

The BRECKINRIDGE PROJECT

Initial Effort

**REPORT IV
VOLUME 5**

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

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**PREPARED FOR
UNITED STATES DEPARTMENT OF ENERGY
UNDER COOPERATIVE AGREEMENT
NO. DE-FC05-80OR20717**

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REPORT IV
VOLUME 5

INTRODUCTION

Report IV, Volume 5, provides descriptions, data, and drawings pertaining to Cryogenic Hydrogen Purification (Plant 8), Sour Water Treating (Plant 9), and the Sulfur Plant (Plant 10).

Cryogenic Hydrogen Purification (Plant 8) purifies the purge gas stream from the Gas Plant (Plant 7, described in Report IV, Volume 4) to a 93% purity hydrogen product.

Sour Water Treating (Plant 9) removes free ammonia and acid gases from sour water and separates them to recover a high quality anhydrous ammonia product.

The Sulfur Plant (Plant 10) recovers, as a saleable liquid product, approximately 95% of the sulfur in feed streams from the Gas Plant (Plant 7, described in Report IV, Volume 4), Sour Water Treating (Plant 9), Gasification and Purification (Plant 12, described in Report IV, Volume 6), and Stack Gas Scrubbing (Plant 35, described in Report V, Volume 3).

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

- A description of the plant's process design, including the utility balance, catalysts and chemicals usage, and a process flow diagram.
- 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 IV
VOLUME 5

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PLANT 8 CRYOGENIC HYDROGEN PURIFICATION

1.0 INTRODUCTION

Plant 8 receives a crude hydrogen stream containing 73% hydrogen. It upgrades this stream to a 93% purity hydrogen product. The compounds removed from the crude hydrogen stream are methane, ethane, heavier hydrocarbons, nitrogen and carbon monoxide.

In a plant designed to liquefy coal, large quantities of hydrogen gas are required. Due to the incomplete reaction of hydrogen with coal, a substantial quantity of unreacted hydrogen leaves the reactor. Since hydrogen is expensive, it is mandatory that the unreacted hydrogen be recovered and recycled to the reactor for reuse.

When hydrogen is recycled back to the reactor in a closed loop system, concentrations of inert products of reaction (e.g., C_1 and C_2 components, CO and CO_2) together with impurities in the makeup hydrogen (i.e., nitrogen) will increase over time, lowering the partial pressure of hydrogen and thereby reducing the hydrogenation reaction rate. To prevent this, a purge stream is continually withdrawn from the recycle stream, purified by the removal of unwanted components and recompressed to join the makeup hydrogen stream.

The objective of Plant 8 is to purify the purge gas stream from the Gas Plant (Plant 7) at a rate of 31,923 lb-moles per hour by reducing the amounts of the undesirable components that are generated in H-Coal[®] Preheating and Reaction (Plant 3) reactor.

PLANT 8 CRYOGENIC HYDROGEN PURIFICATION

2.0 PROCESS DESIGN

2.1 Design Basis

Plant 8 is used to purify a gaseous hydrogen-rich stream received from the saturate Gas Plant (Plant 7) and deliver it to the makeup hydrogen gas compressors in Gasification and Purification (Plant 12).

The hydrogen content in the purified product is 93% and the purification unit is designed to recover 98% of the hydrogen in the feed stream as product.

Plant 8 consists of two sections: a warm end, which consists of a number of gas adsorber beds, and a cryogenic section, which consists of an insulated cold box. The warm end removes those impurities with high freezing points which may plug the cryogenic section of the plant. The cold box is a confined, well insulated box containing process equipment which purifies the hydrogen feed gas at temperatures progressively colder than ambient. The warmest temperature in the cold box is 95°F and the coldest temperature is approximately -295°F.

The plant is designed in accordance with conventional design parameters and code requirements applicable to a low-temperature gas separation plant.

2.2 Process Description

The method of separating the impure components from the crude hydrogen stream consists of cooling the crude hydrogen and removing, at selected temperature levels, liquid fractions which condense during the cooling process. Cryogenic cooling and condensation of heavier constituents is a simple and practical method of upgrading a hydrogen rich stream. A sharp hydrogen separation is possible because of its extremely low liquefaction

temperature. The impurities, however, have boiling points close to each other and clean component cuts are not possible without further processing.

The hydrogen purification unit produces three by-product streams which contain various quantities of the impurities removed from the crude hydrogen. In the separation sequence, beginning with the liquid fraction formed at the warmest temperature, the first by-product stream is principally ethane and heavier hydrocarbons, the next is pipeline fuel gas and the third is relatively inert waste gas. The heavy hydrocarbon stream containing ethane and propane is recycled to the Gas Plant (Plant 7) for recovery and separation. Pipeline fuel contains primarily methane which can be upgraded and sold as synthetic natural gas. The inert waste stream contains nitrogen and carbon monoxide which is burned as an in-plant fuel.

The following detailed process description describes the two major sections of the hydrogen purification unit; warm hydrogen purification and cold hydrogen purification.

2.2.1 Warm Hydrogen Purification

The warm hydrogen purification section is shown on Flowsheet O-252-4Y-9. Hydrogen from Plant 7 is processed through molecular sieve adsorbers to remove residual quantities of H_2O , CO_2 , H_2S and mercaptans. These compounds must be removed because they will freeze out in the cryogenic heat exchangers forming "ice" deposits which gradually plug heat exchangers and reduce the plant output. The adsorbers reduce the impurity level to less than one ppmv, a concentration level which ensures a long operating period between defrosting of the cryogenic heat exchangers.

The system design is mainly reactivation controlled. At all times, two adsorbers will be onstream with the third on reactivation. Reactivation is accomplished in eight hours with an onstream adsorption period of 16 hours. The two active adsorbers are therefore staggered eight hours

apart. The technical description of the system is "two beds on parallel adsorption, step time of eight hours, adsorption time of 16 hours." Onstream performance is monitored by water and carbon dioxide analyzers located downstream of the adsorbers.

The reactivation sequence occurs in nine discrete steps summarized below and discussed in the following text.

<u>Step</u>	<u>Operation</u>
1	Place the newly reactivated adsorber on-line
2	Remove the spent adsorber from service
3	Depressurize the adsorber to the Gas Plant (Plant 7)
4	Depressurize to the flare stack
5	Heat to 500°F with medium Btu gas
6	Cool to 120°F with cooling water
7	Cool to 30°F with the refrigeration unit
8	Pressurize from the feed gas main
9	Place the newly reactivated adsorber on-line

The reactivation sequence begins and ends with the three adsorbers operating in parallel. Placing the third adsorber on-line with the working pair maintains a low-system pressure drop. This procedure minimizes the flow surges as the adsorbers are switched. The inlet and outlet valves are shut off and remain closed as the adsorber is swung from high-pressure operation on hydrogen to low-pressure reactivation with nitrogen. Venting of the process hydrogen is done in two stages.

The first stage is a depressurization through a restrictive orifice to the Gas Plant (Plant 7) Gas Compressors (7K-101 A, B and C) where the vented gas is recompressed. When the adsorber pressure has fallen to

125 pounds, the first depressurizing valve is closed and final depressurizing is effected through a restrictive orifice to the plant flare stack. When the adsorber is at 10 pounds, this vent valve is closed and the reactivation valves at the adsorber inlet and outlet are opened and maintained open through the heating and cooling sequences.

The second stage, reactivation, is accomplished by using an open nitrogen reactivation cycle. Reactivation Blower (8K-1) takes nitrogen from the Oxygen Plant (Plant 15) expander exhaust, compresses it to overcome the system pressure drop and discharges the nitrogen through Nitrogen Vent Stack (8Y-2). The reactivation blower operates continuously while the Reactivation Heater (8E-3), the Reactivation Cooler (8E-4) and the refrigeration unit operate intermittently. A flow switch at the vent stack prevents air being drawn into the adsorbers. Of the intermittent operating items, 8E-3 is valved-in first and the nitrogen from the reactivation blower is heated to 500°F with medium Btu gas. The molecular sieve is heated to 500°F and the impurities adsorbed from the feed gas are desorbed out into the hot gas.

Next, the reactivation heater is shut off and the Reactivation Cooler (8E-4) is valved-in to cool the nitrogen from the reactivation blower to 120°F. This gas then cools the adsorber bed from 500°F to 120°F. Final cooling to the normal 30°F operating temperature is effected by valving the refrigeration unit in series with the reactivation cooler. The reactivation valves are closed and the adsorber is brought to line pressure by opening the repressurizing valve. An orifice is used to limit the pressure build-up to 50 pounds per minute or less. The inlet and outlet valves are opened and the repressurizing valve is closed, completing the adsorber cycle.

2.2.2 Cold Hydrogen Purification

The cold hydrogen purification section is shown on Flowsheet 0-252-4Y-10.

The cold end of the hydrogen purification unit receives a hydrogen-rich stream from the warm hydrogen purification system where water, carbon dioxide and heavy hydrocarbons have been removed.

Feed gas is passed downward through the Heat Exchanger (8E-6) where it is cooled to a temperature of -140°F . Then, it enters the Heavy Hydrocarbon Separator (8Y-96) where most of the C_2 , C_3 and C_4 components in liquid form are separated from the other gases. The liquid stream leaving 8Y-96 is flashed to 30 psia through a Joule-Thomson valve and enters the liquid-vapor Separator (8Y-99). The separated streams return to the cold end of 8E-6 separately, and after being heated inside the exchanger they are joined together at the warm end of the exchanger. This process thereby minimizes problems of distribution of two phases inside exchanger passages.

The gas stream withdrawn from the top of 8Y-96 flows downward through Heat Exchangers (8E-7, 8E-8 and 8E-9) and leaves 8E-9 at -288°F . This cold gas-liquid mixture is separated in the Light-Hydrogen Separator (8Y-98) at 595 psia. The purified hydrogen gas stream which is at least 93% hydrogen, flows upward through Heat Exchangers (8E-6, 8E-7, and 8E-8) and leaves the warm end of 8E-6 at approximately 22°F and 575 psia. The liquid stream leaving 8Y-98 is flashed to 30 psia and enters the inerts Separator (8Y-99).

Inert waste gas and light hydrocarbon liquid from 8Y-99 return to 8E-8 separately, pass through 8E-7 and leave the warm end of 8E-6 at 22°F and 23 psia. Inert waste from 8E-6 then passes through 8E-5 and leaves at approximately 87°F and 20 psia.

Plant 8 has a nitrogen refrigeration system to supply refrigeration needed in the plant. Recycle nitrogen from the Compressor/ Expander Aftercooler (8E-581) enters 8E-5 at 100°F and leaves at 30°F. Approximately 40% of this high-pressure nitrogen is diverted to the Compressor/ Expander (8P-58). The remainder of the nitrogen passes downward through 8E-6 and 8E-7. This high- pressure liquid nitrogen is flashed and sent to the cold end of the Heat Exchanger (8E-9). After leaving 8E-7, it is combined with the expanded nitrogen gas from 8P-58. This recombined nitrogen stream flows upward through 8E-6 and 8E-5 and is recompressed along with some make-up nitrogen from the Oxygen Plant (Plant 15).

This nitrogen is further compressed by the compressor side of 8P-58 and cooled to 100°F in 8E-581.

2.3 Catalysts and Chemicals

The hydrogen purification unit will not consume any chemical compounds or catalysts during plant operation. However, the molecular adsorbers must be changed out every two years. The initial molecular sieve charge of 150,300 pounds, the refrigerant charge for the refrigeration unit and the lubrication oil required for the compressors and the expander are supplied with the basic equipment.

2.4 Utility Balance

Electricity

<u>Item</u>	<u>Name</u>	<u>Motor hp of Connected Load</u>	<u>Operating Normal kW</u>
<u>4.16 kV</u>			
8K-70	Nitrogen Compressor	4,500	2,925
8K-20	Heavy Hydrocarbon Compressor	4,000	2,925
8K-10	Inert Gas Compressor	500	336
8K-1	Reactivation Blower	700	400*
8V-59	Refrigeration Unit	125	25*
<u>13.8 kV</u>			
8K-30	Pipeline Fuel Compressor	12,500	8,085
<u>450 V</u>			
8K-70	Auxiliaries	15	--
8K-30	Auxiliaries	40	--
8K-20	Auxiliaries	10	--
8K-10	Auxiliaries	5	--
8P-58	Auxiliaries	10	8
8P-104	A and B Condensate Pumps	5	3
8	Lighting and Control Transformers	45 KVA	40
8	Mercury Vapor Lights	30 KVA	30
<u>110 V</u>			
Lighting, Instrumentation and Miscellaneous			90
Total kW			<u>14,867</u>

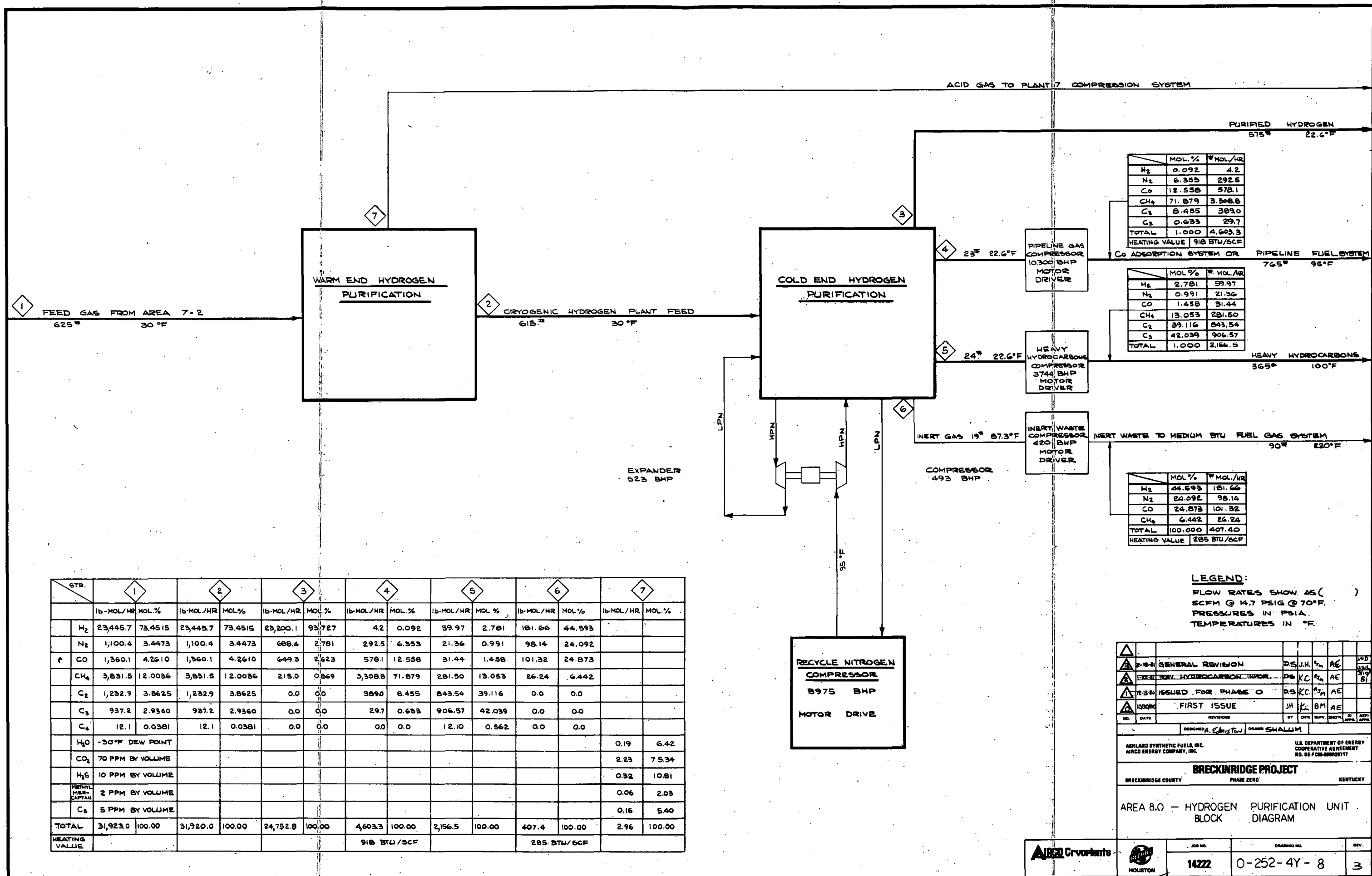
Nitrogen (intermittent) Consumption Rate: 11,000 scfm

Fuel Gas, LHV, MM Btu/hr: 2.22

Instrument Air, scfm: 250

Cooling Water, GPM: 5,000

* Intermittent operation



2-27-81
 ORIGINAL
 DUPLICATE

8-Y-19
(SP-19)
SEPARATOR

8-Y-2
(S-2)
NITROGEN VENT
STACK

8-K-1
(CP-1)
REACTIVATION
BLOWER

8-Y-18A
(D-18A)
MOLECULAR SIEVE
ADSORBER
50,100 LBS.
ER-1170

18-Y-18B
(D-18B)
MOLECULAR SIEVE
ADSORBER
50,100 LBS.
ER-1170

8-Y-18C
(D-18C)
MOLECULAR SIEVE
ADSORBER
50,100 LBS.
ER-1170

8-V-59
(R-59)
REFRIGERATION
UNIT

8-E-4
(HE-4)
REACTIVATION
COOLER

8-E-3
(HE-3)
REACTIVATION
HEATER

8-Y-16A & B
(F-16A & B)
FINAL FILTERS

COMPONENT	LB-MOLS/HR	VOL%
H ₂	23,445.70	73.19
N ₂	1,100.38	3.44
CO	1,360.10	4.25
CH ₄	3,931.54	12.28
C ₂ H ₆	65.72	0.21
C ₂ H ₄	1,167.18	3.65
C ₃ H ₈	21.10	0.07
C ₃ H ₆	916.08	2.86
C ₄ H ₁₀	1.37	0.01
C ₄ H ₈	5.79	0.02
I-C ₄ H ₁₀	5.00	0.02
TOTAL	32019.96	100.00

COMPONENT	PPM V/V
H ₂ O	5.4
CO ₂	70
H ₂ S	10
CH ₃ SH	2
C ₅	5

S-P-19
I.D. = 6"
T/T = 8'

H₂ FEED GAS FROM PROPANE WASH
COLUMN LOCATED IN AREA 7.4 STREAM # 46

3" FINAL PRESSURE LEVEL 20# AFTER 8 MINUTES 39.8 MOLES VENTED

DEPRESSURISED GAS TO FLARE SYSTEM

N₂, 12", 14.7#
TEMPERATURE VARIES FROM 30° TO 500°

R-59
67 TON
99 BHP
50 GPM CW

HE-4
1,182,000 BTU/HR

CWS 4" 118 GPM, 85°

CWR 4" 105°

HE-3
2,220,600 BTU/HR
80% EFF.

MBGAS 4626 FT³/HR.

CP-1
593 BHP

LEGEND

FLOW RATES SHOWN AS ()
SCFM @ 14.7 PSIA @ 70°
PRESSURES IN PSIA
TEMPERATURES IN °F.

2" FINAL PRESSURE LEVEL 140° AFTER 20 MINUTES
165.6 MOLES VENTED
DEPRESSURIZATION GAS TO PLANT 7
O-252-4Y-11

FEED GAS TO H₂ PURIFICATION UNIT

ADSORBER OPERATION - 16 HOURS ON STREAM, 8 HOURS REACTIVATION REACTIVATION SEQUENCE			
STEP	DESCRIPTION	FLOW #/HR	TIME HRS.
1	DEPRESSURIZE THE SPENT ADSORBER - RATE TO BE LESS THAN 50#/MINUTE	VARIES	0.5
2	HEAT ADSORBER TO 500°F USING THE REACTIVATION HEATER - PURGE ON	35,817	2.04
3	COOL ADSORBER TO 120°F USING THE REACTIVATION COOLER - PURGE ON	35,817	1.98
4	COOL ADSORBER TO 30°F USING THE REACTIVATION COOLER & FREON UNIT - PURGE ON	35,817	1.98
5	SLACK TIME TO COVER TROUBLE SHOOTING OF SEQUENCE FAILURES		1.25
6	REPRESSURIZE THE ADSORBER - RATE TO BE LESS THAN 50#/MINUTE	VARIES	0.25

218.81	GENERAL REVISION	BA	J.H.	AE	WHD
F24-81	RELOCATED DEPRESS. GAS	DS	J.H.	AE	WHD
12-12-81	ISSUED FOR PHASE C	DS	J.H.	AE	WHD
10-30-80	FIRST ISSUE	JH	J.H.	AE	WHD
NO.	DATE	REVISIONS	BY	CHKD	SLD
				ENGR	SI
				APPR	ASST

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FG05-80OR217

BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY

AREA - 8 HYDROGEN PURIFICATION UNIT
PROCESS FLOW DIAGRAM

ADSORBER SECTION

AIRCO Cryopants	JOB NO.	DRAWING NO.	REV.
HOUSTON	14222	O-252-4Y-9	3

22 X 34 "D" SIZE

DUPLICATE ORIGINAL 2-27-81

8-E-701 THRU 705
(HE 701 THRU 705)
INTERCOOLER

8-K-70
(CP-70)
RECYCLE NITROGEN
COMPRESSOR

8-E-706
(HE-706)
AFTERCOOLER

8-E-581
(HE-581)
EXPANDER/COMPRESSOR
AFTERCOOLER

8-P-58
(CE-58)
COMPRESSOR/EXPANDER

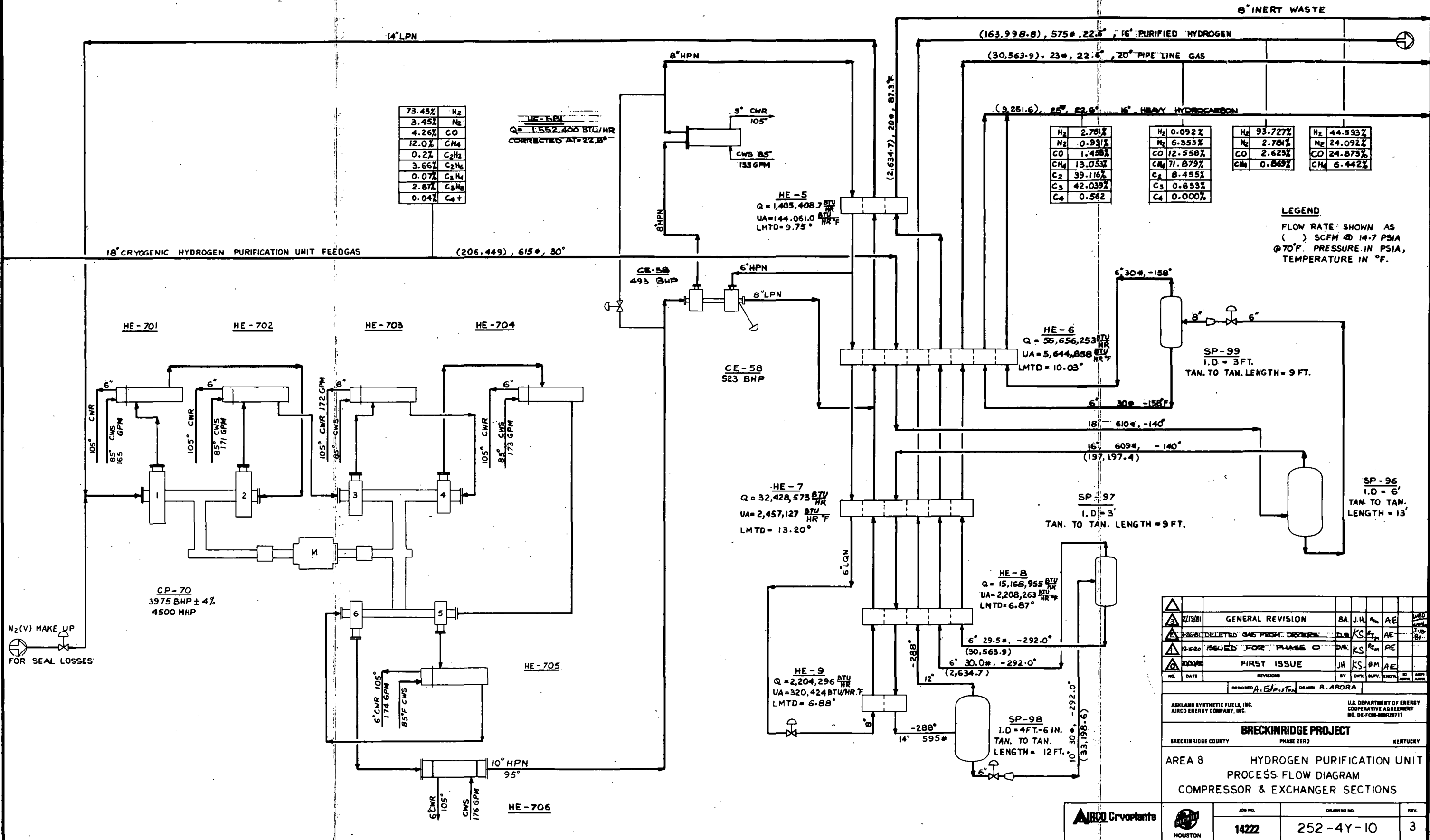
8-E-5 THRU 9
(HE 5 THRU 9)

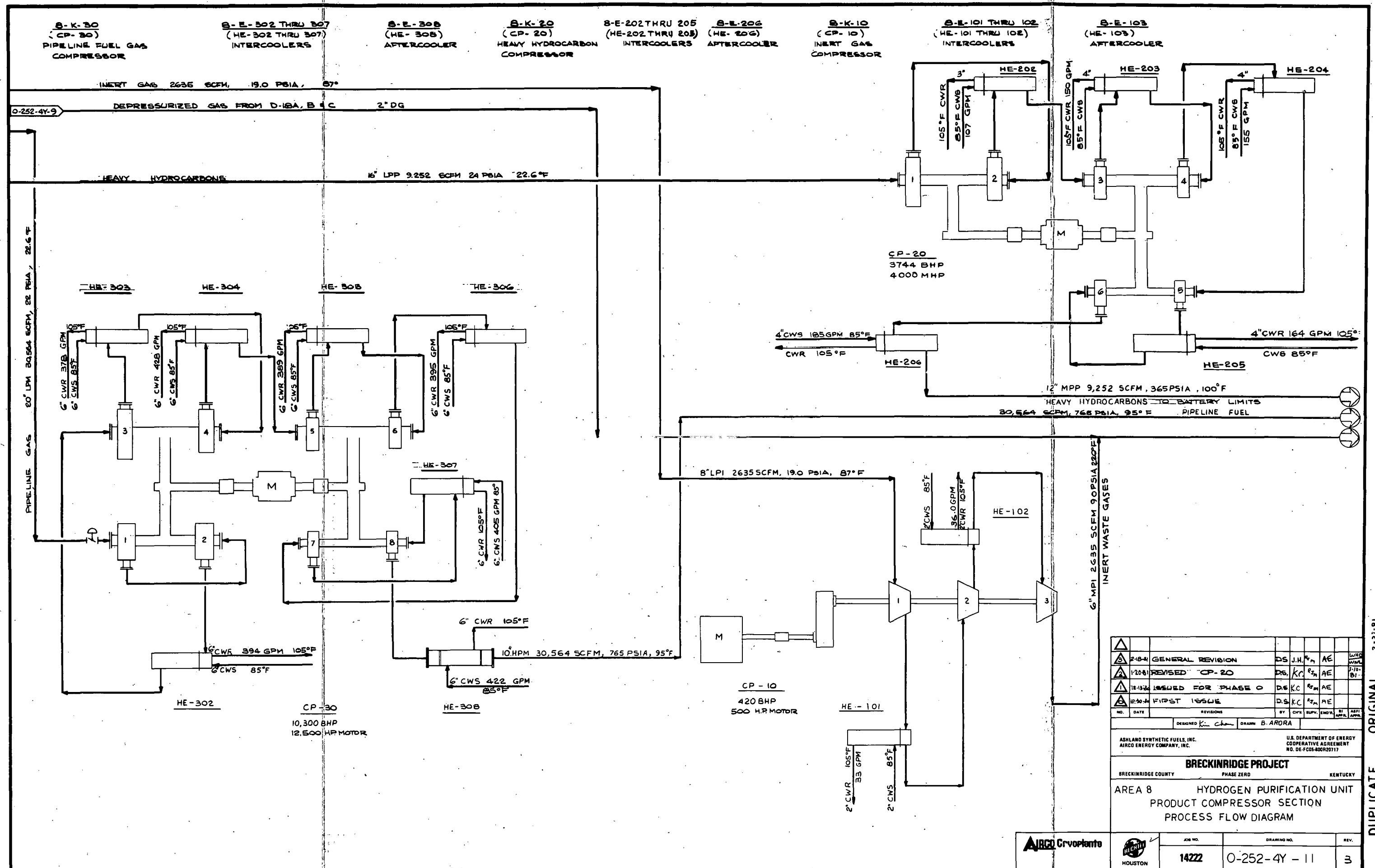
8-Y-98
(SP-98)
LIGHT HYDROGEN
SEPARATOR

8-Y-97
(SP-97)
INERT
SEPARATOR

8-Y-96
(SP-96)
HEAVY HYDROCARBON
SEPARATOR

8-Y-99
SP-99
LIQ./VAP
SEPARATOR





2-18-81	GENERAL REVISION	DS	J.H.	AE	WHD
12-8-81	REVISED CP-20	DS	KC	AE	WHD
12-13-81	ISSUED FOR PHASE 0	DS	KC	AE	WHD
12-30-81	FIRST ISSUE	DS	KC	AE	WHD
NO. DATE REVISIONS BY CHK'D SUPV. ENGR. AT APPR.					
DESIGNED <i>Kim Chan</i> DRAWN <i>B. ARORA</i>					
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					
AREA 8 HYDROGEN PURIFICATION UNIT					
PRODUCT COMPRESSOR SECTION					
PROCESS FLOW DIAGRAM					
AIRCO Cryopoints					
HOUSTON					
JOB NO. 14222		DRAWING NO. 0-252-4Y-11		REV. 3	

2-21-81 ORIGINAL DUPLICATE

CA 171A - 3/76 PRD. 1

Micro Cryptanalysis				☐ STANDARD ☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA				NO. 0-252-1L-4										
								WRITTEN BY		X	DATE		1/1/81					
								APPROVED BY		AE	DATE		2/15/81					
								APPROVED BY		HS	DATE		3/11/81					
								APPROVED BY		HNH	DATE		3/11/81					
REVISION																		
PAGE																		
DATE																		
WRITTEN BY																		
APPROVED BY																		

BRECKINRIDGE PROJECT

Plant 8

Equipment List

REV. NO. A DATE 10/15/80 PLANT NO. 8 JOB NO. 252 SHEET NO. 2 OF 3

AIRCO ITEM NO	BECHTEL ITEM NO	DESCRIPTION	AIRCO FLOW DIAG. NO	AIRCO SPEC NO	DATES			
					FROM PROCESS	TO MECH	FROM MECH	TO BECHTEL
D-18A	8-Y-18A	Hydrogen Adsorber	0-252-4Y-13	1Z-2				
D-18B	8-Y-18B	Hydrogen Adsorber	0-252-4Y-13	1Z-2				
D-18C	8-Y-18C	Hydrogen Adsorber	"	1Z-2				
SP-19	8-Y-19	Inlet Separator	"	1Z-3				
F-16A	8-Y-16A	Final Filter A	"	1Z-4				
F-16B	8-Y-16B	Final Filter B	"	1Z-4				
CP-1	8-K-1	Reactivation Blower	"	1Z-5				
HE-3	8-E-3	Reactivation Heater	"	1Z-6				
HE-4	8-E-4	Reactivation Cooler	"	1Z-7				
S-2	8-Y-2	Nitrogen Vent STACK	"	1Z-8				

REV. NO. A DATE 10/15/80 PLANT NO. 8 JOB NO. 252 SHEET NO. 4 OF 8

AIRCO ITEM NO.	BECHTEL ITEM NO.	DESCRIPTION	AIRCO FLOW DIAG. NO.	AIRCO SPEC NO.	DATES			
					FROM PROCESS	TO MECH	FROM MECH	TO BECHTEL
CE-58	8-P-58	Compressor/Expander	0-252-4Y-15	1Z-11				
HE-581	8-E-581	C/E Aftercocler	"	1Z-12				
HE-5	8-E-5	Heat Exchanger	"	1Z-13				
HE-6	8-E-6	Heat Exchanger	"	1Z-13				
HE-7	8-E-7	Heat Exchanger	"	1Z-13				
HE-8	8-E-8	Heat Exchanger	"	1Z-13				
HE-9	8-E-9	Heat Exchanger	"	1Z-13				
SP-96	8-Y-96	Heavy Hydrocarbon Separator	"	1Z-14				
SP-97	8-Y-97	Light Hydrocarbon Separator	"	1Z-15				
SP-98	8-Y-98	LIGHT HYDROGEN SEPARATOR	"	1Z-16				
SP-99	8-Y-99	Separator		1Z-17				



REV. NO. A DATE 12/20/80 PLANT NO. 8 JOB NO. 252 SHEET NO. 5 OF 8

[illegible]

[illegible]

4.1 Data Sheets for Vessels

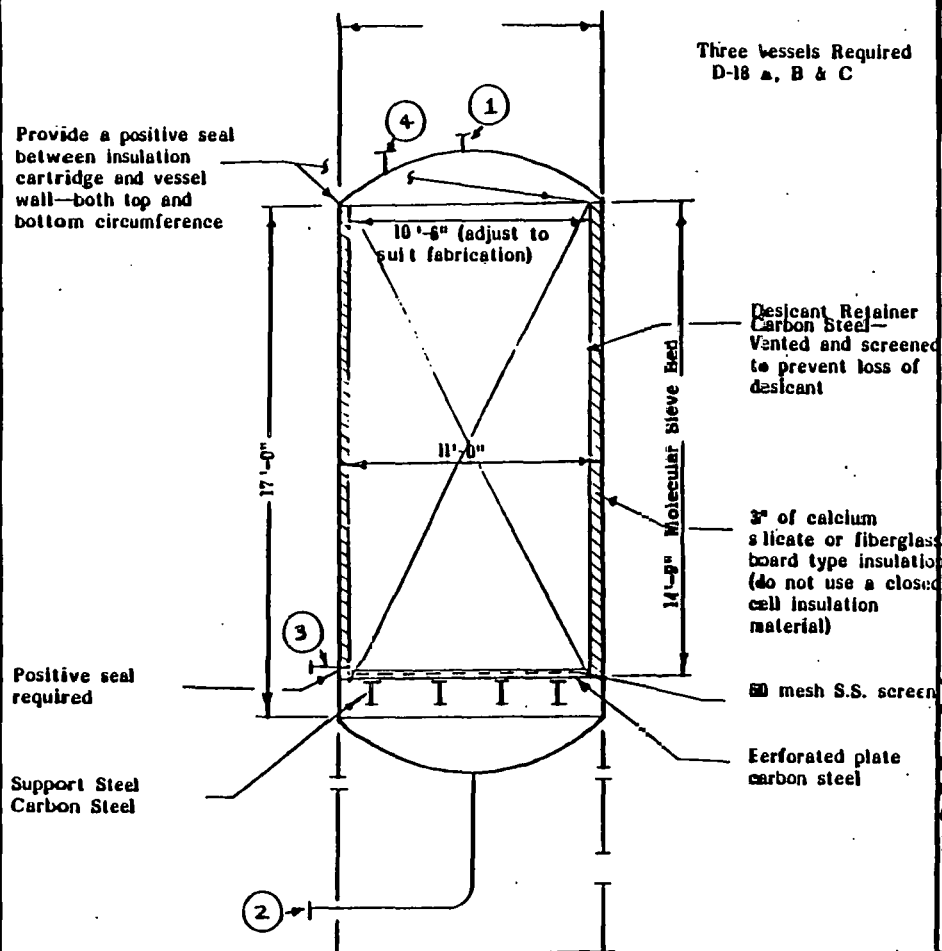
- 252-1Z-2: Molecular Sieve Absorber (8Y-18)
- 252-1Z-3: Inlet Separator (8Y-19)
- 252-1Z-14: Heavy Hydrocarbon Separator (8Y-96)
- 252-1Z-15: Inert Gas Separator (8Y-97)
- 252-1Z-16: Light Hydrocarbon Separator (8Y-98)
- 252-1Z-17: Liquid/Vapor Separator (8Y-99)
- 252-1Z-18: Condensate Flash Tank (8Y-103)

CR 171A - 3/78 PBD. IN U

Airco Cryopants	☐ STANDARDS				N.O.												
	☐ INSTRUCTIONS				WRITTEN BY				DATE								
	☐ SPECIFICATIONS				APPROVED BY				AE				DATE 2/5/81				
	☐ DATA				APPROVED BY				MS				DATE 3/11/81				
APPROVED BY				HNH								DATE 3/11/81					
REVISION																	
PAGE																	
DATE																	
WRITTEN BY																	
APPROVED BY																	

BRECKINRIDGE PROJECT
PLANT 8
HYDROGEN PLANT
VESSELS

ISSUED FOR PHASE 0



1. The vessel will be heated to 500°F every 8 hours.

2. Support steel design loads are
 - a. 15' of molecular sieve at $4111/\text{ft}^3$
 - b. Bed pressure drop of $81/\text{in}^2$

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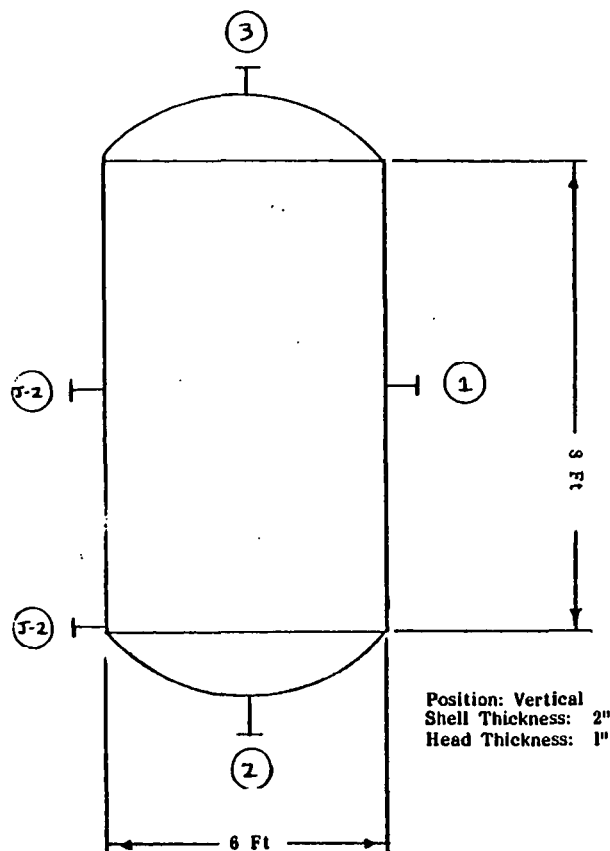
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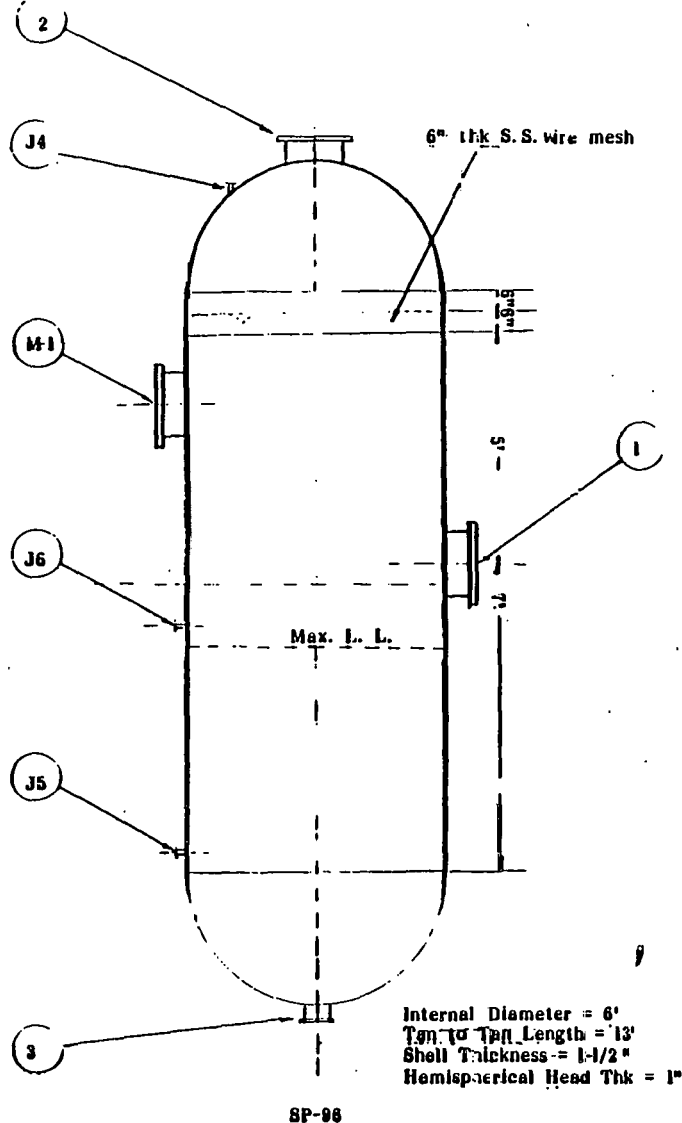
PROCESS INFORMATION



Position: Vertical
Shell Thickness: 2"
Head Thickness: 1"

PROCESS INFORMATION							TIME					
OPERATING DATA		FLUID	FLOW LB/MR	DENSITY LB/CU FT	TEMP °F	PRESS PSI	LL DATA FOR:					
	H ₂ Feed	258,100	0.974	30	30/-10	620.3	685	LCH MLL LAN HLL LAL LLL LCL				
VAPOR PRESS @ MAX. AMB. OF = PSIA												
PROCESS CONTAMINANTS												
COMPONENT							TYP MAT'L	CORR ALLOW	REMARKS			
SHELL & HEADS							A-516-70	1/8" MIN.	Hemispherical Heads			
WELD - IN							None	TOTAL				
REMOVABLE							None	TOTAL				
PRESS MARGIN: MIN SPEC 620.3 + 99.7 = 720 PSIG												
MIN. DESIGN PRESS AT TOP 720 PSIG (MARG + OPER.)												
SYSTEM PSV SET AT 720 PSIG LOCATED On piping												
MIN. DESIGN TEMP -10 °F @ 720 PSIG												
EXTERNAL PRESS DESIGN: Not Required FOR												
VESSEL SUPPORT DATA SKIRT Yes LEGS LUGS												
No Specific Requirement SADDLES (C-527)												
HEIGHT MIN. ABV GRADE FIREPROOFING No												
SPECIAL REQUIREMENTS												
CODE: ASME Section VIII												
LOADINGS												
SERVICE (CYCLIC, LETHAL ETC.)												
Steady												
INSULATION: None THK.												
NOZZLE NO.		SERVICE	NO. REQ'D	BSY SIZE	RATING (P/LNG)	INT'L TYPE OR NOTE	NOZZLE NO.	SERVICE	NO. REQ'D	BSY SIZE	RATING (P/LNG)	INT'L TYPE OR NOTE
J-6												
J-5												
J-4												
J-3												
J-2	Level Taps		2	1"								
J-1	PSV											
9												
8												
7												
6												
5												
4												
3	Crude H ₂ Outlet		1	18"								
2	Liq. Outlet		1	1"								
1	Crude H ₂ Inlet		1	18"			M-1	MANWAY				
DESIGN BASIS												
ISSUED FOR												
PROCESS INSTRUM UNIT PROJ												
JOB NO. VESSEL DESIGN DATA SHEET												
252 SERVICE Hydrogen Purification Plant 8												
UNIT 8-Y-19 Inlet Separator 252-1Z-3												
VESSEL NO. REV.												

AIRCO CRYOPLANTS ISSUED FOR PHASE 0



TIME LL DATA FOR:

PROCESS INFORMATION

LOC OR REF	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F	PRESSURE PSIA
1	Hydrocarbons	262,366	12.1	-140	595
2	Hydrocarbons	184,010	1.093	-140	595
3	Hydrocarbons	78,356	37.956	-140	595

VAPOR PRESS & MAX. AMB. °F = PSIA

PROCESS CONTAMINANTS

METALLURGY

COMPONENT	TYP MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS	304 SS	None MIN.	Hemispherical Heads
INT'L WELD - IN		TOTAL	None
REMOVABLE	304 SS	None TOTAL	6" thk wire mesh

MECHANICAL DESIGN REQ

PRESS MARGIN. MIN SPEC 685 + 35 = 720 PSIG

MIN. DESIGN PRESS AT TOP 720 PSIG (MARG + OPER.)

SYSTEM PSV SET AT 720 PSIG LOCATED on piping

MIN. DESIGN TEMP -320 °F @ 720 PSIG

EXTERNAL PRESS DESIGN: Not required FOR

VESSEL SUPPORT DATA SKIRT LEGS LUGS Yes

Will be positioned at a specific SADDLES (C-527)

HEIGHT of max MIN. ABV GRADE FIREPROOFING None

PROCESS INSTRUMENTS

NO. NO.	SERVICE	NO. REQ'D	TEST SIZE	RATING (FALING)	INT'L TYPE OR NOTE	NO. NO.	SERVICE	NO. REQ'D	TEST SIZE	RATING (FALING)	INT'L TYPE OR NOTE
J-6	Level Trans.	1	1"								
J-5	Level Trans.	1	1"								
J-4	Pressure Ind.	1	1"								
J-3											
J-2											
J-1	PSV										
9											
8											
7											
6											
5											
4											
3	Liquid Outlet	1	6"								
2	Vapor Outlet	1	16"								
1	Vapor/Liq Inlet	1	18"			M-1	MANWAY	1	18"		

TIME	LL DATA FOR:
1	LCM
2	MLL
3	LAL
4	MLL
5	LAL
6	MLL
7	LAL
8	MLL
9	LAL
10	MLL

1) STD DISPLACER RANGES (CIRCLE LOCKS) & SPECIAL COMBIT OVER 48"

2) REFER TO DWG'S J-L-6701 (E702)

3) SURGE, ETC.

4) LG WILL BE NEAREST STD. SIZE TO 685 PSIG. IF NO LG IS USED OR LOWER LG, REQ'D INDICATE LG DIMENSION IN PAGE SUPPLY.

POST WELD HEAT TREATMENT FOR (OTHER THAN CODE)

SPECIAL REQUIREMENTS

CODE: ASME, Section VIII

LOADINGS

SERVICE (CYCLIC, LETHAL ETC.)

Steady

INSULATION: Located in Cold Box

DESIGN BASIS

ISSUED FOR

VESSEL DESIGN DATA SHEET



JOB NO. 252

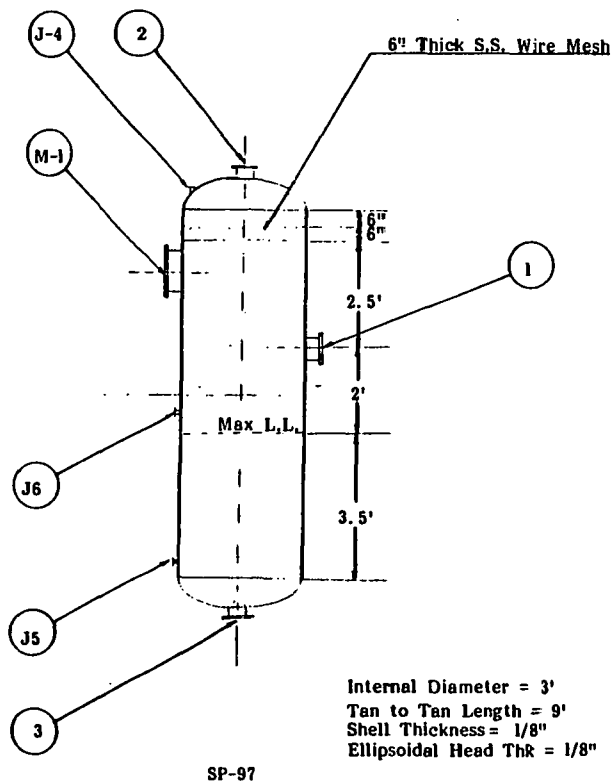
SERVICE Hydrogen Purification, Plant 8

UNIT 8-Y-96 Heavy Hydrocarbon Separator, 252-12-14

PROCESS	INSTRUM	UNIT	PROJECT

AIRCO CRYOPLANTS

ISSUED FOR PHASE 0



TIME LL DATA FOR ECOT.

PROCESS INFORMATION

OPERATING DATA

JOB OR NO.	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP °F	PRESSURE
1	hydrocarbon	96.714	31.846	-292	15 20
2	Inert gas	6.368	0.263	-292	15 20
3	hydrocarbon	90.346	34.072	-292	15 20

VAPOR PRESS & MAX. AND. °F = PSIA
PROCESS CONTAMINANTS

METALLURGY

COMPONENT	TYP MAT'L	CORR ALLOW	REMARKS
SHELL & HEADS	304 SS	None MIN.	Ellipsoidal Heads
WELD-IN		TOTAL	None
INT'L REMOVABLE	304 SS	None TOTAL	6" thk wire mesh

MECHANICAL DESIGN REQ

PRESS MARGIN. MIN SPEC + = 50 PSIG
MIN. DESIGN PRESS AT TOP 50 PSIG (MARG + OPER.)
SYSTEM PSV SET AT 50 PSIG LOCATED On piping
MIN. DESIGN TEMP -320 °F @ 50 PSIG
EXTERNAL PRESS DESIGN: Not Required FOR
VESSEL SUPPORT DATA: SKIRT LEGS LUGS Yes
Will be positioned at a specific elevation in cold box SADDLES (C-527)
HEIGHT MIN. ABV GRADE FIREPROOFING None

PROCESS INSTRUMENT NOZZLES

NO.	SERVICE	NO. REQ'D	TEST SIZE	RATING (SPACING)	INT'L TYPE OR NOTE	NO.	SERVICE	NO. REQ'D	TEST SIZE	RATING (SPACING)	INT'L TYPE OR NOTE
J-6	Level Trans.	1	1"								
J-5	Level Trans.	1	1"								
J-4	Pressure Ind.	1	1"								
J-3											
J-2											
J-1	PSV										
9											
8											
7											
6											
5											
4											
3	Liquid Outlet	1	6"								
2	Vapor Outlet	1	6"								
1	Vap/Liq Inlet	1	10"			M-1	MANWAY	1	18"		

DESIGN BASIS

REV DATE
ISSUED FOR
VESSEL DESIGN DATA SHEET
JOB NO. 252
SERVICE Hydrogen Purification, Plant 8
UNIT 8-7-97 Inert Gas Separator, 252-12-15

TIME LL DATA FOR.

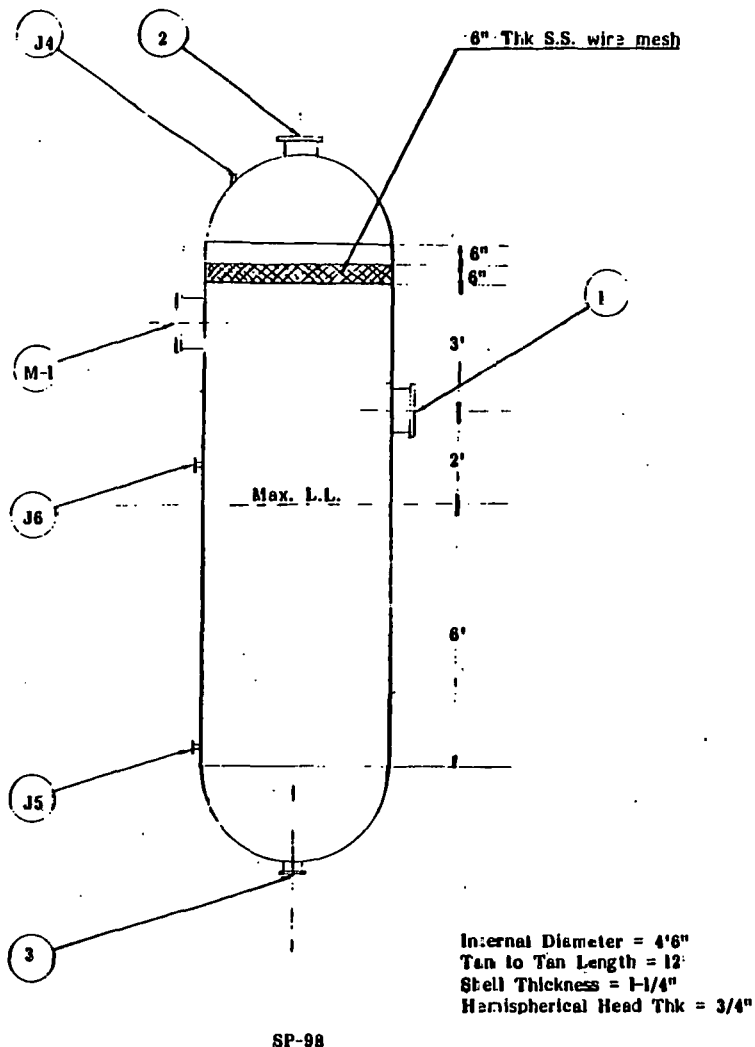
LEG	1	16	16
M-L	1	16	16
L-M	1	16	16
M-L	1	16	16
L-M	1	16	16
L-L	1	16	16
L-L	1	16	16

(1) STD DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDUIT OVER 48"
(2) REFER TO DWG'S J-L-6701 (ETC)
(3) SURGE, ETC.
(4) LG WILL BE NEAREST STD. SIZE TO COVER LG RANGE. IF NO LG IS USED OR LOWER LG, REPP INDICATE LG DIMENSION IN PAGE PROVIDED.
POST WELD HEAT TREATMENT FOR (OTHER THAN CODE)

SPECIAL REQUIREMENTS
CODE: ASME Section VIII
LOADINGS
SERVICE (CYCLIC, LETHAL ETC.)
Steady
INSULATION: Located in cold box

AIRCO CRYCPLANTS

ISSUED FOR PHASE 0



TIME LL DATA FOR (CONT.)

PROCESS INFORMATION

METALLURGY

MECHANICAL REQ

PROCESS INSTRUMENT

DESIGN BASIS

REV DATE

J.C. OR NO. 1

J.C. OR NO. 2

J.C. OR NO. 3

J.C. OR NO. 4

J.C. OR NO. 5

J.C. OR NO. 6

J.C. OR NO. 7

J.C. OR NO. 8

J.C. OR NO. 9

J.C. OR NO. 10

FLUID

FLOW

DENSITY

TEMP. °F

PRESSURE

TIME

LL DATA FOR

J.C. OR NO. 1

J.C. OR NO. 2

J.C. OR NO. 3

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

Hydrocarbons

184,010

87,296

96,714

17,985

0.64

33.64

-288

-288

-288

-288

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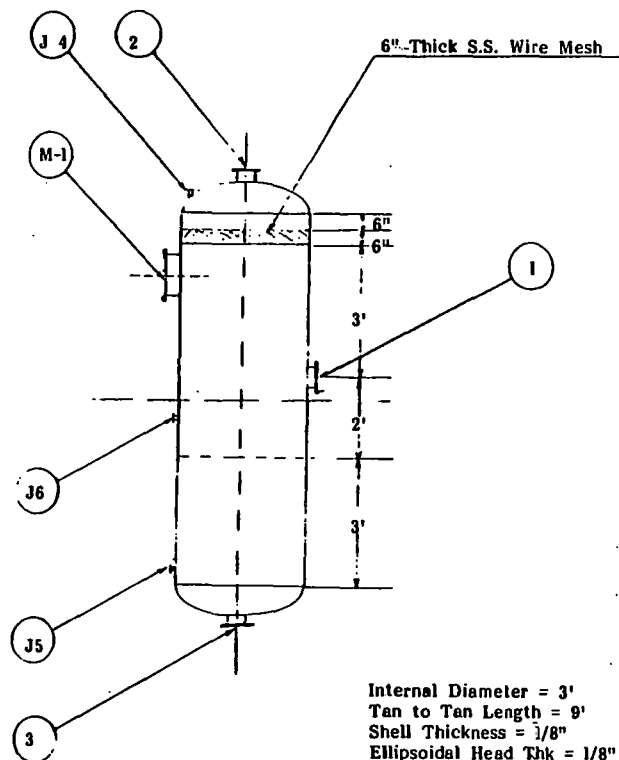
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AIRCO CRYOPLANTS

ISSUED FOR PHASE 0



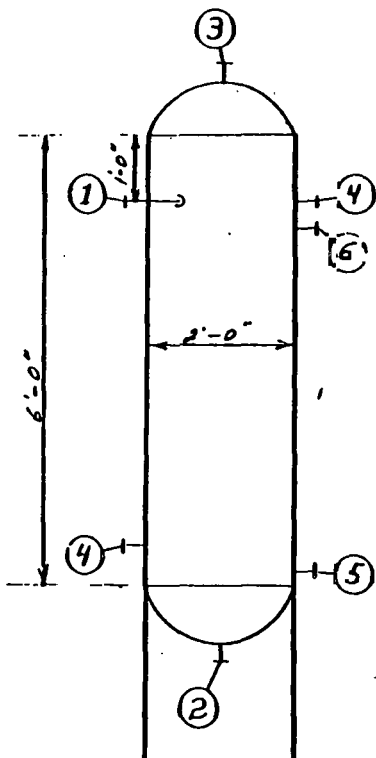
SP-99

Internal Diameter = 3'
Tan to Tan Length = 9'
Shell Thickness = 1/8"
Ellipsoidal Head Thk = 1/8"

PROCESS INFORMATION	OPERATING DATA	FLUID	FLOW LB/HR	DENSITY LB/CU FT	TEMP. °F	VIScosity	TIME	LL DATA FOR:						
		1 Hydrocarbons	78,356	37.645	-158	150/200	15	20	LCL			16		
		2 Hydrocarbons	5,437	0.157	-158	150/200	15	20	HLL			16		
		3 Hydrocarbons	72,919	40.440	-158	150/200	15	20	LAL			16		
									LHL			16		
									LLL			16		
VAPOR PRESS E MAX. AMP. °P = PSIA							① STD DISPLACER RANGES (CIRCLE CHECK) & SPECIAL CONDIT OVER 48"							
PROCESS CONTAMINANTS							② REFER TO DWG'S J-L-6101(ETOZ)							
METALLURGY	COMPONENT		TYP MAT'L	CORR ALLOW	REMARKS			③ SURGE, ETC.						
	SWELL & HEADS		304 SS	None MIN.	Ellipsoidal			④ LG WILL BE NEAREST STD. SIZE TO COVER LG RANGE. IF NO LG IS USED OR LOWER LG, RECORD IMPOSED LG DIMENSION IN PAGE PROVED.						
	INT'L	WELD - IN		TOTAL	None			POST WELD HEAT TREATMENT FOR _____ (OTHER THAN CODE)						
		REMOVABLE	304 SS	None TOTAL	6" thk wire mesh									
MECHANICAL DESIGN REQ'D	PRESS MARGIN, MIN SPEC ____ + ____ = 50 PSI							SPECIAL REQUIREMENTS						
	MIN. DESIGN PRESS AT TOP .50 PSIG (MARG+ OPER.)							CODE: ASME, Section VIII						
	SYSTEM PSV SET AT 50 PSIG LOCATED on piping							LOADINGS						
	MIN.DESIGN TEMP -320 °F @ 50 PSIG							SERVICE(CYCLIC, LETHAL ETC.)						
	EXTERNAL PRESS DESIGN: Not Required FOR							Steady						
	VESSEL SUPPORT DATA SKIRT ____ LEGS ____ LUGS Yes Will be positioned at a specific elevation in the cold SADDLES (C-527) WEIGHT box MIN. ABV GRADE FIREPROOFING None							INSULATION: Located in cold box						
VOZZLES INSTRUMENT	NOML NO.	SERVICE	NOML NO.	EST RECD.	SIZE	RATING (PAULING)	INT'L TYPE OR NOTE	NOML NO.	SERVICE	NOML NO.	EST RECD.	SIZE	RATING (PAULING)	INT'L TYPE OR NOTE
	J-6	Level Trans	1	1"										
	J-5	Level Trans.	1	1"										
	J-4	Pressure Ind.	1	1"										
	J-3													
	J-2													
	J-1	PSV												
	9													
	8													
	7													
	6													
	5													
	4													
	3	Liquid Outlet	1	6"										
2	Vapor Outlet	1	6"											
1	Vap/Liq Inlet	1	8"					M-1	MANWAY	1	18"			
DESIGN BASIS														
ISSUED FOR														
JOB NO. VESSEL DESIGN DATA SHEET														
252 SERVICE Hydrogen Purification, Plant 8														
UNIT 8-1-99 Liquid/Vapor Separator, 252-IZ-17														
PROCESS INSTRUM UNIT PROJECT														
VESSEL NO. REV.														

