

6.6.8 BLOCK FLOW DIAGRAMS

6.6.8.1 OVERALL MATERIAL BALANCE

The overall material balance for the Shell Coal - 40% Fines - SNG Case is shown on Drawing No. 835704-00-4-401. The description given in Section 6.1.8 also applies to this case. The alternate coal has slightly different properties than the Base Case.

6.6.8.2 PLANT WATER BALANCE

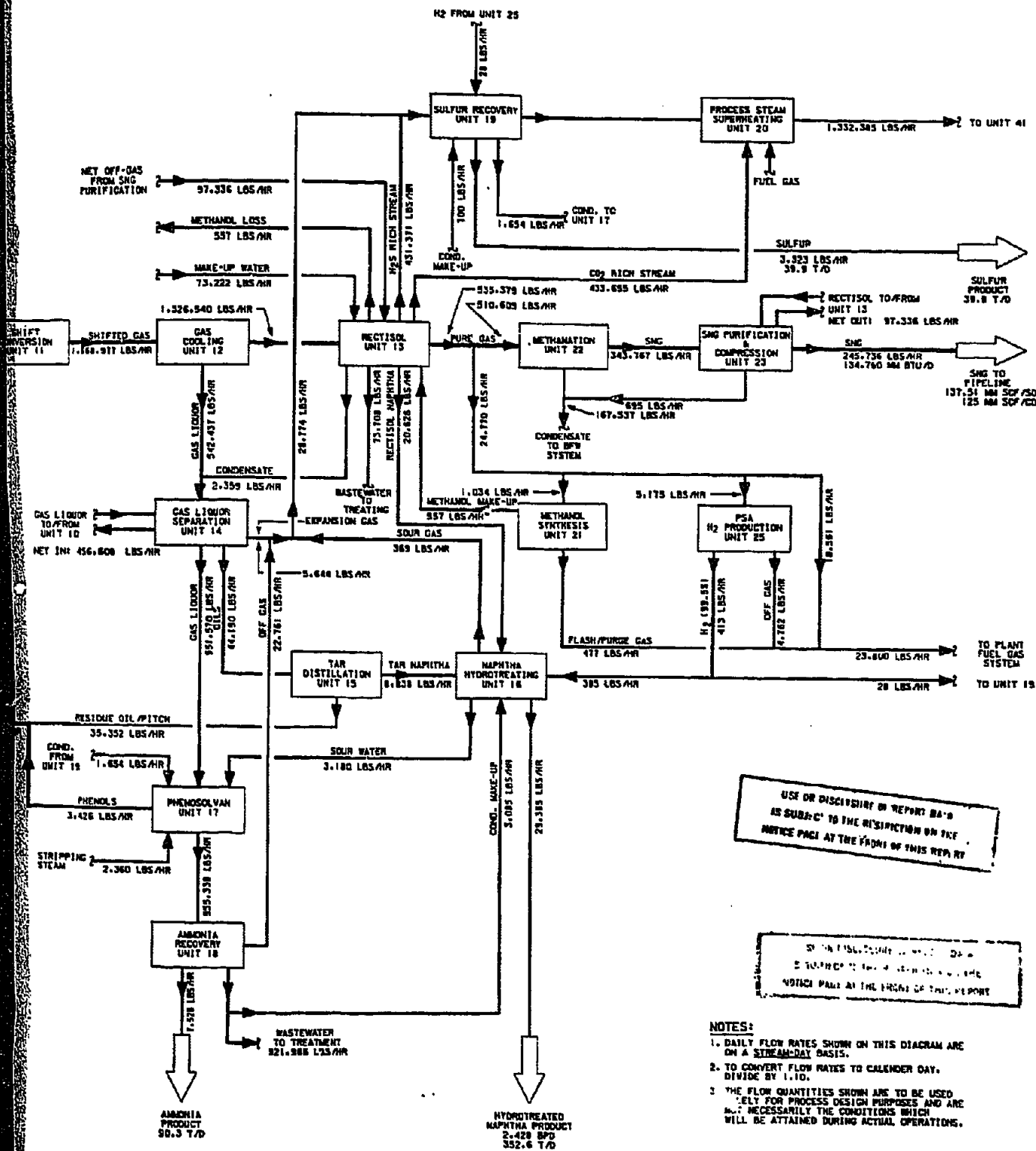
Drawing No. 835704-00-R-402 is the block flow diagram of the plant water balance for the Shell Coal Case. The diagram shows the same overall management scheme as for the Base Case. The only change is re-routing the high TDS wastewater from the Utility Cooling Tower Blowdown Treatment softener to the Flue Gas Desulfurization makeup water instead of to the Ash Handling Unit. The low ash in the coal reduces the water requirement in Ash Handling.

