TABLE 6.2.4-2

EQUIPMENT LIST

COAL GASIFICATION - UNIT 10

Item No.	Equipment Name	Number Required Oper.	Spare
10CB-0101	Coal Bunker	12	2
10CH-0101	Coal Charging Chute	12	2
10CL-0101	Coal Lock	12	2
10GG-0101	Gasifier	12	2
10AL-0101	Ash Lock	12	2
10DM-0101	Jacket Steam K.O. Drum	12	2
10DM-0102	Centrifugal Liquid Separator	12	2
10DM-0103	Hot Flare Separator	1	0
10E-0101	Crude Gas Wash-cooler	12	2
10E-0102	Ash Lock Expansion Condenser	12	2
10E-0103	Waste Heat Boiler	12	2
10E-0104	Relief Vent Cooler	1	0
10P-0101	Wash-cooler Recycle Pump	12	2
10P-0102	Slops Pump	1	0
10EJ-0101	Coal Lock Ejector	12	2
10ME-0101	Lock Gas Recompression System	2	0

6.2.5 CARBON MONOXIDE SHIFT - UNIT 11

6.2.5.1 DESIGN BASIS

Purpose of Unit

The purpose of this unit is to react a portion of the carbon monoxide (CO) and water in the crude gas from Lurgi gasification and Texaco partial oxidation (POX) units to produce additional hydrogen. The catalytic shift conversion thus produces a synthesis gas with an H_2 and CO composition suitable for methanation. The catalyst also hydrocracks all of the tars to lighter species (oils, naphtha, etc).

Scope of Unit

The shift conversion unit includes single stage catalytic reactors, feed-effluent heat exchangers and a catalyst regeneration system. The recovery of the exothermic reaction heat occurs downstream in the Gas Cooling Unit 12. The shift process is licensed by Lurgi Mineraloltechnik of Germany.

General Design Criteria

The unit consists of two operating trains of shift conversion, each with two parallel catalyst beds, and one common catalyst regeneration system. During normal operation, all of Lurgi and POX raw gas is reacted in the shift unit. The onstream factor for the unit is compatible with the overall plant stream factor of 332 days per year. Individual catalyst beds are capable of operation at 25 percent to 33 percent of unit capacity during single train regeneration periods and catalyst change-out. The catalyst bed requires regeneration every 45 days. Due to variances in catalyst activity and exchanger performance, the unit design allows sufficient

General Design Criteria

flexibility in the feed distribution to the two trains so that individual train flows may vary ± 10 to 15 percent from the design point. Expected catalyst life is one year.

Process Performance Objectives

Under normal operation, the unit is designed to react approximately 30 percent of the CO in the combined feed from the gasification and POX units. The shifted gas leaving the unit contains about 11.7 percent CO and 42.6 percent H_2 in the base case.

Feedstock

Combined Feed (from Gasification and POX):

Dry Gas	60,825.1	lb-mol/hr
Moisture	29,898.7	lb-mol/hr
Wet Gas	90,723.8	lb-mol/hr
Total Steam	1,878,162	lb/hr
Battery Limit Conditions: Temperature	355°F	
Pressure	435	psia

Composition:

Component	Dry Mol %
H_2	40.3
N_2/Ar (as N_2)	0.2
CO	17.6
CH_4	10.4
C_2+	0.7
CO_2	30.4
H_2S	0.4
COS	0.01
Tar, Oil, Naphtha	35,065 lb/hr

6.2.5.1 (Continued)

Products

Shifted Gas:

Dry	63,844.9 lb-mol/hr	
Moisture	26,746.8 lb-mol/hr	
Wet Gas	90,591.7 lb-mol/hr	
Total Stream	1,878,162 lb/hr	
Battery Limit Conditions:	Temperature	413°F
	Pressure	415 psia

Composition:

Component	Dry Mol %
H_2	42.7
N_2/Ar (as N_2)	0.2
CO	11.7
CH_4	10.7
C_2+	0.3
CO_2	34.0
H_2S	0.4
COS	0.01

Oil, Naphtha 36,782 lb/hr

Utility Requirements

None during normal operation.

Catalyst Requirements:	Initial	4,055 ft^3
	Annual	4,055 ft^3

6.2.5.2 PROCESS DESCRIPTION

Drawing No. 835704-11-4-101 presents the process flow sketch of the CO Shift Unit. The material balance (Table 6.2.5-1) for the unit is included following the flow sketch. The equipment list is given in Table 6.2.5-2.

6.2.5.2 (Continued)

The raw gas from the Gasification and Partial Oxidation are catalytically reacted in this unit to convert a portion of the carbon monoxide in the raw gas to hydrogen by the exothermic water gas shift reaction:

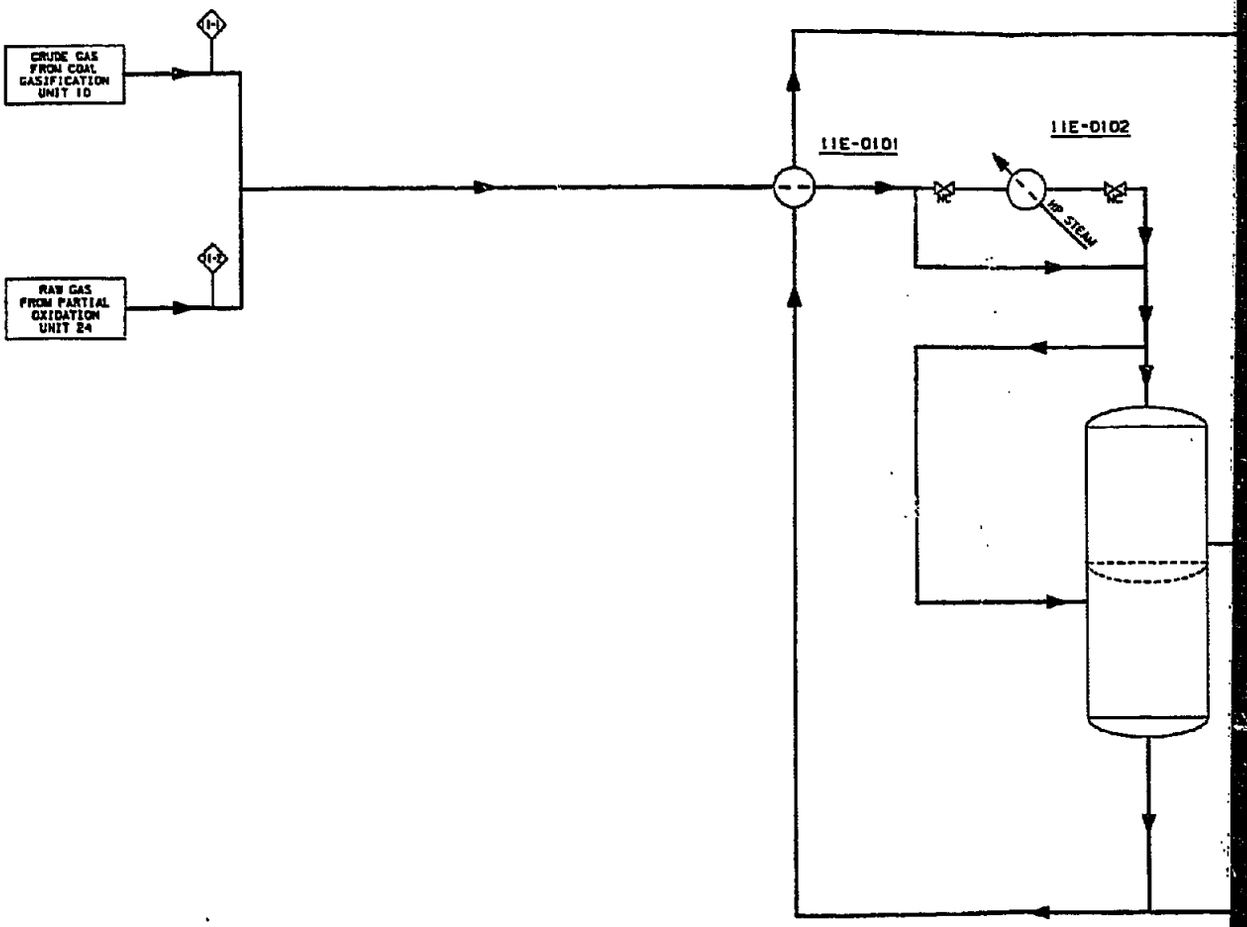
$$CO + H_2O \rightleftharpoons CO_2 + H_2$$

Reaction steam is provided by the normal steam content of the crude gas, and the elevated reaction temperature is attained by a feed-effluent heat exchanger. In addition to converting carbon monoxide, the cobalt molybdenum catalyst hydrogenates unsaturated hydrocarbons and most of the higher phenols, HCN and organic sulfur contained in the crude gas. The catalyst is also expected to hydrocrack all of the tars and a portion of the remaining hydrocarbons to lighter compounds.

The raw gas from Lurgi Gasification and Partial Oxidation are combined and fed to the two-train shift unit. Within each train, the gas is preheated against the reactor effluent and distributed equally among two catalyst beds stacked within one reactor vessel. The reacted gas from each bed is combined, cooled against the feed and flows to the Gas Cooling Unit 12. A steam heater is provided for heating the feed during startup and during upset conditions.

A single train catalyst regeneration system is included in the unit. The shift catalyst is regenerated about every 45 days using an air-steam mixture.

11RE-0101
SHIFT CONVERTER



11RE-0101
SHIFT CONVERTER

11ME-0101
CATALYST REGENERATION
SYSTEM

SHIFTED GAS
TO GAS COOLING
UNIT 12

11E-0102

HP STEAM

11RE-0101

REGENERATION
GAS TO FLARE

REGENERATION
GAS TO/FROM
SHIFT CONVERTER

11ME-0101

AIR/STEAM FOR
REGENERATION

USE OR DISCLOSURE OF REPORT DATA
IS SUBJECT TO THE RESTRICTIONS ON THE
NOTICE PAGE AT THE FRONT OF THIS REPORT

NOTES:

1. THIS DRAWING SHOWS ONE TRAIN OF A TWO TRAIN SECTION. CAPACITY OF EACH TRAIN IS 50% OF UNIT DESIGN. THE CATALYST REGENERATION SYSTEM CONSISTS OF ONE TRAIN.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY REPRESENTED.
3. THE FLOW QUANTITIES, TEMPERATURES AND PRESSURES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

USE OR DISCLOSURE OF REPORT DATA
IS SUBJECT TO THE RESTRICTIONS ON THE
NOTICE PAGE AT THE FRONT OF THIS REPORT

FLUOR

R.WHITE	
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K.O'BELMITO	
R.McCARTHY	6-8-82
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PROCESS FLOW DIAGRAM
CO SHIFT
UNIT 11

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-11-4-101 | 1

003 3571110I

TABLE 6.2.5-1

MATERIAL BALANCE
CO SHIFT - UNIT 11

Stream Number	11-1		11-2		11-3	
Stream Name	Crude Gas from Gasification		POX Gas		Shifted Gas to Cooling	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H_2	23,328.0	40.21	1,161.1	41.35	27,243.7	42.67
N_2	127.6	0.22	15.1	0.54	142.7	0.22
CO	9,257.0	15.96	1,432.9	51.04	7,482.6	11.72
CH_4	6,322.1	10.90	9.4	0.33	6,837.9	10.71
C_2H_4	72.4	0.12				
C_2H_6	289.5	0.50			181.0	0.28
C_3H_6	36.2	0.06				
C_3H_8	36.2	0.06			36.2	0.06
C_4H_8	9.0	0.02				
C_4H_{10}	9.0	0.02			9.0	0.01
CO_2	18,311.3	31.56	183.4	6.53	21,683.3	33.96
H_2S	214.7	0.37	5.5	0.20	224.9	0.35
COS	4.4	0.01	0.3	0.01	3.6	0.01
		100.00		100.00		100.00
Dry Gas, lb-mol/hr	58,017.4	66.99	2,807.7	68.09	63,844.9	70.48
H_2O vapor, lb-mol/hr	28,582.7	33.01	1,316.0	31.91	26,746.8	29.52
Wet Gas, lb-mol/hr	86,600.1	100.00	4,123.7	100.00	90,591.7	100.00
Dry Gas, lb/hr	1,239,695		51,332		1,347,966	
H_2O vapor, lb/hr	514,946		23,709		481,871	
H_2O liquid, lb/hr	-				-	
Tars, lb/hr	12,947				25,265	
Oils, lb/hr	16,843					
Naphtha, lb/hr	5,275				11,517	
Phenols, lb/hr	5,095				3,414	
Fatty Acids, lb/hr	1,139				1,139	
Org. Sulfur, lb/hr	213				22	
Ammonia, lb/hr	6,773		10		6,783	
HCl, lb/hr	185		-		185	
TOTAL, lb/hr	1,803,111		75,051		1,878,162	
Pressure, psia	435		450		415	
Temperature, °F	355		355		413	

NOTE: Flow quantities, pressures and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.

TABLE 6.2.5-2

EQUIPMENT LIST

CO SHIFT - UNIT 11

Item No.	Equipment Name	Number Required	
		Oper.	Spare
11RE-0101[1]	Shift Converter	2	0
11E-0101[1]	Feed-Effluent Heat Exchanger	2	0
11E-0102[1]	Startup Feed Heater	2	0
11ME-0101	Catalyst Regeneration System	1	0

NOTE: (1) Train No. 2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	11RE-0101	11RE-0201

6.2.6 GAS COOLING - UNIT 12

6.2.6.1 DESIGN BASIS

Purpose of Unit

This unit serves to cool the shifted gas to a temperature suitable for feed to the Rectisol unit. In the process, heat is recovered in the form of low pressure steam and boiler feed water (BFW) preheat. Also, as the raw gas is cooled, gas liquor containing recoverable byproducts is condensed and sent to the Gas Liquor Separation unit.

Scope of Unit

Unit 12 cools the shifted gas by generating steam and preheating BFW. The raw gas is then cooled by air and cooling water. The unit also includes separation of the condensed liquor.

General Design Criteria

The Gas Cooling unit contains two 50 percent parallel trains. Maximum heat recovery is obtained by preheating boiler feed water to methanation unit and generating low pressure steam. At lower temperatures, heat is rejected in air coolers and water coolers. Rotating equipment in this unit are motor driven and are not spared. This unit is designed to be compatible with the overall plant onstream factor of 332 days per year.

6.2.6.1 (Continued)

Feedstock

Shifted Gas

Dry Gas	63,844.9 lb-mol/hr	
Moisture	26,746.8 lb-mol/hr	
Wet Gas	90,591.7 lb-mol/hr	
Total Stream	1,878,162 lb/hr	
Battery Limit Conditions	Temperature	413°F
	Pressure	415 psia

Composition:

Component	Dry Mol %
H_2	42.6
N_2/Ar (as N_2)	0.2
CO	11.7
CH_4	10.7
C_2+	0.4
CO_2	34.0
H_2S	0.4
COS	0.01

Products

Cooled Gas (To Rectisol)

Dry Gas	63,184.4 lb-mol/hr	
Moisture	145.7 lb-mol/hr	
Wet Gas	63,330.1 lb-mol/hr	
Total Stream	1,334,218 lb/hr	
Battery Limit Conditions:	Temperature	100°F
	Pressure	405 psia

Cooled (Dry) Gas Composition is essentially the same as the feed gas

Gas Liquor (To Gas Liquor Separation unit)

Total Stream	543,944 lb/hr	
Battery Limit Conditions:	Temperature	233°F
	Pressure	250 psia

6.2.6.1 (Continued)

Utility Requirements

Steam produced (60 psig sat'd)	126,500
Heat available for BFW preheating	132.1 MM BTU/Hr
Electric Power,	350 kW
Cooling Water (ΔT = 30°F),	609 gpm

6.2.6.2 PROCESS DESCRIPTION

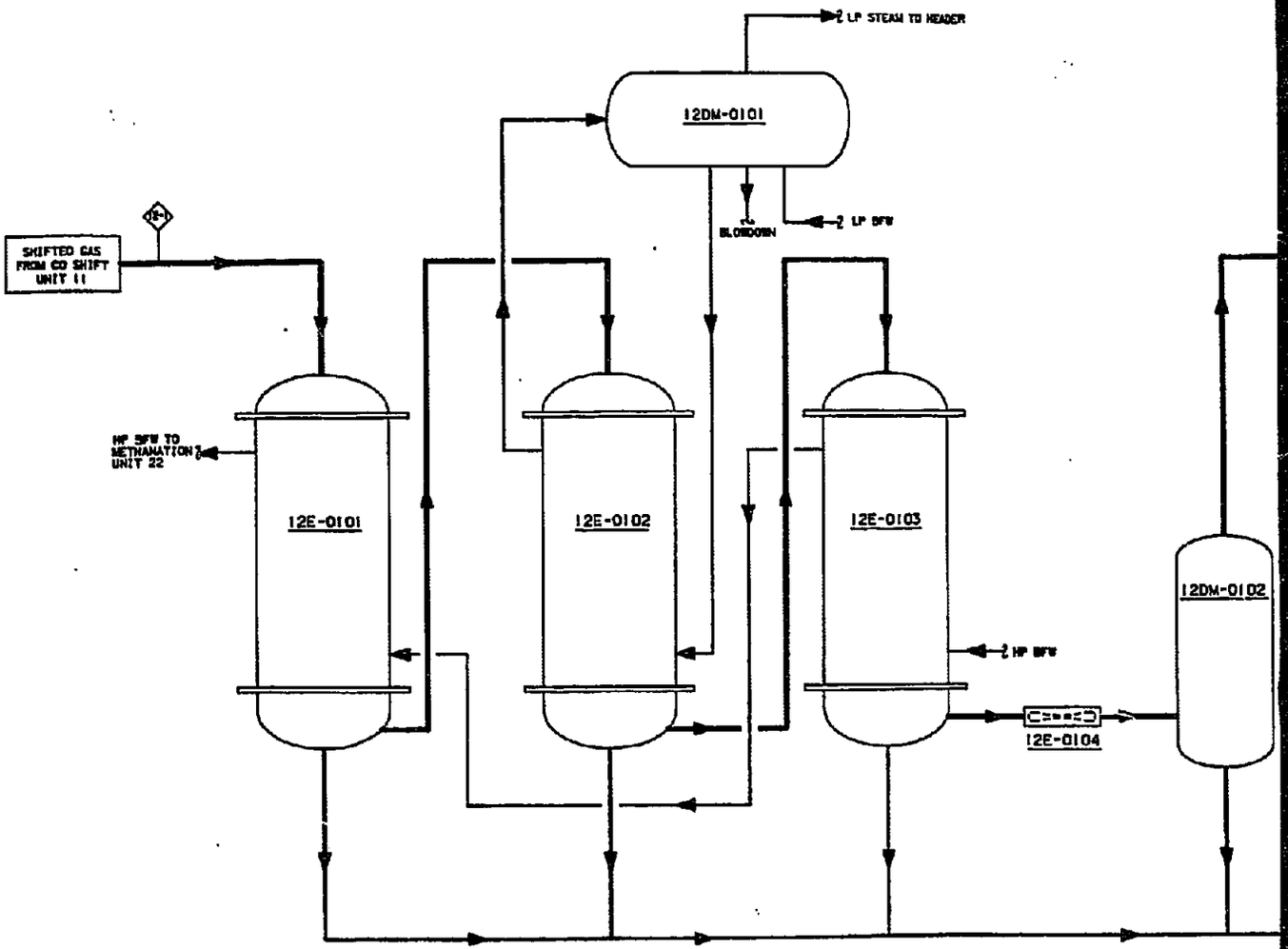
The process flow sketch for the Gas Cooling unit is shown on Drawing No. 835704-12-4-101. The material balance (Table 6.2.6-1) for the unit follows the flow sketch. The equipment list follows in Table 6.2.6-2. The plot plan is shown on Drawing No. 835704-12-5-050.