AIRCO CRYOPLANTS

ISSUED FOR PHASE 0



Position: Vertical
Shell Thickness - 3/16"
Ellipsoidal Head Thickness - 3/16"

TIME LL DATA FOR

PROCESS INFORMATION		FLUID		FLOW	CONCENT	TEMP °F	PRESSURE	TIME	LL DATA FOR
NO.	NAME	UNIT	LB/HR	LB/CH	PERCENT	TEMP °F	PSIA	MIN	MAX
1	Water & Steam		7095			212 350/-10	0	10	
2	Water		4560	60		212 350/-10	0	10	
3	Steam		2535	0.04		212 350/-10	0	10	

COMPONENT	TYP MATL	CORR ALLOW	REMARKS
SHLL & HEADS	516-70	1/8" MIN	Ellipsoidal Head
WELD - IN		TOTAL	None
INTLS		TOTAL	None

MECHANICAL DESIGN REQ		SPECIAL REQUIREMENTS	
PRESS MARGIN MIN SPEC	50 PSIG	CODE	ASME Section VIII
MIN. DESIGN PRESS AT TOP	50 PSIG (MARK + OPER.)	LOADINGS	
SYSTEM PSY SET AT	50 PSIG LOCATED On Piping	SERVICE (CYCLIC, LETHAL ETC)	Steady
MIN. DESIGN TEMP	350 °F @ 50 PSIG	INSULATION: Yes THK 2"	
EXTERNAL PRESS DESIGN: Not Required FOR			
VESSEL SUPPORT DATA: SKIRT LEGS Yes/UGS			
SADDLES (C-527)			
HEIGHT No Specific Requirement			

PROCESS INSTRUMENT		SERVICE		NO. REQ'D		SIZING		TYPE		NOTE	
NO.	NAME	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE
J-6	Level Switch	1	2"								
J-5	Level Switch	1	2"								
J-4											
J-3											
J-2											
J-1	PLV										
8											
7											
6											
5											
4	Hand Hole	2	4"								
3	Steam Outlet	1	2"								
2	Water Outlet	1	2"								
1	Inlet	1	2"								

DESIGN BASIS		ISSUED FOR	
JOB NO.	253	VESSEL DESIGN DATA SHEET	
SERVICE	Hydrogen Purification, Plant 8		
UNIT	8-1-103 Cond. Flash Tank, 252-12-18		

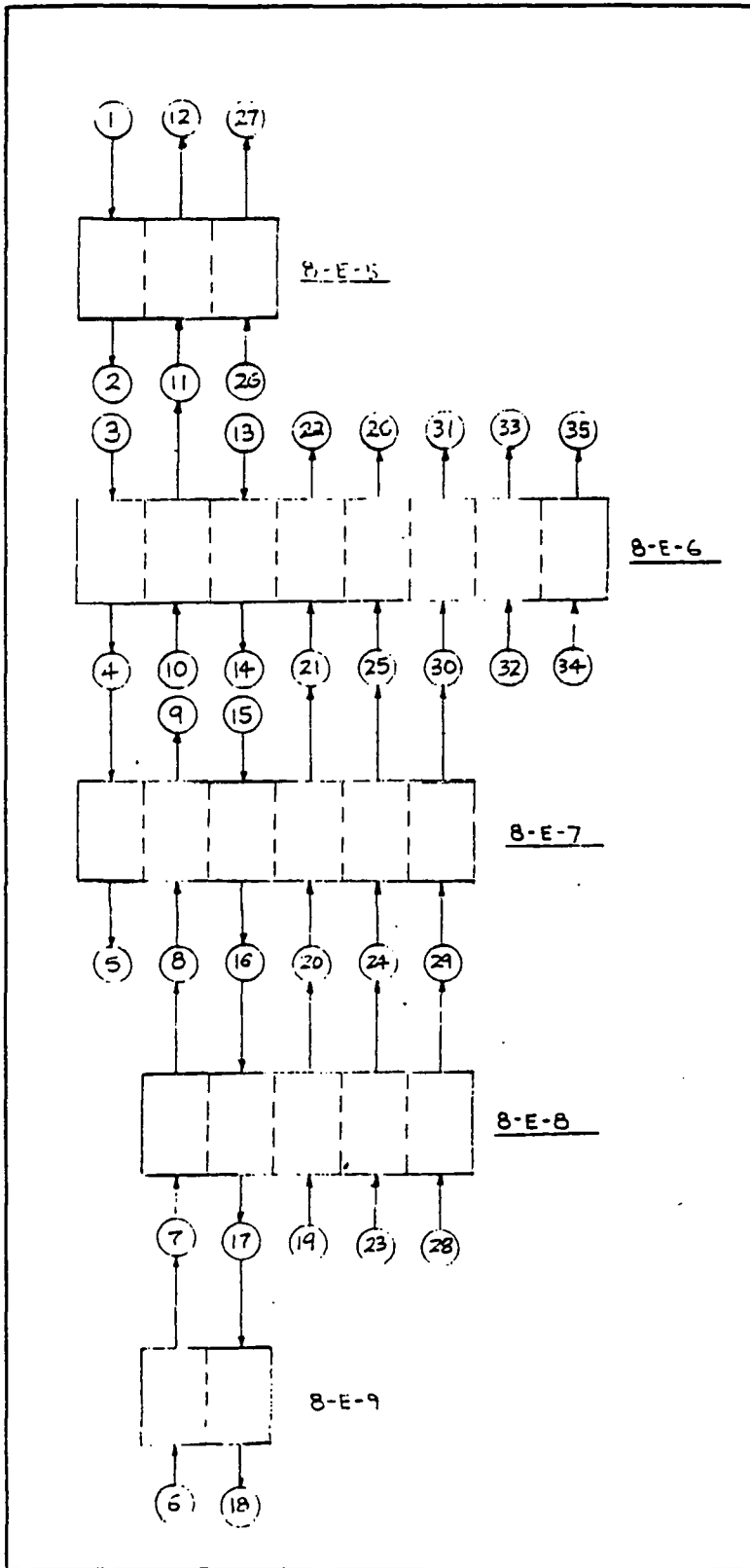
FORM 4-80 REV. 12-65

4.2 Data Sheets for Exchangers

Exchangers:	8E-5 to 8E-9
0-252-1Z-7:	Hydrogen Purification (8E-4)
Refrigeration Unit:	(8V-59)
0-252-1Z-12:	Expander - Comp. After Cooler (8E-581)
0-252-1Z-27:	Derime Heater (8E-98)

CM 171A - 3/76 PRD. 10.1

Airco Cryoplants				☐ STANDARDS ☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA				WRITTEN BY		DATE					
								APPROVED BY <i>AE</i>		DATE <i>2/5/81</i>					
								APPROVED BY <i>ES</i>		DATE <i>3/11/81</i>					
								APPROVED BY <i>HPH</i>		DATE <i>3/11/81</i>					
REVISION															
PAGE															
DATE															
WRITTEN BY															
APPROVED BY															
BRECKINRIDGE PROJECT PLANT 8 HYDROGEN PLANT EXCHANGER DATA SHEETS															
Sheet No. <u>1</u> of <u>6</u>															



HEAT & MATERIAL BALANCE			
PT	FLOW	TEMP °F	PRESSURE, PSI
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13	262.364	30.00	615.0
14	262.360		610.0
15	184.010		607.0
16	184.010		604.0
17	184.010		599.0
18	184.010	-284.00	595.0
19	87.296	-285.00	594.0
20	87.296		589.0
21	87.296		582.0
22	87.296	22.60	575.0
23	6.368	-292.00	27.5
24	6.368		27.5
25	6.368		25.0
26	6.368	22.60	22.0
27	6.368	87.30	20.0
28	90.346	-292.00	20.0
29	90.346		27.0
30	90.346		25.0
31	90.346	22.60	23.0
32	72.919		30.0
33	72.919	22.60	25.0
34	5.437		24.5
35	5.437	22.60	25.0

HE No.	TOTAL Q	ΔT_{eff}	AREA
	BTU/HR	°F	
5			
6			
7			
8			
9			

FROM PT	TO PT	WORKING PRESSURE	MAXIMUM PRESSURE	ALLOWABLE ΔP
		PSIA	PSIA	#
1	11		750	5.00
3	5		750	10.00
6	12		150	9.50
13	18	619/595	750	20.00
19	22	579/575	750	20.00
23	27	29.5/20.0	150	4.50
28	31	30/23.6	150	7.00
32	33	29.5/25.0		4.50
34	35	30/25.0		5.00

[illegible][illegible]

HEAT EXCHANGER SPECIFICATION SHEET

0-252-1Z-7

1	CUSTOMER AND PROJECT LOCATION Bechtel - Breckinridge, Ky.				EXCHANGER MANUFACTURER			
2	PLANT 8 - Hydrogen Purification		EXCH. NO. HE-4		REQ. NO.			
3	SERVICE OF UNIT Reactivation Cooler				ITEM NO. 8-E-4			
4	SIZE 395 Ft ²	TYPE AEP	(HORIZ/VERT) CONNECTED IN		SERIES		PARALLEL	
5	SURF./UNIT (IEFF/GROSS)		SHELLS/UNIT		SURF./SHELL (IEFF/GROSS)		395 ft ²	
6	PERFORMANCE OF ONE UNIT				395 ft ²			
7	FLUID ALLOCATION		SHELLSIDE		TUBESIDE			
8	FLUID CIRCULATED		Cooling Water		Nitrogen			
9	TOTAL FLUID ENTERING LB/HR		59,100		35,817			
10			IN		OUT			
11	LIQUID lb/hr							
12	VAPOR LB/HR, MW				35,817 28		25,817 28	
13	NONCOND LB/HR, MW							
14	STEAM							
15	WATER lb/hr		59,100		59,100			
16	FLUID VAPORIZED/CONDENSED							
17	GRAVITY, LIQ.		1.0		1.0			
18	VISCOSITY, LIQ. (VAP) CP		0.82		0.65		(0.024) (0.071)	
19	THERM. COND., LIQ. (VAP)		0.34		0.34		(0.024) (0.014)	
20	SPECIFIC HEAT, LIQ. (VAP)		1.0		1.0		(0.25) (0.25)	
21								
22	TEMPERATURE °F		85		105		252 120	
23	OPERATING PRESS. (PSI) (PSIG)		35		25		16.7 11.7	
24	NO. PASSES/SHELL		one		one			
25	VELOCITY FT/SEC		3.24		238			
26	PRESS. DROP, ALLOW/CALC. PSI		10 / 4.97		5 / 4.83			
27	FOULING RESISTANCE		0.002		0.001			
28	HEAT EXCHANGED 1,182,000		BTU/HR; MTD (CORR) (WTOI)		78.04		°F	
29	TRANSFER RATE, SERVICE 38.34		CLEAN 45.38		BTU/HR. SQ. FT. °F			
30	CONSTRUCTION							
31			SHELLSIDE		TUBESIDE			
32	DESIGN/TEST PRESS. PSIG		75 / 115		75 / 115			
33	DESIGN TEMPERATURE °F		650		350			
34	CORROSION ALLOWANCE IN		1/8"		1/8"			
35	CONNECTIONS INLET		3"		8"			
36	SIZE OUTLET		3"		8"			
37	RATING							
38	TUBES NO. 186		OD 3/4"		THK (MIN/AVG) 16BWG		LENGTH 11'-0" PITCH 15/16" FLOW →	
39	TUBE MATERIAL Admiralty				TUBE-TUBESHEET JOINT			
40	SHELL C.S. 15"		IP OD		SHELL COVER		(INTEG) (REMOV)	
41	CHANNEL/BONNET				CHANNEL COVER			
42	TUBESHEET-STATIONARY				TUBESHEET FLOATING			
43	FLOATING HEAD COVER				IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS 34		TYPE 25		% CUT (DIA/AREA) SPACING 3.5 inches			
45	BAFFLES-LONG		SEAL TYPE		TUBE SUPPORTS			
46	INSUL. THK.: SHELL		CHAN.		EXPANSION JOINT			
47	GASKETS							
48	CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS		SPEC	
49	WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER			
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED							
51	NOTE: (1) Corrosion allowance on tube side applies only to carbon steel parts.							
52								
53								
54								

	REV.	DATE				JOB NO.	DRWG. NO.	REV.
	△	3/6/81	AES to AEP, N ₂ from Shell to KC FR RM				DS-	1
	△		tube					

 ISSUED FOR PHASE		PROCESS SPECIFICATION REFRIGERATION UNIT		NO. _____ REV. _____ SHEET 5 OF 7	
EQUIPMENT TITLE Refrigeration Unit		ITEM NO. 8-4-59			
CUSTOMER Bechtel		JOB NO. 252			
LOCATION Breckinridge, Ky.		DATE 11/13/80			
QUANTITY One (1)	BY	APP'D BY			
OPERATING CONDITIONS					
COMPOSITION OF GAS BEING COOLED (DRY BASIS) Nitrogen					
MOLECULAR WT. OF DRY GAS		28			
DOES GAS CONTAIN ANY WATER		☐ YES		☒ NO	
IS GAS SATURATED WITH WATER		☐ YES		☒ NO	
DOES GAS CONTAIN MOISTURE OTHER THAN H ₂ O		☐ YES		☒ NO	
IS GAS SATURATED WITH MOISTURE OTHER THAN H ₂ O		☐ YES		☒ NO	
COMPOSITION OF MOISTURE IF DIFFERENT THAN H ₂ O					
MOLECULAR WEIGHT OF MOISTURE					
GAS INLET TEMPERATURE		120.		°F	
VAPOR PRESS. OF MOISTURE AT INLET TEMP.		—		PSIA	
NORMAL OPERATING PRESSURE		22		PSIA	
MAX. OPERATING PRESSURE		35	PSIA	20.3	PSIG
DESIGN PRESSURE (15% ABOVE MAX. OPER. PRESS.)		25		PSIG	
GAS OUTLET TEMPERATURE		30		°F	
NORMAL FLOW RATE (DRY GAS)		0.0	SCFM*	0.0	LB/HR
DESIGN FLOW RATE (DRY GAS)		0.0	SCFM*	0.0	LB/HR
NORMAL FLOW RATE (MOISTURE)		—		LB/HR	
DESIGN FLOW RATE (MOISTURE)		—		LB/HR	
AVE. SPECIFIC HEAT OF DRY GAS ENTERING		.25		BTU/lb/°F	
AVE. SPECIFIC HEAT OF MOISTURE ENTERING		—		BTU/lb/°F	
AVE. LATENT HEAT OF MOISTURE ENTERING		—		BTU/lb	
LBS. MOISTURE PER LB. DRY GAS AT INLET		0.0			
LBS. MOISTURE PER LB. DRY GAS AT OUTLET		0.0			
FLUIDS CONDENSED AT DESIGN FLOW RATE		0.0		LB/HR	
SENSIBLE HEAT LOAD (Q) AT DESIGN FLOW RATE		886,500		BTU/HR	
LATENT HEAT LOAD (Q) AT DESIGN FLOW RATE		0		BTU/HR	
TOTAL HEAT LOAD (Q) AT DESIGN FLOW RATE		886,500		BTU/HR	
TOTAL HEAT LOAD (Q) AT DESIGN FLOW RATE		73.9		TONS	
TYPE OF REFRIGERANT USED		Freon 22			
OPERATING CONDITIONS OF REFRIGERANT IN EVAPORATOR		57.727	PSIA	20	°F
*MEASURED AT 14.7 PSIA & 70 °F					
WRITTEN BY _____		DATE _____		APPROVED _____	
				SHEET NO 4 OF 6	

HEAT EXCHANGER SPECIFICATION SHEET

0-252-1Z-12

1	CUSTOMER AND PROJECT LOCATION Bechtel Breckinridge, Kentucky				EXCHANGER MANUFACTURER			
2	PLANT 8 Hydrogen Puri		EXCH. NO HE-581		REQ. NO.			
3	SERVICE OF UNIT Expander-Comp. Aftercooler				ITEM NO. 8-E-581			
4	SIZE 1200 sq. ft.		TYPE AEP		(HORIZ/VERT) CONNECTED IN		SERIES PARALLE	
5	SURF./UNIT (EFF/GROSS) 1200 sq. ft.		SHELLS/UNIT one		SURF/SHELL (EFF/GROSS) 1200 sq. ft.			
6	PERFORMANCE OF ONE UNIT							
7	FLUID ALLOCATION		SHELLSIDE			TUBESIDE		
8	FLUID CIRCULATED		Water			Nitrogen		
9	TOTAL FLUID ENTERING LB/HR		83,347			76,625		
10			IN OUT			IN OUT		
11	LIQUID							
12	VAPOR LB/HR, MW					76,625 28 76,625 28		
13	NONCOND LB/HR, MW							
14	STEAM							
15	WATER lb/hr		83,347			83,347		
16	FLUID VAPORIZED/CONDENSED							
17	GRAVITY, LIQ.		1.0					
18	VISCOSITY, LIQ. (VAP.) CP		.79			.645 (.0208) (.0194)		
19	THERM. COND., LIQ. (VAP.) Btu/hr.ft. ² °F		1.00			1.00 (.2700) (0.277)		
20	SPECIFIC HEAT, LIQ. (VAP.)							
21								
22	TEMPERATURE °F		85			105 173.4 95		
23	OPERATING PRESS. (PSIG)		50			45 685 680		
24	NO. PASSES/SHELL		One			One		
25	VELOCITY FT/SEC		2.7			11.4		
26	PRESS. DROP. ALLOW/CALC. PSI		5 / 4.95			5 / 0.96		
27	FOULING RESISTANCE		.002			.001		
28	HEAT EXCHANGED 1,664,050		BTU/HR; MTD (CORR) (WTD)			30.4 °F		
29	TRANSFER RATE, SERVICE 45.66		CLEAN 53.8			BTU/HR. SQ. FT. °F		
30	CONSTRUCTION							
31			SHELLSIDE		TUBESIDE			
32	DESIGN/TEST PRESS. PSIG		75 / 150		750 / 1125			
33	DESIGN TEMPERATURE °F		650		250			
34	CORROSION ALLOWANCE IN		1/8"		1/8"			
35	CONNECTIONS		INLET 4"		6"			
36	SIZE		OUTLET 4"		6"			
37	RATING							
38	TUBES NO. 314		OD 3/4"		THK (MIN/AVG)		LENGTH 20 FT PITCH 15/16" FLOW → 	
39	TUBE MATERIAL Admiralty		TUBE-TUBESHEET JOINT					
40	SHELL C.S.		19" ip OD		SHELL COVER		(INTEG.) (REMOV)	
41	CHANNEL/BONNET		CHANNEL COVER					
42	TUBESHEET-STATIONARY		TUBESHEET FLOATING					
43	FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)					
44	BAFFLES-CROSS 45		TYPE 25		% CUT (DIA/AREA)		SPACING 8.2"	
45	BAFFLES-LONG		SEAL TYPE		TUBE SUPPORTS			
46	INSUL. THK.: SHELL		CHAN.		EXPANSION JOINT			
47	GASKETS							
48	CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS		SPECS	
49	WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER			
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED							
51	Note: Corrosion allowance on tubeside applies only to carbon steel parts.							
52								
53								
54								

	REV.	DATE					JOB NO.	DRWG. NO.	REV.
	△	2-25-81	BEU TO AEP, RISE 10° TO 20°			BM		03-	1
	△								

HEAT EXCHANGER SPECIFICATION SHEET

0-252-1Z-27

1	CUSTOMER AND PROJECT LOCATION		Bechtel, Breckinridge, Kentucky		EXCHANGER MANUFACTURER	
2	PLANT		8 - Hydrogen Purification		EXCH. NO. DH-98	
3	SERVICE OF UNIT		Derime Heater		REQ. NO.	
4	SIZE		59.0 ft ²		ITEM NO. 8-E 98	
5	TYPE		Bel		(HORIZ/VERT) CONNECTED IN SERIES PARALLEL	
6	SURF/UNIT (EFF/GROSS)		59.0 ft ²		SHELLS/UNIT one SURF/SHELL (EFF/GROSS) 59.0 ft ²	
PERFORMANCE OF ONE UNIT						
7	FLUID ALLOCATION		SHELLSIDE		TUBESIDE	
8	FLUID CIRCULATED		Steam		Air	
9	TOTAL FLUID ENTERING		LB/HR 962		40,000	
10			IN		OUT	
11	LIQUID		-		-	
12	VAPOR		LB/HR, MW -		-	
13	NONCOND		LB/HR, MW -		40,000 29 -	
14	STEAM		Lb/hr 962		-	
15	WATER		Lb/hr -		962 -	
16	FLUID VAPORIZED/CONDENSED		Lb/hr -		962 -	
17	GRAVITY, LIQ.		-		0.891 -	
18	VISCOSITY, LIQ. (VAP.)		Lb/ft/hr (0.0314)		0.15 (0.0508) -	
19	THERM. COND., LIQ. (VAP.)		Btu/hr-ft-°F (0.018)		0.45 (0.014) -	
20	SPECIFIC HEAT, LIQ. (VAP.)		Btu/lb-°F (0.45)		1.0 0.2425 -	
21						
22	TEMPERATURE		°F 366		366 90 175	
23	OPERATING PRESS.		(PSIA) (PSIG) 150		145 100 96	
24	NO. PASSES/SHELL		One		One	
25	VELOCITY		FT/SEC Two Phases		117.6	
26	PRESS. DROP, ALLOW/CALC.		PSI 10.0 / 0.05		5.0 / 2.79	
27	FOULING RESISTANCE		0.001		0.001	
28	HEAT EXCHANGED		824,500		BTU/HR: MTD (CORR) (WTD) 230 °F	
29	TRANSFER RATE, SERVICE		60.76		CLEAN 72.8 BTU/HR. SQ. FT. °F	
CONSTRUCTION						
31			SHELLSIDE		TUBESIDE	
32	DESIGN/TEST PRESS.		PSIG 165 / 250		110 / 165	
33	DESIGN TEMPERATURE		°F 650°		650°	
34	CORROSION ALLOWANCE		IN 1/8"		1/8"	
35	CONNECTIONS		INLET 2"		6"	
36	SIZE		OUTLET 1"		6"	
37	RATING				DH-98	
38	TUBES NO.		108 OD 3/4"		THK (MIN/AVG) 4 BW LENGTH 3'-0" PITCH FLOW → ◊ ◊ ◊ ◊	
39	TUBE MATERIAL		Carbon Steel		TUBE-TUBESHEET JOINT	
40	SHELL		12" IP OD		SHELL COVER (INTEGR) (REMOVE)	
41	CHANNEL/BONNET				CHANNEL COVER	
42	TUBESHEET-STATIONARY				TUBESHEET FLOATING	
43	FLOATING HEAD COVER				IMPINGEMENT PLATE (YES) (NO)	
44	BAFFLES-CROSS		None TYPE None		% CUT (DIA/AREA) SPACING None	
45	BAFFLES-LONG		SEAL TYPE		TUBE SUPPORTS	
46	INSUL THK: SHELL		CHAN.		EXPANSION JOINT	
47	GASKETS					
48	CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS SPECS	
49	WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED					
51						
52						
53						
54						
REV.		DATE			JOB NO. DRWG. NO. REV.	
△					DS- 0	
△						
△						

4.3 Data Sheets for Fired Heaters

0-252-1Z-6: Reactivation Heater (8F-3)

Airco Cryopants				☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA				WRITTEN BY				DATE							
								APPROVED BY				HE				DATE 2/15/81			
								APPROVED BY								DATE			
								APPROVED BY								DATE			
REVISION																			
PAGE																			
DATE																			
WRITTEN BY																			
APPROVED BY																			

BRECKINRIDGE PROJECT
 PLANT 8
 HYDROGEN PLANT
 FIRED HEATER DATA SHEETS

FIRE HEATER DATA SHEET

Customer Bechtel Manufacturer _____
 Location Breckinridge Ky. Equip. No. _____
 Unit Reactivation Heater Req. No. _____
 Number Required One (1) Item No. 8F-3 (HE-3)
 Total Heat Absorbed mm Btu/h 2.22 Type of Heater Vertical Fired Heater

HEATER PERFORMANCE

Heater Section	Shell	Tubes
Service		
Fluid Name	Gas*	N ₂
Heat Absorption		2.22
Flow Rate		35.817
Pressure Drop (Allowable - Clean/Fouled)		7.0
Pressure Drop (Calculated - Clean/Fouled)		
Coking Allowance		
Average Radiant Flux Density (Allowable)		
Average Radiant Flux Density (Calculated)		
Maximum Radiant Flux Density		
Average Convection Flux Density		
Velocity Limitation		
Maximum Allowable Inside Film Temperature		
Fouling Resistance Inside		0.001

Inlet Conditions:			
Temperature		100	252
Pressure	(psig)(psia)	50	16.7
Liquid Flow	lb/h	-	-
Vapor Flow	lb/h	-	35.817
Density, Liquid (Vapor) At P&T	lb/cu ft	-	(0.025)
Gravity, Liquid	Sp Gr at 60°F	-	-
Vapor	mol wt	-	28
Viscosity, Liquid (Vapor)	CP	-	(0.022)
Specific Heat, Liquid (Vapor)	Btu/lb-°F	-	(0.254)
Conductivity, Liquid (Vapor)	Btu-ft/h-ft ² -°F	-	(0.019)

Outlet Conditions:			
Temperature		-	500
Pressure	(psig)(psia)	-	9.7
Liquid Flow	lb/h	-	-
Vapor Flow	lb/h	-	35.817
Density, Liquid (Vapor) At P&T	lb/cu ft	-	(0.024)
Gravity, Liquid	(Sp Gr at 60°F)	-	-
Vapor	mol wt	-	28
Viscosity, Liquid (Vapor)	CP	-	(0.027)
Specific Heat, Liquid (Vapor)	Btu/lb-°F	-	(0.260)
Conductivity, Liquid (Vapor)	Btu-ft/h-ft ² -°F	-	(0.024)

Remarks and Special Requirements:

Data sheet reference for vaporization curve. * = Medium Btu Gas

Required for Phase 0 Estimate



REV.	Δ					JOB NO.	
	Δ					DATA SHEET	REV.
	Δ					DS	
	Δ						

COMBUSTION AND FUEL DATA

		Medium	Btu Gas
51.	Type of Fuel		
52.	Excess Air	%	
53.	Calculated Heat Release	mm Btu/h (LHV)	
54.	Calculated Efficiency, Percent (LHV)		
55.	Guaranteed Efficiency, Percent (LHV) See Note		
56.	Radiation Loss, Percent of Heat Release (LHV)		
57.	Flue Gas Temp. Leaving Radiant Section	°F	
58.	Flue Gas Temp. Leaving Convection Section	°F	
59.	Flue Gas Temp. (Uncorr) Leaving Air Heater	°F	
60.	Flue Gas Mass Velocity-Conv. Section	lb/sq ft-sec	
61.	Volumetric Heat Release	Btu/h-cu ft	
62.	Altitude Above Sea Level	ft	
63.	Air Temperature, Combustion	°F	
64.	Air Temperature, Draft	°F	
65.	Minimum Furnace Draft/Location	in H ₂ O	
66.	Draft at Burners	in H ₂ O	
67.	Note: A Fuel Savings of mm Btu/h Fuel Value \$6.00		
68.	Will Offset a \$1000 increase in mm Btu		
69.	Furnace Cost (Erected)		

Fuel Characteristics			
71.	Heating Value	HHV	
72.	Heating Value	Net Heating Value LLV	270
73.	Specific Gravity		0.67
74.	Molecular Weight		
75.	Viscosity, At °F	SSU	
76.	Viscosity, At °F	SSU	
77.	Fuel Pressure Available at Burner	psig	5
78.	Atomizing Steam Pressure	psig	
79.	Composition:		
80.	Vanadium	ppm	
81.	Sodium	ppm	
82.	Salt Content	ppm	
83.	Ash	% wt	
84.	Sulfur	Grains/ Cu. Ft. % wt	0.054
85.	Hydrogen	% wt	
86.	Carbon	% wt	
87.	Nitrogen	% wt/% vol	
88.	Oxygen	% wt	
89.	CH ₄	% vol	
90.	C ₂ H ₄	% vol	
91.	C ₂ H ₆	% vol	
92.	C ₃ H ₈	% vol	
93.	H ₂ S	% vol	
94.	H ₂ O	% vol	
95.			
96.			
97.			

98. NOTES: (1) Normal Header Press = 50 psig @ 100°F

99. (2) Max. Fuel Gas Header Press = 75 psig

100. _____

101. _____

102. _____

103. _____

MECHANICAL DESIGN
COIL DATA

105.	General:			
106.	Plot Limitations	_____	Minimum Stack Height	_____
107.	Tube Length Limitations	_____		
108.	Coil:			
109.	Coil Design:			
110.	Heater Section	_____	_____	_____
111.	Design Basis for Wall Thickness	_____	_____	_____
112.	Design Life	_____	_____	_____
113.	Design Pressure	_____ psig	_____	100
114.	Corrosion Allowance, Tubes	_____ in	_____	1/8"
115.	Weld Stress Relieve	_____	_____	_____
116.	Weld Inspection Requirements X-ray or Others	_____	_____	_____
117.	Maximum Wall Temperature (Calculated-Clean)	_____ °F	_____	_____
118.	Maximum Wall Temperature (Design-Fouled)	_____ °F	_____	_____
119.	Inside Film Coefficient	_____ Btu/h-°F sq ft	_____	_____
120.	Overall Heat Transfer Coefficient	_____ Btu/h-°F sq ft	_____	_____
121.	Corrected Mean Temperature Difference	_____ °F	_____	_____
122.	Bare Tubes, Total Exposed Surface	_____ sq ft	_____	_____
123.	Extended Surface Tubes, Total Exposed Surface	_____ sq ft	_____	_____
124.	Coil Configuration:			
125.	Tubes, Vertical or Horizontal	_____	_____	_____
126.	Number of Flow Passes/Tubes Per Pass	_____	_____	_____
127.	Effective Tube Length	_____ ft	_____	_____
128.	Bare Tubes, Number	_____	_____	_____
129.	Extended Surface Tubes, Number	_____	_____	_____
130.	Tube Spacing, Center to Center (Staggered) (In Line)	_____ in	_____	_____
131.	Tube Center to Furnace Wall	_____ in	_____	_____
132.	Tubes:			
133.	Material (ASTM Specification and Grade)	_____	_____	304 SS
134.	Outside Diameter	_____ in	_____	_____
135.	Wall Thickness (Minimum) (Average)	_____ in	_____	_____
136.	Overall Tube Length	_____ ft-in	_____	_____
137.	Description of Extended Surface:			
138.	Type	_____	_____	_____
139.	Fin or Stud Material	_____	_____	_____
140.	Fin or Stud Material	_____	_____	_____
141.	Fin or Stud Dimensions	_____ in	_____	_____
142.	Fin or Stud Dimensions	_____ in	_____	_____
143.	Fin or Stud Spacing	_____ per in	_____	_____
144.	Fin or Stud Spacing	_____ per in	_____	_____
145.	Maximum Fin or Stud Temperature	_____ °F	_____	_____
146.	Maximum Fin or Stud Temperature	_____ °F	_____	_____
147.	Plug-Type Headers:			
148.	Location	_____	_____	_____
149.	Manufacturer and Type	_____	_____	_____
150.	Nominal Rating	_____	_____	_____
151.	Welded or Rolled Joint	_____	_____	_____
152.		_____	_____	_____
153.		_____	_____	_____
154.		_____	_____	_____
155.		_____	_____	_____
156.		_____	_____	_____
157.		_____	_____	_____
158.		_____	_____	_____

4.4 Data Sheets for Miscellaneous Equipment

0-252-1Z-8:	Nitrogen Vent Silencer (8Y-2)
0-252-1Z-4:	Final Filter (8Y-16 A,B)
0-252-1Z-30:	N ₂ Compressor Silencer (8Y-707)

Airco Cryoplants				☐ STANDARDS ☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA				NO.										
								WRITTEN BY				DATE						
								APPROVED BY <i>AE</i>				DATE <i>2/15/81</i>						
								APPROVED BY <i>JS</i>				DATE <i>3/11/81</i>						
								APPROVED BY <i>HNH</i>				DATE <i>3/11/81</i>						
REVISION																		
PAGE																		
DATE																		
WRITTEN BY																		
APPROVED BY																		
BRECKINRIDGE PROJECT PLANT 8 HYDROGEN PLANT MISCELLANEOUS EQUIPMENT																		
Sheet No. <u>1</u> of <u>4</u>																		

SPECIFICATION SILENCER REV. 			
EQUIPMENT TITLE Nitrogen Vent Silencer		ITEM NO. 8-V-2	
CUSTOMER	Bechtel	JOB NO.	252
LOCATION	Breckinridge, Kv	DATE	11/6/80
QUANTITY	One	BY	APP'D BY
OPERATING CONDITIONS			
COMPOSITION OF GAS BEING VENTED (DRY BASIS)			
MOLECULAR WT. OF DRY GAS			
DOES GAS CONTAIN ANY WATER	☐ YES	☒ NO	
IS GAS SATURATED WITH WATER	☐ YES	☒ NO	
DOES GAS CONTAIN MOISTURE OTHER THAN H ₂ O	☐ YES	☒ NO	
IS GAS SATURATED WITH MOISTURE OTHER THAN H ₂ O	☐ YES	☒ NO	
COMPOSITION OF MOISTURE IF DIFFERENT THAN H ₂ O			
MOLECULAR WT. OF MOISTURE			
GAS INLET TEMPERATURE		500	°F
VAPOR PRESS. OF MOISTURE AT INLET TEMP.			PSIA
NORMAL OPERATING PRESSURE		22	PSIA
MAX. OPERATING PRESSURE		25	PSIA
DESIGN PRESSURE	50	PSIA	35.3 PSIG
NORMAL FLOW RATE (DRY GAS)	7000	SCFM*	30.435 LB/Hr
DESIGN FLOW RATE (DRY GAS)	7350	SCFM*	31.957 LB/Hr
NORMAL FLOW RATE (MOISTURE)			LB/Hr
DESIGN FLOW RATE (MOISTURE)			LB/Hr
DEW POINT OF INLET GAS (MEASURED @ 14.7 PSIA)		-320	°F
LBS. MOISTURE PER LB. DRY GAS AT INLET			
- Exit gas velocity not to exceed 12.000 ft/min. - Structural design of silencer to be based on an exit gas velocity of 18.000 ft/min. - Maximum attenuated noise level shall be 80 dba measured at a distance of 25 feet parallel to the silencer. Assume unit is mounted next to a reflective surface. Materials to be carbon steel. Non-metallic internals shall be non-combustible.			
*MEASURED AT 14.7 PSIA & 70°F			
WRITTEN BY _____		DATE _____	APPROVED _____
		SHEET NO 2 of 4	

	PROCESS SPECIFICATION CARTRIDGE FILTER	REV.			
EQUIPMENT TITLE Final Filter		ITEM NO. 8-Y-16 A,B;			
CUSTOMER Bechtel		JOB NO. 252			
LOCATION Breckinridge, Ky.		DATE 11/6/80			
QUANTITY Two		BY R. R. R.		APP'D BY	
OPERATING CONDITIONS					
FLUID FILTERED Crude Hydrogen (1)					
NORMAL FLOW RATE (SPECIFY ONE)		205.000	SCFM	GPM	
NORMAL FLOW RATE				258.100	LB/HR
DESIGN FLOW RATE (SPECIFY ONE)		225.500	SCFM	GPM	
DESIGN FLOW RATE				283,900	LB/HR
NORMAL INLET TEMPERATURE				30	°
MAX. INLET TEMPERATURE				40	°
NORMAL INLET PRESSURE				635	PSIA
MAX. INLET PRESSURE				700	PSIA
DESIGN PRESSURE (15% ABOVE MAX. INLET PRESS)				720	PSIG
MAX. ALLOWABLE ΔP (CLEAN)				3	PSI
MAX. ALLOWABLE ΔP (DIRTY)				5	PSI
DEGREE OF FILTRATION REQ'D				5	MICRONS
SP. GR. AT INLET TEMPERATURE					
VISCOSITY AT INLET TEMPERATURE				.0116	CPS
MISC. INFORMATION					
1. Composition by volume: 73.2% H ₂ , 12.3% CH ₄ , 4.3% CO, 3.7% C ₂ H ₆ , 2.9% C ₃ H ₈ , 3.6% misc.					
2. Filter should be able to take a 50 psi drop for structural strength					
WRITTEN BY R.R.R.		DATE 11/6/80		APPROVED	
				SHEET NO 3 OF 4	

	PROCESS SPECIFICATION SILENCER	NO. 0-252-1Z-30	
		REV.	
EQUIPMENT TITLE N ₂ Compressor Silencer		ITEM NO. 8-Y-707	
CUSTOMER Bechtel		JOB NO. 252	
LOCATION Breckinridge, Kentucky		DATE 3/10/81	
QUANTITY One	BY	APP'D BY	
OPERATING CONDITIONS			
COMPOSITION OF GAS BEING VENTED (DRY BASIS)		Nitrogen	
MOLECULAR WT. OF DRY GAS		28	
DOES GAS CONTAIN ANY WATER		YES	X NO
IS GAS SATURATED WITH WATER		YES	X NO
DOES GAS CONTAIN MOISTURE OTHER THAN H₂O		YES	X NO
IS GAS SATURATED WITH MOISTURE OTHER THAN H₂O		YES	X NO
COMPOSITION OF MOISTURE IF DIFFERENT THAN H₂O		--	
MOLECULAR WT. OF MOISTURE		--	
GAS INLET TEMPERATURE		95	°F
VAPOR PRESS. OF MOISTURE AT INLET TEMP.		--	PSIA
NORMAL OPERATING PRESSURE		22	PSIA
MAX. OPERATING PRESSURE		30	PSIA
DESIGN PRESSURE		50 PSIA	35.3 PSIG
NORMAL FLOW RATE (DRY GAS)		30564 SCFM*	132,086 LB/HR
DESIGN FLOW RATE (DRY GAS)		32098 SCFM*	139,556 LB/HR
NORMAL FLOW RATE (MOISTURE)		-- LB/HR	
DESIGN FLOW RATE (MOISTURE)		-- LB/HR	
DEW POINT OF INLET GAS (MEASURED @ 14.7 PSIA)		-320 °F	
LBS. MOISTURE PER LB. DRY GAS AT INLET			
Exit gas velocity not to exceed 12,000 ft/minute.			
Structural design of silencer to be based on an exit gas velocity of 18,000 ft/minute.			
Maximum attenuated noise level shall be 80 dba measured at a distance of 25 feet parallel to the silencer discharge. Assume unit is mounted next to a reflective surface. Materials to be carbon steel. Non-metallic internals shall be non-combustable.			
*MEASURED AT 14.7 PSIA & 70°F			
WRITTEN BY _____ DATE _____ APPROVED _____ SHEET NO 4 OF 4			

4.5 Data Sheets for Compressors

0-252-1Z-5:	Reactivation Blowers (8K-1)
0-252-1Z-10:	Recycle Nitrogen Compressor (8K-70)
0-252-1Z-11:	Expander/Compressor (8P-58)
0-252-1Z-20:	Inert Waste Gas Compressor (8K-10)
0-252-1Z-23:	Heavy Hydrocarbon Compressor (8K-20)
0-252-1Z-26:	Pipeline Fuel Compressor (8K-30)

Airco Cryopants				☐ STANDARDS ☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA				WRITTEN BY		DATE	
								APPROVED BY <i>HE</i>		DATE <i>2/15/81</i>	
								APPROVED BY		DATE	
								APPROVED BY		DATE	
REVISION											
PAGE											
DATE											
WRITTEN BY											
APPROVED BY											

BRECKINRIDGE PROJECT
 PLANT 8
 HYDROGEN PLANT
 COMPRESSOR DATA SHEETS

POWER VOLTS 4160
CYCLES 60 PHASES 3
STEAM P.S.I.G. AT THROTTLE _____
EXHAUST _____

0-252-1Z-5

A. GAS CHARACTERISTICS SERVICE		FLWSHEET NO.	PLANT EQUIP. NO.				
1. GAS		N ₂	8-K-1				
2. S.P. GR. (AIR = 1.0)		0.967					
3. POUNDS PER HOUR		35,817					
4. STD. C.F.M. @ 60°F & 14.7 PSIA		8085					
5. FLOW TEMP. °F		84					
6. CFM AT FLOW TEMP.		8460					
B PRESSURES							
1. SUCTION PSIA		14.7					
2. DIFFERENTIAL		16.7					
3. DISCHARGE		31.4					
C. OPERATION (Adiabatic)							
1. EFFICIENCY AT RATING (Overall)		70.5%					
2. B.H.P. AT RATING		652					
3. BID IMPELLER DIAM.							
4. MAX BHP FOR BID IMP. DIA.							
5. R.P.M. OF FAN OR BLOWER		11,812					
6. R.P.M. OF DRIVER		1750					
7. TIP SPEED							
8. OUTLET VELOCITY							
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW		CCW					
10. NUMBER OF STAGES							
D. CONSTRUCTION & MATERIAL		Cast Iron					
1. CASE: MATERIAL		Iron					
CONSTRUCTION: HORIZ. OR VERT SPLIT							
2. IMPELLER		Steel					
3. SHAFT MATERIAL							
4. SHAFT DIAMETER							
5. FLEXIBLE COUPLING							
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

Dresser-Roots

MFR'S TYPE & SIZE

20-OIB

BECHTEL

HOUSTON

REV

DATE

DATE

ISSUED FOR PHASE 01

SHEET 2 OF 27

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

FORM N-280 9/66

SHEET 3 OF 27

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FAC: <u>Bechtel</u>		USE: <u>Hydrogen Purification</u>	
LFC: <u>Breckinridge Kentucky</u>		SERIAL NO.: <u>Plant</u>	
SERVICE: <u>Recycle Nitrogen Compressor 8-K-70</u>		NO. REQUIRED: <u>1</u>	
MANUFACTURED: <u>Clark or equal</u>		DRIVE: <u>Elect Motor</u>	
MODEL: <u>1 soPAC or equal</u>		O-252-12-10	
NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; ☐ BY MANUFACTURER			

(ALL DATA ON PER UNIT BASIS)		OPERATING CONDITIONS					
		NORMAL	RATED	OTHER CONDITIONS			
				A	B	C	D
☐ GAS HANDLED (ALSO SEE PAGE <u> </u>)		Nitrogen					
☐ UNSATURATED VAPOR PRESSURE (PSIA) OR (PSI) OR (MM HG)							
☐ WEIGHT FLOW, LB/HR (NET) (GRT)							
INLET CONDITIONS:							
☐ PRESSURE (PSIA)		50					
☐ TEMPERATURE (°F)		87					
☐ RELATIVE HUMIDITY (%)		1 PPM					
☐ MOLECULAR WEIGHT (LB)		28.0					
☐ C _p /C _v (R) OR (°R)		1.4					
☐ COMPRESSIBILITY (Z) OR (°R)		1.0					
☐ INLET VOLUME (CFM) (GRT)		5350					
DISCHARGE CONDITIONS:							
☐ PRESSURE (PSIA)		521		516	Out Aftercooler		
☐ TEMPERATURE (°F)		260		95			
☐ C _p /C _v (R) OR (°R)		1.4					
☐ COMPRESSIBILITY (Z) OR (°R)		1.0					
☐ SHP REQUIRED (ALL LOSSES INCL)		4000	±4%				
☐ SPEED (RPM)	(1)	1800	Input to integral gear				
☐ ESTIMATED SURGE, KPM (AT SPEED ABOVE)		Later					
☐ POLYTROPIC HEAD (FT)		Later					
☐ POLYTROPIC EFFICIENCY (%)		Later					
☐ GUARANTEE POINT		Normal					
☐ PERFORMANCE CURVE NO.		Later					

PROCESS CONTROL	
METHOD:	☐ BYPASS FROM <u>Aftercooler</u> TO <u>Suction</u> ☐ ANTISURGE BYPASS ☐ MANUAL ☐ AUTO with manual override ☐ SUCTION THROTTLE FROM <u> </u> TO <u> </u> ☐ SPEED VARIATION FROM <u> </u> TO <u> </u> ☐ OTHER <u> </u>
SIGNAL:	☐ SOURCE <u> </u> ☐ TYPE <u> </u> ☐ RANGE: FOR PNEUMATIC CONTROL <u> </u> RPM <u> </u> FPM <u> </u> FPM <u> </u> FPM <u> </u> ☐ OTHER <u> </u>

REMARKS: (1) Compressor is 2-poster types, integral gear units, with double ended motor.

ISSUED FOR PHASE 0

NO.	DATE	REVISIONS	BY	CHK'D	DESIGN	ENG'D	PROJ	APPR

SCALE	DESIGNED	DRAWN	CHECKED	JOB NO.

	CENTRIFUGAL COMPRESSOR DATA SHEET	DRAWING NO. <u> </u> PCL <u> </u> DS- <u> </u>
--	-----------------------------------	---

CENTRIFUGAL COMPRESSOR DATA SHEET

0-252-12-10

GAS ANALYSIS		NORMAL	RATED	OTHER CONDITIONS				REMARKS
☐ MOL %	☐ WT. %			A	B	C	D	
AIR	20.946							
OXYGEN	20.946							
NITROGEN	78.014		100					
WATER VAPOR	1.036							
CARBON MONOXIDE	0.010							
CARBON DIOXIDE	0.010							
HYDROGEN SULFIDE	0.010							
HYDROGEN	0.010							
METHANE	0.010							
ETHYLENE	0.010							
ETHANE	0.010							
PROPYLENE	0.010							
PROPANE	0.010							
1-BUTANE	0.010							
2-BUTANE	0.010							
1-PENTANE	0.010							
2-PENTANE	0.010							
HEXANE PLUS								
TOTAL			100					
AVG. MOL. WT.			28.01					

LOCATION

- ☐ INDOOR ☐ HEATED ☐ UNDER ROOF
☐ OUTDOOR ☐ UNHEATED ☐ PARTIAL SIDES
☐ GRADE ☐ MOUNTAIN ☐ _____
☐ ELECTRICAL AREA CLASS _____ GR. _____ DIV. _____
☐ WINTERIZATION REQ. ☐ TROPICALIZATION REQ.

SITE DATA - SEE 14222-A-3

- ☐ ELEVATION _____ FT. BAROMETER _____ PSIA
☐ RANGE OF AMBIENT TEMPS. _____

	DRY BULB	WET BULB
SITE RATED °F	96	
NORMAL °F	105	
MAXIMUM °F	-10	
MINIMUM °F		

UNUSUAL CONDITIONS ☐ DUST ☐ FUMES☐ OTHER _____

Coal Processing Facility

NOISE SPECIFICATIONS

- ☐ APPLICABLE TO MACHINERY
 SEE SPECIFICATION 0-252-12-10
☐ APPLICABLE TO NEIGHBORHOOD
 SEE SPECIFICATION _____
 ACOUSTIC HOUSING: ☐ YES ☐ NO

APPLICABLE SPECIFICATIONS

API 617 CENTRIFUGAL COMP. FOR GEN. REFINERY SERVICES
 Airco Cryoplants 0-252-12-10

PAINTING

- ☐ MANUFACTURER'S STD.
☐ OTHER _____

SHIPMENT

- ☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING RECD.
☐ OUTDOOR STORAGE OVER 3 MONTHS

REMARKS

ISSUED FOR PHASE 0

CENTRIFUGAL COMPRESSOR DATA SHEET

CONSTRUCTION FEATURES

☐ SPEEDS Later
 MAX. CONT. _____ RPM TRIP _____ RPM
 CRITICALS 1ST _____ RPM 2ND _____ RPM
 MAX. TP SPEED: _____ FPM @ RATED SPEED
 _____ FPM @ MAX. CONT. SPEED

☐ ROTATION, VIEWED FROM DRIVEN END: Later

☐ CASING

MODEL Isopac

CASING SPLIT Poster Type

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 (CFM) _____

RADIOGRAPH QUALITY ☐ YES ☐ NO

☐ DIAPHRAGMS

MATERIAL Later

☐ IMPELLERS

NO. 6 DIAMETERS Later

TYPE (OPEN, ENCLOSED, ETC.) _____

TYPE FABRICATION _____

MATERIAL _____

MAX. YIELD STRENGTH (PSI) _____

BRINELL HARDNESS MAX. _____ MIN. _____

SMALLEST TIP INTERNAL WIDTH (IN) _____

MAX. MACH NO. @ IMPELLER EYE _____

MAX. IMPELLER HEAD @ RATED SPEED (FT.) _____

☐ SHAFT

MATERIAL Later

DIA. @ IMPELLERS (IN) _____ DIA. @ COUPLING (IN) _____

SHAFT END ☐ TAPERED ☐ CYLINDRICAL

SHAFT SLEEVE Later

☐ AT INTERF. CLOSE CLEAR. PTL ☐ NATL.

☐ AT SHAFT SEALS _____ ☐ NATL.

☐ LASTROWING Later

TYPE _____ MATERIAL _____

SHAFT SEALS Later

☐ TYPE _____

☐ SEAL STYLE TYPE _____

☐ INNER OIL LEAKAGE GUAR. (GAL/DAY/SEAL) _____

☐ TYPE BUFFER GAS _____

☐ BUFFER GAS FLOW (PER SEAL) _____

NORMAL _____ M/MIN @ _____ PSI @ P

MAX. _____ M/MIN @ _____ PSI @ P

☐ BEARING HOUSING CONSTRUCTION: Later

TYPE SEPARATE, INTEGRAL _____ SPLIT _____

MATERIAL _____

☐ RADIAL BEARINGS: Later

TYPE _____ SPAN (IN) _____

AREA (IN²) _____ LOADING (PSI) ACT. _____ ALLOW. _____

☐ THRUST BEARING: Later

LOCATION _____ TYPE _____

WFR. _____ AREA (IN²) _____

LOADING (PSI) ACTUAL _____ ALLOWABLE _____

GAS LOADING (LBS) _____ OPLG. SLIP LOAD (LBS) _____

OPLG. COEFF. FRICT. _____ OPLG. GEAR PITCH DIA. (IN) _____

BAL. PISTON COMPENSATING LOAD _____ LBS

☐ MAIN CONNECTIONS

	SIZE	AREA RATING	FACING	POSITION
INLET	14	150	RF	
DISCHARGE	10	300	RF	

☐ ALLOWABLE PIPING FORCES AND MOMENTS

	INLET		DISCHARGE			
	FORCE LB	MOMT LB	FORCE LB	MOMT LB	FORCE LB	MOMT LB
Later						
AXIAL						
VERTICAL						
HORIZ. SP						
AXIAL						
VERTICAL						
HORIZ. SP						

☐ 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 FLOW			
SRG. HOUSING			
BETWEEN SRG. & SEAL			
BETWEEN SEAL & GAS			
SOLVENT INJECTION			

REMARKS

ISSUED FOR PHASE C

CENTRIFUGAL COMPRESSOR DATA SHEET

0-252-12-10

VIBRATION DETECTORS

- ☐ TYPE Displacement ☐ MODEL _____
- ☐ MFR Bently Nevada or equal
- ☐ NO. AT EACH SHAFT BEARING _____ TOTAL NO. _____
- ☐ OSCILLATOR-DETECTORS SUPPLIED BY Comp. Mfr
- ☐ MFR B-N or equal ☐ MODEL _____
- ☐ MONITOR SUPPLIED BY Airco
- ☐ LOCATION Local Panel ENCLOSURE NEMA IV
- ☐ MFR B-N or equal ☐ MODEL _____
- ☐ SCALE RANGE _____ ☐ ALARM ☐ SET @ 3 MILS
- ☐ SHUTDOWN: ☐ SET @ _____ MILS ☐ TIME DELAY _____ SEC.

AXIAL MOVEMENT DETECTOR:

- ☐ TYPE _____ ☐ MODEL _____
- ☐ MFR _____ ☐ NO REQUIRED _____
- ☐ OSCILLATOR-DETECTORS SUPPLIED BY _____
- ☐ MFR _____ ☐ MODEL _____
- ☐ MONITOR SUPPLIED BY _____
- ☐ LOCATION _____ ENCLOSURE _____
- ☐ MFR _____ ☐ MODEL _____
- ☐ SCALE RANGE _____ ☐ ALARM ☐ SET @ _____ MILS
- ☐ SHUTDOWN: ☐ SET @ _____ MILS ☐ TIME DELAY _____ SEC.

