLLOW 1 — 40 % FILLED
   HAZARDOUS HOLLOW — 12 % FILLED
3. ACCESS ROADS ARE LOCATED TO LIMIT GRADES TO APPROXIMATELY 10%, ROAD WIDTH = 45 FEET.
4. SECURITY FENCING, NOT SHOWN, IS PROVIDED AT SITE BOUNDARIES.
5. a) NON-HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY TO COLLECTION POND, THEN IS PUMPED TO WASTEWATER TREATMENT PLANT.
   b) HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY DIRECTLY TO THE WASTEWATER TREATMENT PLANT.
6. RUNOFF FROM ACTIVE LANDFILLING AREA IS COLLECTED AND RETURNED TO WASTEWATER TREATMENT PLANT. OTHER RUNOFF IS COLLECTED IN CHANNELS AROUND PERIPHERIES OF FILLS AND DISCHARGED DOWNSTREAM.
7. a) FRONT FACE SLOPE OF NON-HAZARDOUS FILL IS 25%.
   b) FRONT FACE SLOPE OF HAZARDOUS FILL IS 17 %.
8. 100 YEAR FLOOD ZONE IS AT ELEVATION 410.

APPROXIMATE SCALE
80 40 0 80 1600 2400 3200 FEET
GRAPHIC SCALE

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	MGR'S.	DIV. APPR.	ASST. APPR.

DESIGNED — DRAWN

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

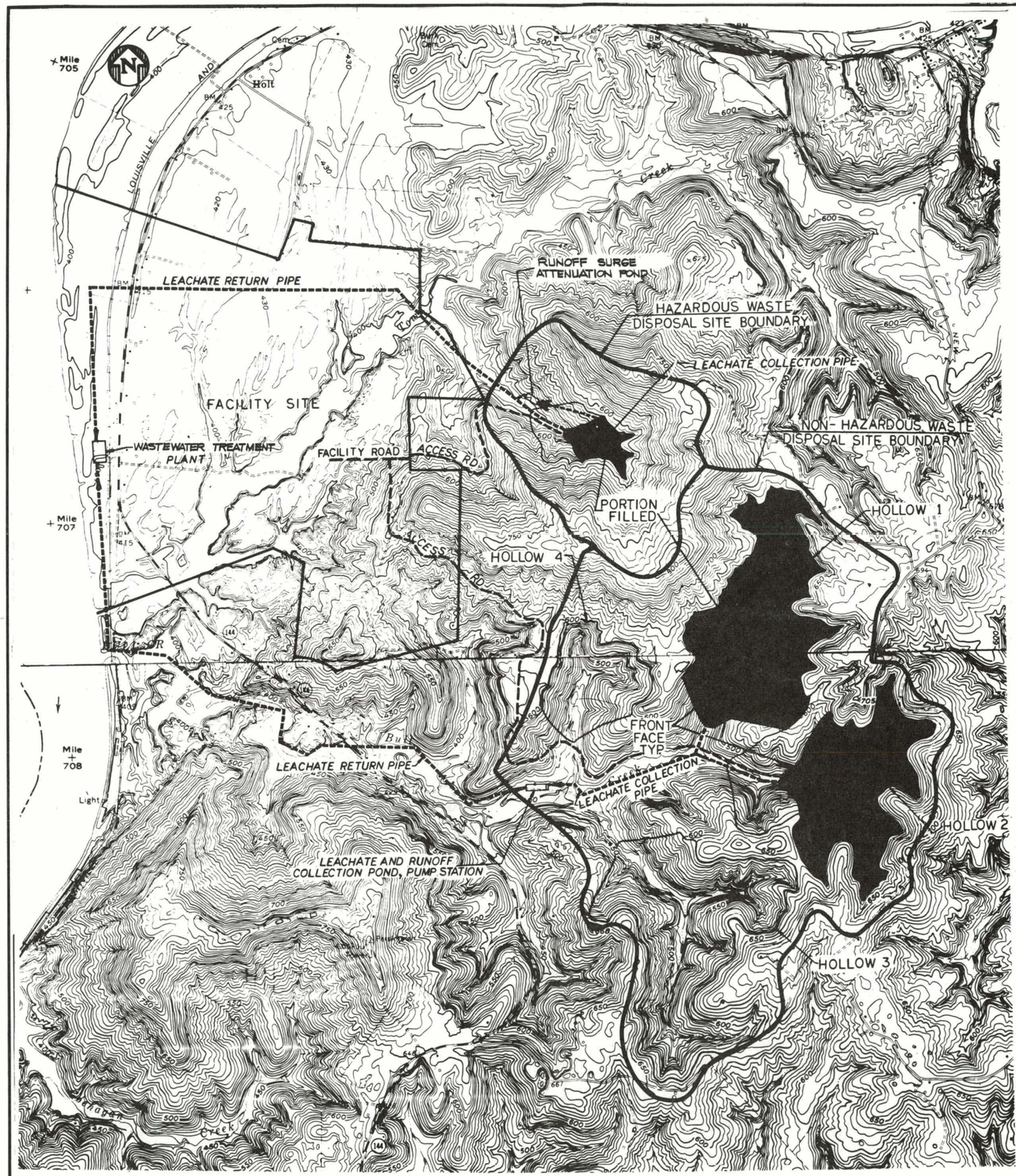
U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-80ER30017

BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

FIGURE 1
SOLID WASTE DISPOSAL SYSTEM
5 YEAR PLANNING PERIOD

HOUSTON — JOB NO. 14222 — DRAWING NO. — REV.

34 X 44 "E" SIZE



NOTES

1. FINAL ELEVATIONS OF FILLED HOLLOWS ARE:

HOLLOWS 1,2	620 FEET
HAZARDOUS HOLLOW	580 FEET

2. SITE DEVELOPMENT FOR 20 YEAR PERIOD IS:

HOLLOW 1	FILLED
HOLLOW 2	70% FILLED
HAZARDOUS HOLLOW	50% FILLED

3. ACCESS ROADS ARE LOCATED TO LIMIT GRADES TO APPROXIMATELY 10%, ROAD WIDTH = 45 FEET.
4. SECURITY FENCING, NOT SHOWN, IS PROVIDED AT SITE BOUNDARIES.
5. a) NON-HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY TO COLLECTION POND, THEN IS PUMPED TO WASTEWATER TREATMENT PLANT.
   b) HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY DIRECTLY TO THE WASTEWATER TREATMENT PLANT.
6. RUNOFF FROM ACTIVE LANDFILLING AREA IS COLLECTED AND RETURNED TO WASTEWATER TREATMENT PLANT. OTHER RUNOFF IS COLLECTED IN CHANNELS AROUND PERIPHERIES OF FILLS AND DISCHARGED DOWNSTREAM.
7. a) FRONT FACE SLOPE OF NON-HAZARDOUS FILL IS 25%.
   b) FRONT FACE SLOPE OF HAZARDOUS FILL IS 17%.
8. 100 YEAR FLOOD ZONE IS AT ELEVATION 410.

APPROXIMATE SCALE
80 40 0 80 1600 2400 3200 FEET
GRAPHIC SCALE

NO	DATE	REVISIONS	BY	CHK	SUPV.	ENGR'G APPR.	M. APPR.	AGEN. APPR.
		DESIGNED		DRAWN				

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
DE-FCR-80RK00717

BRECKINRIDGE PROJECT

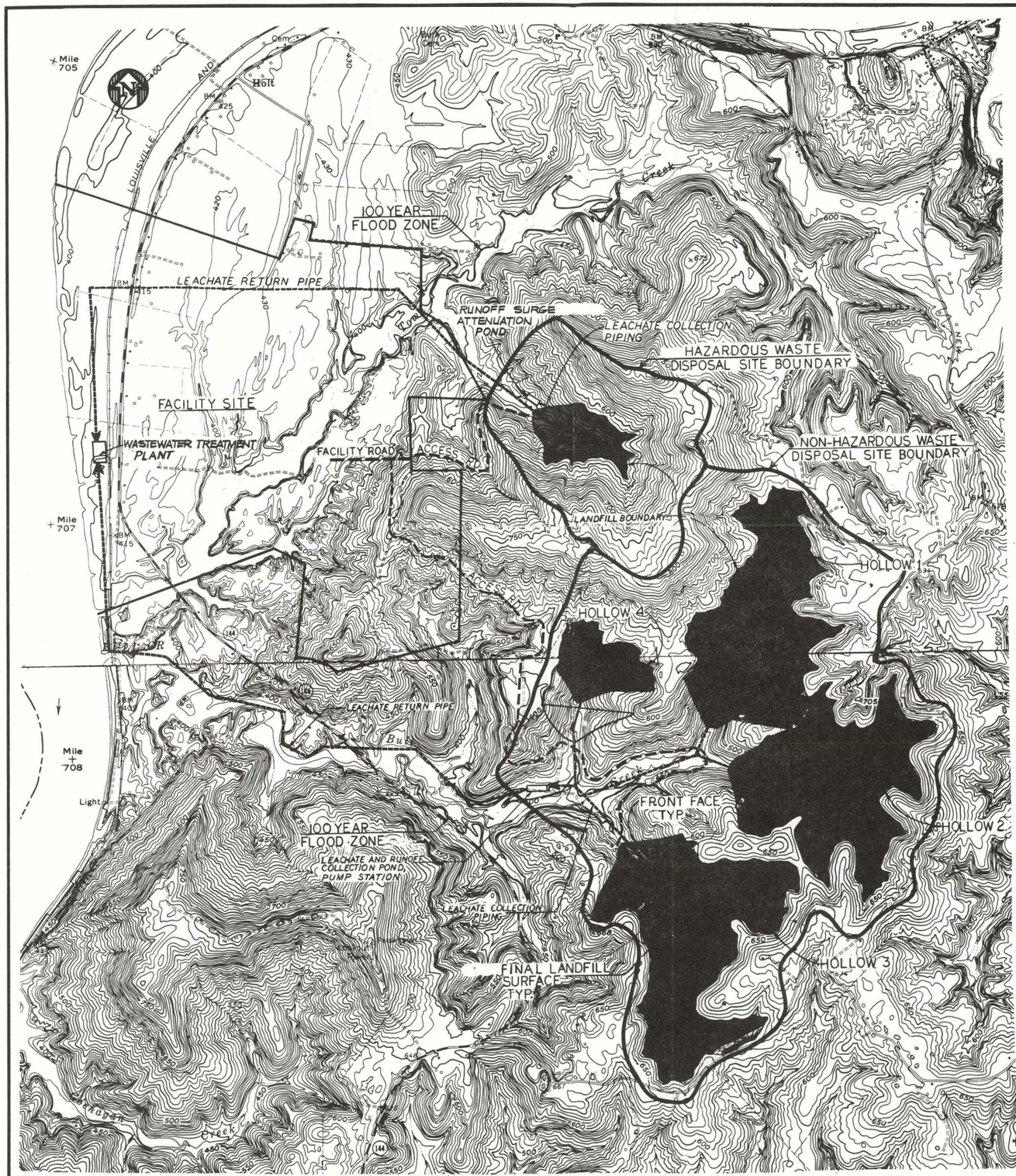
BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

FIGURE 2
SOLID WASTE DISPOSAL SYSTEM
20 YEAR PLANNING PERIOD

HOUSTON | JOB NO. 14222 | DRAWING NO. | REV.

24 X 44 "E" SIZE

8 7 6 5 4 3 2 1 — H G F E D C B A



NOTES

1. FINAL ELEVATIONS OF FILLED HOLLOWS ARE:

HOLLOWS 1, 2, 3	620 FEET
HOLLOW 4	600 FEET
HAZARDOUS HOLLOW	580 FEET

2. SITE DEVELOPMENT FOR 40 YEAR PERIOD IS:

HOLLOWS 1, 2, 3	FILLED
HOLLOW 4	55% FILLED
HAZARDOUS HOLLOW	FILLED

3. ACCESS ROADS ARE LOCATED TO LIMIT GRADES TO APPROXIMATELY 10%, ROAD WIDTH = 45 FEET.
4. SECURITY FENCING, NOT SHOWN, IS PROVIDED AT SITE BOUNDARIES.
5. a) NON-HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY TO COLLECTION POND, THEN IS PUMPED TO WASTEWATER TREATMENT PLANT.
   b) HAZARDOUS SITE LEACHATE FLOWS BY GRAVITY DIRECTLY TO THE WASTEWATER TREATMENT PLANT.
6. RUNOFF FROM ACTIVE LANDFILLING AREA IS COLLECTED AND RETURNED TO WASTEWATER TREATMENT PLANT. OTHER RUNOFF IS COLLECTED IN CHANNELS AROUND PERIPHERIES OF FILLS AND DISCHARGED DOWNSTREAM
7. a) FRONT FACE SLOPE OF NON-HAZARDOUS FILL IS 25%.
   b) FRONT FACE SLOPE OF HAZARDOUS FILL IS 17%.
8. 100 YEAR FLOOD ZONE IS AT ELEVATION 410.

APPROXIMATE SCALE
400 800 0 800 1600 2400 3200 FEET

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	ENGR'G	SR ENGR.	AGEN. APPR.
		ORIGINATED		DRAWN				

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC05-85ER80017

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY — PHASE ZERO — KENTUCKY

FIGURE 3
SOLID WASTE DISPOSAL SYSTEM
40 YEAR PLANNING PERIOD

HOUSTON | JOB NO. 14222 | DRAWING NO. | REV.