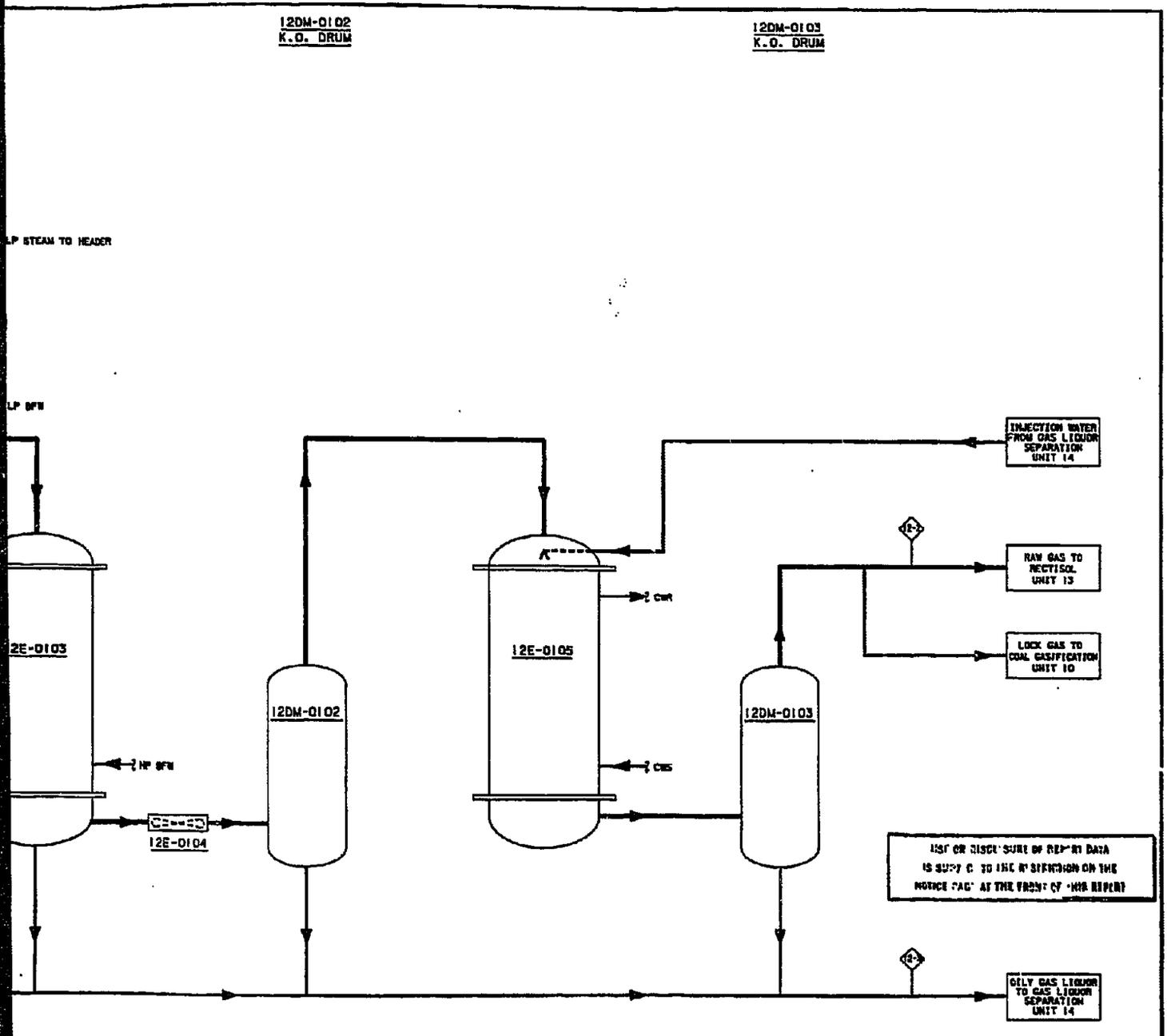
The shifted gas from the CO Shift unit is cooled in a series of heat exchangers and the condensate produced is separated from the cooled gas. High pressure boiler feed water is preheated using the heat from the gas in the first and third exchanger within the unit, while low pressure steam is generated in the second exchanger. Most of the heavy tars and oils are condensed as the gas is cooled. The unit heat exchangers are vertical and are provided with condensate surge capacity. The condensates are combined and piped to the Gas Liquor Separation unit.

Following heat recovery, the gas is cooled in air coolers and water cooled exchangers. The oily gas liquor containing primarily water condensed is separated in knock-out drums and sent to the Gas Liquor Separation unit. The cooled gas, now at 100°F, is directed to the Rectisol Unit 13. A slip stream of the cooled gas is sent to the Gasification unit for repressurizing the coal locks during coal charging operation.

12DM-0101
STEAM DRUM

12DM-0102
K.O. DRUM





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PROCESS FLOW DIAGRAM
GAS COOLING
UNIT 12

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-12-4-101 | 1

003 3571201

TABLE 6.2.6-1

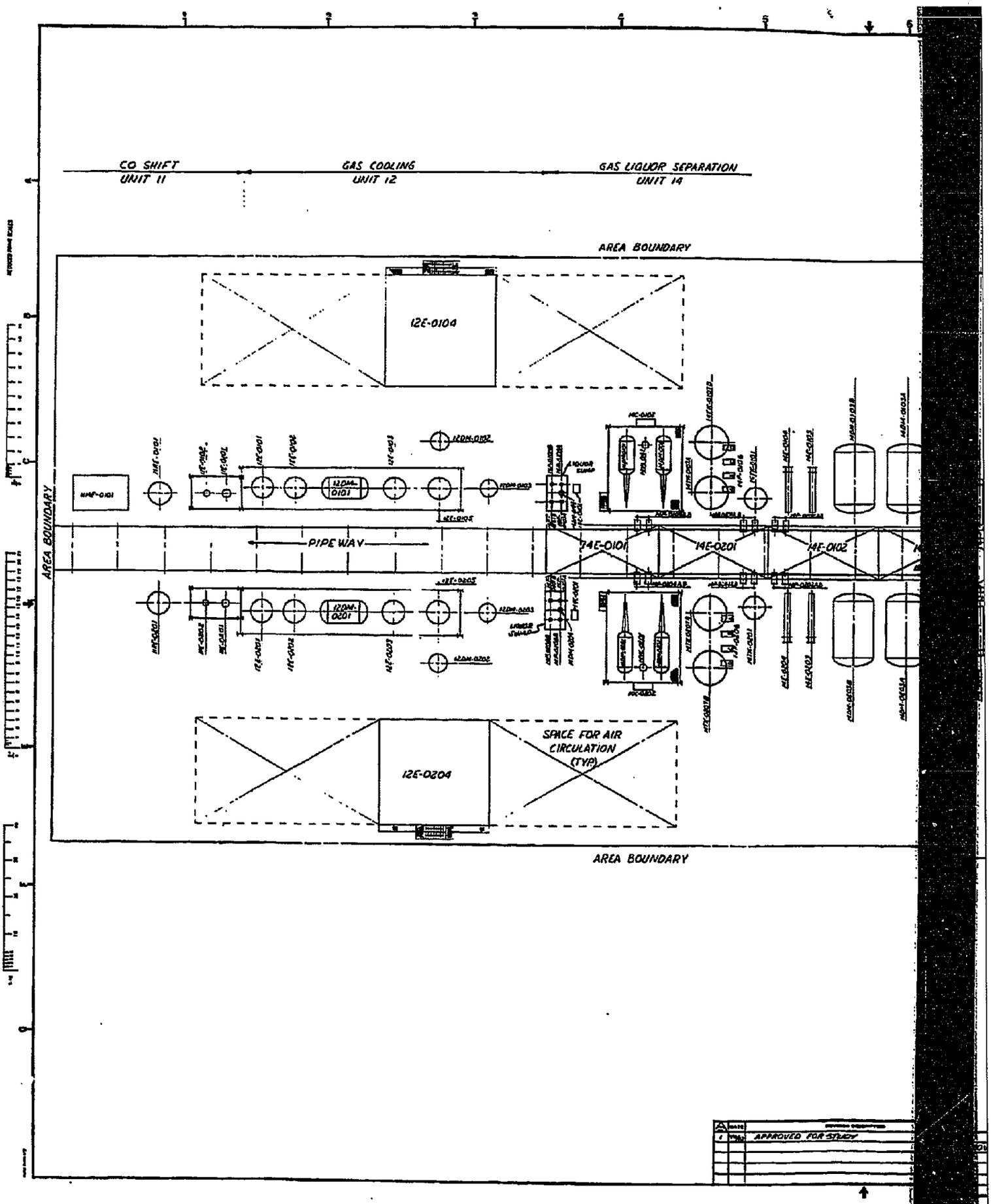
MATERIAL BALANCE

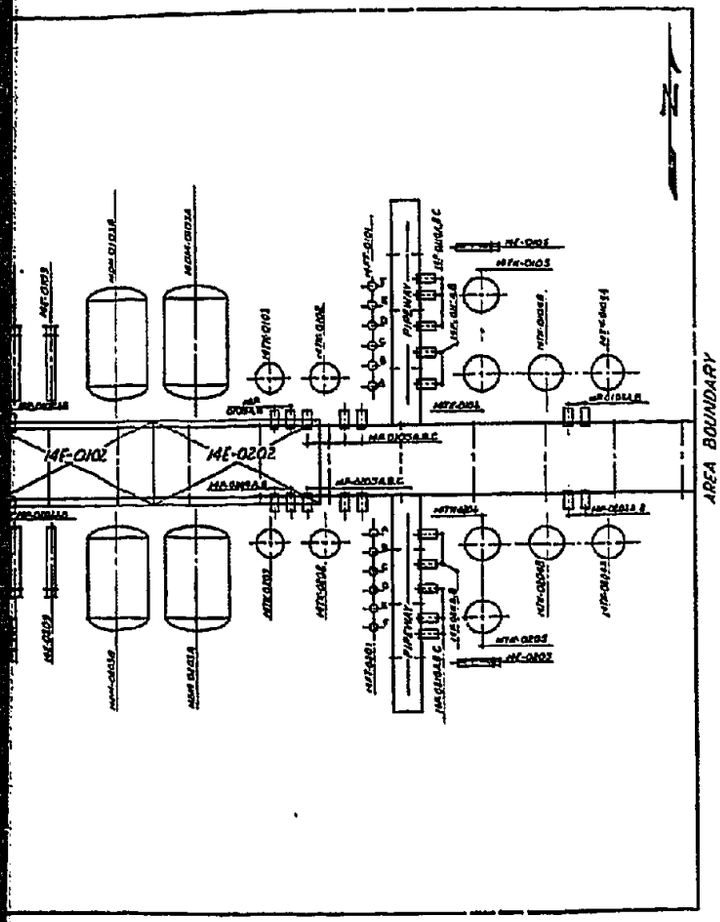
GAS COOLING - UNIT 12

Stream Number	12-1		12-2		12-3	
Stream Name	Shifted Gas		Raw Gas to Rectisol		Oily Gas Liquor(2)	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H_2	27,243.7	42.67	27,226.0	43.09	17.7	2.68
N_2	142.7	0.22	142.7	0.23		
CO	7,482.6	11.72	7,474.0	11.83	8.6	1.30
CH_4	6,837.9	10.71	6,830.5	10.81	7.4	1.12
C_2H_6	181.0	0.28	181.0	0.29		
C_3H_8	36.2	0.06	36.2	0.06		
C_4H_{10}	9.0	0.01	9.0	0.01		
CO_2	21,683.3	33.96	21,063.8	33.34	619.5	93.79
H_2S	224.9	0.35	217.6	0.34	7.3	1.11
COS	3.6	0.01	3.6	0.01		
		100.00		100.00		100.00
Dry Gas, lb-mol/hr	63,844.9	70.48	63,184.4	99.77	660.5	100.00
H_2O Vapor, lb-mol/hr	26,746.8	29.52	145.7	0.23	-	-
Wet Gas, lb-mol/hr	90,591.7	100.00	63,330.1	100.00	660.5	100.00
Dry Gas, lb/hr	1,347,966		1,320,054		27,912	
H_2O, Vapor, lb/hr	481,871		2,625		-	
H_2O, Liquid, lb/hr	-		-		479,246	
Tars/Oils, lb/hr	25,265		-		25,265	
Naphtha, lb/hr	11,517		11,517		-	
Phenols, lb/hr	3,414		-		3,414	
Fatty Acids, lb/hr	1,139		-		1,139	
Org. Sulfur, lb/hr	22		22		-	
Ammonia, lb/hr	6,783		-		6,783	
HCl, lb/hr	185		-		185	
TOTAL, lb/hr	1,878,162		1,334,218		543,944	
Pressure, psia	415		405		250	
Temperature, °F	413		100		233	

NOTES: (1) Flow quantities, pressures and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.

(2) Represents net Gas Liquor flow from Gas Cooling to Gas Liquor Separation unit.


CO SHIFT
UNIT 11
GAS COOLING
UNIT 12
GAS LIQUOR SEPARATION
UNIT 14
AREA BOUNDARY
12E-0104
PIPE WAY
14E-0101
14E-0201
14E-0102
AREA BOUNDARY
SPACE FOR AIR CIRCULATION (TYP)
12E-0204
AREA BOUNDARY
APPROVED FOR STUDY



REDUCED FRONT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE.

APPROVED FOR STUDY

FLUOR

PLOT PLAN-UNITS 11,12&14
CO SHIFT, GAS COOLING & GAS LIQUOR SEPARATION
CROW TRIBE OF INDIANS MONTANA

1"=20'-0" 885704-12-5-050 /

TABLE 6.2.6-2

EQUIPMENT LIST

GAS COOLING - UNIT 12

Item No.	Equipment Name	Number Required Oper.	Spare
12E-0101	Methanation BFW Preheater II	2	0
12E-0102	60 psig Steam Generator	2	0
12E-0103	Methanation BFW Preheater I	2	0
12E-0104	Air Cooler	2	0
12E-0105	Water Cooler	2	0
12DM-0101	Steam Drum	2	0
12DM-0102	K.O. Drum	2	0
12DM-0103	K.O. Drum	2	0

NOTE: Train No. 2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	12E-0101	12E-0201

6.2.7 RECTISOL - UNIT 13

6.2.7.1 DESIGN BASIS

Purpose of Unit

The purpose of the Rectisol unit is to reduce the total sulfur in the synthesis gas to the Methanation unit to 0.1 ppm (maximum), to remove CO_2 in the synthesis gas to 6.6 to 6.7 volume percent level, and to remove naphtha from the synthesis gas.

Scope of Unit

The unit removes H_2S, COS, CS_2, mercaptan, CO_2 and naphtha from the raw gas, includes facilities for regeneration of the absorbent methanol and includes a propylene refrigeration system to cool the raw gas to the sub-zero temperature required for the absorption process. The selective Rectisol process is licensed by Lurgi Mineraloltechnik of Germany.

General Design Criteria

Two 55 percent trains of Rectisol absorption/regeneration and two 56.5 percent propylene refrigeration trains are provided. A selective Rectisol system is used in which CO_2 concentration can be controlled independently of H_2S and COS removal. Refrigeration is available at 32°F, -21°F and -45°F levels. All equipment in critical service in the Rectisol and refrigeration units are sufficiently spared. The unit stream factor is compatible with the overall plant stream factor of 332 days per year.

All rotating equipment in the unit including the large compressors in the refrigeration system are electric motor-driven.

6.2.7.1 (Continued)

Process Performance Objectives

The pure gas product from Rectisol unit is expected to contain no more than 0.1 ppm of total sulfur and about 6.6 to 6.7% CO_2.

Feedstock

Raw Gas:

Dry Gas	63,184.4 lb-mol/hr
Moisture	145.7 lb-mol/hr
Wet Gas	63,330.1 lb-mol/hr
Total Stream	1,334,218 lb/hr

Battery Limit Conditions: Temperature 100°F
Pressure 405 psia

Composition:

Component	Dry Mol %
H_2	43.1
N_2/Ar (as N_2)	0.2
CO	11.8
CH_4	10.8
C_2+	0.4
CO_2	33.3
H_2S	0.34
COS	0.01
Naphtha	11,517 lb/hr

Methanated Gas

Although removal of CO_2 from the methanated gas is included in the SNG Purification Unit 23, the methanated gas feed and pure SNG product are listed here to close the material balance around the Rectisol unit.

6.2.7.1 (Continued)

Dry Gas	18,143.2 lb-mol/hr	
Moisture	25.4 lb-mol/hr	
Wet Gas	18,168.6 lb-mol/hr	
Total Stream	343,038 lb/hr	
Battery Limit Conditions:	Temperature	100°F
	Pressure	680 psia

Composition:

Component	Mol %
H_2	1.24
N_2/Ar (as N_2)	0.75
CO	0.05
CH_4	87.53
CO_2	10.43

Products

Pure Syngas:

Dry Gas	46,064.1 lb-mol/hr	
Moisture	-0- lb-mol/hr	
Wet Gas	46,064.1 lb-mol/hr	
Total Stream	535,384 lb/hr	
Battery Limit Conditions:	Temperature	68°F
	Pressure	360 psia

Composition:

Component	Mol %
H_2	59.0
N_2	0.3
CO	16.2
CH_4	17.6
C_2H_6	0.2
CO_2	6.6
CH_3OH	Trace

6.2.7.1 (Continued)

Pure SNG (Unit 23 SNG Purification & Compression Unit Product):

Dry Gas	15,100.6 lb-mol/hr
Moisture	-0-
Total Stream	245,948 lb/hr
Battery Limit Conditions: T	68°F
P	650 psia

Composition:

Component	Mol %
H_2	1.49
N_2/Ar (as N_2)	0.90
CO	0.06
CH_4	96.34
CO_2	1.21
HHV (Btu/SCF)	980

Acid Gases:

The selective Rectisol unit produces several acid gas streams which are fed to the ADIP or Stretford sections of the Sulfur Recovery units or the process steam superheater depending on their H_2S concentration. The principal acid gas streams are as follows:

		H_2S Rich Gas to ADIP	H_2 Lean Gas to Stretford	CO_2 Rich Gas to Process Steam Superheating
Total gas, lb-mol/hr		900.6	9,243.3	10,032.1
Total gas, lb/hr		38,143	403,382	440,224
Battery Limit Conditions:	T, °F	80	75	100
	P, psia	25	23	25
Dry Composition, Mol%	CO_2	80.9	97.9	99.2
	H_2S	16.9	0.7	trace
	COS	0.2	0.02	trace
	CH_4	-	0.2	0.2
	C_2+	2.0	0.6	0.6
	CO	-	0.2	-
	H_2	-	0.4	-
	MeOH		trace	trace

6.2.7.1 (Continued)

Rectisol Naphtha:

Total Stream	11,327 lb/hr	
Naphtha, wt %	99.8	
Organic Sulfur, wt%	0.2	
MeOH	trace	
Battery Limit Condition:	Temperature	113°F
	Pressure	40 psia

Gas Liquor (~100% H_2O)

Flow Rate	2,327 lb/hr	
Battery Limit Conditions:	Temperature	56°F
	Pressure	230 psia

Utility Requirements

Steam consumed (100 psig sat'd)	46,700 lb/hr
Steam consumed (60 psig sat'd)	91,700 lb/hr
Refrigeration, BHP	20,270 HP (15,110 kW)
Electric power	7,800 kW
Cooling water (ΔT = 30°F)	13,613 gpm
Methanol makeup required	557 lb/hr

6.2.7.2 PROCESS DESCRIPTION

The Rectisol unit process flow sketch is presented on Drawing No. 835704-13-4-101. The unit material balance is included in Table 6.2.7-1. The plot plan is shown on Drawing No. 835704-13-4-050. The equipment list is included in Table 6.2.7-2.

Raw gas from the Gas Cooling unit is first cooled against the pure product gas from the unit, then against propylene refrigerant. The condensate is removed and sent to the Gas Liquor Separation unit. The chilled raw gas is fed to the H_2S Prewash Absorber and contacted countercurrently with

6.2.7.2 (Continued)

CO_2-rich methanol from the CO_2-H_2S Absorber. The naphtha is washed out and the naphtha-rich methanol flows to the Prewash Flash Vessel. In the upper section of the absorber, H_2S is removed from the gas and the CO_2 + H_2S-rich methanol is sent to the Reabsorber column. The gas, now almost H_2S-free, is fed to the CO_2-H_2S absorber where it contacts with lean methanol streams from the SNG Purification unit and the Flash Regenerator. The lean methanol feed to the CO_2-H_2S Absorber from the SNG Purification unit containing the CO_2 removed from SNG is controlled to obtain the required CO_2 concentration in the product gas flowing to methanation.