COUPLINGS: Later

- | | DRIVER-COMP. OR
DRIVER-GEAR | GEAR-COMP. |
|---|--------------------------------|------------|
| ☐ MAKE | | |
| ☐ MODEL | | |
| ☐ LUBRICATION | | |
| ☐ MOUNT CPLG. HALVES | | |
| ☐ SPACER REQD. | | |
| ☐ LIMITED END FLOAT REQD. | | |
| ☐ ISOLING ADAPTOR REQD. | | |
| ☐ CPLG. RATING (HP/100 RPM) | | |
| ☐ KEYED (I) OR (O); OR HYDR. FIT | | |

BASEPLATE & SOLEPLATES

- SOLEPLATES FOR: ☐ COMPRESSOR ☐ GEAR ☐ DRIVER
- BASEPLATE:
- ☐ COMMON (UNDER COMP., GEAR & DRIVER)
- ☐ UNDER COMP. ONLY ☐ OTHER 1000
- ☐ 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

☐ TOTAL UTILITY CONSUMPTION:

COOLING WATER _____ GPM

STEAM, NORMAL _____ // HR

STEAM, MAX. _____ // HR

INSTRUMENT AIR _____ SCFM

HP (DRIVER) 5000 HP

HP (AUXILIARIES) Later HP

SHOP INSPECTION AND TESTS

- | | REC'D. | WITNESS |
|---|--------------------------|--------------------------|
| 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 PROBE, 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 | ☐ | ☐ |

REMARKS:

☐ WEIGHTS (LBS):

COMP. _____ GEAR _____ DRIVER _____ BASE _____

ROTORS: COMP. _____ DRIVER _____ GEAR _____

COMP. UPPER CASE _____

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

MAX. FOR MAINTENANCE IDENTIFY _____

TOTAL SHIPPING WEIGHT 120,000 LBS

☐ SPACE REQUIREMENTS (FEET & INCHES):

COMPLETE UNIT: L 35' W 18' H 12'

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 PLATS REQUIRED ON COMPRESSOR, GEAR & DRIVER _____
- ☐ PROVISION FOR WATER WASHING BEFORE OPENING CASING BY _____
- ☐ TORSIONAL ANALYSIS REPORT REQUIRED _____

REMARKS:

ISSUED FOR PAGE 0

ISSUED FOR PAGE 0

Airco Cryocoolants ELECTRIC MOTOR DATA SHEET

6-252-1Z-10

APPLICABLE FOR ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT	
FOR <u>Bechtel</u>	
UNIT <u>Hydrogen Purification Plant</u>	
SITE <u>Breckinridge Kentucky</u>	
DRIVEN EQUIP. <u>Centrifugal Compressor</u>	
SERVICE <u>Recycle Nitrogen Compressor Drive</u>	
NO. REQUIRED <u>1</u>	
MANUFACTURER <u>GE or equal</u> MODEL <u> </u> SERIAL NO. <u> </u>	
NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; ☐ BY MANUFACTURER	
MOTOR DESIGN DATA	
APPLICABLE SPECIFICATIONS	
☐ NEMA <u>Standards</u>	
☐ <u>Airco Cryocoolants 0-252-1Z-</u>	
SITE DATA	
AREA ☐ <u>620</u> OR ☐ DN. ☐ NONHAZARDOUS	
☐ ALTITUDE <u> </u> FT. ☐ AMBIENT TEMPS. MAX. <u> </u> °F, MIN. <u>-10</u> °F	
UNUSUAL CONDITIONS ☐ DUST ☐ FUMES	
☐ OTHER <u>Coal Processing Facility</u>	
DRIVE SYSTEM ☐ DIRECT CONNECTED	
☐ GEAR	
☐ OTHER <u>Integral Gear</u>	
TYPE MOTOR:	
☐ SQUIRREL CAGE INDUCTION ☐ NEMA DESIGN <u> </u>	
☐ SYNCHRONOUS	
☐ POWER FACTOR RECD. <u>1.0</u>	
EXCITATION ☐ BRUSHLESS ☐ SLIP RING	
☐ FIELD DISCHARGE RESISTOR BY MOTOR MFR.	
☐ WOUND ROTOR INDUCTION	
ENCLOSURE:	
☐ CLASS <u> </u> , GROUP <u> </u> , EXP. PROOF	
☐ TYPE	
☐ TEMPAC ☐ TEMP. USING <u> </u> GAS	
☐ DOUBLE WALL CARBON STEEL TUBES	
☐ WATER SUPPLY PRESS. <u> </u> PSIG TEMP. <u> </u> °F	
☐ WATER ALLOW. <u> </u> GPM PSIG & TEMP. RISE <u> </u> °F	
☐ WATER SIDE MIN. CORR. ALLOW. <u> </u> IN.	
☐ AND FOUL FACTOR <u> </u>	
☐ (AIR) GAS SUPPLY PRESS. <u> </u> PSIG	
☐ WEATHER PROTECTED, TYPE <u>II</u>	
☐ FORCED VENTILATED	
☐ OPEN-OR-PROOF	
☐ OPEN	
BASIC DATA:	
☐ <u>100</u> VOLTS <u>3</u> PHASE <u>60</u> HERTZ	
☐ NAMEPLATE NO. <u>5000</u> SERVICE FACTOR <u>1.0</u>	
☐ SYNCHRONOUS RPM <u>1800</u>	
☐ INSULATION CLASS <u>B</u> TYPE <u> </u>	
☐ TEMP. RISE <u> </u> °C ABOVE <u> </u> °C BY <u> </u>	
STARTING:	
☐ FULL VOLTAGE ☐ REDUCED VOLTAGE <u> </u> %	
☐ LOADED ☐ UNLOADED	
☐ VOLTAGE DFP <u> </u> %	
VIBRATION:	
☐ NEMA STANDARD ☐ <u> </u>	
NOISE:	
☐ NEMA STANDARD ☐ <u> </u>	
ACCESSORY EQUIPMENT	
☐ BASEPLATE ☐ SOLEPLATE ☐ STATOR SHRT.	
☐ MFR. STD. FANS ☐ NONSPARKING FANS	
☐ D.C. EXCITATION	
☐ KV RECD. <u>Later</u> VOLTS <u>Later</u>	
BY ☐ PURCHASER ☐ MANUFACTURER	
DESCRIPTION <u>Brushless</u>	
☐ ENCLOSED COLLECTOR RINGS	
☐ PURGED: MEDIUM <u> </u> PRESS. <u> </u> PSIG	
☐ EXPLOSION-RESISTANT NONPURGED	
☐ FORCED VENTILATION	
☐ CFM <u> </u> PRESS. DROP <u> </u> IN. H ₂ O	
☐ BEARING TEMP. DEVICES:	
☐ LOCATION <u> </u>	
☐ DESCRIPTION <u> </u>	
☐ SET <u> </u> °C FOR ALARM <u> </u> °C FOR SHUTDOWN	
☐ SPACE HEATERS:	
☐ <u> </u> KW <u> </u> VOLTS <u> </u> PHASE <u> </u> HERTZ	
☐ MAX. SHEATH TEMP. <u> </u> °C	
WINDING TEMPERATURE DETECTORS:	
☐ THERMISTORS NO./PHASE <u> </u>	
TYPE ☐ POS. TEMP. COEFF. ☐ NEG. TEMP. COEFF.	
TEMPERATURE SWITCH ☐ YES ☐ NO	
☐ RESISTANCE TEMPERATURE DETECTORS NO./PHASE <u>2</u>	
☐ RESISTANCE MATL. <u> </u> ☐ <u> </u> OHMS	
SELECTOR SWITCH & INDICATOR ST. ☐ PURCH. ☐ MFR.	
☐ MAX. STATOR WINDING TEMP.	
<u>11</u> °C FOR ALARM <u> </u> °C FOR SHUTDOWN	
WINDING TEMP. DETECTOR & SPACE HEATER LEADS:	
☐ IN SAME CONDUIT BOX	
☐ IN SEPARATE CONDUIT BOXES	
☐ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION	
☐ SELF-BALANCE PRIMARY CURRENT METHOD	
☐ C.T. DESCRIPTION <u> </u>	
☐ EXTENDED LEADS ☐ LENGTH <u> </u> FT.	
☐ SURGE CAPACITORS	
☐ LIGHTNING ARRESTERS	
☐ C.T. FOR AMMETER	
☐ DESCRIPTION <u> </u>	
MAIN CONDUIT BOX SIZED FOR:	
☐ MAIN MOTOR LEADS ☐ TYPE <u>Bus</u>	
☐ INSULATED ☐ NONINSULATED	
☐ C.T.'S FOR DIFF. PROTECTION INQUINITY BY <u>Mfr</u>	
☐ SURGE CAPACITORS INQUINITY BY <u>Mfr</u>	
☐ LIGHTNING ARRESTERS INQUINITY BY <u>Mfr</u>	
☐ C.T. FOR AMMETER INQUINITY BY <u>Mfr</u>	
☐ SPACE FOR STRESS CONES	
☐ AIR FILTERS	
☐ MFR. <u>later</u> ☐ TYPE <u>later</u>	
REMARKS: <u> </u>	

ISSUED FOR PHASE 3

SHEET 8 of 27

ELECTRIC MOTOR DATA SHEET

MANUFACTURER'S DATA		SHOP INSPECTION AND TESTS	
MANUFACTURER <u>Later</u>			
FRAME NO. _____	FULL LOAD RPM (INOJ) _____	SHOP INSPECTION	REQUIRED ○
EFFICIENCY: F.L. _____ 3/4L _____ V.L. _____		TESTING PER NEMA	○
POWER FACTOR (INOJ): F.L. _____ 3/4L _____ V.L. _____		MFR. STD. SHOP TESTS	○
CURRENT RATED VOLT: FULL LOAD _____ LOCKED ROTOR _____		IMMERSION TEST	○
LOCKED ROTOR POWER FACTOR _____		SPECIAL TESTS (LIST BELOW)	
LOCKED ROTOR WITHSTAND TIME (COLD START) _____			○
TORQUES (FT.-LBS): FULL LOAD _____			○
LOCKED ROTOR _____ STARTING (SYN) _____			○
PULL-UP (INOJ) _____ PULL-IN (SYN) _____			○
BREAKDOWN (INOJ) _____ PULL-OUT (SYN) _____			○
OPEN CIRCUIT TIME CONSTANT (SEC) _____		COUPLING	
SYMMETRICAL CONTRIBUTION TO 38 TERMINAL FAULT:		○ SUPPLIED BY <u>Compr. Mfr.</u>	
AT 1/2 CYCLES _____ AT 3 CYCLES _____		○ MFR. _____ ○ MODEL _____	
REACTANCES: SUB-TRANSIENT (X _d) _____		○ MOTOR MFR. ○ COMPR. MFR. ○ PURCH. TO MOUNT MTR. HALP	
TRANSIENT (X _d) _____ SYNCHRONOUS (X _s) _____		PAINTING	
AC STATOR RESISTANCE _____ OHMS @ _____ °C		○ MANUFACTURER'S STANDARD	
RATED KVA _____		○ _____	
KVA INRUSH @ FULL VOLT. & LOCKED ROTOR (SYN) _____ %		SHIPMENT	
KVA @ FULL VOLTAGE & 15% SPEED _____ %		○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQUIRED	
MAX. LINE CURR. IN STATOR ON 1ST SLIP CYC. @ PULL-OUT (SYN) _____		○ OUTDOOR STORAGE OVER 3 MONTHS	
ACCELERATION TIME (MOTOR ONLY @ RATED VOLT) _____ SEC.		○ _____	
ACCEL. TIME (MOTOR & LOAD @ 15% RATED VOLT) _____ SEC.		REMARKS	
ROTOR/FIELD W.K.'S MOTOR SHAFT (ILS-FT) _____		ISSUED FOR PHASE 1	
ROTATION FACING COUPLING END _____			
NO. OF STARTS PER HOUR _____			
FIELD DISCHARGE RESISTOR _____ OHMS			
RATED EXCITATION FIELD VOLTAGE _____ DC			
RESISTANCE OF EXCITATION FIELD @ 25°C _____ OHMS			
EXCITATION FIELD AMPS @ FULL LOAD & RATED P.F. _____			
EXCITATION FIELD AMPS MAX. _____ MIN. _____			
EXCITATION FIELD ☐ RHEOSTAT ☐ FIXED RESISTOR RECD.			
SUPPLIED BY _____			
BEARING: TYPE _____ LUBR. _____			
LUBE OIL REQUIRED: _____ GPM @ _____ PSI			
TOTAL SHAFT END FLOAT _____			
LIMIT END FLOAT TO _____			
MOTOR ROTOR ☐ SOLID ☐ SPLIT			
MOTOR HUB: ☐ SOLID ☐ SPLIT			
FOR TEWAC & TEMP MOTORS:			
COOLING WATER RECD. _____ GPM			
C.W. TEMP. RISE _____ °F PRESS. DROP _____ PSI			
AIR (GAS) RECD. _____ SCFM PRESS. MAINT. _____ IN. H ₂ O			
CURVES RECD. BASED ON MOTOR SATURATION @ RATED VOLTAGE:			
☐ SPEED VS TORQUE (ALSO @ _____ % RATED VOLTAGE)			
☐ SPEED VS POWER FACTOR			
☐ SPEED VS CURRENT			
WEIGHTS (LBS):			
NET WEIGHT _____ SHIPPING WEIGHT _____			
ROTOR WEIGHT _____ MAX. ERECTION WT. _____			
MAX. MAINT. WT. (IDENTIFY) _____			
DIMENSIONS (FEET & INCHES)			
L _____ W _____ H _____			

ISSUED FOR: PROCESS SPECIFICATION		NO. 0-252-12-11	
		REV.	
		EXPANDER/COMPRESSORS	
EQUIPMENT TITLE	Expander/Compressor	ITEM NO. 8-P-58	
CUSTOMER	Bechtel	JOB NO. 252-1200	
LOCATION	Breckinridge, Ky.	DATE 10/17/80	
QUANTITY	One	BY K. C.	APP'D BY
OPERATING CONDITIONS			
	COMPRESSOR	EXPANDER	
GAS HANDLED	Nitrogen	Nitrogen	
NORMAL FLOW RATE	17,623.7	6,665.4	SCFM*
NORMAL FLOW RATE	76,624.8	38,980.0	LB/HR
DESIGN FLOW RATE	19,386.0	7,332.0	SCFM*
DESIGN FLOW RATE	84,287.0	38,878.0	LB/HR
INLET TEMPERATURE	95.0	30.0	*F
INLET PRESSURE	492.0	685.0	PSIA
OUTLET TEMPERATURE	173.4	- 171.0	*F
OUTLET PRESSURE	700.0	55.0	PSIA
RELATIVE HUMIDITY	1PPM	1PPM	
MOL. WEIGHT @ INLET	28.0	28.0	
CP/CY @ INLET	1.40	1.40	
Z @ INLET	1.00	1.00	
EFFICIENCY	0.75	0.78	
THEO. - HP. / THEO. WORK	369.8	671.0	
BHP/ACTUAL WORK	493.0	523.0	
COOLING WATER AVAILABLE @		50	PSIG 85 *F
MAX. ALLOW. RISE ON COOLING WATER			15 *F
MISC. INFORMATION			
Shaft loss is assumed to be 30 BHP			
* MEASURED AT 14.7 PSIA & 70°F.			
WRITTEN BY	DATE	APPROVED	SHEET NO 10 OF 27

Airco Cryoplants RECIPROCATING COMPRESSOR DATA SHEET		0-252-17-20 (8K-10) JOB NO. <u>252</u> ITEM NO. <u>CP-10</u> PURCHASE ORDER NO. _____ REQUISITION NO. _____ INQUIRY NO. _____ PAGE NO. _____ BY <u>LPL</u>	
APPLICABLE TO: PROPOSALS ☐ PURCHASE ☐ AS BUILT ☐ DATE <u>2/27/81</u>			
FOR <u>Bechtel</u>		UNIT _____	
SITE <u>Breckinridge, Kentucky</u>		SERIAL NO. <u>—</u>	
SERVICE <u>Inert Waste Gas Compressor</u>		NO. REQ'D ONE	
MANUFACTURER <u>CES, IR, Worth or Equal</u>		RPM: MAX. <u>600</u>	RATED <u>400</u> MIN. <u>—</u>
TYPE <u>Balanced opposed reciprocating</u>			
DRIVER TYPE <u>E-Motor</u> DRIVER RATED HP. <u>400</u> DRIVER FURNISHED BY: ☐ COMPR MFR, ☐ —			

RATED OPERATING CONDITIONS (EACH MACHINE)

ITEM NO./SERVICE	<u>CP-10</u>		APPLICABLE SPECIFICATIONS ☐ API STANDARD 618 ☐ API STANDARD 615 ☐ Airco Spec.
STAGE	<u>1</u>	<u>2</u>	
GAS COMPRESSED	<u>Inert Waste</u>		
CORROSIVE DUE TO RELATIVE HUMIDITY	<u>—</u>		
MOL WGT. AT INTAKE	<u>15.63</u>		ACCESSORIES COMPR MFR SHALL FURNISH: ☐ PULSATION (DAMPERS) (VOLUME BOTTLES) ☐ INTERSTAGE PIPING ☐ INTERCOOLERS ☐ SEPARATE MOISTURE SEPARATORS W/TRAPS ☐ AFTERCOOLERS ☐ COOLING WATER PIPING, SINGLE INLET-OUTLET MANIFOLD ☐ INSTRUMENT PANEL ☐ SIGHT FLOW INDICATORS ☐ INTERCONNECTING UTILITY PIPING
C ₂ /C ₁ VALUE, AT SUCTION	<u>1.39</u>	<u>Avg.</u>	
C ₂ /C ₁ VALUE, AT DISCHARGE	<u>—</u>		
INLET TEMP, DEG F	<u>87</u>		
INLET PRESS., PSIA	<u>18.8</u>	<u>41.5</u>	NET WGT COMPLETE UNIT INCLUDING COMPR DRIVER AND BASEPLATE, LB <u>12,000</u> ERECTION WGT, LB <u>Later</u> MAINTENANCE WGT, LB _____ APPROX FLOOR SPACE: L <u>12'</u> W <u>17'</u> H <u>8'</u> ROD REMOVAL DISTANCE <u>5'</u>
DISCHARGE TEMP, DEG F			
DISCHARGE PRESS., PSIA	<u>42.3</u>	<u>92</u>	
Z AT SUCTION	<u>1.0</u>		
Z AT DISCHARGE	<u>1.0</u>		
CAPACITY—NORMAL			
LB PER HR, WET	<u>6368</u>	<u>6368</u>	
INLET CFM (Corrected)	<u>2126</u>	<u>995</u>	
MMSCFD PER SCFM	<u>2635</u>	<u>2635</u>	<u>(14.7 psia, 70°F)</u>
BRAKE HORSEPOWER/STAGE	<u>201</u>	<u>203</u>	
NORMAL BRAKE HORSEPOWER	<u>406</u>		
CAPACITY—RATED			
LB PER HR, WET	<u>6687</u>	<u>6687</u>	
INLET CFM (Corrected)	<u>2232</u>	<u>1045</u>	
MMSCFD PER SCFM	<u>2767</u>	<u>2767</u>	<u>(14.7 psia, 170°F)</u>
BRAKE HORSEPOWER/STAGE	<u>218</u>	<u>212</u>	
MAX. BRAKE HORSEPOWER (GUARANTEED)	<u>430</u>		

CAPACITY CONTROL

TO PERMIT OPERATION AT AN INLET CFM OF _____ POCKETS/VALVES OPEN _____ INLET PRESS., PSIA _____ DISCHARGE PRESS., PSIA _____ DISCHARGE TEMP, DEG F _____ BRAKE HORSEPOWER/STAGE _____ TOTAL BRAKE HORSEPOWER, _____	CAPACITY CONTROL SHALL BE BY: ☐ VARIABLE SPEED TO _____% RATED ☐ PURCHASERS BYPASS ☐ MFR STANDARD AUTOMATIC CONTROL ☐ START-STOP ☐ 2 STEP ☐ 3 STEP ☐ 5 STEP ☐ PILOTED BY REC PRESS. ☐ PILOTED BY PURCH INSTR W/ _____ PSIG AIR SIGNAL ☐ CLEARANCE POCKETS ☐ FIXED ☐ VARIABLE ☐ MANUAL ☐ AUTOMATIC ☐ SUCTION VALVE UNLOADING ☐ MANUAL ☐ AUTOMATIC ON AIR/POWER FAILURE COMPR SHALL: ☐ UNLOAD ☐ LOAD	TO PERMIT OPERATION AT AN INLET CFM OF _____ POCKETS/VALVES OPEN _____ INLET PRESS., PSIA _____ DISCHARGE PRESS., PSIA _____ DISCHARGE TEMP, DEG F _____ BRAKE HORSEPOWER/STAGE _____ TOTAL BRAKE HORSEPOWER, _____										
	REVISIONS <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>NO</th> <th>DATE</th> <th>BY</th> <th>CHK'D</th> <th>APPR</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	NO	DATE	BY	CHK'D	APPR						JOB NO. _____ SPEC. DES GUIDE NO. _____ REV. _____
NO	DATE	BY	CHK'D	APPR								

0-252-12-20

RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. 252 ITEM NO. CP-10
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 PAGE NO. _____ BY LPL
 DATE 2/27/81

CYLINDER DATA		COMPRESSOR PACKING	
ITEM NO./SERVICE	<u>CP-10</u>	☐ STANDARD FIBROUS ☐ FULL-FLOATING VENTED METALLIC PACKING W/STAINLESS STEEL SPRINGS ☐ FORCED-FEED LUBRICATED ☐ NONLUBRICATED ☐ TEFLON ☐ CARBON ☐ WATER-COOLED VENTED TO <u>Suction 1st Stage</u>	
STAGE	<u>1 2</u>	DISTANCE PIECE	
NO. OF CYL PER STAGE	<u>2 2</u>	☐ STANDARD ☐ EXTRA LONG SINGLE COMPARTMENT ☐ TWO COMPARTMENT ☐ SOLID COVER ☐ OPEN	
TYPE CYLINDER	<u>Liner</u>	LUBRICATION	
SINGLE/DOUBLE ACTING	<u>DA DA</u>	FRAME	
CYLINDER LINER, YES/NO	<u>yes yes</u>	☐ SPLASH SYSTEM ☐ PRESSURE SYSTEM, INCLUDING THE FOLLOWING: ☐ OIL PUMP DRIVEN BY COMPR SHAFT ☐ OIL PUMP DRIVEN BY ELECTRIC MOTOR ☐ HAND-OPERATED PUMP FOR STARTING SYSTEM OIL CAPACITY <u>35</u> GAL	
CYLINDER LINER, WET/DRY	<u>dry dry</u>	TYPE OIL _____ GRADE _____	
OD LINER, IN.	<u>Later</u>	☐ ELECTRIC HEATER W/THERMOSTAT <u>2.0</u> KW	
BORE, IN.	<u>20 14</u>	CYLINDERS	
STROKE, IN.	<u>9 9</u>	LUBRICATOR TO BE-DRIVEN BY:	
PISTON DISPLACEMENT, CFM	<u>2416 1130</u>	☐ COMPRESSOR SHAFT ☐ ELECTRIC MOTOR LUBRICATOR CAPACITY _____ QT	
CLEARANCE, %	<u>9 8</u>	TYPE OIL _____ GRADE _____	
VOLUMETRIC EFFICIENCY, %	<u>11.8 16.2</u>	LUBRICATOR ALSO TO BE EQUIPPED WITH:	
AVG VALVE GAS VELOCITY, FPM	<u>6000 6000</u>	☐ STEAM COIL ☐ ELECTRIC HEATER W/THERMOSTAT <u>0.5</u> KW	
NO. OF INLET-OUTLET VALVES	<u>8/6 6/4</u>	NO. OF COMPARTMENTS _____ NO. OF PUMPS _____	
TYPE OF VALVES	<u>Plate</u>	COUPLING <u>LOW SPEED</u>	
MAX. ALLOW. PISTON SPEED, FPM	<u>900</u>	MFR _____ MODEL _____	
NORMAL PISTON SPEED, FPM	<u>600</u>	TYPE _____	
ROD DIAMETER, IN.	<u>2-1/4 2-1/4</u>	COUPLING <u>HIGH SPEED</u>	
MAX. ALLOW. ROD LOADING, T	<u>15,000 15,000</u>	MFR _____ MODEL _____	
MAX. ALLOW. ROD LOADING, C	<u>7215 7410</u>	TYPE _____	
RATED ROD LOADING, T	<u>7460 7940</u>	AIR INTAKE FILTER	
RATED ROD LOADING, C	<u>60 150</u>	MFR _____ MODEL _____	
MAX. ALLOW. CYL PRESS, PSIG	<u>450 450</u>	TYPE _____	
MAX. ALLOW. CYL TEMP, DEG F	<u>Later</u>		
SUCTION VOLUME BOTTLE, CU FT	<u>Later</u>		
DISCHARGE VOLUME BOTTLE, CU FT	<u>50 120</u>		
RECOM RELIEF VALVE, PSIG	<u>90 225</u>		
HYDROSTATIC TEST, PSIG	<u>12-150 8-150</u>		
SUCTION SIZE: RATING	<u>FF FF</u>		
FACING	<u>FF FF</u>		
DISCHARGE SIZE: RATING	<u>12-150 8-150</u>		
FACING	<u>FF FF</u>		
COMPRESSOR MATERIALS			
CYLINDERS	<u>CI CI</u>		
CYLINDER LINERS	<u>CI CI</u>		
PISTONS	<u>CI CI</u>		
PISTON RINGS	<u>SS SS</u>		
PISTON RODS	<u>CI CI</u>		
VALVE SEATS	<u>CI CI</u>		
VALVE STOPS	<u>SS SS</u>		
VALVE PLATES	<u>SS SS</u>		
VALVE SPRINGS	<u>SS SS</u>		
REMARKS _____			

RECIPROCATING COMPRESSOR DATA SHEET (Cont'd)

JOB NO. _____ ITEM NO. _____

PURCHASE ORDER NO. _____

REQUISITION NO. _____

PAGE NO. _____ BY _____

DATE _____

SITE DATA (see

ALTITUDE 420 FT BAROMETER 14.5 PSIADESIGN TEMP, DEG 100 SUMMER -10 WINTER MIN.

DESIGN WET BULB TEMP, DEG F _____

COOLING WATER

PRESS. PSIG 50 SUPPLY 40 RETURNTEMP, DEG F 85 SUPPLY 105 RETURN MAX.

ELECTRIC POWER

500 HP & OVER 4160 VOLTS 3 PH 60 CYCLES

_____ HP to _____ HP _____ VOLTS _____ PH _____ CYCLES

_____ HP & LESS _____ VOLTS _____ PH _____ CYCLES

AUXILIARY MOTORS

☐ TEFC ☐ EXP PROOF ☐ DRIP PROOF☐ OPEN ☐ _____

INSULATION TYPE _____ CLASS _____

EQUIPMENT SHALL BE SUITABLE FOR:

☐ INDOORS ☐ HEATED ☐ UNHEATED☐ OUTDOORS ☐ UNDER ROOF ☐ WITHOUT ROOF

STEAM SUPPLY

NORMAL PRESS. _____ PSIG @ _____ FT

MIN. PRESS. _____ PSIG @ _____ FT

INSTRUMENT AIR SUPPLY _____ PSIG

STEAM EXHAUST

NORMAL PRESS. _____ PSIG @ _____ FT

MAX. PRESS. _____ PSIG @ _____ FT

FUEL GAS: NORMAL PRESS _____ PSIG @ _____ F

HEATING VALUE, BTU PER CU FT _____ LHV _____ HHV

QUANTITY H.S. _____ GRAINS PER 100 CU FT

STARTUP FUEL SEE GAS ANALYSIS DATA SHEET

UTILITY CONSUMPTION

ELECTRIC _____ HP _____ LOCKED _____ FULL LOAD _____

MAIN DRIVER 500 ROTOR AMPS _____ AMPSMAIN LUBE OIL PUMP Incl _____

STARTING AIR COMPR _____

M.G. SET _____

MECH LUBRICATOR _____

Sump Heater 2000 watts _____LUBRICATOR HEATER 500 WATTS _____ VOLTS _____ PH

SPACE HEATER _____ WATTS _____ VOLTS _____ PH

STEAM _____

MAIN DRIVER _____ #/HR _____ PSIG _____ FT to _____ PSIG

LUBR HEATER _____ #/HR _____ PSIG _____ FT to _____ PSIG

_____ #/HR _____ PSIG _____ FT to _____ PSIG

FUEL GAS—MAIN DRIVER NORMAL FUEL

RATED RPM, % 100 75 50

BTU/HP/HR _____

TOTAL BTU/HR _____

COOLING WATER _____

_____ COMPR _____ LO. _____ TURBO _____ ENG _____

CYL _____ COOLER _____ COOLER _____ JKT _____ COOLER _____

TYPE WATER _____

QUANTITY, GPM _____

INLET TEMP, DEG F 85 _____OUTLET TEMP, DEG F 105 _____PRESS. DROP, PSIG 10 _____MAX. PRESS. PSIG 60 _____TOTAL C.W., GPM 110 Total _____

ALARMS AND SHUTDOWNS

INSPECTION AND SHOP TESTS

☐ SHOP INSPECTION BY PURCHASER DURING CONSTRUCTION☐ MANUFACTURERS STANDARD SHOP TESTS☐ BARRING OVER TO CHECK CLEARANCES☐ RUNNING TEST WITH SHOP DRIVER☐ RUNNING TEST WITH SHOP FUEL AT RATED LOAD☐ HELIUM LEAK TEST ON COMPR CYL☐ OTHER TESTS _____

PURCHASER SHALL WITNESS THE FOLLOWING:

☐ HYDROSTATIC TEST ☐ MECH RUN TEST☐ PERFORMANCE TEST ☐ AUX EQUIP. OPER TEST☐ DISMANTLE-REASSEMBLY INSPECTION☐ HELIUM LEAK TEST

COMPR MFR SHALL FURNISH CONTACTS FOR:

LUBE OIL PRESS. _____ ALARM _____ SHUTDOWN _____

LOW MECH LUBR OIL LEVEL _____

HIGH COMP J.W. TEMP _____

HIGH ENG J.W. TEMP _____

HIGH GAS DISCH TEMP _____

HIGH VIBRATION _____

REMOTE SHUTDOWN: ☐ ELECTRONIC ☐ PNEUMATIC☐ HYDRAULIC

ALARM CONTACTS SHALL:

☐ OPEN ☐ CLOSE TO SOUND ALARM

SHUTDOWN CONTACTS SHALL:

☐ OPEN ☐ CLOSE TO SHUTDOWN

CONTROL CURRENT _____ VOLTS _____ PHASE _____ CYCLES

SWITCH ENCLOSURE ☐ EXP PROOF ☐ WEATHERPROOF

REMARKS

JOB NO. 252 ITEM NO. CP-10
PURCHASE ORDER NO. _____
REQUISITION NO. _____
PAGE NO. _____ BY LPL
DATE 2/27/81

MOTOR DATA SHEET		JOB NO. <u>252</u> ITEM NO. <u>CP-10</u>
		PURCHASE ORDER NO. _____
		REQUISITION NO. _____
		PAGE NO. _____ BY <u>LPL</u>
		DATE _____
MOTOR DESIGN DATA DRIVE SYSTEM: ☐ DIRECT CONNECTED ☐ GEAR REDUCER ☐ V-BELTS CURRENT CONDITIONS <u>4160</u> VOLTS <u>3</u> PHASE <u>60</u> CYCLES TYPE MOTOR: ☐ SQUIRREL CAGE IND NEMA DESIGN ☐ SYNCHRONOUS ☐ WOUND ROTOR INDUCTION ENCLOSURE: ☐ CLASS 1, GROUP D, EXP PROOF ☐ TEFC/TEFY ☐ WEATHER PROTECTED (I) (II) ☐ FORCED VENTILATED ☐ OPEN-DRIPPROOF NAMEPLATE HORSEPOWER <u>500</u> SERVICE FACTOR <u>1.0</u> SITE ALTITUDE <u>420</u> SYNCHRONOUS, RPM <u>400</u> POWER FACTOR REQ'D <u>1.0</u> INSULATION CLASS <u>B</u> TYPE _____ TEMPERATURE RISE, DEG C <u>80</u> SYN MOTOR ROTOR: ☐ SOLID ☐ SPLIT SYN MOTOR HUB: ☐ SOLID ☐ SPLIT STARTING: ☐ FULL VOLTAGE ☐ UNLOADED ☐ LOADED ☐ REDUCED VOLTAGE _____% TRANSMISSION EQUIPMENT ☐ SPEED-REDUCING GEAR <u>None</u> ☐ INTEGRAL ☐ SEPARATE MFR _____ SIZE & TYPE _____ MAX. CONT HP RATING _____ AGMA SERVICE FACTOR _____ RATIO _____ MECH EFFICIENCY _____ ☐ PRESSURE LUBE ☐ SPLASH LUBE ☐ V-BELTS AND V-BELT SHEAVES ☐ STATIC CONDUCTING ☐ GUARD REQUIRED WEIGHTS AND DIMENSIONS MOTOR: NET WGT. <u>Later</u> MAX. ERECTION WGT. _____ HEIGHT _____ FLOOR SPACE: L _____ W _____ H _____ GEAR: NET WGT. _____ MAX. ERECTION WGT. _____ MAX. MAINT WGT. _____ FLOOR SPACE: L _____ W _____ H _____	MANUFACTURERS DATA MFR <u>GE or Equal</u> FRAME NO. _____ FULL LOAD RPM _____ EFFICIENCY: F.L. <u>3/4</u> <u>1/2</u> POWER FACTOR: F.L. <u>3/4</u> <u>1/2</u> CURRENT: FULL LOAD _____ LOCKED ROTOR _____ FULL-LOAD TORQUE, FT-LB _____ STARTING TORQUE, FT-LB _____ PULL-OUT TORQUE, FT-LB _____ ACCELERATION TIME _____ SEC ROTATION FACING COUPLING END _____ NUMBER CONSECUTIVE STARTS _____ FIELD DISCHARGE RESISTOR _____ OHMS BEARINGS, TYPE _____ LUBR _____ TOTAL SHAFT END FLOAT _____ LIMIT END FLOAT TO _____ ACCESSORY EQUIPMENT ☐ BASEPLATE ☐ SOLEPLATE ☐ STATOR SHIFT FOR _____ ☐ SPACE HEATERS: KW _____ VOLTS _____ PHASE _____ CYCLES ☐ RESISTANCE TEMPERATURE DETECTORS NUMBER _____ RESISTANCE MAT'L _____ SELECTOR SWITCH AND INDICATOR BY: ☐ PURCHASER R.T.D.'S SET @ _____ C ☐ MFR ☐ D.C. EXCITATION KW REQ'D <u>6.5</u> VOLTS _____ BY: ☐ PURCHASER ☐ MANUFACTURER DESCRIPTION _____ ☐ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION ☐ EXTENDED LEADS LENGTH _____ FT ☐ ENCLOSED COLLECTOR RINGS ☐ PURGED MEDIUM _____ PRESS. _____ PSIG ☐ EXPLOSION-RESISTANT NONPURGED ☐ FORCED VENTILATION CFM _____ PRESS. DROP _____ IN. H₂O CONDUIT BOX SIZED FOR: ☐ R.T.D.'S IN SEPARATE BOX ☐ MAIN MOTOR LEADS ☐ C.T.'S FOR DIFF PROTECTION ☐ SURGE PROTECTION	
REMARKS _____		

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APPLICABLE TO: ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT		DATE: <u>2/27/81</u>	REVISION: _____
FOR: <u>Bechtel</u>		UNIT: <u>Cryo H₂ Plant</u>	SERIAL NO.: _____
SITE: <u>Breckinridge Kentucky</u>		NO. REQUIRED: <u>one</u>	DRIVER: <u>Elec Motor</u>
SERVICE: <u>Heavy Hydrocarbon Compressor CP-20 (9K-20)</u>		NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; ☐ BY MANUFACTURER	
MANUFACTURER: <u>Dresser-Clark</u>		MODEL: <u>2M8</u>	<u>0-252-12-23</u>

(ALL DATA ON PER UNIT BASIS)		OPERATING CONDITIONS				
	NORMAL	RATED	OTHER CONDITIONS			
			A	B	C	D
☐ GAS HANDLED (ALSO SEE PAGE <u>30</u>)						
☐ KWH/ICFM (14.7 PSIA 25°C DRY) (70°F)		13.870				
☐ WEIGHT FLOW, LBS/H (MET) (DRY)		1.200				
INLET CONDITIONS						
☐ PRESSURE (PSIA)		24.0				
☐ TEMPERATURE (°F)		23				
☐ RELATIVE HUMIDITY (%)		1 ppm				
☐ MOLECULAR WEIGHT (MW)		33.4				
☐ C _p /C _v (K) OR (R _{avg})		1.22				
☐ COMPRESSIBILITY (Z ₁) OR (Z _{avg})		1.0				
☐ INLET VOLUME, (ICFM) (MET)		7.741				
DISCHARGE CONDITIONS						
☐ PRESSURE (PSIA)		365				
☐ TEMPERATURE (°F)		100	Out Aftercooler			
☐ C _p /C _v (K) OR (R _{avg})		1.22				
☐ COMPRESSIBILITY (Z ₂) OR (Z _{avg})		1.0				
☐ SHP REQUIRED (ALL LOSSES INCL)		3.860				
☐ SPEED (RPM)						
☐ ESTIMATED SURGE, ICFM (AT SPEED ABOVE)						
☐ POLYTROPIC HEAD (FT)						
☐ POLYTROPIC EFFICIENCY (%)						
☐ GUARANTEE POINT						
☐ PERFORMANCE CURVE NO.						

PROCESS CONTROL	
METHOD: ☐ BYPASS FROM <u>Aftercooler Outlet</u>	TO <u>Suction</u>
☐ ANTI-SURGE BYPASS ☐ MANUAL ☐ AUTO	
☐ SUGGESTION THROTTLING FROM _____ TO _____	
☐ SPEED VARIATION FROM _____ TO _____	
☐ OTHER _____	
SERIAL: ☐ SOURCE _____	
☐ TYPE _____	
☐ RANGE: FOR PNEUMATIC CONTROL _____ RPM @ _____ PSIA _____ RPM @ _____ PSIA	
OTHER _____	

REMARKS: _____

REVIEWED FOR PRICE 0 ESTIMATE

NO.	DATE	REVISIONS	BY	CHKD	DESIGN SUPV	ENG. #	PROJ. CHG	APPR
SCALE		DESIGNED	DRAWN		CHIEF ENG			
ORDER		CENTRIFUGAL COMPRESSOR DATA SHEET				JOB NO.		
						DRAWING NO.		
						DS-		

CENTRIFUGAL COMPRESSOR DATA SHEET

O-252-12-23

GAS ANALYSIS		NORMAL	RATED	OTHER CONDITIONS				REMARKS
☐ MOL %	☐ M.W.			A	B	C	D	
AIR	28.944							
OXYGEN	32.000							
NITROGEN	28.016		1.0					
WATER VAPOR	18.016							
CARBON MONOXIDE	28.010		1.45					
CARBON DIOXIDE	44.010							
HYDROGEN SULFIDE	34.076							
HYDROGEN	2.016		2.78					
METHANE	16.042		13.05					
ETHYLENE	28.052							
ETHANE	30.068		89.12					
PROPYLENE	42.078							
PROPANE	44.094		42.04					
I - BUTANE	58.120							
S - BUTANE	58.120		0.56					
I - PENTANE	72.146							
S - PENTANE	72.146							
HEXANE PLUS								
TOTAL			100.0					
AVG. MOL. WT.			33.4					

LOCATION ☐ INDOOR ☐ HEATED ☐ UNDER ROOF ☐ OUTDOOR ☐ UNHEATED ☐ PARTIAL SIDES ☐ GRADE ☐ MEZZANINE ☐ _____ ☐ ELECTRICAL AREA CLASS 1 OR <u>D</u> DIV. <u>2</u> ☐ WINTERIZATION REQ. ☐ TROPICALIZATION REQ. SITE DATA - SEE 14222-A-3 ☐ ELEVATION _____ FT. BAROMETER _____ PSIA ☐ RANGE OF AMBIENT TEMP. _____		NOISE SPECIFICATIONS ☐ APPLICABLE TO MACHINE: SEE SPECIFICATION <u>Airco Spec.</u> ☐ APPLICABLE TO NEIGHBORHOOD SEE SPECIFICATION _____ ACOUSTIC HOUSING: ☐ YES ☐ NO <u>Quote Option</u>
APPLICABLE SPECIFICATIONS API 617 CENTRIFUGAL COMP. FOR GEN. REFINERY SERVICES		
PAINTING ☐ MANUFACTURER'S STD. ☐ OTHERS _____		
SHIPMENT ☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING REQ. ☐ OUTDOOR STORAGE OVER 3 MONTHS		

UNUSUAL CONDITIONS ☐ DUST ☐ FUMES ☐ OTHER <u>Coal Processing Facility</u>
TEMPERATURES DRY BULB WET BULB SITE RATED °F _____ NORMAL °F <u>96</u> <u>78</u> MAXIMUM °F <u>110</u> MINIMUM °F <u>-10</u>

REMARKS _____ _____ _____ _____ _____

CENTRIFUGAL COMPRESSOR DATA SHEET

O-252-12-23

CONSTRUCTION FEATURES

☐ SPEEDS Later
MAX. CONT. _____ RPM _____ TRIP _____ RPM
CRITICALS 1ST _____ RPM 2ND _____ RPM
MAX. TRIP SPEED: _____ FPS @ RATED SPEED
_____ FPS @ MAX. CONT. SPEED

☐ ROTATION, VIEWED FROM DRIVEN END

☐ CASING

MODEL 2M8
CASING SPLIT Horizontal
MATERIAL Cast Steel

THICKNESS (IN) _____ CORR. ALLOW. (IN) _____
MAX. WORK. PRESS. _____ PSI MAX. DESIGN PRESS. _____ PSI
TEST PRESS (PSIG) HELIUM HYDRO
MAX. OPER. TEMP. _____ °F MIN. OPER. TEMP. _____ °F
MAX. NO. OF IMPELLERS FOR CASING _____
MAX. CASING CAPACITY (ICFPM) _____
RADIOGRAPH QUALITY ☐ YES ☐ NO

☐ DIAPHRAGMS

MATERIAL _____

☐ IMPELLERS Later

NO. 8 DIAMETERS _____

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 Alloy Steel

DIA. @ IMPELLERS (IN) _____ DIA. @ COUPLING (IN) _____

SHAFT END: ☐ TAPERED ☐ CYLINDRICAL

SHAFT SLEEVE

☐ AT INTERF. CLOSE CLEAR. PTL. ☐ MATL. _____

☐ AT SHAFT SEALS _____ ☐ MATL. _____

☐ LASTRONTIN

TYPE _____ MATERIAL _____

SHAFT SEALS

☐ TYPE _____

☐ SEAL SYSTEM TYPE Vendor Std

☐ INNER OIL LEAKAGE GUAR. (GAL/DAY/SEAL) _____

☐ TYPE BUFFER GAS N₂ Available

☐ BUFFER GAS FLOW (PCF SEALS)

NORMAL _____ SCFH @ _____ PSI ΔP

MAX. _____ SCFH @ _____ PSI ΔP

REMARKS _____

☐ BEARING HOUSING CONSTRUCTION

TYPE (SEPARATE, INTEGRAL) _____ SPLIT _____

MATERIAL _____

☐ RADIAL BEARINGS

TYPE _____ SPAN (IN) _____

AREA (IN²) _____ LOADING (PSI) ACT. _____ ALLOW. _____

☐ THRUST BEARING

LOCATION _____ TYPE _____

NO. _____ AREA (IN²) _____

LOADING (PSI) ACTUAL _____ ALLOWABLE _____

GAS LOADING (LBS) _____ CPG. SLIP LOAD (LBS) _____

CPG. COEFF. FRICT. _____ CPG. GEAR PITCH DIA. (IN) _____

BAL. PISTON COMPENSATING LOAD _____ LBS

☐ MAIN CONNECTIONS

	SIZE	AREA RATING	FACING	POSITION
INLET	12			
DISCHARGE	8			

☐ ALLOWABLE PIPING FORCES AND MOMENTS Later

	INLET		DISCHARGE			
	FORCE LB	MOMT LB	FORCE LB	MOMT LB	FORCE LB	MOMT LB
AXIAL						
VERTICAL						
HORIZ. SP						
AXIAL						
VERTICAL						
HORIZ. SP						

☐ OTHER CONNECTIONS

SERVICE	NO.	SIZE	TYPE
LUBE OIL INLET			<u>Later</u>
LUBE OIL OUTLET			
SEAL OIL INLET			
SEAL OIL OUTLET			
CASING DRAINS			
STAGE DRAINS			
VENTS			
COOLING WATER			
PRESSURE			
TEMPERATURE			
PURGE FLOW			
DRG. HOUSING			
BETWEEN DRG. & SEAL			
BETWEEN SEAL & GAS			
SOLVENT INJECTION			

CENTRIFUGAL COMPRESSOR DATA SHEET

0-252-12-23

VIBRATION DETECTORS

- ☐ TYPE Displacement ☐ MODEL _____
- ☐ MFR Bently Nevada or Equal
- ☐ NO. AT EACH SHAFT BEARING 2 TOTAL NO. 4
- ☐ OSCILLATOR-DETECTORS SUPPLIED BY Vendor
- ☐ MFR _____ ☐ MODEL _____
- ☐ MONITOR SUPPLIED BY Airco
- ☐ LOCATION Panel ENCLOSURE _____
- ☐ MFR N-N or Equal ☐ MODEL _____
- ☐ SCALE RANGE _____ ALARM ☐ SET @ Later MILS
- ☐ SHUTDOWN: ☐ SET @ Later MILS ☐ TIME DELAY _____ SEC.

AXIAL MOVEMENT DETECTOR:

- ☐ TYPE Displacement ☐ MODEL _____
- ☐ MFR B-N or Equal ☐ NO REQUIRED 1
- ☐ OSCILLATOR-DETECTORS SUPPLIED BY Vendor
- ☐ MFR B-N or Equal ☐ MODEL _____
- ☐ MONITOR SUPPLIED BY Airco
- ☐ LOCATION Panel ENCLOSURE _____
- ☐ MFR B-N or Equal ☐ MODEL _____
- ☐ SCALE RANGE _____ ALARM ☐ SET @ _____ MILS
- ☐ SHUTDOWN: ☐ SET @ _____ MILS ☐ TIME DELAY 3 SEC.

COUPLINGS:

- | | DRIVER-COMP. OR
DRIVER-GEAR | GEAR-COMP. |
|---|--------------------------------|------------|
| ☐ MAKE | <u>Vendor Std.</u> | |
| ☐ MODEL | | |
| ☐ LUBRICATION | <u>Vendor to Advise</u> | |
| ☐ MOUNT CPLG. HALVES | | |
| ☐ SPACER REQD. | | |
| ☐ LIMITED ENG. FLOAT REQD. | | |
| ☐ IDLING ADAPTOR REQD. | | |
| ☐ CPLG. RATING (HP/100 RPM) | | |
| ☐ KEYED (IN OR OUT) OR NYLON FIT | | |

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 RM ☐ WITH OPEN DRAIN
- ☐ HORIZ. ADJUSTING SCREWS FOR EQUIPMENT
- ☐ SUITABLE FOR POINT SUPPORT
- ☐ SUITABLE FOR PERIMETER SUPPORT

TOTAL UTILITY CONSUMPTION:

COOLING WATER 980 GPM

STEAM, NORMAL _____ HP

STEAM, MAX. _____ HP

INSTRUMENT AIR _____ SCFM

HP (DRIVER) 4500 HP

HP (AUXILIARIES) Later HP

SHOP INSPECTION AND TESTS

	REQD.	WITNESS
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 SYL.	☐	☐
USE JOB LUBE & SEAL SYL.	☐	☐
USE SHOP VIBRATION PROBE, ETC.	☐	☐
USE JOB VIB. & AXIAL DISP. PROBE,	☐	☐
OSCILLATOR-DETECTORS & MONITOR	☐	☐
PRESSURE COMP. TO FULL OPER. PRESS.	☐	☐
DISASSEMBLE-REASSEMBLE COMP. AFTER TEST	☐	☐
CHECK BRGS & SEALS AFTER TEST	☐	☐
NOISE LEVEL TEST	☐	☐

REMARKS:

☐ WEIGHTS (LBS): 77,000 Total

COMP. 11,000 GEAR _____ DRIVER _____ BASE _____

ROTOR: COMP. _____ DRIVER _____ GEAR _____

COMP. UPPER CASE _____

L.O. CONSOLE 21,000 L.O. CONSOLE _____

MAX. FOR MAINTENANCE (IDENTIFY) _____

TOTAL SHIPPING WEIGHT 98,000

SPACE REQUIREMENTS (FEET & INCHES):

COMPLETE UNIT: L 24' W 10' H 8'

L.O. CONSOLE: L 24' W 10' H 6'

L.O. CONSOLE: L _____ W _____ H _____

MISCELLANEOUS:

- ☐ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETERS BEFORE SUCTION Later
- ☐ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION
- ☐ OPTICAL ALIGNMENT PLATS REQUIRED ON COMPRESSOR, GEAR & DRIVER
- ☐ PROVISION FOR WATER WASHING BEFORE OPENING CASING BY _____
- ☐ TORSIONAL ANALYSIS REPORT REQUIRED

REMARKS:

ELECTRIC MOTOR DATA SHEET

0-252-12-23

APPLICABLE TO ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT.FOR Bechtel

UNIT

SITE Breckinridge, KentuckyDRIVEN EQUIP. Centrifugal Comp.SERVICE CP-20 Heavy H.C. Comp.NO. REQUIRED oneMANUFACTURER GE or Equal MODEL

SERIAL NO.

NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER☐ BY MANUFACTURER

MOTOR DESIGN DATA

APPLICABLE SPECIFICATIONS

☐ NEMA Airco Spec.

SITE DATA

AREA ☐ CL one ☐ GR. D ☐ SW. 2 ☐ NONHAZARDOUSALTITUDE 420 FT. ☐ AMBIENT TEMP. MAX. 105 MIN. -10UNUSUAL CONDITIONS ☐ DUST ☐ FUMES☐ OTHER

DRIVE SYSTEM

☐ DIRECT CONNECTED☐ GEAR☐ OTHER

TYPE MOTOR

☐ SCRAMBLER CAGE INDUCTION ☐ NEMA DESIGN☐ SYNCHRONOUS☐ POWER FACTOR RECD. 1.0EXCITATION ☐ BRUSHLESS ☐ SLP RING☐ FIELD DISCHARGE RESISTOR BY MOTOR MFR.☐ WOUND ROTOR INDUCTION

ENCLOSURE

☐ CLASS , GROUP , EXP. PROOF☐ TENV☐ TENVAC ☐ TENV, USING N₂ GAS☐ DOUBLE WALL CARBON STEEL TUBES☐ W/ILN SUPPLY PRESS. 50 PSIG TEMP. 85 °F☐ WATER ALLOW. ΔP 10 PSI & TEMP. RISE 30 °F☐ WATER SIDE MIN. CORR. ALLOW. IN.AND FOUL FACTOR 0.003☐ (AIR) (GAS SUPPLY PRESS. PSIG)☐ WEATHER PROTECTED, TYPE ☐ FORCED VENTILATED☐ OPEN-DRIP-PROOF☐ OPEN

BASIC DATA

☐ 4100 VOLTS 3 PHASE 60 HERTZ☐ NAMEPLATE HP 45,000 SERVICE FACTOR 1.0☐ SYNCHRONOUS RPM 1200☐ INSULATION CLASS B TYPE ☐ TEMP. RISE 80 °C ABOVE 40 °C BY Resistance

STARTING

☐ FULL VOLTAGE ☐ REDUCED VOLTAGE %☐ LOADED ☐ UNLOADED☐ VOLTAGE DIP %

VIBRATION

☐ NEMA STANDARD☐ NEMA STANDARD

ACCESSORY EQUIPMENT

☐ BASEPLATE ☐ SOLEPLATE ☐ STATOR SHUNT☐ MFR. STD. FANS ☐ NONSPARKING FANS☐ D.C. EXCITATION☐ KW REQ. VOLTS BY ☐ PURCHASER ☐ MANUFACTURERDESCRIPTION Brushless☐ ENCLOSED COLLECTOR RINGS☐ PURGED: MEDIUM PRESS. PSIG☐ EXPLOSION-RESISTANT NONPURGED☐ FORCED VENTILATION☐ CFM PRESS. DROP IN. H₂O☐ BEARING TEMP. DEVICES☐ LOCATION ☐ DESCRIPTION ☐ SET °C FOR ALARM °C FOR SHUTDOWN☐ SPACE HEATERS☐ KW 460 VOLTS 3 PHASE 60 HERTZ☐ MAX. SHEATH TEMP. °C

WINDING TEMPERATURE DETECTORS

☐ THERMISTORS NO/PHASE TYPE ☐ POS. TEMP. COEFF. ☐ NEG. TEMP. COEFF.TEMPERATURE SWITCH ☐ YES ☐ NO☐ RESISTANCE TEMPERATURE DETECTORS NO/PHASE 2☐ RESISTANCE MATL. ☐ OHMSSELECTOR SWITCH & INDICATOR BY ☐ PURCH. ☐ MFR.☐ MAX. STATOR WINDING TEMP. °C FOR ALARM °C FOR SHUTDOWN

WINDING TEMP. DETECTOR & SPACE HEATER LEADS

☐ IN SAME CONDUIT BOX☐ IN SEPARATE CONDUIT BOXES☐ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION☐ SELF-BALANCE PRIMARY-CURRENT METHOD☐ C.T. DESCRIPTION ☐ LATHEAD LEADS ☐ LENGTH FT.☐ SURGE CAPACITORS☐ LIGHTNING ARRESTERS☐ C.T. FOR AMMETER☐ DESCRIPTION

MAIN CONDUIT BOX SIZED FOR:

☐ MAIN MOTOR LEADS ☐ TYPE ☐ UNILATED ☐ NONUNILATED☐ C.T.'S FOR DIFF. PROTECTION MOUNTED BY %☐ SURGE CAPACITORS MOUNTED BY %☐ LIGHTNING ARRESTERS MOUNTED BY %☐ C.T. FOR AMMETER MOUNTED BY %☐ SPACE FOR STRESS CONES☐ AIR FILTERS☐ MFR. ☐ TYPE REMARKS

ELECTRIC MOTOR DATA SHEET

0-252-12-23

MANUFACTURER'S DATA		SHOP INSPECTION AND TESTS	
MANUFACTURER <u>GE or Equal</u>			
FRAME NO. _____	FULL LOAD RPM (INQ) <u>1200</u>	SHOP INSPECTION	REQUIRED O
EFFICIENCY: P.L. _____ %	V.L. _____ %	TESTING PER NEMA	O
POWER FACTOR (INQ) P.L. _____ %	V.L. _____ %	MFR. STD. SHOP TESTS	O
CURRENT (RATED VOLT) FULL LOAD _____	LOCKED ROTOR _____	IMMERSION TEST	O
LOCKED ROTOR POWER FACTOR _____		SPECIAL TESTS (LIST BELOW)	
LOCKED ROTOR WITHSTAND TIME (COLD START) _____			O
TORQUES (FT-LBS): FULL LOAD _____			O
LOCKED ROTOR _____	STARTING (SYN) _____		O
PULL-UP (INQ) _____	PULL-IN (SYN) _____		O
BREAKDOWN (INQ) _____	PULL-OUT (SYN) _____		O
OPEN CIRCUIT TIME CONSTANT (SEC) _____		COUPLING	
SYMMETRICAL CONTRIBUTION TO 10 TERMINAL FAULT:		☐ SUPPLIED BY <u>Compr. Mfr.</u>	
AT 1/2 CYCLES _____ AT 1 CYCLES _____		☐ MFR. _____ ☐ MODEL _____	
REACTANCES: SUB-TRANSIENT (X _d) _____		☐ MOTOR MFR. ☐ COMPR. MFR. ☐ PURCH. TO MOUNT MTR. HALF	
TRANSIENT (X _d) _____ SYNCHRONOUS (X _s) _____		PAINTING	
A.C. STATOR RESISTANCE _____ OHMS @ _____ °C		☐ MANUFACTURER'S STANDARD	
RATED KVA _____		☐ _____	
KVA INRUSH @ FULL VOLT. & LOCKED ROTOR (SYN) _____		SHIPMENT	
KVA @ FULL VOLTAGE & 15% SPEED _____		☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING REQUIRED	
MAX. LINE CURR. IN STATOR ON 1ST SLIP CYC. @ PULL-OUT (SYN) _____		☐ OUTDOOR STORAGE OVER 3 MONTHS	
ACCELERATION TIME (MOTOR ONLY @ RATED VOLT) _____ SEC.		☐ _____	
ACCEL. TIME (MOTOR & LOAD @ 15% RATED VOLT) _____ SEC.		REMARKS _____	
ROTOR/FIELD W ₂ MOTOR SHAFT (LBS-FT ²) _____		_____	
ROTATION FACING COUPLING END _____		_____	
NO. OF STARTS PER HOUR _____		_____	
FIELD DISCHARGE RESISTOR _____ OHMS		_____	
RATED EXCITATION FIELD VOLTAGE _____ D.C.		_____	
RESISTANCE OF EXCITATION FIELD @ 25°C _____ OHMS		_____	
EXCITATION FIELD AMPS @ FULL LOAD & RATED P.F. _____		_____	
EXCITATION FIELD AMPS: MAX. _____ MIN. _____		_____	
EXCITATION FIELD ☐ RHODSTAT ☐ FIXED RESISTOR REGD.		_____	
SUPPLIED BY _____		_____	
BEARING: TYPE <u>Sleeve</u> LUBR. <u>Oil</u>		_____	
LUBE OIL REQUIRED: _____ GPM @ _____ PSI		_____	
TOTAL SHAFT END FLOAT _____		_____	
LIMIT END FLOAT TO _____		_____	
MOTOR ROTOR: ☐ SOLID ☐ SPLIT		_____	
MOTOR HUB: ☐ SOLID ☐ SPLIT		_____	
FOR TEVAC & TEMF MOTORS		_____	
COOLING WATER REGD. _____ GPM		_____	
C.W. TEMP. RISE _____ °F PRESS. DROP _____ PSI		_____	
AIR (GAS) REGD. _____ SCFM PRESS. MAINT. _____ IN. H ₂ O		_____	
CURVES REGD. BASED ON MOTOR SATURATION @ RATED VOLTAGE:		_____	
☐ SPEED VS TORQUE (ALSO @ _____ % RATED VOLTAGE)		_____	
☐ SPEED VS POWER FACTOR		_____	
☐ SPEED VS CURRENT		_____	
WEIGHTS (LBS):		_____	
NET WEIGHT <u>Later</u>	SHIPPING WEIGHT _____	_____	
ROTOR WEIGHT _____	MAX. ERECTION WT. _____	_____	
MAX. MAINT. WT. (IDENTIFY) _____		_____	
DIMENSIONS (FEET & INCHES)		_____	
L _____ W _____ H _____		_____	

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APPLICABLE TO ☐ PROPOSAL ☐ PURCHASE ☐ ASBUILT		DATE <u>2/27/81</u>	REVISION
FOR <u>Bechtel</u>		UNIT <u>Crvo H2 Plant</u>	SERIAL NO. <u>—</u>
SITE <u>Breckinridge, Kentucky</u>		NO. REQUIRED <u>One</u>	DRIVER <u>Electric Motor</u>
SERVICE <u>Pipeline Fuel Compr. CP-30 (BK-30)</u>		MODEL <u>3M + 553B 5/5</u>	
MANUFACTURER <u>Dresser Clark</u>		NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; ☐ BY MANUFACTURER	
O-252-12-26			

(ALL DATA ON PER UNIT BASIS)		OPERATING CONDITIONS				
	NORMAL	RATED	OTHER CONDITIONS			
			A	B	C	D
☐ GAS HANDLED (ALSO SEE PAGE <u>—</u>)	Pipeline	Fuel				
☐ MMCFD/ICFM (AT 14.7 PSIA & 60°F DRY)	30564		(Basis 14.7 psia, 70°F, Dry)			
☐ WEIGHT FLOW, MMBTU/HR (WET) (DRY)	15077					
INLET CONDITIONS						
☐ PRESSURE (PSIA)	23					
☐ TEMPERATURE (°F)	22.6					
☐ RELATIVE HUMIDITY (%)	1 ppm					
☐ MOLECULAR WEIGHT (MW)	19.63					
☐ C _p /C _v (R ₁) OR (R ₂)	1.32					
☐ COMPRESSIBILITY (Z ₁) OR (Z ₂)	1.0					
☐ INLET VOLUME, ICFM (WET)	17790					
DISCHARGE CONDITIONS						
☐ PRESSURE (PSIA)	765					
☐ TEMPERATURE (°F)	95					
☐ C _p /C _v (R ₁) OR (R ₂)	1.32					
☐ COMPRESSIBILITY (Z ₁) OR (Z ₂)	1.0					
☐ SHD REQUIRED (ALL LOSSES INCL)	10800					
☐ SPEED (RPM)	Later					
☐ ESTIMATED SURGE, ICFM (AT SPEED ABOVE)	Later					
☐ POLYTROPIC HEAD (FT)	Later					
☐ POLYTROPIC EFFICIENCY (%)	Later					
☐ GUARANTEE POINT	*					
☐ PERFORMANCE CURVE NO.	Later					

PROCESS CONTROL	
METHOD	☐ BYPASS FROM <u>Aftercooler Outlet</u> TO <u>Suction</u>
	☐ ANTI-SURGE BYPASS ☐ MANUAL ☐ AUTO
	☐ SUCTION THROTTLING FROM <u>—</u> TO <u>—</u>
	☐ SPEED VARIATION FROM <u>—</u> TO <u>—</u>
	☐ OTHER <u>—</u>
SIGNAL	☐ SOURCE <u>—</u>
	☐ TYPE <u>—</u>
	☐ RANGES FOR PNEUMATIC CONTROL: <u>—</u> PSIG <u>—</u> PSIG <u>—</u> PSIG <u>—</u> PSIG
	OTHER <u>—</u>

REMARKS	
<u>REQUIRED FOR PHASE 0 ESTIMATE</u>	

NO.	DATE	REVISIONS	BY	CHECK	DESIGN	ENG.	PROJ.	APPR.
SCALE	DESIGNED	DRAWN	CHECKED					
JOB NO.		DRAWING NO.		REV.				
05-		K						

CENTRIFUGAL COMPRESSOR DATA SHEET

O-252-12-26

GAS ANALYSIS		NORMAL	RATED	OTHER CONDITIONS				REMARKS
☐ MOL %	☐ M.W.			A	B	C	D	
AIR	28.966							
OXYGEN	32.000							
NITROGEN	28.016		6.35					
WATER VAPOR	18.016							
CARBON MONOXIDE	28.010		12.56					
CARBON DIOXIDE	44.010							
HYDROGEN SULFIDE	34.076							
HYDROGEN	2.016		0.1					
METHANE	16.042		71.88					
ETHYLENE	28.052		8.45					
ETHANE	30.068		0.6					
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			100					
AVG. MOL. WT.			19.63					

LOCATION

☐ INDOOR ☐ HEATED ☐ UNDER ROOF

☐ OUTDOOR ☐ UNHEATED ☐ PARTIAL SHED

☐ GRADE ☐ MEZZANINE ☐ _____

☐ ELECTRICAL AREA CLASS _____ GR. D DIV. 2

☐ WINTERIZATION REQ. ☐ TROPICALIZATION REQ.

SITE DATA - SEE 14222-A-3

☐ ELEVATION _____ FT. BAROMETER _____ PSIA

☐ RANGE OF AMBIENT TEMPS.

	DRY BULB	WET BULB
SITE RATED °F	96	78
NORMAL °F	110	
MAXIMUM °F	-10	
MINIMUM °F		

UNUSUAL CONDITIONS: ☐ DUST ☐ FUMES

☐ OTHER Coal Processing Facility

NOISE SPECIFICATIONS

☐ APPLICABLE TO MACHINE
SEE SPECIFICATION Airco Spec.

☐ APPLICABLE TO NEIGHBORHOOD
SEE SPECIFICATION _____

ACOUSTIC HOUSING: ☐ YES ☐ NO
Quote Option

APPLICABLE SPECIFICATIONS
API 617 CENTRIFUGAL COMP. FOR GEN. REFINERY SERVICES

PAINTING:

☐ MANUFACTURER'S STD.

☐ OTHERS _____

SHIPMENT:

☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING REQ.

☐ OUTDOOR STORAGE OVER 3 MONTHS

REMARKS: _____

CENTRIFUGAL COMPRESSOR DATA SHEET

0-252-12-26

CONSTRUCTION FEATURES

☐ SPEEDS

MAX. CONT. _____ RPM TRIP _____ RPM
 CRITICALS 1ST _____ RPM 2ND _____ RPM
 MAX. TIP SPEED: _____ FPS @ RATED SPEED
 _____ FPS @ MAX. CONT. SPEED

☐ ROTATION, VIEWED FROM DRIVEN END☐ CASING

MODEL 3M + 553B 5/5 Compound
 CASING SPLIT Horiz/Vert
 MATERIAL Later
 THICKNESS (IN.) _____ CORR. ALLOW. (IN.) _____
 MAX. WORK. PRESS. _____ PSIG MAX. DESIGN PRESS. _____ PSIG
 TEST PRESS (PSIG) HELIUM _____ HYDRO _____
 MAX. OPER. TEMP. _____ °F MAX. OPER. TEMP. _____
 MAX. NO. OF IMPELLERS FOR CASING _____
 MAX. CASING CAPACITY (ICFM) _____
 RADIOGRAPH QUALITY ☐ YES ☐ NO

☐ DIAPHRAGMS

MATERIAL _____

☐ IMPELLERS

NO. _____ DIAMETERS _____
 TYPE (OPEN, ENCLOSED, ETC.) _____
 TYPE FABRICATION _____
 MATERIAL _____
 MAX. YIELD STRENGTH (PSI) _____
 BRINELL HARDNESS MAX. _____ MIN. _____
 SMALLEST TIP INTERNAL RADIUS (IN.) _____
 MAX. MACH NO. @ IMPELLER EYE _____
 MAX. IMPELLER HEAD @ RATED SPEED (FT.) _____

☐ SHAFT

MATERIAL Alloy Steel
 DIA. @ IMPELLERS (IN.) _____ DIA. @ COUPLING (IN.) _____
 SHAFT END ☐ TAPERED ☐ CYLINDRICAL

SHAFT SLEEVES

☐ AT INTERST. CLOSE CLEAR. PTS. ☐ NAT'L _____
☐ AT SHAFT SEALS ☐ NAT'L _____

☐ LASTRONS

TYPE _____ MATERIAL _____

SHAFT SEALS

☐ TYPE _____
☐ SEAL SYSTEM TYPE Vendor Std.
☐ INNER OR. LEAKAGE GUAR. (BAL/DAY/SEAL)
☐ TYPE BUFFER GAS N₂ Available
☐ BUFFER GAS FLOW (PER SEAL)
 NORMAL _____ SCFM @ _____ PSI ΔP
 MAX. _____ SCFM @ _____ PSI ΔP

REMARKS _____

☐ BEARING HOUSING CONSTRUCTION

TYPE (SEPARATE, INTEGRAL) _____ SPLIT _____

MATERIAL _____

☐ RADIAL BEARING

TYPE _____ SPAN (IN.) _____
 AREA (IN.²) _____ LOADING (PSI) ACT. _____ ALLOW. _____

☐ THRUST BEARING

LOCATION _____ TYPE _____
 MFR. _____ AREA (IN.²) _____
 LOADING (PSI) ACTUAL _____ ALLOWABLE _____
 GAS LOADING (LBS) _____ CPG. SLIP LOAD (LBS) _____
 CPG. COEFF. FRICT. _____ CPG. GEAR PITCH DIA. (IN.) _____
 BAL. PISTON COMPENSATING LOAD _____ LBS.