8 7 6 5 4 3 2 1
H G F E D C B A

TABLE 1

LIST OF EQUIPMENT

Nonhazardous Waste Disposal System

Type	Size or Capacity	Number
Off-road, rear dump hauler	85 tons	12
Concrete mixer truck	12 yd^3	4
Rear loader, compactor garbage truck	25 yd^3	2
Rear loader, wheeled container	4 yd^3	30
Wheeled loader	40,000 lb	6
Track dozer	480 yd^3/hr	4
Motor grader	Equivalent to Cat. Model 12G	2

Hazardous Waste Disposal System

Type	Size or Capacity	Number
Off-road, rear dump hauler	40 tons	2
Wheeled loader	3,800 lb	1
Track dozer	100 yd^3/hr	1
Motor grader	Equivalent to Cat. Model 12G	1

TABLE 2

LIST OF BULK MATERIAL

Nonhazardous Waste Disposal System

Item	Quantity
Excavation for clearing and grubbing	5.7×10^6 yd^3
Clay liner	5.7×10^6 yd^3
Drainage layer (gravel)	3.8×10^6 yd^3
Clay for soil cover	1.9×10^6 yd^3
Topsoil	1.9×10^6 yd^3
Soil cement	0.3×10^6 yd^2
Grass seeding area	5.7×10^6 yd^2
Perforated leachate pipe--20 in. dia.	56,000 ft
Transmission Pipe--10 in. dia.	800 ft
12 in. dia.	6,800 ft
20 in. dia.	21,600 ft
Drainage collection pipe--48 in. dia	14,000 ft
Active surface runoff collection pipe--60 in. dia	10,000 ft
Pump station--pumps (900 gpm, 25 ft TDH)	3
--pond (180 ft x 500 ft, 600,000 ft^3 active capacity)	1

Hazardous Waste Disposal System

Item	Quantity
Excavation for clearing and grubbing	0.27×10^6 yd^3
Leak detection permeable layer	0.14×10^6 yd^3
Sand bedding and liner cover	0.14×10^6 yd^2
Synthetic liner	0.4×10^6 yd^2
Clay liner	0.4×10^6 yd^3
Drainage layer (gravel & sand)	0.4×10^6 yd^3
Clay for soil cover	0.27×10^6 yd^3
Topsoil	0.14×10^6 yd^3
Soil cement	0.05×10^6 yd^2
Grass seeding area	0.4×10^6 yd^2
Perforated pipe--8 in. dia.	4,800 ft
Transmission pipe--12 in. dia.	12,000 ft
Settlement pond--180 ft x 280 ft (240,000 ft^3 capacity	1
Drainage collection pipe--48 in. dia.	4,200 ft
Active surface runoff collection pipe--60 in. dia.	2,100 ft

PLANT 44 LANDFILL

2.0 PLANT DESIGN

2.1 Types of Waste

2.1.1 Sources and Characteristics

Solid waste includes ash, solid residue, dewatered sludge, trash, and garbage from the operation and maintenance of the facility. The many possible sources of solid waste are grouped into eight categories of sources or groups of sources for Phase Zero engineering. These sources, and corresponding waste descriptions and characteristics, are listed in Table 3. The values presented are estimates based on Phase Zero process engineering and on characteristics of similar waste and should be verified in the future.

Moisture content is generally low enough, 50 percent or less, for the waste to be handled as a solid material. The water treatment waste has significant moisture content, 79 percent, but it is assumed for this phase of the study that it can be handled as a solid.

The densities listed in Table 3 are estimates based on a review of the literature. The values are based on material placed and compacted at a disposal site.

Estimated characteristics relating to pollution potential and structural stability are discussed in other sections of this report.

TABLE 3

SOLID WASTE SOURCES AND CHARACTERISTICS

Source	Waste	Characteristics	
		Moisture,* % by wt	Density,** lb ft^3
Coal crushing and washing	Coal refuse	22	90
Gasifier	Slag, ash, soot	40	90
Boiler plant	Fly ash	0	75
Boiler plant	Bottom ash	43	90
Flue gas scrubber	Sulfate by-product	0	70
Water treatment	Filter cake	79	70
Wastewater treatment	Filter cake, salts	48	70
Miscellaneous	Facility refuse, floatsam	20	50

*Wet basis

**In-place, compacted density on a dry basis

2.1.2 Classification

Section 3001 of Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, classifies solid waste as either hazardous or nonhazardous. The United States Environmental Protection Agency (U.S. EPA) is responsible under RCRA for establishing a hazardous waste management system, including regulations for identifying hazardous waste. Part 261 of Subtitle C contains the identification and listing of hazardous waste. Included are characteristics of hazardous waste and procedures for determining whether or not a waste is hazardous (45 FR 33119, Federal Register, May 19, 1980). It should be noted that the U.S. EPA's hazardous waste identification regulations currently exclude "fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels" (45 FB 33120, Federal Register, May 19, 1980).

Almost all of the waste, 98 percent, is defined as nonhazardous. This waste includes coal refuse, ash, slag, and general facility garbage and trash. A small portion, two percent, is defined as hazardous because of the potential presence of heavy metals and compounds that can be toxic in high concentrations, corrosive material, or highly soluble material. For this reason stack gas scrubber and wastewater treatment wastes are classified as hazardous in this study. Sample analysis in accordance with the U.S. EPA regulations is necessary to determine the actual classification as some waste classified as hazardous herein may be found to be nonhazardous according to EPA's classification.

The highly soluble hazardous waste consists of sulfate by-products, sour water residue, and cooling tower blowdown residue from wastewater treatment. The soluble waste disposal alternatives are discussed in Section 2.3, Nonhazardous Waste Disposal.

2.1.3 Quantities

Estimated quantities of solid waste from the facility are listed in Table 4 for each of the eight sources previously identified. Source totals listed include dry solids and moisture. Refuse from coal crushing and washing and ash and slag from the gasifier constitute 72 percent and 21 percent, respectively, of the total quantity. Also listed are totals for the nonhazardous component, approximately 11,650 TPD, and for the hazardous component, approximately 230 TPD.

Disposal properties of the hazardous waste are improved by adding to it an equal quantity of coal refuse (solids). The purpose is to combine the granular, bulky coal refuse with the filter cake, dried sludge, and salts (hazardous waste) to produce a more stable, free-draining material. The total quantity of hazardous waste disposed of is increased by about 160 TPD, including moisture.

Fly ash is wetted to approximately 15 percent moisture content before it is hauled to the disposal site. This minimizes fugitive dust emissions during truck loading and unloading, and increases the total quantity of fly ash disposed of from about 230 TPD to about 270 TPD. The assumption made for this study is that the fly ash is self-hardening.

The resulting approximate total quantities disposed of at the two disposal sites are as follows:

Nonhazardous site	11,530 TPD (8,450 TPD dry solids)
Hazardous site	390 TPD (250 TPD dry solids)

Estimated volumes of waste disposed of at the nonhazardous and hazardous sites for the 5-, 20-, and 40-year planning periods are listed in Table 5. These values are based on the waste quantities listed above and the densities listed in Table 3. The density values assume material is in place and compacted. It is also assumed that the facility operates, and solid waste is produced, 85 percent of the days of the year.

TABLE 4

WASTE QUANTITIES

Source	Quantity		
	Dry Solids, TPD	Source Total, TPD**	
Coal crushing and washing	6,690	8,588	
Gasifier	1,524	2,545	
Boiler plant (fly ash)	233	233	(274)
Boiler plant (bottom ash)	96	168	
Flue gas scrubber*	12	12	
Water treatment	24	114	
Wastewater treatment*	114	217	
Miscellaneous	5	6	
TOTAL	8,698	11,883	(11,929)
Nonhazardous component	8,572	11,654	(11,695)
Hazardous component	126	229	

* Defined as hazardous for this study.

** Paranthetical values have 40 TPD of water added to fly ash.

TABLE 5

VOLUMES OF DISPOSED WASTE

Planning Period, years	Total Volume, 10^6 ft^3	
	Nonhazardous Site*	Hazardous Site**
5	290	9.9
20	1,180	40
40	2,350	79

* Approximate in-place, compacted dry density is 89 lb/ft^3 for the combined nonhazardous waste.

** Approximate in-place, compacted dry density is 79 lb/ft^3 for the combined hazardous waste and coal residue.

2.2 Nonhazardous Waste Collection

2.2.1 Service

Nonhazardous waste is collected from the various sources and transported to the disposal site. The approximate locations of the sources are shown in Figure 4. Also shown are plant roads that can be used for collection. As noted previously, most of the solid waste originates at the coal crushing and washing plant and at the gasifier.

Daily collection is anticipated to minimize onsite waste storage of all wastes. Furthermore, collection is assumed to occur during two 8-hour shifts for all nonhazardous waste except miscellaneous refuse, for which collection during one shift is sufficient.

2.2.2 Storage

The onsite waste storage included here is for miscellaneous plant refuse and garbage. Sources of waste include the cafeteria, administration building, warehouse, and water intake screens. The estimated total quantity of this waste is 6 TPD. The number of storage containers necessary at each facility cannot be estimated without knowing the expected waste quantities for each facility. The containers selected are standard 4-cubic-yard-capacity wheeled rear-loader containers. The estimated number of these containers for the entire plant is 30.

Solid waste storage in elevated bins or hoppers is already provided at the other sources, including coal washing and crushing and the gasifier. The daily collection service provided should be consistent with storage volumes provided at the sources. Actual onsite storage requirements arising from interruptions in transporting, such as severe weather restrictions, will be evaluated in the following project phases.

2.2.3 Transportation

Collection vehicles haul the waste from the sources to the disposal site. The one-way haul distance varies from 3 to 5 miles depending on the source location and the portion of the disposal site being used. Each vehicle makes multiple trips to the disposal site each day. The types and sizes of trucks are selected for the quantities and types of waste to be collected. The trucks are also compatible with the kinds of storage provided at the various sources. The truck types, sizes and numbers are identified below.

Off-Road Rear-Dump Haulers. These trucks transport the large quantities of wastes from coal crushing and washing and the gasifier to the disposal site. The trucks operate off road and have open tops. Other wastes transported include the water treatment filter cake and the boiler plant bottom ash. The total quantity transported daily is approximately 11,400 tons. Two truck loads a day of coal residue are hauled to the hazardous disposal site. The remainder is hauled to the nonhazardous disposal site. The wastes have sufficient moisture and consistency to make transportation in these open-top trucks practical. The truck size selected holds 85 tons. Twelve trucks are provided, including spares.

Fly Ash Trucks. The selection of trucks for transporting fly ash is highly dependent on the properties of the fly ash. Fly ash from the combustion of eastern coal generally is not self-hardening and can be wetted and transported to the disposal site in off-road haulers. One 85-ton-capacity truck would be required.

It is assumed, however, for Phase Zero engineering, that the fly ash is self-hardening. The fly ash is wetted in rotary unloaders below the storage bins and unloaded into ready-mix-concrete trucks for transportation to the disposal site. These trucks are enclosed, and the fly

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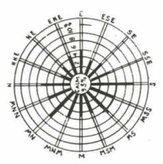
TRUE NORTH 0.0°
PLANT NORTH 0.0°



TOTAL % OF WINDS
FROM INDICATED DIRECTION

NOTES

1. BASE DRAWING TAKEN FROM PHASE ZERO DRWG. NO. 50E-A1, REV. 1

2. SOURCE IDENTIFICATION
   - ① COAL REFUSE
   - ② GASIFIER SLAG, ASH
   - ③ BOILER FLY ASH
   - ④ BOILER BOTTOM ASH
   - ⑤ FLUE GAS DESULFURIZATION PURGE
   - ⑥ WATER TREATMENT WASTE
   - ⑦ WASTEWATER TREATMENT WASTE
   - ⑧ MISCELLANEOUS REFUSE

3. WASTE CLASSIFICATION
   - NON-HAZARDOUS
   - HAZARDOUS

LEGEND

- COLLECTION ROADS
- BOUNDARY LINE
- EXISTING ROAD
- NEW ROAD
- EXISTING RAILROAD
- NEW RAILROAD
- RIPRAP
- FLOODWAY FRINGE
- CONVEYOR
- EXISTING POWER LINE
- FENCE

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENG'R.	BI APPR.	ASFI APPL

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

FIGURE 4
SOLID WASTE SOURCE LOCATIONS

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222		

ash is constantly agitated. The truck size selected is 12-cubic-yard capacity. Four trucks are provided, including spares.

Compactor Trucks. Conventional rear-loader municipal-type compactor trucks are used to transport miscellaneous plant trash, refuse, and garbage to the disposal site. The trucks are compatible with the wheeled rear loader containers selected for storage of this waste. The total quantity hauled is approximately 6 TPD. These trucks make one trip to the disposal site each day. The truck size selected holds 25 cubic yards. Two trucks are provided, one as a spare.

2.3 Nonhazardous Waste Disposal

2.3.1 Site Characteristics

Location and Setting. The disposal site is located two miles east of the Ohio River at approximately River Mile 707 and is located southeast of the facility, site as shown in Figure 1.

The site consists of hollows comprising part of the Bull Creek drainage basin above a surface elevation of approximately 390 feet. The nearest towns are Addison and Stephensport, Kentucky, located about 1-1/2 miles to the northwest and 2 miles to the north-northeast, respectively.