The product synthesis gas, now H_2S-free and with the desired CO_2 content, leaves the absorber, is warmed by heat exchange with the raw feed gas, and flows to the Methanation unit. Slip streams of the synthesis gas are taken to Methanol Synthesis unit, PSA Hydrogen Production unit and Fuel Gas system.

The naphtha-rich methanol from the Prewash Absorber is flashed to an intermediate pressure in the Prewash Flash Vessel. The offgas is fed to the Reabsorber and the liquid stream is sent to the naphtha extractor where it is extracted using boiler feed water. The naphtha phase is sent to the Naphtha Hydrotreating unit, while the methanol-water phase is pumped to the Methanol Regeneration system.

The CO_2-rich methanol from the CO_2-H_2S Absorber that is not fed to the H_2S Prewash Absorber is fed to the Flash Regenerator. The high pressure flash gases from the top section of the regenerator contains any H_2, CO or CH_4 that may have been absorbed. These gases are compressed, cooled and combined with the raw gas feed. The intermediate pressure flash gases from the lower section of the regenerator is the CO_2-rich acid gas which, after compression, flows to the Process Steam Superheating

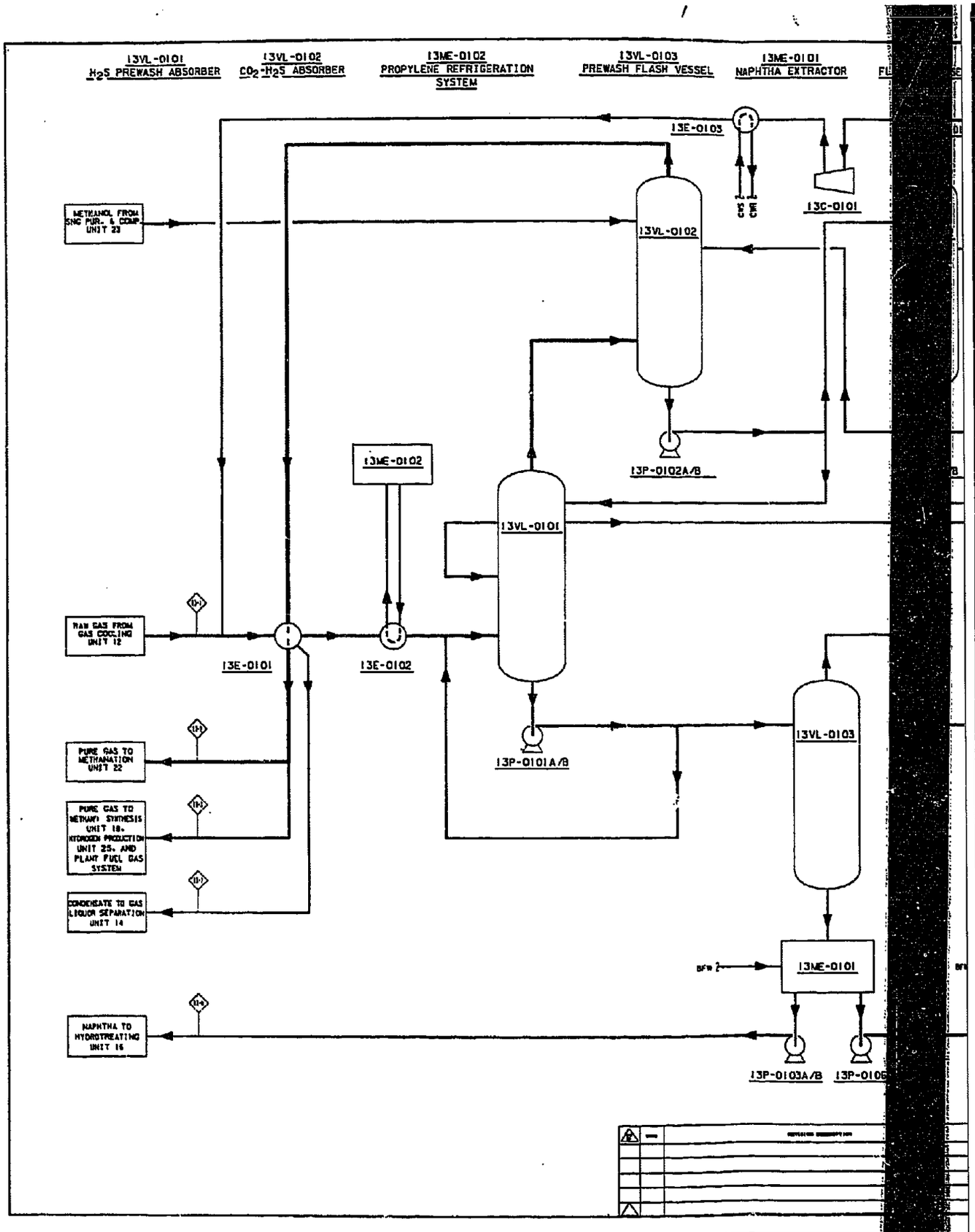
6.2.7.2 (Continued)

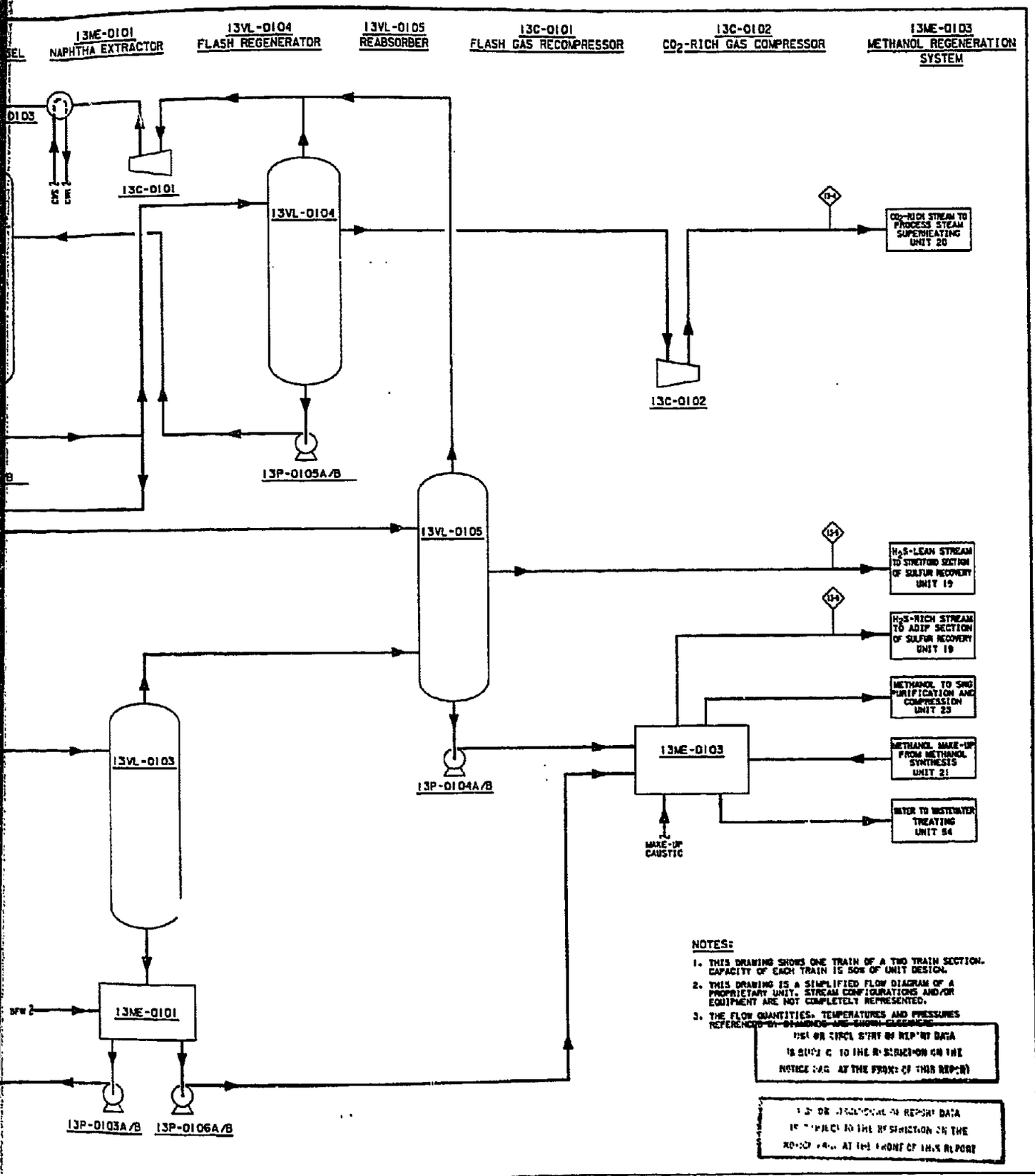
Unit (20). The CO_2-lean methanol from the bottom of the regenerator is pumped to CO_2-H_2S Absorber as the main solvent.

The Reabsorber column serves to recover CO_2 selectively from the H_2S and CO_2-rich methanol. The H_2S/CO_2-rich methanol from the H_2S Prewash Absorber is fed to the top section of the Reabsorber where it is flashed at high pressure. The offgas is recycle gas which combines with that from the Flash Regenerator. The offgas from the lower section of the Reabsorber where the liquid is flashed at an intermediate pressure is the H_2S-lean acid gas. This gas flows to the Stretford section of Unit 19. The Prewash Flash offgases are also introduced at the bottom of the Reabsorber to recover any H_2, CO, CH_4 or acid gas. The H_2S-rich methanol from the bottom of the Reabsorber is sent to the Methanol Regeneration System.

In the Methanol Regeneration system, a sequence of hot regeneration and distillation using low pressure steam is employed to remove remaining acid gases and recover the methanol solvent. The liquid feed streams to the system consist of the Reabsorber bottoms and the methanol-water phases from the Naphtha Extractor. Makeup methanol from the Methanol Synthesis unit is also fed to the Regeneration system to remove the excess water. The lean methanol solvent product is sent to the SNG Purification unit to remove the CO_2 in the SNG product prior to use as the solvent in the CO_2-H_2S Absorber. The offgas from the Methanol Regeneration system is the H_2S-rich acid gas stream which is sent to the ADIP section of the Sulfur Recovery unit. Water removed from the Regeneration system is pumped to the Wastewater Treating unit.

A propylene refrigeration system is provided within the unit. In addition to serving the primary Rectisol unit, the system also provides refrigeration for the SNG Purification unit.


13VL-0101
H2S PREWASH ABSORBER
13VL-0102
CO2-H2S ABSORBER
13ME-0102
PROPYLENE REFRIGERATION SYSTEM
13VL-0103
PREWASH FLASH VESSEL
13ME-0101
NAPHTHA EXTRACTOR
13E-0103
CWS 2
CWR 2
13C-0101
METHANOL FROM SNC PUR. & COMP. UNIT 23
13VL-0102
13P-0102A/B
13ME-0102
13VL-0101
RAW GAS FROM GAS COOLING UNIT 12
13E-0101
13E-0102
13P-0101A/B
13VL-0103
PURE GAS TO METHANATION UNIT 22
PURE GAS TO METHANOL SYNTHESIS UNIT 18, HYDROGEN PRODUCTION UNIT 25, AND PLANT FUEL GAS SYSTEM
CONDENSATE TO GAS LIQUOR SEPARATION UNIT 14
BFW 2
13ME-0101
NAPHTHA TO HYDROTREATING UNIT 16
13P-0103A/B
13P-0106



NOTES:

1. THIS DRAWING SHOWS ONE TRAIN OF A TWO TRAIN SECTION. CAPACITY OF EACH TRAIN IS 50% OF UNIT DESIGN.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY REPRESENTED.
3. THE FLOW QUANTITIES, TEMPERATURES AND PRESSURES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

DRAWN BY	R. WHITE
ENGINEER	C. C. ABATAY
PROJECT ENGINEER	W. O'BELMITO
PROJECT MANAGER	R. McCARTHY
APPROVED	R. LANG
DATE	JAN. 2-0-84

PROCESS FLOW DIAGRAM
RECTISOL
UNIT 13

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

SCALE	DRAWING NUMBER	REV
NONE	835704-13-4-101	1

003 3571310I

TABLE 6.2.7-1

MATERIAL BALANCE

RECTISOL - UNIT 13

Stream Number	13-1		13-2		13-3		13
Stream Name	Raw Gas from Gas Cooling		Pure Gas to Methanation		Pure Gas to MeOH Synthesis, PSA & Fuel Gas		CO_2-Ric Stm. Su
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/h
H_2	27,226.0	43.09	25,706.1	59.03	1,425.5	59.03	
N_2	142.7	0.23	135.3	0.31	7.4	0.31	
CO	7,474.0	11.83	7,062.1	16.18	393.2	16.18	
CH_4	6,830.5	10.81	7,695.0	17.63	425.6	17.63	20.
C_2H_6	181.0	0.29	96.0	0.22	3.6	0.22	53.
C_3H_8	36.2	0.06					4.
C_4H_{10}	9.0	0.01					
CO_2	21,063.8	33.34	2,893.8	6.63	161.5	6.63	9,953.
H_2S	217.6	0.34					0.
COS	3.6	0.01					0.
		100.00		100.00		100.00	
Dry Gas, lb-mol/hr	63,184.4	99.77	43,647.3	100.00	2,416.8	100.00	10,032.
H_2O vapor, lb-mol/hr	145.7	0.23	-0-	-0-	-0-	-0-	-0-
Wet Gas, lb-mol/hr	63,330.1	100.00	43,647.3	100.00	2,416.8	100.00	10,032.
Dry Gas, lb/hr	1,320,054		507,295		28,089		4
H_2O vapor, lb/hr	2,625		-		-		
H_2O liquid, lb/hr	-		-		-		
Naphtha, lb/hr	11,517		-		-		
Org. Sulfur, lb/hr	22		-		-		
TOTAL, lb/hr	1,334,218		507,295		28,089		4
Pressure, psia	405		360		360		
Temperature, °F	100		68		68		

NOTES: 1. Flow quantities, pressures, and temperatures shown are for the total
design purposes, and are not necessarily the conditions which will be a