6.6.8.3 SULFUR BALANCE

The sulfur balance for the Shell Coal Case is shown on Drawing No. 835704-00-4-404. The description given in Section 6.1.8 applies to this case.

6.6.8.4 AIR EMISSIONS

The air emissions diagram for the Shell Coal Case is shown on Drawing No. 835704-00-4-405. The description given in Section 6.1.8 also applies to this case.



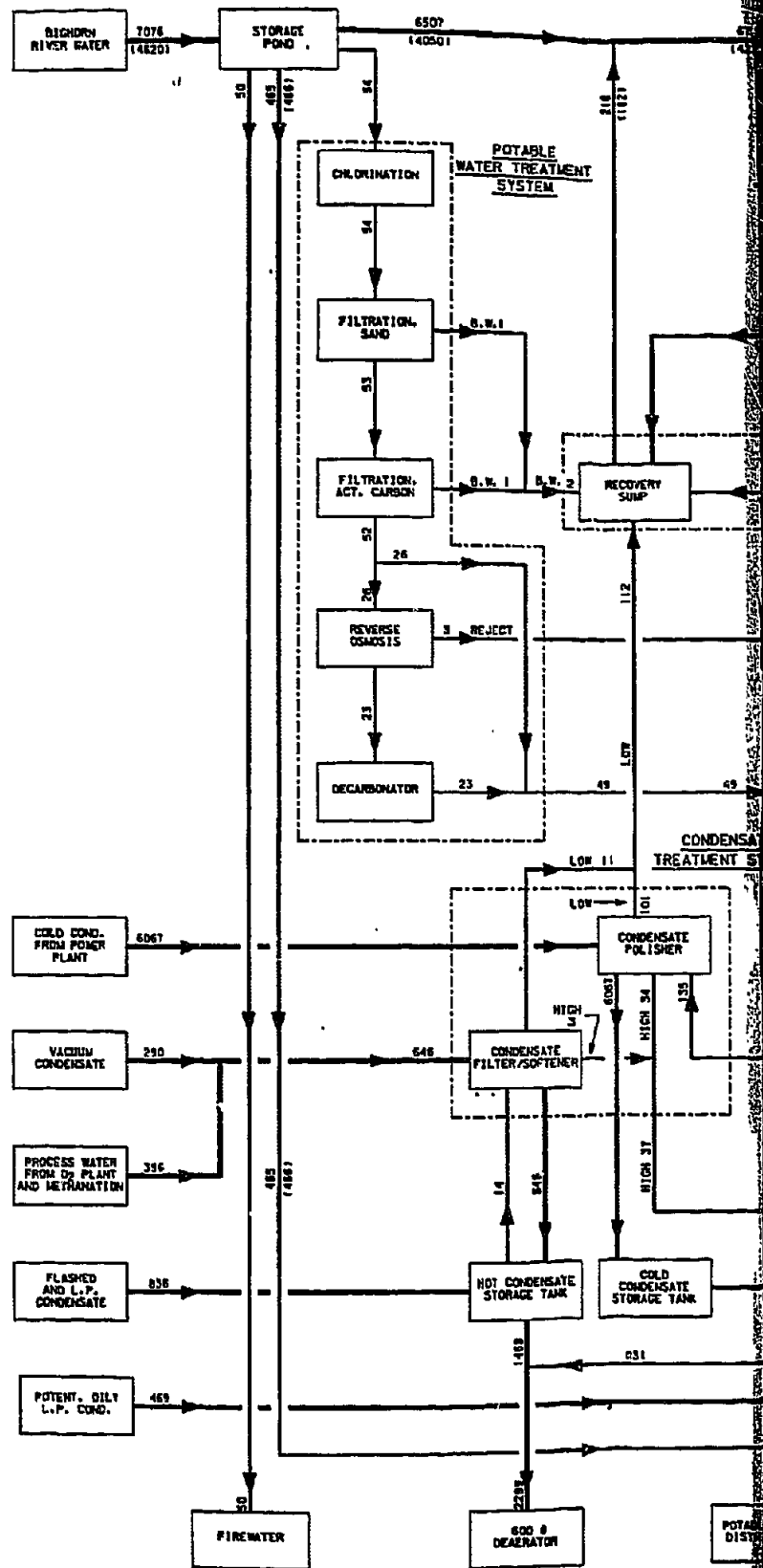
USE OR DISCLOSE IN REPORT OR AS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