The existing ground surface at the site varies from gentle to steep slopes, in which the steep slopes predominate. Gentle to moderate slopes are generally found along the creek and are either grassy or under some form of cultivation. Most of the area consists of sharply pointed wooded ridges.

Climate. The climate in the area varies from moderately warm summers to cold winters. The mean annual temperature is 57°F with a seasonal

range of 37°F in winter to 77°F in summer. Winds in the area are variable, with a mean speed of 9 miles per hour (mph). The 100-year "fastest mile" wind speed is 82 mph at this location. Rainfall at the site averages 45 inches annually. Yearly totals range from 26 to 63 inches (at Evansville, Ind.). Monthly averages of relevant meteorological parameters for the site are given in Table 6. The 10-year return period precipitation event for various durations is given in Table 7 (Reference 1).

Hydrology. The Ohio River is the predominant hydrologic feature of the area and controls the flood elevations at the site. A recent study by the Corps of Engineers (Reference 2) has determined flood levels at the site. The 100-year flood level is at elevation 409.2; the 10-year level is at elevation 401.8 feet.

The disposal site basin has a drainage area of 3,530 acres, of which the disposal area utilizes the upper 1,940 acres (including both the filled and the unfilled areas). An approximate backwater calculation was made, assuming preconstruction conditions, to determine if flood levels on Bull Creek are increased by local runoff. A 100-year precipitation event was used to estimate a peak flow of 3,640 cubic feet per second (cfs) in Bull Creek at its confluence with the Ohio River with a corresponding flow of 2,750 cfs at the outlet section from the disposal area. The Ohio River was assumed to be at the 100-year level. A calculation using the Corps of Engineers HEC-2 computer program indicated a negligible backwater effect in Bull Creek. The lowest elevation of any development in the disposal site is conservatively set at elevation of 415 feet.

Land Features. Surface and subsurface conditions in the disposal site are based on available geotechnical data contained in a preliminary study performed by Dames and Moore (Reference 3). A comprehensive geotechnical investigation will be necessary in a later phase of the project to

TABLE 6

AVERAGE MONTHLY METEOROLOGICAL DATA,*
EVAPOTRANSPIRATION AND PERCOLATION

	Air Temp, F°	Wind Speed, mph	Precipitation, mm	Evapotranspiration		
				Potential,** mm	Actual,*** mm	Percolation, mm
Jan	36	10	122	21	21	62
Feb	37	10	89	24	24	46
Mar	46	11	117	59	59	23
Apr	57	10	102	86	86	0
May	66	8	104	113	111	0
June	75	7	102	131	120	0
July	78	7	99	145	116	0
Aug	77	6	94	122	99	0
Sept	71	7	76	94	80	0
Oct	59	7	66	56	56	0
Nov	46	9	91	32	32	0
Dec	37	9	86	20	20	7
Annual Total			1148	903	824	138

* Meteorological data taken from Reference 8

** Calculated using Reference 5

*** Calculated from methods of Reference 4

TABLE 7

10-YEAR PRECIPITATION AT SITE

Duration, hours	Total Precipitation, inches
0.5	1.67
1	2.1
3	2.8
6	3.4
12	4.0
24	4.6

develop a specific design as it relates to site geology, groundwater well canvass data, and other appropriate engineering characteristics of the subsurface soils.

The dominant features of this portion of the Ohio River valley were formed by glacial activity. The site disposal area is located over a wide trench that has been eroded to an elevation of approximately 260 feet. The regional bedrock exposed by the down-cutting of this trench consists mainly of Upper Mississippian fine-grained sandstones and shales. The deep channel was then filled with alluvial deposits of glacial sands and gravels. The upper silty to clayey soils that form the surface stratum covering the glacial sands and gravels are also of alluvial deposition. Localized minor deposition as a result of flooding on the Ohio River has occurred periodically since glaciation.

Subsurface conditions were explored by Dames and Moore by drilling three widely spaced borings and advancing 10 hand auger probes. Depth to bedrock at each boring location and probe was established. Shallow standpipe piezometers were installed in each of the borings to measure the depth to groundwater. Results of the study reported in Reference 3 are as follows:

- Subsurface conditions in the flatter drainage basin of Bull Creek consist of approximately 25 feet of soil overlying light gray, fossiliferous limestone. The upper soils vary from fine-grained silts and clays to mostly clayey coarse-to-fine sands. Shallow probes on the steeper slopes adjacent to the creek valley indicate that a thin mantle of silty clays and clayey silts, ranging from 1 to 5 feet in thickness, overlies the bedrock

- Groundwater under artesian pressure was encountered at a depth of approximately 33 feet in one boring

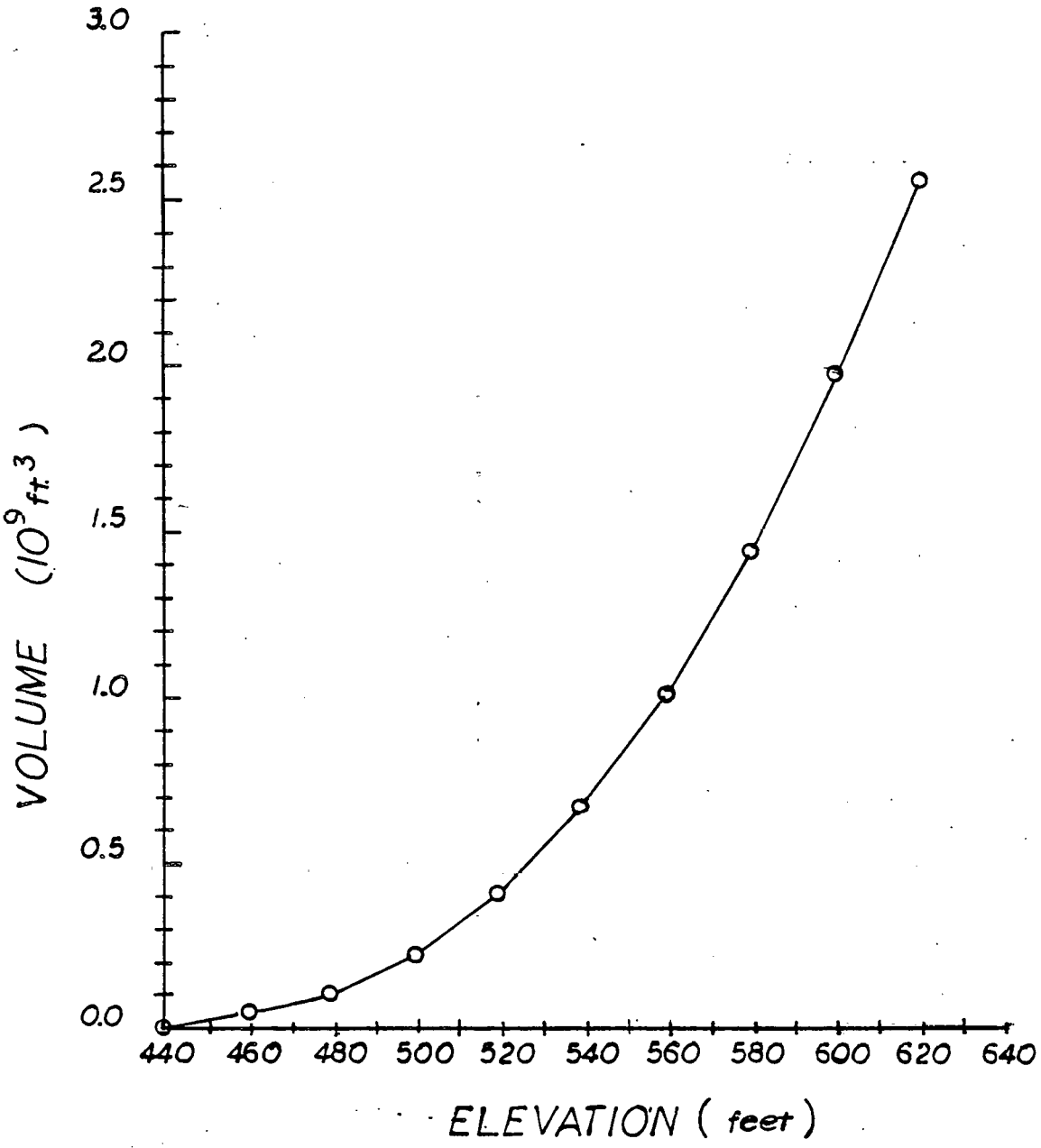
Further details of the subsurface soil conditions and their physical and engineering properties are presented in Reference 3.

Available Volume. Site size is best expressed as available volume for disposal, since the basic disposal plan is to fill the hollows with solid waste. This is a common disposal method in Kentucky. The available volume for disposal of the nonhazardous waste material was developed from USGS topographic maps for the Rome and Mattlingly, Kentucky-Indiana Quadrangles. The identified disposal site was subdivided into four hollows, designated as 1 though 4, and the available volume of each hollow was calculated, using a planimeter to measure areas at 20-foot intervals. The lowest elevation considered for waste disposal 420 feet, which is safely above the flood elevation of 409.2 feet. The highest elevation considered was determined principally by the watershed boundary at an elevation of approximately 600 to 620 feet.

The total available volume for all four hollows is shown in Figure 5 as a function of elevation. For comparison, the total waste volume for 40 years is 2.4×10^9 cubic feet. Although the curve extends to an elevation of 620 feet, Hollow 4 is filled only to its maximum elevation of 600 feet. Available volumes also include a front-face slope of 25 percent for stability.

2.3.2 Site Preparation

Site preparation includes the following steps: (1) clearing, grubbing, grading, and compacting the surface soils; and (2) installing liners and leachate drainage equipment. Preparation of a particular section of the landfill is shown in Figure 6. The solid waste disposal scheme includes a starter dike of compacted soil cement constructed at the toe of each of the fill stages, behind which the waste is placed and compacted. Clearing, grubbing, and grading ensure that the clay liner will adhere to the side slopes of the hollows, and that sufficient slope for each leachate drainage exists. Soil compaction helps ensure the integrity of the clay liner, especially in this area where the limited soil borings suggest porous limestone formations.