2. CO_2, CH_4 and H_2O removed from SNG in Unit 23 also flow to the unit

TABLE 6.2.7-1

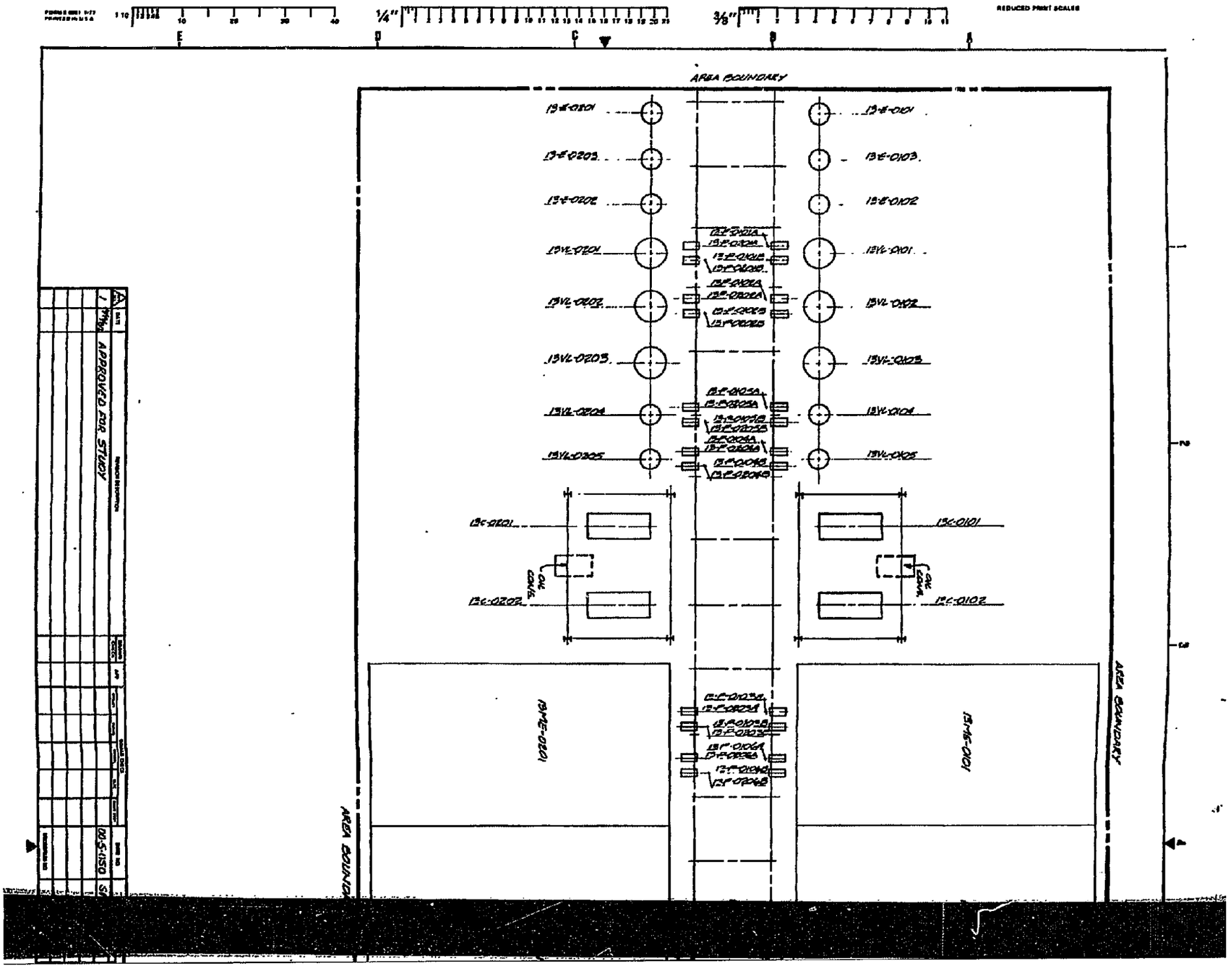
MATERIAL BALANCE

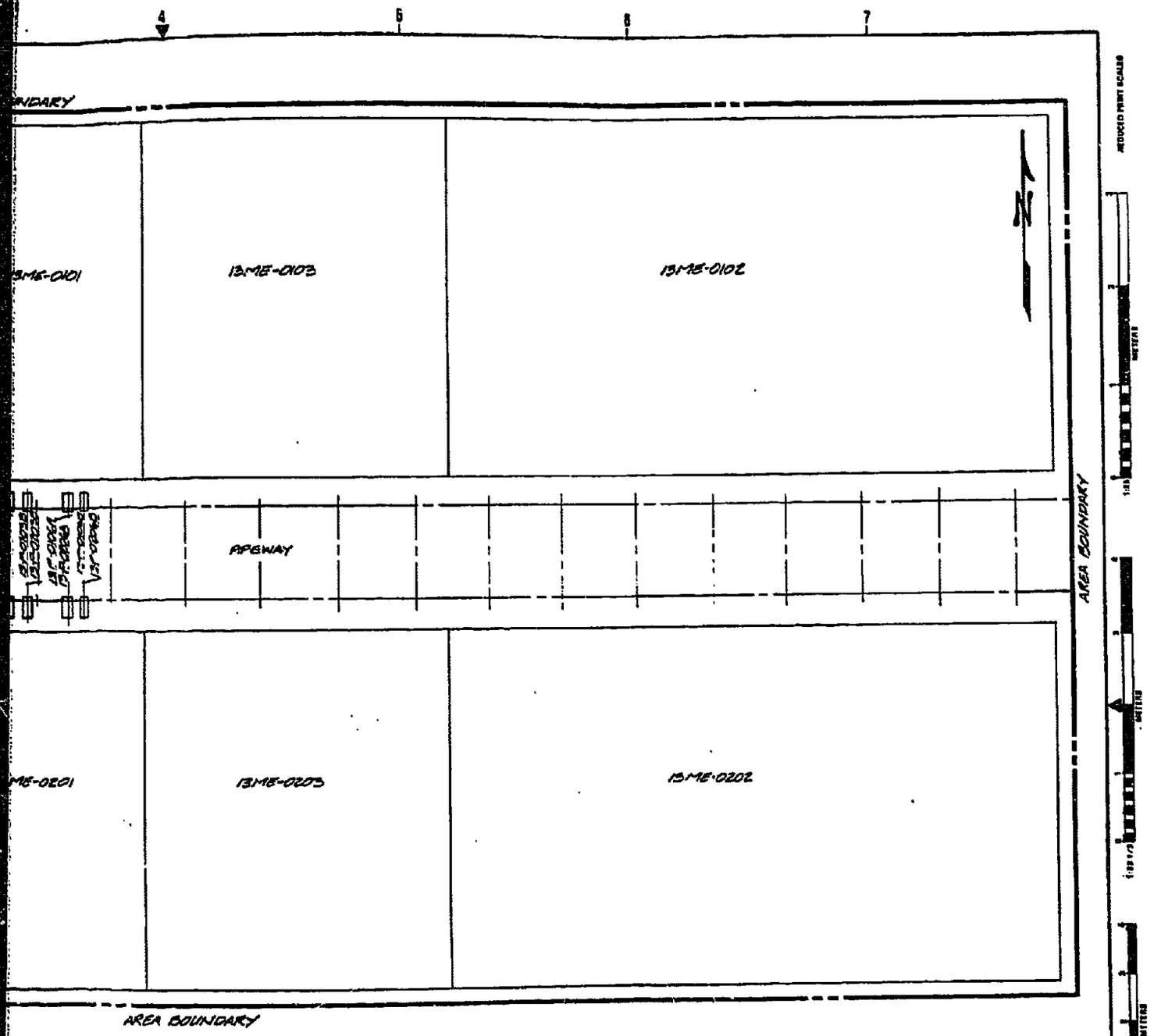
RECTISOL - UNIT 13

	13-3		13-4		13-5		13-6		13-7	13-8
to n	Pure Gas to MeOH Synthesis, PSA & Fuel Gas		CO_2-Rich Gas to Stm. Superheater		H_2S Lean Gas to Stretford		H_2S Rich Gas to ADIP		Gas Liquor to Gas Liq. Seper.	Naphtha to Nap. HT.
Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%		
9.03	1,425.5	59.03			35.4	0.38				
0.31	7.4	0.31								
6.18	393.2	16.18			18.7	0.20				
7.63	425.6	17.63	20.2	0.20	22.5	0.24				
0.22	3.6	0.22	53.2	0.53	27.8	0.30	0.4	0.05		
			4.5	0.05	21.2	0.23	10.5	1.18		
					1.8	0.02	7.2	0.81		
6.63	161.5	6.63	9,953.8	99.22	9,046.8	97.88	717.7	80.87		
			0.02	-	67.6	0.73	150.0	16.90		
			0.4	-	1.5	0.02	1.7	0.19		
0.00		100.00		100.00		100.00		100.00		
0.00	2,416.8	100.00	10,032.1	100.00	9,243.3	100.00	887.5	98.55		
-0-	-0-	-0-	-0-	-0-	-0-	-0-	13.1	1.45		
0.00	2,416.8	100.00	10,032.1	100.00	9,243.3	100.00	900.6	100.00		
5	28,089		440,224		403,382		37,696		-	-
	-		-		-		236		-	-
	-		-		-		-		2,327	-
	-		-		-		211		-	11,306
	-		-		-		-		-	21
5	28,089		440,224		403,382		38,143		2,327	11,327
0	360		25		23		25		230	40
8	68		100		75		80		56	113

eratures shown are for the total unit on a stream-day basis, are to be used solely for process rily the conditions which will be attained during actual operations.

G in Unit 23 also flow to the unit at the rate of 97,090 lb/hr.


AREA BOUNDARY
13E-0101
13E-0201
13E-0202
13E-0102
13VL-0101
13VL-0201
13VL-0202
13VL-0102
13VL-0203
13VL-0103
13VL-0204
13VL-0104
13VL-0205
13VL-0105
13C-0101
13C-0201
13C-0202
13C-0102
13ME-0201
13ME-0101
AREA BOUNDARY
APPROVED FOR STUDY



USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE

DRAWING NO	00-5-050	SITE #1 PLOT PLAN

FLUOR

DRAWN	KUWAHARA
DESIGNED	HUTTEN
CHECKED	T.CONTI
APPROVED	J.SMETS
PROJECT MGR	R.LANG

PLOT PLAN - UNIT 13
RECTISOL
CROW TRIBE OF INDIANS MONTANA

SCALE	1" = 20'-0"	835704-131-4-050

REVISION 1

TABLE 6.2.7-2

EQUIPMENT LIST

RECTISOL - UNIT 13

Item No.	Equipment Name	Number Required Oper.	Spare
13VL-0101	H_2S Prewash Absorber	2	0
13VL-0102	CO_2 - H_2S Absorber	2	0
13VL-0103	Prewash Flash Vessel	2	0
13VL-0104	Flash Regenerator	2	0
13VL-0105	Reabsorber	2	0
13E-0101	Crude/Pure Gas Exchanger	2	0
13E-0102	Crude Gas Refrigeration Cooler	2	0
13E-0103	Flash Gas Recompression After Cooler	2	0
13C-0101	Flash Gas Recompressor	2	0
13C-0102	CO_2-Rich Gas Compressor	2	0
13P-0101 A/B	Prewash Absorber Bottoms Pump	2	2
13P-0102 A/B	Absorber Bottoms Pump	2	2
13P-0103 A/B	Naphtha Pump	2	2
13P-0104 A/B	Reabsorber Bottoms Pump	2	2
13P-0105 A/B	Flash Regenerator Bottoms Pump	2	2
13P-0106 A/B	Solvent Pump	2	2
13ME-0101	Naphtha Extractor	2	0
13ME-0102	Refrigeration System	2	0
13ME-0103	Methanol Regeneration System	2	0

NOTE: Train No. 2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	13VL-0101	13VL-0201

6.2.8 GAS LIQUOR SEPARATION - UNIT 14

6.2.8.1 DESIGN BASIS

Purpose of Unit

The Gas Liquor Separation unit receives the process condensate (gas liquor) from Gasification, Gas Cooling and Rectisol units and separates the combined stream into a tar/oil fraction (hydrocarbon phase) and a gas liquor containing predominantly water, phenols and ammonia (aqueous phase). The tar/oil fraction is sent to the Tar Distillation unit and the gas liquor is fed to the Phenosolvan unit. The flash gas resulting from reducing the pressure of the feed liquor is sent to the Sulfur Recovery unit.

Scope of Unit

The unit includes cooling, expansion and physical separation of the gas liquor feed. The unit is licensed by Lurgi Mineraloltechnik of Germany.

General Design Criteria

All separator stages in the unit have multiple parallel vessels to yield from 50 to 100 percent spare capacity. In addition, the dusty gas liquor trains are designed as two 100 percent trains to allow for the frequent maintenance required on these trains. The unit onstream factor is compatible with the overall plant stream factor of 332 days per year. All the rotating equipment in the unit are motor driven.

6.2.8.1 (Continued)

Process Performance Objectives

The gas liquor effluent from the unit is expected to be essentially free of tar and oil.

Feedstock

Net Gas Liquor from Gas Cooling Unit:

H_2O	479,246 lb/hr	
Dissolved Gases	27,912 lb/hr	
Oils	25,265 lb/hr	
Phenols	3,414 lb/hr	
Ammonia	6,783 lb/hr	
Total Stream	543,944 lb/hr	
Battery Limit Conditions:	Temperature	233°F
	Pressure	225 psia

(Net) Dusty Gas Liquor from Gasification:

Total Stream	454,365 lb/hr	
Battery Limit Conditions:	Temperature	350°F
	Pressure	300 psia

Gas Liquor from Rectisol Unit:

H_2O	2,327 lb/hr	
HCN & Dry Gas	trace	
Battery Limit Conditions:	Temperature	56°F
	Pressure	225 psia

Products

Oils to Tar Distillation Unit:

Oils	25,265 lb/hr	
Battery Limit Conditions:	Temperature	104°F
	Pressure	90 psia

6.2.8.1 (Continued)

Gas Liquor to Phenosolvan Unit:

H_2O	935,766 lb/hr
Dissolved Gases	22,309 lb/hr
Phenols	3,414 lb/hr
Ammonia	6,783 lb/hr
Total Stream	969,596 lb/hr
Battery Limit Conditions: Temperature	95°F
Pressure	55 psia

Expansion Gas to Sulfur Recovery Unit:

Dry Gas	152.7 lb-mol/hr
H_2O	9.5 lb-mol/hr
Total Stream	5,775 lb/hr
Battery Limit Conditions: Temperature	135°F
Pressure	20 psia

Composition:

Component	Mol %
H_2	11.5
CO	5.6
CH_4	4.9
CO_2	76.0
H_2S	2.0

Utility Requirements

Electric Power	690 kW
Cooling water (ΔT = 30°F)	5,548 gpm

6.2.8.2 PROCESS DESCRIPTION

A simplified process flow diagram for this unit is shown on drawing No. 835704-14-4-101. The material balance (Table 6.2.8-1) and equipment list (Table 6.2.8-2) for the unit following the flow diagram.

Dusty gas liquor from the Coal Gasification unit is partially cooled in air coolers and depressurized to near atmospheric pressure. During the expansion process, dissolved gases (mostly CO_2 and some H_2S) are released from the dusty gas liquor, which subsequently flows to the primary tar separator. In the primary tar separator, entrained tar settles to the bottom of the vessel. A portion of the tar containing a significant amount of coal dust is withdrawn from the bottom of the separator and is continuously recycled to the Coal Gasification unit. Tar is also drawn from the upper portion of the hydrocarbon phase and is sent to the final gas liquor separator for recovery of entrained oil. A portion of the warm dusty gas liquor from the surge tank is recycled to the Coal Gasification unit and the Gas Cooling unit as crude gas quench and wash respectively.

The oily gas liquor stream condensed in the Gas Cooling unit is cooled to ambient temperature and mixed with the gas liquor from the Rectisol unit. This mixture is also depressurized to near atmospheric pressure to release dissolved gases. After the depressurization, the oily gas liquor is processed to separate the oil. The recovered oil is sent to storage before it is fed to the Tar Distillation unit. The de-oiled gas liquor then flows to a final separator where it is combined with the gas liquor from the dusty gas liquor separation.

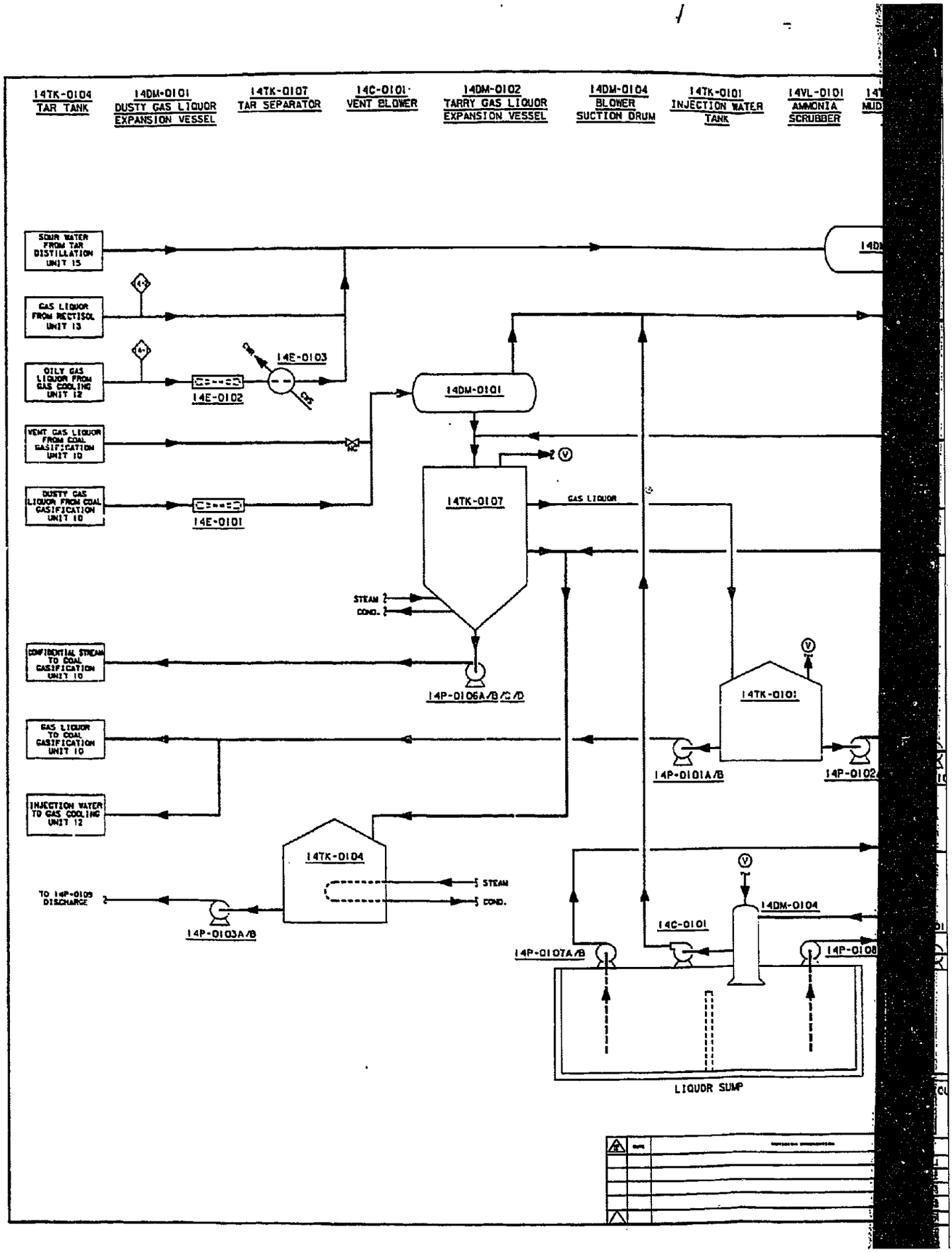
The final gas liquor separator handles the separation of the remaining dissolved oil and tar from the combined gas liquor. The processed gas liquor is sent to the final gas liquor surge tank. Gas liquor from this surge tank is pumped through a filter to remove remaining entrained tar or dust. After filtration, the gas liquor flows to the Phenosolvan unit.

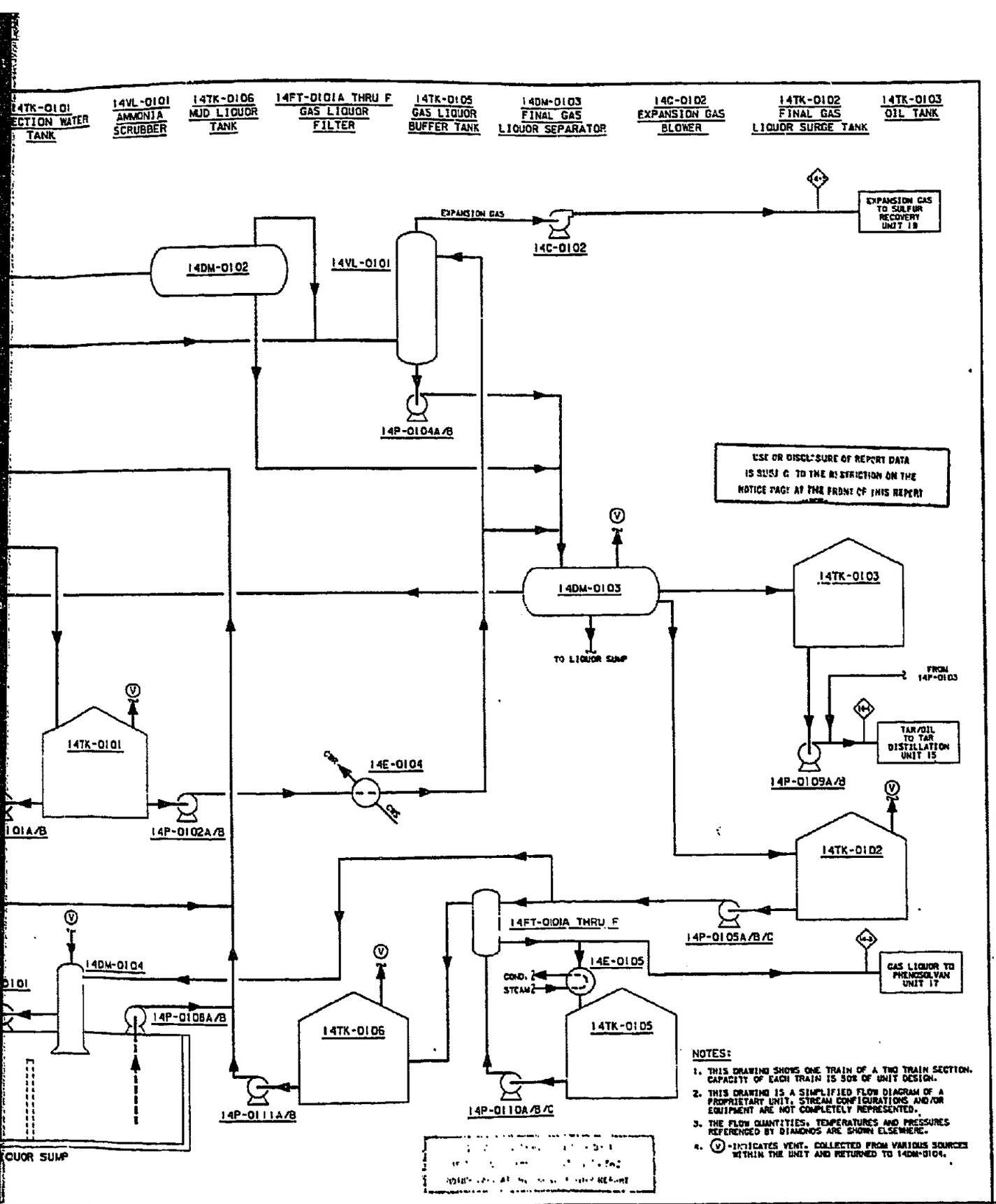
6.2.8.2 (Continued)

The filtration system contains an exchanger to heat the filter flush water. This water after flushing the filters is held in the mud liquor tank prior to recycle to the tar separator.

The unit also contains a liquor sump to receive process area drains and run-off which are fed to the tar separator.

The gas from the depressurizations and vents is collected throughout the unit and called expansion gas. The expansion gas is scrubbed with gas liquor to reduce its ammonia content and sent to the Stretford section of the Sulfur Recovery unit.


14TK-0104 TAR TANK
14DM-0101 DUSTY GAS LIQUOR EXPANSION VESSEL
14TK-0107 TAR SEPARATOR
14C-0101 VENT BLOWER
14DM-0102 TARRY GAS LIQUOR EXPANSION VESSEL
14DM-0104 BLOWER SUCTION DRUM
14TK-0101 INJECTION WATER TANK
14VL-0101 AMMONIA SCRUBBER
SOUR WATER FROM TAR DISTILLATION UNIT 15
GAS LIQUOR FROM RECTISOL UNIT 13
OILY GAS LIQUOR FROM GAS COOLING UNIT 12
VENT GAS LIQUOR FROM COAL GASIFICATION UNIT 10
DUSTY GAS LIQUOR FROM COAL GASIFICATION UNIT 10
14E-0103
14E-0102
14E-0101
14DM-0101
14TK-0107
GAS LIQUOR
STEAM
COND.
CONFIDENTIAL STREAM TO COAL GASIFICATION UNIT 10
14P-0106A/B/C/D
GAS LIQUOR TO COAL GASIFICATION UNIT 10
INJECTION WATER TO GAS COOLING UNIT 12
14TK-0104
TO 14P-0109 DISCHARGE
14P-0103A/B
14TK-0101
14P-0101A/B
14P-0102
14DM-0104
14C-0101
14P-0107A/B
14P-0108
LIQUOR SUMP



NOTES:

1. THIS DRAWING SHOWS ONE TRAIN OF A TWO TRAIN SECTION. CAPACITY OF EACH TRAIN IS 50% OF UNIT DESIGN.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY REPRESENTED.
3. THE FLOW QUANTITIES, TEMPERATURES AND PRESSURES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.
4. (V) INDICATES VENT, COLLECTED FROM VARIOUS SOURCES WITHIN THE UNIT AND RETURNED TO 14DM-0104.