☐ MAIN CONNECTIONS

	SIZE	ANSI RATING	FACING	POSITION
INLET	20			
DISCHARGE	14			

☐ ALLOWABLE PIPING FORCES AND MOMENTS

	INLET		DISCHARGE			
	FORCE LB	MOMT LB	FORCE LB	MOMT LB	FORCE LB	MOMT LB
AXIAL						
VERTICAL						
HORIZ. 30°						
AXIAL						
VERTICAL						
HORIZ. 30°						

☐ 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 FLOW			
DRG. HOUSING			
BETWEEN DRG. & SEAL			
BETWEEN SEAL & GAS			
SOLVENT INJECTION			

0-252-17-26

[illegible]

ELECTRIC MOTOR DATA SHEET

O-252-17-26

APPLICABLE TO: ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILTFOR BechtelUNIT Crvo. H₂ PlantSITE Breckinridge, KentuckyDRIVEN EQUIP. Centrifugal CompSERVICE CP-30 Pipeline Fuel Comp.NO. REQUIRED oneMANUFACTURER GE or Equal

SERIAL NO. _____

NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER ☐ BY MANUFACTURER

MOTOR DESIGN DATA

APPLICABLE SPECIFICATIONS:

☐ NEMA☐ Airco

SITE DATA

AREA ☐ CL 1 OR D ON 2 105 -10☐ ALTITUDE FT. ☐ AMBIENT TEMP. MAX. °F. MIN. °F.UNUSUAL CONDITIONS: ☐ DUST ☐ FUMES☐ OTHER _____DRIVE SYSTEM: ☐ DIRECT CONNECTED☐ GEAR☐ OTHER _____

TYPE MOTOR:

☐ SCRAMBLER CAGE INDUCTION ☐ NEMA DESIGN _____☐ SYNCHRONOUS☐ POWER FACTOR REGD. 1.0EXCITATION: ☐ BRUSHLESS ☐ SLIP RING☐ FIELD DISCHARGE RESISTOR BY MOTOR MFR.☐ WOUND ROTOR INDUCTION

ENCLOSURE:

☐ CLASS 1, GROUP D, EXP. PROOF☐ TERC☐ TENV ☐ TENV, USING N₂ GAS☐ DOUBLE WALL CARBON STEEL TUBES☐ WATER SUPPLY PRESS. 50 PSI TEMP. 85 °F☐ WATER ALLOW. 10 PSI & TEMP. RISE 30 °F☐ WATER SIDE MIN. CORR. ALLOW. _____ IN.AND FOUL FACTOR 0.003☐ LAMB (GAS SUPPLY PRESS. _____ PSI)☐ WEATHER PROTECTED, TYPE _____☐ FORCED VENTILATED☐ OPEN/PROOF☐ OPEN

BASIC DATA

☒ 3.800 VOLTS 3 PHASE 60 HERTZ☐ NAMEPLATE NO. 15000 SERVICE FACTOR 100☐ SYNCHRONOUS RPM 1200☐ INSULATION CLASS B TYPE _____☐ TEMP. RISE 80 °C ABOVE 40 °C BY Resist.

STARTING

☐ FULL VOLTAGE ☐ REDUCED VOLTAGE _____ %☐ LOADED☐ UNLOADED☐ VOLTAGE DIP _____ %

VIBRATION

☐ NEMA STANDARD

NOTE:

☐ NEMA STANDARD

ACCESSORY EQUIPMENT

☐ BASEPLATE☐ SOLEPLATE☐ STATOR SHFT.☐ MFR. STD. FANS☐ NON-SPARKING FANS☐ D.C. EXCITATION☐ KW REQD. _____ VOLTS _____BY ☐ PURCHASER☐ MANUFACTURERDESCRIPTION Brushless☐ ENCLOSED COLLECTOR RINGS☐ PURGED: MEDIUM N₂ PRESS. _____ PSI☐ EXPLOSION-RESISTANT NONPURGED☐ FORCED VENTILATION☐ CFM _____ PRESS. DROP _____ IN. H₂O☐ BEARING TEMP. DEVICES☐ LOCATION _____☐ DESCRIPTION _____☐ SET ° °C FOR ALARM _____ °C FOR SHUTDOWN☐ SPACE HEATERS☐ _____ KW ☐ _____ VOLTS _____ PHASE _____ HERTZ☐ MAX. SHEATH TEMP. _____ °C

WINDING TEMPERATURE DETECTORS

☐ THERMISTORS NO./PHASE _____TYPE: ☐ POS. TEMP. COEFF. ☐ NEG. TEMP. COEFF.TEMPERATURE SWITCH ☐ YES ☐ NO☐ RESISTANCE TEMPERATURE DETECTORS NO. PHASE _____☐ RESISTANCE MATL. _____ ☐ OTHER _____SELECTION SWITCH & INDICATION BY ☐ PURCHASER ☐ MFR.☐ MAX. STATOR WINDING TEMPS

_____ °C FOR ALARM _____ °C FOR SHUTDOWN

WINDING TEMP. DETECTOR & SPACE HEATER LEADS

☐ IN SAME CONDUIT BOX☐ IN SEPARATE CONDUIT BOXES☐ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION☐ SELF-BALANCE PRIMARY-CURRENT METHOD☐ C.T. DESCRIPTION _____☐ EXTENDED LEADS ☐ LENGTH _____ FT.☐ SURGE CAPACITORS☐ LIGHTNING ARRESTERS☐ C.T. FOR AMMETER☐ DESCRIPTION _____

MAIN CONDUIT BOX SIZED FOR

☐ MAIN MOTOR LEADS ☐ TYPE _____☐ INSULATED ☐ NON-INSULATED☐ C.T.'S FOR DIFF. PROTECTION (MOUNTED BY _____) 1☐ SURGE CAPACITORS (MOUNTED BY _____) 1☐ LIGHTNING ARRESTERS (MOUNTED BY _____) 1☐ C.T. FOR AMMETER (MOUNTED BY _____) 1☐ SPACE FOR STRESS CONES☐ AIR FILTERS☐ MFR. _____ ☐ TYPE _____

REMARKS

ELECTRIC MOTOR DATA SHEET

0-252-17-26

MANUFACTURER'S DATA		SHOP INSPECTION AND TESTS	
MANUFACTURER <u>GE, EM, WEST. or Equal</u>			
FRAME NO. _____	FULL LOAD RPM (INQ) <u>1200</u>	SHOP INSPECTION	☐ REQUIRED ☐ WITNESS
EFFICIENCY: F.L. <u>3/4L</u> <u>V2L</u>		TESTING PER NEMA	☐ ☐ ☐
PWR. FACTOR (INQ): F.L. <u>3/4L</u> <u>V2L</u>		MFR. STD. SHOP TESTS	☐ ☐ ☐
CURRENT (RATED VOLT): FULL LOAD _____ LOCKED ROTOR _____		IMMERSION TEST	☐ ☐
LOCKED ROTOR POWER FACTOR _____		SPECIAL TESTS (LIST BELOW)	☐ ☐
LOCKED ROTOR WITHSTAND TIME (COLD START) _____			☐ ☐
TORQUES (FT-LBS): FULL LOAD _____			☐ ☐
LOCKED ROTOR _____ STARTING (SYN) _____			☐ ☐
PULL-UP (INQ) _____ PULL-IN (SYN) _____			☐ ☐
BREAKDOWN (INQ) _____ PULL-OUT (SYN) _____			☐ ☐
OPEN-CIRCUIT TIME CONSTANT (SEC) _____		COUPLING	
SYMMETRICAL CONTRIBUTION TO 38 TERMINAL FAULT: AT 1/2 CYCLES _____ AT 3 CYCLES _____		☐ SUPPLIED BY <u>Compr. Mfg.</u>	
REACTANCES: SUB-TRANSIENT (X _d) _____ TRANSIENT (X _d) _____ SYNCHRONOUS (X _s) _____		☐ MFR. _____ ☐ MODEL _____	
A.C. STATOR RESISTANCE _____ OHMS @ _____ °C		☐ MOTOR MFR. ☐ COMPR. MFR. ☐ PURCH. TO MOUNT MTR. HALP	
RATED EVA _____		PAINTING	
KVA INRUSH @ FULL VOLT. & LOCKED ROTOR (SYN) _____		☐ MANUFACTURER'S STANDARD	
KVA @ FULL VOLTAGE & 1ST SPEED _____		☐ _____	
MAX. LINE CURR. IN STATOR ON 1ST SLIP CYC. @ PULL-OUT (SYN) _____		SHIPMENT	
ACCELERATION TIME (MOTOR ONLY @ RATED VOLT) _____ SEC.		☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING REQUIRED	
ACCEL. TIME (MOTOR & LOAD @ 1/2 RATED VOLT) _____ SEC.		☐ OUTDOOR STORAGE OVER 3 MONTHS	
ROTOR/FIELD WK' @ MOTOR SHAFT (LB-FT) _____		REMARKS _____	
ROTATION FACING COUPLING END _____		_____	
NO. OF STARTS PER HOUR _____		_____	
FIELD DISCHARGE RESISTOR _____ OHMS		_____	
RATED EXCITATION FIELD VOLTAGE _____ V.C.		_____	
RESISTANCE OF EXCITATION FIELD @ 25°C _____ OHMS		_____	
EXCITATION FIELD AMPS @ FULL LOAD & RATED P.F. _____		_____	
EXCITATION FIELD AMPS: MAX. _____ MIN. _____		_____	
EXCITATION FIELD ☐ RHEOSTAT ☐ FIXED RESISTOR REGD.		_____	
SUPPLIED BY _____		_____	
BEARING: TYPE <u>Sleeve</u> LUBR. <u>Oil</u>		_____	
LUBE OIL REQUIRED: _____ GPM @ _____ PSI		_____	
TOTAL SHAFT END FLOAT _____		_____	
LIMIT END FLOAT TO _____		_____	
MOTOR ROTOR: ☐ SOLID ☐ SPLIT		_____	
MOTOR HUB: ☐ SOLID ☐ SPLIT		_____	
FOR TEWAC & TENG MOTORS:		_____	
COOLING WATER RECD. _____ GPM		_____	
C.W. TEMP. RISE _____ °F PRESS. DROP _____ PSI		_____	
AIR (LOAD RECD. _____ SCFM PRESS. MAINT. _____ IN. H ₂ O		_____	
CURVES RECD. BASED ON MOTOR SATURATION @ RATED VOLTAGE:		_____	
☐ SPEED VS TORQUE (ALSO @ _____ % RATED VOLTAGE)		_____	
☐ SPEED VS POWER FACTOR		_____	
☐ SPEED VS CURRENT		_____	
WEIGHTS (LBS):		_____	
NET WEIGHT <u>Later</u> SHIPPING WEIGHT _____		_____	
ROTOR WEIGHT _____ MAX. ERECTION WT. _____		_____	
MAX. MAINT. WT. (IDENTIFY) _____		_____	
DIMENSIONS (FEET & INCHES)		_____	
L _____ W _____ H _____		_____	

4.6 Motor List

Airco Cryoplants			☐ INSTRUCTIONS ☐ SPECIFICATIONS ☐ DATA								WRITTEN BY		DATE		
											APPROVED BY		DATE		
											APPROVED BY		DATE		
											APPROVED BY		DATE		
REVISION	/														
PAGE															
DATE	7/19														
WRITTEN BY															
APPROVED BY	Bm.														

BRECKINRIDGE PROJECT
 PLANT 8
 HYDROGEN PLANT
 MOTOR LIST

TITLE HYDROGEN PLANT — UNIT #8
MOTOR LIST

Motor HP

at 13,800 KV

k-30 Pipeline Fuel Compressor 12,500

Motor HP

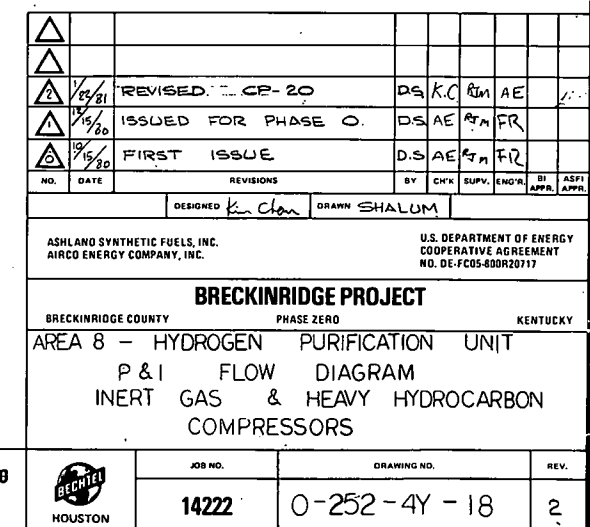
at 4.16 KV

K-70	Nitrogen Compressor	4500
K-20	Heavy Hydrocarbon Compressor	4000
K-10	Inert Gas Compressor	500
K-1	Reactivation Blower	700
V-59	Refrigeration Unit	125

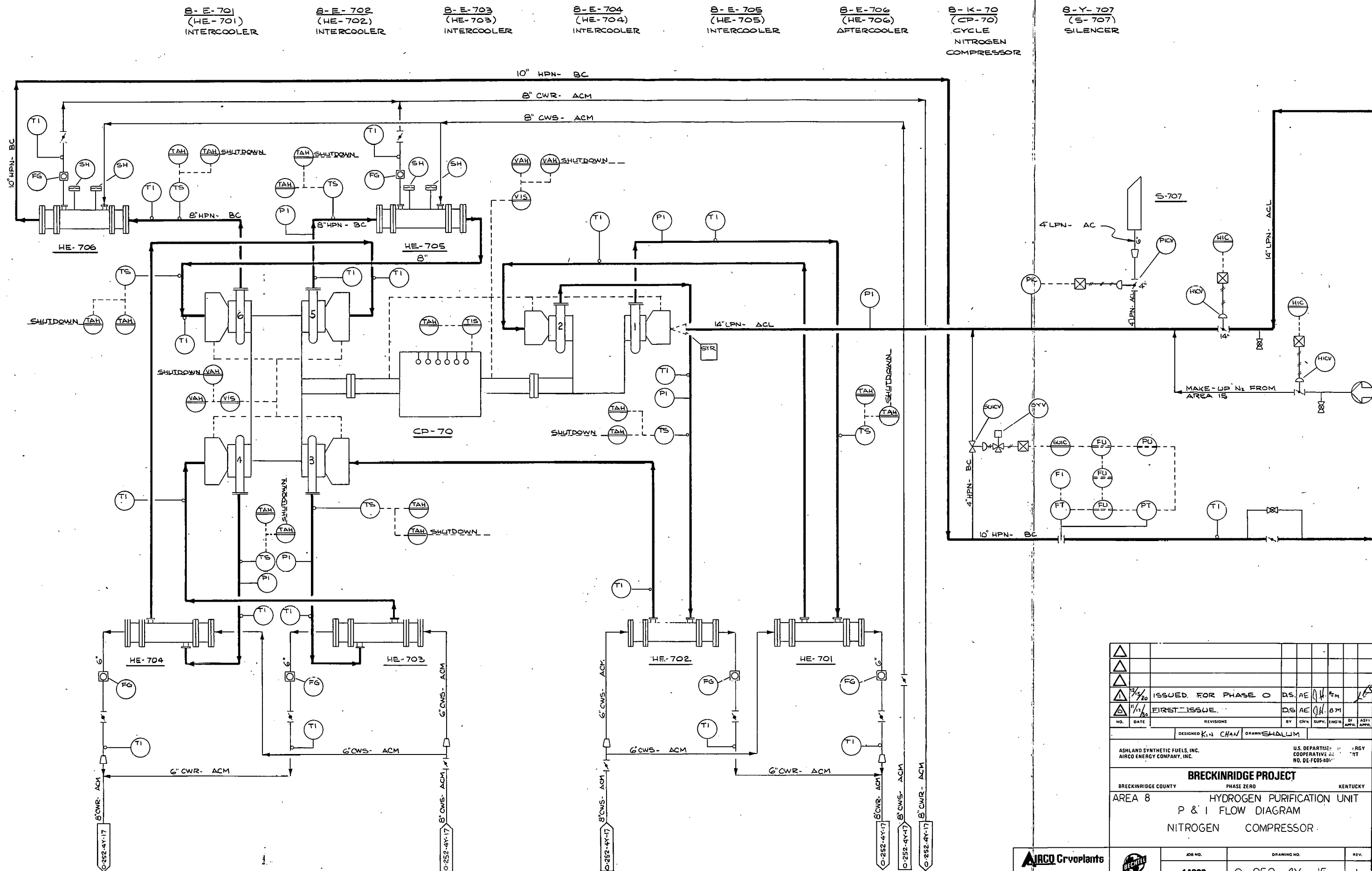
at 480 Volts

K-70	Auxiliaries	15
K-30	Auxiliaries	40
K-20	Auxiliaries	10
K-10	Auxiliaries	5
P-58	Auxiliaries	10
P-104	A & B Condensate Pumps	5

B-E-103
(HE-103)
AFTERCOOLER



22 X 34 "D" SIZE

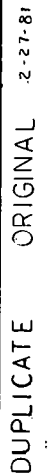


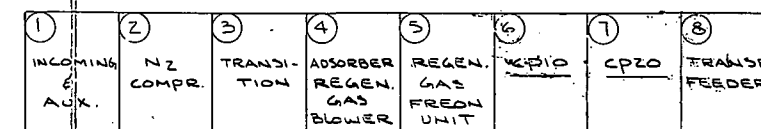
DESIGNED	K. N. CHAN	DRAWN	SHALLUM
ASHLAND SYNTHETIC FUELS, INC. AIRCO ENERGY COMPANY, INC.			
U.S. DEPARTMENT OF ENERGY COOPERATIVE PROGRAM NO. DE-FC05-80-101			
BRECKINRIDGE PROJECT PHASE ZERO			
AREA 8 HYDROGEN PURIFICATION UNIT P & I FLOW DIAGRAM NITROGEN COMPRESSOR			
NO.	DATE	REVISIONS	BY
1	10/1/80	ISSUED FOR PHASE 0	DS, AE
2	10/1/80	FIRST ISSUE	DS, AE
JOB NO. 14222 DRAWING NO. 0-252-4Y-15 REV. 1			

AIRCO Croplants

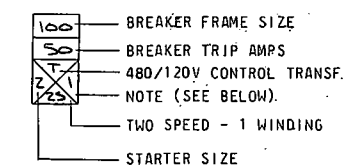


2-27-81
ORIGINAL
DUPLICATE





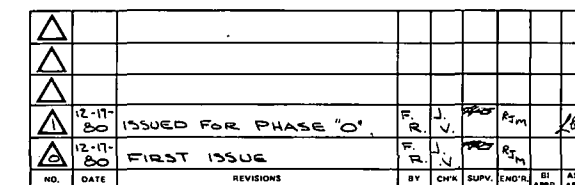
LEGEND



COMBINATION STARTER

NOTES:

1. BREAKER SHALL HAVE AN INTERLOCK CONTACT.
2. CONTACTOR - NO OVERLOADS



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	KEN
AREA 8	HYDROGEN PURIFICATION PLANT	

4.16KV & 480V SINGLE LINE DIAGRAM

AIACO Cryoplants

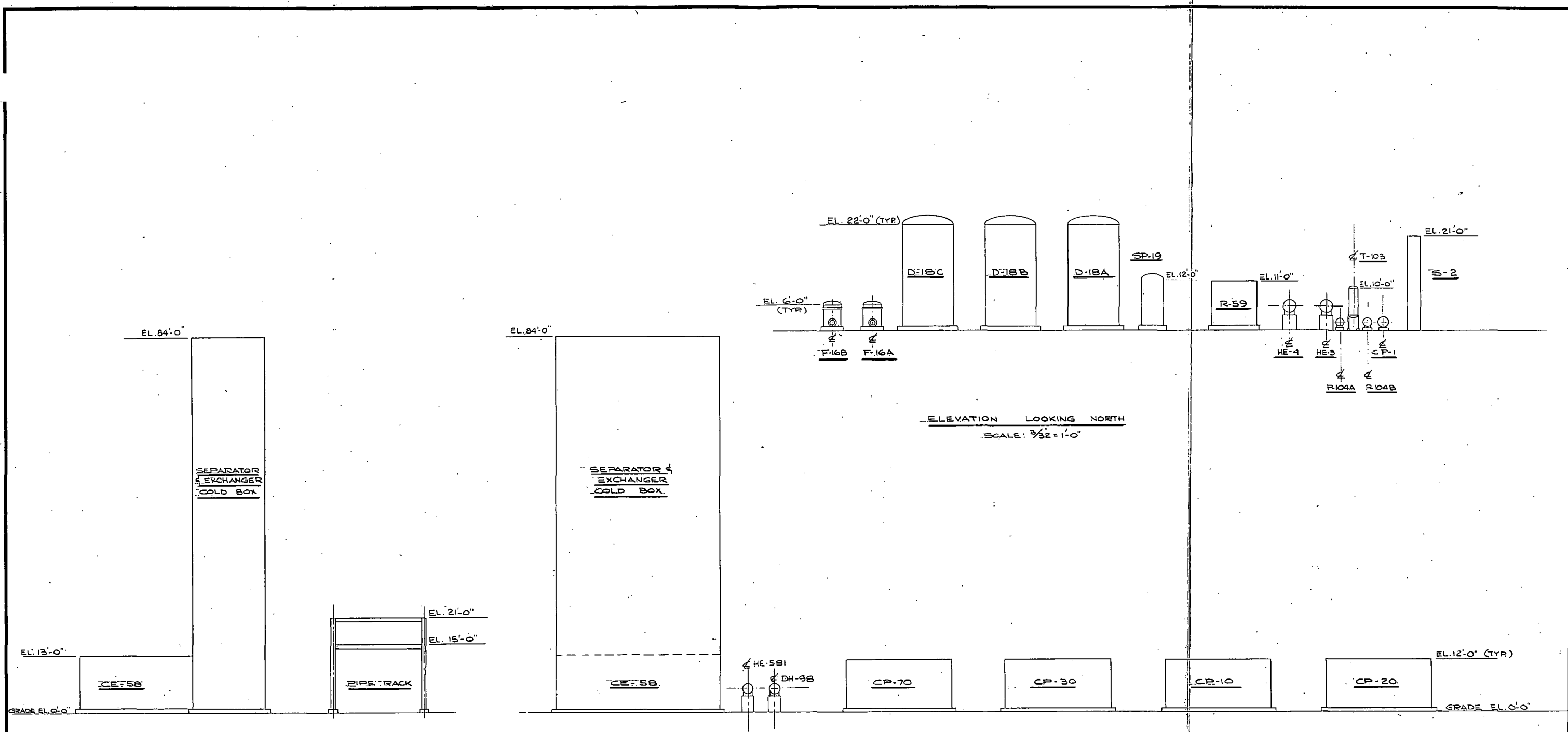


BECHTEL
HOUSTON

JOB NO.
14222

	DRAWING NO.
	0-252-4N-2

DUPLICATE ORIGINAL 2-27-81



ELEVATION LOOKING EAST
SCALE: 3/32" = 1'-0"

ELEVATION LOOKING NORTH
SCALE: 3/32" = 1'-0"

△									
△									
△									
△	12/18/81	ISSUED FOR PHASE	01	J.H.	K.M.	FR			
△	12/18/80	FIRST ISSUE	05	J.H.	K.M.	FR			
NO.	DATE	REVISIONS	BY	CHK	SUPV.	ENGR.	BI	ASFT	
DESIGNED		J.H.		DRAWN		SHALUM			
ASHLAND SYNTHETIC FUELS, INC. AIRCO ENERGY COMPANY, INC.					U.S. DEPARTMENT OF ENERGY COOPERATIVE AGREEMENT NO. DE-FC05-80OR2017				
BRECKINRIDGE PROJECT									
BRECKINRIDGE COUNTY			PHASE ZERO				KENTUCKY		
AREA 8									
HYDROGEN PURIFICATION UNIT EQUIPMENT ELEVATIONS									
JOB NO.		DRAWING NO.		REV.					
14222		0-252-4P-2		1					

AIRCO Cryoplants

BECHTEL
HOUSTON

DUPLICATE ORIGINAL 2-27-81

PLANT 9 SOUR WATER TREATING

1.0 INTRODUCTION

The USS PHOSAM-W[®] Process is a development of United States Steel Corp., licensed by the USS Engineers and Consultants, Inc. The process removes free ammonia and acid gases from sour waters and separates them to recover a high quality anhydrous ammonia product. This is accomplished by selective absorption of ammonia from the H₂S stripper overhead vapors into an ammonium phosphate solution. The ammonia-rich phosphate solution is stripped to produce aqueous ammonia and a lean ammonium phosphate solution, which is recycled to ammonia absorption. The aqueous ammonia is refined by fractionation to pure, anhydrous ammonia.

The terms "rich" and "lean" solution refer to the ammonia content of the ammonium phosphate solution used in the process. The solutions are characterized by their H₃PO₄ content and their molar ratio of NH₃ to H₃PO₄. The PHOSAM-W[®] Process typically employs a 25 to 35 wt% H₃PO₄ solution with mole ratios of 1.2 to 1.3 in lean solution and 1.7 to 1.80 in rich solution. These concentrations and mole ratios are well below the values that could cause crystal formation at process temperatures.

The solvent extraction process for Phenols Recovery-Stripped Sour Water Dephenolization is a process technology development of Jones and Laughlin Steel Corporation licensed by Chem-Pro Equipment Corp. The dephenolization process recovers a salable product consisting of phenol and its homologs, cresols and xylenols. This is accomplished by means of liquid-liquid extraction, in which the phenols are extracted from the stripped sour water feed with an organic solvent. The solvent is recovered by fractionation from the extracted phenols.

PLANT 9 SOUR WATER TREATING

2.0 PROCESS DESIGN

2.1 Design Basis

The unit capacity is 1,000 GPM of concentrated sour water feed from which approximately 193 TPSD of anhydrous ammonia and approximately 103 TPSD of phenols are recovered. Caustic is added to this feed to reduce the amount of ammonia "fixed" as salts. This preliminary design also includes a sour steam feed from Gasification and Purification (Plant 12). The justification for incorporation of this steam feed will be reexamined in the next design phase. Feed compositions and quantities as specified for design to USS Engineers and Consultants, Inc., and Chem-Pro are specified in Table 1. These data will be updated as additional H-Coal[®] pilot plant design data for H-Coal[®] Primary Separation (Plant 4) become available.

TABLE 1
FEED STREAMS

<u>Component</u>	<u>Concentrated Sour Water from Plant 4</u>		<u>Sour Steam from Plant 12</u>	<u>Total</u>
	<u>lb/hr</u>	<u>wt%</u>	<u>lb/hr est.</u>	<u>lb/hr</u>
NH ₃ (free)	16,161	3.24	trace	16,161
H ₂ S	27,086	5.44	trace	27,086
CO ₂	4,791	0.96	--	4,791
HCN	3	--	--	3
Phenolics	8,888	1.78	--	8,888
Other Organics	8,888	1.78	--	8,888
Water	<u>432,359</u>	<u>86.80</u>	<u>30,000</u>	<u>462,359</u>
Total	498,177	100.00	30,000	528,177

The following products are obtained from the unit:

USS PHOSAM-W[®] Process

Acid gas

Anhydrous ammonia

Stripped H₂O

Dephenolization Process (J&L)

Phenols

Extracted H₂O

The predicted product compositions and quantities are shown in Tables 2 and 4. Typical anhydrous ammonia specifications are presented in Table 3.

The product recoveries of Plant 9 are:

USS PHOSAM-W[®] Process

99.0% NH₃ Recovery

Stripped water (200 ppm NH₃ maximum)

Dephenolization Process (J&L)

95% Phenol Recovery
(minimum)

2.2 Process Description

Sour water is processed first in the PHOSAM-W[®] process, followed by dephenolization. This processing sequence will be reviewed in the next phase. To guarantee a continuous supply of H₂S Feed for the Sulfur Plant (Plant 10), two 100% PHOSAM-W units are specified and individual pieces of equipment are spared as required for reliability.

2.2.1 Sour Water Stripping and Ammonia Recovery

The stripping of ammonia and acid gases from concentrated sour water and the recovery of free ammonia from these acid gases by means of the PHOSAM-W[®] process are presented on Flowsheet 9-D-B-1. The sour water feed is delivered to battery limits and preheated against H₂S stripper bottoms in 9E-101, lean solution in 9E-102 and 50 psig steam in 9E-104 so that it is at or near its bubble point. The preheated feed enters the top of H₂S Stripper (9C-101) where acid gases and free ammonia are

TABLE 2
PRODUCT STREAMS FOR PHOSAM PROCESS

<u>Component</u>	<u>lb/hr</u>		
	<u>Acid Gas</u>	<u>Anhydrous NH₃</u>	<u>Stripped Water</u>
NH ₃ (free)	<14 (<1,000 ppmv)	16,007	<140 (<200 ppm)
H ₂ S	27,085	--	2
CO ₂	4,790	--	1
HCN	3	--	Trace
Phenolics	360	--	8,528
Other Organics	726	--	8,162
H ₂ O (1)	<u>1,212</u>	<u>80</u>	<u>461,901</u> (3)
Total	34,190	16,087	478,734
H ₂ O (2)			<u>252,580</u>
Total			731,314

Notes: (1) Without stripping steam
 (2) Condensed stripping steam
 (3) Includes NaOH injected into 9C-105

TABLE 3
ANHYDROUS AMMONIA SPECIFICATIONS
(Typical Analysis)

Assay	99.50% NH ₃ (min.)
Color	Colorless
Water	0.5% (max.)

TABLE 4
PRODUCT STREAMS FOR DEPHENOLIZATION PROCESS

<u>Components</u>	<u>lb/hr</u>	
	<u>Phenolics (Tar Acids)</u>	<u>Extracted Water</u>
NH ₃	--	140 (200 ppm)
H ₂ S	--	2 (20 ppm)
Phenolics	8,401	127
Other Organics	80	8,082
Solvent	85	8
Water	<u>--</u>	<u>714,481</u>
Total	8,566	722,841

stripped from the water. The water, stripped to an ammonia content of less than 200 ppm, leaves the bottom of the H_2S stripper and is cooled against sour water feed in H_2S Stripper Feed/Bottom Exchanger (9E-101). The stripped water is then sent to the dephenolization section of Plant 9 for further cleanup. Boilup for the stripper is provided primarily by direct injection of 50 psig steam. Flashing of bottoms water from Ammonia Fractionator (9C-106) into the H_2S stripper provides supplemental boilup.

The H_2S stripper overhead vapor containing the stripped ammonia and acid gases passes into NH_3 Absorber (9C-102) where it is contacted with recirculated ammonium phosphate solution. Vapors released from the rich solution in PHOSAM Contactor (9C-103), containing some ammonia and essentially all of the entrained acid gases, are recycled to the spray section of the absorber to recover the ammonia and purge the system of acid gases. About 75% of the ammonia is removed in the spray stage. The remaining vapor passes upward through trays where final scrubbing of ammonia from the vapors occurs by countercurrent contact with cooled, lean ammonium phosphate solution returning to the top of the absorber from the regeneration section of the plant. The solution, together with the absorbed ammonia, drains from the bottom tray into the absorber sump. The vapor leaving the NH_3 absorber contains approximately 6,000 ppmv ammonia. It flows to the Acid Gas Cooler (9E-103) where sufficient ammoniacal water is condensed to lower the ammonia content of the acid gas product to less than the specified 1,000 ppmv. The gas then passes to the Claus-type Sulfur Plant (Plant 10). The condensed ammoniacal water is recycled back to the H_2S stripper with the sour water feed.

The net flow of the rich absorber solution is drawn off the discharge of the absorber circulation pump and heated against hot lean solution from the bottom of the PHOSAM- NH_3 Stripper (9C-104) in the NH_3 Absorber

Bottoms/Lean Solution Exchanger (9E-105). The heated rich solution is flashed in the PHOSAM Contactor (9C-103) to remove acid gases which are recycled to the NH_3 absorber.

The rich solution, free of acid gases, is pumped from the PHOSAM contactor and preheated in the upper section of PHOSAM- NH_3 Stripper Condenser (9E-107). The preheated rich solution flows to the PHOSAM- NH_3 Stripper (9C-104), which operates at elevated pressure.

The PHOSAM- NH_3 stripper removes the absorbed ammonia and generates lean solution for recycle to the NH_3 absorber. Boilup in the stripper is provided by direct steam injection. The hot, lean solution leaving the stripper bottom is cooled in a series of three Heat Exchangers (9E-105, 9E-102, 9E-106). In the first, 9E-105, the hot lean solution is exchanged against PHOSAM Contactor (9C-103) feed. In the second, 9E-102, the sour water feed is preheated as previously described. In the third, 9E-106, the lean solution is cooled with cooling water. The cooled lean solution then enters the top of the NH_3 absorber.

The aqueous ammonia vapor (10 to 20 wt% ammonia) from the top of the PHOSAM- NH_3 Stripper (9C-104) passes through the two-section PHOSAM- NH_3 Stripper Condenser (9E-107). The vapor is cooled and partly condensed in the upper section by exchange against stripper feed. The remaining vapor is condensed and the total flow cooled in the lower section with cooling water. The PHOSAM- NH_3 stripper pressure is automatically controlled by backflooding the bottom section of the 9E-107. The aqueous ammonia condensate flows by gravity to the PHOSAM Stripper Overhead Drum (9C-105). The condensed aqueous ammonia in 9C-105 is maintained at its boiling point by a warm vapor bypass.

Trace amounts of CO_2 and H_2S in the fractionator feed tend to be trapped and collected in the ammonia fractionator. To prevent their buildup a small stream of sodium hydroxide (NaOH) is continuously metered into drum 9C-105 by the Caustic Metering Pump (9G-108). The NaOH combines chemically with the acid gases to form salts which leave with the bottoms stream from the ammonia fractionator.

The aqueous ammonia is pumped from 9C-105 into the Ammonia Fractionator (9C-106) where it is fractionated into an overhead anhydrous ammonia product (at least 99.5% NH_3) and a bottoms stream of water containing a small amount of ammonia. The alkaline, pressurized hot water from the bottom of the fractionator is flashed directly into the bottom of the H_2S stripper to provide a portion of its boilup requirement. The Ammonia Fractionator Reboiler (9E-109) is heated with 600 psig steam and provides the necessary stripping vapor for fractionation of the ammonia and water. The overhead vapor is condensed in the Ammonia Fractionator Condenser (9E-108) with cooling water. The fractionator pressure is automatically controlled by backflooding the condenser. Part of the condensed overhead is returned to the top of the fractionator as reflux, with the remaining amount going to product storage.

For the PHOSAM-W[®] processing section, the use of direct stripping steam may be replaced by using indirect steam reboiled exchangers for the H_2S stripping column and the PHOSAM- NH_3 stripping column. This would reduce the quantity of stripped water to be further processed in the dephenolization section of Plant 9 and the wastewater treatment system of Sewers and Wastewater Treatment (Plant 34). A comparison of reboiled versus live steam stripping will be conducted when more complete sour water data are available from H-Coal[®] pilot plant operations.

The sour steam entering Plant 9 is inconsistent with that shown leaving Gasification and Purification (Plant 12). This inconsistency will be corrected in the next design stage. The impact on capital and operating costs will be negligible.

It is essential that an H_2S -rich acid gas be supplied to the Claus type Sulfur Plant (Plant 10) at all times due to the quantity of SO_2 being supplied from the Wellman Lord process in Stack Gas Scrubbing (Plant 35). For this reason, the Phase Zero design and cost estimate include two 100% capacity PHOSAM-W[®] process trains. The reliability and operability of one PHOSAM-W[®] process train versus two trains will be further analyzed in the next design phase.

2.2.2 Dephenolization Section

The removal of phenolics from the stripped sour water and their recovery are presented in Figure 1 (located in Section 5.1). The stripped sour water from the sour water stripping and ammonia recovery section of Plant 9 is charged to the top of the extraction column where it is contacted countercurrently with the solvent. The raffinate (dephenolized water) from the extractor is fed to the solvent stripping column where solvent is removed from the dephenolized water by distillation. These bottoms are then pumped to Sewers and Wastewater Treatment (Plant 34) for further treatment. The overhead product from the solvent stripping column, after condensing, goes to the solvent column overhead drum where the water is separated and pumped back to the column. The solvent recovered here is ready for recirculation to the extractor.

The extract from the top of the extractor flows to the solvent recovery column through a control valve which maintains a constant interface level between extract and liquor at the top of the extractor.

In the solvent recovery column, a separation is made between the solvent and extracted phenols. The overhead product, after condensing, goes to the solvent pumping tank and from there is pumped back to the extractor as recycle solvent. A side stream of the condensed overhead product is pumped back to the top of the solvent recovery column as reflux. The solvent recovery column bottoms are pumped to the phenols column in which, under vacuum, the solvent content of the crude tar acids is further reduced to less than 1%. The overhead product is, after condensing, returned to the solvent recovery column with a side stream to the phenols column as reflux. The phenols are cooled and transferred to storage in Tankage (Plant 20).

2.3 Catalysts and Chemicals

<u>Chemicals</u>	<u>Initial Inventory</u>	<u>Consumption Rate</u>
75 wt% Phosphoric Acid (as 100%)	68,800 lb	28,200 lb/month
Dephenolization Solvent	8,700 gal	2,160 lb/day
20 wt% Caustic Solution (as 100%)	38,400 lb	144,360 lb/day

2.4 Utility Balance

Electricity, kW

<u>Condition</u>	<u>Consumed</u>
Operating	531

Steam, M lb/hr

Level

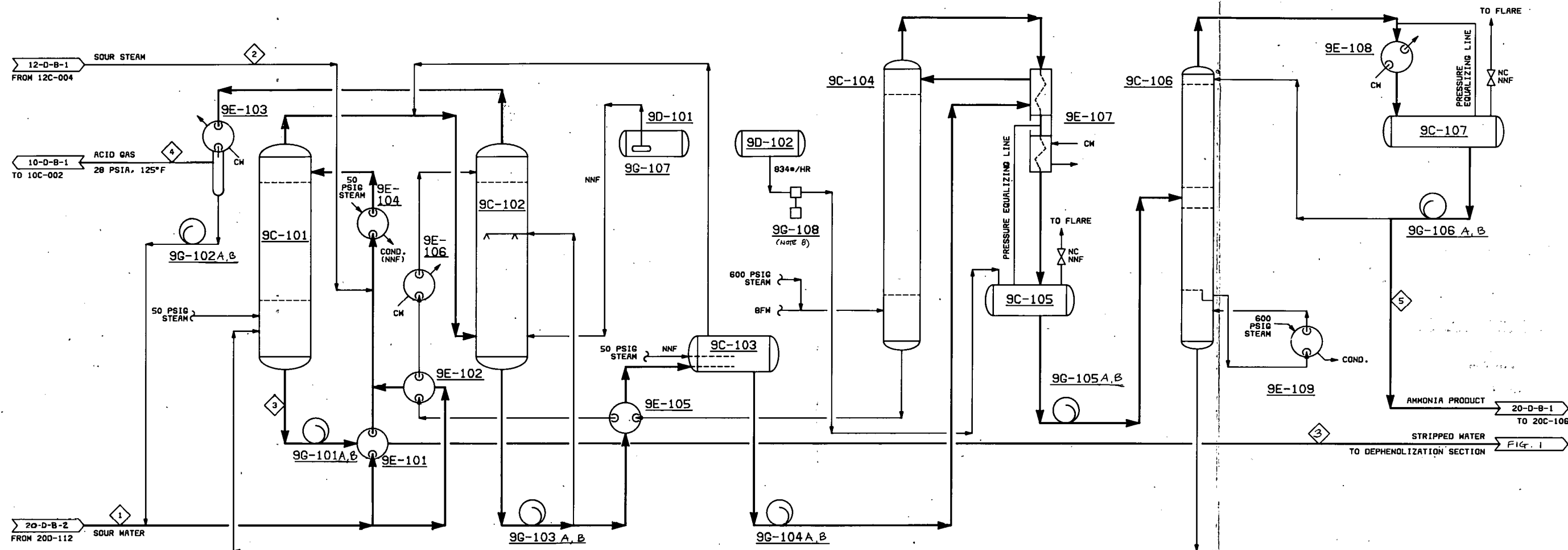
psig	206,330
150 psig	19,200
50 psig	123,960

Condensate Returned: 95,810 lb/hr

Water, GPM

Cooling Water Circulation: 19,835

9E-103 ACID GAS COOLER
 9C-101 H₂S STRIPPER 12'-6" 64' TT
 9E-104 H₂S STRIPPER FEED PREHEAT EXCHANGER
 9E-106 LEAN-SOLUTION COOLER
 9E-102 H₂S STRIPPER FEED/LEAN-SOLUTION EXCHANGER
 9E-101 H₂S STRIPPER FEED/BOTTOMS EXCHANGER
 9C-102 NH₃ ABSORBER 13'-3" 60' TT
 9E-105 NH₃ ABSORBER BOTTOMS/LEAN-SOLUTION EXCHANGER
 9D-101 PHOSPHORIC ACID TANK 7000 GAL.
 9D-102 CAUSTIC TANK 23000 GAL.
 9C-103 PHOSAM CONTACTOR 10'-0" 20' TT
 9C-104 PHOSAM-NH₃ STRIPPER 9'-6" 60' TT
 9E-107 PHOSAM-NH₃ STRIPPER CONDENSER
 9C-105 PHOSAM STRIPPER OVHD DRUM 10'-0" 30' TT
 9C-106 AMMONIA FRACTIONATOR 6'-0" 60' TT
 9E-109 AMMONIA FRACTIONATOR REBOILER
 9E-108A&B AMMONIA FRACTIONATOR CONDENSER
 9C-107 AMMONIA FRACTIONATOR REFLUX DRUM 2'-0" 4' TT



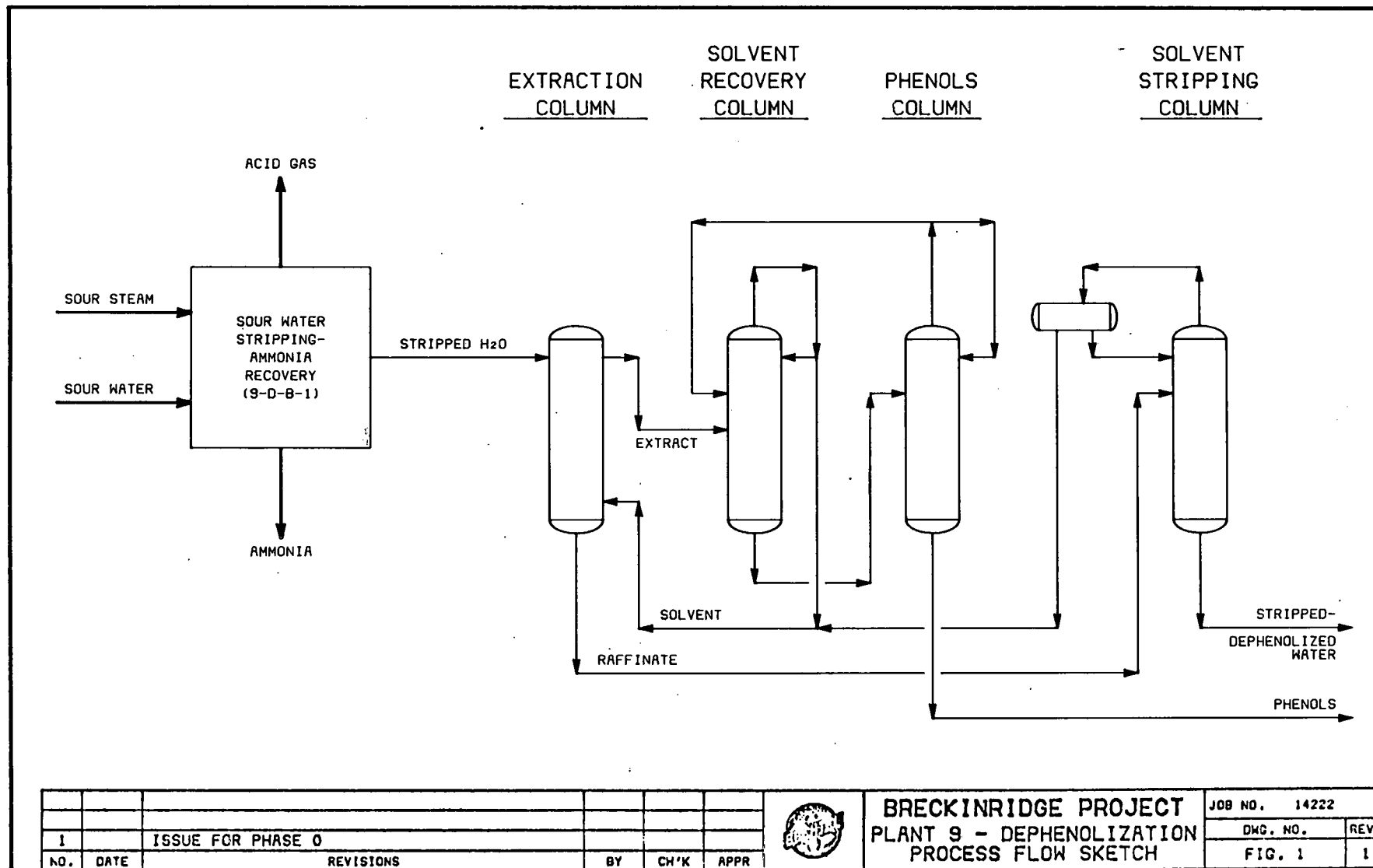
STREAM NO.	1	2	3	4	5
DESCRIPTION	SOUR WATER FEED	SOUR WATER FEED	STRIPPED WATER PRODUCT	ACID GAS	NH ₃ PRODUCT
COMPONENTS					
LBS/HR					
NH ₃ (FREE)	16161.	TRACE	< 200 PPM	< 1000 PPM	16007.
H ₂ S	27086.	TRACE	< 20 PPM	27085.	
CO ₂	4791.		TRACE	4790.	
H ₂ O	3.		TRACE	3.	
PHENOLS	8888.		8528.	360.	
OTHER ORGANICS	8888.		8162.	726.	
H ₂ O	432359.	30000.	714320.	1212.	80.
NAOH			161.		
TOTAL	498177.	30000.	731314.	34190.	16007.

- NOTES:
- MM = 1,000,000 BTU/HR
 - MMSCFD AT 60°F AND 14.7 PSIA
 - PUMP GPM ARE AT FLOW CONDITIONS
 - NC = NORMALLY CLOSED
 - NNF = NORMALLY NO FLOW
 - # = DIAMETER
 - TT = TANGENT TO TANGENT DIMENSION
 - 9G-008 COMMON SPARE TO 108/208

AMMONIA RECOVERY
BY CONFIDENTIAL
U.S.S. "PHOSAM-W"
PROCESS.

ISSUED FOR PHASE 0	ISSUED FOR REVIEW/APPROVAL
NO. DATE	REVISIONS
DESIGNED	DRAWN
ASHLAND SYNTHETIC FUELS, INC. AIRCO ENERGY COMPANY, INC.	
U.S. DEPARTMENT OF ENERGY COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717	
BRECKINRIDGE PROJECT	
BRECKINRIDGE COUNTY	PHASE ZERO KENTUCKY
PROCESS FLOW DIAGRAM PLANT 9 - SOUR WATER/AMMONIA SOUR WATER STRIPPING/ AMMONIA RECOVERY	
JOB NO.	DRAWING NO.
14222	9-D-B-1
REV.	1

FIGURE 1
DEPHENOLIZATION PROCESS FLOW SKETCH



MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09	SOUR WATER TREATING	000000
	-	
09C-101	H2S STRIPPER	000000
	-	
09C-201	H2S STRIPPER	000000 NA
	-	
09C-102	NH3 ABSORBER	000000
	-	
09C-202	NH3 ABSORBER	000000 NA
	-	
09C-103	PHOSAM CONTACTOR	000000
	-	
09C-203	PHOSAM CONTACTOR	000000 NA
	-	
09C-104	PHOSAM-NH3 STRIPPER	000000
	-	
09C-204	PHOSAM-NH3 STRIPPER	000000 NA
	-	
09C-105	PHOSAM STRIPPER OVHD DRUM	000000
	-	
09C-205	PHOSAM STRIPPER OVHD DRUM	000000 NA
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09C-106	AMMONIA FRACTIONATOR	000000
09C-206	AMMONIA FRACTIONATOR	000000 NA
09C-107	AMMONIA FRACTIONATOR REFLUX DRUM	000000 NA
09C-207	AMMONIA FRACTIONATOR REFLUX DRUM	000000 NA
09C-108	EXTRACTION COLUMN FEED SURGE DRUM	000000
09C-109A	PHENOL EXTRACTION COLUMN	000000
09C-109B	PHENOL EXTRACTION COLUMN	000000
09C-109C	PHENOL EXTRACTION COLUMN	000000 NA
09C-109D	PHENOL EXTRACTION COLUMN	000000 NA
09C-110	EXTRACT SURGE TANK	000000
09C-111	STRIPPING COLUMN	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09C-112	DECANTER	000000
09C-113	SOLVENT RECOVERY COLUMN	000000
09C-114	SOLVENT RECOVERY COLUMN REFLUX DRUM	000000
09C-115	PHENOL COLUMN	000000
09C-116	PHENOL COLUMN REFLUX DRUM	000000
09C-117	VAPOR/LIQUID SEPARATOR	000000 NA
09C-217	VAPOR/LIQUID SEPARATOR	000000 NA
09C-118	60 PSIG CONDENSATE TANK	000000 NA
09C-119	150 PSIG CONDENSATE TANK	000000 NA
09C-120	VACUUM CONDENSATE TANK	000000 NA
09D-001	PHOSPHORIC ACID TANK	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09D-002	CAUSTIC TANK	000000
09D-103	SOLVENT TANK	000000
09E-101	H2S STRIPPER FEED/BOTTOM EXCHANGER	000000
09E-201	H2S STRIPPER FEED/BOTTOM EXCHANGER	000000 NA
09E-102	H2S STRIPPER FEED/LEAN-SOLUTION EXCHANGER	000000
09E-202	H2S STRIPPER FEED/LEAN-SOLUTION EXCHANGER	000000 NA
09E-103A	ACID GAS COOLER	000000
09E-103B	ACID GAS COOLER	000000 NA
09E-103C	ACID GAS COOLER	000000 NA
09E-103D	ACID GAS COOLER	000000 NA
09E-203A	ACID GAS COOLER	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09E-203B	ACID GAS COOLER	000000 NA
	-	
09E-203C	ACID GAS COOLER	000000 NA
	-	
09E-203D	ACID GAS COOLER	000000 NA
	-	
09E-104	H2S STRIPPER FEED PREHEAT EXCHANGER	000000
	-	
09E-204	H2S STRIPPER FEED PREHEAT EXCHANGER	000000 NA
	-	
09E-105	NH3 ABSORBER BOTTOMS/ LEAN-SOLUTION EXCHANGER	000000
	-	
09E-205	NH3 ABSORBER BOTTOMS/ LEAN-SOLUTION EXCHANGER	000000 NA
	-	
09E-106	LEAN-SOLUTION COOLER	000000
	-	
09E-206	LEAN SOLUTION COOLER	000000 NA
	-	
09E-107	PHOSAM-NH3 STRIPPER CONDENSER	000000
	-	
09E-207	PHOSAM-NH3 STRIPPER CONDENSER	000000 NA
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09E-108A	AMMONIA FRACTIONATOR CONDENSER	000000
09E-108B	AMMONIA FRACTIONATOR CONDENSER	000000
09E-208A	AMMONIA FRACTIONATOR CONDENSER	000000 NA
09E-208B	AMMONIA FRACTIONATOR CONDENSER	000000 NA
09E-109	AMMONIA FRACTIONATOR REBOILER	000000
09E-209	AMMONIA FRACTIONATOR REBOILER	000000 NA
09E-110	STRIPPING COLUMN CONDENSER	000000
09E-111A	STRIPPING COLUMN FEED/ BOTTOMS EX.	000000 NA
09E-111B	STRIPPING COLUMN FEED/BOTTOMS EX.	000000 NA
09E-111C	STRIPPING COLUMN FEED/BOTTOMS EX.	000000 NA
09E-111D	STRIPPING COLUMN FEED/BOTTOMS EX.	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09E-111E	STRIPPING COLUMN FEED/BOTTOMS EX.	000000 NA
09E-111F	STRIPPING COLUMN FEED/BOTTOMS EX.	000000 NA
09E-112	SOLVENT RECOVERY COLUMN FEED/RECOVERED SOLVENT	000000
09E-113	SOLVENT RECOVERY COLUMN CONDENSER	000000
09E-114	SOLVENT RECOVERY COLUMN REBOILER	000000
09E-115	PHENOL COLUMN CONDENSER	000000
09E-116	PHENOL COLUMN REBOILER	000000
09E-117	STRIPPING COLUMN REBOILER	000000 NA
09E-118	VACUUM CONDENSER	000000 NA
09E-119	PHENOLS PRODUCT COOLER	000000 NA
09G-101A	H2S STRIPPER BOTTOMS PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09G-101B	H2S STRIPPER BOTTOMS PUMP	000000
09G-201A	H2S STRIPPER BOTTOMS PUMP	000000 NA
09G-201B	H2S STRIPPER BOTTOMS PUMP	000000 NA
09G-102A	ABSORBER OVHD CONDENSATE PUMP	000000
09G-102B	ABSORBER OVHD CONDENSATE PUMP	000000
09G-202A	ABSORBER OVHD CONDENSATE PUMP	000000 NA
09G-202B	ABSORBER OVHD CONDENSATE PUMP	000000 NA
09G-103A	NH3 ABSORBER BOTTOMS PUMP	000000
09G-103B	NH3 ABSORBER BOTTOMS PUMP	000000
09G-203A	NH3 ABSORBER BOTTOMS PUMP	000000 NA
09G-203B	NH3 ABSORBER BOTTOMS PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09G-104A	PHOSAM RICH-SOLUTION PUMP	000000
09G-104B	PHOSAM RICH-SOLUTION PUMP	000000
09G-204A	PHOSAM RICH-SOLUTION PUMP	000000 NA
09G-204B	PHOSAM RICH-SOLUTION PUMP	000000 NA
09G-105A	AMMONIA FRACTIONATOR FEED PUMP	000000
09G-105B	AMMONIA FRACTIONATOR FEED PUMP	000000
09G-205A	AMMONIA FRACTIONATOR FEED PUMP	000000 NA
09G-205B	AMMONIA FRACTIONATOR FEED PUMP	000000 NA
09G-106A	AMMONIA FRACTIONATOR REFLUX PUMP	000000
09G-106B	AMMONIA FRACTIONATOR REFLUX PUMP	000000
09G-206A	AMMONIA FRACTIONATOR REFLUX PUMP	000000 NA

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09G-206B	AMMONIA FRACTIONATOR REFLUX PUMP	000000 NA
09G-007	PHOSPHORIC ACID ADDITION PUMP	000000 NA
09G-008	CAUSTIC METERING PUMP	000000
09G-108	CAUSTIC METERING PUMP	000000
09G-208	CAUSTIC METERING PUMP	000000 NA
09G-109A	EXTRACTION COLUMN FEED PUMP	000000 NA
09G-109B	EXTRACTION COLUMN FEED PUMP	000000 NA
09G-110A	EXTRACTION COLUMN BOTTOMS PUMP	000000
09G-110B	EXTRACTION COLUMN BOTTOMS PUMP	000000
09G-110C	EXTRACTION COLUMN BOTTOMS PUMP	000000
09G-110D	EXTRACTION COLUMN BOTTOMS PUMP	000000 1

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09G-110E	EXTRACTION COLUMN BOTTOMS PUMP	000000 NA
09G-111A	EXTRACT PUMP	000000
09G-111B	EXTRACT PUMP	000000
09G-112A	DECANTER RECOVERED SOLVENT PUMP	000000
09G-112B	DECANTER RECOVERED SOLVENT PUMP	000000
09G-113A	DECANTER RECOVERED WATER PUMP	000000
09G-113B	DECANTER RECOVERED WATER PUMP	000000
09G-114A	STRIPPED WATER PUMP	000000
09G-114B	STRIPPED WATER PUMP	000000
09G-115A	SOLVENT RECOVERY COLUMN REFLUX PUMP	000000
09G-115B	SOLVENT RECOVERY COLUMN REFLUX PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
09G-116A	SOLVENT RECOVERY COLUMN BOTTOMS PUMP	000000
09G-116B	SOLVENT RECOVERY COLUMN BOTTOMS PUMP	000000
09G-117A	PHENOL COLUMN REFLUX PUMP	000000
09G-117B	PHENOL COLUMN REFLUX PUMP	000000
09G-118A	PHENOL COLUMN BOTTOMS PUMP	000000
09G-118B	PHENOL COLUMN BOTTOMS PUMP	000000
09G-119A	SOLVENT PUMP	000000
09G-119B	SOLVENT PUMP	000000
09G-120A	50 PSIG CONDENSATE PUMP	000000
09G-120B	50 PSIG CONDENSATE PUMP	000000
09G-121A	150 PSIG CONDENSATE PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER

ITEM DESCRIPTION

09G-121B

150 PSIG CONDENSATE
PUMP

000000
NA

09H-101

VACUUM EDUCTOR

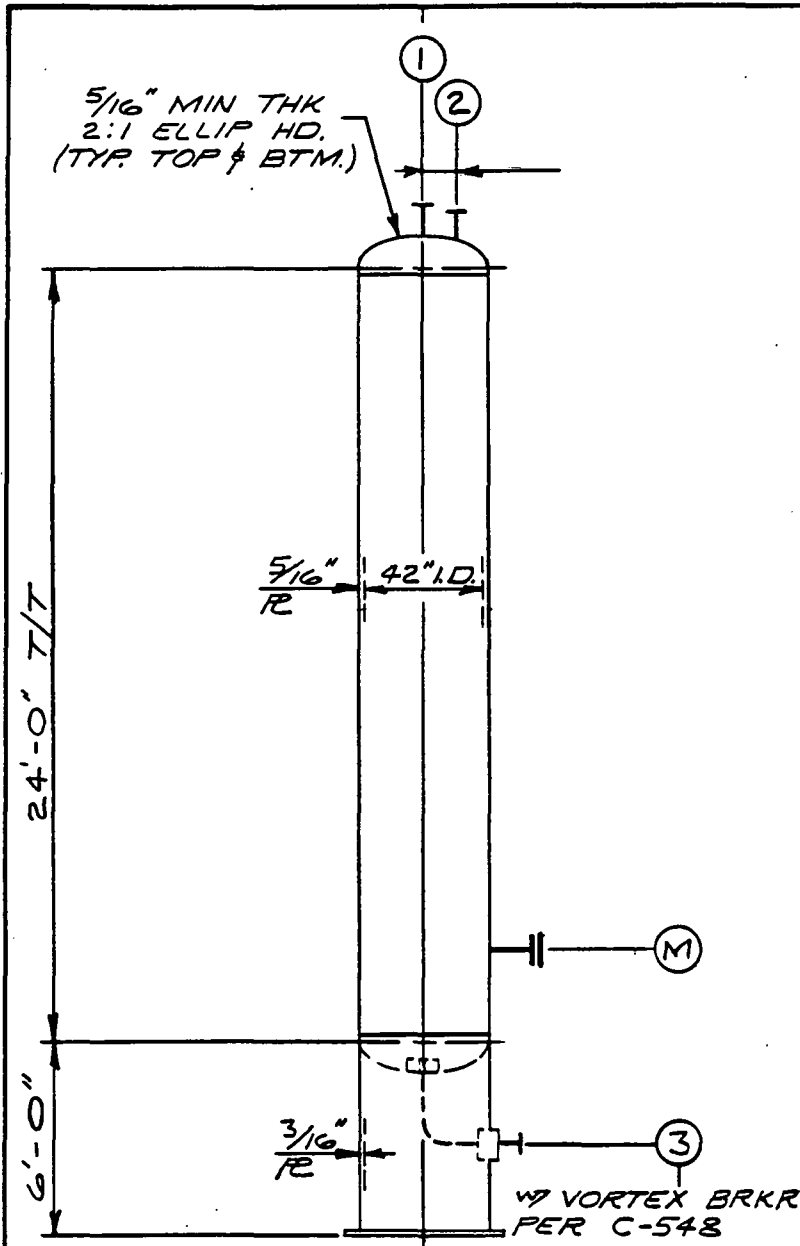
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4.1 Data Sheets for Columns and Pressure Vessels

- 9-OS-C-1: H₂S Stripper (9C-101, 9C-201)
NH₃ Absorber (9C-102, 9C-202)
Contactor (9C-103, 9C-203)
PHOSAM Stripper (9C-104, 9C-204)
OVHD Drum (9C-105, 9C-205)
Ammonia Fractionator (9C-106, 9C-206)
Reflux Drum (9C-107, 9C-207)
- 9-DS-C-2: Caustic (9D-002)
Phosphoric Acid (9D-001)
- 9-DS-C-017: Vapor/Liquid Separator;
H₂S Removal (9C-117, 9C-217)

NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:			
NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE		
9C-101,-201 H ₂ S STRIPPER FO / 300 A-816-70 / VB		9C-102,-202 NH ₃ ABSORBER SO / 300 A-816-70 / 304 SS CLAD / VB		9C-103,-203 CONTACTOR SO / 300 A-816-70 / 304 SS CLAD / VB		9C-104,-204 PHOSAM STRIPPER 300 / 425 A-816-70 / 304 SS CLAD / VB		9C-105,-205 OVHD DRUM 300 / 425 A-816-70 / 304 SS CLAD / VB		9C-106,-206 AMMONIA FRACTIONATOR 300 / 425 A-816-70 / 304 SS CLAD / VB		MC-107,-207 REFLUX DRAIN 300 / 425 A-106-B	
NOT REQ'D 20 TRAYS 1 1/2" 79 K.		SPOT / .85 NOT REQ'D 20 TRAYS 1 1/2" 80 K. (INCL 15 K. 55)		SPOT / .85 NOT REQ'D — 1 1/2" 22 K. (INCL 4.5 K. 55)		NOT REQ'D 25 TRAYS 1 1/2" 120 K. (INCL 16 K. 55)		FULL / 1.0 NOT REQ'D 25 TRAYS 1 1/2" 68 K. (INCL 6 K. 55)		SPOT / .85 NOT REQ'D 25 TRAYS 1 1/2" 57 K. (INCL 6 K. 55)		SPOT / .85 NOT REQ'D — 1 1/2" O.H. K.	
NOZZLES: NO. SIZE		NOZZLES: NO. SIZE		NOZZLES: NO. SIZE		NOZZLES: NO. SIZE		NOZZLES: NO. SIZE		NOZZLES: NO. SIZE		NOZZLES: NO. SIZE	
SKETCH													
VESSEL(S) SERIAL NO. DESIGN NUMBER MATERIAL PAINT INTERNAL INSULATION AT R/S FA.													
JOB NO. 14222													
DATA SHEET NO. REV													
9-DS-C-1 0													
BRECKINRIDGE PROJECT													
VESSEL DATA SHEET													
PLANT 9 - SOUR WATER/AMMONIA													

	NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:	
	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE
SKETCH												
VESSEL NO.												
SERVICE												
DESIGN PRESSURE												
NO. SHELL MAT'L/CAL												
W. J. JOINT EFF.												
INTERVALS												
INSULATION												
WT. R/S EA.												
SKETCH	NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:		NOZZLES:	
	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE	NO.	SIZE
VESSEL NO.	9D-002											
SERVICE	CAUSTIC											
DESIGN PRESSURE	ATM /											
NO. SHELL MAT'L/CAL	A-785C / 1/8"											
W. J. JOINT EFF.	SPOT / .85											
INTERVALS	NOT REQ'D											
INSULATION												
WT. R/S EA.	21 K.											
VESSEL NO.	9D-001											
SERVICE	PHOSPHORIC ACID											
DESIGN PRESSURE	ATM /											
NO. SHELL MAT'L/CAL	A-785C / 5/16 SS CLAD / 1/8"											
W. J. JOINT EFF.	SPOT / .85											
INTERVALS	NOT REQ'D											
INSULATION												
WT. R/S EA.	12 K. (INCL. D.B.R. 55)											
1 2/5/80 REVISED 9D-103 0 11/13/80 Issued for Phase NO. DATE REVISION Zero BY APP BY CHK BY APP BRECKINRIDGE PROJECT VESSEL DATA SHEET PLANT 9 - SOUR WATER/AMMONIA JOB NO. 14222 DATA SHEET NO. 9-DS-C-2 REV. 0												



CODE	ASME SEC. VIII DIV I-80						
SPEC.	14222-C1						
OPER. COND.	PRESS.	25 PSIG					
	TEMP.	250 °F					
DES. COND.	PRESS.	50 PSIG					
	TEMP.	300 °F					
MATERIALS	SHELL & HDS	A-516-70					
	SKIRT	A-36					
	FORGING	A-181-II					
	PIPING	A-106-B					
	STRUCTURAL						
	BOLTS						
C.A.		1/8"					
PWHT		No					
TESTS/EXAM.	X-RAY	SPOT	JOINT EFF.	85%			
	UT	MT	PT	CV @ °F.			
	HARDNESS MAX. BHN						
	WELD SAMPLING						
NOZZLES & MANWAYS	CODE	POSITION HORIZ					
	HYDRO	PRESS @ TOP 75 PSIG					
	MK	NO.	SIZE	RATING SERVICE			
	1	1		150"			
	2	1		150"			
	3	1		150"			
	M	1	20"	150"	MANWAY		
LADDER & PTFM CLIPS		REQD.	✓	NO			
PIPE SUPPORT CLIPS		REQD.		NO			
INSUL. SUPPORT CLIPS		REQD.	✓	NO			
INSUL. THICKNESS		2 IN.					
PAINTING							
VESSEL CAPACITY		242 CU. FT.					
VESSEL WEIGHT	EMPTY	4.93 KIPS					
	TEST	20 KIPS					
OPER. WT = 23 K.							
REF. DWGS.							
NO.	DATE	REVISION	DESIGN	OWN.	CHK.	APPR.	APPR.
0	12/29/80	ISSUED FOR Phase Zero	NN	EG		MP	HNTT
THE BECKINRIDGE PROJECT		JOB NO. 14222					
VAPOR / LIQUID SEPARATOR		DRAWING NO.		REV.			
H ₂ S REMOVAL 9C-117, 9C-217		9-DS-C-017		0			



4.2 Data Sheets for Exchangers

- 9-DS-E-01: H₂S Stripper Feed/Bottoms Exchanger (9E-101, 9E-201)
- 9-DS-E-02: H₂S Stripper Feed/Lean Solution Exchanger (9E-102, 9E-202)
- 9-DS-E-03: Acid Gas Cooler (9E-103 A, B, C, D, 9E-203, A, B, C, D)
- 9-DS-E-04: H₂S Stripper Feed/Preheat Exchanger (9E-104, 9E-204)
- 9-DS-E-05: NH₃ Absorber Bottoms/Lean Solution Exchanger (9E-105, 9E-205)
- 9-DS-E-06: Lean Solution Cooler (9E-106, 9E-206)
- 9-DS-E-07: PHOSAM - NH₃ Stripper Condenser (9E-107, 9E-207)
- 9-DS-E-08: NH₃ Fractionator Condensor (9E-108 A, B, 9E-208 A, B)
- 9-DS-E-09: NH₃ Fractionator Reboiler (9E-109, 9E-209)

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS INC. BUCKINGHAM, KENTUCKY		EXCHANGER MANUFACTURER			
2	PLANT # 9 SOUR WATER TREATING		EXCH. NO. 9E-101, 201	REQ. NO.		
3	SERVICE OF UNIT H₂S STRIPPER FEED/BOTTOMS EXCHANGER		ITEM NO.			
4	SIZE	TYPE BEU	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL		
5	SURF./UNIT (EFF/GROSS) 1320		SHELLS/UNIT	SURF/SHELL (EFF/GROSS) 1320		
6	PERFORMANCE OF ONE UNIT					
7	FLUID ALLOCATION		SHELLSIDE TUBESIDE			
8	FLUID CIRCULATED		STRIPPER BOTTOMS SOUR WATER			
9	TOTAL FLUID ENTERING LB/HR					
10			IN	OUT		
11	LIQUID					
12	VAPOR LB/HR, MW					
13	NONCOND LB/HR, MW					
14	STEAM					
15	WATER					
16	FLUID VAPORIZED/CONDENSED					
17	GRAVITY, LIQ.					
18	VISCOSITY, LIQ. (VAP.)					
19	THERM. COND., LIQ. (VAP.)					
20	SPECIFIC HEAT, LIQ. (VAP.)					
21						
22	TEMPERATURE °F					
23	OPERATING PRESS. (PSIA) (PSIG)					
24	NO. PASSES/SHELL					
25	VELOCITY FT/SEC					
26	PRESS. DROP, ALLOW/CALC. PSI					
27	FOULING RESISTANCE					
28	HEAT EXCHANGED		BTU/HR; MTD (CORR) (WTD) °F			
29	TRANSFER RATE, SERVICE		CLEAN BTU/HR. SQ. FT. °F			
30	CONSTRUCTION					
31			SHELLSIDE	TUBESIDE		
32	DESIGN/TEST PRESS. PSIG	100	150	FOR 2 UNITS 9E-101 9E-201		
33	DESIGN TEMPERATURE °F	300	250			
34	CORROSION ALLOWANCE IN	1/8	1/8 (EXCEPT TUBES)			
35	CONNECTIONS	INLET				
36	SIZE	OUTLET				
37	RATING					
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH	FLOW → ◁ △ ◇ □
39	TUBE MATERIAL 304 SS TUBES		TUBE-TUBESHEET JOINT			
40	SHELL C.S.	ID	OD	SHELL COVER (INTEG.) (REMOV)		
41	CHANNEL/BONNET		CHANNEL COVER			
42	TUBESHEET-STATIONARY		TUBESHEET FLOATING			
43	FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING	
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS		
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT		
47	GASKETS					
48	CODE REQUIREMENTS		STAMP (YES) (NO)	TEMA CLASS	SPECS	
49	WEIGHT: EACH SHELL		BUNDLE	FULL OF WATER		
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED					
51						
52						
53						
54						



REV.