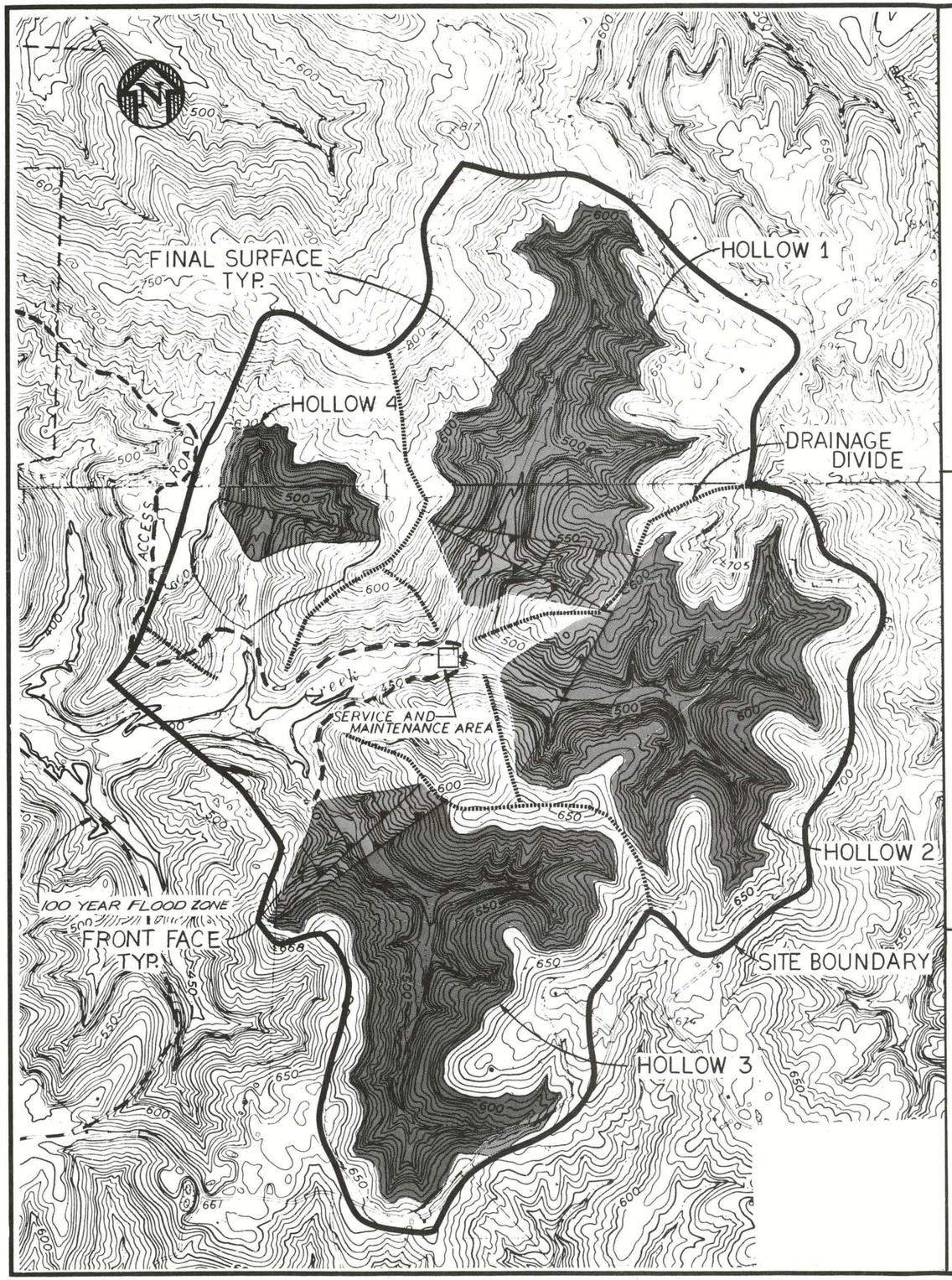
BRECKINRIDGE PROJECT

SOLID WASTE DISPOSAL STUDY

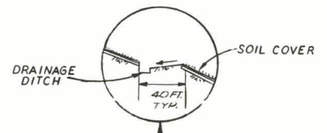
FIGURE 5

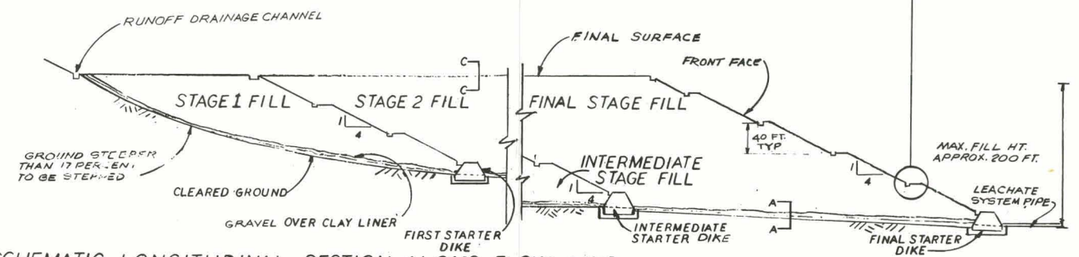
DISPOSAL VOLUME

NON HAZARDOUS SITE

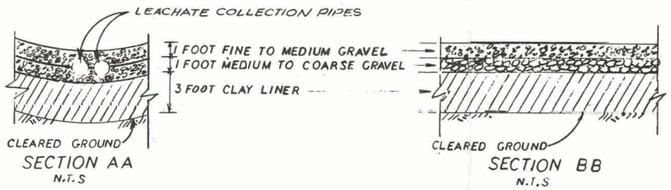


TYPICAL BENCH DETAIL



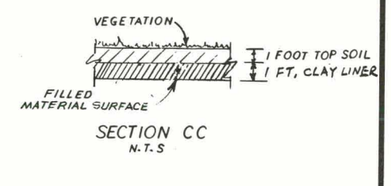


SCHEMATIC LONGITUDINAL SECTION ALONG FLOW LINE
N.T.S



SECTION AA
N.T.S

SECTION BB
N.T.S



SECTION CC
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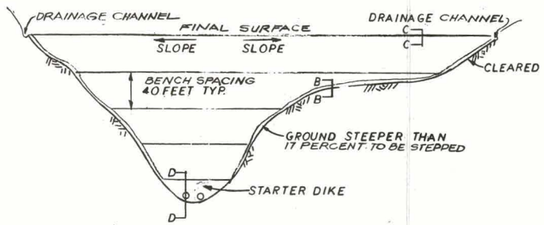
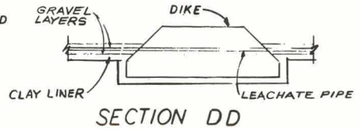


SCHEMATIC CROSS SECTION
N.T.S



SECTION DD
N.T.S

NOTES

1. HOLLOWS 1,2 AND 3 ARE FILLED TO ELEVATION 620
2. HOLLOW 4 IS FILLED TO ELEVATION 600
3. SERVICE AND MAINTENANCE AREA SIZE = 40,000 FT.^{2}
4. SITE DEVELOPMENT:

5 YEARS	40 PERCENT OF HOLLOW 1 FILLED
20 YEARS	HOLLOW 1 PLUS 70 PERCENT OF HOLLOW 2 FILLED
40 YEARS	HOLLOWS 1,2,3 AND 55 PERCENT OF HOLLOW 4 FILLED

NO.	DATE	REVISIONS	BY	CHK.	SUPV.	ENG'R.	DI APPR.	ADPI APPR.

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

FIGURE 6
NON-HAZARDOUS WASTE DISPOSAL SITE

HOUSTON

JOB NO.	DRAWING NO.	REV.
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A clay liner of a minimum thickness of 3 feet is placed on the surface and compacted to protect the ground water from landfill leachate. As indicated in Reference 3, some clay of sufficiently low permeability, 10^{-7} cm/s, is available nearby the site. The quantity of material available is not known at this stage and will be investigated in detail in a later phase of the project.

Clearing, Grubbing, and Removal of Top Soil. The gentle to moderate slopes along the creek edges are either grassy or cultivated. In this area about one to two feet of material is removed in order to clear the vegetation and remove the topsoil. The steeper slopes are wooded. In these areas the vegetation is cleared by cutting trees, removing stumps and roots, and removing grass, bushes and topsoil. About 2 to 4 feet of material is removed in the wooded areas. The vegetation and highly organic parts (root zones) of the top soil may be incinerated or incorporated in the fill area. Most of the remaining excavated topsoil may be suitable for future use as cover material and is stockpiled for such use.

Treatment of Water Springs, Cavities in Rock, or Other Adverse Ground Conditions. During the preliminary and design stages, detailed site and groundwater investigations will be conducted. The impact of non-hazardous waste disposal on any water springs, rock cavities or other adverse ground conditions will be studied in detail in the design phase of the project. Engineering solutions tailored to specific problems encountered at this site will be developed and incorporated in the final design.

Benching into Sloping Ground. On sloping ground where the grades are steeper than 17 percent (six horizontal to one vertical), the ground surface is benched for placement of all fills (including clay liner and drainage layer) in order to maintain lateral stability.

Perimeter Drainage Ditch. Water runoff from the slopes surrounding the disposal area is intercepted and diverted by a perimeter drainage ditch system. This is discussed detail in Section 2.3.6, Runoff Control.

Clay Liner. The entire bottom and sides of the area to be filled with solid waste are lined with a clay liner. It is anticipated that the clay material should be available from one or a combination of the following sources: (1) superficial clayey silt and silty clay in the flat areas of Bull Creek, (2) superficial clayey silt and silty clay from the borrow area for granular material, (3) superficial clayey silt and silty clay from plant excavations, and (4) superficial clayey silt and silty clay soils at other nearby alluvial areas. The liner soil is placed in thin layers and thoroughly compacted. Density and moisture content requirements for placement will be developed by laboratory testing of the actual soil to be used for the liner.

Soil-cement Dikes. Each hollow is filled from upstream to downstream in several stages. A starter dike of compacted soil-cement is constructed at the toe of each of the fill stages. The soil-cement dikes are about 40 feet wide at the top and about 20 feet high at the center. The dikes have 45-degree (one horizontal to one vertical) side slopes. The foundations of the dikes will be designed on the basis of the detailed site soil investigation. The surface of the foundation excavation for the dikes is created by horizontal benching. The dikes serve several purposes such as: (1) providing lateral stability at the toe of the fill slope; (2) providing access to the face of the fill slope; and (3) acting as a part of the temporary runoff retaining system during waste placement.

Gravel Drainage. A 24-inch-thick graded gravel layer is placed on top of the compacted clay liner to provide leachate drainage both from the sides of the hollow to the center, and downstream to the leachate collection point. Two layers, finer on top of coarser, are provided to protect the

gravel from plugging with landfilled material. Perforated leachate collection piping along the thalwegs (lowest point of the stream channel) of each hollow transports the leachate to the downstream collection point.

2.3.3 Material Placement

The basic plan for solid waste disposal is to fill up the hollows at the Bull Creek site. Each hollow is developed separately, one at a time; i.e., surface preparation, material placement to the final grades, and final soil covering and seeding.

Each hollow is filled in several stages, starting at the upper end as conceptually indicated in Figure 6. For a given hollow, site preparation for the uppermost portion and construction of the uppermost starter dike are performed first. This is followed by the first stage placement of solid waste on the upstream side of the uppermost dike. The placement of the solid wastes begins in the lowest portions of the first stage and progresses upwards in horizontal layers. The fill materials are mixed and spread in layers not exceeding 9 inches when loosely spread, and are then compacted to densities to be determined during the design phase. The purposes of the compaction are (1) to reduce volume of fill; (2) to minimize future settlement within the fill that may effect surface drainage of the completed fill; and (3) to increase shear strength of the fill and improve the slope stability.

Once the fill placement for the first stage reaches the top of the uppermost dike, the fill face is sloped back at a 25 percent grade (four horizontal to one vertical). Forty-foot-wide benches with drainage ditches are provided at vertical intervals not to exceed 40 feet. The benches provide access to the fill slope during and after construction and assist in controlling surface erosion. Benches also reduce overall gradients of the slope face, thus improving stability of the slope.

The first stage fill placement continues until the finished grades are reached. At this time, the first phase fill (top surface and slope face) is covered with one foot of compacted clay and one foot of soil, then seeded to minimize leachate production and maximize runoff.

First stage filling is followed by site preparation, dike construction, and fill placement for the second stage. Prior to placing second stage fill against the sloping face of the first stage, the soil cover on the first stage is removed and the second stage fill is benched into the first stage fill. After the second stage fill is placed and covered with soil and seed, the subsequent stages will be similarly filled one at a time until the hollow is filled to final grades.

2.3.4 Site Development

Development of the nonhazardous waste disposal site for the 5-, 20-, and 40-year planning periods is shown in Figures 1, 2, and 3. The hollows are filled in numerical order starting with Hollow 1. Rough estimates of filling times corresponding to the planning periods are listed in Table 8. Percentages are listed by volume. Site development is based on filling Hollows 1, 2, and 3 to an elevation of 620 feet and Hollow 4 to an elevation of 600 feet. Filling begins at the upstream end of each hollow.

Forty-year development uses essentially all the readily available capacity of the site.

This capacity is limited by three main concerns: (1) keeping the final grade (elevation) within the Bull Creek watershed; (2) keeping the final grade below the visibility point from adjacent property to minimize aesthetically adverse effects; and (3) maintaining a horizontal final grade to simplify runoff control and minimize erosion.

TABLE 8

SITE DEVELOPMENT SEQUENCE

Planning Period, years	Hollows Filled
5	40 percent of Hollow 1
20	Hollow 1 plus 70 percent of Hollow 2
40	Hollows 1, 2, 3, and 55 percent of Hollow 4

2.3.5 Leachate Management

All leachate from the disposed nonhazardous waste is collected and returned to the plant for treatment. The system is developed in stages as the hollows are filled. During the filling operation, leachate and surface runoff from the active area are minimized by limiting the exposed area. After completing a fill, the surface is graded and covered with one foot of compacted clay and one foot of soil.

Leachate Quantities. The quantity of leachate from the post-closure fill was estimated using the water balance method as described by the U.S. Environmental Protection Agency (Reference 4). Average meteorological characteristics at the site for each month were determined from data reported in Reference 8. Average monthly potential evapotranspiration was calculated using the modified Penman equation (Reference 5). Soil moisture changes were calculated using Thornthwaite-Mather tables (Reference 6), and average monthly runoff coefficients, adjusted for precipitation variation, were approximated from Reference 7.

In order to size the leachate pipe collector system, the waste pile material was assumed to be at its field capacity moisture content. Thus, the leachate generation is equal to the net percolation. Design of the

system is based on the maximum monthly percolation of 62 mm (January). The total in-place disposal area after closure is approximately 1,150 acres, resulting in a maximum expected leachate flow of 1,700 gallons per minute (GPM). Average annual leachate generation is approximately 325 GPM.

Leachate generation is expected to occur normally from December through March as shown in Table 4. Precipitation amounts larger than those given in Table 6 will generally produce larger quantities of leachate.

Leachate Collection System. The overall leachate collection system is shown in Figure 6. The drainage layer, which is placed directly above the clay liner, provides a high permeability medium for gravity drainage to the perforated collector pipes. The collector pipes shown lie near the thalweg (lowest point) of each of the hollows where the waste mate- rial covers the area. Each pipe is sized for the full capacity and assures redundancy in the design. The perforated pipes drain to single, solid-wall pipes which transport leachate, via gravity flow, from each hollow to a common leachate pond.

Leachate Return. A single leachate pond and pumping station are pro- vided. The system serves two functions: (1) to return collected leachate to the facility; and (2) to return surface runoff from the active landfilling area as described later. The pond location, shown on Figure 1, has a normal water surface elevation below 410 feet, thus providing gravity flow drainage from the various hollows. The pump station equipment is located above 415 feet of elevation. A flood pro- tection berm is provided around the pond in areas where the ground is below 415 feet.

The leachate pond size is dictated primarily by the large working area runoff flow, with additional volume requirements for solids retention. Two parallel cells are provided to permit periodic removal of settled

material. The pond has an impermeable lining to prevent groundwater interchange. The pond dimensions are 500 ft x 180 ft, with an operating volume of 600,000 cubic feet and an inactive (sediment) storage of 100,000 cubic feet. Total pond depth is 12 feet with an operating depth of 8 feet.