FLUOR

P. WHITE
C. C. ABATAY
C. O'BELMITO
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
GAS LIQUOR SEPARATION
UNIT 14

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-14-4-101 | 1

003 3571410 1

TABLE 6.2.8-1

MATERIAL BALANCE

GAS LIQUOR SEPARATION - UNIT 14

Stream Number Stream Name	14-1 Oily Gas Liquor (2)	14-2 Gas Liquor from Rectisol	14-3 Gas Liquor to Phenosolvan	14-4 Tar/Oil to Tar Distillation	14-5 Expansion Gas to Stretford
H_2, lb/hr	36				36
CO, lb/hr	241				241
CH_4, lb/hr	119				119
CO_2, lb/hr	27,766		22,161		5,105
H_2S, lb/hr	250		148		102
H_2O, lb/hr	479,246	2,327	935,766		172
Tar/Oils, lb/hr	25,265		-	25,265	
Phenols, lb/hr	3,414		3,414		
Fatty Acids, lb/hr	1,139		1,139		
Ammonia, lb/hr	6,783		6,783		
HCl, lb/hr	185		185		
TOTAL, lb/hr	543,944	2,327	969,596	25,265	5,775
Pressure, psia	225	225	55	90	20
Temperature, °F	233	56	95	104	135

NOTES: (1) Flow quantities, pressures, and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.

(2) Represents net Gas Liquor flow from Gas Cooling unit to Gas Liquor Separation.

(3) Net inflow to the unit of Dusty Gas Liquor from Gasification unit equals 454,365 lb/hr, assumed to be all water.

TABLE 6.2.8-2

EQUIPMENT LIST

GAS LIQUOR SEPARATION - UNIT 14

Item No.	Equipment Name	Number Required Oper.	Spare
14TK-0101	Injection Water Tank	2	0
14TK-0102	Final Gas Liquor Surge Tank	2	0
14TK-0103	Oil Tank	2	0
14TK-0104	Tar Tank	4	0
14TK-0105	Gas Liquor Buffer Tank	2	0
14TK-0106	Mud Liquor Tank	2	0
14TK-0107	Tar Separator	4	0
14VL-0101	Ammonia Scrubber	2	0
14DM-0101	Dusty Gas Liquor Expansion Vessel	2	0
14DM-0102	Tarry Gas Liquor Expansion Vessel	2	0
14DM-0103	Final Gas Liquor Separator	4	0
14DM-0104	Blower Suction Drum	2	0
14E-0101	Dusty Gas Liquor Air Cooler	2	0
14E-0102	Oily Gas Liquor Air Cooler	2	0
14E-0103	Oily Gas Liquor Trim Cooler	2	0
14E-0104	Gas Liquor Final Cooler	2	0
14E-0105	Filter Flush Water Heater	2	0
14C-0101	Vent Blower	2	0
14C-0102	Expansion Gas Blower	2	0

TABLE 6.2.8-2 (Continued)

EQUIPMENT LIST

GAS LIQUOR SEPARATION - UNIT 14

Item No.	Equipment Name	Number Required Oper.	Spare
14P-0101 A/B	Injection Water Pump	2	2
14P-0102 A/B	Tarry Gas Liquor Pump	2	2
14P-0103 A/B	Tar Pump	2	2
14P-0104 A/B	Ammonia Scrubber Water Recycle Pump	2	2
14P-0105 A/B/C	Final Gas Liquor Pump	4	2
14P-0106 A/B/C/D	Dusty Tar Recycle Pump	4	4
14P-0107 A/B	Gas Liquor Sump Pump	2	2
14P-0108 A/B	Slurry Pump	2	2
14P-0109 A/B	Oil Pump	2	2
14P-0110 A/B/C	Filter Flushing Pump	4	2
14P-0111 A/B	Mud Liquor Pump	2	2
14FT-0101 A/B/C/ D/E/F/	Gas Liquor Filter	6	6

NOTE: (1) This is a Lurgi proprietary unit. Consequently, the above equipment list is not all-inclusive, although the estimated cost is for the complete unit.

(2) Train #2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	14TK-0101	14TK-0201

6.2.9 TAR DISTILLATION - UNIT 15

6.2.9.1 DESIGN BASIS

Purpose of Unit

Tar distillation unit receives the oil from Gas Liquor Separation unit and distills it into a heavy tar/oil fraction -- feedstock to the POX unit -- and a tar naphtha fraction which is sent to the Naphtha Hydrotreating unit.

Scope of Unit

The unit includes a distillation column and associated heat exchange including a small fired heater. The unit is licensed by Lurgi Mineraloltechnik.

General Design Criteria

The unit consists of two 50 percent trains. All rotating equipment in the unit are motor-driven and are spared to provide trouble-free operation of the unit. The unit onstream factor is compatible with the overall plant stream factor of 332 days per year.

Tankage for 14 days capacity feed storage is provided offplot.

Feedstock

Oils from Gas Liquor Separation Unit

Oils	25,265 Lbs/hr		
Battery Limit Conditions:		Temperature	104°F
		Pressure	85 psia

6.2.9.1 (Continued)

Products

Tar Naphtha to Naphtha Hydrotreating

Naphtha	5,053 lb/hr
Battery Limit Conditions: Temperature	158°F
Pressure	55 psia

Residue Tar/Oil to POX

Tar/Oil	20,212 lb/hr
Battery Limit Conditions: Temperature	329°F
Pressure	55 psia

Utility Requirements

Steam consumed (600 psig sat'd)	7,600 lb/hr
Steam consumed (60 psig sat'd)	7,250 lb/hr
Electric Power	190 kW
Cooling Water ($\Delta T = 30°F$)	240 GPM
Fuel Gas	12.2 MM Btu/hr

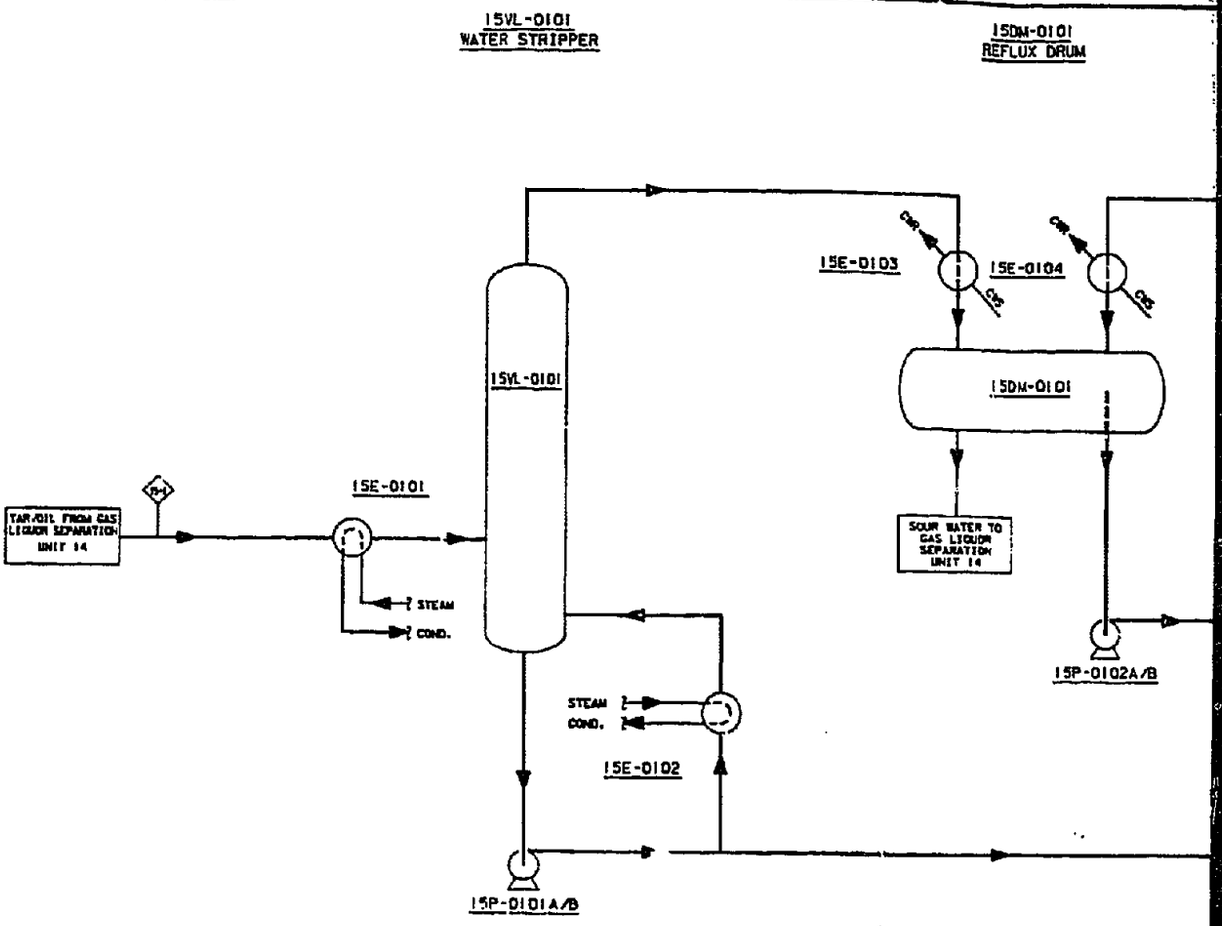
6.2.9.2 PROCESS DESCRIPTION

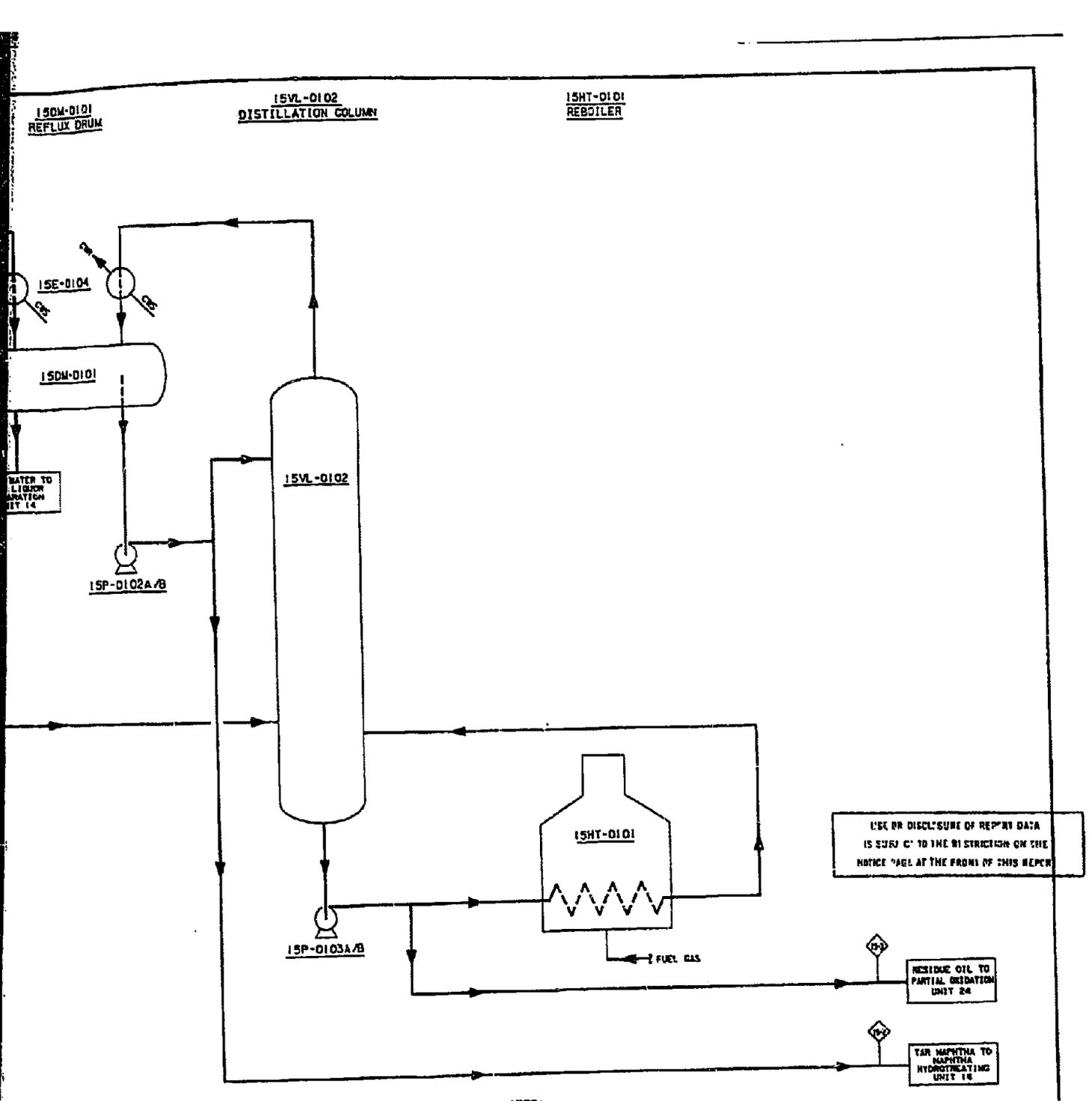
The process flow sketch for this unit is shown on drawing No. 835704-15-4-101. Material balance (Table 6.2.9-1), plot plan (Drawing No. 835704-15-4-050), and equipment list (Table 6.2.9-2) for the unit follow the flow sketch.

The tar and oil recovered in the Gas Liquor Separation unit are combined and processed first in a water stripper in the Tar Distillation unit. Dissolved water in the mixed feed is removed in the overhead of the stripper column and recycled back to the Gas Liquor Separation unit. The hydrocarbon stream from the bottom of the stripper is then pumped to the distillation column.

6.2.9.2 (Continued)

The oil mixture is fractionated into naphtha and oil residue in the distillation column. Naphtha is recovered in the overhead and then pumped to the Naphtha Hydrotreating unit. Residue oil from the bottom of the column is routed to the Partial Oxidation unit for gasification.


15VL-0101
WATER STRIPPER
15DM-0101
REFLUX DRUM
15E-0103
15E-0104
CWR
CWS
15VL-0101
15DM-0101
15E-0101
TAR/OIL FROM GAS LIQUOR SEPARATION UNIT 14
STEAM
COND.
SOUR WATER TO GAS LIQUOR SEPARATION UNIT 14
15P-0102A/B
STEAM
COND.
15E-0102
15P-0101A/B



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NOTES:

1. THIS DRAWING REPRESENTS ONE TRAIN OF A TWO TRAIN UNIT. CAPACITY OF EACH TRAIN IS 50% OF UNIT DESIGN.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY PRESENTED.
3. THE FLOW QUANTITIES, PRESSURES AND TEMPERATURES REPRESENTED BY DIAMONDS ARE SHOWN ELSEWHERE.

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FLUOR

R. WHITE
C. C. ARATAY
T. O'BELMITO
R. McCARTHY
D. LANG

PROCESS FLOW DIAGRAM
TAR DISTILLATION
UNIT 15

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-15-4-101 | 1

003 3571510I

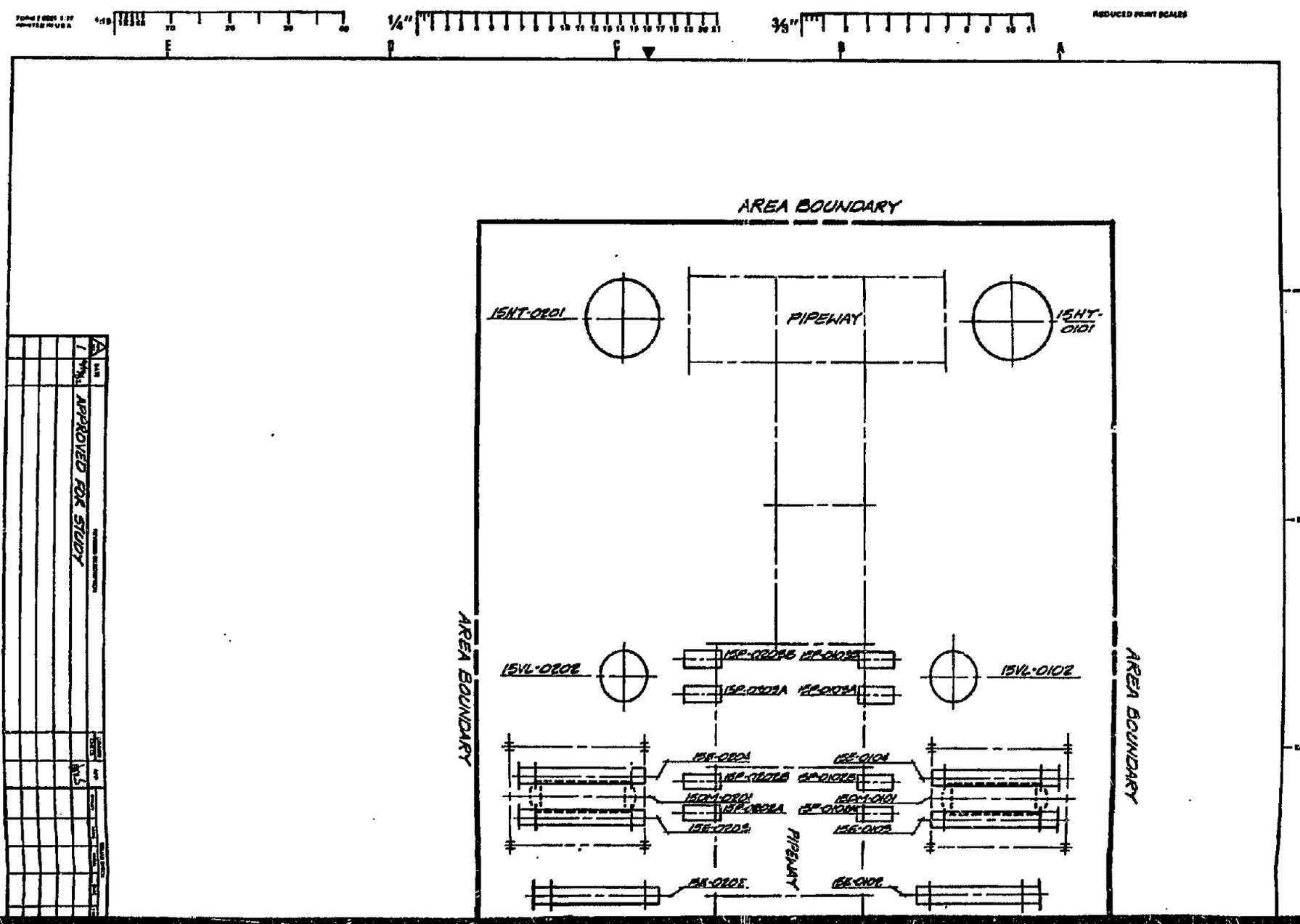
TABLE 6.2.9-1

MATERIAL BALANCE

TAR DISTILLATION - UNIT 15

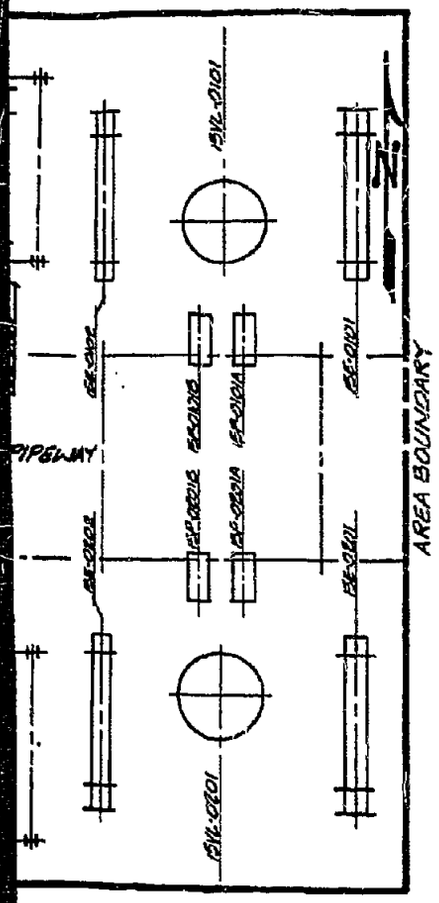
Stream Number Stream Name	15-1 Tar/Oil from Gas Liquor Separation	15-2 Tar Naphtha to Hydrotreating	15-3 Residue Oil to POX
Tar/Oils, lb/hr	25,265	-	20,212
Naphtha, lb/hr	-	5,053	-
TOTAL, lb/hr	25,265	5,053	20,212
Pressure, psia	85	55	55
Temperature, °F	104	158	329

NOTE: Flow quantities, pressures, and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.