DATE



11/13/80

Issued for Phase Zero

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JOB NO.

DRWG. NO.

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HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS INC. BRECKINRIDGE CO., KY		EXCHANGER MANUFACTURER	
2	PLANT 9 SOUR WATER TREATING EXCH. NO. 9E-102, 202		REQ. NO.	
3	SERVICE OF UNIT L.S. STRIPPER FEED/LEAN SOLUTION EXCH.		ITEM NO.	
4	SIZE	TYPE BEU	HORIZ/VERT	CONNECTED IN
5	SURF./UNIT (EFF/GROSS) 2890		SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 2890
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION		SHELLSIDE	
8	FLUID CIRCULATED		TUBESIDE	
9	TOTAL FLUID ENTERING LB/HR		SOUR WATER	
10			LEAN SOLUTION	
11				
12	LIQUID			
13	VAPOR LB/HR, MW			
14	NONCOND LB/HR, MW			
15	STEAM			
16	WATER			
17	FLUID VAPORIZED/CONDENSED			
18	GRAVITY, LIQ.			
19	VISCOSITY, LIQ. (VAP.)			
20	THERM. COND., LIQ. (VAP.)			
21	SPECIFIC HEAT, LIQ. (VAP.)			
22	TEMPERATURE °F			
23	OPERATING PRESS. (PSIA) (PSIG)			
24	NO. PASSES/SHELL			
25	VELOCITY FT/SEC			
26	PRESS. DROP, ALLOW/CALC. PSI			
27	FOULING RESISTANCE			
28	HEAT EXCHANGED		BTU/HR: MTD (CORR) (WTD) °F	
29	TRANSFER RATE, SERVICE		CLEAN BTU/HR. SQ. FT. °F	
30	CONSTRUCTION			
31			SHELLSIDE	TUBESIDE
32	DESIGN/TEST PRESS. PSIG		150	300
33	DESIGN TEMPERATURE °F		375	425
34	CORROSION ALLOWANCE IN		1/8	1/8
35	CONNECTIONS		FOR 2 UNITS 9E-102 9E-202	
36	SIZE			
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH
39	TUBE MATERIAL 304 SS WELDED		TUBE-TUBESHEET JOINT	
40	SHELL C.S.	ID	OD	SHELL COVER (INTEG.) (REMOV)
41	CHANNEL/BOXNET 304 LSS		CHANNEL COVER	
42	TUBESHEET-STATIONARY		TUBESHEET FLOATING	
43	FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)	
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA) SPACING
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS SPECS
49	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED			
51				
52				
53				
54				

	REV.	DATE				JOB NO.	DRWG. NO.	REV
	△							
	△	11/13/80	Issued for Phase Zero	R.B.	KN	OW	14200	DS-

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS INC BRECKINRIDGE, KENTUCKY. 203A,B,C,D		EXCHANGER MANUFACTURER	
2	PLANT # 9 SOLAR WATER TREATING		EXCH. NO. 9E-103A,B,C,D	REQ. NO.
3	SERVICE OF UNIT ACID GAS COOLER		ITEM NO.	
4	SIZE	TYPE BEM	(HORIZ/VERT) CONNECTED IN	SERIES 4 PARALLEL
5	SURF./UNIT (EFF/GROSS) 20,710		SHELLS/UNIT 4	SURF/SHELL (EFF/GROSS) 5177.5
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION		SHELLSIDE	TUBESIDE
8	FLUID CIRCULATED		COOLING WATER	ACID GAS + WATER
9	TOTAL FLUID ENTERING LB/HR			
10		IN	OUT	IN OUT
11	LIQUID			
12	VAPOR	LB/HR, MW		
13	NONCOND	LB/HR, MW		
14	STEAM			
15	WATER			
16	FLUID VAPORIZED/CONDENSED			
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.)			
19	THERM. COND., LIQ. (VAP.)			
20	SPECIFIC HEAT, LIQ. (VAP.)			
21				
22	TEMPERATURE °F			
23	OPERATING PRESS. (PSIA) (PSIG)			
24	NO. PASSES/SHELL			
25	VELOCITY FT/SEC			
26	PRESS. DROP, ALLOW/CALC. PSI		1	1
27	FOULING RESISTANCE			
28	HEAT EXCHANGED		BTU/HR; MTD (CORR) (WTD)	°F
29	TRANSFER RATE, SERVICE		CLEAN	BTU/HR. SQ. FT. °F
30	CONSTRUCTION			
31		SHELLSIDE	TUBESIDE	
32	DESIGN/TEST PRESS. PSIG	150	50	
33	DESIGN TEMPERATURE °F	300	300	
34	CORROSION ALLOWANCE IN	1/8	1/8	
35	CONNECTIONS	INLET		
36	SIZE	OUTLET		
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH PITCH FLOW → ◀ ▲ ▽ □
39	TUBE MATERIAL		TUBES-TITANIUM GRADE 2 TUBE-TUBESHEET JOINT	
40	SHELL C.S.	ID	OD	SHELL COVER (INTEG.) (REMOV)
41	CHANNEL 304LSS			CHANNEL COVER
42	TUBESHEET-STATIONARY		TUBESHEET FLOATING	
43	FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)	
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS	
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT	
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED			
51	* VERTICAL SHELL & TUBE WITH FIXED TUBE SHEET. 1 UNIT WITH VAPOR /			
52	LIQUID SEPARATOR BOOT ON TUBE SIDE OUTLET			
53				
54				

	REV.	DATE					JOB NO.	DRWG. NO.	REV.
	△								
	△	11/13/80	ISSUED FOR PHASE ZERO	R.B.	KN	W.P.	14220	DS-	0

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS		EXCHANGER MANUFACTURER	
2	PLANT 9 SCUR WATER TREATING		EXCH. NO. 9E-104, 204	
3	SERVICE OF UNIT 2 STRIPPER FEED PREHEAT EXCHANGER		ITEM NO.	
4	SIZE	TYPE BEU	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL
5	SURF./UNIT (EFF/GROSS)	1210	SHELLS/UNIT	1 SURF/SHELL (EFF/GROSS) 1210
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION	SHELLSIDE		TUBESIDE
8	FLUID CIRCULATED	SD = STEAM		SOUR WATER
9	TOTAL FLUID ENTERING	LB/HR	IN	OUT
10				
11	LIQUID			
12	VAPOR	LB/HR, MW		
13	NONCOND	LB/HR, MW		
14	STEAM			
15	WATER			
16	FLUID VAPORIZED/CONDENSED			
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.)			
19	THERM. COND., LIQ. (VAP.)			
20	SPECIFIC HEAT, LIQ. (VAP.)			
21				
22	TEMPERATURE	°F		
23	OPERATING PRESS.	(PSIA) (PSIG)		
24	NO. PASSES/SHELL			
25	VELOCITY	FT/SEC		
26	PRESS. DROP, ALLOW/CALC.	PSI	1	1
27	FOULING RESISTANCE			
28	HEAT EXCHANGED	BTU/HR: MTD (CORR) (WTD)		°F
29	TRANSFER RATE, SERVICE	CLEAN		BTU/HR: SQ. FT. °F
30	CONSTRUCTION			
31		SHELLSIDE	TUBESIDE	
32	DESIGN/TEST PRESS.	PSIG	75	150
33	DESIGN TEMPERATURE	°F	300	300
34	CORROSION ALLOWANCE	IN	1/8	1/8 (EXCEPT TUBES)
35	CONNECTIONS	INLET		
36	SIZE	OUTLET		
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH PITCH FLOW → ◀ ▲ ▼ □
39	TUBE MATERIAL	304 SS		TUBE-TUBESHEET JOINT
40	SHELL	C.S.	ID OD	SHELL COVER (INTEG.) (REMOV)
41	CHANNEL	304 LSS		CHANNEL COVER
42	TUBESHEET-STATIONARY			TUBESHEET FLOATING
43	FLOATING HEAD COVER			IMPINGEMENT PLATE (YES) (NO)
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS	
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT	
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED			
51				
52				
53				
54				

	REV.	DATE					JOB NO.	DRWG. NO.	RE
	△								
	△	11/13/80	ISSUED FOR PHASE ZERO	R.B	K.N	W.P	14222	DS-	0

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS INC. BRECKINRIDGE, KENTUCKY		EXCHANGER MANUFACTURER	
2	PLANT # 9 , SOUR WATER TREATING		EXCH. NO. 9E-105, 205	
3	SERVICE OF UNIT NH, ABSORBER BOTTOMS / LEAN SOLN. EXCHANGER		REQ. NO.	
4	SIZE	TYPE BEU	(HORIZ/VERT)	CONNECTED IN
5	SURF./UNIT (EFF/GROSS) 4,100		SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 4,100
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION		SHELLSIDE	
8	FLUID CIRCULATED		TUBESIDE	
9	TOTAL FLUID ENTERING LB/HR		LEAN SOLUTIONS	
10			IN	OUT
11	LIQUID			
12	VAPOR LB/HR, MW			
13	NONCOND LB/HR, MW			
14	STEAM			
15	WATER			
16	FLUID VAPORIZED/CONDENSED			
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.)			
19	THERM. COND., LIQ. (VAP.)			
20	SPECIFIC HEAT, LIQ. (VAP.)			
21				
22	TEMPERATURE °F			
23	OPERATING PRESS. (PSIA) (PSIG)			
24	NO. PASSES/SHELL			
25	VELOCITY FT/SEC			
26	PRESS. DROP, ALLOW/CALC. PSI		1	1
27	FOULING RESISTANCE			
28	HEAT EXCHANGED		BTU/HR: MTD (CORR) (WTD) °F	
29	TRANSFER RATE, SERVICE		CLEAN BTU/HR. SQ. FT. °F	
30	CONSTRUCTION			
31			SHELLSIDE	TUBESIDE
32	DESIGN/TEST PRESS. PSIG	150	1	300
33	DESIGN TEMPERATURE °F	375		425
34	CORROSION ALLOWANCE IN	1/8		1/8 (EXCEPT TUBES)
35	CONNECTIONS	INLET		
36	SIZE	OUTLET		
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH PITCH
39	TUBE MATERIAL	304SS WELDED TUBES		
40	SHELL	304LSS CLAD	ID OD	SHELL COVER (INTÉG.) (REMOV)
41	CHANNEL	304LSS		
42	TUBESHEET-STATIONARY	CHANNEL COVER		
43	FLOATING HEAD COVER	TUBESHEET FLOATING		
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS	
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT	
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED			
51				
52				
53				
54				

FOR 2 UNITS
9E-105
9E-205

	REV.	DATE					JOB NO.	DRWG. NO.	REV.
	△								
	△	11/13/80	ISSUED FOR PHASE ZERO	R.B.	KAJ	JWP	MMH	14222	05

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND SYNTHETIC FUELS INC. BRECKINRIDGE CO., KY.		EXCHANGER MANUFACTURER			
2	PLANT 9 SOVR WATER TREATING		EXCH. NO. 9E-106, 206	REQ. NO.		
3	SERVICE OF UNIT LEAN SOLUTION COOLING		ITEM NO.			
4	SIZE	TYPE BEU	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL		
5	SURF./UNIT (EFF/GROSS) 1210		SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 1210		
6	PERFORMANCE OF ONE UNIT					
7	FLUID ALLOCATION		SHELLSIDE TUBESIDE			
8	FLUID CIRCULATED		COOLING WATER LEAN SOLUTION			
9	TOTAL FLUID ENTERING LB/HR					
10			IN	OUT		
11	LIQUID					
12	VAPOR LB/HR, MW					
13	NONCOND LB/HR, MW					
14	STEAM					
15	WATER					
16	FLUID VAPORIZED/CONDENSED					
17	GRAVITY, LIQ.					
18	VISCOSITY, LIQ. (VAP.)					
19	THERM. COND., LIQ. (VAP.)					
20	SPECIFIC HEAT, LIQ. (VAP.)					
21						
22	TEMPERATURE °F					
23	OPERATING PRESS. (PSIA) (PSIG)					
24	NO. PASSES/SHELL					
25	VELOCITY FT/SEC					
26	PRESS. DROP, ALLOW/CALC. PSI		1	1		
27	FOULING RESISTANCE					
28	HEAT EXCHANGED		BTU/HR: MTD (CORR) (WTD) °F			
29	TRANSFER RATE, SERVICE		CLEAN BTU/HR. SQ. FT. °F			
30	CONSTRUCTION					
31			SHELLSIDE	TUBESIDE		
32	DESIGN/TEST PRESS. PSIG	150	300	FOR 2 UNITS 9E-106 9E-206		
33	DESIGN TEMPERATURE °F	375	425			
34	CORROSION ALLOWANCE IN	1/8	1/8 (EXCEPT TUBES)			
35	CONNECTIONS	INLET				
36	SIZE	OUTLET				
37	RATING					
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH	FLOW → ☒ ☐ ☐ ☐
39	TUBES MATERIAL 304CS WELDED TUBES		TUBE-TUBESHEET JOINT			
40	SHELL C.S.	ID	OD	SHELL COVER		(INTEG.) (REMOV)
41	CHANNEL 304LSS			CHANNEL COVER		
42	TUBESHEET-STATIONARY		TUBESHEET FLOATING			
43	FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING	
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS		
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT		
47	GASKETS					
48	CODE REQUIREMENTS	STAMP (YES) (NO)		TEMA CLASS	SPECS	
49	WEIGHT: EACH SHELL	BUNDLE		FULL OF WATER		
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED					
51						
52						
53						
54						

	REV.	DATE					JOB NO.	DRWG. NO.	REV.
		11/13/80	ISSUED FOR PHASE ZERO	R.B.	KN	3.0	MMH	14222	DS-

HEAT EXCHANGER SPECIFICATION SHEET

CUSTOMER AND ASHLAND SYNTHETIC FUELS INC.		EXCHANGER MANUFACTURER			
PROJECT LOCATION BRECKINRIDGE, KENTUCKY, 207		REQ. NO.			
PLANT #9 SOUR WATER/AMMONIA EXCH. NO. 9E-107 (TOP SEC.)		ITEM NO.			
SERVICE OF UNIT PHOSAM-NH ₃ STRIPPER CONDENSER					
SIZE	TYPE BEM	VERT CONNECTED IN	SERIES PARALLEL		
SURF./UNIT (EFF/GROSS) 9710	SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 9710			
PERFORMANCE OF ONE UNIT					
FLUID ALLOCATION		SHELLSIDE			
FLUID CIRCULATED		TUBESIDE			
TOTAL FLUID ENTERING LB/HR		RICH SOLUTION			
		AQUA-AMMONIA VAPOR			
		IN	OUT		
LIQUID					
VAPOR LB/HR, MW					
NONCOND LB/HR, MW					
STEAM					
WATER					
FLUID VAPORIZED/CONDENSED					
GRAVITY, LIQ.					
VISCOSITY, LIQ. (VAP.)					
THERM. COND., LIQ. (VAP.)					
SPECIFIC HEAT, LIQ. (VAP.)					
TEMPERATURE °F					
OPERATING PRESS. (PSIA) (PSIG)					
NO. PASSES/SHELL					
VELOCITY FT/SEC					
PRESS. DROP, ALLOW/CALC. PSI		1	1		
FOULING RESISTANCE					
HEAT EXCHANGED BTU/HR; MTD (CORR) (WTD)		°F			
TRANSFER RATE, SERVICE CLEAN		BTU/HR. SQ. FT. °F			
CONSTRUCTION					
		SHELLSIDE	TUBESIDE		
DESIGN/TEST PRESS. PSIG	300	300	FOR 2 UNITS 9E-107 9E-207		
DESIGN TEMPERATURE °F	425	425			
CORROSION ALLOWANCE IN	1/8 CA	1/8 CA (EXCEPT TUBES)			
CONNECTIONS	INLET				
SIZE	OUTLET				
RATING					
TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH	FLOW → ◁ ▷ ◊ □
TUBE MATERIAL 304 SS WELDED TUBES		TUBE-TUBESHEET JOINT			
SHELL 304 LSS CLAD ID OD		SHELL COVER (INTEG.) (REMOV)			
CHANNEL 304 LSS		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. THK.: SHELL CHAN.		EXPANSION JOINT			
GASKETS					
CODE REQUIREMENTS		STAMP (YES) (NO)	TEMA CLASS	SPECS	
WEIGHT: EACH SHELL		BUNDLE	FULL OF WATER		
REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED					
* VERTICAL SHELL & TUBE (FIXED TUBE SHEET).					
18" SPACER BETWEEN SHELL SECTIONS					

R&C SPE FORM 158 (6/74)

9-DS-E-07

SHEET 1 OF 2

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION ASHLAND CYNTHETIC FUELS INC. BRECKINRIDGE, KENTUCKY.				EXCHANGER MANUFACTURER			
2	PLANT # 9 SINK WATER / AMMONIA				EXCH. NO. 9E-107 (BOTTOM SEC.) REQ. NO.			
3	SERVICE OF UNIT PHOSAM-NH STRIPPER CONDENSER				ITEM NO.			
4	SIZE	TYPE	(HORIZ/VERT)	CONNECTED IN	SERIES	PARALLEL		
5	SURF./UNIT (EFF/GROSS) 3580		SHELLS/UNIT		SURF/SHELL (EFF/GROSS)			
6	PERFORMANCE OF ONE UNIT							
7	FLUID ALLOCATION		SHELLSIDE			TUBESIDE		
8	FLUID CIRCULATED		COOLING WATER			AQUA-AMMONIA (V/L)		
9	TOTAL FLUID ENTERING		LB/HR					
10			IN		OUT		IN	
11	LIQUID							
12	VAPOR		LB/HR, MW					
13	NONCOND		LB/HR, MW					
14	STEAM							
15	WATER							
16	FLUID VAPORIZED/CONDENSED							
17	GRAVITY, LIQ.							
18	VISCOSITY, LIQ. (VAP.)							
19	THERM. COND., LIQ. (VAP.)							
20	SPECIFIC HEAT, LIQ. (VAP.)							
21								
22	TEMPERATURE		°F					
23	OPERATING PRESS.		(PSIA) (PSIG)					
24	NO. PASSES/SHELL							
25	VELOCITY		FT/SEC					
26	PRESS. DROP, ALLOW/CALC.		PSI		1		1	
27	FOULING RESISTANCE							
28	HEAT EXCHANGED				BTU/HR; MTD (CORR) (WTD)		°F	
29	TRANSFER RATE, SERVICE				CLEAN		BTU/HR. SQ. FT. °F	
30	CONSTRUCTION							
31			SHELLSIDE		TUBESIDE			
32	DESIGN/TEST PRESS.		PSIG		150		300	
33	DESIGN TEMPERATURE		°F		375		425	
34	CORROSION ALLOWANCE		IN		1/8 CA		1/8 CA (EXCEPT TUBES)	
35	CONNECTIONS		INLET					
36	SIZE		OUTLET					
37	RATING							
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH	PITCH	FLOW → ◀ ▲ ◆ □		
39	TUBE MATERIAL 304 SS WELDED TUBES				TUBE-TUBESHEET JOINT			
40	SHELL	C.S.	ID	OD	SHELL COVER		(INTEG.) (REMOV)	
41	CHANNEL	304 LSS		CHANNEL COVER				
42	TUBESHEET-STATIONARY				TUBESHEET FLOATING			
43	FLOATING HEAD COVER				IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS	TYPE		% CUT (DIA/AREA)	SPACING			
45	BAFFLES-LONG	SEAL TYPE		TUBE SUPPORTS				
46	INSUL. THK.: SHELL	CHAN.		EXPANSION JOINT				
47	GASKETS							
48	CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS		SPECS	
49	WEIGHT: EACH SHELL		BUNOLE		FULL OF WATER			
50	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED							
51	* VERTICAL SHELL AND TUBE (OUTSIDE PACKED FLOATING HEAD)							
52								
53								
54								

	REV.	DATE						JOB NO.	DRWG. NO.	RE		
	△											
	△	11/13/80	ISSUED FOR PHASE ZERO				R-B	K N	5-12	PHW	14222	OS-

R&C SPE FORM 158 (6/78)

9-DS-E-07
SHEET 2 OF 2

HEAT EXCHANGER SPECIFICATION SHEET

1	CUSTOMER AND PROJECT LOCATION <i>ASPLAND SYNTHETIC FUEL INC. WHEELING, KENTUCKY 208 A, B</i>		EXCHANGER MANUFACTURER	
2	PLANT <i>NH₃ FRACTIONATOR CONDENSER</i> EXCH. NO. <i>9E-108 A, B</i>		REQ. NO.	
3	SERVICE OF UNIT		ITEM NO.	
4	SIZE	TYPE <i>BEU</i>	(HORIZ/VERT) CONNECTED IN	SERIES <i>2</i> PARALLEL
5	SURF./UNIT (EFF/GROSS) <i>9860</i>	SHELLS/UNIT <i>2</i>	SURF/SHELL (EFF/GROSS) <i>4930</i>	
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION		SHELLSIDE	
8	FLUID CIRCULATED		TUBESIDE	
9	TOTAL FLUID ENTERING	LB/HR	AMMONIA	
10			IN	OUT
11	LIQUID			
12	VAPOR	LB/HR, MW		
13	NONCOND	LB/HR, MW		
14	STEAM			
15	WATER			
16	FLUID VAPORIZED/CONDENSED			
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.)			
19	THERM. COND., LIQ. (VAP.)			
20	SPECIFIC HEAT, LIQ. (VAP.)			
21				
22	TEMPERATURE	°F		
23	OPERATING PRESS.	(PSIA) (PSIG)		
24	NO. PASSES/SHELL			
25	VELOCITY	FT/SEC		
26	PRESS. DROP, ALLOW/CALC.	PSI	<i>1</i>	<i>1</i>
27	FOULING RESISTANCE			
28	HEAT EXCHANGED	BTU/HR: MTD (CORR) (WTD)		°F
29	TRANSFER RATE, SERVICE	CLEAN		BTU/HR. SQ. FT. °F
30	CONSTRUCTION			
31		SHELLSIDE	TUBESIDE	
32	DESIGN/TEST PRESS.	PSIG	<i>300</i>	<i>150</i>
33	DESIGN TEMPERATURE	°F	<i>425</i>	<i>375</i>
34	CORROSION ALLOWANCE	IN	<i>1/8 CA</i>	<i>1/8 (EXCEPT TUBES)</i>
35	CONNECTIONS	INLET		
36	SIZE	OUTLET		
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH PITCH
39	TUBE MATERIAL <i>CS.</i>	TUBE-TUBESHEET JOINT		
40	SHELL <i>CS.</i>	ID	OD	SHELL COVER (INTEG.) (REMOV)
41	CHANNEL/BONNET	CHANNEL COVER		
42	TUBESHEET-STATIONARY	TUBESHEET FLOATING		
43	FLOATING HEAD COVER	IMPINGEMENT PLATE (YES) (NO)		
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS	
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT	
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED			
51				
52				
53				
54				

	REV.	DATE					JOB NO.	DRWG. NO.	REV.
	△								
	△	11/13/80	ISSUED FOR PHASE ZERO	R.B.	KJ	WJ	HW	14222	DS.

HEAT EXCHANGER SPECIFICATION SHEET

RAC 3FK FORM 138 (6/74)

9-DS-E-09

4.3 Data Sheets for Pumps and Drivers

- 9-DS-G-01: H₂S Stripper Bottoms Pump (9G-101 A, B, 9G-201 A, B)
- 9-DS-G-02: Absorber OVHD Condensate Pump (9G-102 A, B, 9G-202 A, B)
- 9-DS-G-03: NH₃ Absorber Bottoms Pump (9G-103 A, B, 9G-203 A, B)
- 9-DS-G-04: PHOSAM Rich Solution Pump (9G-104 A, B, 9G-204 A, B)
- 9-DS-G-05: Ammonia Fractionator (9G-105 A, B, 9G-205 A, B)
- 9-DS-G-06: NH₃ Fractionator Reflux Pump (9G-106 A, B, 9G-206 A, B)
- 9-DS-G-07: Phosphoric Acid Addition Pump (9G-007)
- 9-DS-G-08: Caustic Metering Pump (9G-008, 9G-108, 9G-208)

CENTRIFUGAL PUMP DATA SHEET

APPLICABLE TO: PROPOSALS ☐ PURCHASE ☐ AS BUILT ☐

NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:

☐ BY MANUFACTURER

JOB NO. 14222 ITEM NO. 96-101 A, B
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE 10/16/80 REVISION _____

FOR BRECKINRIDGE PROJECT SITE KENTUCKY
 UNIT PLANT #9 SERVICE H2S STRIPPER BOTTOMS PUMP
 NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. 96-101 A, B PROVIDED BY _____ MTD BY _____
 NO. TURBINES REQ'D _____ ITEM NO. 96-201 A, B PROVIDED BY _____ MTD BY _____
 PUMP MFR _____ SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

** OPERATING CONDITIONS, EACH PUMP	** PERFORMANCE
LIQUID <u>H2S STRIPPER BOTTOMS</u> U.S. GPM at PT. NOR. <u>1600</u> RATED _____	PROPOSAL CURVE NO. _____
DISCH. PRESS. PSIG _____	RPM _____ NPSHR (WATER) _____
PT. F. NOR. _____ MAX. _____ SUCT. PRESS. PSIG MAX. _____ RATED _____	EFF. _____ BHP RATED _____
SP. GR. at PT. _____ DIFF. PRESS. PSI _____	MAX. BHP RATED IMP. _____
VAP. PRESS. at PT. PSIA _____ DIFF. HEAD. FT. _____	MAX. HEAD RATED IMP. _____
VIS. at PT. Sec _____ CP _____ NPSHA, FT. _____	MIN. CONTINUOUS GPM _____
CORR./EROS. CAUSED BY _____ HYD. HP _____	ROTATION (VIEWED FROM CPLG END) _____

CONSTRUCTION					SHOP TESTS
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF. ☐ WIT. PERF.
SUCTION					☐ NON-WIT. HYDRO ☐ WIT. HYDRO
DISCHARGE					☐ NPSH REQ'D. ☐ WIT. NPSH

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 _____

AUXILIARY PIPING
☐ C.W. PIPE PLAN _____ ☐ CU: ☐ S.S.: ☐ TUBING: ☐ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM _____ ☐ SIGHT F.L. 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 _____

MOTOR DRIVER
 HP 40 RPM 1800 * FRAME _____ VOLTS/PHASE/CYCLES 460/3/60
 MFR _____ BEARINGS _____ LUBE _____
 TYPE _____ INSUL _____ FULL LOAD AMPS _____
 ENC _____ TEMP RISE C _____ LOCKED ROTOR AMPS _____
☐ VHS ☐ VSS VERT. THRUST CAP. LB. _____ SERVICE FACTOR _____

MATERIALS
 API CASE/TRIM CLASS C.S. CASE/
304 SS IMPELLER

BASEPLATE: ☐ _____

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

TURBINE DRIVER
 APPROX. WT. PUMP & BASE _____
 MOTOR _____ TURBINE _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* USE FOR ESTIMATING ONLY

** OPERATING DATA UNAVAILABLE FROM LICENSOR

FORM NO 130 (REVISED SEP 73)



NO.	DATE	REVISION	JOB NO.	DRAWING NO.	REV.
1	12/10/80	REISSUE FOR PAPER D, QTY REVIS	14222	9-DS-1-01	1
0	10/21/80	ISSUED FOR BLUE PRINT			
SHEET 1 OF 1					

JOB NO. 14222 ITEM NO. 9G-202 A, B
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE 10/16/80 REVISION _____

PURCHASE ORDER NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
DATE 10/16/80 REVISION _____

** OPERATING CONDITIONS, EACH PUMP				** PERFORMANCE	
LIQUID <u>ASSOKBER OVDH CONDENSE</u>		U.S. GPM at PT. NOR. <u>275</u>	RATED	PROPOSAL CURVE NO.	
STATE		DISCH. PRESS. PSIG		RPM _____ NPSHR (WATER)	
PT. F. NOR. _____	MAX. _____	SUCT. PRESS. PSIG MAX. _____	RATED	EFF. _____ BHP RATED	
SP. GR. at PT. _____		DIFF. PRESS. PSI		MAX. BHP RATED IMP	
VAP. PRESS. at PT. PSIA _____		DIFF. HEAD, FT		MAX. HEAD RATED IMP	
VIS. at PT. Ssm _____	CP _____	NPSHA, FT		MIN. CONTINUOUS GPM	
CORR/EROS. CAUSED BY _____		HYD. HP		ROTATION (VIEWED FROM CPLG END)	

SHOP TESTS

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____

SPLIT: ☐ AXIAL ☐ RAD: TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER

PRESS: ☐ MAX. ALLOW. _____ PSI ☐ HYDRO TEST _____ PSI

☐ SHOP INSPECTION

☐ DISMANT. & INSP. AFTER TEST

☐ OTHER _____

CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE
IMPELLER DIA: ☐ RATED _____ ☐ MAX _____ ☐ TYPE _____

MOUNT: ☐ BETWEEN SIGS ☐ OVERHUNG ☐ WEAR RG. DRAM/CLINC _____ API CASE/TRIM CLASS ☐ _____
 READING TYPE: ☐ RADIAL ☐ THINIST _____ ALL 304 SS

WIDE: ☐ TUNG OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐ _____

DRIVER HALF MTD BY: ☐ PUMP MFR ☐ DRIVER MFR ☐ PURCHASER

PACKING: ☐ MFR & TYPE _____ ☐ SIZE/NO. OF RINGS _____ BASEPLATE: ☐ _____

MECH. SEAL: ☐ MFR & MODEL _____ API CLASS. CODE _____

VERTICAL PUMPS

☐ MFR CODE _____ FT OR SUMP DEPTH ☐ _____
 _____ MIN. SUBMERGENCE REQ'D. ☐ _____

VERTICAL PUMPS

☐ C.W. PIPE PLAN _____ ☐ CU: ☐ S.S.: ☐ TUBING: ☐ PIPE _____
☐ TOTAL COOLING WATER RECD. GPM _____ ☐ SIGHT GL. RECD. _____
 COLUMN PIPE: ☐ FLANGED ☐ THREADED
 LINE SHAFT: ☐ OPEN ☐ ENCLOSED

PACKING COOLING INJECTION REGR: ☐ TOTAL GPM _____ ☐ PSI _____ BRGS: ☐ BOWL _____ ☐ LINE SHAFT _____
BOL LUBE ☐ WATER ☐ OIL ☐ GREASE _____

☐ EXTERNAL SEAL FLUSH FLUID ☐ GPM ☐ PSIG
☐ AUXILIARY SEAL FLASH ☐ GPM ☐ PSIG

FLOAT & ROD ☐ C.I. ☐ S.S. ☐ BRZ ☐ NON
 FLOAT SWITCH ☐

☐ AUX. SEAL QUENCH FLUID
 ☐ G.S.
 ☐ S.S.
 ☐ TUBING
 ☐ PIPE
 PUMP THRUST. LB ☐ UP ☐ DOWN

TURBINE DRIVER

HP 20 RPM 1800 * FRAME _____ VOLTS/PHASE/CYCLES 460/3/60
MFR _____ BEARINGS _____ LUBE _____

TYPE	TRAIL	FULL LOAD AMPS
ENC	TEMP ENC C	LOCKED ROTOR AMPS
		APPROX MAX BRK & BATT

☐ VMS ☐ VSS VERT. THRUST CAP. LB. _____ SERVICE FACTOR _____ MOTOR _____ TURBINE _____

API STANDARD 810 GOVERNS UNLESS OTHERWISE NOTED.
* USE FOR ESTIMATING ONLY.

** OPERATING DATA UNAVAILABLE FROM LICENSOR

				JOB NO.	DRAWING NO.	REV.
1	12/10/63	REISSUED FOR PHASE 2, QTY REVISED	RD ^{OWP}	14222	9-DS-G-02	1
0	10/2/1960	ISSUED FOR Phase 3 and	RB ^{OWP}			
NO.	DATE			SHEET	1 OF 1	



CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 96-103 A.B
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE 10/16/80 REVISION _____

FOR BRECKINRIDGE PROJECT SITE KENTUCKY
 UNIT PLANT #9 SERVICE NH₃ ABSORBER BOTTOMS PUMP
 NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. 96-103 A.B PROVIDED BY _____ MTD BY _____
 NO. TURBINES REQ'D _____ ITEM NO. 96-203 A.B PROVIDED BY _____ MTD BY _____
 PUMP MFR _____ SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

** OPERATING CONDITIONS, EACH PUMP		** PERFORMANCE	
LIQUID <u>NH₃ ABSORBER</u>	U.S. GPM at PT. NOR. <u>4300</u> RATED	PROPOSAL CURVE NO. _____	
<u>BOTTOMS</u>	DISCH. PRESS. PSIG _____	RPM _____ NPSHR (WATER) _____	
PT. F. NOR. _____ MAX. _____	SUCT. PRESS. PSIG MAX. _____ RATED _____	EFF. _____ SHP RATED _____	
SP. GR. at PT. _____	DIFF. PRESS. PSI _____	MAX. SHP RATED IMP _____	
VAP. PRESS. at PT. PSIA _____	DIFF. HEAD. FT. _____	MAX. HEAD RATED IMP _____	
VIS. at PT. SSM _____ CP _____	NPSHA, FT. _____	MIN. CONTINUOUS GPM _____	
CORR./EROS. CAUSED BY _____	HYD. HP _____	ROTATION (VIEWED FROM CPLG END) _____	

CONSTRUCTION					SHOP TESTS	
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF.	☐ WIT. PERF.
SUCTION					☐ NON-WIT. HYDRO	☐ WIT. HYDRO
DISCHARGE					☐ NPSH REQ'D.	☐ WIT. NPSH

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____
 SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ OBL ☐ 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 INSPECTION
☐ DISMANT. & INSP. AFTER TEST
☐ OTHER _____

MATERIALS
 API CASE/TRIM CLASS ALL 304 SS

BASEPLATE: ☐ _____

VERTICAL PUMPS

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

TURBINE DRIVER

APPROX. WT. PUMP & BASE
 MOTOR _____ TURBINE _____

AUXILIARY PIPING
☐ C.W. PIPE PLAN ☐ CU: ☐ S.S.: ☐ TUBING: ☐ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM _____ ☐ SIGHT F.L. 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 _____

MOTOR DRIVER

HP 125 RPM 1800 FRAME _____ VOLTS/PHASE/CYCLES 460/3/60
 MFR _____ BEARINGS _____ LUBE _____
 TYPE _____ INSUL _____ FULL LOAD AMPS _____
 ENC _____ TEMP RISE, C. _____ LOCKED ROTOR AMPS _____
☐ VHS ☐ VSS VERT. THRUST CAP. LB. _____ SERVICE FACTOR _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* USE FOR ESTIMATING ONLY

** OPERATING DATA UNAVAILABLE FROM LICENSOR



						JOB NO.	DRAWING NO.	REV.
1	12/14/80	REISSUED FOR PHASE D, QTY. REVISED	UD	UP	HW	14222	9-DS-G-03	1
0	10/21/80	ISSUED FOR PHASE 3 RD	RB	UP				
NO.	DATE					SHEET	OF	
						1	1	

CENTRIFUGAL PUMP DATA SHEET

APPLICABLE TO: PROPOSALS ☐ PURCHASE ☐ AS BUILT ☐

NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER

☐ BY MANUFACTURER

JOB NO. 14222 ITEM NO. 96-104 A, B

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE 10/16/00 REVISION _____

FOR BRECKINRIDGE PROJECT SITE KENTUCKY
 UNIT PLANT #9 SERVICE PHOSAM RICH SOLUTION PUMP
 NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. 96-104 A, B PROVIDED BY _____ MTD BY _____
 NO. TURBINES REQ'D _____ ITEM NO. 96-104 A, B PROVIDED BY _____ MTD BY _____
 PUMP MFR _____ SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

** OPERATING CONDITIONS, EACH PUMP

LIQUID PHOSAM RICH SOLUTION U.S. GPM at FT. HOR. 1100 RATED _____
 DISCH. PRESS. PSIG _____
 FT. F. HOR. _____ MAX. _____ SUCT. PRESS. PSIG MAX. _____ RATED _____
 SP. GR. at FT. _____ DIFF. PRESS. PSI _____
 VAP. PRESS. at FT. PSIA _____ DIFF. HEAD. FT. _____
 VLS. at FT. S.W. _____ CP _____ NPSHA, FT. _____
 CORR/ENGS. CAUSED BY _____ HYD. HP _____

** PERFORMANCE

PROPOSAL CURVE NO. _____
 RPM _____ NPSHR (WATER) _____
 EFF. _____ BHP RATED _____
 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 SNGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLUNG
 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-WT. PERF. ☐ WT. PERF.
☐ NON-WT. HYDRO ☐ WT. HYDRO
☐ NPSH REQ'D ☐ WT. NPSH
☐ SHOP INSPECTION
☐ DISMANT. & INSP. AFTER TEST
☐ OTHER _____

MATERIALS

API CASE/TRIM CLASS ALL 304 SS
 BASEPLATE: ☐ _____

VERTICAL PUMPS

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

TURBINE DRIVER

APPROX. WT. PUMP & BASE _____
 MOTOR _____ TURBINE _____

AUXILIARY PIPING

☐ C.W. PIPE PLAN _____ ☐ C.W. ☐ S.S. ☐ TUBING: ☐ PIPE
☐ TOTAL COOLING WATER REQ'D. GPM _____ ☐ SIGHT FL. 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 _____

MOTOR DRIVER

HP 400 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 _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

* USE FOR ESTIMATING ONLY

** OPERATING DATA UNAVAILABLE FROM LICENSOR

FORM NO. 130 (REVISED SEPT 72)



NO.	DATE	DESCRIPTION	BY	CHKD	JOB NO.	DRAWING NO.	REV.
1	12/10/00	REISSUE FOR CHANGE O. QTY. REVISED	DD	4-00	14222	9-05-6-04	1
2	10/21/00	ISSUED FOR Phase 3-00	DB	2-00			
					SHEET <u>1</u> OF <u>1</u>		

CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 9G-105 A, B
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE 10/15/80 REVISION _____

FOR BRECKINRIDGE PROJECT SITE KENTUCKY
 UNIT PLANT #9 SERVICE AMMONIA FRACTIONATOR
 NO. PUMPS REQ'D 4 NO. MOTORS REQ'D 4 ITEM NO. 9G-105 A, B PROVIDED BY _____ MTD BY _____
 NO. TURBINES REQ'D _____ ITEM NO. 16-203 A, B PROVIDED BY _____ MTD BY _____
 PUMP MFR _____ SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

** OPERATING CONDITIONS, EACH PUMP	** PERFORMANCE
LIQUID <u>NH₃ FRACTIONATOR FEED</u> U.S. GPM at PT. NOR. <u>300</u> RATED _____	PROPOSAL CURVE NO. _____
DISCH. PRESS. PSIG _____	RPM _____ NPSHR (WATER) _____
PT. F. NOR. _____ MAX. _____ SUCT. PRESS. PSIG MAX. _____ RATED _____	EFF. _____ BHP RATED _____
SP. GR. at PT. _____ DIFF. PRESS. PSI _____	MAX. BHP RATED IMP _____
VAP. PRESS. at PT. PSIA _____ DIFF. HEAD. FT. _____	MAX. HEAD RATED IMP _____
VIS. at PT. SSS _____ CP _____ NPSHA FT. _____	MIN. CONTINUOUS GPM _____
CORR/EROS. CAUSED BY _____ HYD. HP _____	ROTATION (VIEWED FROM CPLG END) _____

CONSTRUCTION					SHOP TESTS
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF. ☐ WIT. PERF.
SUCTION					☐ NON-WIT. HYDRO ☐ WIT. HYDRO
DISCHARGE					☐ NPSH REQ'D. ☐ WIT. NPSH
CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____					☐ SHOP INSPECTION
SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER					☐ DISMANT. & INSP. AFTER TEST
PRESS: ☐ MAX. ALLOW. _____ PSIG _____ °F. ☐ HYDRO TEST _____ PSIG					☐ OTHER _____
CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE					
IMPELLER DIA: ☐ RATED _____ ☐ MAX. _____ ☐ TYPE _____					
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLINC. _____					
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 _____					

AUXILIARY PIPING	VERTICAL PUMPS
☐ C.W. PIPE PLAN _____ ☐ CU: ☐ S.S. ☐ TUBING: ☐ PIPE	PIT OR SUMP DEPTH ☐ _____
☐ TOTAL COOLING WATER REQ'D. GPM _____ ☐ SIGHT F.L. REQ'D _____	MIN. SUBMERGENCE REQ'D. ☐ _____
☐ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM _____ ☐ PSIG _____	COLUMN PIPE: ☐ FLANGED ☐ THREADED
☐ SEAL FLUSH PIPE PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE	LINE SHAFT: ☐ OPEN ☐ ENCLOSED
☐ EXTERNAL SEAL FLUSH FLUID _____ ☐ GPM _____ ☐ PSIG _____	BRGS: ☐ BOWL _____ ☐ LINE SHAFT _____
☐ AUXILIARY SEAL PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE	BRS. LUBE ☐ WATER ☐ OIL ☐ GREASE
☐ AUX. SEAL QUENCH FLUID _____	FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NONE
	FLOAT SWITCH ☐ _____
	PUMP THRUST. LB ☐ UP _____ ☐ DOWN _____

MOTOR DRIVER	TURBINE DRIVER
HP <u>75</u> RPM <u>1800</u> X FRAME _____ VOLTS/PHASE/CYCLES <u>460/3/60</u>	
MFR _____ BEARINGS _____ LUBE _____	
TYPE _____ INSUL _____ FULL LOAD AMPS _____	
ENC _____ TEMP RISE C _____ LOCKED ROTOR AMPS _____	
☐ VHS ☐ VSS VERT. THRUST CAP. LB _____ SERVICE FACTOR _____	
	APPROX. WT. PUMP & BASE _____
	MOTOR _____ TURBINE _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* USE FOR ESTIMATING ONLY

** OPERATING DATA UNAVAILABLE FROM LICENSEE



						JOB NO.	DRAWING NO.	REV.
1	12/10/80	REISSUE FOR PUMP D, QTY. REVISED	01	2/1	MMH	14222	9-DS-6-05	1
0	10/21/80	ISSUED FOR PUMP 2 & 3	R.D.	2/1				
NO.	DATE					SHEET	1	OF 1

FORM NO 120 (REVISED SEPT 72)

JOB NO. 142-2 ITEM NO. 9G-206A,B
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE 10/13/82 REVISION _____

FOR <u>BRECKINRIDGE PROJECT</u>		SITE <u>KENTUCKY</u>	
UNIT <u>PLANT # 9</u>		SERVICE <u>NH₃ EXTRACTOR REFLUX PUMP</u>	
NO. PUMPS REQ'D <u>4</u>	NO. MOTORS REQ'D <u>4</u>	ITEM NO. <u>96-10 LAB</u>	PROVIDED BY _____ MTD BY _____
		<u>36-20628</u>	
NO. TURBINES REQ'D _____	ITEM NO. _____	PROVIDED BY _____	MTD BY _____
PUMP MFR _____	SIZE AND TYPE _____	STAGES _____	SERIAL NO _____

** OPERATING CONDITIONS, EACH PUMP				** PERFORMANCE	
LIQUID <u>NH₃ FRACTIONATOR</u>		U.S. GPM at PT. NOM. <u>2100</u>	RATED _____	PROPOSAL CURVE NO. _____	
<u>REFLUX</u>		DISCH. PRESS. PSIG _____		RPM _____ NPSHR (WATER) _____	
PT. F. NOM. _____	MAX. _____	SUCT. PRESS. PSIG MAX. _____	RATED _____	EFF. _____ BHP RATED _____	
SP. GR. at PT _____		DIFF. PRESS. PSI _____		MAX. BHP RATED IMP _____	
VAP. PRESS. at PT. PSIA _____		DIFF. HEAD. FT _____		MAX. HEAD RATED IMP _____	
VIS. at PT. Sme _____		CP _____	NPSHA, FT _____	MIN. CONTINUOUS GPM _____	
CORR./EROS. CAUSED BY _____			HYD. HP _____	ROTATION (VIEWED FROM CPLG END) _____	

CONSTRUCTION					SHOP TESTS	
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF.	☐ WIT. PERF.
SUCTION					☐ NON-WIT. HYDRO	☐ WIT. HYDRO
DISCHARGE					☐ NP SH REQ'D.	☐ WIT. NP SH

CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____

SPLIT: ☐ AXIAL ☐ RAQ: TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER

PRESS: ☐ MAX. ALLOW. _____ PSIG _____ "F: ☐ HYDRO TEST _____ PSIG

CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE

IMPELLER DIA.: ☐ RATED _____ ☐ MAX _____ ☐ TYPE: _____

MOUNT: ☐ BETWEEN RINGS ☐ OVERHUNG ☐ WEAR. RG. DIAM./CLRNG. _____

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
☐ NPISH REQ'D.	☐ WIT. NPISH
☐ SHOP INSPECTION	
☐ DISMANT. & INSP. AFTER TEST	
☐ OTHER _____	

MATERIALS	
API CASE/TRIM CLASS	CS CASE/304 SS
	IMPELLER

BASEPLATE: ☐ _____

VERTICAL PUMPS

PIT OR SUMP DEPTH 0MIN. SUBMERGENCE REQ'D. ☐ _____

COLUMN PIPE ☐ FLANGED ☐ THREADED

LINE SHAFT: ☐ OPEN ☐ ENCLOSED

BRGS: ☐ BOWL _____ ☐ LINE SHAFT _____

SOL. LUB. ☐ WATER ☐ OIL ☐ GREASE

FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NON

FLQAT SWITCH ☐ _____

PUMP THRUST, LB ☐ UP _____ ☐ DOWN _____

TURBINE DRIVER

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

MOTOR **TURBINE**

AMSTON _____ THOMAS _____

SENSOR

		JOB NO.	DRAWING NO.	
--	--	---------	-------------	--

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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14233	9-01-6-06
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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SHEET 7 OF 7

FORM NO 130 (REVISED SEPT 72)



									JOB NO.	DRAWING NO.	REV.
1	12/10/80	REISSUE FOR PHASE 0, QTY. REVISED	RD	2 nd							
0	10/15/81	ISSUED FOR Phase ZERO	RIS	2 nd					14233	9-D5-G-06	1
NO.	DATE								SHEET	OF	

CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 96-007

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE 10/14/80 REVISION _____

FOR BRECKINRIDGE PROJECT

SITE _____

UNIT PLANT #9

SERVICE PHOSPHORIC ACID ADDITION PUMP

NO. PUMPS REQ'D 1 NO. MOTORS REQ'D 1 ITEM NO. _____

PROVIDED BY _____ MTD BY _____

NO. TURBINES REQ'D _____ ITEM NO. _____

PROVIDED BY _____ MTD BY _____

PUMP MFR _____ SIZE AND TYPE _____

STAGES _____ SERIAL NO. _____

OPERATING CONDITIONS, EACH PUMP

LIQUID PHOSPHORIC ACID U.S. GPM at PT. NOR 10 RATED _____

DISCH. PRESS. PSIG _____

PT. F. NOR _____ MAX _____ SUCT. PRESS. PSIG MAX _____ RATED _____

SP. GR. at PT. _____ DIFF. PRESS. PSI _____

VAP. PRESS. at PT. PSIA _____ DIFF. HEAD. FT. _____

VIS. at PT. Sec _____ CP _____ NPSHA, FT. _____

CORR/EROS. CAUSED BY _____ HYD. HP _____

PERFORMANCE

PROPOSAL CURVE NO. _____

RPM _____ NPSHR (WATER) _____

EFF. _____ BHP RATED _____

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) SUBMERGED VERTICAL

SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER CENTRIFUGAL

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 ☐ _____

ALL 316 SS

BASEPLATE: ☐ _____

VERTICAL PUMPS

PIT OR SUMP DEPTH ☐ _____

MIN. SUBMERGENCE REQ'D. ☐ _____

COLUMN PIPE: ☐ FLANGED ☐ THREADED

LINE SHAFT: ☐ OPEN ☐ ENCLOSED

BRGS: ☐ BOWL _____ ☐ LINE SHAFT _____

BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE

FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NONE

FLOAT SWITCH ☐ _____

PUMP THRUST. LB ☐ UP _____ ☐ DOWN _____

TURBINE DRIVER

APPROX. WT. PUMP & BASE _____

MOTOR _____ TURBINE _____

MOTOR DRIVER

HP 3/4 RPM 1800 FRAME _____ VOLTS/PHASE/CYCLES _____

MFR _____ BEARINGS _____ LUBE _____

TYPE _____ INSUL _____ FULL LOAD AMPS _____

ENC _____ TEMP RISE, C _____ LOCKED ROTOR AMPS _____

☐ VHS ☐ VSS VERT. THRUST CAP. LB _____ SERVICE FACTOR _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

* USE FOR ESTIMATING ONLY

FORM NO 130 (REVISED SEPT 73)



NO.	DATE	ISSUED FOR	JOB NO.	DRAWING NO.	REV.
0	10/24/80	ISSUED FOR Phase zero	14222	9-05-0-07	0
			SHEET	1	OF 1

CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 96-008, 108, 208
 PURCHASE ORDER NO. _____
 REQUISITION NO. _____
 INQUIRY NO. _____
 DATE _____ REVISION _____

FOR BRECKINRIDGE PROJECT SITE KENTUCKY
 UNIT PLANT 9 SERVICE CAUSTIC METERING PUMP
 NO. PUMPS REQ'D 3 NO. MOTORS REQ'D 3 ITEM NO. 96-108, 208 PROVIDED BY _____ MTO BY _____
 NO. TURBINES REQ'D _____ ITEM NO. 008 PROVIDED BY _____ MTO BY _____
 PUMP MFR _____ SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

** OPERATING CONDITIONS, EACH PUMP				** PERFORMANCE	
LIQUID _____	U.S. GPM at PT. NOR. <u>0-80 gpm</u> RATED			PROPOSAL CURVE NO. _____	
	DISCH. PRESS. PSIG _____			RPM _____ NPSHR (WATER) _____	
PT. F. NOR. _____ MAX _____	SUCT. PRESS. PSIG MAX _____ RATED			EFF. _____ BHP RATED _____	
SP. GR. at PT. _____	DIFF. PRESS. PSI _____			MAX. BHP RATED IMP _____	
VAP. PRESS. at PT. PSIA _____	DIFF. HEAD. FT _____			MAX. HEAD RATED IMP _____	
VIS. at PT. Sec _____ CP _____	NPSHA, FT _____			MIN. CONTINUOUS GPM _____	
CORR./EROS. CAUSED BY _____	HYD. HP _____			ROTATION (VIEWED FROM CPLG END) _____	

CONSTRUCTION					SHOP TESTS	
NOZZLES _____	SIZE _____	RATING _____	FACING _____	LOCATION _____	☐ NON-WT. PERF.	☐ WT. PERF.
SUCTION _____					☐ NON-WT. HYDRO	☐ WT. HYDRO
DISCHARGE _____					☐ NPSH REQ'D	☐ WT. NPSH
CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) <u>DIAPHRAGM METERING</u>					☐ SHOP INSPECTION	
SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER (MILTON ROY)					☐ DISMANT. & INSP. AFTER TEST	
PRESS: ☐ MAX ALLOW. _____ PSIG _____ "F. ☐ HYDRO TEST _____ PSIG					☐ OTHER _____	
CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE						
IMPELLER DIA: ☐ RATED _____ ☐ MAX _____ ☐ TYPE _____						
MOUNT: ☐ BETWEEN BAGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLING _____						
BEARINGS-TYPE: ☐ RADIAL _____ ☐ THRUST _____						
LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE ☐						
COUPLING: ☐ MFR _____ ☐ MODEL _____						
DRIVER HALF MTO BY: ☐ PUMP MFR ☐ DRIVER MFR ☐ PURCHASER						
PACKING: ☐ MFR & TYPE _____ ☐ SIZE/NO. OF RINGS _____						
MECH. SEAL: ☐ MFR & MODEL _____ API CLASS. CODE _____						
☐ MFR CODE _____						

AUXILIARY PIPING		VERTICAL PUMPS	
☐ C.W. PIPE PLAN _____ ☐ C.W. ☐ S.S. ☐ TUBING ☐ PIPE		PIT OR SUMP DEPTH ☐	
☐ TOTAL COOLING WATER REQ'D, GPM _____ ☐ SIGHT FL. REQ'D _____		MIN. SUBMERGENCE REQ'D ☐	
☐ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM _____ ☐ FEET _____		COLUMN PIPE: ☐ FLANGED ☐ THREADED	
☐ SEAL FLUSH PIPE PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE		LINE SHAFT: ☐ OPEN ☐ ENCLOSED	
☐ EXTERNAL SEAL FLUSH FLUID _____ ☐ GPM _____ ☐ PSIG _____		BARS: ☐ BOWL _____ ☐ LINE SHAFT _____	
☐ AUXILIARY SEAL PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE		BKG. LUBE ☐ WATER ☐ OIL ☐ GREASE	
☐ AUX. SEAL QUENCH FLUID _____		FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NONE	
		FLOAT SWITCH ☐	
		PUMP THRUST, LB ☐ UP _____ ☐ DOWN _____	

MOTOR DRIVER		TURBINE DRIVER	
HP <u>3</u> RPM <u>1800</u> * FRAME _____ VOLTS/PHASE/CYCLES <u>460/3/60</u>			
MFR _____ BEARINGS _____ LUBE _____			
TYPE _____ INSUL _____ FULL LOAD AMPS _____			
ENC _____ TEMP RISE, C _____ LOCKED ROTOR AMPS _____			
☐ VHS ☐ VSS VERT. THRUST CAP. LB _____ SERVICE FACTOR _____		APPROX. WT. PUMP & BASE _____	
		MOTOR _____ TURBINE _____	

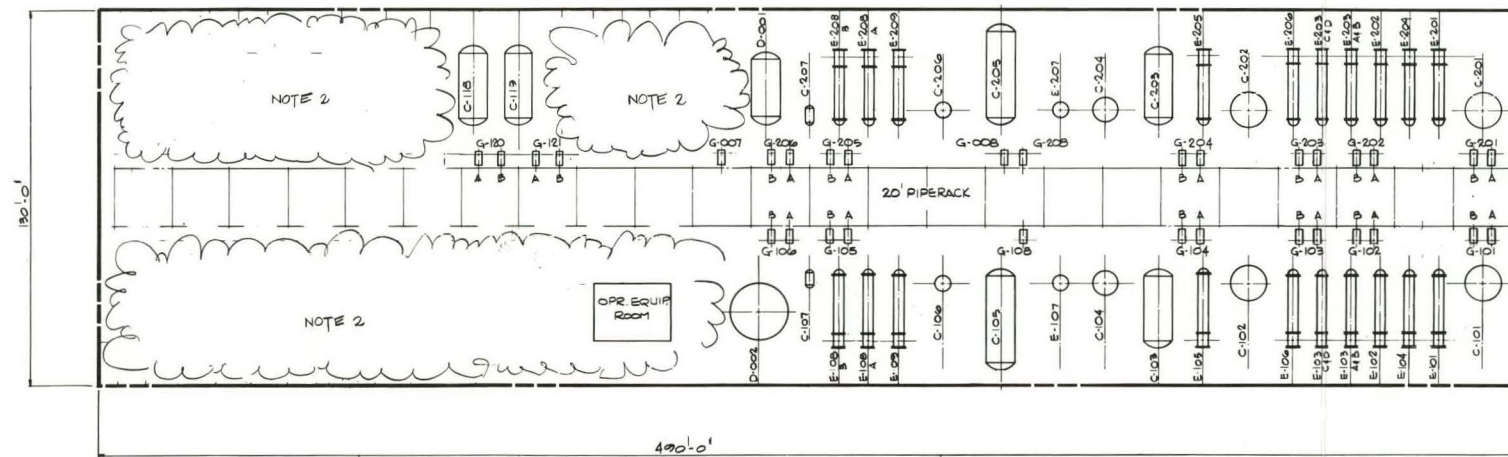
API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED. * USE FOR ESTIMATING ONLY

** OPERATING DATA UNAVAILABLE FROM MANUFACTURER

14222 - 9-008, 108, 208



NO.	DATE		JOB NO.	DRAWING NO.	REV.
1	12/10/50	REISSUED FOR THREE O. QTY. REVISED	14222	9-008, 108, 208	1
2	10/21/60	ISSUED FOR Phase 2nd			
SHEET 1 OF 1					



EQUIPMENT LIST

9C-101, C-201	H ₂ S STRIPPER	26-2
9C-102, C-202	NH ₃ ABSORBER	26-3
9C-103, C-203	PHOSAM CONTACTOR	26-3
9C-104, C-204	PHOSAM NH ₃ STRIPPER	26-4
9C-105, C-205	PHOSAM STRIPPER OVHD DRUM	26-4
9C-106, C-206	AMMONIA FRACTIONATOR	26-4
9C-107, C-207	AMMONIA FRACTIONATOR REFLUX DRUM	26-4
9C-110	50 PSIG CONDENSATE TANK	E-7
9D-001	PHOSPHORIC ACID TANK	D-6
9D-002	CAUSTIC TANK	D-6
9E-101, E-201	H ₂ S STRIPPER FEED/BOTTOMS EXCHANGER	26-2
9E-102, E-202	H ₂ S STRIPPER FEED/LEAN SOLUTION EXCH	26-3
9E-103, E-203	(A,B,C,D) ACID GAS COOLER	26-3
9E-104, E-204	H ₂ S STRIPPER FEED DRUM-HEAT EXCHANGER	26-3
9E-105, E-205	NH ₃ ABSORBER BOTTOMS/LEAN SOLUTION EXCH	26-3
9E-106, E-206	LEAN SOLUTION COOLER	26-3
9E-107, E-207	PHOSAM NH ₃ STRIPPER CONDENSER	26-3
9E-108, E-208	(A,B) AMMONIA FRACTIONATOR CONDENSER	26-4
9E-109, E-209	AMMONIA FRACTIONATOR REBOILER	26-4
9G-007	PHOSPHORIC ACID ADDITION PUMP	26-9
9G-101A,B G-201A,B	H ₂ S STRIPPER BOTTOMS PUMP	26-2
9G-102A,B G-202A,B	ABSORBER OVHD CONDENSATE PUMP	26-3
9G-103A,B G-203A,B	NH ₃ ABSORBER BOTTOMS PUMP	26-3
9G-104A,B G-204A,B	PHOSAM RICH SOLUTION PUMP	26-3
9G-105A,B G-205A,B	AMMONIA FRACTIONATOR FEED PUMP	26-4
9G-106A,B G-206A,B	AMMONIA FRACTIONATOR REFLUX PUMP	26-4
9G-120A,B	50 PSIG CONDENSATE PUMP	26-9
9G-008	COMMON SPARE (CAUSTIC METERING)	26-9
9G-108 G-208	CAUSTIC METERING PUMP	26-9
9G-121A,B	100" CONDENSATE PUMPS	26-9

NOTES

- HIGH POINT OF FINISHED GRADE IS BL 1000'
- EQUIPMENT NOT SHOWN CAUSTIC - LIMITED DISTRIBUTION RIGHTS.