The leachate pumps return collected runoff and leachate to the wastewater treatment area of the facility via the leachate return pipe. The pumps are contained in a concrete structure located at the pond. Three pumps, each rated at a capacity of one-half the maximum leachate flow, are provided. The design of the pump intakes will minimize entrainment of deposited solids in the return flow. The third pump provides backup capacity when one pump is out of service. The leachate collection system components are listed in Table 9.

TABLE 9

LEACHATE COLLECTION SYSTEM COMPONENTS

Item	Size	Quantity	Remarks
Perforated Collector pipe	10 in	56,000 ft	Leachate collectors are laid in parallel
Plain pipe	10 in 12 in 20 in	800 ft 6,800 ft 21,600 ft	Plain pipe is laid singly
Pump station			
Pumps	900 GPM	3	Rated at 25 ft TDH
Ponds	180 ft x 500 ft	1	600,000 ft^3 capacity (active)

2.3.6 Runoff Control

Runoff control for the nonhazardous site is provided both during the landfilling operation and for the postclosure situation. The runoff control system is developed separately for each hollow.

The system described for clean runoff diversion, using a single perimeter drainage channel at the uppermost fill elevation, could perhaps be optimized by using a series of temporary ditches. The temporary ditches could be cut at relatively small elevations above the actual working fill elevation with subsequent covering over and cutting of new ditches as the fill proceeds. Temporary conduit systems could be used to bring the intercepted flow to the stream level. The final perimeter channel and outlet structure as described would be built at the last stage of hollow development rather than at the first stage. Subsequent working area runoff volumes could also be reduced with an optimized design. The design as described is consistent with Phase Zero engineering of the waste management system.

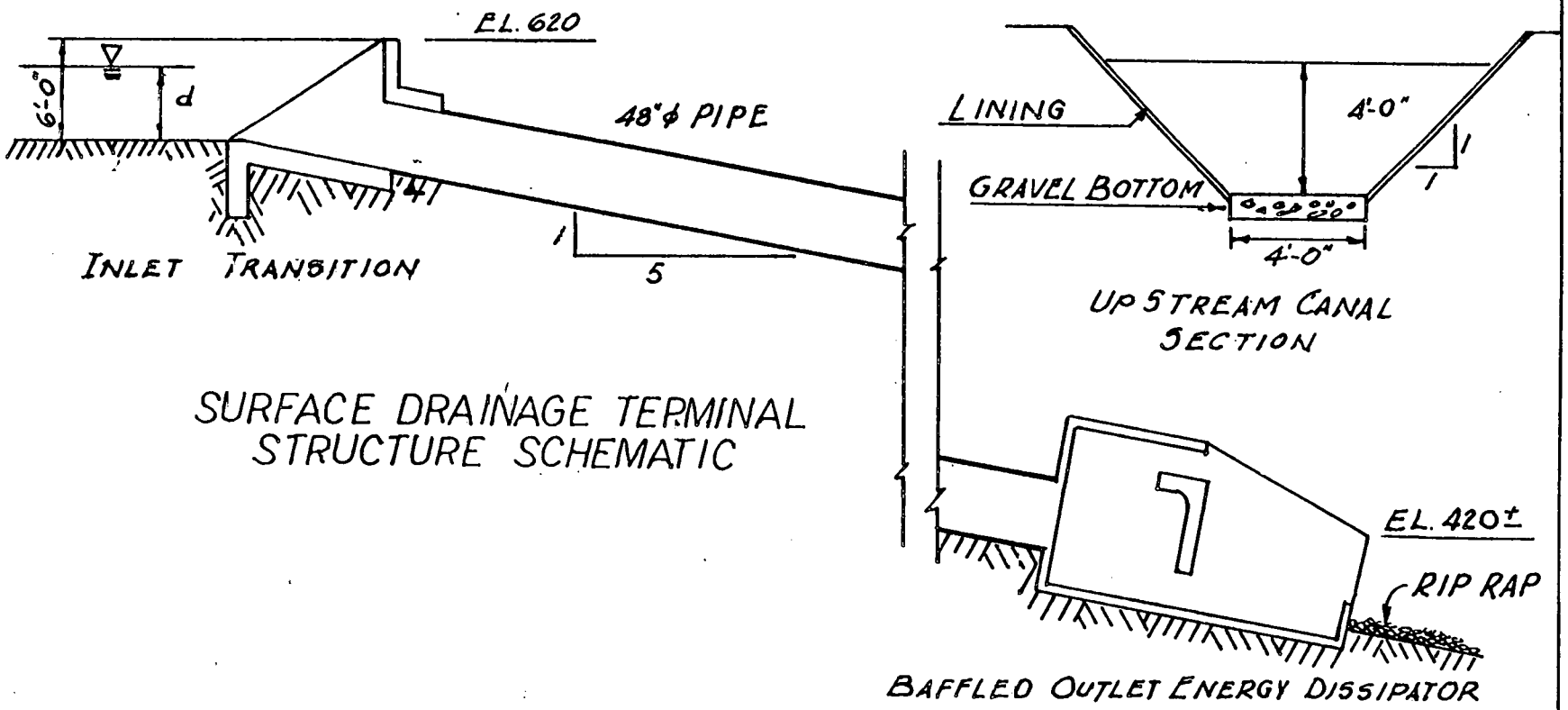
Postclosure System. The maximum fill elevation for Hollows 1, 2, and 3 is 620 feet; and for Hollow 4, 600 feet. Before each hollow is filled, a diversion channel is constructed around the periphery of the hollow at the maximum elevation to be filled, which extends over the entire final placement area.

These channels catch all runoff above the maximum fill elevation and divert the runoff away from the working area. When a hollow is prepared for final closure, the cover material over the fill is graded such that runoff from this area is also diverted to the collector channel. The final closure condition is the maximum flow design case for the drainage channels. The rational formula was used to estimate peak flow rates for each channel, using the respective drainage areas and flow length. The resulting 10-year design flow for Hollows 1, 2, and 3 is 130 cfs for each channel. The channels for Hollow 4 have a 70 cfs design capacity.

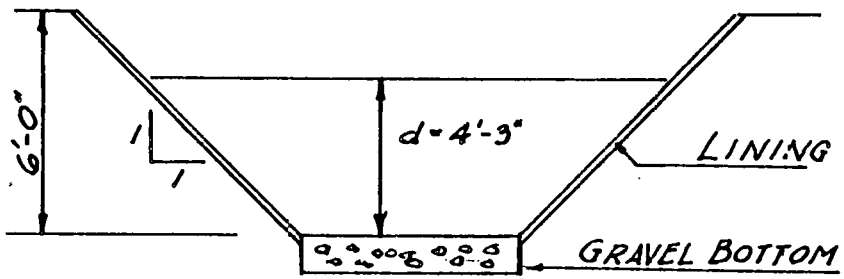
The peripheral channels for the larger hollows are in two different sections, as shown in Figure 7. The smaller section runs for half the total length and is designed for 70 cfs peak flow; the larger section is in the lower half of the channels. The side slopes are lined while the channel bottom is gravel lined. The upper channel has a normal depth of 4.0 feet; the lower channels have a normal depth of 4.25 feet. The total elevation change from the upper to the lower end of the canal is approximately four feet for the longer hollows. Hollow 4 requires only a single channel equivalent to the upstream section.

Table 10 gives the lengths of drainage channel required for each hollow. The collected runoff at elevation 620 must be lowered to the natural channel at about elevation 420. For this purpose, a terminal structure is used, as shown in Figure 7. The structure uses a concrete inlet transition to a 48-inch pipe. To minimize length requirements the pipes will be laid on slopes varying from 15 to 20 percent. The high exit velocity will be dissipated at a baffled energy dissipator structure on the downstream end. A rip-rap apron is provided downstream of the energy dissipator. Hollows 1, 2, and 3 will each have two structures like the one in Figure 7, one at either end, where the perimeter channel terminates at the final fill front face. Hollow 4 also has two similar structures using a 42-inch pipe.

Interim Runoff Control System. Runoff from the portion of the hollow where active filling is taking place is collected and diverted back to the plant for treatment. Nonhazardous fill is placed in stages which use only a portion of the hollow area; thus the interim control system collects runoff only from a particular working area.



SURFACE DRAINAGE TERMINAL STRUCTURE SCHEMATIC



DOWN STREAM CANAL SECTION

BRECKINRIDGE PROJECT

SOLID WASTE DISPOSAL STUDY

FIGURE 7
SURFACE DRAINAGE SYSTEM COMPONENTS

TABLE 10

SURFACE RUNOFF DIVERSION CHANNELS

Hollow	Section Length, ft	
	Upstream	Downstream
1	7,300	7,300
2	9,000	9,000
3	8,100	8,100
4	6,100	-

As each stage of fill is developed, a series of transverse runoff collection channels is placed on the front face of the fill. As fill is placed, it is sloped such that runoff is directed toward the front face. The uppermost channel collects the runoff and diverts it to a collector pipe at the edge of the front face. The area of each active working area is about 100 acres. A 10-year 24-hour equivalent runoff hydrograph was developed using the methods of Reference 7. The resulting peak flow is 180 cfs with a net volume of 13.8 acre-feet. The channel has a base width of 6 feet, side slopes of 1:1, and a design flow depth of 4.5 feet.

The channels terminate at an inlet structure similar to a storm sewer inlet. The inlet drains to a 60-inch collector pipe which runs down the face of the fill. The collector pipe continues to the leachate lift station pond where it discharges via a baffled energy dissipator structure. The collector pipe is built up of concrete sections and continues to increase in length as fill layers are added. Additional inlets are added when required. The collector pipe below the working area can be laid prior to initial filling operations; and the same collector can be used for subsequent fill sections developed in the same hollow. The leachate lift pond collects the working area runoff and has sufficient capacity to contain the 10-year 24-hour runoff. The runoff enters one end of the

pond; the pump structure is located at the opposite end. This arrangement provides a mean detention time of 21 hours for settlement of solids contained in the working area runoff. Cleaning of the pond is necessary periodically.

The working face runoff volume could be reduced by reverse sloping of the working fill so that elevations decrease from front face of fill toward hollow sides. This reverse slope will allow precipitation to pond on the fill, thus reducing both volumes and peak runoff flows; however, the leachate flow quantity will increase. Phase Zero engineering has not attempted to optimize the interim runoff design system.

2.3.7 Access Road

A 3-mile gravel road with oil-treated surface runs from the plant area to the disposal site and into the site. Because solid waste is transported by trucks as large as 85-ton-capacity off-road haulers, which are about 16 feet wide, a 45-foot wide road is provided for two-lane traffic. A typical road cross-section is shown in Figure 8. The route shown in Figure 1 was selected with the aim of limiting overall road grades to approximately ten percent or less.

2.3.8 Equipment Requirements

Three types of equipment are required to prepare the disposal site; move, place, compact, and grade the waste; move, place, and grade cover soil; and prepare and maintain roads. They are described below. All the equipment is sized for daylight operation, assuming one eight-hour shift per day.

Wheeled Loaders. Loaders move solid waste from the dumping area to the active landfilling area, an estimated distance of 500 feet. The total quantity of waste moved is approximately 11,500 TPD. They also move liner material, gravel and cover soil as necessary. The loader size

selected is the 40,500 lb capacity. Sizing is based on Caterpillar Model 992C. Six units are estimated to be required, including spares.

The need for wheeled loaders may be significantly reduced if articulated 4-wheel-drive off-road haulers are able to haul waste onto the working face itself. Further site and material definition are necessary before that can be determined.

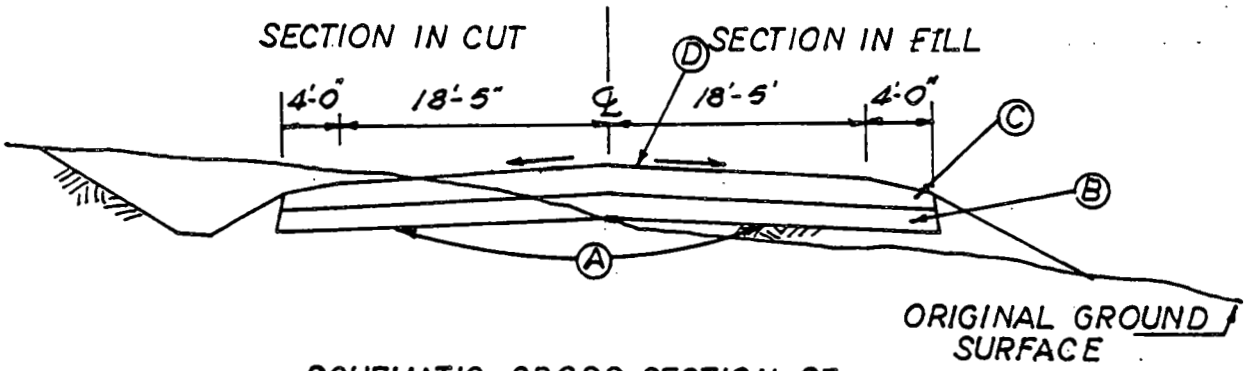
Track Dozers. Dozers place and grade the waste in the landfill and do some compaction. They prepare and grade the surface and also place and compact cover-soil on the completed sections. The dozers handle approximately 1,500 cubic yards of waste per hour. This dozer size was selected on the basis of an estimated unit production of 480 cubic yards per hour. Sizing is based on Caterpillar Model D10. Four units are provided, including spares.