AREA BOUNDARY
15HT-0201
PIPEWAY
15HT-0101
15VL-0202
15VL-0102
AREA BOUNDARY
AREA BOUNDARY
PIPEWAY
APPROVED FOR STUDY

4 5 6 7

USE OR DISCLOSURE OF REPORT DATA
IS SUBJECT TO THE RESTRICTION ON THE
TITLE PAGE AT THE FRONT OF THIS REPORT



0 5 10 20 30 40 50

REDUCED PRINT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS
AREA APPROXIMATE

DWG NO	REFERENCE DRAWING
00-A-050	SITE PLAN 1 PLOT PLAN

FLUOR

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DESIGNED BY	R.UMEKANA	
DRAWN BY	HUTTEN	
CHECKED BY	T.CONTI	
APPROVED BY	J.SHETS	
APPROVED BY	R.LANG	

PLOT PLAN-UNIT IE
TAR DISTILLATION
CROW TRIBE OF INDIANS MONTANA

SCALE	DRAWING NUMBER	REVISION
1"=10'-0"	835704-15-4-050	1

TABLE 6.2.9-2

EQUIPMENT LIST

TAR DISTILLATION - UNIT 15

Item No.	Equipment Name	Number Required Oper.	Spare
15VL-0101	Water Stripper	2	0
15VL-0102	Distillation Column	2	0
15DM-0101	Reflux Drum	2	0
15HT-0101	Reboiler	2	0
15E-0101	Feed Preheater	2	0
15E-0102	Stripper Reboiler	2	0
15E-0103	Stripper Condenser	2	0
15E-0104	Distillation Column Condenser	2	0
15P-0101 A/B	Stripper Bottoms Pump	2	2
15P-0102 A/B	Naphtha Pump	2	2
15P-0103 A/B	Distillation Column Reboiler Pump	2	2

NOTE: Train No. 2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	15VL-0101	15VL-0201

6.2.10 NAPHTHA HYDROTREATING - UNIT 16

6.2.10.1 DESIGN BASIS

Purpose of Unit

This unit hydrotreats Rectisol naphtha and tar naphtha for sulfur, nitrogen, and oxygen removal and also eliminates the gum forming tendency by hydrogenating the unsaturated hydrocarbons present in the feed. The hydrogen required is obtained from the PSA Hydrogen Production unit. The sour offgases from the hydrotreating unit flow to the Stretford Sulfur Recovery unit.

Scope of Unit

The unit encompasses hydrogenation of the feed naphtha and separation of the treated naphtha from the sour water containing undesirable reaction products. The unit is licensed by Lurgi Mineraloltechnik.

General Design Criteria

The naphtha hydrotreating unit consists of one 100 percent train. The unit stream factor is compatible with the overall plant stream factor of 332 days per year. All rotating equipment in the unit are motor driven.

Tankage for 14 days capacity feed storage is provided offplot.

Feedstock

Rectisol Naphtha

Feed Rate	11,327 lb/hr	
Battery Limit Conditions:	Temperature	113°F
	Pressure	35 psia

6.2.10.1 (Continued)

Tar Naphtha

Feed Rate	5,053 lb/hr
Battery Limit Conditions:	Temperature 158°F
	Pressure 50 psia

H_2 from PSA

Feed Rate	105.5 lb-mol/hr
	or 226 lb/hr
Composition:	99.5% H_2
	0.5% N_2
Battery Limit Conditions:	Temperature 380°F
	Pressure 890 psia

Products

Hydrotreated (Aromatic) Naphtha Product

Production Rate	16,348 lb/hr or 1,351 BPSD
Battery Limit Conditions:	Temperature 108°F
	Pressure 50 psia

Sour Gas to Sulfur Recovery Unit

Flow Rate	13.8 lb-mol/hr
	or 223 lb/hr
Battery Limit Conditions:	Temperature 100°F
	Pressure 25 psia

6.2.10.1 (Continued)

Composition:

Component	Mol %
H_2	47.1
N_2	11.6
CO	0.7
CH_4	15.9
C_2	7.3
C_3	4.4
C_4	2.9
CO_2	0.7
H_2S	9.4

Utility Requirements

Steam consumed (600 psig sat'd)		10,200 lb/hr
Steam consumed (60 psig sat'd)		34,800 lb/hr
Electric Power		190 kW
Cooling Water (ΔT = 30°F)		206 GPM
Fuel Gas (Intermittent only)		1.4 MM Btu/hr
Catalyst Requirements:	Initial	38,900 lb
	Annual	13,000 lb

6.2.10.2 PROCESS DESCRIPTION

Process flow for the Naphtha Hydrotreating unit is shown on drawing No. 835704-16-4-101. The material balance (Table 6.2.10-1), plot plant (Drawing No. 835704-16-4-050), and equipment list (Table 6.2.10-2) for the unit follow.

Naphtha recovered from the Rectisol and Tar Distillation Units is collected and combined in a day tank within the Naphtha Hydrotreating unit. The mixed naphtha feed is passed through a filter and then vaporized in a steam heated exchanger. The naphtha combines with the makeup and

6.2.10.2 (Continued)

recycle hydrogen. Pure makeup hydrogen (99.5%) flows from the PSA Hydrogen Production unit to replenish the hydrogen consumed in the hydrotreating reaction. Makeup hydrogen is precooled, filtered and added to the naphtha feed along with the recycle hydrogen.

The combined charge of naphtha vapor and hydrogen is preheated by the feed/effluent exchanger and then fed to the hydrotreating reactor. The reaction of sulfur and nitrogen compounds, and olefins with hydrogen occur over a bed of catalyst. The hydrogenation reaction results in evolution of heat (exothermic reaction).

The reactor effluent is cooled by heat exchange with the feed and then with the hydrogen recycle stream. A gas liquor stream from the Ammonia Recovery unit is mixed with the cooled effluent before cooling in air coolers. Any of the ammonia produced in the reaction of nitrogen with hydrogen is washed out in these coolers. The combined stream is collected in a horizontal drum for phase separation.

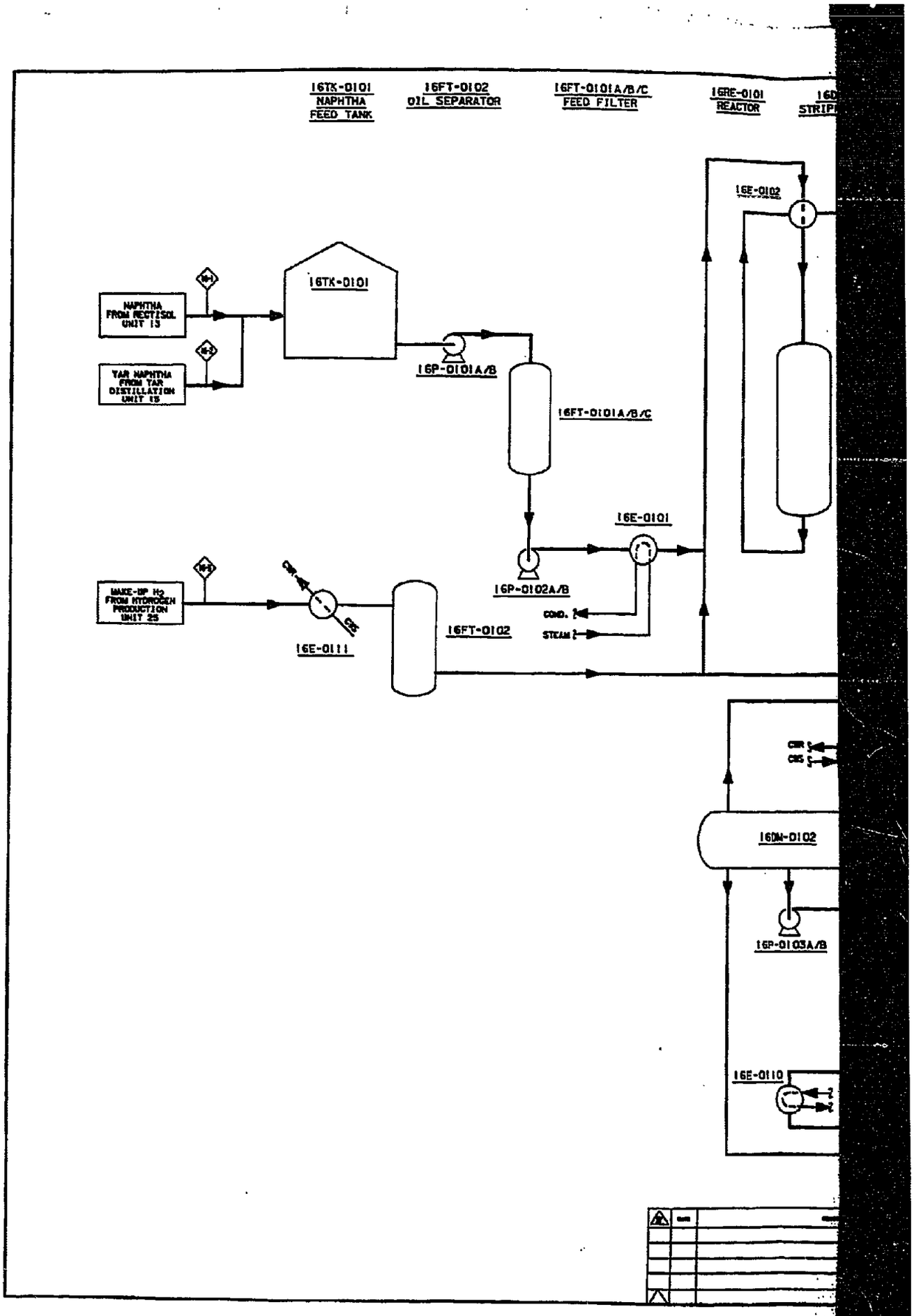
The main portion of the hydrogen-rich vapor phase is preheated using steam, compressed, and then heated by the reactor effluent before recycle to the reactor. A purge stream of vapor from the separator is used to control the concentration of hydrogen in the recycle.

The hydrocarbon phase from the separator is stripped of any remaining dissolved gases in a steam reboiled stripper column. Hydrotreated naphtha product is withdrawn from the bottom of the stripper, cooled by preheating the feed to the column and by cooling water, and then piped to tank farm for sale.

The offgas released from the stripper overhead-condensate is combined with the purge stream from the separator and sent to the Stretford section of the Sulfur Recovery unit.

6.2.10.2 (Continued)

A sour water stream, containing primarily ammonia, from the separator and the stripper overhead accumulator is sent to the Phenosolvan unit.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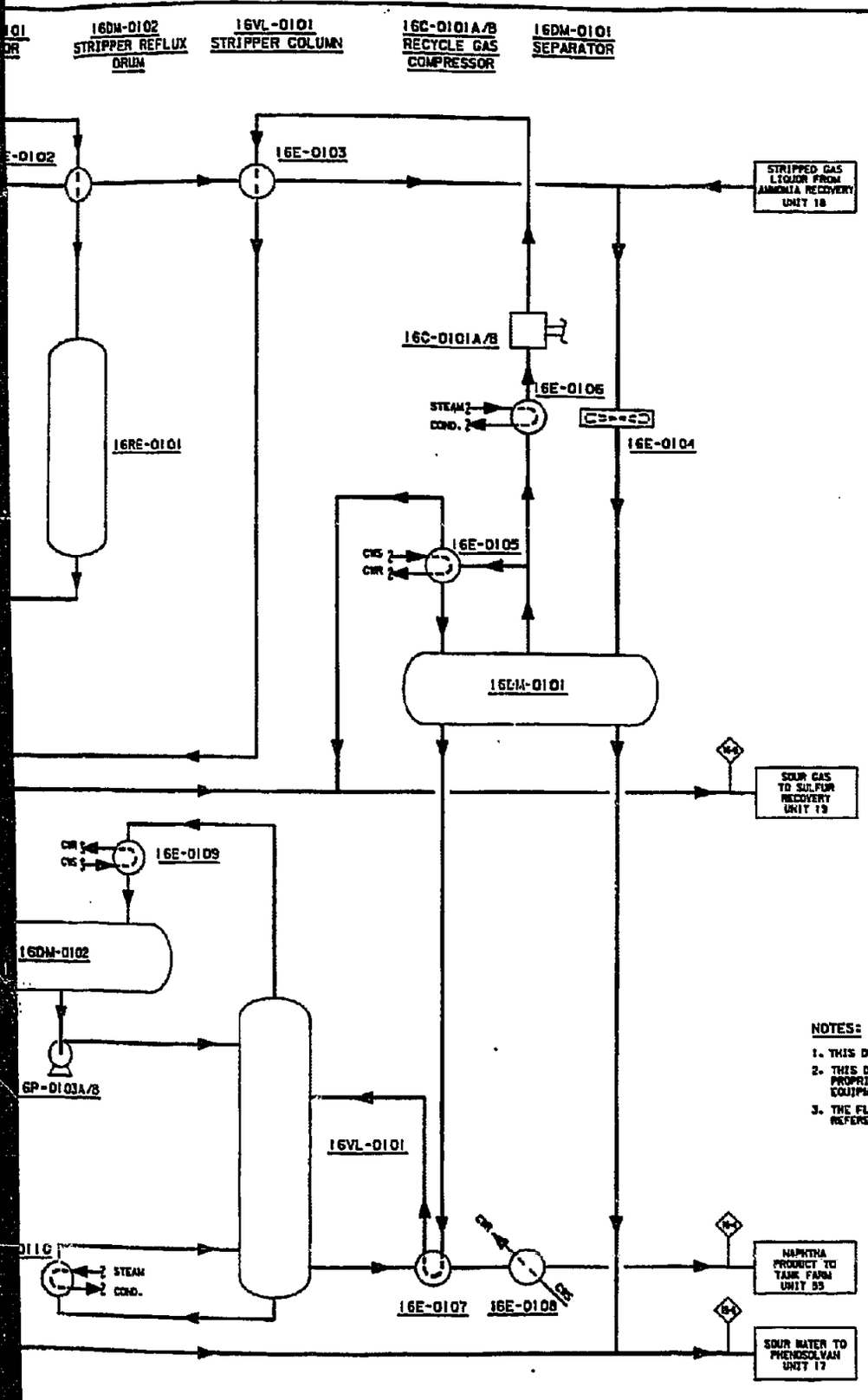
NAPHTHA FEED TANK
16FT-0102
OIL SEPARATOR
16FT-0101A/B/C
FEED FILTER
16RE-0101
REACTOR
16E-0102
NAPHTHA FROM RECTISOL UNIT 15
TAR NAPHTHA FROM TAR DISTILLATION UNIT 15
16TK-0101
16P-0101A/B
16FT-0101A/B/C
16E-0101
16P-0102A/B
COND.
STEAM
MAKE-UP H2 FROM HYDROGEN PRODUCTION UNIT 25
16E-0111
16FT-0102
16DM-0102
16P-0103A/B
16E-0110



NOTES:

1. THIS DRAWING REPRESENTS A SINGLE TRAIN UNIT.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY REPRESENTED.
3. THE FLOW QUANTITIES, TEMPERATURES AND PRESSURES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

R.WHITE
C.C. ABATAY
W.O'BELMITO
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
NAPHTHA HYDROTREATING
UNIT 16

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 635704-16-4-101 | 1

003 3371610I

TABLE 6.2.10-1

MATERIAL BALANCE

NAPHTHA HYDROTREATING UNIT 16

Stream Number	16-1	16-2	16-3	16
Stream Name	Naphtha from Rectisol	Tar Naphtha from Tar Dist.	Make-up Hydrogen	Nap Pro
Component			lb-mol/hr Mol%	
H_2			105.0 99.50	
N_2			0.5 0.50	
CO				
CH_4				
C_2H_6				
C_3H_8				
C_4H_{10}				
CO_2				
H_2S				
Dry Gas, lb.mol/hr			105.5 100.00	
H_2O Vapor, lb.mol/hr			- -0-	
Wet Gas, lb.mol/hr			105.5 100.00	
Dry Gas, lb/hr	-	-	226	-
H_2O Vapor, lb/hr	-	-	-	-
H_2O Liquid, lb/hr	-	-	-	-
Naphtha, lb/hr	11,306	5,053	-	16,3
Org. Sulfur, lb/hr	21	-	-	-
TOTAL, lb/hr	11,327	5,053	226	16,3
Pressure, psia	35	50	890	
Temperature, °F	113	158	380	1

NOTES:
1. Flow quantities, pressures, and temperatures shown are on a stream-day basis, are and are not necessarily the conditions which will be attained during actual operatio
2. A slipstream of stripped gas liquor from Ammonia Recovery unit flows to this unit a