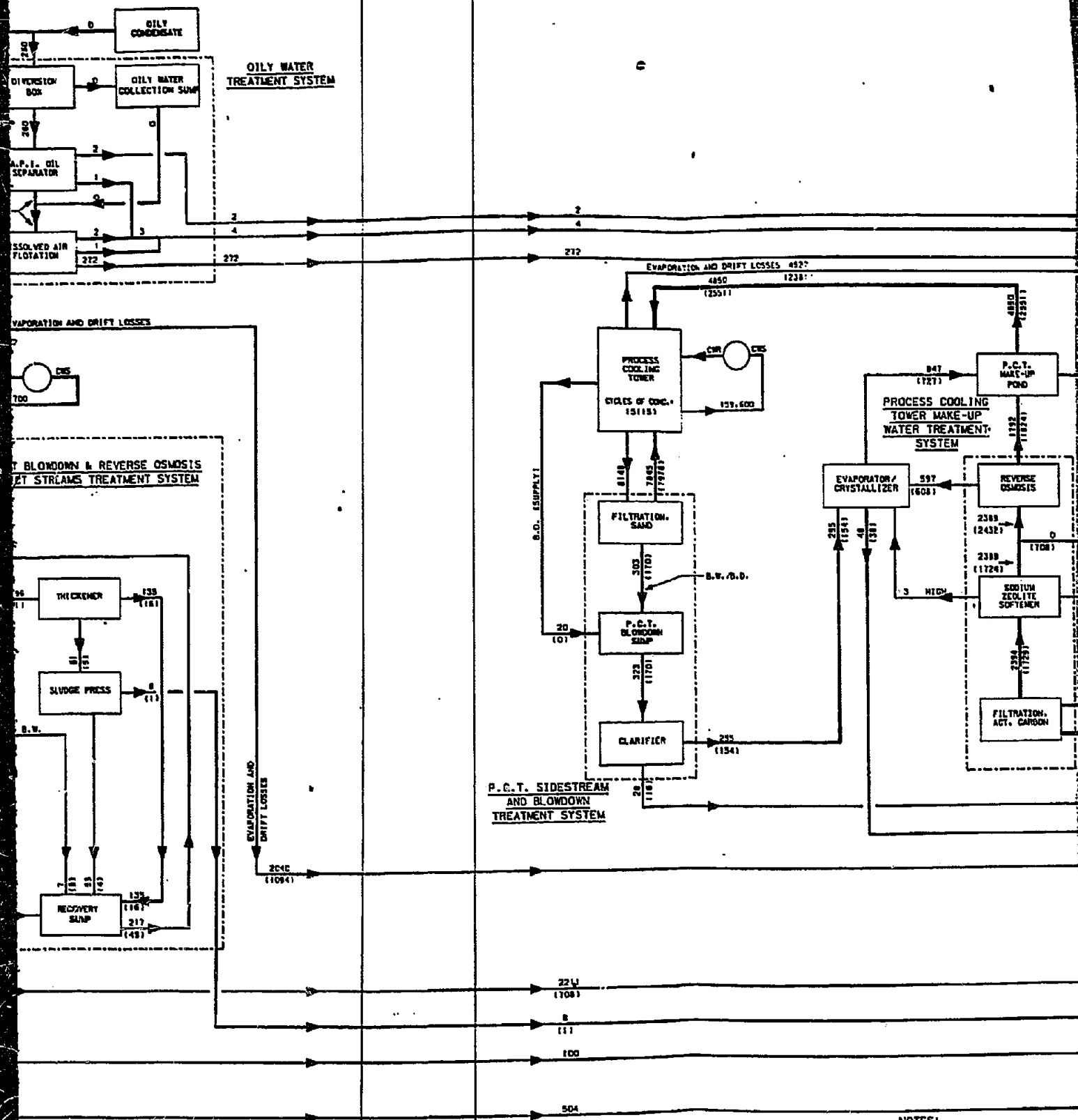
SYNTHESIS GAS FROM UNIT 25
 5 TONNES PER DAY (TPD) OF SNG TO PIPELINE
 NOTICE PAGE AT THE FRONT OF THIS REPORT

- NOTES:**
- DAILY FLOW RATES SHOWN ON THIS DIAGRAM ARE ON A STREAM-DAY BASIS.
 - TO CONVERT FLOW RATES TO CALENDAR DAY, DIVIDE BY 1.10.
 - THE FLOW QUANTITIES SHOWN ARE TO BE USED ONLY FOR PROCESS DESIGN PURPOSES AND ARE NOT NECESSARILY THE CONDITIONS WHICH WILL BE ATTAINED DURING ACTUAL OPERATIONS.