Motor Graders. Graders are used to prepare and maintain access roads to and within the landfill site. They may also be used for final grading of the completed landfill sections. The grader size selected is based on Caterpillar Model 12G. Two units are provided, including spares.

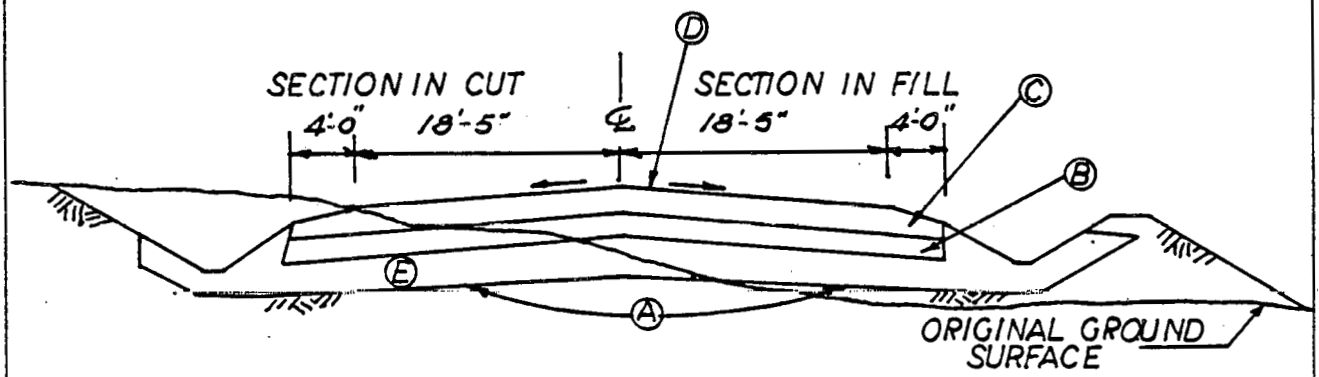
Other Equipment. Motorized or towed compactors may be necessary depending on the actual compactability of the waste.

Other Facilities. Security fencing with a vehicle access gate is provided to limit unauthorized access to the disposal site.

An equipment-servicing and maintenance area is located at the site. Specific facilities include a refueling station, limited equipment maintenance and repair building, personnel parking and rest facilities, and equipment parking area. This service and maintenance area is for both the collection trucks and the landfill equipment. An area of approximately 40,000 square feet is reserved for this purpose, as shown in Figure 6.



SCHEMATIC CROSS-SECTION OF
NON HAZARDOUS SITE HAUL ROAD
N.T.S



SCHEMATIC CROSS-SECTION OF
HAZARDOUS ROAD
N.T.S

KEY:

(A) PREPARED SUB GRADE
(B) COMPACTED GRANULAR MATERIAL
(C) COMPACTED CRUSHED STONE
(D) ASPHALTIC OIL TREATED SURFACE
(E) 3 FT. THICK COMPACTED CLAY LINER BENEATH ROADWAY TO HAZARDOUS WASTE SITE ONLY

BRECKINRIDGE PROJECT

SOLID WASTE DISPOSAL STUDY

FIGURE 8
ACCESS ROADS
TYPICAL CROSS-SECTIONS

2.4 Hazardous Waste Collection

2.4.1 Service

Hazardous waste is collected separately from Stack Gas Scrubbing (Plant 35) and Sewers and Wastewater Treatment (Plant 34) and transported to the separate hazardous waste disposal site. The locations of the sources are shown in Figure 4.

Daily collection, assumed to occur during each 8-hour shift, minimizes onsite storage requirements.

2.4.2 Transportation

Collection trucks transport the waste from the sources to the disposal site, a distance of approximately two miles. Each vehicle makes multiple trips to the site each day. The intent is that these trucks transport only hazardous waste; One size and type of truck is sufficient for hazardous waste collection. Off-road rear-dump haulers are selected to transport the wastewater treatment filter cake and salts and the FGD sulfate by-product, which has sufficient moisture for hauling in open-top trucks. The total quantity transported daily is approximately 230 tons. The truck size selected is 40-tons. Two trucks are provided, including one spare.

Two truckloads a day of nonhazardous coal refuse are also transported to the hazardous disposal site. The trucks used are the 85-ton offroad haulers described in Section 2.2, Nonhazardous Waste Collection.

2.5 Hazardous Waste Disposal

2.5.1 Site Selection

Hazardous solid waste is disposed of in a landfill designed to accept it. The disposal site selected for this study is due east of the plant

site and adjacent to the nonhazardous disposal site in a hollow of the Town Creek watershed as shown in Figure 1. The area was selected for the reasons that follow.

Capacity. The site has sufficient capacity to accommodate the combined hazardous waste and coal refuse, as described in Section 1.0, Introduction, over the 40-year planning period. Available volume as a function of elevation is shown in Figure 9. For comparison, the total waste volume for 40 years is 7.9×10^7 cubic feet. Disposal site volumes are based on planimeter measurements of U.S. Geological Survey Topographic Maps of the area, as described in Chapter IV. The lowest elevation used in calculating volumes was 440 feet, which is well above the 100-year flood zone of approximately 410 feet. The front face slope assumed was 17 percent (one vertical to six horizontal).

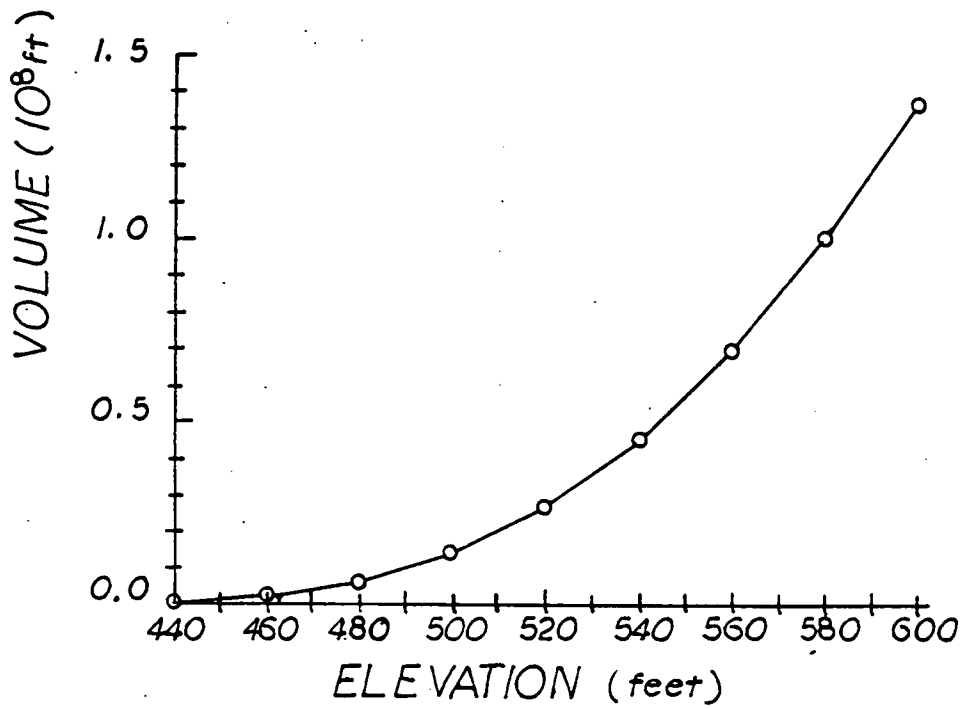
Proximity to Plant Site. The selected disposal site is nearby, at an average one-way hauling distance of about two miles, but is not on the plant site.

Isolation. The site is away from public roads and inhabited areas. Furthermore, it is physically separated from the nonhazardous disposal site, and has a separate access road to ensure that hazardous and nonhazardous disposals are not mixed.

2.5.2 Site Characteristics

The general location and climatic conditions of the hazardous site are similar to those described for the nonhazardous site in Section 2.3, Nonhazardous Waste Disposal.

Hydrology. Hydrology is not an important consideration, because the flood zone elevation, 410 feet, is significantly lower than the actual waste disposal area elevations of 440 feet and higher.



BRECKINRIDGE PROJECT

SOLID WASTE DISPOSAL STUDY

FIGURE 9

DISPOSAL VOLUME
HAZARDOUS SITE

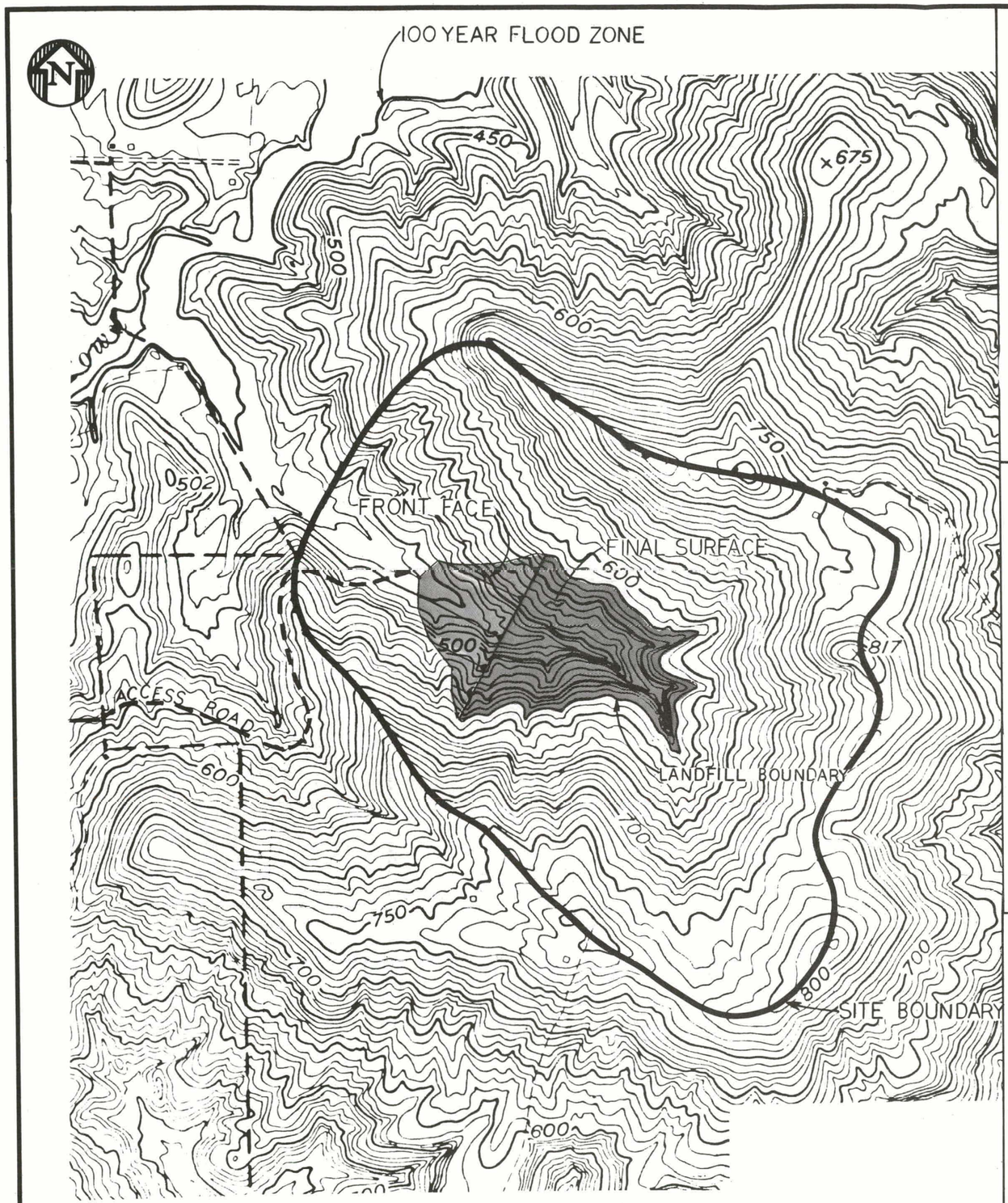
Land Features. Surface and subsurface conditions in the hazardous solid waste disposal area are assumed to be similar to those in the nonhazardous area as discussed previously. A comprehensive geotechnical investigation is necessary in a later phase of the project to develop specific design information related to site geology, groundwater level and other appropriate engineering characteristics of the subsurface soils.

Based on the preliminary geotechnical studies performed at the nonhazardous site, subsurface conditions in the hazardous waste disposal area are assumed to consist of approximately 25 feet of soil overlying light gray, fossiliferous limestone. The upper soils are assumed to vary from fine-grained silts and clays to mostly clayey sand. A thin mantle of silty clays and clayey silts ranging from 1 to 5 feet in thickness is believed to overlie the bedrock. Groundwater is assumed to occur at shallow depths within the flat portions of Town Creek.