TABLE 6.2.10-1

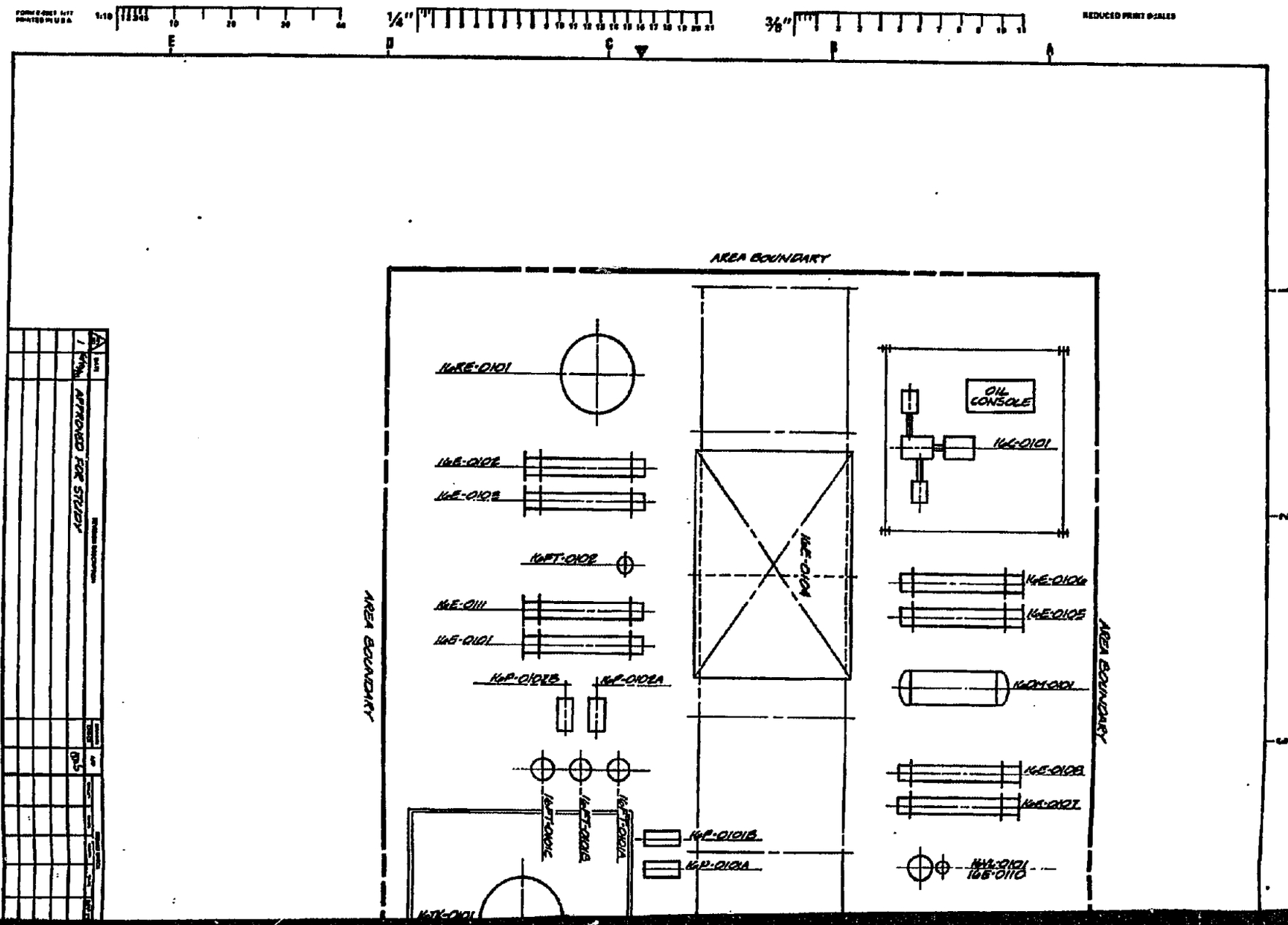
MATERIAL BALANCE

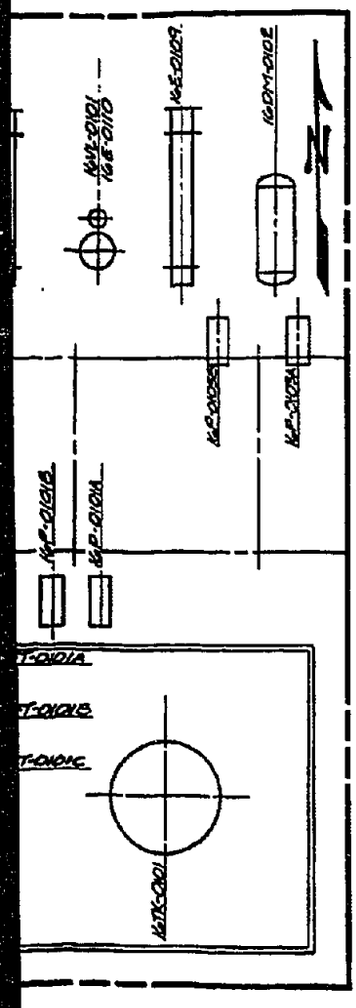
NAPHTHA HYDROTREATING UNIT 16

16-2 Tar Naphtha from Tar Dist.	16-3 Make-up Hydrogen		16-4 Naphtha Product	16-5 Sour Gas to Stretford		16-6 Sour Water to Phenosolvan
	lb-mol/hr	Mol%		lb-mol/hr	Mol%	
	105.0	99.50		6.5	47.10	
	0.5	0.50		1.6	11.60	
				0.1	0.72	
				2.2	15.94	
				1.0	7.25	
				0.6	4.35	
				0.4	2.90	
				0.1	0.72	
				1.3	9.42	
	105.5	100.00		13.8	100.00	
	-	-0-		-	-0-	
	105.5	100.00		13.8	100.00	
-	226		-	223		-
-	-		-	-		-
-	-		-	-		1,750
5,053	-		16,348	-		-
-	-		-	-		-
5,053	226		16,348	223		1,750
50	890		50	25		75
158	380		108	100		100

d temperatures shown are on a stream-day basis, are to be used solely for process design purposes, nditions which will be attained during actual operations.

quor from Ammonia Recovery unit flows to this unit at the rate of 1,715 lb/hr.


AREA BOUNDARY
AREA BOUNDARY
AREA BOUNDARY
OIL CONSOLE
APPROVED FOR STUDY
1/4"
3/8"
REDUCED PRINT SCALES



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REDUCED PRINT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE

DWG NO	00-5-050	SITE PLOT PLAN	
DRAWN	R. UYEKAWA	PLOT PLAN - UNIT 16 NAPHTHA HYDROTREATING	
DESIGNED	HUTTEN		
CHECKED	T. CONTI		
APPROVED	J. SHETS	CROW TRIBE OF INDIANS	MONTANA
PROJ. ENGR.	R. IANS	SCALE 1" = 10'-0"	835704-16-4-050

FLUOR

TABLE 6.2.10-2

EQUIPMENT LIST

NAPHTHA HYDROTREATING - UNIT 16

Item No.	Equipment Name	Number Required Oper.	Spare
16TK-0101	Naphtha Feed Tank	1	0
16VL-0101	Stripper Column	1	0
16DM-0101	Separator	1	0
16DM-0102	Stripper Reflux Drum	1	0
16RE-0101	Hydrogenation Reactor	1	0
16E-0101	Vaporizer	1	0
16E-0102	Reactor Feed-Effluent Exchanger	1	0
16E-0103	Recycle Hydrogen Heater	1	0
16E-0104	Reactor Product Air Cooler	1	0
16E-0105	Purge Gas Cooler	1	0
16E-0106	Recycle Hydrogen Cooler	1	0
16E-0107	Stripper Feed Preheater	1	0
16E-0108	Naphtha Product Cooler	1	0
16E-0109	Stripper Overhead Condenser	1	0
16E-0110	Stripper Reboiler	1	0
16E-0111	Makeup Hydrogen Cooler	1	0
16C-0101 A/B	Recycle Gas Compressor	1	1
16P-0101 A/B	Feed Booster Pump	1	1
16P-0102 A/B	Feed Pump	1	1
16P-0103 A/B	Stripper Reflux Pump	1	1
16FT-0101 A/B/C	Feed Filter	2	1
16FT-0102	Oil Separator	1	0

6.2.11 PHENOSOLVAN - UNIT 17

6.2.11.1 DESIGN BASIS

Purpose of Unit

The purpose of this unit is to recover the phenols in the gas liquor from the Gas Liquor Separation unit. The phenols are fed to the Partial Oxidation unit while the remaining liquor is sent to the Ammonia Recovery unit.

Scope of Unit

The unit includes facilities for gas liquor filtration, solvent extraction of phenols, and regeneration of the isopropylether (IPE) solvent. The unit is licensed by Lurgi Mineraloltechnik of Germany.

General Design Criteria

The unit consists of two operating trains. The unit is designed for 115 percent of normal flow. Additionally, critical rotating equipment are spared. The design is based on the overall plant stream factor of 332 days per year.

The solvent distillation column can be turned down to 25 percent of gas load, while the turn-down capability for the scrubbers and strippers is 60 percent of gas load.

Three-day surge storage of gas liquor feed is provided within the unit.

6.2.11.1 (Continued)

Process Performance Objectives

The unit is designed to recover approximately 91 percent of the phenols in the feed liquor. The gas liquor leaving the unit is expected to contain no more than 600 ppm weight phenols.

Feedstock

Gas Liquor (including condensate from Naphtha Hydrotreating and Sulfur Recovery units)

Feed Rate	974,479 lb/hr	
H_2O in Feed	940,649 lb/hr	
Phenols in Feed	3,414 lb/hr	
Battery Limit Conditions:	Temperature	95°F
	Pressure	55 psia

Stripping Steam

Feed Rate	2,400 lb/hr
Battery Limit Conditions:	60 psig sat'd

Products

Phenols to POX

Flow Rate	3,275 lb/hr	
Phenols	95% by wt.	
Battery Limit Conditions:	Temperature	180 to 285°F
	Pressure	72 psia

Gas Liquor to Ammonia Recovery

Flow Rate	973,604 lb/hr	
Phenols	600 ppm by wt.	
Battery Limit Conditions:	Temperature	120°F
	Pressure	100 psia

6.2.11.1 (Continued)

Utility Requirements

Steam consumed (600 psig sat'd)	3,400 lb/hr
Steam consumed (100 psig sat'd)	5,700 lb/hr
Steam consumed (60 psig sat'd)	54,100 lb/hr
Electric Power	670 kW
Cooling Water ($\Delta T = 30°F$)	779 gpm
IPE Solvent Makeup Required	318,794 lb/year

6.2.11.2 PROCESS DESCRIPTION

The process flow for the Phenosolvan unit is shown on Drawing No. 835704-17-R-101, and the unit material balance and equipment list follow (Tables 6.2.11-1 and 6.2.11-2). The plot plan is shown on Drawing No. 835704-17-4-050.

Gas liquor from Gas Liquor Separation, the major feed stream to the unit, is combined with sour water from the Naphtha Hydrotreating and Sulfur Recovery units. The stream is used as scrubbing liquid in the saturator column for the mixed vent streams collected in the unit. The gas liquor withdrawn from the bottom of the saturator is then brought into contact with the isopropylether (IPE) solvent in a multistage countercurrent extractor.

The phenol-free gas liquor stream from the extractor (raffinate) flows to the raffinate after-settler for separation of entrained solvent. The raffinate is pumped to the Ammonia Recovery unit for further processing.

The phenol-rich solvent flows by gravity from the extractor to the extract settler. The solvent-phenol slop layer is separated and collected in a slops receiver.

6.2.11.2 (Continued)

The upper solvent-phenol layer from the extract settler, with a small solvent makeup, overflows to the extract receiver. The extract is distilled in the steam reboiled solvent regenerator.

The solvent recovered from the overhead of the regenerator is condensed and collected in the overhead settler. A slop layer is separated and sent to the slops receiver. From the settler, the solvent overflows to the overhead receiver. Part of the regenerated solvent is refluxed to the regenerator and the rest is recycled to the extractor.

The solvent-phenol mixture leaving the bottom of the regenerator flows into a surge drum below the column. A water-phenol stream withdrawn from the bottom of two scrubber columns is also collected in the surge drum.

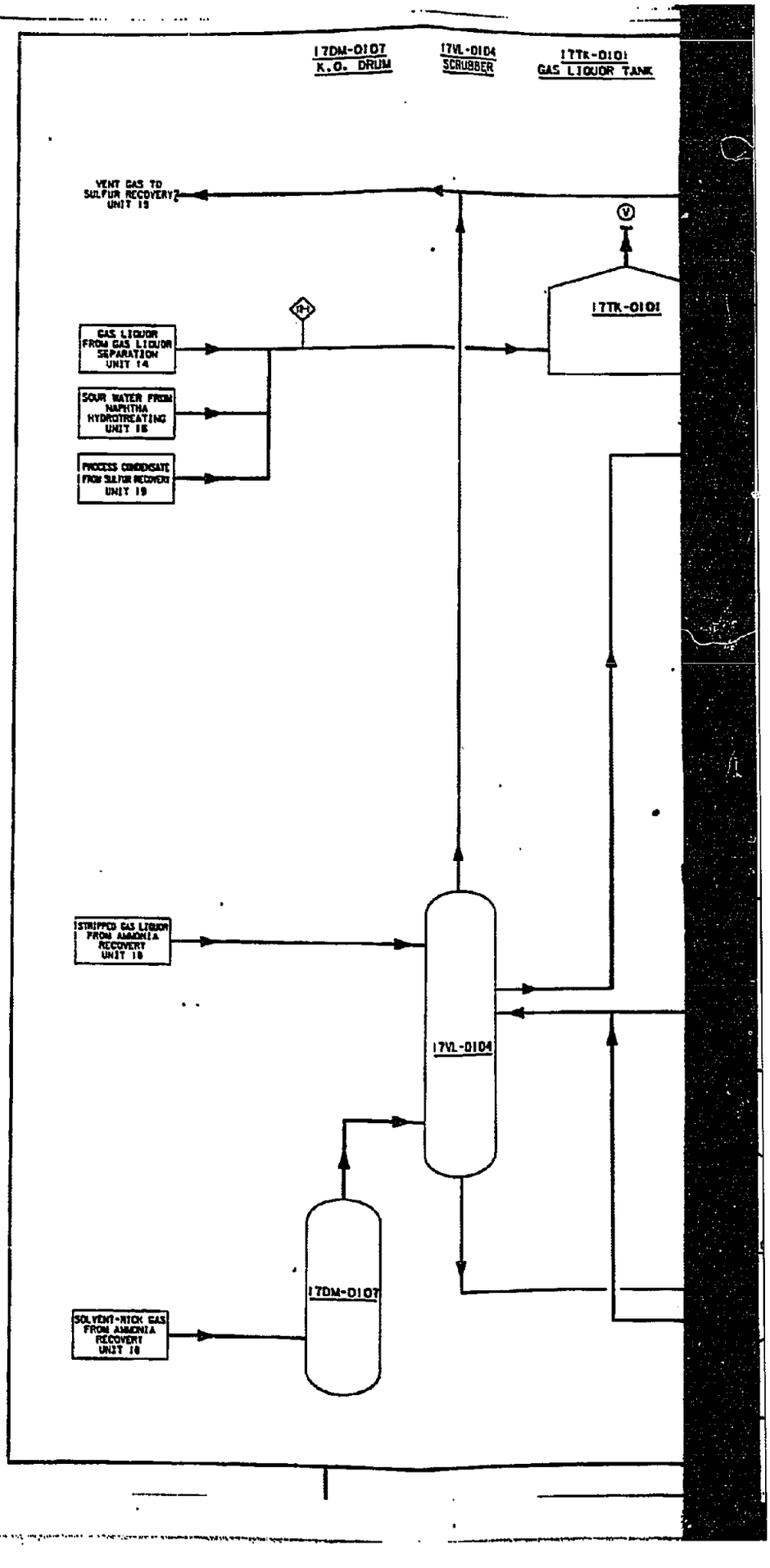
One column scrubs the solvent-rich gas coming from the solvent stripper in the Ammonia Recovery unit. A stripped gas liquor stream from the same unit and crude phenol are used for scrubbing. The offgas, scrubbed of the solvent, is vented from the overhead into the gas line from the saturator. The mixed gas is sent to the Stretford section of the Sulfur Recovery unit. The gas liquor is withdrawn as a column side draw and fed into the bottom section of the saturator.

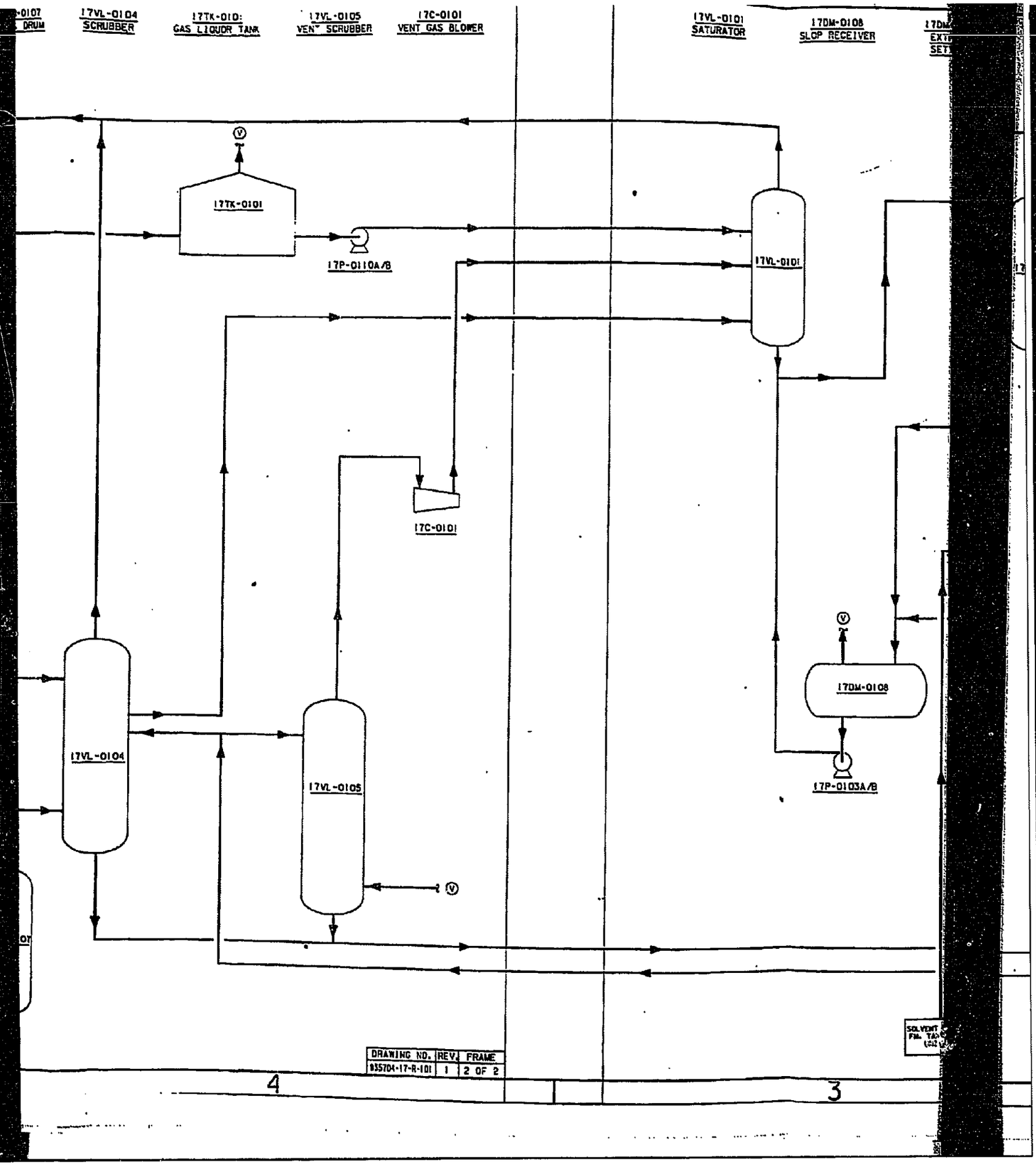
The second scrubber column is used to wash the mixed vent streams collected in this unit, with crude phenol. The offgas from the column is compressed and fed to the saturator.

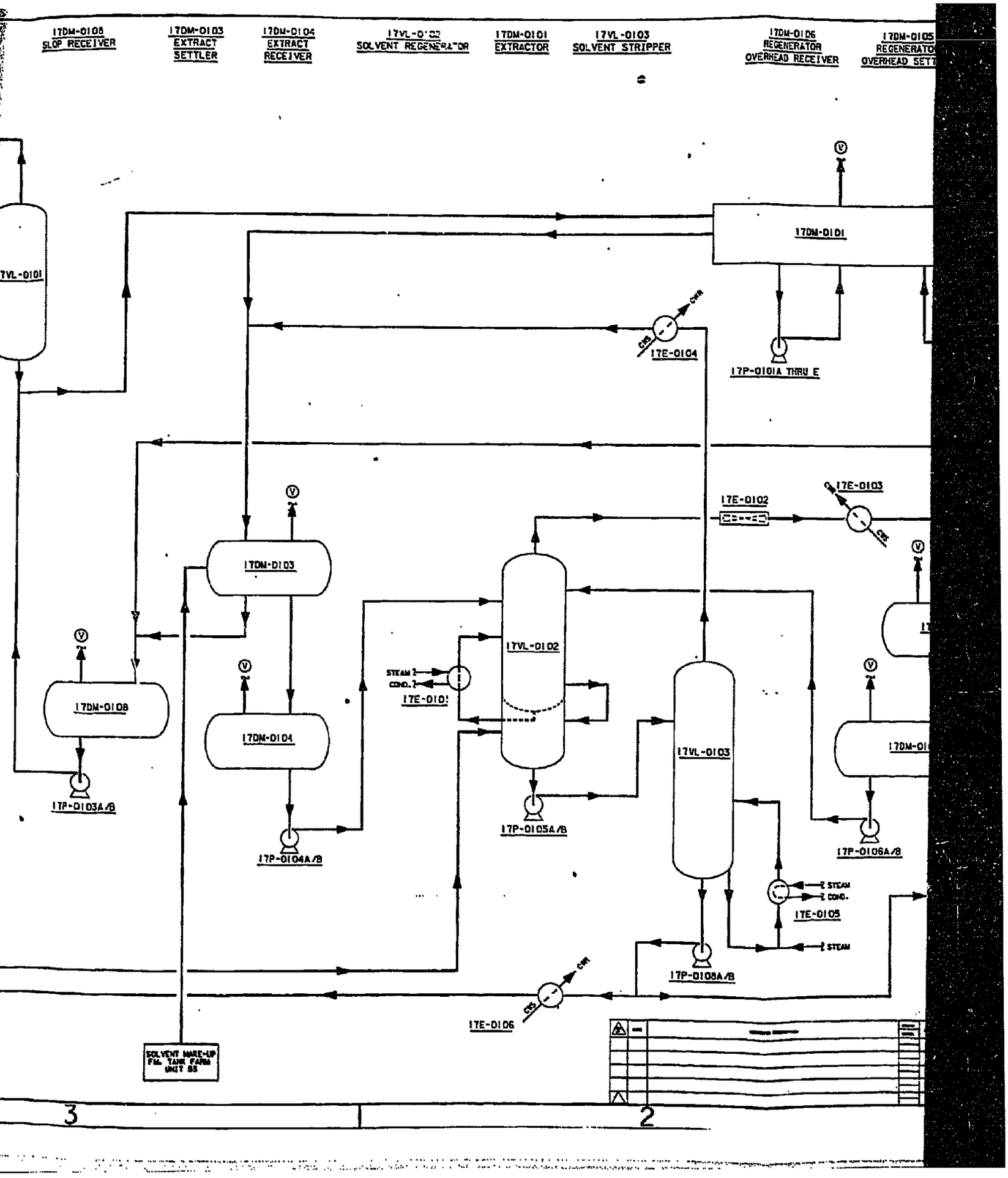
The mixed water-solvent-phenol in the surge drum is then pumped into a steam-reboiled stripper to strip entrained solvent. The stripped solvent, with some water and phenol, is condensed and injected into the extract stream flowing into the extract settler.