REFERENCE DRAWINGS

50E-A-4	PLOT PLAN INDEX
50E-A-1	OVERALL SITE PLAN

1"=20'-0"

GRAPHIC SCALE

△									
△									
△									
△	11/18	ISSUED FOR PHASE ZERO				TR	JK	JK	HS
△	11/18	ISSUED FOR REVIEW & APPROVAL				TR	JK	JK	HS
NO.	DATE	REVISION	BY	CHK	APPV	ENGINEER	IN CHARGE	DATE	APPR.
SCALE 1"=20'-0" DESIGNED <u>TR/J.C.</u> DRAWN <u>T. BRECKINRIDGE</u>									

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

U.S. DEPARTMENT OF ENERGY
COOPERATIVE AGREEMENT
NO. DE-FC86-80MD177

BRECKINRIDGE PROJECT

BRECKINRIDGE COUNTY

PHASE ZERO

KENTUCKY

PLOT PLAN-PLANT 9
SOUR WATER & AMMONIA

JOB NO.

14222

DRAWING NO.

9E-A-2

REV.

1

34 X 44 "E" SIZE

PLANT 10 SULFUR PLANT

1.0 INTRODUCTION

Sulfur contaminants are scrubbed from various gas streams that utilize sour water stripping, amine treating, Selexol and Wellman-Lord processes. Sulfur dioxide and hydrogen sulfide-bearing streams from these processes become the feed to the sulfur recovery plant. These feed streams include:

- Acid gas from the Gas Plant (Plant 7)
- Ammonia free acid gas from Sour Water Treating (Plant 9)
- Acid gas from Gasification and Purification (Plant 12)
- Sulfur dioxide from Stack Gas Scrubbing (Plant 35)

Approximately 95% of the sulfur in the feed streams is recovered as a saleable liquid product. The Sulfur Plant tail gas is incinerated in the boilers of Steam Generation and Boiler Feedwater Treating (Plant 31) and processed in Stack Gas Scrubbing (Plant 35) along with boiler fuel combustion products. Approximately 90% of the contained sulfur in the tail gas is recovered in Plant 35 and recycled to Plant 10. This recycling will increase the effective recovery of sulfur from Plant 10 acid gas feeds to approximately 99%.

Classic "Claus" reaction data serve as the principal basis for the plant design. In the Claus reaction, hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) react in 2:1 molar ratio to form elemental sulfur and water vapor. The SO_2 in the feed to Plant 10 is insufficient to meet the 2:1 H_2S to SO_2 overall reaction requirement and 12% of the H_2S in the feed must be oxidized to SO_2 and water vapor to provide additional SO_2 needed to meet reaction requirements. Oxidation takes place in special furnaces equipped with supplemental fuel gas and waste heat boilers.

A split-flow configuration is used in which a portion of the feed to the Sulfur Plant (Plant 10) is routed around the combustion zone and later combined with the combustion products. Feed and air which are sent to the combustion zone are preheated to minimize the amount of bypassed feed. This helps to achieve the desired flame temperature and also increases sulfur recovery.

Since part of the plant feed bypasses the combustion zone, the products of combustion need not have a 2:1 H_2S to SO_2 molar ratio. However, considerable uncatalyzed conversion of H_2S and SO_2 to sulfur does occur in the furnace and downstream exchangers. Approximately 30% of the total sulfur produced in the plant is formed in this manner. This sulfur is condensed and separated from the process gas stream upstream from the catalytic reactors.

Three successive catalytic reaction stages are provided for further conversion of the remaining H_2S and SO_2 to elemental sulfur. To provide high operating flexibility and ease of operation, steam reheaters are used to heat the feed to each catalytic converter bed. Sulfur condensers are provided downstream of each reaction stage for condensation and removal of sulfur product.

The tail gas from the final reactor and condenser, containing about 5% of the sulfur in the plant feed, is sent to Steam Generation and Boiler Feedwater Treating (Plant 31) for incineration in the steam boilers and further processing in Stack Gas Scrubbing (Plant 35).

PLANT 10 SULFUR PLANT

2.0 PROCESS DESIGN

2.1 Design Basis

2.1.1 Plant Capacity (contained sulfur in the feed) LT/D

Number of trains

- Design 3
- Operating 2

Design capacity per train 332

Total plant capacity

- Design (3 trains) 996
- Operating (2 trains) 664

2.1.2 Feed Compositions

<u>Stream Component</u>	<u>Acid Gas from Plant 7 mol/hr</u>	<u>Acid Gas from Plant 9 mol/hr</u>	<u>Acid Gas from Plant 12 mol/hr</u>	<u>SO₂ from Plant 35 mol/hr</u>	<u>Total Feed mol/hr</u>
H ₂ O (vapor)	12.08	184.20	263.05	39.35	498.68
CO ₂	28.74	121.75	1,475.95	--	1,626.44
H ₂ S	266.13	901.71	332.16	--	1,500.00
CO	--	--	50.66	--	50.66
COS	--	--	2.75	--	2.75
H ₂	1.82	--	16.44	--	18.26
C ₁ ⁺	5.02	--	0.13	--	5.15
N ₂ +Ar	0.21	--	0.23	--	0.44
NH ₃	--	0.73	--	--	0.73
HCN	--	0.12	--	--	0.12
SO ₂	--	--	--	430.00	430.00
Phenolics	--	3.53	--	--	3.53
Other organics	--	8.29	--	--	8.29
Totals	314.00	1,220.33	2,141.37	469.35	4,145.05
Total sulfur content, LT/D	91	310	115	148	664

2.1.3 Product Compositions

Stream Component	mol/hr	
	<u>Tail Gas</u>	<u>Liquid Sulfur</u>
H ₂ O	2,106.41	--
H ₂ S	31.13	--
SO ₂	15.63	--
S ₆ (vapor)	0.48	--
S ₈ (vapor)	1.39	--
COS	3.78	--
CS ₂	0.71	--
CO	133.94	--
CO ₂	1,630.85	--
N ₂ + Ar	1,393.98	--
H ₂	59.48	--
C ₁	0.11	--
S (as S ₁ liquid)	<u>2.51</u>	<u>1,864.36</u>
Total	5,380.40	1,864.36
Total sulfur content, LT/D	24	640

2.1.4 Typical Sulfur Industry Specifications

- Sulfur: 99.5% minimum
- Carbon: 0.2% maximum
- Ash: 50 ppm maximum
- Arsenic, Selenium, Tellurium: commercially free
- H₂S: 50 ppm maximum
- SO₂: 50 ppm maximum
- Color: Bright yellow

2.1.5 Yields

Minimum sulfur recovery is 95% before credit for tail gas processing.

2.2 Process Description

Refer to Drawing 10-D-8-1 for the following process description.

To ensure high operating reliability three separate processing trains have been provided. Each train is designed to handle 50% of the total feed to the plant. In normal operation it is anticipated that all three trains will be in simultaneous operation at roughly 67% of each train's capacity. Since the flow scheme and design operating conditions are the same for each train, only a single train will be discussed.

Acid gas feeds from Plants 7, 9, 12 and 35 enter the Sulfur Plant (Plant 10) through the separate Knockout Drums (10C-001, 10C-002, 10C-003 and 10C-004). These drums protect downstream processing equipment, such as reaction furnace refractory, from slugs of liquid which may be in the feeds. Any liquids collected in the drums are returned to the upstream plants from which they originated by the Knockout Drum Pumps (10G-002, 10G-003, 10G-004 and 10G-005).

The effluent gas from each knockout drum is equally divided and sent to the three trains. Effluent gas flow to two of the trains is on flow control. The flow to the third train is on pressure control to adjust for fluctuations in the feed. The acid gas feed streams are combined and preheated to approximately 460°F by the Feed Preheater (10E-105) utilizing 600 psig steam.

A portion of the Selexol acid gas from 10C-003 is not sent to the feed preheater but is combined under flow control with the SO₂ acid gas from 10C-004. This combined stream is the split-flow stream which bypasses the Reaction Furnace (10F-101) and the Waste Heat Boiler (10F-102).

The acid gas from the feed preheater is substoichiometrically combusted by means of the Acid Gas Burner (10F-103). The air requirement for this combustion is a function of the rates and compositions of the four acid gas feeds to the processing train. Flow signals from each of the feed streams are individually biased by laboratory stream composition data. The biased signals are combined in an electronic summing device which outputs the proper signal to the combustion air flow control valve. Air from the Claus Air Blower (10K-101) is preheated, by exchange with 600 psig steam, to approximately 460°F in the Air Preheater (10E-106). Heated air from the air preheater is introduced under flow control into the acid gas burner.

The acid gas burner fires directly into the refractory lined Reaction Furnace (10F-101). Combustion temperature is approximately 2000°F. About 30% of the total sulfur produced in the plant is formed by reaction of combustion gases in the reaction furnace. Effluent from the reaction furnace is cooled to 650°F in the Waste Heat Boiler (10F-102). Steam at 600 psig is generated on the shellside of the waste heat boiler.

The previously described split-flow acid gas stream is combined with the effluent from the waste heat boiler. The combined gases are cooled to 375°F in the first tube pass of Condenser 1 (10E-104). Steam at 50 psig is generated on the shellside of condenser 1. Most of the sulfur formed in the reaction furnace is condensed as the gas is cooled. Liquid sulfur and condenser exit gas are separated in the first pass exit chamber of the condenser. The sulfur is drained to Seal Pot 1 (10D-101) through a steam jacketed drain leg. This drain leg is submerged to a depth of 17-1/2 feet in the seal pot. The seal pot maintains a liquid sulfur seal to prevent process gases from escaping through the sulfur drain leg.

The cooled gas from condenser 1 first pass flows to the tubeside of Reheat Exchanger 1 (10E-101) where it is heated to 400°F by exchange with 600 psig steam on temperature control.

Heated gas from the reheat exchanger 1 enters the top of Converter 1 (10C-101) and passes downflow through a fixed bed of alumina catalyst. H_2S and SO_2 react in the catalyst bed and form approximately 52% of the total sulfur produced in the plant. Due to the exothermic nature of the reaction the converter outlet temperature reaches approximately 654°F.

Converter 1 effluent is cooled to 375°F in the second tube pass of Condenser 1 (10E-104). Condensed liquid sulfur is separated and then drained to Seal Pot 2 (10D-102) in a manner similar to that described previously for sulfur from the first pass of condenser 1. Separated gas from the second pass flows to the tubeside of Reheat Exchanger 2 (10E-102) where it is heated to 420°F by exchange with 600 psig steam on temperature control.

Heated gas from reheat exchanger 2 enters the top of Converter 2 (10C-102) and passes downflow through a fixed bed of alumina catalyst. Since the H_2S and SO_2 concentrations in the inlet gas are less than those in the gas to converter 1, less reaction takes place and the exit gas temperature rises to only about 490°F.

Effluent from converter 2 is cooled to 375°F in the first tube pass of Condenser 2 (10E-107). Steam at 50 psig is generated on the shellside of condenser 2. Condensed liquid sulfur is separated and drained to Seal Pot 3 (10D-103) in the same manner as described for sulfur from condenser 1. Effluent gas from the first pass of condenser 2 flows to the tubeside of Reheat Exchanger 3 (10E-103) where it is heated to 420°F by exchange with 600 psig steam on temperature control.

Heated gas from reheat exchanger 3 enters the top of Converter 3 (10C-103) and flows down through a fixed bed of alumina catalyst. The H_2S and SO_2 content of the gas to converter 3 is lower than that for either of the other two converters. This results in converter 3 having the lowest amount of reaction of the three converters. Temperature increase across converter 3 is only 12°F.

Converter 3 exit gas is cooled to 320°F in the second tube pass of Condenser 2 (10E-107). Condensed liquid sulfur is separated and drained to Seal Pot 4 (10D-104). Effluent gas from the second pass is sent to the tubeside of the Tail Gas Superheater (10E-108) where it is heated to 375°F by exchange with 600 psig steam on temperature control. The tail gas is heated to prevent the condensation of sulfur in the transfer line between Plant 10 and Steam Generation and Boiler Feedwater Treating (Plant 31) where it is incinerated in the steam boilers.

An online analyzer-controller determines the H_2S to SO_2 mole ratio in the heated tail gas. If the H_2S to SO_2 ratio is not 2:1, an adjustment control signal is sent to the combustion air control valve which trims the air flow to the Acid Gas Burner (10F-103) thus readjusting the combustion of H_2S . Approximately 10% of the total combustion air flows through the trim control valve.

Liquid sulfur from the four sulfur Seal Pots (10D-101, 102, 103 and 104) flows by gravity to the Sulfur Pit (10D-001) where it is combined with sulfur from the other two processing trains. The Sulfur Pump (10G-001) transfers the product liquid sulfur to tank storage in Tankage (Plant 20).

2.3 Catalysts, Packings and Chemicals

<u>Rate or Catalysts Life)</u>	<u>Initial Inventory</u>	<u>Consumption (Estimated</u>
Activated Alumina, (3 years) Kaiser S-201, 3 x 8 Mesh	504,150 lb	
<u>Packing</u>		
Norton Denstone 57, (3 years) 3/8 x 1/2 inch	435,504 lb	
<u>Chemicals (for startups only)</u>		
Sulfur	75,000 lb	--
Caustic Soda -- (as 100%)	1,100 lb	
Soda Ash -- (as 100%)	1,100 lb	

2.4 Utility Balance

Electricity, kW

<u>Condition</u>	<u>Consumed</u>
Operating	10

Steam, M lb/hr

<u>Level</u>	<u>Consumed</u>	<u>Imported Generated</u>	<u>(Exported)</u>
600 psig	50,940	58,120	(7,180)
50 psig	5,000	73,980	(68,980)

Water, GPM

Boiler Feedwater Consumed: 227

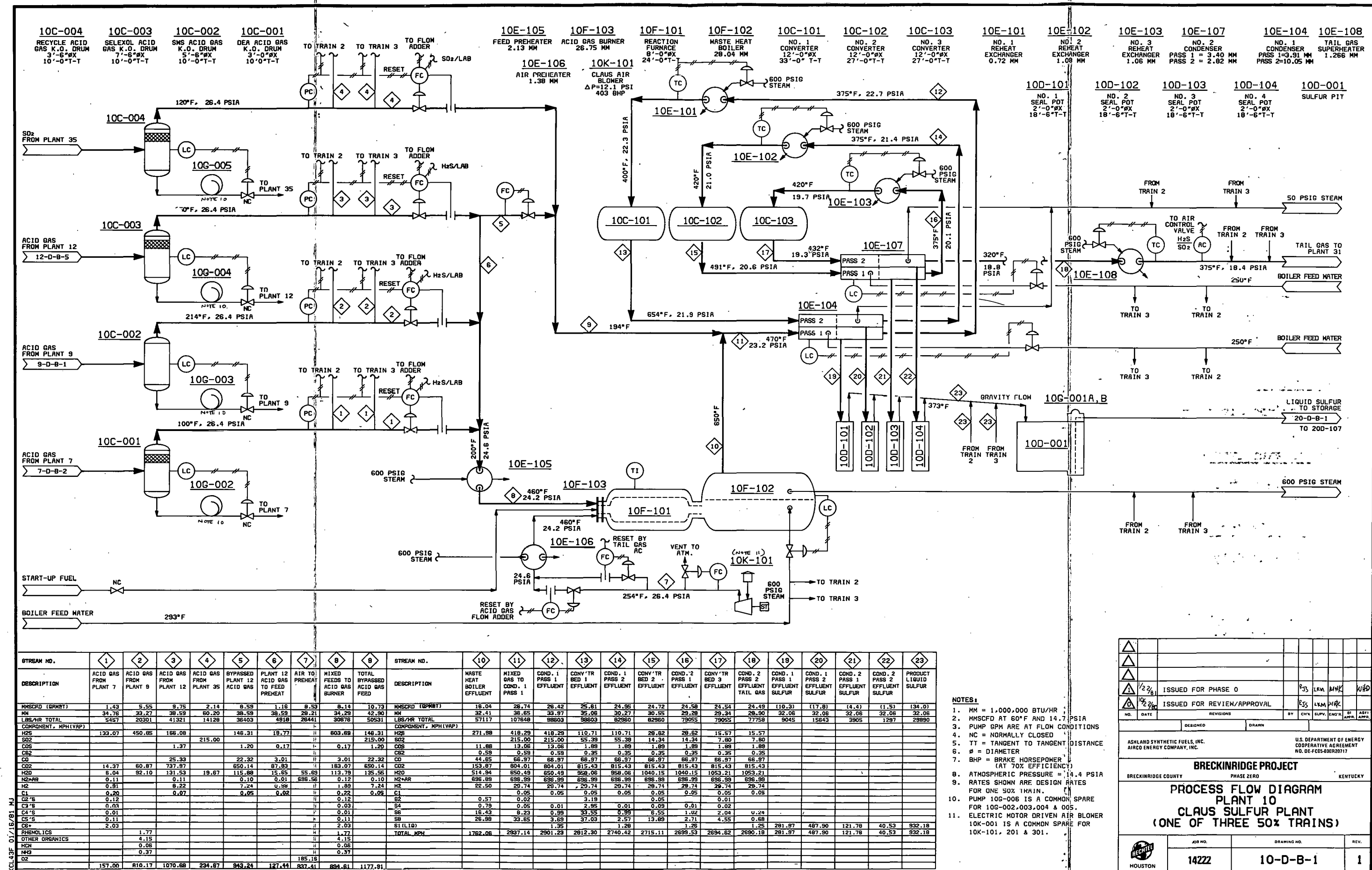
Condensate Returned:

(From steam tracing) 20,940 lb/hr

Fuel, MM Btu/hr:

Total Fired Duty 7.35 (Startup only, per furnace)

*Values above are for three-train Sulfur Plant operation at design production rates.



MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10C-203	NO. 3 CONVERTER	000000
-	-	-
10C-303	NO. 3 CONVERTER	000000
-	-	-
10C-004	RECYCLE ACID GAS K.O. DRUM	000000
-	-	-
10D-001	SULFUR PIT	000000
-	-	-
10D-101	NO. 1 SEAL POT	000000
-	-	-
10D-201	NO. 1 SEAL POT	000000
-	-	-
10D-301	NO. 1 SEAL POT	000000
-	-	-
10D-102	NO. 2 SEAL POT	000000
-	-	-
10D-202	NO. 2 SEAL POT	000000
-	-	-
10D-302	NO. 2 SEAL POT	000000
-	-	-
10D-103	NO. 3 SEAL POT	000000
-	-	-

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10	SULFUR PLANT	000000
	-	
10C-001	DEA ACID GAS K.O. DRUM	000000
	-	
10C-101	NO. 1 CONVERTER	000000
	-	
10C-201	NO. 1 CONVERTER	000000
	-	
10C-301	NO. 1 CONVERTER	000000
	-	
10C-002	SWS ACID GAS K.O. DRUM	000000
	-	
10C-102	NO. 2 CONVERTER	000000
	-	
10C-202	NO. 2 CONVERTER	000000
	-	
10C-302	NO. 2 CONVERTER	000000
	-	
10C-003	SELEXOL ACID GAS K.O. DRUM	000000
	-	
10C-103	NO. 3 CONVERTER	000000
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10D-203	NO. 3 SEAL POT	000000
	-	
10D-303	NO. 3 SEAL POT	000000
	-	
10D-104	NO. 4 SEAL POT	000000
	-	
10D-204	NO. 4 SEAL POT	000000
	-	
10D-304	NO. 4 SEAL POT	000000
	-	
10E-101	NO. 1 REHEAT EXCHANGER	000000
	-	
10E-201	NO. 1 REHEAT EXCHANGER	000000
	-	
10E-301	NO. 1 REHEAT EXCHANGER	000000
	-	
10E-102	NO. 2 REHEAT EXCHANGER	000000
	-	
10E-202	NO. 2 REHEAT EXCHANGER	000000
	-	
10E-302	NO. 2 REHEAT EXCHANGER	000000
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10E-103	NO. 3 REHEAT EXCHANGER	000000
	-	
10E-203	NO. 3 REHEAT EXCHANGER	000000
	-	
10E-303	NO. 3 REHEAT EXCHANGER	000000
	-	
10E-104	NO. 1 CONDENSER	000000
	-	
10E-204	NO. 1 CONDENSER	000000
	-	
10E-304	NO. 1 CONDENSER	000000
	-	
10E-105	FEED PREHEATER	000000
	-	
10E-205	FEED PREHEATER	000000
	-	
10E-305	FEED PREHEATER	000000
	-	
10E-106	AIR PREHEATER	000000
	-	
10E-206	AIR PREHEATER	000000
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10E-306	AIR PREHEATER	000000
	-	
10E-107	NO. 2 CONDENSER	000000
	-	
10E-207	NO. 2 CONDENSER	000000
	-	
10E-307	NO. 2 CONDENSER	000000
	-	
10E-108	TAIL GAS SUPERHEATER	000000
	-	
10E-208	TAIL GAS SUPERHEATER	000000
	-	
10E-308	TAIL GAS SUPERHEATER	000000
	-	
10F-101	REACTION FURNACE	
	-	
10F-201	REACTION FURNACE	000000
	-	
10F-301	REACTION FURNACE	000000
	-	
10F-102	WASTE HEAT BOILER	000000
	-	

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10F-202	WASTE HEAT BOILER	000000
10F-302	WASTE HEAT BOILER	000000
10F-103	ACID GAS BURNER	000000
10F-203	ACID GAS BURNER	000000
10F-303	ACID GAS BURNER	000000
10G-001A	SULFUR PUMP	000000
10G-001B	SULFUR PUMP	000000
10G-002	DEA K.O. PUMP	000000
10G-003	SWS K.O. PUMP	000000
10G-004	SELEXOL K.O. PUMP	000000
10G-005	RECYCLE K.O. PUMP	000000

MAJOR EQUIPMENT LIST SORTED BY SEQUENCE NUMBER

THE BRECKINRIDGE PROJECT

PHASE ZERO
MAJOR EQUIPMENT LIST-14222

ITEM NUMBER	ITEM DESCRIPTION	
10G-006	K.O. PUMP (COMMON SPARE)	000000 NA
	-	
10K-001	AIR BLOWER SPARE	000000
	-	
10K-101	AIR BLOWER	000000
	-	
10K-201	AIR BLOWER	000000
	-	
10K-301	AIR BLOWER	000000
	-	

4.1 Data Sheets for Columns and Pressure Vessels

- 10-DS-C-01: DEA Acid Gas K.O. Drum (10C-001)
- 10-DS-C-02: SWS Acid Gas K.O. Drum (10C-002)
- 10-DS-C-03: SELEXOL Acid Gas K.O. Drum (10C-003)
- 10-DS-C-04: Recycle Acid Gas K.O. Drum (10C-004)
- 10-DS-C-05: No. 1 Converter (10C-101, 10C-201, 10C-301)
- 10-DS-C-06: No. 2 Converter (10C-102, 10C-202, 10C-302)
- 10-DS-C-07: No. 3 Converter (10C-103, 10C-203, 10C-303)

3/8" MIN THK 2:1
ELLIP: HEAD. TYP
TOP & BTM.

2'-0" DIA X 4" THK MESH
PAD. YORK TYPE 431
OR EQUAL. SECTIONAL
TYPE PAD AND TOP &
BTM GRIDS, ALL TO BE
SUITABLY SUPPORTED
& TO BE REMOVABLE
THRU MANWAY.

WITH DISTRIBUTOR
PER C-506.

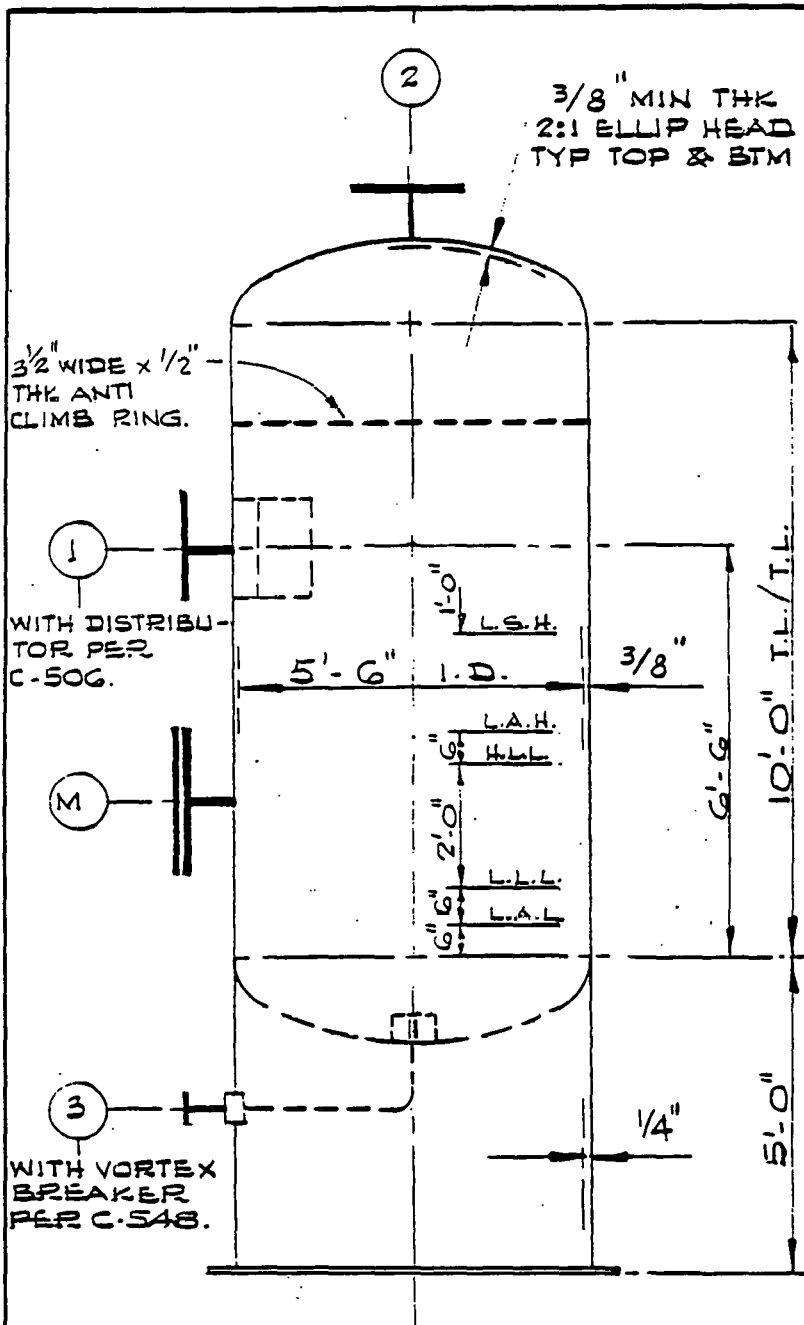
WITH VORTEX
BREAKER PER
C-548

NOTE : THIS VESSEL CAN BE
SUPPORTED ON (3) ANGLE LEGS.

CODE	A.S.M.E. SECT VIII DIV 1 '80		
SPEC.	14222 - C1		
OPER. COND.	PRESS.	11 PSIG	
	TEMP.	100 °F	
DES. COND.	PRESS.	50 PSIG	
	TEMP.	300 °F	
MATERIALS	SHELL & HDS	SA-516-70	
	SKIRT	A-36	
	FORGING	A-181	
	PIPING	A-106 B	
	STRUCTURAL		
BOLTS			
INTERNAL	304 SS MESH		
C.A.	3/16"		
PWHT	NO		
TESTS/EXAM.	X-RAY	SPOT	JOINT EFF. 85%
	UT	MT	PT CV @ °F.
	HARDNESS MAX. BHN		
	WELD SAMPLING		
NOZZLES & MANWAYS	CODE	POSITION	HORIZ
	HYDRO	PRESS @ TOP	75 PSIG
	MK NO.	SIZE	RATING SERVICE
	1 1	6"	150#
2 1	6"	79	OUTLET "
3 1	2"	300#	" LIQUID
M 1	20"	150#	MANWAY
W/COVER & DAVIT			
LADDER & PTFM CLIPS		REQD.	NO
PIPE SUPPORT CLIPS		REQD.	NO
INSUL. SUPPORT CLIPS		REQD.	NO
INSUL. THICKNESS		IN.	
PAINTING			
VESSEL CAPACITY		CU. FT.	
VESSEL WEIGHT	EMPTY TEST	3.3	KIPS
REF. DWGS.			
NO.	DATE	REVISION	DESIGN
0	11/13/80	ISSUED FOR PHASE ZERO	NN
			RWN
			CHK.
			APPR.
			APPR.
THE BRECKINRIDGE PROJECT		JOB NO. 14222	
DEA ACID GAS K.O. DRUM.		DRAWING NO.	
10C-001		REV.	
		10-DS-C-01	
		0	

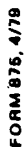
FORM 876, 4/79



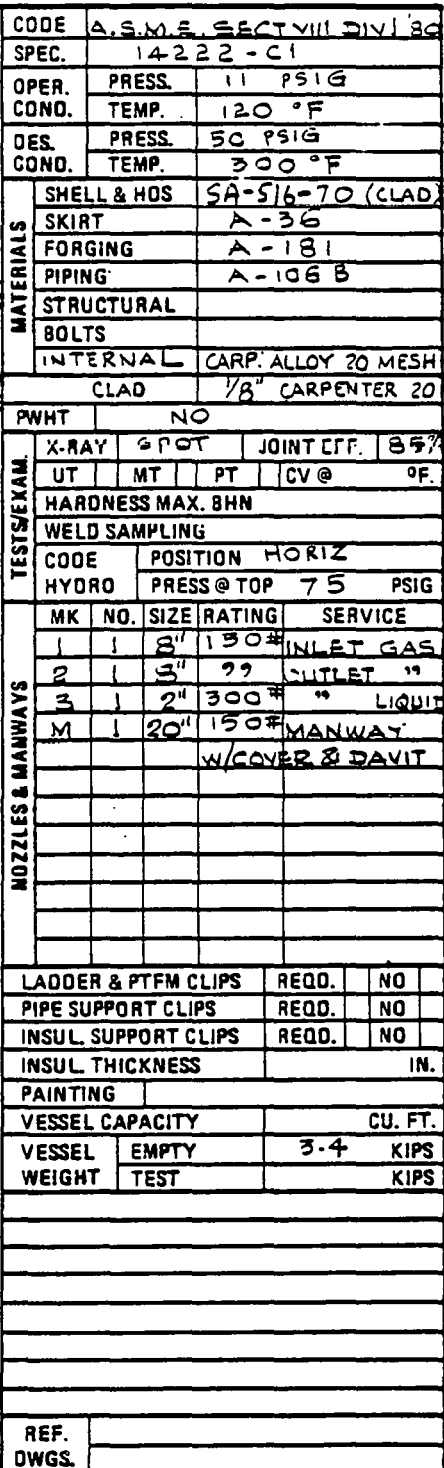


NOTE DRUM IS EXTERNALLY STEAM TRACED,
INTERNAL SOLID FORMATION IS PREVENTED
BY INSULATION.

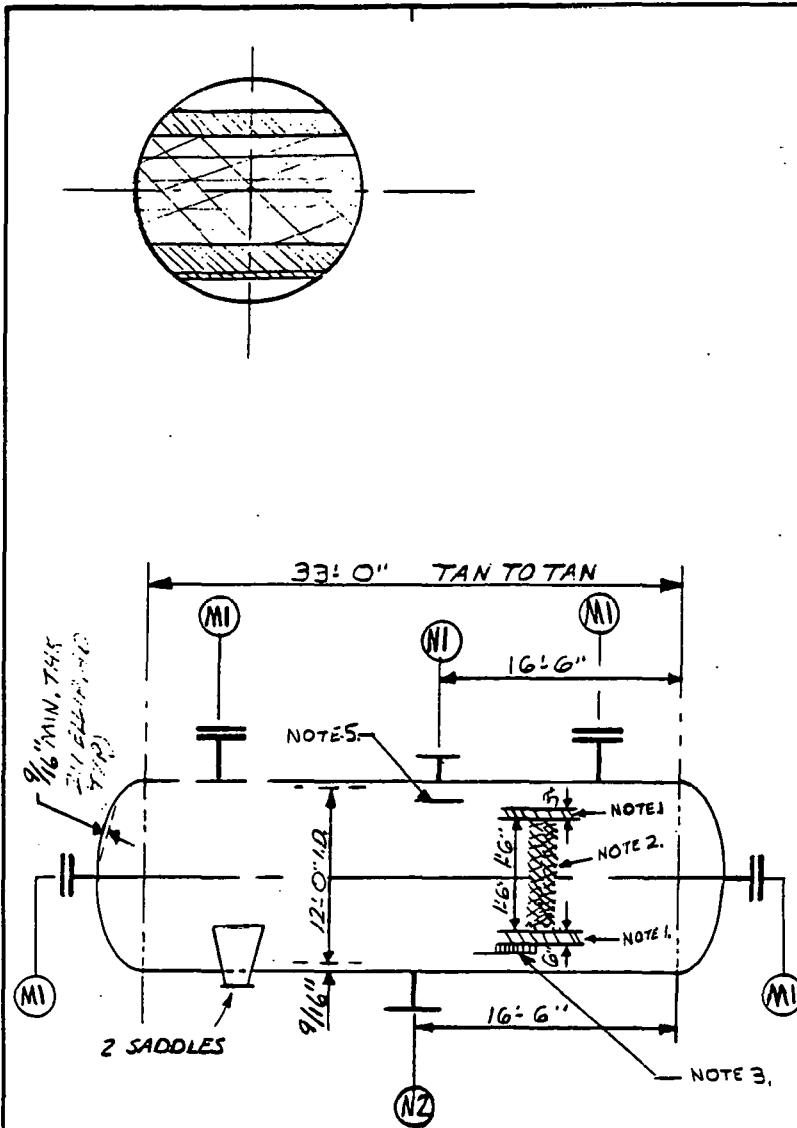
CODE	A.S.M.E. SECT VIII DIV 1 '90			
SPEC.	14222 - C1			
OPER. COND.	PRESS.	11 PSIG		
COND.	TEMP.	214 °F		
DES. COND.	PRESS.	50 PSIG		
	TEMP.	300 °F		
MATERIALS	SHELL & HOS	SA-516-70		
	SKIRT	A-36		
	FORGING	A-181		
	PIPING	A-106B		
	STRUCTURAL			
BOLTS				
C.A.	3/16"			
FWHT	NO			
TESTS/EXAM	X-RAY	SPOT	JOINT EFF.	85%
	UT	MT	PT	CV @ °F.
	HARDNESS MAX. BHN			
NOZZLES & MANWAYS	WELD SAMPLING			
	CODE	POSITION	HORIZ	
	HYDRO	PRESS @ TOP	75 PSIG	
	MK	NO.	SIZE	RATING SERVICE
	1	1	14"	150# INLET GAS
	2	1	14"	79 OUTLET GAS
	3	1	2"	300# OUTLET LIQ
	M	1	20"	150# MANWAY
	WITH COVER & LIFT.			
LADDER & PTFM CLIPS		REQD.	NO	
PIPE SUPPORT CLIPS		REQD.	NO	
INSUL. SUPPORT CLIPS		REQD.	NO	
INSUL. THICKNESS		2	IN.	
PAINTING				
VESSEL CAPACITY		CU. FT.		
VESSEL WEIGHT	EMPTY	6.7	KIPS	
	TEST		KIPS	
REF. DWGS.				
0	11/13/80	ISSUED FOR PHASE ZERO		NN
NO.	DATE	REVISION	DESIGN	OWN.
			CHK.	APPR.
THE BRECKINRIDGE PROJECT		JOB NO. 14222		
SWS ACID GAS K.O. DRUM.		DRAWING NO. REV.		
10C-002		10-DS-C-02 0		



CODE		A.S.M.E. SECT VIII DIV 1 '80									
SPEC.		14222-C1									
OPER. COND.		PRESS.		11 PSIG							
		TEMP.		250 °F							
DES. COND.		PRESS.		50 PSIG							
		TEMP.		300 °F							
MATERIALS	SHELL & HDS		SA-516-70								
	SKIRT		A-36								
	FORGING		A-181								
	PIPING		A-106 B								
	STRUCTURAL										
	BOLTS										
		INTERNAL		304 SS MESH							
C.A.		3/16"									
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	20"	150#	INLET GAS						
	2	1	20"	99	OUTLET "						
	3	1	2"	300#	" LIQUID						
	M	1	20"	150#	MANWAY						
					W/COVER & DAVIT						
LADDER & PTFM CLIPS				REQD.		NO					
PIPE SUPPORT CLIPS				REQD.		NO					
INSUL. SUPPORT CLIPS				REQD.		NO					
INSUL. THICKNESS				1 1/2		IN.					
PAINTING											
VESSEL CAPACITY						CU. FT.					
VESSEL		EMPTY		11.2		KIPS					
WEIGHT		TEST				KIPS					
REF. DWGS.											
N N		RWN		SL		UGL		M N N			
DESIGN		DWN.		CHK.		APPR.		APPR.			
CT		JOB NO. 14222									
M		DRAWING				NO.		REV.			
		10-DS-C-03							0		



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NOTE: 1. NORTON DENSTONE PELLETS, $\frac{3}{8}$ " ϕ x $\frac{1}{2}$ " LONG, DENSITY = 85 LB/CF
 TOP 3" THICK DISTRIBUTOR LAYER = 18163 LBS
 BOTTOM 6" THICK SUPPORT LAYER = 36089 LBS
 TOTAL INERTS = 54254 LBS.

2. KAISER 5-201 CATALYST, 3-6 MESH, DENSITY = 48 LB/CF, WEIGHT 61872 LBS.

3. SUPPORT GRATING COVERED WITH 3 MESH, 310 SS SCREEN.

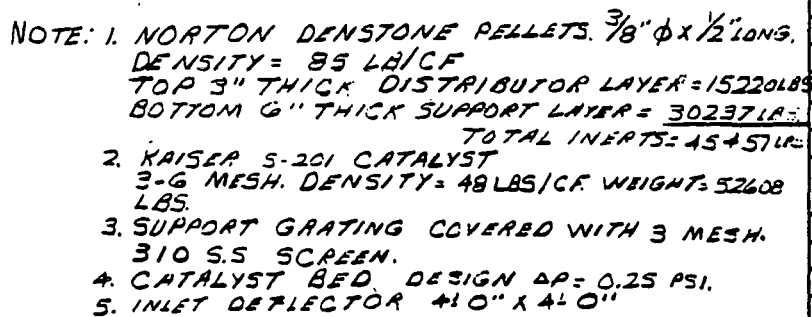
4. CATALYST BED DESIGN CP = 0.25 PSI

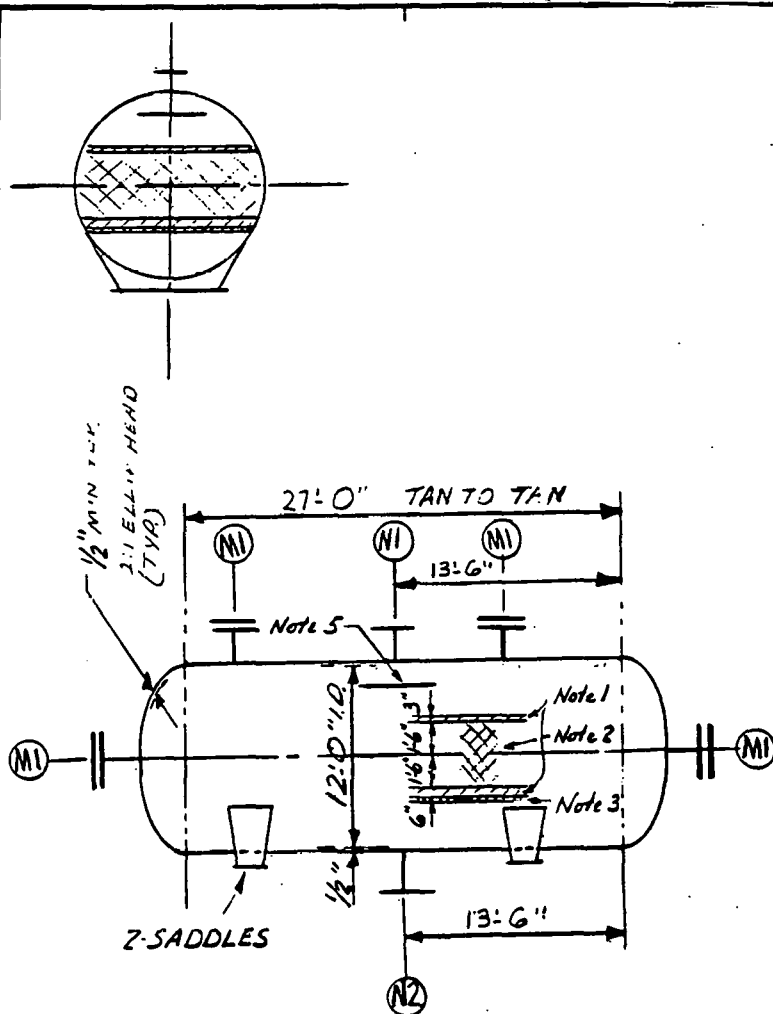
5. INLET DEFLECTOR 40" X 40"

CODE	ASME SECTION VIII						
SPEC.	14222-C1						
OPER. COND.	PRESS.	12 PSIG					
	TEMP.	700 °F					
DES. COND.	PRESS.	50 PSIG					
	TEMP.	700 °F					
MATERIALS	SHELL & HOS	SA-516-70					
	SKIRT	SA-76					
	FORGING	SA-105					
	PIPING	SA-106B					
	STRUCTURAL BOLTS						
C.A.	1/4"						
PWHT	NONE						
TESTS/EXAM.	X-RAY	SPOT	JOINT EFF.	.85			
	UT	MT	PT	CV @ °F.			
	HARDNESS MAX. BHN						
WELD SAMPLING	CODE	POSITION HORIZONTAL					
	HYDRO	PRESS @ TOP 75 PSIG					
NOZZLES & MANWAYS	MK	NO.	SIZE	RATING SERVICE			
	N2	1	30"	150°	OUTLET GAS		
	N1	1	30"	150°	INLET GAS		
	M1	4	24"	150°	MANWAY		
LADDER & PTFM CLIPS	REQD.	NO					
PIPE SUPPORT CLIPS	REQD.	NO					
INSUL. SUPPORT CLIPS	REQD.	NO					
INSUL. THICKNESS	3 IN.						
PAINING							
VESSEL CAPACITY	4191 CU. FT.						
VESSEL WEIGHT	EMPTY	47 KIPS					
	TEST	KIPS					
REF. DWGS.							
NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
0	11/13/80	ISSUED FOR PHASE ZERO		sk	YMT	UAK	HMH
THE BRECKINRIDGE PROJECT			JOB NO. 14222				
NO.1 CONVERTER 10C-101/201/301			DRAWING NO. REV.				
			10-DS-C-05 0				

FORM 876, 4/79







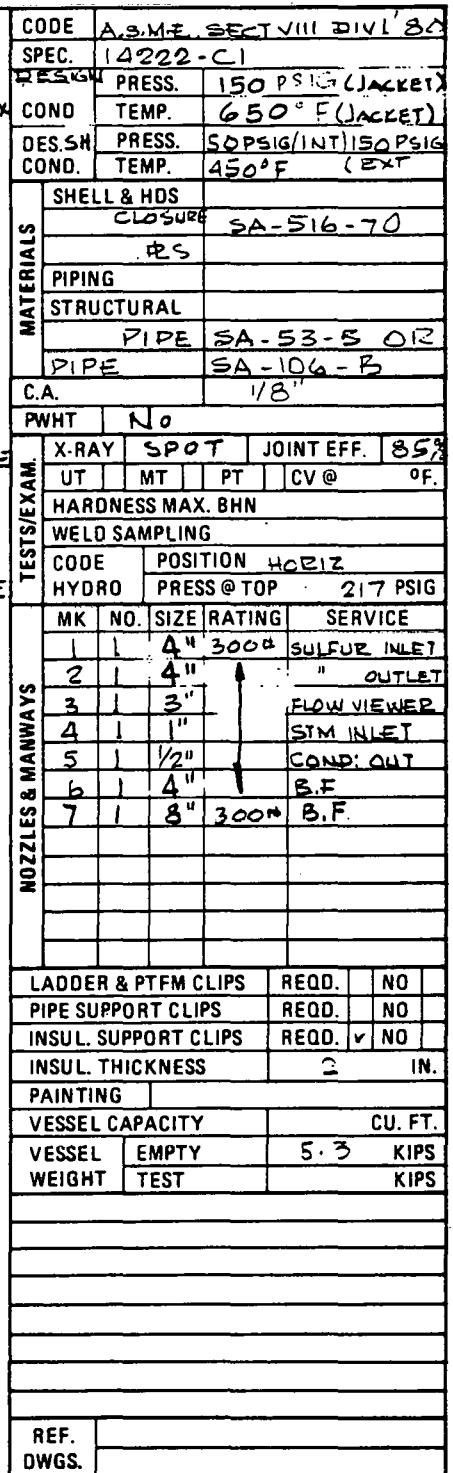
1. NORTON DENSTONE PELLETS. $\frac{3}{8}$ " ϕ x $\frac{1}{2}$ " LONG.
DENSITY = 85 LB/CF.
TOP 3" THICK DISTRIBUTOR LAYER = 15220 LBS
BOTTOM 6" THICK SUPPORT LAYER = 30237 LBS
TOTAL INERTS = 45457 LBS.
2. KAISER S-201 CATALYST 3-6 MESH. DENSITY
= 48 LB/CF. WEIGHT = 51840 LBS.
3. SUPPORT GRATING COVERED WITH 3 MESH,
310 S.S. SCREEN.
4. CATALYST BED DESIGN $\Delta P = 0.25$ PSI.
5. INLET DEFLECTOR 4'-0" X 4'-0".