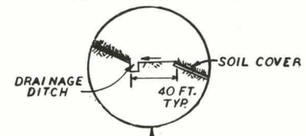
2.5.3 Site Preparation

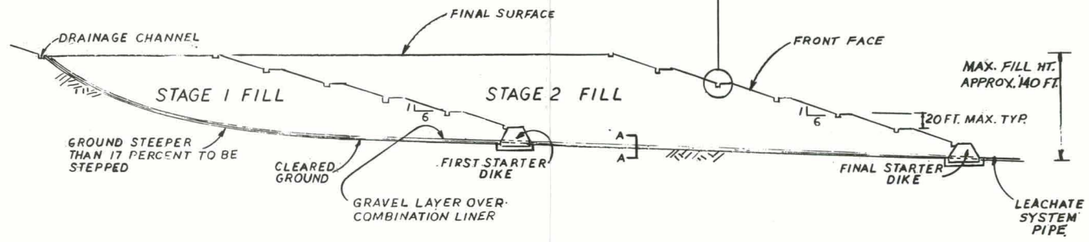
Site preparation includes clearing, grubbing, grading, and compacting the surface soils, and installing liners and leachate drainage equipment. Preparation of a particular section of the landfill is shown in Figure 10. Clearing and grading will ensure that the liner adheres to the side slopes of the hollows and that there is sufficient slope for leachate drainage. Soil compaction will help ensure the integrity of the liner.

A double-walled impervious liner, including a 3-foot minimum thickness of clay over a sand protected synthetic liner is used to protect the groundwater from landfill leachate. Reference 3 indicates that clay of 10^{-7} cm/s permeability is available near the site. The quantity available is unknown at present.

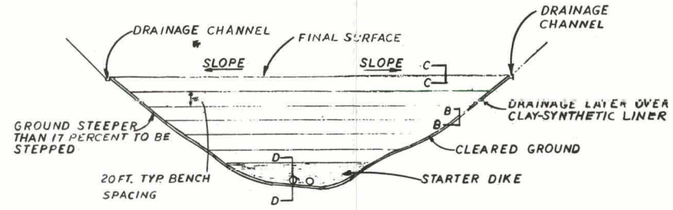


TYPICAL BENCH DETAIL

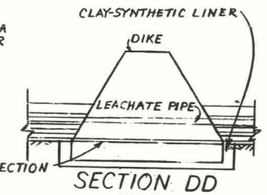




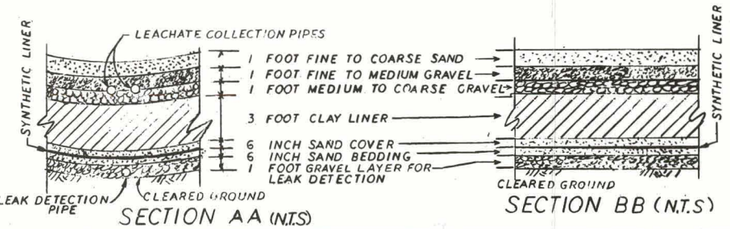
SCHEMATIC LONGITUDINAL SECTION ALONG FLOW LINE
N.T.S



SCHEMATIC CROSS-SECTION
N.T.S

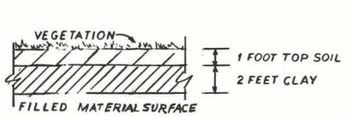


SECTION DD
N.T.S



SECTION AA (N.T.S)

SECTION BB (N.T.S)



SECTION CC
N.T.S

NOTES

1. HOLLOW IS FILLED TO ELEVATION 580
2. SITE DEVELOPMENT :

5	YEARS	12 PERCENT OF HOLLOW FILLED
20	YEARS	50 PERCENT OF HOLLOW FILLED
40	YEARS	100 PERCENT OF HOLLOW FILLED

NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENG'R.	BY APPR.	ASP'T APPR.

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

FIGURE 10
HAZARDOUS WASTE DISPOSAL SITE

HOUSTON

JOB NO.	DRAWING NO.	REV.
14222		

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Clearing, Grubbing, and Removal of Top Soil. About one to two feet of material is removed in the disposal site in order to clear the vegetation and remove the topsoil. Wooded areas require the removal of stumps and roots.

Treatment of Water Springs, Cavities, or other Adverse Ground Conditions. Disposal on any water springs, rock cavities, or other adverse ground conditions will be studied in detail in the design phase of the project. Specific engineering solutions will be developed and incorporated as required.

Benching into Sloping Ground. On sloping ground, at the grades steeper than 17 percent (six horizontal to one vertical) the ground surface is benched for placement of all compacted fills (including clay liner and drainage layers) in order to maintain lateral stability.

Construction of Perimeter Drainage Channels. Water runoff from the slopes surrounding the hazardous waste disposal area is intercepted and diverted by lined perimeter drainage channels. The details of drainage routing are discussed in detail in Section 2.5.7, Runoff Control.

Placement of Combination Liner. The entire bottom and sides of the area to be filled with hazardous waste are lined with a double-walled impervious liner. The liner consists of a sandwich of materials, incorporating both a natural liner and a membrane liner, as shown in Figure 10. The sandwich consists of the following (from top to bottom): a leachate collection system (minimum 36 inches of gravel and sand); a clay liner (minimum 3 feet thick, maximum 10^{-7}cm/s permeability); minimum 6 inches of clean sand; a synthetic-membrane liner; minimum 6 inches of clean sand; and a leakage detection system. It is anticipated that the clay material is available from the sources listed in Section 2.3.2, Site Preparation under Nonhazardous Waste Disposal. The liner material is

placed in thin layers and thoroughly compacted. Placement moisture content and density requirements will be developed by laboratory testing of the actual soil to be used for the liner.

Drainage Layer. A graded drainage layer with a total thickness of 36 inches is placed on top of the compacted clay liner to provide leachate drainage both from the sides of the hollow to the center and downstream to the leachate collection point. A sand layer is placed on top of the gravel layers to protect the gravel from plugging with landfilled material. Perforated leachate collection piping along the thalwegs of the hollow transports the leachate to the downstream collection point. A one foot thick layer of gravel is also placed on top of the compacted subgrade for leakage detection as shown in Figure 10.

The design described in the preceeding paragraph is based on RCRA regulations, Section 250.45.2, which specifies minimum thicknesses of 12 inches and 6 inches for the drainage layer and leakage detection layer, respectively. The drainage and leak detection layer thicknesses for the Phase Zero study have been conservatively selected and will be engineered to meet applicable regulatory requirements in the next phase of the project.

Construction of Soil-Cement Dikes. Each hollow will be filled from upstream to downstream in two stages. A starter dike of compacted soil-cement will be constructed at the toe of each of the fill stages. The soil-cement dikes are anticipated to be about 40 feet wide at the top and about 20 feet high at the center. Other aspects of dike design and use are the same as were discussed in Section 2.3.2, Site Preparation under Nonhazardous Waste Disposal.

2.5.4 Material Placement

Each hollow will be developed in two phases. Surface preparation, material placement to the final contour, and final covering and seeding will begin in the upstream portion and proceed downstream.

The material placement method is shown in Figure 10. Starter dikes are installed to assist in material stability and provide access across the face of the fill. The general sequence of events is as follows:

- Place leakage detection layer, combination liner, and drainage layer
- Construct dike
- Mix and place material in roughly horizontal layers, approximately 9 inches thick; then compact
- Continue material placement while maintaining a working face slope of 17 percent (six horizontal to one vertical) to reach final elevation
- Construct 40 foot wide benches at vertical intervals not exceeding 20 feet
- Apply cover-material and seed
- Construct next dike

Intermediate cover material is applied to the active landfilling surface as required to prevent significant quantities of soluble material from being leached by direct precipitation. The frequency of covering depends on material properties and local climatic conditions. After the first phase reaches the final elevation, the surface is sealed with a clay cap of 2-foot minimum thickness to minimize infiltration. The surface is then covered with 1 foot of top soil and seeded to minimize erosion and graded to a slope of approximately 2 percent to enhance runoff. The second phase then begins until it also reaches final elevation. In this manner, the hollow is filled to its final elevation.

2.5.5 Site Development

Development of the hazardous waste disposal site for the 5-, 20-, and 40-year planning periods is shown on Figures 1, 2, and 3. The contour at an elevation of 580 feet corresponds to 40-year development. The percentages filled during the 5- and 20-year periods are 13 percent and 50 percent, respectively.

The site has a capacity significantly larger than will be used during the 40-year planning period that could be used for nonhazardous waste disposal in emergencies.

2.5.6 Leachate Management

Leachate and surface runoff from the active filling area are collected and returned to the plant area. Runoff from areas above the maximum fill elevation and runoff after closure of the fill are collected in peripheral channels and diverted to natural drainage.

The leachate system is conceptually similar to that of the nonhazardous site and consists of a gravel drainage layer, perforated collector pipe, solid wall transfer pipe, leachate pond, and gravity flow return pipe.

Leachate Quantities. The quantity of leachate was estimated by the procedures described for the nonhazardous fill areas. The maximum expected leachate generation for the ultimate development area of 59 acres is 90 GPM. The average annual leachate generation is expected to be about 20 GPM.

Leachate Collection System. The overall leachate collection system is shown in Figure 10. Leachate is collected by a gravel layer placed directly above the clay liner to provide a high permeability flow path to the perforated collector pipes. The 8-inch pipes are laid in parallel

to assure redundancy in the collector system. The regular solid wall pipe returning to the plant area is a single line.

The leachate collector system drains by gravity directly to the plant area in a 12-inch pipe sized to accommodate both leachate and outflow from the interim runoff surge attenuation pond.

Table 11 provides a list of components required for the hazardous area leachate collection system and runoff attenuation pond.

TABLE 11
LEACHATE COLLECTION AND RUNOFF SURGE POND

Item	Size	Quantity	Remarks
Perforated pipe	8-inch	4,800 ft	Pipes are laid parallel
Normal pipe	12-inch	12,000 ft	Single pipe
Storm surge pond	180 ft x 280 ft	1	240,000 ft^3 capacity

Runoff control for the hazardous area is controlled during the interim filling operation and the postclosure situation. The runoff design criterion used for Phase Zero engineering is the 10-year rainfall event. Events of greater magnitude will result in spillage of working area runoff into the natural drainage system. Depending on regulatory requirements, a design event of 25- to 100-year frequency may be chosen as the design criterion in the next phase of engineering.

Postclosure System. The maximum fill elevation for the hazardous storage area is 580 feet. A peripheral diversion channel is initially constructed around the area as in nonhazardous area development. The

diversion minimizes runoff in the working fill area and discharges surface runoff after closure.

Supposing a 10-year design storm, a 106 cfs peak flow results for the maximum drainage areas. The peripheral canals for this area are trapezoidal in section with a 1:1 side slope and a 5-foot bottom width. The side slopes are lined, and the bottom is gravel. Normal depth in the channels for the design flow is approximately four feet. The total length of channel required is 5,000 feet.

The collected runoff is lowered from elevation 580 to elevation 440 using a terminal structure and energy dissipator similar to that shown in Figure 7.

Interim Runoff Control. The filling operation for hazardous waste will be done in two stages, as in the nonhazardous area fill. The front face of the fill will be built up and a series of transverse canals placed across this face. The interim hazardous runoff collection system will function in the same manner as that for the nonhazardous area.

There are about 40 acres in each of the active working areas. The relatively steep slope and short flow path of the area result in computed peak flows of 175 cfs for the 10-year design storm. Interim runoff collector pipe and inlets are placed in the fill and extended as described for the nonhazardous area.

The interim runoff collector terminates at the runoff surge attenuation pond, which is sized to contain the 10-year 24-hour runoff volume of 240,000 cubic feet. This pond is approximately 180 feet by 270 feet, with an operating depth of 6 feet and total depth of 8 feet. Outflow from the settling pond is through a pipe outlet, which ties into the 12-inch leachate return pipe. The design flow rate from the settling pond is 4 cfs. This arrangement provides a mean detention time of

7.5 hours for settlement of solids from the working area runoff. Periodic clean-out of deposited solids will be necessary.

2.5.8 Monitoring Wells

Wells will be drilled hydraulically upgrade and downgrade from the site for use in monitoring groundwater quality at the hazardous waste disposal site. Monitoring prior to waste placement is suggested to provide background data on groundwater conditions. Proposed U.S. EPA regulations for groundwater quality monitoring at hazardous waste land disposal facilities require as a minimum of one well hydraulically upgradient of the site, three wells hydraulically downgradient at the site boundary, and three wells hydraulically downgradient from the site boundary (Reference 10).

The number of wells, their location, and the frequency of sampling will be determined in later phases of the project when subsurface conditions and regulatory requirements are known.

2.5.9 Access Road

A dedicated access road approximately a mile long runs between the plant area and the disposal site. The road handles two-lane traffic of 40-ton or 85-ton capacity off-road haulers. Because the larger vehicles are 16 feet wide, the road width is 45 feet. The suggested route shown in Figure 1 minimizes elevation changes and limits road grades to approximately 10 percent or less.

A typical section for the hazardous site access road is shown in Figure 8. The road and drainage ditches are underlain by a clay liner three feet thick. As an alternative to the clay liner, a synthetic liner can also be considered. The ditches collect potentially contaminated surface runoff, which can be returned to the facility wastewater treatment plant if necessary.

2.5.10 Equipment Requirements

Equipment is required at the disposal site to: prepare the site; move, place, compact, and grade the waste; move, place, and grade cover-clay and soil; and prepare and maintain roads. Three types of equipment are provided, as described below.