		BLOCK FLOW DIAGRAM OVERALL MATERIAL BALANCE CASE: SHELL COAL - 40% FINES - SNG CHON TRIBE OF INDIANS		835704-00-4-401	1
D.P. HALVERSON E.C. ARATAY R. MCCARTHY R. LANG		NONE			

001 35700140





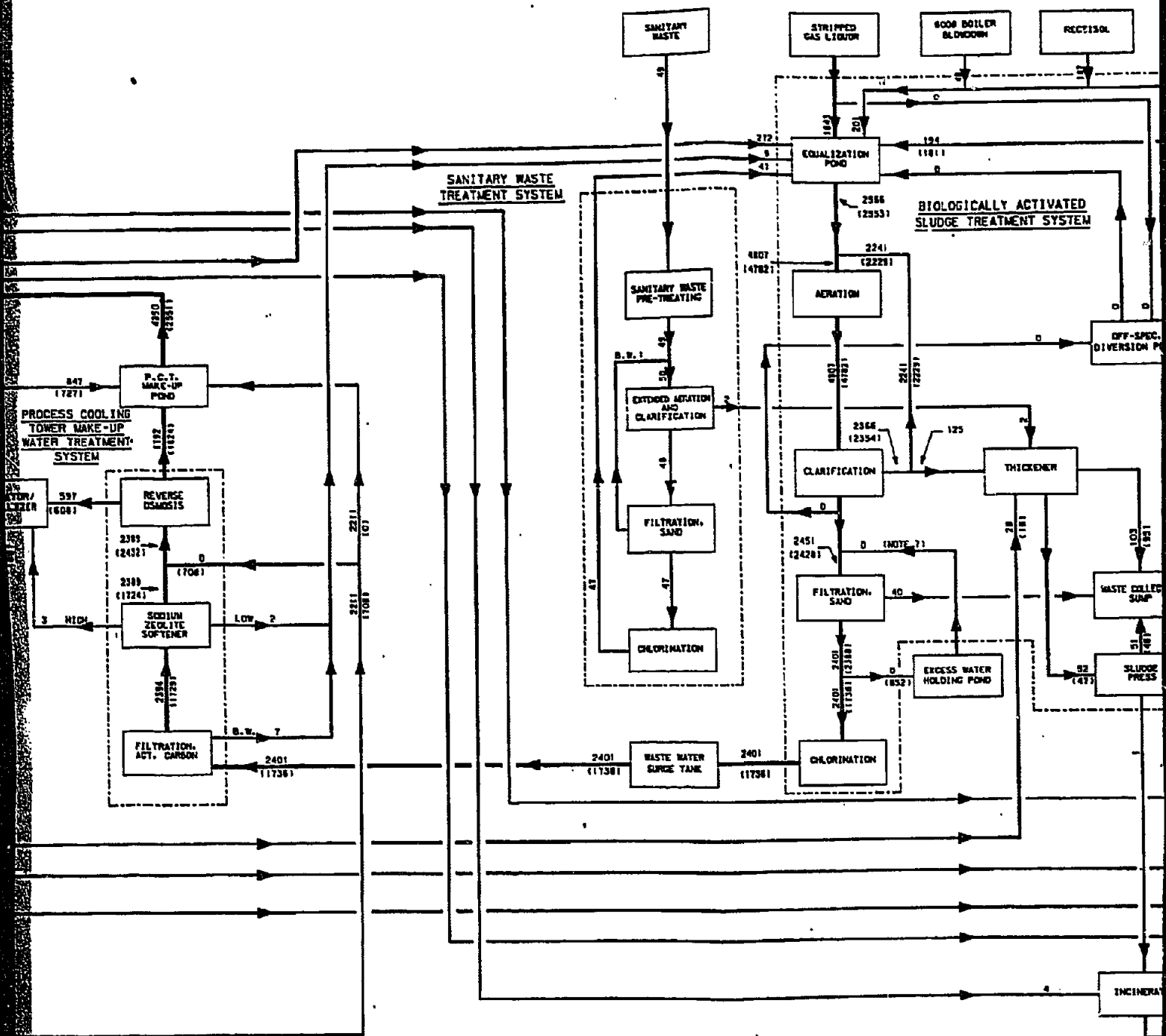
NOTES:

1. ALL FLOW RATES IN GALLONS PER MINUTE.
2. NUMBERS WITHOUT PARENTHESES ARE FLOW RATES TO THE TREATMENT SYSTEMS. NUMBERS INSIDE PARENTHESES ARE FLOW RATES FROM SUBSYSTEMS TO THE TREATMENT SYSTEMS.
3. REVERSE OSMOSIS INCLUDES HIGH PRESSURE PUMP.
4. HIGH IS FOR HIGH TDS WASTE.
5. B.W. IS FOR BACKWASH.
6. B.D. IS FOR BLOWDOWN.
7. DURING WINTER, 614 GPM OF WATER HOLDING POND FOR 10 DAYS.

DRAWING NO.	REV.	FRAME
835104-00-R-402	1	2 OF 2

4

3



NOTES:

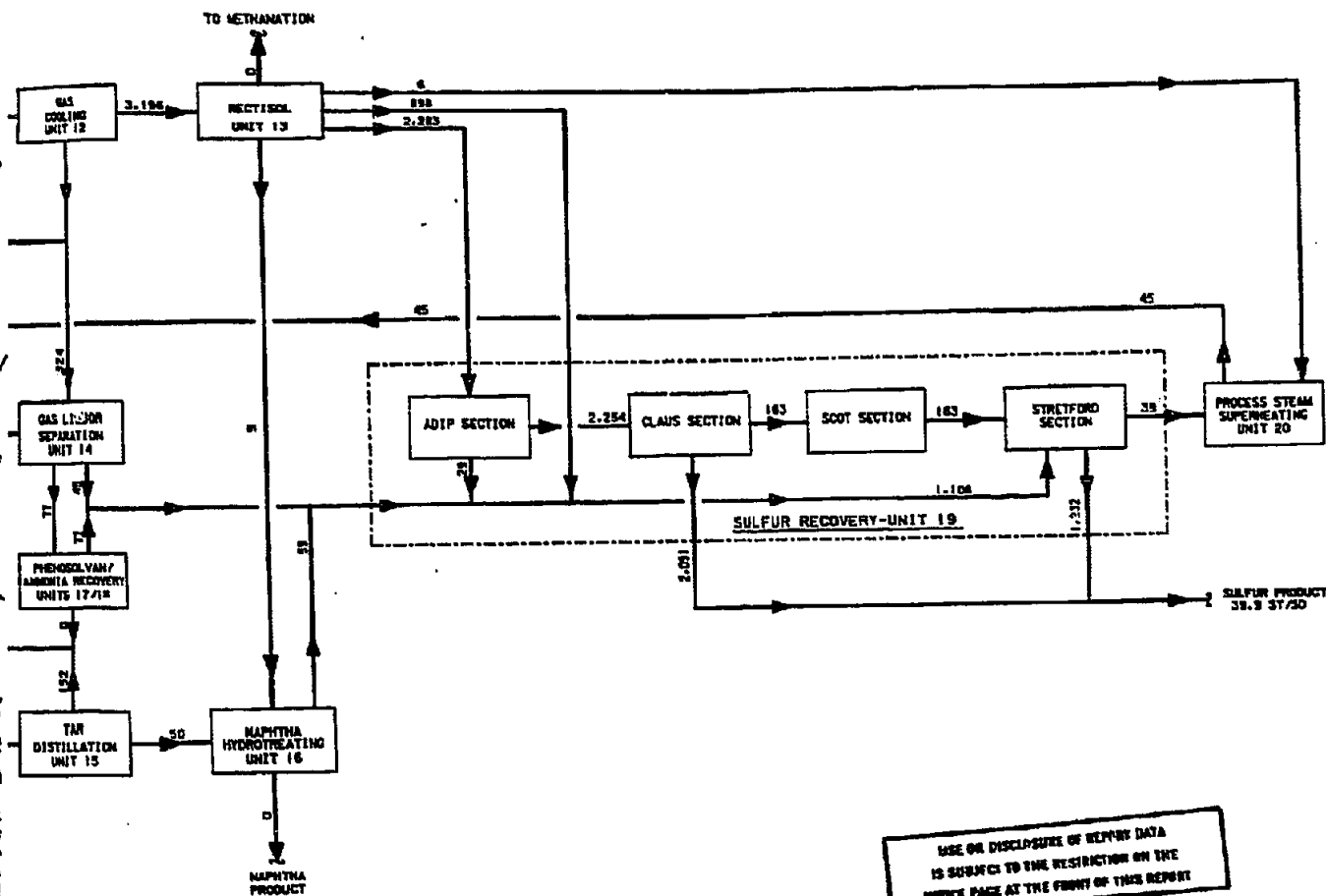
1. ALL FLOW RATES IN GALLONS PER MINUTE.
2. NUMBERS WITHOUT PARENTHESES ARE FOR SUMMERTIME CASE; NUMBERS INSIDE PARENTHESES ARE FOR WINTERTIME CASE IF DIFFERENT FROM SUMMERTIME CASE.
3. REVERSE OSMOSIS INCLUDES MICRA FILTRATION.
4. HIGH IS FOR HIGH TDS WASTE. LOW IS FOR LOW TDS WASTE.
5. B.W. IS FOR BACKWASH.
6. B.D. IS FOR BLOWDOWN.
7. DURING WINTER, 614 GPM OF WATER IS STORED IN THE EXCESS WATER HOLDING POND FOR 10 DAYS FOR LATER USAGE.