CODE	ASME SEC VIII DIV 1						
SPEC.	14.2-1 C1						
OPER. COND.	PRESS.	12 PSIG					
COND.	TEMP.	650°F					
DES. COND.	PRESS.	50 PSIG					
	TEMP.	650°F					
MATERIALS	SHELL & HDS	SA-516-70					
	SKIRT	SA-36					
	FORGING	SA-105					
	PIPING	SA-106-B					
	STRUCTURAL BOLTS						
C.A.	1/8"						
PWHT	NONE						
TESTS/EXAM	X-RAY	SPOT	JOINT EFF.	1.85			
	UT	MT	PT	CV @ °F.			
	HARDNESS MAX. BHN						
	WELD SAMPLING						
NOZZLES & MANWAYS	CODE	POSITION					
	HYDRO	PRESS @ TOP 75 PSIG					
	MK	NO.	SIZE	RATING SERVICE			
	N2	1	30"	150#	OUTLET GAS		
N1	1	30"	150#	INLET GAS			
M1	4	24"	150#	MANWAY			
LADDER & PTFM CLIPS	REQD.	NO					
PIPE SUPPORT CLIPS	REQD.	NO					
INSUL. SUPPORT CLIPS	REQD.	NO					
INSUL. THICKNESS	3 IN.						
PAINTING							
VESSEL CAPACITY	3503 CU. FT.						
VESSEL WEIGHT	EMPTY	37 KIPS					
TEST	KIPS						
REF. DWGS.							
NO.	DATE	REVISION	DESIGN	DWN.	CHK.	APPR.	APPR.
0	11/13/80	ISSUED FOR PHASE ZERO					
THE BRECKINRIDGE PROJECT			JOB NO. 14222				
NO.3 CONVERTER 10C-103/203/303			DRAWING NO. REV.				
			10-DS-G-07 0				



4.2 Data Sheet for Tanks

10-DS-D-01: Seal Pot (10D-101, 2, 3, 4, 10D-201, 2, 3, 4,
10D-301, 2, 3, 4)



4.3 Data Sheets for Exchangers

10-DS-E-01: No. 1 Reheat Exchanger (10E-101, 10E-201, 10E-301)

10-DS-E-02: No. 2 Reheat Exchanger (10E-102, 10E-202, 10E-302)

10-DS-E-03: No. 3 Reheat Exchanger (10E-103, 10E-203, 10E-303)

10-DS-E-04: Sulfur Condenser (10E-104, 10E-204, 10E-304)

10-DS-E-05: Feed Preheater (10E-105, 10E-205, 10E-305)

10-DS-E-06: Air Preheater (10E-106, 10E-206, 10E-306)

10-DS-E-07: Sulfur Condenser (10E-107, 10E-207, 10E-307)

10-DS-E-08: Tail Gas Superheater (10E-108, 10E-208, 10E-308)

HEAT EXCHANGER SPECIFICATION SHEET

PAGE 1/3

1	CUSTOMER AND PROJECT LOCATION ASFL BRECKINRIDGE CO., KY.		EXCHANGER MANUFACTURER		
2	PLANT 10 (SULFUR PLANT)	EXCH. NO. 10E-101, 201, 301	REQ. NO. 3		
3	SERVICE OF UNIT NO. 1 REHEAT EXCHANGER	ITEM NO.			
4	SIZE 41-144	TYPE CEN	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL	
5	SURF. UNIT (EFF/GROSS) 2235	SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 2235		
6	PERFORMANCE OF ONE UNIT (NORMAL CONDITION)				
7	FLUID ALLOCATION	SHELLSIDE		TUBESIDE	
8	FLUID CIRCULATED	600 PSIG STEAM		ACID GAS (H₂S, SO₂, CO₂, H₂)	
9	TOTAL FLUID ENTERING LB/HR	983		98,603	
10		IN	OUT	IN	
11	LIQUID				
12	VAPOR LB/HR, MW			98,603 33.7 98,603 33.97	
13	NONCOND LB/HR, MW				
14	STEAM	983			
15	WATER		983		
16	FLUID VAPORIZED (CONDENSED)		983		
17	GRAVITY, LIO.				
18	VISCOSITY, LIO. (VAP.) CP			(0.0223) (0.0229)	
19	THERM. COND., LIO. (VAP.) BTU/FT²/HR/F			(0.0183) (0.0184)	
20	SPECIFIC HEAT, LIO. (VAP.) BTU/LB-F			(0.261) (0.263)	
21					
22	TEMPERATURE °F	489	489	375 400	
23	OPERATING PRESS. (PSIA) (PSIG)	600	600	8.3 7.9	
24	NO. PASSES/SHELL	ONE		ONE	
25	VELOCITY FT/SEC				
26	PRESS. DROP, ALLOW/CALC. PSI	N/L		0.4 1	
27	FOULING RESISTANCE	0.0005		0.002	
28	HEAT EXCHANGED 0.717 X 10⁶	BTU/HR: MTD (CORR) (WTD)		°F	
29	TRANSFER RATE, SERVICE	CLEAN		BTU/HR. SQ. FT. °F	
30	CONSTRUCTION				
31		SHELLSIDE	TUBESIDE		
32	DESIGN/TEST PRESS. PSIG	660 1	501	MAX^M DUTY CASE IS LIMITING NO. OF UNITS = 3 AREA = 2,235 ft²/unit	
33	DESIGN TEMPERATURE °F	600	600		
34	CORROSION ALLOWANCE IN	1/8"	1/8"		
35	CONNECTIONS INLET	2	32		
36	SIZE OUTLET	2	32		
37	RATING	600 RF	150 RF		
38	TUBES NO 569	OD 1 1/4"	THK (MIN/AVG) 14 GA	LENGTH 12'	PITCH
39	TUBE MATERIAL CS	TUBE-TUBESHEET JOINT			FLOW → ↙ ↘ ↻
40	SHELL CS	ID 41" OD	SHELL COVER	(INTEG.) (REMOV)	
41	CHANNEL/BONNET	CHANNEL COVER			
42	TUBESHEET-STATIONARY	TUBESHEET FLOATING			
43	FLOATING HEAD COVER	IMPINGEMENT PLATE (YES) (NO)			
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING	
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS		
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT		
47	GASKETS				
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS	
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER		
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED (4) TUBES TO BE SEAL WELDED				
51	(1) EXCHANGER TO PERFORM UNDER ALL THREE CONDITIONS (NORMAL, TURN DOWN AND MAX. DUTY)				
52	(2) EXCHANGER TO BE VERTICALLY IN-LINE MOUNTED				
53	(3) AXIAL TUBESIDE INLET AND OUTLET NOZZLES REQUIRED				
54	REV.	DATE	ISSUED FOR PHASE ZERO	JOB NO. 14222	DRWG. NO. 10-05 - E-01

HEAT EXCHANGER SPECIFICATION SHEET

PAGE 2/3

1	CUSTOMER AND PROJECT LOCATION ASF- BRECKINRIDGE CO. KY.		EXCHANGER MANUFACTURER	
2	PLANT 10 (SULFUR PLANT)		EXCH. NO. 10E-101, 201, 301	REQ. NO. 3
3	SERVICE OF UNIT NO. 1 REHEAT EXCHANGER		ITEM NO.	
4	SIZE	TYPE	(HORIZ/VERT)	CONNECTED IN
5	SURF./UNIT (EFF/GROSS)		SHELLS/UNIT	SURF./SHELL (EFF/GROSS)
6	PERFORMANCE OF ONE UNIT TURN DOWN CONDITION			
7	FLUID ALLOCATION		SHELLSIDE	
8	FLUID CIRCULATED		TUBESIDE	
9	TOTAL FLUID ENTERING LB/HR		32,868	
10			32,868	
11	LIQUID		32,868	
12	VAPOR LB/HR, MW		32,868	
13	NONCOND LB/HR, MW		32,868	
14	STEAM		32,868	
15	WATER		32,868	
16	FLUID VAPORIZED (CONDENSED)		32,868	
17	GRAVITY, LIQ.		32,868	
18	VISCOSITY, LIQ. (VAP.) CP		32,868	
19	THERM. COND., LIQ. (VAP.) BTU/FT/HR/F		32,868	
20	SPECIFIC HEAT, LIQ. (VAP.) BTU/LB-F		32,868	
21			32,868	
22	TEMPERATURE °F		32,868	
23	OPERATING PRESS. (PSIA) (PSIG)		32,868	
24	NO. PASSES/SHELL		32,868	
25	VELOCITY FT/SEC		32,868	
26	PRESS. DROP, ALLOW/CALC. PSI		32,868	
27	FOULING RESISTANCE		32,868	
28	HEAT EXCHANGED 0.473 x 10 ⁶		32,868	
29	TRANSFER RATE, SERVICE		32,868	
30	CONSTRUCTION			
31	DESIGN/TEST PRESS. PSIG		32,868	
32	DESIGN TEMPERATURE °F		32,868	
33	CORROSION ALLOWANCE IN		32,868	
34	CONNECTIONS INLET		32,868	
35	SIZE OUTLET		32,868	
36	RATING		32,868	
37	TUBES NO. OD		32,868	
38	THK (MIN/AVG)		32,868	
39	LENGTH		32,868	
40	PITCH		32,868	
41	FLOW		32,868	
42	TUBE MATERIAL		32,868	
43	SHELL ID OD		32,868	
44	CHANNEL/BONNET		32,868	
45	TUBESHEET-STATIONARY		32,868	
46	FLOATING HEAD COVER		32,868	
47	BAFFLES-CROSS TYPE		32,868	
48	BAFFLES-LONG SEAL TYPE		32,868	
49	INSUL. THK.: SHELL CHAN.		32,868	
50	GASKETS		32,868	
51	CODE REQUIREMENTS		32,868	
52	WEIGHT: EACH SHELL		32,868	
53	REMARKS: MARK (SR) AND PERCENT (RT) AS REQUIRED		32,868	
54				

HEAT EXCHANGER SPECIFICATION SHEET

1/2

NORMAL CONDITION

CUSTOMER AND PROJECT LOCATION		ASFL BRECKINRIDGE CO. KY.		EXCHANGER MANUFACTURER	
PLANT	10 (SULFUR PLANT)	EXCH. NO.	10E-102,202,302	REQ. NO.	3
SERVICE OF UNIT	No. 2 REHEAT EXCHANGER	ITEM NO.			
SIZE	37-96	TYPE	CEN	CONNECTED IN	PARALLEL
SURF./UNIT (EFF. GROSS)	1200	SHELLS/UNIT	1	SURF/SHELL (EFF. GROSS)	1200
PERFORMANCE OF ONE UNIT					
FLUID ALLOCATION		SHELLSIDE		TUBESIDE	
FLUID CIRCULATED		600 PSIG STEAM		ACID GAS (H ₂ S, CO ₂ , H ₂)	
TOTAL FLUID ENTERING LB/HR		1,481		82,960	
		IN OUT		IN OUT	
LIQUID					
VAPOR LB/HR, MW				82,960 30.27 82,960 30.27	
NONCOND LB/HR, MW					
STEAM		1,481			
WATER		1,481			
FLUID VAPORIZED/CONDENSED		1,481			
GRAVITY, LIQ.					
VISCOSITY, LIQ. (VAP.) CP				(0.0231) (0.0240)	
THERM. COND., LIQ. (VAP.) BTU/FT-HR-F				(0.0185) (0.0194)	
SPECIFIC HEAT, LIQ. (VAP.) BTU/LB-F				(0.287) (0.290)	
TEMPERATURE °F		489		375 420	
OPERATING PRESS. (PSIA) (PSIG)		ONE		7.0 6.6	
NO. PASSES/SHELL		ONE		ONE	
VELOCITY FT/SEC					
PRESS. DROP, ALLOW/CALC. PSI		NIL		0.4	
FOULING RESISTANCE		0.0005		0.002	
HEAT EXCHANGED 1.08 x 10 ⁹		BTU/HR: MTD (CORR) (WTD)		°F	
TRANSFER RATE, SERVICE 12.08		CLEAN		BTU/HR. SQ. FT. °F	
CONSTRUCTION					
DESIGN/TEST PRESS. PSIG		SHELLSIDE 600		TUBESIDE 50	
DESIGN TEMPERATURE °F		600		600	
CORROSION ALLOWANCE IN		1/8"		1/8"	
CONNECTIONS		INLET 2"		30"	
SIZE		OUTLET 2"		30"	
RATING		600 #		150 #	
TUBES NO. 457 OD 1.315" THK (MIN/AVG) 14 GA LENGTH 8' PITCH FLOW →					
TUBE MATERIAL CS		TUBE-TUBESHEET JOINT			
SHELL CS		1037" OD		SHELL COVER (INTEG.) (REMOVE)	
CHANNEL/BONNET		CHANNEL COVER			
TUBESHEET-STATIONARY		TUBESHEET FLOATING			
FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)			
BAFFLES-CROSS		TYPE		% CUT (ID/AREA) SPACING	
BAFFLES-LONG		SEAL TYPE		TUBE SUPPORTS	
INSUL. THK.: SHELL		CHAN.		EXPANSION JOINT	
GASKETS					
CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS SPECS	
WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER	
REMARKS: MARK (DR) AND PERCENT (RT) AS REQUIRED 5. TUBES TO BE SEAL LUGGED					
1. 10% EXCESS SURFACE REQUIRED OVER ABOVE INDICATED REQUIREMENTS					
2. EXCHANGER TO PERFORM UNDER BOTH NORMAL AND TURNDOWN CONDITIONS					
3. EXCHANGER TO BE VERTICALLY, IN-LINE MOUNTED					
4. AXIAL TUBESIDE INLET AND OUTLET NOZZLES REQUIRED					
REV.		DATE		JOB NO. DRWG. NO. REV.	
1/15		ISSUED FOR PHASE 2 FRO PM		HNN 14322 10-CS-E-02 D	

HEAT EXCHANGER SPECIFICATION SHEET

2/2
TURN DOWN CONDITION

1	CUSTOMER AND PROJECT LOCATION ASFI BRECKENRIDGE CO KY		EXCHANGER MANUFACTURER	
2	PLANT 10 SULFUR PLANT	EXCH. NO. 10E-102,202,302	REQ. NO. 3	
3	SERVICE OF UNIT NO. 2 REHAT EXCHANGER	ITEM NO.		
4	SIZE TYPE BEM	(HORIZ/VERT)	CONNECTED IN	SERIES PARALLEL
5	SURF./UNIT (EFF/GROSS)	SHELLS/UNIT	SURF./SHELL (EFF/GROSS)	
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION	SHELLSIDE		TUBESIDE
8	FLUID CIRCULATED	600 PSIG STEAM		ACID GAS
9	TOTAL FLUID ENTERING LB/HR	751		82,960
10		IN	OUT	IN OUT
11	LIQUID			
12	VAPOR LB/HR, MW			82,960 Bu. 7 82,960 3027
13	NONCOND LB/HR, MW			
14	STEAM	751		
15	WATER		751	
16	FLUID VAPORIZED/CONDENSED		751	
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.) CP			(0.0226) (0.0240)
19	THERM. COND., LIQ. (VAP.) BTU/FT/HR/F			(0.0180) (0.0194)
20	SPECIFIC HEAT, LIQ. (VAP.) BTU/LB F			(0.285) (0.290)
21				
22	TEMPERATURE °F	489	489	351 420
23	OPERATING PRESS. (PSIA/PSIG)	600	600	4.4 4.3
24	NO. PASSES/SHELL	ONE		ONE
25	VELOCITY FT/SEC			
26	PRESS. DROP, ALLOW/CALC. PSI	NIL	1	0.4 1
27	FOULING RESISTANCE	0.0005		0.002
28	HEAT EXCHANGED 0.547 x 10⁶	BTU/HR; MTD (CORR) (WTD)		°F
29	TRANSFER RATE, SERVICE	CLEAN		BTU/HR. SQ. FT. °F
30	CONSTRUCTION			
31		SHELLSIDE	TUBESIDE	
32	DESIGN/TEST PRESS. PSIG	1	1	
33	DESIGN TEMPERATURE °F			
34	CORROSION ALLOWANCE IN			
35	CONNECTIONS	INLET		
36	SIZE	OUTLET		
37	RATING			
38	TUBES NO.	OD	THK (MIN/AVG)	LENGTH PITCH
39	TUBE MATERIAL	TUBE-TUBESHEET JOINT		
40	SHELL	ID	OD	SHELL COVER (INTEG.) (REMOV)
41	CHANNEL/BONNET	CHANNEL COVER		
42	TUBESHEET-STATIONARY	TUBESHEET FLOATING		
43	FLOATING HEAD COVER	IMPINGEMENT PLATE (YES) (NO)		
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)	SPACING
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS	
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT	
47	GASKETS			
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED			
51				
52				
53				
54				



REV.	DATE
△	
△	
△	

ISSUED FOR PHASE ZFRU

JOB NO.	DRWG. NO.	REV.
14222	0-05	D
	E-02	

HEAT EXCHANGER SPECIFICATION SHEET

NORMAL CONDITION

1	CUSTOMER AND PROJECT LOCATION		ASFC BRECKENRIDGE CO. KY		EXCHANGER MANUFACTURER	
2	PLANT	10 (SULFUR PLANT)	EXCH. NO.	10E-103, 203, 303	REQ. NO.	3
3	SERVICE OF UNIT		No. 3 REHEAT EXCHANGER		ITEM NO.	
4	SIZE	37-96	TYPE	CEN	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL
5	SURF./UNIT (EFF. GROSS)	1200	SHELLS/UNIT	1	SURF./SHELL (EFF. GROSS)	1200
6	PERFORMANCE OF ONE UNIT					
7	FLUID ALLOCATION		SHELLSIDE		TUBESIDE	
8	FLUID CIRCULATED		600 PSIG STEAM		ACID GAS (H ₂ S, SO ₂ , CO ₂ , H ₂)	
9	TOTAL FLUID ENTERING LB/HR		1,454		79,055	
10			IN		OUT	
11	LIQUID					
12	VAPOR	LB/HR, MW			79,055	24.8
13	NONCOND	LB/HR, MW			79,055	24.8
14	STEAM		1,454			
15	WATER		1,454			
16	FLUID VAPORIZED/CONDENSED		1,454			
17	GRAVITY, LIQ.					
18	VISCOSITY, LIQ. (VAP.) CP				(0.0234)	(0.0244)
19	THERM. COND., LIQ. (VAP.) BTU/FT ² /HR/F				(0.0197)	(0.0207)
20	SPECIFIC HEAT, LIQ. (VAP.) BTU/LF-F				(0.295)	(0.299)
21						
22	TEMPERATURE °F		489		375	420
23	OPERATING PRESS. (PSIA) (PSIG)		600		5.7	5.3
24	NO. PASSES/SHELL		ONE		ONE	
25	VELOCITY FT/SEC					
26	PRESS. DROP, ALLOW/CALC. PSI		NIL		0.4	
27	FOULING RESISTANCE		0.0005		0.002	
28	HEAT EXCHANGED 1.06 X 10 ⁶		BTU/HR; MTD (CORR) (WTD)		°F	
29	TRANSFER RATE, SERVICE 11.83		CLEAN		BTU/HR. SQ. FT. °F	
30	CONSTRUCTION					
31			SHELLSIDE		TUBESIDE	
32	DESIGN/TEST PRESS. PSIG		660		50	
33	DESIGN TEMPERATURE °F		600		600	
34	CORROSION ALLOWANCE IN		1/8		1/8	
35	CONNECTIONS		INLET		30	
36	SIZE		OUTLET		30	
37	RATING		600		150	
38	TUBES NO.	457	OD	1 1/4"	THK (MIN/AVG)	14GA
39	TUBE MATERIAL	CS	TUBE-TUBESHEET JOINT			
40	SHELL	CS	ID	37	OD	
41	CHANNEL/BONNET		SHELL COVER		(INTG.) (REMOVE)	
42	TUBESHEET-STATIONARY		CHANNEL COVER			
43	FLOATING HEAD COVER		TUBESHEET FLOATING			
44	BAFFLES-CROSS	TYPE	% CUT (DIA/AREA)		SPACING	
45	BAFFLES-LONG	SEAL TYPE	TUBE SUPPORTS			
46	INSUL. THK.: SHELL	CHAN.	EXPANSION JOINT			
47	GASKETS					
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS		SPECS	
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER			
50	REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED					
51	1. 10% EXCESS SURFACE REQUIRED OVER ABOVE INDICATED REQUIREMENTS					
52	2. EXCHANGER TO PERFORM UNDER BOTH NORMAL AND TURN DOWN CONDITIONS					
53	3. EXCHANGER TO BE VERTICALLY, IN-LINE MOUNTED					
54	4. AXIAL TUBESIDE INLET AND OUTLET NOZZLES REQUIRED					
	REV.	DATE	JOB NO.		DRWG. NO.	REV.
	1	11/19	ISSUED FOR PHASE ZERO		10-05-E-C3	0

2/2
TURN DOWN CONDITION

RAC SFE FORM 155 (6/76)

HEAT EXCHANGER SPECIFICATION SHEET

CUSTOMER AND PLANT LOCATION		EXCHANGER MANUFACTURER	
PLANT SULFUR PLANT-16		EXCH. NO.	
SERVICE OF UNIT SULFUR COND.		REQ. NO.	
DATE		ITEM NO. 10E-104,204,304	
TYPE		SERIES	
(HORI/VERT) CONNECTED IN		PARALLEL	
SURF. UNIT (EFF/GROSS) 4143 SQ.FT		SHELLS/UNIT	
SURF/SHELL (EFF/GROSS)		PERFORMANCE OF ONE UNIT	
FLUID ALLOCATION		SHELLSIDE	
FLUID CIRCULATED		PASS-1 TUBESIDE (SEE NOTE 1)	
TOTAL FLUID ENTERING		WATER	
LB/HR		ACID GAS	
16901		107648	
IN		OUT	
OUT		IN	
OUT		OUT	
LIQUID		9045	
VAPOR		107648	
LB/HR, MWI		98603	
CONDENSED		LB/HR, MWI	
STEAM		15211	
WATER		1690	
FLUID VAPORIZED/CONDENSED			
GRAVITY LIQ.			
LIQUID (LIQ. VAP.)			
THERM. COND. LIQ. (VAP.)			
SPECIFIC HEAT, LIQ. (VAP.)			
TEMPERATURE		293	
OPERATING PRESS.		297	
(PSIA) (PSIG)		470	
NO. PASSES/SHELL		375	
VELOCITY		50	
FT/SEC		8.8	
PRESS. DROP, ALLOW/CALC.		8.3	
PSI		0.5	
COUPLING RESISTANCE		0.5	
HEAT EXCHANGED		0.0001	
BTU/HR: MTD (CORR) (WTD)		0.002	
TRANSFER RATE, SERVICE		13.958x10 ⁶	
CLEAN		BTU/HR. SQ. FT. °F	
CONSTRUCTION			
DESIGN/TEST PRESS.		SHELLSIDE	
PSIG		TUBESIDE	
DESIGN TEMPERATURE		751	
°F		501	
CORROSION ALLOWANCE		650	
IN		700	
CONNECTIONS		1/8"	
INLET		2" 150# RF	
OUTLET		30" 150# RF	
RATING		3" 150# RF	
TUBE NO.		4" 16" STEAM JACKETED	
135 00		3" THK (MIN/AVG) 12GA	
TUBE MATERIAL		LENGTH 16'-3" PITCH	
C.S.		FLOW → ↓ Δ ◇ □	
SHELL		TUBE-TUBESHEET JOINT	
C.S.		SHELL COVER	
10 00		(INTEG.) (REMOV)	
CHANNEL BONNET		CHANNEL COVER	
TUBESHEET-STATIONARY		TUBESHEET FLOATING	
FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)	
RAFFLES-CROSS		TYPE	
RAFFLES-LONG		% CUT (DIA/AREA) SPACING	
INSUL. THK. SHELL		SEAL TYPE	
CHAN.		TUBE SUPPORTS	
BASKETS		EXPANSION JOINT	
CODE REQUIREMENTS		STAMP (YES) (NO)	
WEIGHT EACH SHELL		TEMA CLASS R SPECS	
FILLING DATA (GRI AND PERCENT RTI) AS REQUIRED		SUNGLE	
		FULL OF WATER	
NOTE 1. TUBE SIDE HAS TWO PASSES WITH DIFFERENT PROCESS CONDITIONS AND TUBE DESIGN. FOR PASS 2 PROCESS CONDITION AND TUBE DESIGN REFER TO SH 2 OF 2.			
JOB NO.		DRWG. NO.	
14222		10-DS-0	
		E-04 0	

NO. OF UNITS = 3
SURFACE / UNIT = 4,143 ft²

RECEIVED

ISSUED FOR PHASE ZERO

SH 1 OF 2

HEAT EXCHANGER SPECIFICATION SHEET

CUSTOMER AND PROJECT LOCATION		EXCH. NO.		EXCHANGER MANUFACTURER	
PLANT SULFUR PLANT (10)		REQ. NO.		ITEM NO. 10E-104, 304, 304	
SERVICE OF UNIT SULFUR CONDENSER		SERIES		PARALLEL	
SIZE	TYPE	(HORIZ/VERT)	CONNECTED IN		
SURF. UNIT (EFF/GROSS)	SHELLS/UNIT		DUMP/SHELL (EFF/GROSS)		
PERFORMANCE OF ONE UNIT					
FLUID ALLOCATION		SHELLSIDE		PASS-2 TUBESIDE	
FLUID CIRCULATED				ACID GAS	
TOTAL FLUID ENTERING LB/HR				98603	
		IN	CUT	IN	CUT
LIQUID					15643
VAPOR LB/HR, MW				98603	82960
NONCOND LB/HR, MW					
STEAM					
WATER					
FLUID VAPORIZED/CONDENSED					
GRAVITY, LIQ.					
VISCOSITY, LIQ. (VAP.)					
THERM. COND., LIQ. (VAP.)					
SPECIFIC HEAT, LIQ. (VAP.)					
TEMPERATURE °F				654	375
OPERATING PRESS. (PSIA) (PSIG)				7.5	7.0
NO. PHASES/SHELL					
VELOCITY FT/SEC					
PRESS. DROP, ALLOW/CALC. PSI				0.5	
FOULING RESISTANCE				0.002	
HEAT EXCHANGED BTU/HR: MTD (CORR) (WTO)					
TRANSFER RATE, SERVICE CLEAN					STL FOR SOL. PT. °F
CONSTRUCTION					
		SHELLSIDE	TUBESIDE		
DESIGN/TEST PRESS. PSIG			50		
DESIGN TEMPERATURE °F			700		
CORROSION ALLOWANCE IN					
CONNECTIONS		30" 150 # RF			
SIZE		30" 150 # RF			
RATING		4" 16" STEAM JACKETED			
THICK. IN		3/4	THK. MIN/AVG: RGA	LENGTH 16'-3" PITCH	FLOW →
TUBE MATERIAL C.S.		TUBE-TUBESHEET JOINT			
SHELL ID OD		SHELL COVER INTERL (REMOV)			
CHANNEL BONNET		CHANNEL COVER			
TUBESHEET STATIONARY		TUBESHEET FLOATING			
FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)			
BAFFLES/CROSS TYPE		B CUT (OIA/AREA) SPACING			
BAFFLES/LONG SEAL TYPE		TUBE SUPPORTS			
INSUL. THK. SHELL CHAN.		EXPANSION JOINT			
BASKETS					
CODE REQUIREMENTS STAMP (YES) (NO)		TEMA CLASS		SPECS	
WEIGHT, EACH SHELL		BUNDLE		FULL OF WATER	
REMARKS, MARK (SRI) AND PERCENT (RT) AS REQUIRED					
DATE					
11/17/19 ISSUED FOR PHASE ZERO					
JOB NO. 14222 10-DS-0					
E-04					

RECEIVED

HEAT EXCHANGER SPECIFICATION SHEET

CUSTOMER AND PROJECT LOCATION ASFI BRECKINRIDGE CO. KY.		EXCHANGER MANUFACTURER.				
PLANT 10 (SULFUR PLANT)	EXCH. NO. 10E-105, 205, 305	REQ. NO. 3				
SERVICE OF UNIT FEED PREHEATER	ITEM NO.					
SIZE 26-192	TYPE CEN	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL			
SURF/UNIT (EFF/GROSS) 1500	SHELLS/UNIT 1	SURF/SHELL (EFF/GROSS) 1500				
PERFORMANCE OF ONE UNIT						
FLUID ALLOCATION	SHELLSIDE		TUBESIDE			
FLUID CIRCULATED	600 PSIG STEAM		ACID GAS (H₂S, CO₂, H₂)			
TOTAL FLUID ENTERING LB/HR	12,921		30,676			
	IN	OUT	IN OUT			
LIQUID						
VAPOR LB/HR, MW			30,676 34.39 30,676 34.39			
NONCOND LB/HR, MW						
STEAM	2,921					
WATER		2,921				
FLUID VAPORIZED (CONDENSED)		2,921				
GRAVITY, LIQ.						
VISCOSITY, LIQ. (VAP.) CP			(0.0163) (0.0221)			
THERM. COND., LIQ. (VAP.) BTU/FT/HR/F			(0.0133) (0.0195)			
SPECIFIC HEAT, LIQ. (VAP.) BTU/LB-F			(0.257) (0.277)			
TEMPERATURE °F	489	489	200 460			
OPERATING PRESS. (PSIA) (PSIG)	600	600	10.2 9.8			
NO. PASSES/SHELL						
VELOCITY FT/SEC						
PRESS. DROP, ALLOW/CALC. PSI	NIL		0.4			
FOULING RESISTANCE	0.0005		0.002			
HEAT EXCHANGED 2.13 X 10⁶	BTU/HR; MTD (CORR) (WTD)		°F			
TRANSFER RATE, SERVICE	CLEAN		BTU/HR. SQ. FT. °F			
CONSTRUCTION						
DESIGN/TEST PRESS. PSIG	SHELLSIDE 660	TUBESIDE 50	NO. OF UNITS = 3 AREA = 1,500 sq ft/unit			
DESIGN TEMPERATURE °F	600	600				
CORROSION ALLOWANCE IN	1/8	1/8				
CONNECTIONS	INLET 2	OUTLET 18				
SIZE	2	18				
RATING	600 #	150 #				
TUBES NO. 34	OD 1.00	THK (MIN/AVG) 14 GA	LENGTH 16'	PITCH	FLOW → Δ Δ Δ	
TUBE MATERIAL CS	TUBE-TUBESHEET JOINT					
SHELL CS	OD 26" 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 THK.: SHELL	CHAN.	EXPANSION JOINT				
GASKETS						
CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS R		SPECS		
WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER				
REMARKS: MARK (SRI) AND PERCENT (IRT) AS REQUIRED						
1. 10% EXCESS SURFACE REQUIRED OVER ABOVE INDICATED REQUIREMENTS						
2. TUBES TO BE SEAL WELDED						
						
REV.	DATE			JOB NO.	DRWG. NO.	REV.
1/1/81	ISSUED FOR PHASE 2 FRO	PPM	14222	10-05	-E-05	0

HEAT EXCHANGER SPECIFICATION SHEET

NORMAL CONDITION

1	CUSTOMER AND PROJECT LOCATION ASFI BRECKINRIDGE CO. KY		EXCHANGER MANUFACTURER	
2	PLANT 10 (SULFUR PLANT)		EXCH. NO. 10E-106, 206, 306	REQ. NO. 3
3	SERVICE OF UNIT AIR PREHEATER		ITEM NO.	
4	SIZE 15-240	TYPE CEM	(HORIZ/VERT) CONNECTED IN	SERIES PARALLEL
5	SURF./UNIT (EFF. GROSS) 500		SHELLS/UNIT 1	SURF./SHELL (EFF. GROSS) 500
6	PERFORMANCE OF ONE UNIT			
7	FLUID ALLOCATION		SHELLSIDE TUBESIDE	
8	FLUID CIRCULATED		AIR 600 PSIG STEAM	
9	TOTAL FLUID ENTERING LB/HR		26,441 1,893	
10			IN	OUT
11	LIQUID			
12	VAPOR	LB/HR, MW	26,441 28.21	26,441 28.21
13	NONCOND	LB/HR, MW		
14	STEAM			1,893
15	WATER			1,893
16	FLUID VAPORIZED/CONDENSED			1,893
17	GRAVITY, LIQ.			
18	VISCOSITY, LIQ. (VAP.)	CP	(0.0230)	(0.0270)
19	THERM. COND., LIQ. (VAP.)	BTU/FT/HR/F	(0.0189)	(0.0223)
20	SPECIFIC HEAT, LIQ. (VAP.)	BTU/LB-F	(0.252)	(0.257)
21				
22	TEMPERATURE	°F	254	460
23	OPERATING PRESS.	(PSIA) (PSIG)	10.2	9.8
24	NO. PASSES/SHELL			600
25	VELOCITY	FT/SEC		489
26	PRESS. DROP, ALLOW/CALC.	PSI	0.4	600
27	FOULING RESISTANCE		0.002	0.0005
28	HEAT EXCHANGED	1.38 x 10⁶	BTU/HR; MTD (CORR) (WTD)	°F
29	TRANSFER RATE, SERVICE		CLEAN	BTU/HR. SQ. FT. °F
30	CONSTRUCTION			
31			SHELLSIDE	TUBESIDE
32	DESIGN/TEST PRESS.	PSIG	50	660
33	DESIGN TEMPERATURE	°F	600	600
34	CORROSION ALLOWANCE	IN	1/8	1/8
35	CONNECTIONS	INLET	8	3
36	SIZE	OUTLET	8	2
37	RATING		150 #	600 #
38	TUBES NO.	91	OD 1-00"	THK (MIN/AVG) 14 GA
39	TUBE MATERIAL	CS	LENGTH 20'	PITCH FLOW
40	SHELL	CS	ID 15	OD
41	CHANNEL/BONNET		SHELL COVER	(INTEG.) (REMOV)
42	TUBESHEET-STATIONARY		CHANNEL COVER	
43	FLOATING HEAD COVER		TUBESHEET FLOATING	
44	BAFFLES-CROSS	TYPE	IMPINGEMENT PLATE (YES) (NO)	
45	BAFFLES-LONG	SEAL TYPE	% CUT (DIA/AREA)	SPACING
46	INSUL. THK.: SHELL	CHAN.	TUBE SUPPORTS	
47	GASKETS		EXPANSION JOINT	
48	CODE REQUIREMENTS	STAMP (YES) (NO)	TEMA CLASS	SPECS
49	WEIGHT: EACH SHELL	BUNDLE	FULL OF WATER	
50	REMARKS: MARK (SRI) AND PERCENT (INT) AS REQUIRED			
51	EXCHANGER TO PERFORM UNDER BOTH NORMAL AND WINTER			
52	CONDITIONS, SEE SHEET 2.			
53				
54				

AREA BASED ON WINTER CONDITIONS.
 NO. OF UNITS = 3
 AREA = 500 sq ft/UNIT

	REV.	DATE					JOB NO.	DIWG. NO.	REV.
			ISSUED FOR PHASE ZERO				14-002	10-05-E-06	0

WINTER CONDITION

RAC SFL FORM 138 (6/76)

HEAT EXCHANGER SPECIFICATION SHEET

1. PLANT AND PROJECT LOCATION		EXCH. NO.		REQ. NO.	
2. SERVICE OF UNIT		ITEM NO.		SERIES	
3. SIZE	4. TYPE	5. (HORIZ/VERT) CONNECTED IN		6. PARALLEL	
7. SURF./UNIT (EFF/GROSS)	8. SHELLS/UNIT	9. SURF./SHELL (EFF/GROSS)		10. PERFORMANCE OF ONE UNIT	
11. FLUID ALLOCATION		12. SHELLSIDE		13. TUBESIDE	
14. FLUID CIRCULATED		15. WATER		16. ACID GAS	
17. TOTAL FLUID ENTERING		18. LB/HR		19. 7529	
20. IN		21. OUT		22. IN	
23. OUT		24. IN		25. OUT	
26. LIQUID		27. VAPOR		28. LB/HR, MW	
29. NONCOND		30. LB/HR, MW		31. 82960	
32. STEAM		33. WATER		34. 7529	
35. FLUID VAPORIZED/CONDENSED		36. GRAVITY, LIQ.		37. 6776	
38. VISCOSITY, LIQ. (VAP.)		39. THERM. COND., LIQ. (VAP.)		40. 753	
41. SPECIFIC HEAT, LIQ. (VAP.)		42. TEMPERATURE		43. 293	
44. OPERATING PRESS.		45. (PSIA) (PSIG)		46. 297	
47. NO. PASSES/SHELL		48. VELOCITY		49. FT/SEC	
50. PRESS. DROP, ALLOW/CALC.		51. PSIG		52. 0.5	
53. FOULING RESISTANCE		54. HEAT EXCHANGED		55. 6.219 X 10 ⁶	
56. TRANSFER RATE, SERVICE		57. CLEAN		58. STU/HR. MTD (CORR) (WTD)	
59. CONSTRUCTION		60. SHELLSIDE		61. TUBESIDE	
62. DESIGN/TEST PRESS.		63. PSIG		64. 75	
65. DESIGN TEMPERATURE		66. °F		67. 650	
68. CORROSION ALLOWANCE		69. IN		70. 1/8"	
71. CONNECTIONS		72. INLET		73. 2" 150# RF	
74. SIZE		75. OUTLET		76. 30" 150# RF	
77. RATING		78. OUTLET (HAND)		79. 2" 150# RF	
80. FLANS NO.		81. OD		82. 3"	
83. TUBE MATERIAL		84. C.S.		85. THK (MIN/AVG)	
86. SHELL		87. C.S.		88. ID	
89. CHANNEL BONNET		90. TUBESHEET-STATIONARY		91. CHANNEL COVER	
92. FLOATING HEAD COVER		93. IMPINGEMENT PLATE (YES) (NO)		94. RAPFLES-CROSS	
95. RAPFLES-LONG		96. SEAL TYPE		97. TUBE SUPPORTS	
98. INFL. THK. SHELL		99. CHAN.		100. EXPANSION JOINT	
101. GASKETS		102. CODE REQUIREMENTS		103. STAMP (YES) (NO)	
104. WEIGHT EACH SHELL		105. BUNDLE		106. FULL OF WATER	
107. REMARKS: MARK (SRI) AND PERCENT (RT) AS REQUIRED		108. NOTE 1: TUBE SIDE HAS TWO PASSES WITH DIFFERENT PROCESS CONDITIONS AND TUBE DESIGN.		109. FOR PASS 2 PROCESS CONDITION AND TUBE DESIGN REFER TO SH 2 OF 2.	
110. DATE		111. DESIG. NO.		112. REV.	
113. 0.1/1/81 ISSUED PHASE ZERO		114. 14222		115. 10-25-0	
116. SH 1 OF 2		117. E-07		118. 0	

RECEIVED

HEAT EXCHANGER SPECIFICATION SHEET

EXCHANGER AND INSTALL LOCATION		EXCHANGER MANUFACTURER	
UNIT SULFUR PLANT (10)		EXCH. NO.	
SERVICE OF UNIT SULFUR CONDENSER		REQ. NO.	
SIZE TYPE		ITEM NO. 10E-107, 207, 307	
SURF. UNIT (EFF/GROSS)		SHELLS/UNIT	
SURF/SHELL (EFF/GROSS)		PARALLEL	
PERFORMANCE OF ONE UNIT			
FLUID ALLOCATION		SHELLSIDE	
FLUID CIRCULATED		PASS(2) TUBESIDE	
TOTAL FLUID ENTERING LB/HR		ACID GAS	
		79055	
		IN CUT	
		IN CUT	
TEMPERATURE °F		1297	
PRESS. LB/HR, MW		79055	
PRESS. LB/HR, MW		77758	
WATER			
FLUID VAPORIZED/CONDENSED			
GRAVITY, LQ.			
VISCOSITY, LQ. (VAP.)			
TEMP. A. COND., LQ. (VAP.)			
SPECIFIC HEAT, LQ. (VAP.)			
TEMPERATURE °F		432	
OPERATING PRESS. (PSIA) (SIC)		4.4	
CORR. RATES/SHELL		4.4	
VELOCITY FT/SEC			
PRESS. DROP, ALLOW. (PSI)		0.5	
FOLLING RESISTANCE		0.002	
HEAT EXCHANGED		BTU/HR: MTD (CORR) (WTO)	
TRANSFER RATE, SERVICE		CLEAN	
		BTU/HR. SQ. FT. °F	
CONSTRUCTION			
DESIGN/TEST PRESS. (PSIG)		SHELLSIDE	
DESIGN TEMPERATURE °F		TUBESIDE	
CORROSION ALLOWANCE (IN)		50	
CONNECTIONS		650	
SIZE		30" 150 # RF	
RATING		30" 150 # RF	
TUBES NO. 320		4" 6" STEAM JACKED	
TUBE MATERIAL C.S.		TUBE-TUBESHEET JOINT	
SHELL		SHELL COVER	
CHANNEL BONNET		CHANNEL COVER	
TUBESHEET STATIONING		TUBESHEET FLOATING	
FLOATING HEAD COVER		IMPINGEMENT PLATE (YES) (NO)	
Baffles-CROSS		TYPE	
Baffles-Long		SEAL TYPE	
INSUL. THK. SHELL		CHAN.	
JACKETS		EXPANSION JOINT	
CODE REQUIREMENTS		STAMP (YES) (NO)	
WEIGHT EACH SHELL		BUNDLE	
REMARKS: MARK (R) 10 PERCENT (RT) AS REQUIRED		FULL OF WATER	
 ISSUED FOR PHASE ZERO 14222			

HEAT EXCHANGER SPECIFICATION SHEET

NORMAL CONDITION

CUSTOMER AND PROJECT LOCATION		ASFI BRECKINRIDGE CO., KY.		EXCHANGER MANUFACTURER	
PLANT	10 (SULFUR PLANT)	EXCH. NO.	10E-108, 208, 308	REQ. NO.	3
SERVICE OF UNIT	TAIL GAS SUPERHEATER				ITEM NO.
SIZE	37-96	TYPE	CEN	(HORIZ/VERT)	CONNECTED IN
SURF./UNIT (EFF. GROSS)	1200	SHELLS/UNIT	1	SURF/SHELL (EFF. GROSS)	1200
PERFORMANCE OF ONE UNIT					
FLUID ALLOCATION		SHELLSIDE		TUBESIDE	
FLUID CIRCULATED		600 PSIG STEAM		ACID GAS (H ₂ S, SO ₂ , CO ₂ , H ₂)	
TOTAL FLUID ENTERING		1,737		77,758	
		IN		OUT	
LIQUID					
VAPOR		LB/HR, MW		77,758 28.9 77,758 28.9	
NONCOND		LB/HR, MW			
STEAM		1,737			
WATER		1,737			
FLUID VAPORIZED (CONDENSED)		1,737			
GRAVITY, LIQ.					
VISCOSITY, LIQ. (VAP.)		CP		(0.0221) (0.0234)	
THERM. COND., LIQ. (VAP.)		BTU/FT/HR/F		(0.0183) (0.0197)	
SPECIFIC HEAT, LIQ. (VAP.)		BTU/LB-F		(0.294) (0.298)	
TEMPERATURE		°F		320 375	
OPERATING PRESS.		(PSIA) (PSIG)		4.4 4.0	
NO. PASSES/SHELL		ONE		ONE	
VELOCITY		FT/SEC			
PRESS. DROP, ALLOW/CALC.		PSI		0.4 1	
FOULING RESISTANCE		0.0005		0.002	
HEAT EXCHANGED		1.27 X 10 ⁶		BTU/HR; MTD (CORR) (WTD)	
TRANSFER RATE, SERVICE		9.08		CLEAN	
				BTU/HR. SQ. FT. °F	
CONSTRUCTION					
DESIGN/TEST PRESS.		PSIG		SHELLSIDE TUBESIDE	
DESIGN TEMPERATURE		°F		660 1 501	
CORROSION ALLOWANCE		IN		1/8 1/8	
CONNECTIONS		INLET		2 30	
SIZE		OUTLET		2 30	
RATING					
TUBES NO.		457		OD 1-25 THK (MIN/AVG) 14 GA LENGTH PITCH FLOW	
TUBE MATERIAL		CS		TUBE-TUBESHEET JOINT	
SHELL		CS		ID 37 OD SHELL COVER (INTEG.) (REMOV)	
CHANNEL/BONNET				CHANNEL COVER	
TUBESHEET-STATIONARY				TUBESHEET FLOATING	
FLOATING HEAD COVER				IMPINGEMENT PLATE (YES) (NO)	
BAFFLES CROSS		TYPE		% CUT (ID/AREA) SPACING	
BAFFLES LONG		SEAL TYPE		TUBE SUPPORTS	
INSUL. THK.: SHELL		CHAN.		EXPANSION JOINT	
GASKETS					
CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS SPECS	
WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER	
REMARKS: MARK (SRI) AND PERCENT (IRT) AS REQUIRED					
1. 10% EXCESS SURFACE REQUIRED OVER ABOVE INDICATED REQUIREMENTS					
2. EXCHANGER TO PERFORM UNDER BOTH NORMAL AND TURN DOWN CONDITIONS					
3. EXCHANGER TO BE VERTICALLY, IN-LINE MOUNTED					
4. AXIAL TUBESIDE INLET AND OUTLET NOZZLES REQUIRED					
REV.		DATE		JOB NO. DRWG. NO. REV.	
1		1/7/93		14222 10-66 -E-08 D	

HEAT EXCHANGER SPECIFICATION SHEET

TURN DOWN CONDITION

1	CUSTOMER AND PROJECT LOCATION		ASFI BRECKINRIDGE CO. KY		EXCHANGER MANUFACTURER	
2	PLANT	10 SULEUR PLANT	EXCH. NO.	10E-108, 208, 308	REQ. NO.	3
3	SERVICE OF UNIT		TAIL GAS SUPERHEATER		ITEM NO.	
4	SIZE	TYPE	BEM	(HORIZ/VERT)	CONNECTED IN	SERIES / PARALLEL
5	SURF./UNIT (EFF/GROSS)		SHELLS/UNIT		SURF/SHELL (EFF/GROSS)	
6	PERFORMANCE OF ONE UNIT					
7	FLUID ALLOCATION		SHELLSIDE		TUBESIDE	
8	FLUID CIRCULATED		600 PSIG STEAM		ACID GAS	
9	TOTAL FLUID ENTERING		LB/HR		25,919	
10			IN OUT		IN OUT	
11	LIQUID					
12	VAPOR		LB/HR, MW		25,919 28.9 25,919 28.9	
13	NONCOND		LB/HR, MW			
14	STEAM		658			
15	WATER		658			
16	FLUID VAPORIZED/CONDENSED		658			
17	GRAVITY, LIQ.					
18	VISCOSITY, LIQ. (VAP.)		CP		(0.0221) (0.0334)	
19	THERM. COND., LIQ. (VAP.)		BTU/FT ² /HR/F		(0.0183) (0.0197)	
20	SPECIFIC HEAT, LIQ. (VAP.)		BTU/LB-F		(0.294) (0.298)	
21	TEMPERATURE		°F		489 489 312 375	
22	OPERATING PRESS.		(PSIA) (PSIG)		600 600 4.1 4.0	
23	NO. PASSES/SHELL		ONE		ONE	
24	VELOCITY		FT/SEC			
25	PRESS. DROP, ALLOW/CALC.		PSI		NIL 1	
26	FOULING RESISTANCE		0.0005		0.002	
27	HEAT EXCHANGED		0.48 X 10 ⁶		BTU/HR: MTD (CORR) (WTD)	
28	TRANSFER RATE, SERVICE		CLEAN		BTU/HR. SQ. FT. °F	
29	CONSTRUCTION					
30	DESIGN/TEST PRESS.		PSIG		SHELLSIDE TUBESIDE	
31	DESIGN TEMPERATURE		°F			
32	CORROSION ALLOWANCE		IN			
33	CONNECTIONS		INLET			
34	SIZE		OUTLET			
35	RATING					
36	TUBES NO.		OD THK (MIN/AVG)		LENGTH PITCH	
37	TUBE MATERIAL				TUBE-TUBESHEET JOINT	
38	SHELL		ID OD		SHELL COVER (INTEG) (REMOV)	
39	CHANNEL/BONNET				CHANNEL COVER	
40	TUBESHEET-STATIONARY				TUBESHEET FLOATING	
41	FLOATING HEAD COVER				IMPINGEMENT PLATE (YES) (NO)	
42	BAFFLES-CROSS		TYPE		% CUT (DIA/AREA) SPACING	
43	BAFFLES-LONG		SEAL TYPE		TUBE SUPPORTS	
44	INSUL. THK.: SHELL		CHAN.		EXPANSION JOINT	
45	GASKETS					
46	CODE REQUIREMENTS		STAMP (YES) (NO)		TEMA CLASS SPECS	
47	WEIGHT: EACH SHELL		BUNDLE		FULL OF WATER	
48	REMARKS: MARK (S) AND PERCENT (RT) AS REQUIRED					
49						
50						
51						
52						
53						
54						



REV.

DATE

ISSUED FOR PHASE ZERO

JOB NO. 14-22

DRWG. NO. 10-05 -E-08

REV. D

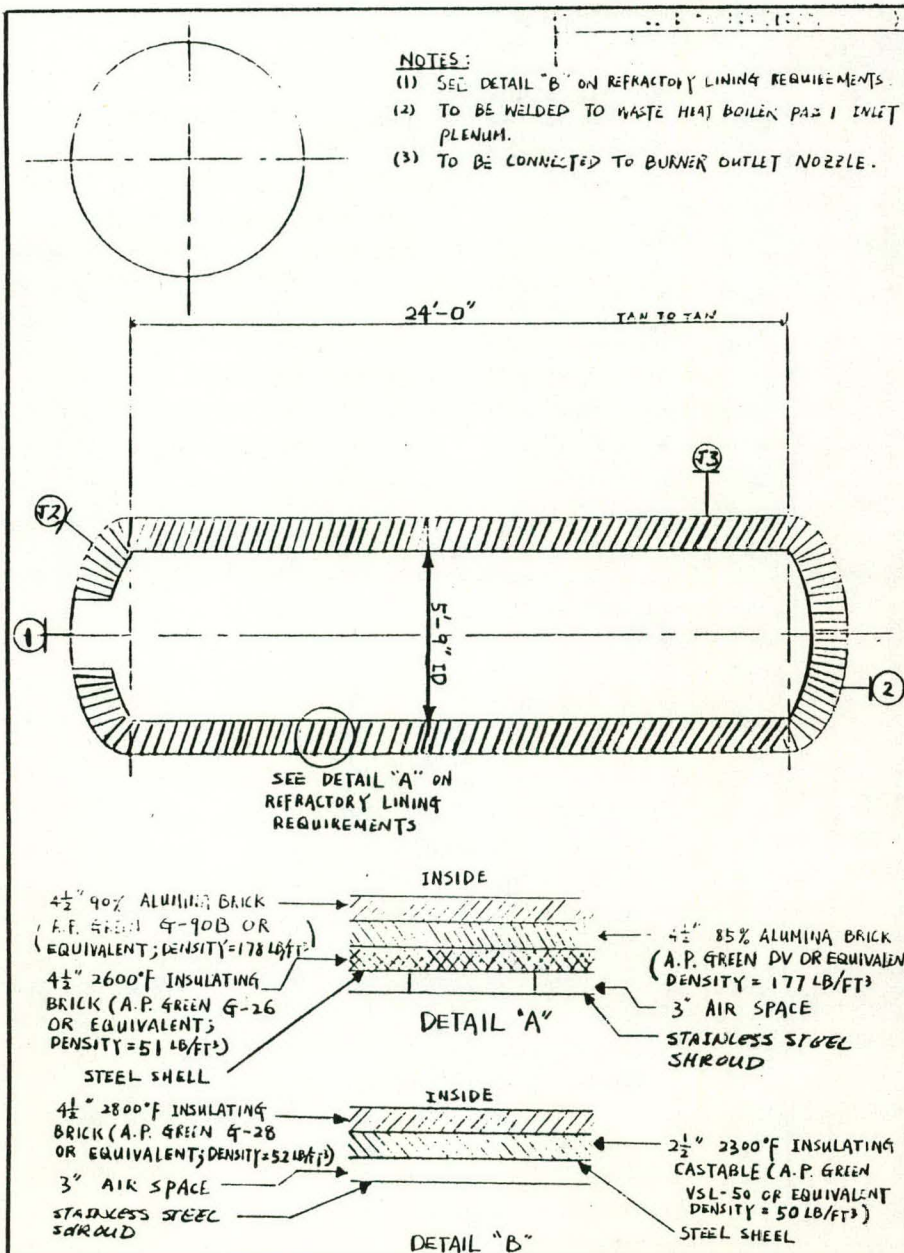
4.4 Data Sheets for Fired Heaters

Reaction Furnace (10F-101, 10F-201, 10F-301)

Waste Heat Boiler (10F-102, 10F-202, 10F-302)

Acid Gas Burner and Waste Heat Recovery (10F-101, 10F-102, 10F-103)

Acid Gas Burner (10F-103, 10F-203, 10F-303)



PROCESS INFORMATION				CALCULATED DATA																																																																																																							
VAPOR PRESS & MAX. AMB. P_{11} = P_{12} PROCESS CONTAMINANTS $H_2S, SO_2, CO, CO_2, H_2$				(1) STD. DISPLACER RANGES (CIRCLE CHOICE) & SPECIAL CONDIT. OVER 45" (2) REFER TO DESIG. J.L. 6701 (6707)																																																																																																							
COMPONENT TYPE MAT'L CORR. ALLOW. REMARKS SHELL & HEADS CS 1/8" MIN INLET & OUTLET TOTAL				3" SOURCE ETC. ALSO WILL BE HEAVIEST STE. BUT TO BE 1/2" THICKER IF IT IS TO BE OR LONGER TO BE 1/2" THICKER IN DIMENSIONS IN CASE OF WELDING																																																																																																							
PRESS. MAX. MIN. SPEC. DESIGN PRESS. 50 PSIG (MAX. + 10%) SYSTEM HYD. TEST AT 100% LOCATED MAX. DESIGN TEMP. 1000°F EXTERNAL PRESS. DESIGN. FOR				SPECIAL REQUIREMENTS CORN. ASME SECTION I SERVICE CONDITIONS, LETHAL ETC.																																																																																																							
VESSEL SUPPORT DATA: SKIRT _____ LEGS _____ SADDLES (C-527) HEIGHT _____ MIN. AVE. GRADE FIREPROOFING _____				INSULATION: YES																																																																																																							
<table border="1"> <thead> <tr> <th>NO.</th> <th>SERVICE</th> <th>INS. TEMP.</th> <th>INS. SIZE</th> <th>INS. TYPE</th> <th>NO.</th> <th>SERVICE</th> <th>INS. TEMP.</th> <th>INS. SIZE</th> <th>INS. TYPE</th> </tr> </thead> <tbody> <tr> <td>1-1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1-2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1-3</td> <td>THERMOCOUPLE</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1-4</td> <td>OPTICAL TT</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				NO.	SERVICE	INS. TEMP.	INS. SIZE	INS. TYPE	NO.	SERVICE	INS. TEMP.	INS. SIZE	INS. TYPE	1-1										1-2										1-3	THERMOCOUPLE									1-4	OPTICAL TT									<table border="1"> <thead> <tr> <th>NO.</th> <th>SERVICE</th> <th>INS. TEMP.</th> <th>INS. SIZE</th> <th>INS. TYPE</th> <th>NO.</th> <th>SERVICE</th> <th>INS. TEMP.</th> <th>INS. SIZE</th> <th>INS. TYPE</th> </tr> </thead> <tbody> <tr> <td>2-1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2-2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2-3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2-4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				NO.	SERVICE	INS. TEMP.	INS. SIZE	INS. TYPE	NO.	SERVICE	INS. TEMP.	INS. SIZE	INS. TYPE	2-1										2-2										2-3										2-4									
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ISSUED FOR APPROVAL VESSEL DESIGN DATA SHEET 14222 REACTION FURNACE PLANT 10 (SULFUR PLANT) CENTER "E" ON PROCESS MASTER ONLY				JIC PROCESS MASTER DATA SHEET VESSEL NO. 10 10F-101, 201, 301																																																																																																							

NOTES (cont.) :

6. (CONT).

GREENCAST 97 L DENSITY = 85 LB/CF

PASS 1 INLET TUBES TO HAVE 85% ALUMINA
FERRULES WITH 1/8" THICK KAO WOOL (OR EQUIV)
WRAPPING AT TUBE CONTACT AREAS.

7. 36" DIAMETER REACTION FURNACE NOZZLE
(NOZZLE (E) ON DWG FOR VESSEL 10F-101, 201, 301)
TO BE WELDED TO INLET PLENUM.

8. THINGS TO BE DONE WGLD.

[illegible]

(ENTER "C" ON LICENSE PLATE ONLY)

ATTACHMENT NO. 2

5H 20

FIRE HEATER DATA SHEET FOR PRICING PURPOSE 10F-101, 102, 103

3 UNITS REQD.
TOGETHER FORMS
ONE UNIT.

Customer DSFI Manufacturer 10F-101, 10F-102, 10F-103
Location BRECKINRIDGE Equip. No. 10F-201, 10F-202, 10F-203
Unit ACID GAS BURNER & WASTE HEAT RECOVERY 10F-301, 10F-302, 10F-303
Number Required 3 Type of Heater
Total Heat Absorbed mm Btu/h

HEATER PERFORMANCE

Heater Section
Service
Fluid Name
Heat Absorption mm Btu/h 28,042
Flow Rate lb/h
Pressure Drop (Allowable - Clean/Fouled) psi
Pressure Drop (Calculated - Clean/Fouled) psi
Coking Allowance in
Average Radiant Flux Density (Allowable) Btu/h-sq ft
Average Radiant Flux Density (Calculated) Btu/h-sq ft
Maximum Radiant Flux Density Btu/h-sq ft
Average Convection Flux Density Btu/h-sq ft
Velocity Limitation ft/sec
Maximum Allowable Inside Film Temperature °F
Fouling Resistance Inside h-ft²/Btu

Inlet Conditions:
Temperature °F 293
Pressure (psig)(psia) 614.4
Liquid Flow lb/h 32286 (WATER)
Vapor Flow lb/h
Density, Liquid (Vapor) At P&T lb/cu ft 57.54
Gravity, Liquid (Sp Gr at 60°F)
Vapor mol wt
Viscosity, Liquid (Vapor) CP
Specific Heat, Liquid (Vapor) Btu/lb-°F
Conductivity, Liquid (Vapor) Btu-ft/h-ft²-°F

Outlet Conditions:
Temperature °F 489
Pressure (psig)(psia) 614.4
Liquid Flow lb/h 3229
Vapor Flow lb/h 29057 (STEAM)
Density, Liquid (Vapor) At P&T lb/cu ft 49.53
Gravity, Liquid (Sp Gr at 60°F)
Vapor mol wt
Viscosity, Liquid (Vapor) CP
Specific Heat, Liquid (Vapor) Btu/lb-°F
Conductivity, Liquid (Vapor) Btu-ft/h-ft²-°F

Remarks and Special Requirements:

Data sheet reference for vaporization curve

SEE NOTE 1 ON PAGE 2.



REV.

Δ					JOB NO. 14222	
Δ					DATA SHEET	REV.
Δ						0
Δ	1/1/9	ISSUED FOR PHASE 2EAD	27/1/9	WAC	10-DS-F-01	

COMBUSTION AND FUEL DATA

51. Type of Fuel.....
 52. Excess Air %
 53. Calculated Heat Release mm Btu/h(LHV)
 54. Calculated Efficiency, Percent (LHV)
 55. Guaranteed Efficiency, Percent (LHV) See Note.....
 56. Radiation Loss, Percent of Heat Release (LHV).....
 57. Flue Gas Temp. Leaving Radiant Section..... °F
 58. Flue Gas Temp. Leaving Convection Section..... °F
 59. Flue Gas Temp. (Uncorr) Leaving Air Heater..... °F
 60. Flue Gas Mass Velocity-Conv. Section..... lb/sq ft-sec
 61. Volumetric Heat Release..... Btu/h-cu ft
 62. Altitude Above Sea Level..... ft
 63. Air Temperature, Combustion..... °F
 64. Air Temperature, Draft..... °F
 65. Minimum Furnace Draft/Location..... in H₂O
 66. Draft at Burners..... in H₂O
 67. Note: A Fuel Savings of mm Btu/h Fuel Value \$.....
 68. Will Offset a \$1000 increase in mm Btu
 69. Furnace Cost (Erected)

Fuel Characteristics

71. Heating Value..... HHV
 72. Heating Value..... LLV
 73. Specific Gravity.....
 74. Molecular Weight.....
 75. Viscosity, At °F..... SSU
 76. Viscosity, At °F..... SSU
 77. Fuel Pressure Available at Burner..... psig
 78. Atomizing Steam Pressure..... psig
 79. Composition:
 80. Vanadium..... ppm
 81. Sodium..... ppm
 82. Salt Content..... ppm
 83. Ash..... % wt
 84. Sulfur..... % wt
 85. Hydrogen..... % wt
 86. Carbon..... % wt
 87. Nitrogen..... % wt/% vol
 88. Oxygen..... % wt
 89. CH₄..... % vol
 90. C₂H₄..... % vol
 91. C₂H₆..... % vol
 92. C₃H₈..... % vol
 93. H₂S..... % vol
 94. H₂O..... % vol

97. NOTE:-1
 98. THIS IS A SPECIAL TYPE OF FIRED HEATER,
 99. COMPRISING OF THREE PARTS ACID GAS
 100. BURNER (10F-101, 201, 301), REACTION FURNACE
 101. (10F-102, 202, 302) AND WASTE HEAT BOILER(10F-
 102. 103, 203, 303). PROCESS AND MECHANICAL CONDITIONS
 103. ARE DIFFICULT TO BE SHOWN ON THIS DATA SHEET AND ARE
 104. THEREFORE SHOWN SEPARATELY (PLEASE SEE ATTACHMENTS)



CALCULATION SHEET

P. O. BOX 2166
HOUSTON, TEXAS 77001

ATTACHMENT NO. 3

REV. A

SIGNATURE James Chang DATE _____ CHECKED _____ DATE 11/7/80
PROJECT BRECKINRIDGE PROJECT JOB NO. 14222
SUBJECT PLANT 10 (SULFUR PLANT) ACID GAS BURNER SHEET 1 OF 3 SHEETS
10 F-103, 203, 303

This specification covers one assembly (three total required) consisting of:

1. Combination forced draft burner for the combustion of acid process gas or pipeline gas, with all the required accessories.
2. Pilot burner for the combustion of pipeline gas, with all the required accessories.
3. Electric ignitor for the burner.

PERFORMANCE SPECIFICATIONS

I. Combustion Burner - Acid Process Gas (normal operation)

1) <u>Acid Gas Composition</u>	<u>Mols/hr</u>	<u>Mol %</u>
H ₂ S	603.69	67.48
CO ₂	163.08	18.23
H ₂ O	113.80	12.72
CO	3.02	0.34
H ₂	1.89	0.21
NH ₃	0.37	0.04
COS	0.17	0.02
N ₂	0.12	0.01
HCN	0.06	0.01
C ₁	0.21	0.02
C ₂	0.12	0.012
C ₃	0.04	0.004
C ₄	0.02	0.002
C ₅	0.12	0.012
C ₆ ⁺	2.03	0.23
Phenolics (as phenol)	1.77	0.20
Others (as valeric acid)	4.15	0.46
Total	894.61	100.00



CALCULATION SHEET

P. O. BOX 2166
HOUSTON, TEXAS 77001

ATTACHMENT NO. 3
REV. A

SIGNATURE James Chang DATE _____ CHECKED _____ DATE 11/7/80
PROJECT BRECKINRIDGE PROJECT JOB NO. 14222
SUBJECT PLANT 10 (SULFUR PLANT) ACID GAS BURNER SHEET 2 OF 3 SHEETS
KF-107, 203, 303

1		
2	2) Acid Gas Temperature	460°F
3	3) Acid Gas Pressure	9.8 psig
4	4) Acid Gas Volume	8.147 MMSCF/D
5	5) Number of Burners	One
6	6) Combustion Air Composition	
7	O ₂	19.75
8	H ₂	74.31
9	H ₂ O	5.94
10		100.00 By Volume
11	7) Air Temperature	460°F
12	8) Air Pressure	9.8 psig
13	9) Air Volumetric Rate	8.535 MMSCF/D
14	10) Combustion Chamber Pressure	9.5 psig
15	11) Required Heat Duty	26.75 MM Btu/Hr
16	12) Design Heat Duty *	29.43 MM Btu/Hr
17	13) Required Turn Down	25% of Design
18	14) Gas Outlet Temperature	2000°F
19	15) Gas Outlet Pressure	9.5 psig

II. Combination Burner - Pipeline Gas (Startup Operations)

23		
24	1) Pipeline Gas Higher Heating Value at	950 Btu/SCF
25	60°F 14.7 psi	
26	2) Pipeline Gas Mol. Weight	16.51
27	3) Pipeline Gas Temperature	100°F (Ambient)
28	4) Pipeline Gas Pressure	500 psig (Maximum)
29	5) Pipeline Gas Volumetric Rate	0.186 MMSCF/D
30	6) Air Pressure	9.8 psig
31	7) Required Heat Duty **	7.35 MM Btu/Hr

* Values include 10% contingency

** 25% of design heat duty of combustion burner



CALCULATION SHEET

P. O. BOX 2166
HOUSTON, TEXAS 77001

ATTACHMENT NO. 3

CALC NO. REV A

SIGNATURE JAMES Chang DATE 11/7/80 CHECKED _____ DATE 11-7-80
PROJECT BRECKINRIDGE PROJECT JOB NO. 14222
SUBJECT PLANT 10 (SULFUR PLANT) ACID GAS BURNER SHEET 3 OF 2 SHEETS
10F-103, 203, 303

III. Pilot Burner

- 1) Pipeline Gas Pressure
- 2) Pipeline Gas Volumetric Rate Vendor to specify
- 3) Combustion Air Pressure 115 psig
(Maximum available)
- 4) Combustion Air Volumetric Rate Vendor to specify
- 5) Purge Air Pressure (Maximum available) 115 psig
- 6) Purge Air Volumetric Rate Vendor to specify
- 7) Pilot Duty Vendor to specify

IV. Electric Ignitor

The burner is to be equipped with electric ignitor.

V. Mechanical and Structural Details

- 1) Electric supply available at 120 & 240V/60 cy/1 phase
- 2) Copper and copper alloys should not be used.
- 3) Purge air is required on sight ports, natural gas line (pipeline gas), acid gas line and pilot lines. Vendor shall specify volume and pressure required.
- 4) Each burner is to be installed on its respective reaction furnace, i.e.

10F-103 on 10F-101

10F-203 on 10F-201

10F-303 on 10F-301

- 5) Burner to fire horizontally along the central axis of a horizontal cylindrical reaction furnace of 5'-9" ID x 24'-0" T-T length. Vendor to design to prevent flame impingement on vessel refractory.