Wheeled Loaders. Loaders move solid waste an estimated distance of 500 feet from the dumping area to the active landfilling area. Loaders also move clay, gravel, and cover soil as necessary. The total quantity of waste moved is approximately 390 TPD. The loader size selected is 3,800 lb capacity. One unit is estimated to be required; backup is available at the nonhazardous site. Sizing is based on Caterpillar Model 910.

Track Dozers. Dozers place the waste in the land fill and do some compaction. They prepare and grade the surface and also place and compact cover-soil on the completed sections, handling approximately 50 cubic yards of waste per hour. The dozer size selected is one which will produce up to 100 cubic yards per hour. One unit is provided; backup is available at the nonhazardous site.

Motor Graders. Graders are used to prepare and maintain the temporary access roads to and within the landfill site. They may also be used to final grade the completed landfill sections. The grader size selected is based on Caterpillar Model 12G. One unit is provided; backup is available at the nonhazardous site.

Other Equipment. Motorized or towed compactors may be necessary depending on the actual compactability of the waste.

Other Facilities. Security fencing with a vehicle access gate is provided to limit unauthorized access to the disposal site. Equipment

servicing and maintenance are provided at the nonhazardous disposal site as described in Section 2.3.8, Equipment Requirements, under Nonhazardous Waste Disposal.

2.6 References

1. Technical Paper No. 40, "Rainfall Frequency Atlas for the United States," U.S. Dept. of Commerce, 1961.

2. Flood Plain Information, Ohio River, Meade & Breckinridge Counties, Kentucky, Corps of Engineers, Louisville District, Louisville, Kentucky, Nov. 1977.

3. "Preliminary Geotechnical and Geohydrological Studies, Proposed H-Coal Conversion Plant, for Ashland Synthetic Fuels, Inc.," Dames and Moore, Houston, TX, April 1981.

4. Environmental Protection Agency, "Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites." EPA/530/SW-168, October, 1975.

5. Lamoreux, W. W., "Modern Evaporation Formulae Adopted to Computer Use." Monthly Weather Review, January, 1962.

6. Thornthwaite, C. W., and Mather, J. R., "Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." Centerton, N. J., 1957. Drexel Institute of Technology, Laboratory of Technology. Publications in Climatology, V. 10, No. 3.

7. Haan, C. T. and B. J. Barfield, "Hydrology and Sedimentology of Surface Mined Lands," University of Kentucky, Lexington, KY 1978.

8. Climatic Atlas of the United States, U.S. Dept. of Commerce, Environmental Data Service, June 1968.

9. Duvel, W.A. Jr., "Solid Waste Disposal: Land Filling," Chemical Engineering, July 2, 1979.

10. Federal Register, 46FR 11163, February, 1981.

3.0 EQUIPMENT LIST

Due to the nature of Landfill (Plant 44), no equipment list is required.

4.0 DATA SHEETS AND SKETCHES

Due to the nature of Landfill (Plant 44), no data sheets are required.

5.0 DRAWINGS

Due to the nature of Landfill (Plant 44), no drawings are required.

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) 0.8",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.	ORID 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 DURING NORMAL OPERATION
3.	NO	OPEN DURING NORMAL OPERATION (BUTTERFLY ONLY)
4.	NC	CLOSED DURING NORMAL OPERATION (BUTTERFLY ONLY)
5.	LO	LO - LOCKED OPEN LC - LOCKED CLOSED CSO - CAR SEALED OPEN CSC - CAR SEALED CLOSED

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.	B — 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, OB" LONG MAX.	PERSONAL PROTECTION INSERATION
24.	— 0.2" WIDE, 0.8" LONG MAX.	JACKETED
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.	G	ACTUATOR G - GEAR (SHOWN) A - AIR MMEMCH CH- CHAIN E - EXTENSION STEM S - SPECIAL TYPE

MISCELLANEOUS

1.		SPECTACLE BLIND
2.		CIRCULAR OR HAMER BLIND
3.	BS	SIMPLEX BASKET STRAINER
4.	BS	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 S325	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.	H 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) SAS - 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 FL - INDICATES FAIL LOCKED (POSITION DOES NOT CHANGE) FI - INDICATES FAIL INDETERMINATE
2.	FO 3-WAY	
3.	FO 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	CO2 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	CK'K	SUPV.	ENGR.	PROJ. MGR.	DEPT. APPR.
1	12/21/81	ISSUED FOR PHASE 0	JAC	JAC	[illegible]	[illegible]	[illegible]	
0		ISSUED FOR REVIEW / APPROVAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

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.	DRAWING NO.	REV.
14222	OE-A-1	1

34X44 "E" SIZE

M8605A 12/22/80 BM

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

PX 12 3 4B 5

- PX — ISA FUNCTION
- 12 — TRAIN NUMBER (SINGLE TRAIN IS 1)
- 3 — PLANT NUMBER
- 4B — LOOP NUMBER
- 5 — 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.

PX 3488 FOR EXAMPLE

NO.	DATE	REVISIONS	BY	CH'K'D	SUPV.	ENGR.	BY (APPL. APPR.)
2	12-14-81	ISSUED FOR PHASE 0	JDC	AAT	HS	HS	
1		ISSUED FOR REVIEW / APPROVAL	JDC	AAT	AAT	HS	

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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

ANSIB36A 12/02/80 BH

8 7 6 5 4 3 2 1

H G F E D C B A

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 — 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. F( ) — ROTAMETER
10. F( ) — IN-LINE INSTRUMENT (NOTE 2, DWG. O-EA-4)
11. FX — FLOW STRAIGHTENING VANES

SENSORS - LEVEL

1. L( ) — GAGE GLASS OR FLOAT OR DISPLACEMENT TYPE LEVEL INSTRUMENT
2. L( ) — DIFFERENTIAL PRESSURE TYPE (NOTE 3, DWG. O-EA-4)
3. L( ) — TANK-MOUNTED DIFFERENTIAL PRESSURE TYPE (NOTE 3, DWG. O-EA-4)
4. L( ) — INTERNAL BALL-FLOAT TYPE
5. L( ) — GAGE BOARD TYPE

SENSORS - PRESSURE

1. P( ) — DIRECT CONNECTED
2. P( ) — WITH DIAPHRAGM SEAL, PIPED

SENSOR - ANALYSIS

1. A( ) — THROUGH-FLOW TYPE
2. AE — NON THROUGH-FLOW TYPE

SENSORS - TEMPERATURE

1. T( ) — TI - BIMETALLIC THERMOMETER, TW - THERMOWELL, TE - SINGLE SENSOR
2. TE TE — DUAL SENSOR (SHOWN WHEN BOTH ARE USED)
3. T( ) — 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. M — ROTARY MOTOR (SHOWN TYPICALLY WITH ELECTRIC SIGNAL)
4. PNEUMATIC CYLINDER, SINGLE ACTING
5. HYDRAULIC CYLINDER, DOUBLE ACTING
6. PNEUMATIC CYLINDER, DOUBLE ACTING
7. S — PNEUMATIC CYLINDER, DOUBLE ACTING, WITH PILOT VALVE
8. S — SINGLE SOLENOID RESET AFTER LATCH
9. ELECTRO-HYDRAULIC (SHOWN) OR PNEUMATIC-HYDRAULIC (SYMBOL P/H)
10. X — UNCLASSIFIED (TYPE OF ACTUATOR TO BE WRITTEN ADJACENT TO THE SYMBOL)

VALVE BODY WITH ACTUATOR - TYPICAL

(NOTE 4, DWG. O-EA-4)

1. FV — FC

SELF-ACTUATED DEVICES - FLOW

1. FCV — FLOW REGULATOR (NOTE 5, DWG. O-EA-4)
2. FG — SIGHT FLOW GLASS

SELF-ACTUATED DEVICES - LEVEL

1. LCV — LEVEL REGULATOR WITH MECHANICAL LINKAGE

SELF-ACTUATED DEVICES - PRESSURE

1. PCV — PRESSURE REDUCING REGULATOR SELF-CONTAINED
2. PCV — PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
3. PDCV — DIFFERENTIAL PRESSURE REDUCING REGULATOR WITH INTERNAL AND EXTERNAL PRESSURE TAPS
4. PCV — BACKPRESSURE REGULATOR SELF-CONTAINED
5. PCV — BACKPRESSURE REGULATOR WITH EXTERNAL PRESSURE TAP
6. PSV — PRESSURE RELIEF OR SAFETY VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
7. PSV — VACUUM RELIEF VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
8. PSV — PRESSURE AND VACUUM RELIEF VALVE
9. PSE — RUPTURE DISK OR RAFFTY HEAD, FOR PRESSURE RELIEF
10. PSE — RUPTURE DISK OR SAFETY HEAD, FOR VACUUM RELIEF

SELF-ACTUATED DEVICES - TEMPERATURE

1. TCV — TEMPERATURE REGULATOR, FILLED SYSTEM TYPE

HAND ACTUATED DEVICES

1. HCV — TWO-WAY HAND CONTROL VALVE IN PROCESS LINE (NOTE 6, DWG. O-EA-4)
2. HO — MANUALLY ADJUSTABLE RESTRICTION ORIFICE IN SIGNAL LINE
3. HS — TWO-WAY HAND ACTUATED SWITCHING VALVE IN PNEUMATIC SIGNAL LINE

MISCELLANEOUS DEVICES

(NOTE 7, DWG. O-EA-4)

TYPICAL SYMBOL

1. ( )Y — SIGNAL RELAY (NOTE 8, DWG. O-EA-4)

RELAY SIGNALS

2. √ — SQUARE ROOT EXTRACTOR
3. E/P — VOLTAGE TO PNEUMATIC CONVERTER
4. I/P — CURRENT TO PNEUMATIC CONVERTER
5. E/I — VOLTAGE TO CURRENT CONVERTER
6. Σ — 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. P — 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. I — INTERLOCK
15. A — "AND" INTERLOCK - EFFECTIVE ONLY IF ALL INPUT EXIST
16. O — "OR" INTERLOCK - EFFECTIVE IF ONE OR MORE INPUT EXISTS
17. ACS — ANALOG CONTROL SIGNAL
18. BCS — BURNER CONTROL SIGNAL

NO.	DATE	REVISIONS	BY	CK'K	SUPV.	ENGR	OPER.	DEPT APPROV.
3	12/12/80	ISSUED FOR PHASE 0	WSC	WSC	JHB	JHB		
2	12/12/80	ISSUED FOR REVIEW / APPROVAL	JHB	JHB	JHB	JHB		

DESIGNED | DRAWN

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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

MOBILOIL 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) LOW	ALARM ANNUNCIATOR (NOTE 15) HIGH	ALARM ANNUNCIATOR (NOTE 15) HIGH & LOW	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)
TYPICAL SYMBOL	( )	( )E	( )T	( )I	( )R	( )QI	( )AL	( )AH	( )AHL	( )K	( )C	( )V	( )CV	( )Z	( )S	( )G	( )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	PD		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 TANGENTIAL 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: LT/LC: A DUAL-PILOT LEVEL INSTRUMENT, ONE TRANSMITTER AND ONE CONTROLLER.

   HCV/ZSH: 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 BLANKED. 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 OR A LOOP TO UNIQUELY 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. FQ - 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.

    AHH - DESIGNATES HIGH-HIGH LEVEL ALARM
    ALL - DESIGNATES LOW-LOW LEVEL ALARM
    AHL - 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 H, HH, L, LL AND HL 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
    TW - 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.Y)

NO.	DATE	REVISIONS	BY	CH'K	SUPV.	ENGR.	M. ENG. MGR.	PROJ. MGR.
		DESIGNED	DRAWN					
1	12/21/81	ISSUED FOR PHASE 0	WDC	WDC	JHD	RS		
0	8/28/81	ISSUED FOR REVIEW / APPROVAL	WDC	JHD	JHD	RS		

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BRECKINRIDGE PROJECT
BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

SYMBOLS & LEGEND
PIPING & INSTRUMENT DIAGRAMS

HOUSTON | JOB NO. 14222 | DRAWING NO. 0E-A-4 | REV. 1

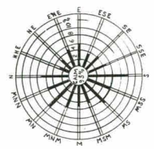
34X44 "E" SIZE

M81LA 12/02/80 BH

8 7 6 5 4 3 2 1

A B C D E G P T

TRUE NORTH 0°0'
PLANT NORTH 0°0'



TOTAL % OF WINDS
FROM INDICATED DIRECTION

LEGEND

1. COAL DRYING AND PULVERIZING
2 COAL SLURRY PREPARATION
3 H-COAL PREHEATING 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 RECIEVING 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.
   REFERENCE: COMMONWEALTH LAND TITLE INSURANCE COMPANY PHILADELPHIA, PENNSYLVANIA FILE No. K-0055892.
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 706.
4. MEAN HIGHWAY ELEVATION IS EL. 415'-0"
5. TOP OF RAILROAD BALLAST EL IS 413'-0"

REFERENCE DRAWINGS

50E-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.	SUPV.	ENG'R.	BI APP'L	ASST. APP'L
1	12/29/81	ISSUED FOR PHASE ZERO	R.P.	J.K.	J.K.	W.S.		
0	2-4-80	ISSUED FOR REVIEW AND APPROVAL	R	J.K.	J.K.	W.S.		

SCALE 1"=400' | DESIGNED J. KUTLIK | DRAWN T. ROBERTSON

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

OVERALL SITE PLAN

HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	50E-A-1	1

34 X 44 "E" SIZE

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

H | G | F | E | D | C | B | A