NO.	DESCRIPTION	DATE	BY

FLUOR

D. MIRA
 P. C. AB
 R. McCAR
 R. LANG

NOTICE: THIS DRAWING HAS NOT BEEN PUBLISHED AND IS THE SOLE PROPERTY OF FLUOR ENGINEERING AND CONSTRUCTION, INC. AND IS LOANED TO THE USER'S FOR HIS CONSTRUCTION. THE USER AND ITS REPRESENTATIVES OF THE USER OF THIS DRAWING, THE USER'S PRINCIPALS AND AGENTS TO RETURN TO FLUOR ENGINEERING AND CONSTRUCTION, INC. IN WRITING, WITHIN 10 DAYS OF THE DATE OF THIS DRAWING, THE USER'S PRINCIPALS AND AGENTS TO RETURN TO FLUOR ENGINEERING AND CONSTRUCTION, INC. IN WRITING, WITHIN 10 DAYS OF THE DATE OF THIS DRAWING, THE USER'S PRINCIPALS AND AGENTS TO RETURN TO FLUOR ENGINEERING AND CONSTRUCTION, INC. IN WRITING, WITHIN 10 DAYS OF THE DATE OF THIS DRAWING.



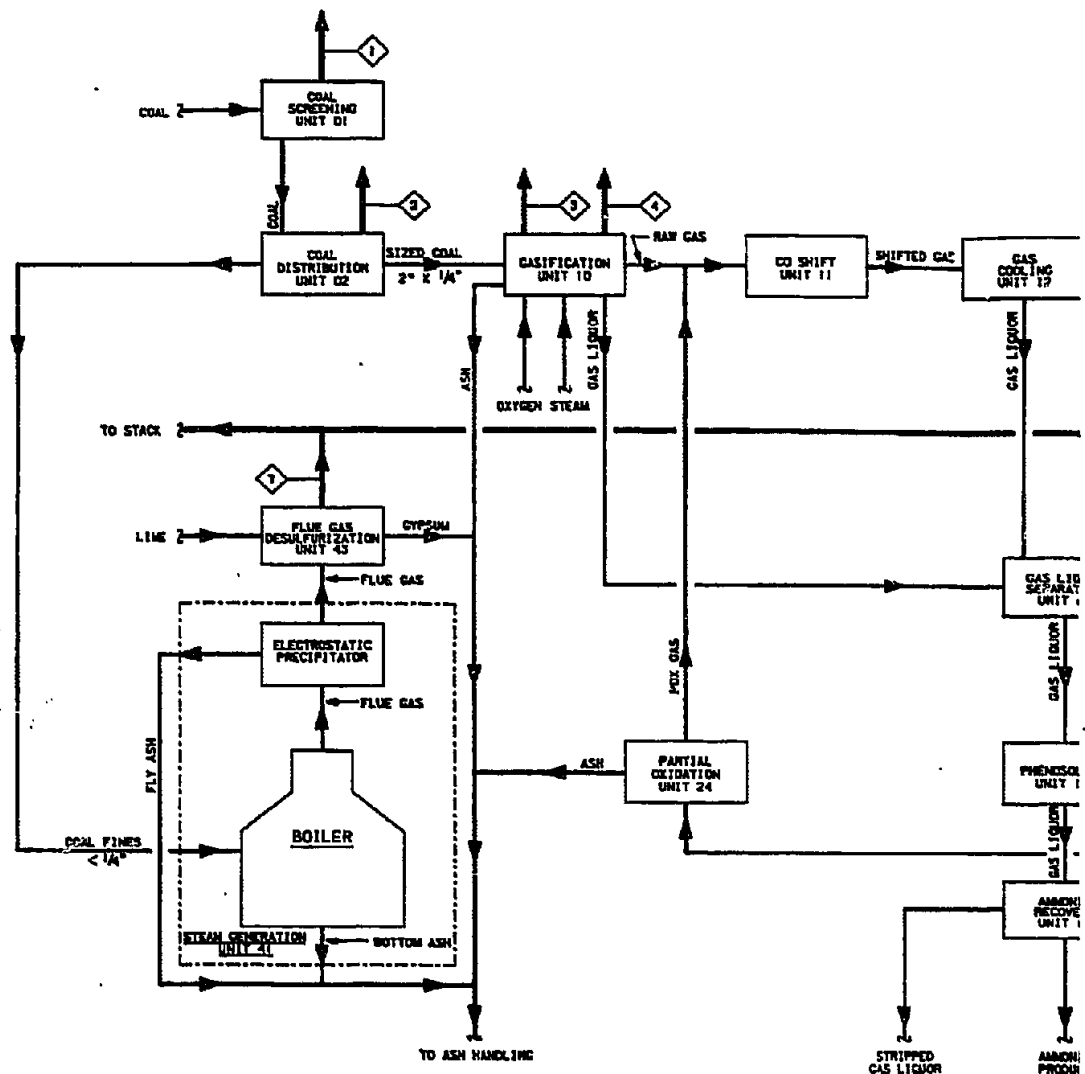
NOTES:

1. FLOWS SHOWN ARE LBS/HR OF SULFUR.
2. DESIGN BASIS IS 733 T/HR COAL TO PLANT.
GASIFIER FEED COAL = 440 T/HR
BOILER FEED COAL = 293 T/HR
3. FGD SULFUR REMOVAL EFFICIENCY IS 94%
BASED ON 50 PPM SO₂ EXIT FGD UNIT.
4. MORE THAN 98% OF SULFUR ENTERING GASIFICATION
IS RECOVERED.
5. THE FLOW QUANTITIES SHOWN ARE TO BE USED
SOLELY FOR PROCESS DESIGN PURPOSES AND ARE
NOT NECESSARILY THE CONDITIONS WHICH WILL
BE ATTAINED DURING ACTUAL OPERATIONS.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED
DATE 08-14-2010 BY 60322 UCBAW/SJS/STP

		BLOCK FLOW DIAGRAM SULFUR BALANCE CASE: SHELL COAL-40% FINES-SNG SYNFUELS FEASIBILITY STUDY	
PROJECT: CROW TRIBE OF INDIANS SHEET NO: 835704-00-4-404	DESIGNER: D.P. HALVERSON CHECKER: G.C. ARATAY APPROVER: R. LANG	DATE: 8-2-82	DRAWING NO: 835704-00-4-404
THIS DRAWING HAS NOT BEEN PUBLISHED AND IS THE SOLE PROPERTY OF FLUOR CORP. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. THE COMPANY MAKES NO WARRANTY, EXPRESS OR IMPLIED, REGARDING THE ACCURACY, COMPLETENESS, OR SUFFICIENCY OF THE INFORMATION CONTAINED HEREIN. THE USER SHALL BE RESPONSIBLE FOR OBTAINING NECESSARY PERMITS AND APPROVALS FROM ALL AFFECTED AGENCIES AND AGENCIES. THE USER SHALL BE RESPONSIBLE FOR OBTAINING NECESSARY PERMITS AND APPROVALS FROM ALL AFFECTED AGENCIES AND AGENCIES. THE USER SHALL BE RESPONSIBLE FOR OBTAINING NECESSARY PERMITS AND APPROVALS FROM ALL AFFECTED AGENCIES AND AGENCIES.		SCALE: NONE	SHEET NO: 1