4.5 Data Sheets for Pumps and Drivers

10-DS-G-01: Molten Sulfur Pit Pump (10G-001 A, B)

10-DS-G-02: Sour Water Return (10G-002, 10G-003, 10G-004)

10-DS-G-03: Sour Water Return (10G-005, 10G-006)

CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 10G-001A, B
PURCHASE ORDER NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
DATE _____ REVISION _____

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KY.
UNIT PLANT 10 SERVICE MOLTEN SULFUR PIT PUMP
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D _____ ITEM NO. _____ PROVIDED BY _____ MTD BY _____
NO. TURBINES REQ'D _____ ITEM NO. _____ PROVIDED BY _____ MTD BY _____
PUMP MFR LAWRENCE SIZE AND TYPE 1 1/2" D STAGES 1 SERIAL NO. _____

OPERATING CONDITIONS, EACH PUMP				PERFORMANCE	
LIQUID <u>MOLTEN SULFUR</u>	U.S. GPM at PT. NOR. <u>75</u>	RATED <u>75</u>	DISCH. PRESS. PSIG <u>74</u>	PROPOSAL CURVE NO. _____	
PT. F. NOR. <u>300</u>	MAX. <u>300</u>	SUCT. PRESS. PSIG MAX. _____	RATED <u>0</u>	RPM <u>1750</u>	NPSHR (WATER) _____
SP. GR. at PT. <u>1.78</u>	DIFF. PRESS. PSI <u>71.8</u>			EFF. <u>44</u>	BHP RATED <u>7.3</u>
VAP. PRESS. at PT. PSIA _____	DIFF. HEAD. FT. <u>93</u>			MAX. BHP RATED IMP. <u>9.2</u>	
VIS. at PT. <u>653.8</u>	NPSHA. FT. <u>18.5</u>			MAX. HEAD RATED IMP. _____	
CORR./EROS. CAUSED BY _____	HYD. HP. <u>3.2</u>			MIN. CONTINUOUS GPM _____	
				ROTATION (VIEWED FROM CPLG END) _____	

CONSTRUCTION					SHOP TESTS	
NOZZLES	SIZE	RATING	FACING	LOCATION	☒ NON-WIT. PERF.	☐ WIT. PERF.
SUCTION					☒ NON-WIT. HYDRO	☐ WIT. HYDRO
DISCHARGE					☐ NPSH REQ'D.	☐ WIT. NPSH
CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ VERT. (TYPE) <u>SUBMERGED</u>					☐ SHOP INSPECTION	
- SPLIT: ☐ AXIAL ☐ RAD. TYPE VOLUTE ☐ SGL ☐ DBL ☐ DIFFUSER					☐ DISMANT. & INSP. AFTER TEST	
- PRESS: ☐ MAX. ALLOW. _____ PSIG _____ °F. ☐ HYDRO TEST _____ PSIG					☐ OTHER _____	
- CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE						
IMPELLER DIA: ☐ RATED _____ ☐ MAX. _____ ☐ TYPE: _____						
MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG ☐ WEAR RG. DIAM./CLANC.						
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 _____						

AUXILIARY PIPING		VERTICAL PUMPS	
☐ C.W. PIPE PLAN _____	☐ CU: ☐ S.S.: ☐ TUBING: ☐ PIPE _____	PIT OR SUMP DEPTH <u>8'</u>	
☐ TOTAL COOLING WATER REQ'D. GPM _____	☐ SIGHT F.I. REQ'D _____	MIN. SUBMERGENCE REQ'D. ☐ <u>7'</u>	
☐ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM _____ ☐ PSIG _____		COLUMN PIPE: ☐ FLANGED ☐ THREADED	
☐ SEAL FLUSH PIPE PLAN _____	☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE _____	LINE SHAFT: ☐ OPEN ☐ ENCLOSED	
☐ EXTERNAL SEAL FLUSH FLUID _____	☐ GPM _____ ☐ PSIG _____	BRGS: ☐ BOWL ☐ LINE SHAFT	
☐ AUXILIARY SEAL PLAN _____	☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE _____	BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE	
☐ AUX. SEAL QUENCH FLUID _____		FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NONE	
		FLOAT SWITCH ☐ _____	
		PUMP THRUST. LB ☐ UP ☐ DOWN	

MOTOR DRIVER		TURBINE DRIVER	
HP <u>10</u>	RPM <u>1800</u>	FRAME _____	VOLTS/PHASE/CYCLES <u>460/3/60</u>
MFR _____	BEARINGS _____	LUBE _____	
TYPE _____	INSUL _____	FULL LOAD AMPS _____	
ENC. <u>TEFC</u>	TEMP RISE C. _____	LOCKED ROTOR AMPS _____	
☐ VHS ☐ VSS	VERT. THRUST CAP. LB. _____	SERVICE FACTOR <u>1.0</u>	
APPROX. WT. PUMP & BASE _____		MOTOR _____ TURBINE _____	

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED

PUMP IS SUBMERGED IN LIQUID SULFUR PIT.
NO COPPER OR COPPER BEARING ALLOYS, STEAM JACKETED.
- NO FRT.



NO.	DATE	ISSUED FOR	PHASE	ZERO	JMW	WBL	HMM	JOB NO.	DRAWING NO.	REV.
0	11-21-80	ISSUED FOR	PHASE	ZERO				14222	10-DS-G-01	0
								SHEET	1	OF 1

JOB NO. 14222 ITEM NO. 10G-002003.004

PURCHASE ORDER NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
DATE _____ REVISION _____

OPERATING CONDITIONS, EACH PUMP				PERFORMANCE	
LIQUID <u>SOUR WATER</u>	U.S. GPM at PT. NOR. <u>50</u>	RATED <u>50</u>	PROPOSAL CURVE NO. _____		
	DISCH. PRESS. PSIG <u>60</u>		RPM _____	NPSHR (WATER) _____	
PT. F. NOR. <u>100</u> MAX.	SUCT. PRESS. PSIG MAX. _____	RATED <u>14</u>	EFF. <u>50</u>	BHP RATED <u>2.68</u>	
SP. GR. at PT. <u>0.993</u>	DIFF. PRESS. PSI <u>46</u>		MAX. BHP RATED IMP. <u>3.35</u>		
VAP. PRESS. at PT. PSIA _____	DIFF. HEAD, FT. <u>107</u>		MAX. HEAD RATED IMP. _____		
VIS. at PT. Sec _____	CP _____	NPSHA, FT. <u>30</u>	MIN. CONTINUOUS GPM _____		
CORN/EROS. CAUSED BY <u>H2S, CO2</u>		HYD. HP <u>1.33</u>	ROTATION (VIEWED FROM CPLG END) _____		

SHOP TESTS

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

API CASE/TRIM CLASS 5-3

BASEPLATE: ☐

PIT OR SUMP DEPTH ☐ _____
 MIN. SUBMERGENCE RECD. ☐ _____
 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 _____

APPROX. WT. PUMP & BASE

MOTOR _____	TURBINE _____
-------------	---------------

☐ C.W. PIPE PLAN _____ ☐ C.U. ☐ 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 _____

HP 5 RPM 3600 FRAME 194T 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 _____

DATA SHEET COMMON TO 104-002, 003, 004



						JOB NO.	DRAWING NO.	REV.
0	11/21/90	ISSUED FOR PHASE ZERO				MMH	10-DS-G-02	0
NO.	DATE					SHEET		

CENTRIFUGAL PUMP DATA SHEET

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

JOB NO. 14222 ITEM NO. 10G-005,006

PURCHASE ORDER NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

DATE _____ REVISION _____

FOR BRECKINRIDGE PROJECT SITE BRECKINRIDGE COUNTY KY.
UNIT PLANT 10 SERVICE SOUR WATER RETURN
NO. PUMPS REQ'D 2 NO. MOTORS REQ'D _____ ITEM NO. _____ PROVIDED BY _____ MTD BY _____
NO. TURBINES REQ'D _____ ITEM NO. _____ PROVIDED BY _____ MTD BY _____
PUMP MFR EST BY MECHANICAL SIZE AND TYPE _____ STAGES _____ SERIAL NO. _____

OPERATING CONDITIONS, EACH PUMP

LIQUID SOUR WATER U.S. GPM at PT. NOR. 50 RATED 50
DISCH. PRESS., PSIG 60
PT. F. NOR. 120 MAX. SUCT. PRESS., PSIG MAX. _____ RATED 14
SP. GR. at PT. 0.988 DIFF. PRESS., PSI 46
VAP. PRESS. at PT. PSIA _____ DIFF. HEAD, FT. 107
VIS. at PT. Sse _____ CP _____ NPSHA, FT. 30
CORR/EROS. CAUSED BY SO2 HYD. HP 1.33

PERFORMANCE

PROPOSAL CURVE NO. _____
RPM _____ NPSHR (WATER) _____
EFF. 50 BHP RATED 2.68
MAX. BHP RATED IMP 3.35
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 ☐ OBL ☐ 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 20
CARPENTER 20
BASEPLATE: ☐ _____

VERTICAL PUMPS

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

TURBINE DRIVER

APPROX. WT. PUMP & BASE _____
MOTOR _____ TURBINE _____

MOTOR DRIVER

HP 5 RPM 3600 FRAME 184T 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 _____

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

DATA SHEET COMMON TO 10G-005 & 10G-006
EST. PRICE w/DRIVE -



NO.	DATE	ISSUED FOR	PHASE	REV.
0	11/21/80	ISSUED FOR	PHASE ZERO	0
SHEET 1 OF 1				

4.6 Data Sheets for Compressors and Drivers

10-DS-K-01: Air Blower (10K-101, 10K-201, 10K-301)

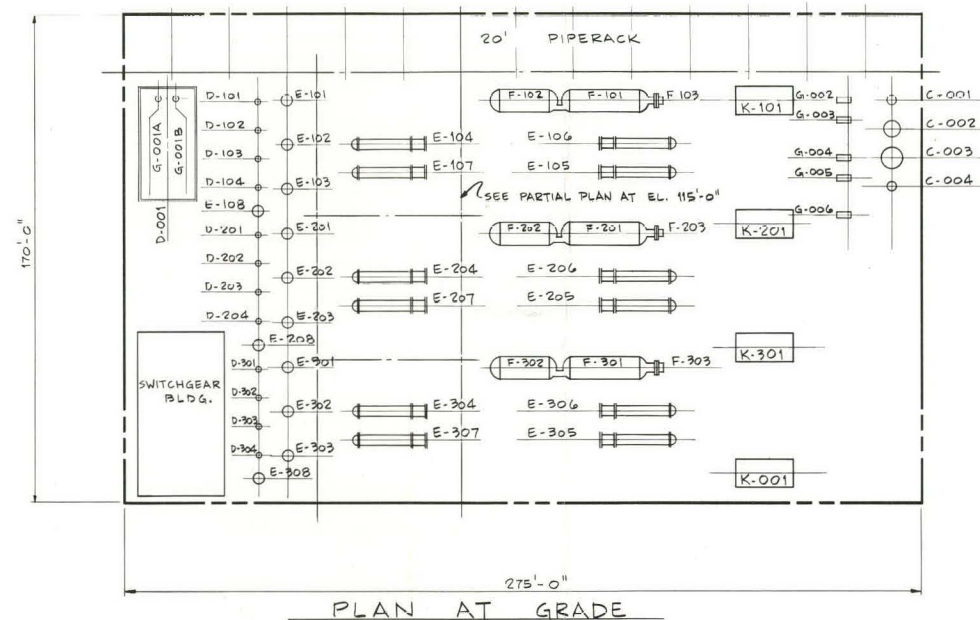
10-DS-K-02: Air Blower (Spare common for three trains)

SPECIFICATION NO. _____
B. M. NO. _____

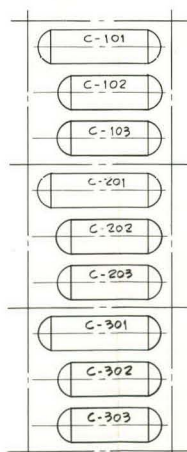
A. GAS CHARACTERISTICS SERVICE		10K-101 10K-201 10K-301	E. BEARINGS & LUBRICATION SERVICE		10K-101 10K-201 10K-301
1. GAS		AIR	1 THRUST (S.A.E. NO. ON FINAL DATA SHEET)		
2 S.P. GR. (AIR = 1.0)		1.0	2 RADIAL (S.A.E. NO. ON FINAL DATA SHEET)		
3 POUNDS PER HOUR		9085	3 GREASE PKD. FLOOD OILING. RING OILING.		
4 STD. C.F.M. @ 60°F & 14.7 PSIA		6522	THRUST		
5 FLOW TEMP. °F		96	RADIAL		
6 CFM AT FLOW TEMP.		7169	A B C		
B PRESSURES			A B C		
1 SUCTION PSIA		14.3	4 TYPE OF CLOSURES:		
2 DIFFERENTIAL PSI		12.1	5 METHOD OF SEALING		
3 DISCHARGE PSID		26.4	6 VISIBLE LUBRICATORS TYPE		
C. OPERATION			7 VISIBLE LUBRICATORS CAPACITY		
1 EFFICIENCY AT RATING			8 BEARINGS WATER COOLED		
2 B.H.P. AT RATING		460	9 LUBRICATING OIL PUMP		
3 BID IMPELLER DIAM		—	10 LUBRICATING OIL COOLER		
4 MAX BHP FOR BID IMP DIA		—	F. CONNECTIONS		
5 R.P.M. OF FAN OR BLOWER		950	1A INLET SIZE		
6 R.P.M. OF DRIVER		STEAM TURBINE (4000 RPM)	1B INLET RATING		
7 TIP SPEED			1C INLET FACING		
8 OUTLET VELOCITY			2A DISCHARGE SIZE		
9 DIRECTION OF ROTATION CCW			2B DISCHARGE RATING		
FACING COUPLING END CW			2C DISCHARGE FACING		
10 NUMBER OF STAGES		ONE	2D DISCHARGE LOCATION		
D. CONSTRUCTION & MATERIAL			G. TESTING		
1 CASE MATERIAL		C.I.	STATE EXTRA COST IF ANY FOR EACH		
CONSTRUCTION: HORIZ. OR VERT. SPLIT		VERT.	1 DYNAMIC BALANCING OF IMPELLERS		
2 IMPELLER		MECHNITE	2 WITNESSED PERFORMANCE TEST		
3 SHAFT MATERIAL			3 INSPECTION		
4 SHAFT DIAMETER			4 RUNNING TEST WITH ACTUAL DRIVER		
5 FLEXIBLE COUPLING		FALK	H. MISCELLANEOUS		
6 COUPLING GUARD		YES	1 PRICE EACH F.O.B.		
7 BASE PLATE		YES	2 WEIGHT POUNDS NET		
8 GLASS (FANS)		—	2A WEIGHT BOXED FOR SHIPMENT		
9 ARRANGEMENT (FANS)		—	3 SHIPMENT FROM RCPT OF ORDER WEEKS		
10 INLET SCREEN		—	4 DRIVER H.P.		
11 CLEAN-OUT REQUIRED		—	5 TYPE OF DRIVER: TURBINE		
12 VARIABLE INLET VANES REQ'D.		—	6 DRIVER COUPLED: GEARED		
13 INLET/DISCHARGE SILENCER		STANDARD	7 PERFORMANCE CURVE MANUFACTURERS NO.		
14 SWITCHES - PRESSURE / TEMP.		INCL.	7A PERFORMANCE CURVE FOREIGN PRINT NO.		
MANUFACTURER		HOLMES BLOWER / THERMO, INC.	8. OUTLINE DRAWING MANUFACTURERS NO.		
MFR'S TYPE & SIZE		HRBdcl	8A OUTLINE DRAWING FOREIGN PRINT NO.		
BECHTEL			9. CROSS SECTION DWG. MANUFACTURERS NO.		
HOUSTON			9A CROSS SECTION DWG. FOREIGN PRINT NO.		
REV			10 MFR'S SERIAL NO. ON FINAL DATA SHEET		
DATE			11. SKID MOUNTED / FLOORS, PIPING		
O 11/1/81 ISSUED FOR PHASE 2E.D. (PM) YW) LBC HNN			12. INLET FILTER		
AIR BLOWER			F 21- 203 STANDARD		
JOB. NO.			10K-101		
DWS. NO.			10K-201		
10-DS-K-01			10K-301		

SPECIFICATION NO. _____
B. M. NO. _____

A. GAS CHARACTERISTICS SERVICE		E. BEARINGS & LUBRICATION SERVICE	
1. GAS		1. THRUST (S.A.E. NO. ON FINAL DATA SHEET)	
2. S.P. GR. (AIR = 1.0)		2. RADIAL (S.A.E. NO. ON FINAL DATA SHEET)	
3. POUNDS PER HOUR		3. GREASE PACK. FLOOD OILING. RING OILING.	
4. STD. C.F.M. @ 60°F @ 14.7 PSIA		THRUST A B C	
5. FLOW TEMP. °F		RADIAL A B C	
6. CFM AT FLOW TEMP.		4. TYPE OF CLOSURES:	
B. PRESSURES		5. METHOD OF SEALING	
1. SUCTION		6. VISIBLE LUBRICATORS TYPE	
2. DIFFERENTIAL		7. VISIBLE LUBRICATORS CAPACITY	
3. DISCHARGE		8. BEARINGS WATER COOLED	
C. OPERATION		9. LUBRICATING OIL PUMP	
1. EFFICIENCY AT RATING		10. LUBRICATING OIL COOLER	
2. B.H.P. AT RATING		F. CONNECTIONS	
3. BID IMPELLER DIAM		1A. INLET SIZE	
4. MAX. BHP FOR BID IMP DIA		1B. INLET RATING	
5. R.P.M. OF FAN OR BLOWER		1C. INLET FACING	
6. R.P.M. OF DRIVER		2A. DISCHARGE SIZE	
7. TIP SPEED		2B. DISCHARGE RATING	
8. OUTLET VELOCITY		2C. DISCHARGE FACING	
9. DIRECTION OF ROTATION CCW		2D. DISCHARGE LOCATION	
10. NUMBER OF STAGES		G. TESTING	
D. CONSTRUCTION & MATERIAL		STATE EXTRA COST IF ANY FOR EACH	
1. CASE MATERIAL		1. DYNAMIC BALANCING OF IMPELLERS	
CONSTRUCTION: HORIZ. OR VERT. SPLIT		2. WITNESSED PERFORMANCE TEST	
2. IMPELLER		3. INSPECTION	
3. SHAFT MATERIAL		4. RUNNING TEST WITH ACTUAL DRIVER	
4. SHAFT DIAMETER		H. MISCELLANEOUS	
5. FLEXIBLE COUPLING		1. PRICE EACH F.O.B.	
6. COUPLING GUARD		2. WEIGHT POUNDS NET	
7. BASE PLATE		2A. WEIGHT BOXED FOR SHIPMENT	
8. CLASS (FANS)		3. SHIPMENT FROM RCPT OF ORDER WEEKS	
9. ARRANGEMENT (FANS)		4. DRIVER H.P.	
10. INLET SCREEN		5. TYPE OF DRIVER: MOTOR	
11. CLEAN-OUT REQUIRED		6. DRIVER COUPLED. GEARED	
12. VARIABLE INLET VANES REQ'D.		7. PERFORMANCE CURVE MANUFACTURERS NO.	
13. INLET/DISCHARGE SILENCER		7A. PERFORMANCE CURVE FOREIGN PRINT NO.	
A. SILENCER PRESSURE / TEMP		8. OUTLINE DRAWING MANUFACTURERS F.O.	
MANUFACTURER		8A. OUTLINE DRAWING FOREIGN PRINT NO.	
MFR'S TYPE & SIZE		9. CROSS SECTION DWG. MANUFACTURERS NO.	
BECHTEL		9A. CROSS SECTION DWG. FOREIGN PRINT NO.	
HOUSTON		10. MFR'S SERIAL NO. ON FINAL DATA SHEET	
REV.		11. SILENCE MAINTENANCE / REPAIRS	
DATE		12. INLET FILTER	
O. PRICE ISSUED FOR PRICE REVIEW		AIR BLOWER (SPARE COMMON FOR 3 THERMO)	
DATE		JOB NO.	
DATE		DWS. NO.	
DATE		10-DS-K-02	



PLAN AT GRADE

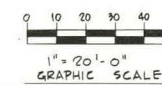


PARTIAL PLAN AT EL. 115'-0"

EQUIPMENT LIST		
ITEM	DESCRIPTION	LOC.
10C-001	DEA ACID GAS K.O. DRUM	E-4
10C-101,201,301	N°1 CONVERTER	E-5
10C-002	SW5 ACID GAS K.O. DRUM	E-4
10C-102,202,302	N°2 CONVERTER	E-5
10C-003	SELEXOL ACID GAS K.O. DRUM	E-4
10C-103,203,303	N°3 CONVERTER	E-5
10C-004	RECYCLE ACID GAS K.O. DRUM	E-4
10D-001	SULFUR PIT	E-6
10D-101,201,301	N°1 SEAL POT	E-6
10D-102,202,302	N°2 SEAL POT	E-6
10D-103,203,303	N°3 SEAL POT	E-6
10D-104,204,304	N°4 SEAL POT	E-6
10E-101,201,301	N°1 REHEAT EXCHANGER	E-6
10E-102,202,302	N°2 REHEAT EXCHANGER	E-6
10E-103,203,303	N°3 REHEAT EXCHANGER	E-6
10E-104,204,304	N°1 CONDENSER	E-6
10E-105,205,305	FEED PREHEATER	E-5
10E-106,206,306	AIR PREHEATER	E-5
10E-107,207,307	N°2 CONDENSER	E-6
10E-108,208,308	TAIL GAS SUPERHEATER	E-6
10F-101,201,301	REACTION FURNACE	E-5
10F-102,202,302	WASTE HEAT BOILER	E-5
10F-103,203,303	ACID GAS BURNER	E-5
10G-001 A & B	SULFUR PUMP	E-6
10G-002	DEA K.O. PUMP	E-4
10G-003	SW5 K.O. PUMP	E-4
10G-004	SELEXOL K.O. PUMP	E-4
10G-005	RECYCLE K.O. PUMP	E-4
10G-006	COMMON SPARE	E-4
10K-001	AIR BLOWER SPARE	D-4
10K-101,201,301	AIR BLOWER	E-4

NOTES
1. HIGH POINT OF FINISHED GRADE IS EL. 100'-0".

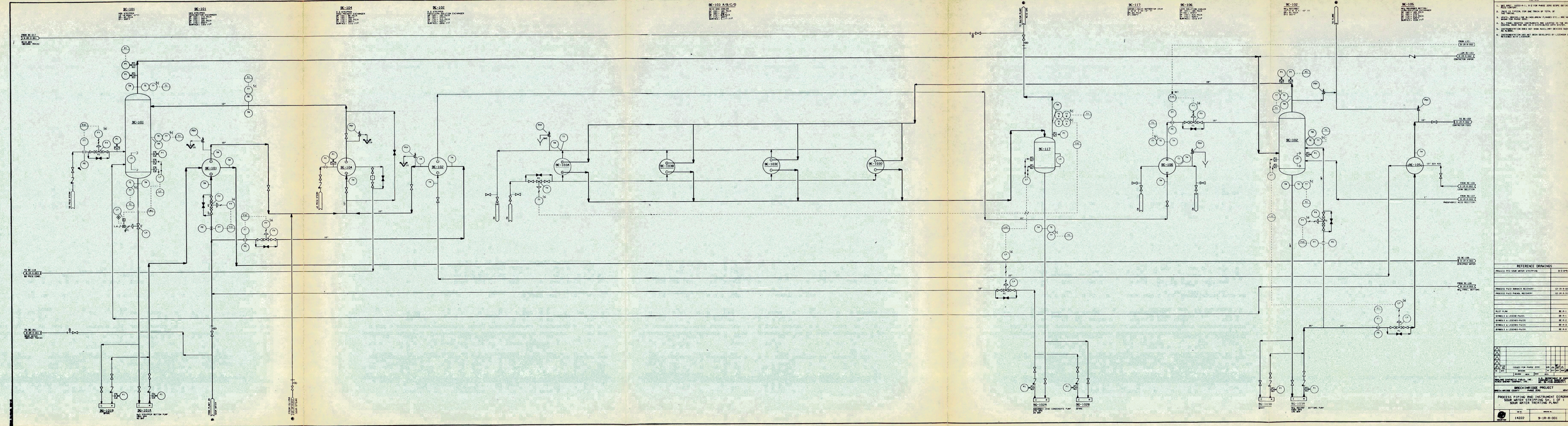
REFERENCE DRAWING
50E-A-1 OVERALL SITE PLAN
50E-A-4 PLOT PLAN INDEX



ISSUED FOR PHASE ZERO	P	J/K	J/K	H/S	
ISSUED FOR REVIEW & APPROVAL	T.R.	J/K	J/K	H/S	
NO.	DATE	REVISION	BY	CHKD	SUPV
1					

1" = 20'-0" DESIGNED T.R./J.K. DRAWN P. POWELL

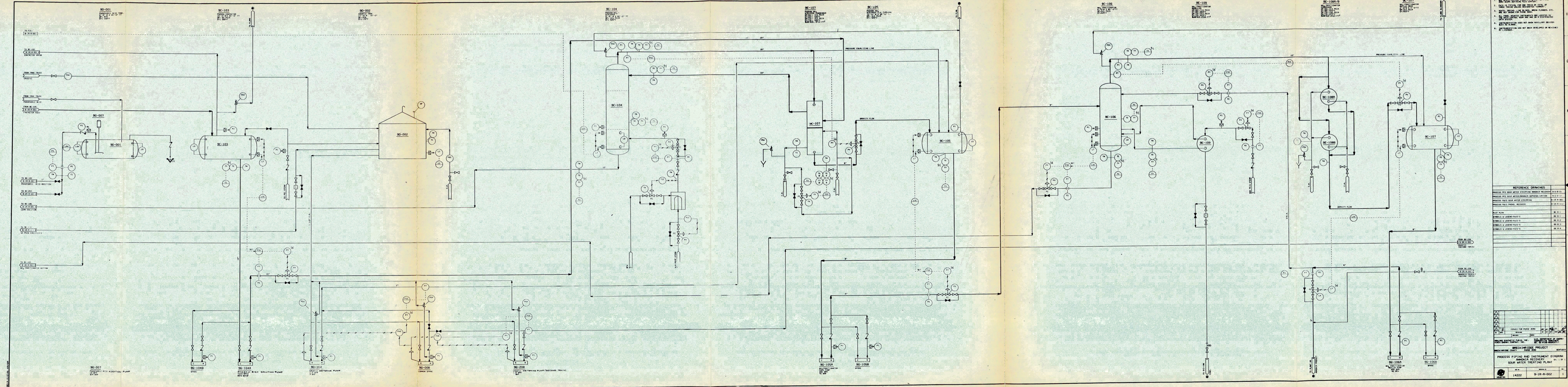
ASHLAND SYNTHETIC FUELS, INC. AIRCO ENERGY COMPANY, INC.	U.S. DEPARTMENT OF ENERGY COOPERATIVE AGREEMENT NO. DE-FCO-80002717
BRECKINRIDGE PROJECT	
BRECKINRIDGE COUNTY	PHASE ZERO
KENTUCKY	
PLOT PLAN-PLANT 10 SULFUR PLANT	
JOB NO. 14222	DRAWING NO. 10E-A-1
REV. 1	

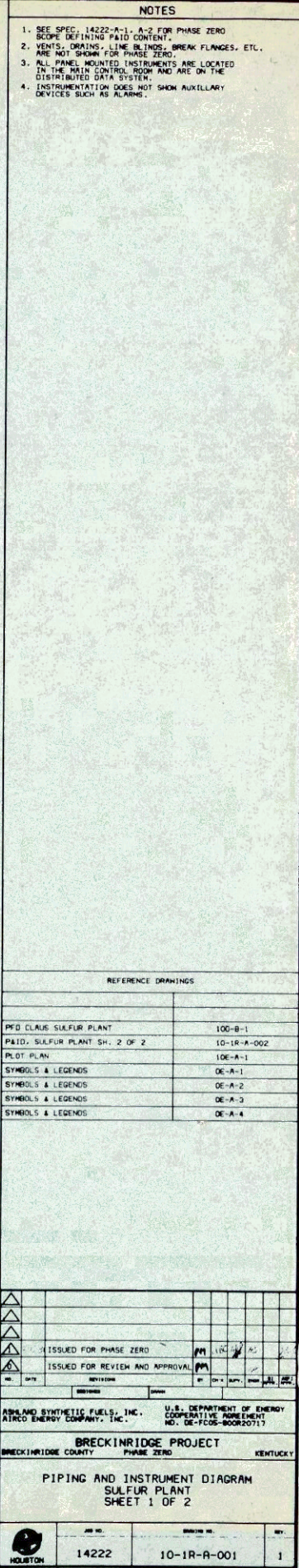


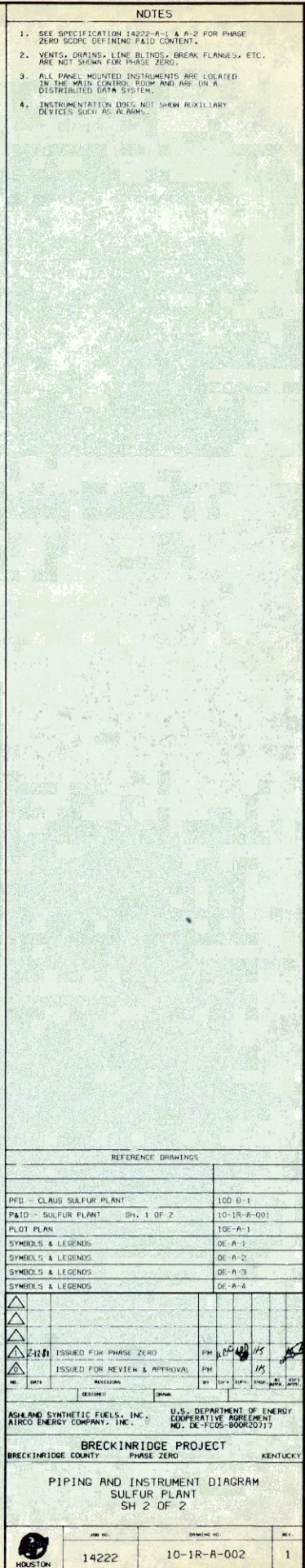
NOTES	
1. SEE 14222-A-1, A-2 FOR PHASE ZERO SCOPE DEFINITION.	
2. THIS IS A PIPING AND INSTRUMENT DIAGRAM FOR ONE TRAIN OF TOTAL OF TWO TRAINS.	
3. ALL INSTRUMENTS, EXCEPT WHERE NOTED OTHERWISE, ARE TO BE PROVIDED BY THE USER.	
4. ALL INSTRUMENTS, EXCEPT WHERE NOTED OTHERWISE, ARE TO BE PROVIDED BY THE USER.	
5. ALL INSTRUMENTS, EXCEPT WHERE NOTED OTHERWISE, ARE TO BE PROVIDED BY THE USER.	
6. INSTRUMENTATION HAS NOT BEEN DEVELOPED BY LICENSEE OR REVIEWED BY LICENSEE.	

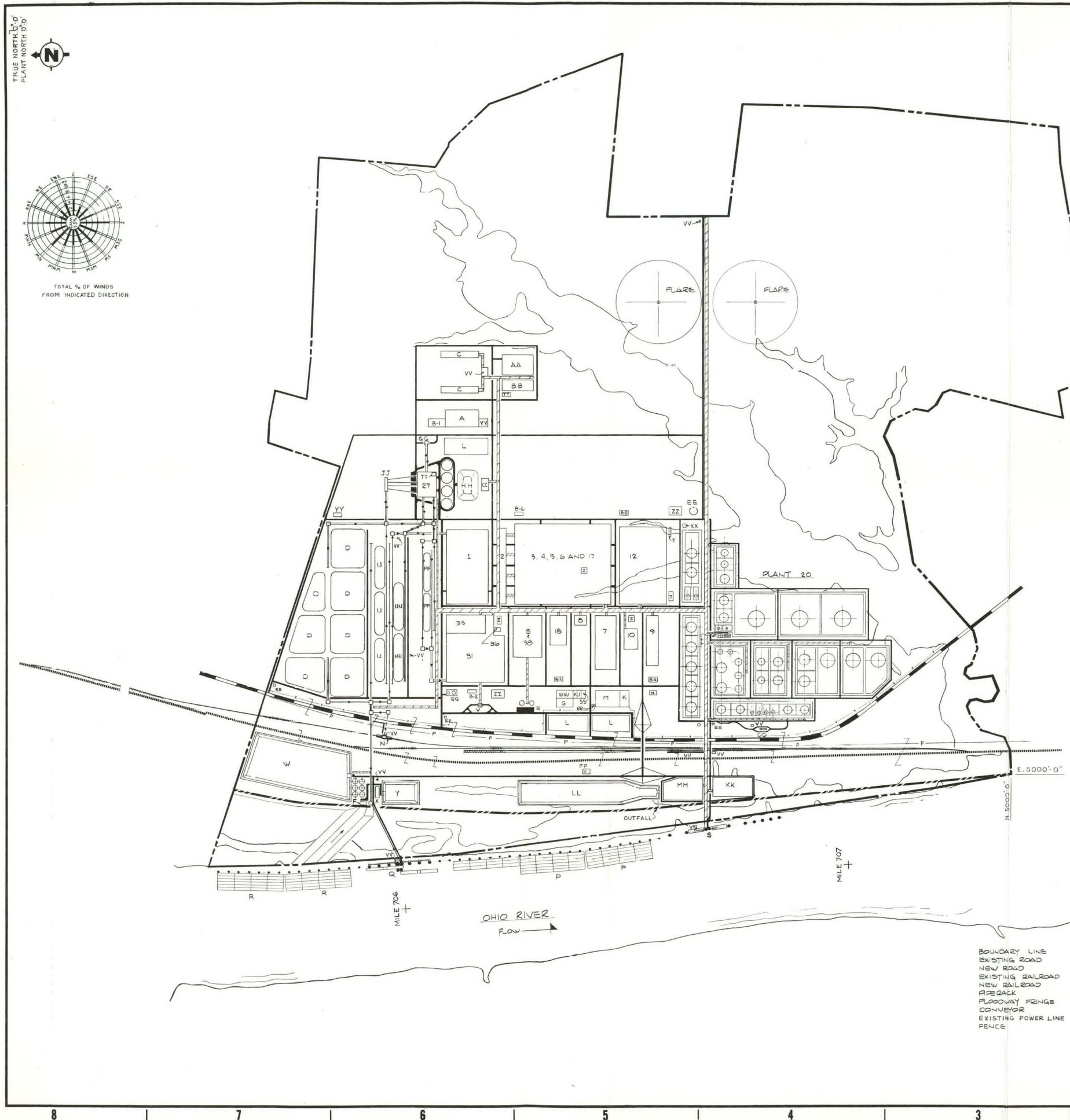
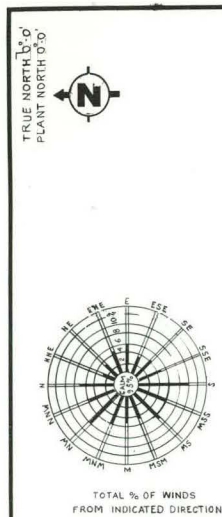
REFERENCE DRAWINGS	
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-1, A-2
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-3, A-4
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-5, A-6
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-7, A-8
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-9, A-10
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-11, A-12
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-13, A-14
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-15, A-16
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-17, A-18
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-19, A-20
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-21, A-22
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-23, A-24
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-25, A-26
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-27, A-28
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-29, A-30
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-31, A-32
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-33, A-34
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-35, A-36
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-37, A-38
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-39, A-40
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-41, A-42
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-43, A-44
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-45, A-46
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-47, A-48
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-49, A-50
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-51, A-52
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-53, A-54
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-55, A-56
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-57, A-58
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-59, A-60
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-61, A-62
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-63, A-64
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-65, A-66
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-67, A-68
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-69, A-70
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-71, A-72
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-73, A-74
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-75, A-76
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-77, A-78
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-79, A-80
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-81, A-82
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-83, A-84
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-85, A-86
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-87, A-88
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-89, A-90
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-91, A-92
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-93, A-94
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-95, A-96
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-97, A-98
PROCESS PIPING AND INSTRUMENT DIAGRAM	14222-A-99, A-100

14222	9-1R-A-001	1
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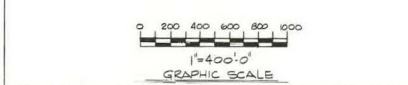


- ## LEGEND
- | | |
|------|---|
| 1. | COAL DRYING AND PULVERIZING |
| 2. | COAL SLURRY PREPARATION |
| 3. | H-COAL PREHEATING AND REACTION |
| 4. | H-COAL PRIMARY SEPARATION |
| 5. | H-COAL RECYCLE SLURRY PREPARATION |
| 6. | H-COAL RECYCLE HYDROGEN CONCENTRATION AND COMPRESSION |
| 7. | GAS PLANT |
| 8. | CRYGENIC HYDROGEN PURIFICATION |
| 9. | SOUL WATER TREATING |
| 10. | SULFUR PLANT |
| 12. | GASIFICATION AND PURIFICATION |
| 15. | OXYGEN PLANT |
| 17. | O-STALLATE SEPARATION |
| 19. | NAPHTHA TREATING AND REFORMING |
| 20. | TANAGE |
| 21. | INTERCONNECTING PIPING (PIPERACKS) |
| 22. | RIVER LOADING FACILITIES |
| 23. | RAIL AND TRUCK LOADING |
| 26a. | COAL RECEIVING AND STORAGE |
| 27. | COAL WASHING AND SECONDARY CRUSHING |
| 31. | STEAM GENERATION AND S.F.W. TREATING |
| 32. | WATER SYSTEM |
| 33. | FIRE SYSTEM |
| 34. | WASTE WATER TREATMENT PLANTS |
| 35. | STACK GAS SCRUBBING |
| 36. | DISTRIBUTION AND PLANT AIR SYSTEM |
| 37. | INERT GAS SYSTEM |
| 39. | PURGE AND FLUSH OIL SYSTEM |
| 42. | WASTE SLUDGE INCINERATOR |

- | | | |
|----|---|---------------------|
| A | WAREHOUSE | |
| B | TRAIL B/W 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 BARGE, 24 BARGE TOW (PLT.22) | |
| Q | COAL UNLOADING (PLT.22) | |
| R | EMPTY BARGE, 24 BARGE TOW (PLT.22) | |
| S | LIQUID LOADING DOCK (PLT.22) | |
| T | SWITCHGEAR | ZZ SUBSTATION |
| U | RAW COAL (PLT.26) | |
| V | PLY ASH UNLOADING AREA (PLT.31) | |
| W | RAW WATER POND | |
| X | CSF RUNOFF TREATING AREA (PLT.34) | |
| Y | LIQUID WASTE FLOES (CSF) 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 | WASTEWATER TREATMENT (PLT.34) | |
| NN | CLEAN COAL STORAGE (PLT.26) | |
| PP | BOLVER FUEL STORAGE (PLT.26) | |
| QQ | BUMP AND TANK FOR INCINERATOR (PLT.42) | |
| RR | GATE HOUSE | VV OPERATOR SHELTER |
| SS | GUARD/SECURITY HOUSE | WW LABORATORY |
| TT | OPERATING EQUIPMENT ROOM | XX SPECIAL CLEANING |

- NOTES**
- SITE COORDINATES 450000'0" 850000'0" ARE ESTABLISHED ON THE NORTH OF TOWN CREEK AT THE INTERSECTION OF THE WATER LINE OF THE OHIO RIVER
- 1) REFERENCE: COMMONWEALTH LAND TITLE INSURANCE COMPANY PHILADELPHIA, PENNSYLVANIA FILE NO. K-005232.
2. HIGH POINT OF FINISHED GRADE ELEVATION 100'-0" EQUALS ELEVATION 415'-0" ABOVE M.S.L.
3. NORMAL WATER ELEVATION OF THE OHIO RIVER IS EL 282.3' AT RIVER MILE 700.
4. MEAN HIGHWAY ELEVATION IS EL 415'-0"
5. TOP OF RAILROAD BALLAST EL IS 415'-0"

- | REFERENCE DRAWINGS | |
|--------------------|--------------------------------|
| 50E-A-4 | INDEX DRAWING |
| 50E-A-6 | CONSTRUCTION REQUIREMENT STUDY |



10/28/91	ISSUED FOR PHASE ZERO					P.P.	J.K.	J.K.	H.S.
2-4-92	ISSUED FOR REVIEW AND APPROVAL					R	J.K.	J.K.	M.T. H.S.
NO.	DATE	REVISIONS				BY	CHEK	SUPV.	ENGR.
ECA-1	1-1-92								

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

BRECKINRIDGE PROJECT

OVERALL SITE PLAN

 BECHTEL HOUSTON	JOB NO.	DRAWING NO.	REV.
	14222	50E-A-1	1

P&ID LINE WORK STANDARDS

1. INSTRUMENTATION	LINE WIDTH	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 & SAFETY VALVES		0.022 IN.
6. TEXT, 1/10" HIGH		0.010 IN.
7. ARROWS FOR LINE WEIGHT		
A. ELECTRICAL SIGNALS	0.1" LINE, 0.1" SPACE	
B. PNEUMATIC SIGNALS	1/8" x 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	0.1" 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) 0.9" x 0.1" LINES, 0.1" SPACE	
H. FURNISHED BY OTHERS	0.6" (NOTE 1) 0.9" x 0.1" LINES, 0.1" SPACE	
I. UNDERGROUND	0.4" LINE, 0.1" SPACE	
J. UNDERGROUND (EXISTING)	0.5" x 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. TIL-IN POINT BETWEEN NEW & EXISTING	0.40" SIDES
4. LINE BREAK OR RESUMPTION POINT	0.25" X 1.4"
5. INSTRUMENTATION TO/FROM	0.25" X 1.2"
6. GRID NUMBER	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. OPEN DURING NORMAL OPERATION (BUTTERFLY ONLY)	
4. CLOSED DURING NORMAL OPERATION (BUTTERFLY ONLY)	
5. 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. SCREENED CAP	
7. HRSF CONNECTION	
8. QUICK DISCONNECT	
9. REMOVABLE SPYH	
10. FLEXIBLE CONNECTION	
11. BLIND FLANGE	
12. INSULATING FLANGES (IF) OR DIELECTRIC UNION (DU) (SHOWN)	
13. BREATHING CAP	
14. LOOP SEAL	
15. DOWNWARD SLOPE (1" PER 8' SHOWN)	
16. UPWARD SLOPE (1" PER 5' SHOWN)	
17. ATM. OR ATMOSPHERIC VENT	
18. HEAT CONSERVATION	
19. PROCESS CONTROL	
20. COLD INSULATION	
21. STEAM TRACING	
22. ELECTRIC TRACING	
23. PERSONAL PROTECTION INSULATION	
24. JACKETED	
25. 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. 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. ACTUATOR G - GEAR (SHOWN) A - AIR WRENCH CH - CHAIN E - EXTENSION STEM S - SPECIAL TYPE	

MISCELLANEOUS

1. SPECTACLE BLIND	
2. CIRCULAR OR HAMER BLIND	
3. SIMPLEX BASKET STRAINER	
4. DUPLEX BASKET STRAINER	
5. Y-TYPE STRAINER (SHOWN WITHOUT BLOWOFF VALVE)	
6. TEMPORARY STARTUP STRAINER	
7. SCREEN TYPE STRAINER	
8. FILTER	
9. EXPANSION JOINT	
10. FLAME ARRESTER	
11. TRAP ST - STEAM TRAP (SHOWN) AT - AIR TRAP DT - DRAIN TRAP	
12. PIPE SPEC. CHANGE U125 - S325	
13. EJECTOR OR EDUCTOR	
14. EXHAUST HEAD	
15. SPRAY NOZZLE OR SPARGER (SHOWN WITH UPWARD FLOW)	
16. DESUPERHEATER	
17. SAMPLING CONNECTION (IND. INDICATES TYPE)	
18. SAMPLE COOLER (IND. INDICATES TYPE)	
19. STEAM OUT	
20. UTILITY STATION (WATER, AIR, STEAM SHOWN)	
21. DRINKING FOUNTAIN	
22. HEATING COIL	

MISCELLANEOUS (CONTINUED)

22. IN-LINE MIXER	
23. COLD BOX	
24. MODULATING-TYPE BY-PASS RECIRCULATING VALVE (YAWWAY)	
25. ASME BOILER PRESSURE VESSEL LOAD LIMITS	
26. DRAIN TO SEWER OWS - OILY WATER SEWER (SHOWN) SWS - SANITARY WATER SEWER CS - CHEMICAL SEWER WS - WATER SEWER (STORM DRAIN)	
27. AIR FILTER	

CONTROL VALVE FAILURE MODES

1. TWO-WAY (TYPICAL, GLOBE SHOWN) FO - INDICATES FAIL OPEN FC - INDICATES FAIL CLOSED FL - INDICATES FAIL LOCKED FI - INDICATES FAIL INDETERMINATE	
2. 3-WAY	
3. 4-WAY	

FIRE PROTECTION

1. FIRE HYDRANT	
2. FIRE HYDRANT WITH PUMPER CONNECTION	
3. FIRE HYDRANT WITH MONITOR (PUMP CONNECTION SHOWN)	
4. ELEVATED MONITOR	
5. HOSE AND STAND PIPE SYSTEM PER NFPA-14	
6. FIXED SPRAY SYSTEM PER NFPA-15	
7. SPRINKLER SYSTEM PER NFPA-13	
8. HRLON 1301 SYSTEM PER NFPA-12A	
9. CO2 SYSTEM PER NFPA-12	
10. HOSE HOUSE	
11. DELUGE VALVE	
12. 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.

REV.	DATE	DESCRIPTION	BY	CHKD	APPD	REV.
1		ISSUED FOR PHASE 0				
2		ISSUED FOR REVIEW / APPROVAL				
ASHLAND SYNTHETIC FUELS, INC. U.S. DEPARTMENT OF ENERGY AIRCO ENERGY COMPANY, INC. COOPERATIVE AGREEMENT NO. DE-FC05-80OR20717						
BRECKINRIDGE PROJECT BRECKINRIDGE COUNTY PHASE ZERO KENTUCKY						
SYMBOLS & LEGEND PIPING & INSTRUMENT DIAGRAMS						
HOUSTON	JOB NO. 14222	DRAWING NO. OE-A-1	REV. 1	34x44 "E" SIZE		

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

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

1.		PRESSURE VESSELS, VERTICAL (SHOWN) OR HORIZONTAL (TANKS, RECEIVERS, DRYERS, SEPARATORS, ETC.)
2.		CLAMPED
3.		CONE ROOF TANK
4.		FLOATING TOP TANK
5.		FIRE HEATER
6.		SUMP
7.		GASIFIER

C - CENTRIFUGAL
P - PROPORTIONING
R - RECIPROCATING
RO - ROTARY
M - MOTOR DRIVEN
T - TURBINE DRIVEN
H - HYDRAULIC TURBINE DRIVEN

```

COMPLETE TAC NUMBER

PX 12 3 4 8 0
| | | | |
| | | | | --- MODIFIER A,B,C ETC.
| | | | | --- LOOP NUMBER
| | | | | --- TRAIN NUMBER (SINGLE TRAIN IS 1)
| | | | | --- PLANT NUMBER
| | | | | --- ISA FUNCTION

LOOP NUMBER IS NORMALLY TWO DIGITS, 10 THROUGH 99.
A THIRD SPACE IS FOR SPillover.
PLANT NUMBER IS NORMALLY ONE DIGIT, SHOWN IF IT
CARRIES THE SAME NUMBER AS THE DRAWING.

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PV
348A FOR EXAMPLE

[illegible]

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. 0-EA-4)

SENSORS - FLOW

1. FE - ORIFICE PLATE
FD - RESTRICTION ORIFICE
2. ORIFICE PLATE IN QUICK-CHANGE FITTING
3. VENTURI TUBE OR FLOW METER
4. PITOT OR PITOT-VENTURI TUBE
5. FORWARD-REVERSE PITOT TUBE
6. FLUME
7. WEIR
8. TURBINE OR PROPELLER TYPE
9. ROTAMETER
10. IN-LINE INSTRUMENT (NOTE 2, DWG. 0-EA-4)
11. FLOW STRAIGHTENING VANES

SENSORS - LEVEL

1. GAGE GLASS OR FLOAT OR DISPLACEMENT TYPE LEVEL INSTRUMENT
2. DIFFERENTIAL PRESSURE TYPE (NOTE 3, DWG. 0-EA-4)
3. (NOTE 3, DWG. 0-EA-4) TANK-MOUNTED DIFFERENTIAL PRESSURE TYPE
4. INTERNAL BALL-FLOAT TYPE
5. GAGE BOARD TYPE

SENSORS - PRESSURE

1. DIRECT CONNECTED
2. WITH DIAPHRAGM SEAL, PIPED

SENSOR - ANALYSIS

1. THROUGH-FLOW TYPE
2. NON THROUGH-FLOW TYPE

SENSORS - TEMPERATURE

1. TI - BIMETALLIC THERMOMETER
TM - THERMOMETER
TC - SINGLE SENSOR
2. DUAL SENSOR (SHOWN WHEN BOTH ARE USED)
3. FILLED SENSOR

VALVE BODIES & FAILURE MODES

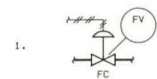
SEE DWG. 0-EA-1
(NOTE 4, DWG. 0-EA-4)

VALVES - ACTUATORS

1. PNEUMATIC DIAPHRAGM
2. DIAPHRAGM, PRESSURE BALANCED
3. ROTARY MOTOR (SHOWN TYPICALLY WITH ELECTRIC SIGNAL)
4. PNEUMATIC CYLINDER, SINGLE ACTING
5. HYDRAULIC CYLINDER, DOUBLE ACTING
6. PNEUMATIC CYLINDER, DOUBLE ACTING
7. PNEUMATIC CYLINDER, DOUBLE ACTING, WITH PILOT VALVE
8. SINGLE SOLENOID RESET AFTER LATCH
9. ELECTRO-HYDRAULIC (SHOWN OR PNEUMATIC-HYDRAULIC (SYMBOL P/H))
10. UNCLASSIFIED TYPE OF ACTUATOR TO BE WRITTEN ADJACENT TO THE SYMBOL

VALVE BODY WITH ACTUATOR - TYPICAL

(NOTE 4, DWG. 0-EA-4)



SELF-ACTUATED DEVICES - FLOW

1. FLOW REGULATOR (NOTE 5, DWG. 0-EA-4)
2. SIGHT FLOW GLASS

SELF-ACTUATED DEVICES - LEVEL

1. LEVEL REGULATOR WITH MECHANICAL LINKAGE

SELF-ACTUATED DEVICES - PRESSURE

1. PRESSURE REDUCING REGULATOR SELF-CONTAINED
2. PRESSURE REDUCING REGULATOR WITH INTERNAL PRESSURE TAP
3. DIFFERENTIAL PRESSURE REDUCING REGULATOR WITH INTERNAL AND EXTERNAL PRESSURE TAPS
4. BACKPRESSURE REGULATOR SELF-CONTAINED
5. BACKPRESSURE REGULATOR WITH EXTERNAL PRESSURE TAP
6. PRESSURE RELIEF OR SAFETY VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
7. VACUUM RELIEF VALVE, ANGLE PATTERN SPRING OR WEIGHT LOADED, OR WITH INTEGRAL PILOT
8. PRESSURE AND VACUUM RELIEF VALVE
9. RUPTURE DISK OR SAFETY HEAD, FOR PRESSURE RELIEF
10. RUPTURE DISK OR SAFETY HEAD, FOR VACUUM RELIEF

SELF-ACTUATED DEVICES - TEMPERATURE

1. TEMPERATURE REGULATOR, FILLED SYSTEM TYPE

HAND ACTUATED DEVICES

1. TWO-WAY HAND CONTROL VALVE IN PROCESS LINE (NOTE 6, DWG. 0-EA-4)
2. MANUALLY ADJUSTABLE RESTRICTION ORIFICE IN SIGNAL LINE
3. TWO-WAY HAND ACTUATED SWITCHING VALVE IN PNEUMATIC SIGNAL LINE

MISCELLANEOUS DEVICES

(NOTE 7, DWG. 0-EA-4)

- TYPICAL SYMBOL
1. SIGNAL RELAY (NOTE 8, DWG. 0-EA-4)
- RELAY SIGNALS
2. SQUARE ROOT EXTRACTOR
 3. VOLTAGE TO PNEUMATIC CONVERTER
 4. CURRENT TO PNEUMATIC CONVERTER
 5. VOLTAGE TO CURRENT CONVERTER
 6. ADD AND SUBTRACT
 7. HIGH SELECT
 8. LOW SELECT
 9. BIAS
 10. MULTIPLY
 11. DIVIDE

FOR ADDITIONAL RELAY SYMBOLS, SEE ISA 55.1, TABLE 2

12. PURGE DEVICE (MEANS OF REGULATING PURGE MAY BE SHOWN IN PLACE OF THE SYMBOL; PURGE FLUID AND POWER SUPPLIES ARE 1)
- AIR SUPPLY
ELECTRICAL SUPPLY
GAS SUPPLY
HYDRAULIC FLUID SUPPLY
NITROGEN SUPPLY
STEAM SUPPLY
WATER SUPPLY

14. INTERLOCK
15. "AND" INTERLOCK - EFFECTIVE ONLY IF ALL INPUT EXIST
16. "OR" INTERLOCK - EFFECTIVE IF ONE OR MORE INPUT EXIST
17. ANALOG CONTROL SIGNAL
18. BURNER CONTROL SIGNAL

DESIGNED BY	DATE	REVIEWED BY	DATE	APPROVED BY	DATE
ISSUED FOR PHASE 0 ISSUED FOR REVIEW / APPROVAL					
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SYMBOLS & LEGEND PIPING & INSTRUMENT DIAGRAMS					
JOB NO.	DRAWING NO.	REV.			
HOUSTON	14222	0E-A-3	1		

FIRST LETTER (NOTE 9)			SUCCEEDING LETTER(S) (NOTE 9)																						
MEASURED OR INITIATING VARIABLE (NOTE 10)	SYMBOL	SENSING DEVICE (NOTE 5)		DISPLAY DEVICE					CONTROL DEVICE (NOTE 5)							MISCELLANEOUS DEVICE									
		PRIMARY ELEMENT	TRANSMITTER	INDICATOR	RECORDER	INTEGRATING INDICATOR	ALARM ANNUNCIATOR (NOTE 15)			CONTROL STATION MAN/AUTO	CONTROLLER	CONTROL VALVE	SELF- ACTUATED VALVE	OTHER FINAL ELEMENT (NOTE 16)	SWITCH (NOTE 17)	LOCAL OBSERVATION GLASS	TEST POINT CONNECTION (NOTE 18)	RELAY COMBINATION (NOTE 6)	USER'S CHOICE (NOTE 13)	UNCLASSIFIED (NOTE 14)					
							LOW	HIGH	HIGH & LOW																
TYPICAL SYMBOL	()	()E	()T	()I	()R	()QI	()AL	()RH	()AHL	()K	()C	()V	()CV	()Z	()S	()G	()P	()Y	()B	()N	()X				
ANALYSIS (NOTE 11)	A	AE	AT	AI	AR		AAL	ARH	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 HEIGHT	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	FQ	FP	FY	FB	FN	FX				
GAGING (DIMENSIONAL)	G	GE	GT	GI	GR		GAL	GAH	GAHL	GK	GC				GS		GQ	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	KK	KC	KV		KZ	KS			KY	KB	KN	KX				
LEVEL	L	LE	LT	LI	LR		LAL	LAH	LAHL	LK	LC	LV	LCV	LZ	LS	LQ	LP	LY	LB	LN	LX				
MOISTURE	M	ME	MT	MI	MR		MAL	MAH	MAHL	MK	MC	MV		MZ	MS		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	PD1	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	S1	SR	SQI	SAL	SAH	SAHL	SK	SC			SZ	SS			SY	SB	SN	SX				
TEMPERATURE	T	TE	TT	T1	TR		TAL	TAH	TAHL	TK	TC	TV	TCV		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				
HEIGHT	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	Y1	YR			YAH							YS		YP	YY	YB	YN	YX				
POSITION	Z	ZE	ZT	Z1	ZR		ZAL	ZAH	ZAHL		ZC				ZS		ZY	ZB	ZN		ZX				

GENERAL NOTES

1. EXAMPLES OF THE USE OF TANGENTIAL INSTRUMENT CIRCLES TO DEFINE A SINGLE INSTRUMENT WITH TWO VARIABLES (INDICATOR TWO FUNCTIONS):
TWO VARIABLES: FLOW, A 2 PEN RECORDER, ONE FOR FLOW ONE FOR PRESSURE.
TWO FUNCTIONS: LTR/PP, A DUAL-PEN LEVEL INSTRUMENT, ONE TRANSMITTER AND ONE CONTROLLER.
HYDRAZINE, MANUAL CONTROL VALVE WITH POSITIONER, SWITCH.
2. THE TYPE OF FLOW INSTRUMENT MAY BE NAMED USING THE INSTRUMENT CIRCLE, E.G. MAGNETIC FLOW METER, DISPLACEMENT METER, MASS FLOW METER, ETC.
3. THE UPPER INSTRUMENT LEAD LINE IS LIMITED IF LEVEL IS MEASURED BY PRESSURE INSTEAD OF DIFFERENTIAL PRESSURE.
4. VALVE BODY PORTS THAT ARE CLOSED IN NORMAL OPERATION ARE NOT INDICATED.
A VALVE BODY PORT THAT IS OPEN IN NORMAL OPERATION AND CLOSING CORRESPONDS TO FULL-LOAD OR NORMAL OPERATION. REVERSING VALVES ARE INDICATED BY A VALVE BODY PORT THAT IS ENERGIZED OR DE-ENERGIZED DURING THIS MODE OF OPERATION.
REVERSARY VALVES, PORT THAT CLOSURES DURING UPSETS CONTAINS A DOT.
5. A CONTROL OR SENSING DEVICE OR RELAY HAVING A DISPLAY FUNCTION SHOULD HAVE THE APPROPRIATE DISPLAY LETTERS INDICATED UNDER THE INSTRUMENT CIRCLE.
THE ALLC DESIGNATES ANALYSIS INDICATING CONTROL STATION.
6. A HAND CONTROL VALVE HVC IS A HAND-ACTUATED VALVE THAT EITHER MODULATED A PROCESS STREAM OR IS USED AS AN INTERLOCKING DEVICE.

7. FOR ROOT AND OTHER INSTRUMENT VALVES, USE INSTRUMENT INSTALLATION DETAILS.
8. THE DESCRIPTION IDENTIFYING A RELAY FUNCTION CAN BE SHOWN ON THE FIRST 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 85.1-1973 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) |
| K - INTEGRATE OR TOTALIZE | (KJ - FLW INTEGRATING INDICATOR) |
11. THE LETTER A IS USED FOR ALL ANALYSIS VARIABLES. THE FOLLOWING TERMS MAY BE PLACED OUTSIDE THE INSTRUMENT CIRCLE AS A LOG TO DENOTE THE SPECIFIC VARIABLES.
- | | |
|-------------------------|------------------------|
| CHR - CHROMATOGRAPH | NOX - NITROGEN OXIDES |
| CLR - CHLORINE | OD - DISSOLVED OXYGEN |
| CON - CONVERSION NUMBER | OX - OXYGEN |
| COMB - COMBUSTIBLE | OXID - OXIDATION |
| COND - CONDUCTIVITY | RED - REDUCTION |
| CS - DISSOLVED HYDROGEN | SIP - SILICA |
| IS - GASEOUS HYDROGEN | SIO2 - SULPHUR DIOXIDE |
| PHS - PHOSPHORUS | TR - TURBIDITY |
| M - MOISTURE | VIS - VISCOSITY |
| W - WATER | |

12. FD - DESIGNATES FLOW RESTRICTION ORIFICE
FC - DESIGNATES FLOW RATE CONTROLLER
FFC - DESIGNATES FLOW RATIO CONTROLLER
13. A USER'S CHOOSE LETTER A OR N FOR UNLISTED MEANINGS
THAT WILL BE USED REPEITIVELY ON A PARTICULAR PROJECT.
THE MEANINGS WILL BE DEFINED ONLY ONE FOR THAT PROJECT
AND HAVE ONE MEANING AS THE FIRST LETTER AND ANOTHER
UNIQUE MEANING AS THE SUCCEEDING LETTER.
14. THE LETTER X IS FOR UNLISTED MEANINGS THAT WILL BE USED
ONLY ON LOW OR LOW-HIGH LEVEL ALARMS THAT HAVE AN AMOUNT
OF MEANINGS AS A FIRST LETTER AND ANY NUMBER OF MEANINGS
BEHIND IT. THE MEANINGS WILL BE DEFINED WITH DISTINCTIVE
SYMBOLS. THE MEANINGS WILL BE DEFINED OUTSIDE THE
INSTRUMENT CIRCLE.
15. HIGH-LOW ALARMS HAVE LOW, LOW-LOW ALARMS HAVE L AND
LOW-HIGH ALARMS HAVE H IN THE INSTRUMENT CIRCLE, E.G.
LAHH - DESIGNATES HIGH-LOW LEVEL ALARM
LH DESIGNATES LOW-LEVEL ALARM
LHLL - DESIGNATES LOW-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, ACTUATORS, ETC.
17. THE LETTERS H, HH, L, LL AND HL ARE ADDED TO THE MEASURED
VARIABLES FOR HIGH, HIGH-HIGH, LOW, LOW-LOW AND LOW-HIGH

18. A TEST POINT IS A PROCESS CONNECTION TO WHICH NO INSTRUMENT IS PERMANENTLY CONNECTED, BUT WHICH IS INTENDED FOR TEMPORARY, INTERMITTENT, OR FUTURE CONNECTION OF AN INSTRUMENT.
- | | |
|----|--------------------------------|
| PP | - DESIGNATES PRESSURE POINT |
| AP | - DESIGNATES ANALYSIS POINT |
| TP | - DESIGNATES TEMPERATURE POINT |
| TH | - DESIGNATES THROCKLE POINT |
| HP | - DESIGNATES HAND TEST POINT |
19. TEXT LOCATIONS AROUND INSTRUMENT "Balloons" SHALL BE STANDARDIZED AS SHOWN IN THE SKETCH BELOW.

J3 J4

J1
J2

J1 - ISA CODE (INSTRUMENT TYPE)
J2 - LOOP NUMBER
J3 - VENDOR DESIGNATOR (E.G. *)
J4 - FUNCTION (E.G. √)

[illegible]