6.2.11.2 (Continued)

The main portion of the crude phenol withdrawn from the bottom of the stripper is cooled and used as scrubbing liquid for the solvent-rich gas and the unit vent gas scrubbers. The remaining portion flows to the crude phenol rundown drum and to a storage tank. From the storage tank, the crude phenol is fed to the Partial Oxidation unit with the residue oil from Tar Distillation unit.


17DM-0107
K.O. DRUM
17VL-0104
SCRUBBER
17TK-0101
GAS LIQUOR TANK
VENT GAS TO SULFUR RECOVERY UNIT 19
17TK-0101
GAS LIQUOR FROM GAS LIQUOR SEPARATION UNIT 14
SOUR WATER FROM NAPHTHA HYDROTREATING UNIT 16
PROCESS CONDENSATE FROM SULFUR RECOVERY UNIT 19
STRIPPED GAS LIQUOR FROM AMMONIA RECOVERY UNIT 18
17VL-0104
17DM-0107
SOLVENT-RICH GAS FROM AMMONIA RECOVERY UNIT 18


-0107
DRUM
17VL-0104
SCRUBBER
17TK-0101
GAS LIQUOR TANK
17VL-0105
VENT SCRUBBER
17C-0101
VENT GAS BLOWER
17VL-0101
SATURATOR
17DM-0108
SLOP RECEIVER
17TK-0101
17P-0110A/B
17VL-0101
17C-0101
17DM-0108
17VL-0104
17VL-0105
17P-0103A/B
DRAWING NO.
REV.
FRAME
835704-17-R-101
1
2 OF 2
4
3


17DM-0108 SLOP RECEIVER
17DM-0103 EXTRACT SETTLER
17DM-0104 EXTRACT RECEIVER
17VL-0102 SOLVENT REGENERATOR
17DM-0101 EXTRACTOR
17VL-0103 SOLVENT STRIPPER
17DM-0106 REGENERATOR OVERHEAD RECEIVER
17DM-0105 REGENERATOR OVERHEAD SETT
17VL-0101
17DM-0101
17E-0104
CWR
CWS
17P-0101A THRU E
17E-0103
17E-0102
17DM-0103
17VL-0102
STEAM
COND.
17E-0101
17DM-0108
17DM-0104
17VL-0103
17P-0103A/B
17P-0104A/B
17P-0105A/B
17P-0106A/B
17DM-01
STEAM
COND.
17E-0105
17P-0108A/B
17E-0106
SOLVENT MAKE-UP FM. TANK FARM UNIT 55
3
2

17VL-0103
SOLVENT STRIPPER

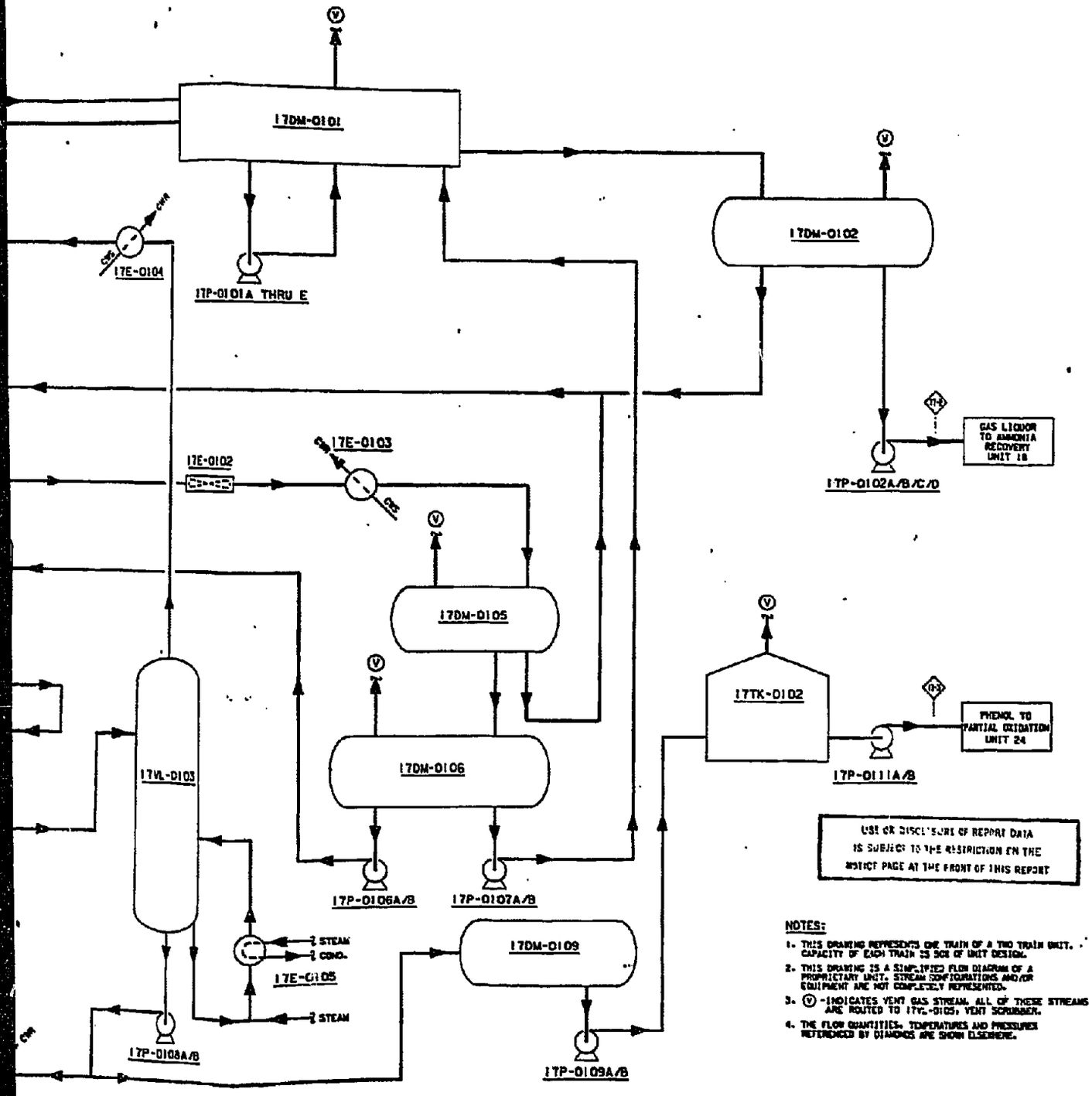
17DM-0106
REGENERATOR
OVERHEAD RECEIVER

17DM-0105
REGENERATOR
OVERHEAD SETTLER

17DM-0109
CRUDE PHENOL
RUNDOWN DRUM

17TK-0102
PHENOLS TANK

17DM-0102
RAFFINATE
AFTER-SETTLER



USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

NOTES:

1. THIS DRAWING REPRESENTS ONE TRAIN OF A TWO TRAIN UNIT. CAPACITY OF EACH TRAIN IS 50% OF UNIT DESIGN.
2. THIS DRAWING IS A SIMPLIFIED FLOW DIAGRAM OF A PROPRIETARY UNIT. STREAM CONFIGURATIONS AND/OR EQUIPMENT ARE NOT COMPLETELY REPRESENTED.
3. Ⓥ -INDICATES VENT GAS STREAM. ALL OF THESE STREAMS ARE ROUTED TO 17VL-0103, VENT SCRUBBER.
4. THE FLOW QUANTITIES, TEMPERATURES AND PRESSURES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

R. WHITE
C. C. ABATAY
M. O'BEIRNE
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
PHENOSOLVAN
UNIT 17

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE

835704-17-R-101

MICROFILM FRAME NO. 1 OF 2

1

003 3511710I

2

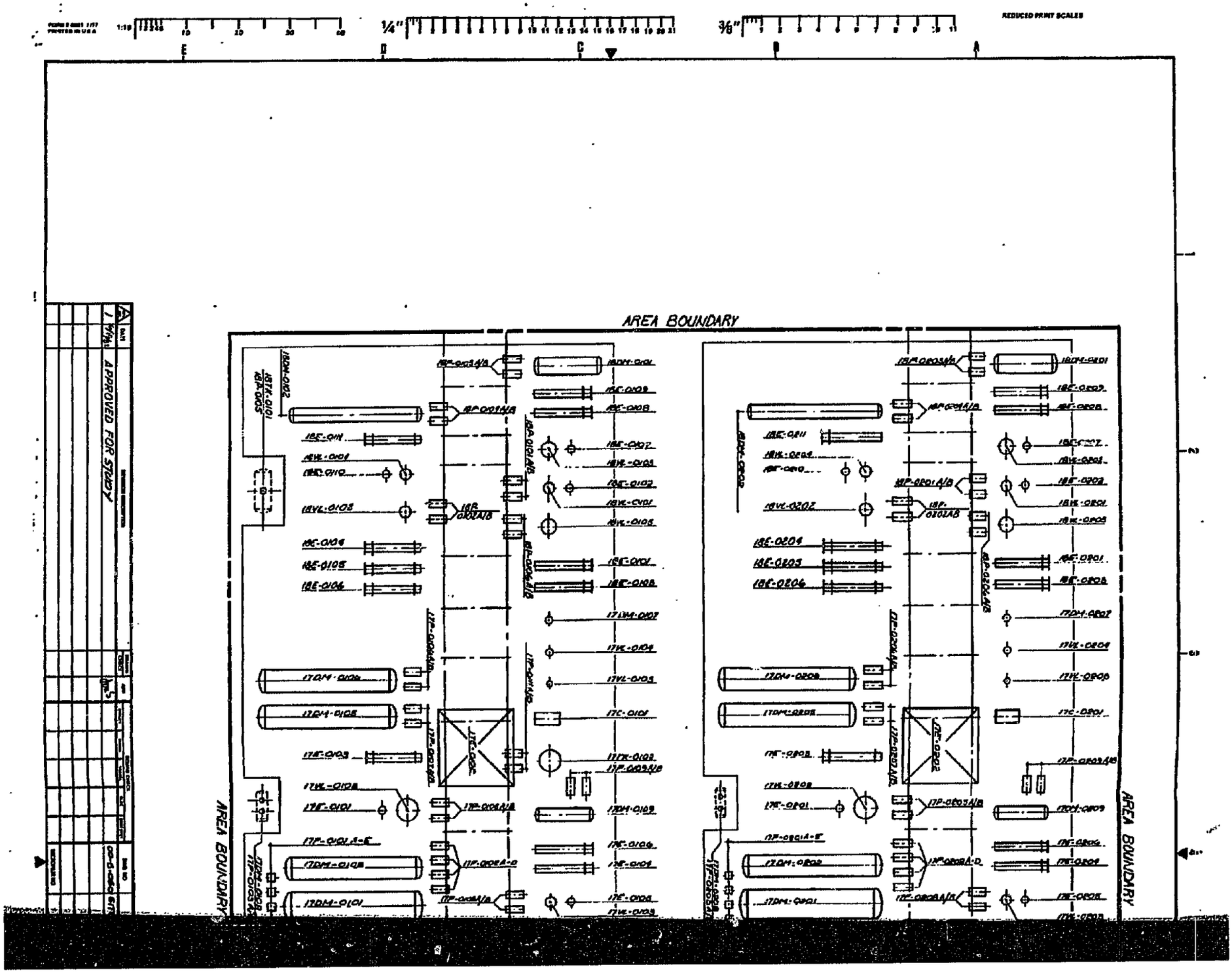
TABLE 6.2.11-1

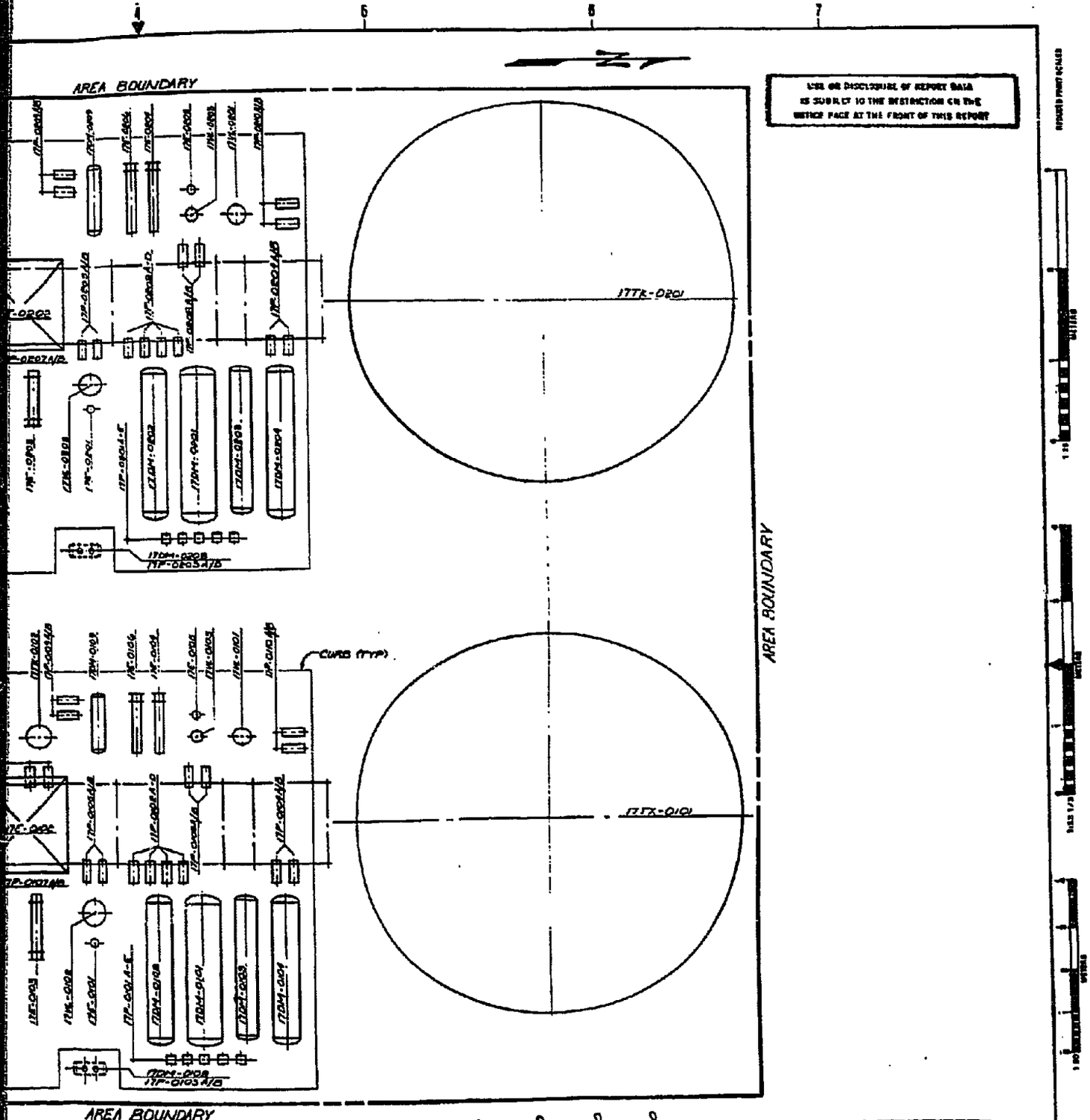
MATERIAL BALANCE

PHENOSOLVAN-UNIT 17

Stream Number Stream Name	17-1 Gas Liquor Feed	17-2 Gas Liquor to NH_3 Recov.	17-3 Phenols to POX
CO_2, lb/hr	22,161	22,161	-
H_2S, lb/hr	148	148	-
H_2O, lb/hr	940,649	942,920	129
Phenols, lb/hr	3,414	301	3,113
Fatty Acids, lb/hr	1,139	1,106	33
Ammonia, lb/hr	6,783	6,783	-
HCl, lb/hr	185	185	-
TOTAL, lb/hr	974,479	973,604	3,275
Pressure, psia	55	100	72
Temperature, °F	95	120	180-285

NOTES:
1. Flow quantities, pressures, and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessary the conditions which will be attained during actual operations.
2. 2,400 lb/hr of stripping steam is added to the unit.


AREA BOUNDARY
AREA BOUNDARY
AREA BOUNDARY
APPROVED FOR STUDY



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REDUCED PRINT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE

DWG NO.	00-5-050 SITE(1)- PLOT PLAN
DRAWN	R. MILLER
DESIGNED	E. MACKETT
CONTR.	
SHEETS	1 OF 5
R. LAWS	

FLUOR

PLOT PLAN - UNITS 17 & 18
PHENOSOLVAN & AMMONIA RECOVERY
CROW TRIBE OF INDIANS MONTANA

SCALE 1"-20'-0" | 835704-17-4-050 | 1

TABLE 6.2.11-2

EQUIPMENT LIST

PHENOSOLVAN - UNIT 17

Item No.	Equipment Name	Number Required Oper.	Spare
17TK-0101	Gas Liquor Tank	2	0
17TK-0102	Phenols Tank	1	0
17DM-0101	Extractor	2	0
17DM-0102	Raffinate After Settler	2	0
17DM-0103	Extract Settler	2	0
17DM-0104	Extract Receiver	2	0
17DM-0105	Regenerator Overhead Settler	2	0
17DM-0106	Regenerator Overhead Receiver	2	0
17DM-0107	K.O. Drum	2	0
17DM-0108	Slop Receiver	2	0
17DM-0109	Crude Phenol Rundown Drum	2	0
17VL-0101	Saturator	2	0
17VL-0102	Solvent Regenerator	2	0
17VL-0103	Solvent Stripper	2	0
17VL-0104	Scrubber	2	0
17VL-0105	Vent Scrubber	2	0
17E-0101	Regenerator Reboiler	2	0
17E-0102	Regenerator Air Condenser	2	0
17E-0103	Regenerator Water Condenser	2	0
17E-0104	Stripper Condenser	2	0
17E-0105	Stripper Reboiler	2	0
17E-0106	Recycle Phenol Cooler	2	0

TABLE 6.2.11-2 (Continued)

EQUIPMENT LIST

PHENOSOLVAN - UNIT 17

Item No.	Equipment Name	Number Required Oper.	Spare
17C-0101	Vent Gas Blower	2	0
17P-0101 A/B/C/D/E	Extractor Pump	6	4
17P-0102 A/B/C/D	Raffinate Pump	4	4
17P0103 A/B	Solvent Phenol Slop Pump	2	2
17P-0104 A/B	Extract Pump	2	2
17P-0105 A/B	Regenerator Bottoms Pump	2	2
17P0106 A/B	Regenerator Reflux Pump	2	2
17P-0107 A/B	Solvent Recycle Pump	2	2
17P-0108 A/B	Stripper Bottoms Pump	2	2
17P-0109 A/B	Phenol Pump	2	2
17P-0110 A/B	Gas Liquor Feed Pump	2	2
17P-0111 A/B	Crude Phenols Pump	1	1

NOTE: Train No. 2 equipment numbers which are not shown are the same as indicated above except the train designation is 02 instead of 01.

Example:	Train No. 1	Train No. 2
	17TK-0101	17TK-0201