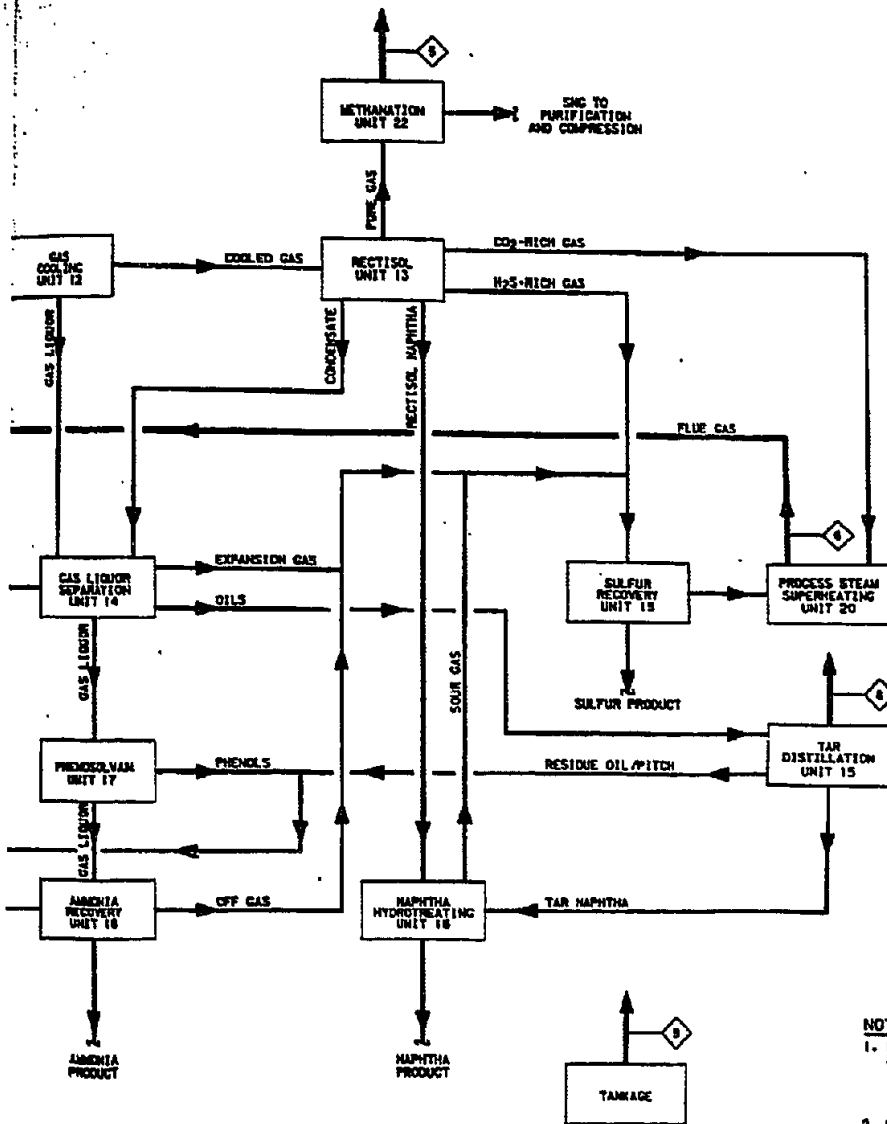
DBT 035700404



NOTE: NUMBERS IN PARENTHESES REFER TO NOTES AT RIGHT.

	1	2	3	4 (3)	5 (4)	6	7	8 (5)	9 (6)	
	COAL SCREENING	COAL DISTRIBUTION	GASIFICATION LOCK GAS VENT	GASIFIER START-UP VENT	HEATER FLUE GAS	SUPERHEATER FLUE GAS	BOILER FLUE GAS	HEATER FLUE GAS	PRODUCT STORAGE TANK FARM	
D ₂	LBS/HR			CONFIDENTIAL	849	23,510	276,792	448		
N ₂	LBS/HR		2		24,228	313,695	3,954,360	11,437		
CO	LBS/HR		338		3,147	937,100	1,129,827	2,430		
N ₂ O	LBS/HR		1		4,675	57,757	611,820	2,207		
SO ₂	LBS/HR					80	(6) 717			
H ₂ S	LBS/HR		1							
CO ₂	LBS/HR		TRACE							
NO _x	LBS/HR				22	222	2,867	10		
CO	LBS/HR		112		2	11	293	1		
CH ₄	LBS/HR		43							
H ₂	LBS/HR		20							
HYDROCARBONS	LBS/HR		6		TRACE					
PARTICULATES	LBS/HR	5	2				183	148	6	
TOTAL FLOW	LBS/HR	5	2	323						
TOTAL FLOW	MMBtu/HR		25		1,271	36,436	209,823	800	8	
TEMPERATURE	°F	AMB.	AMB.		300	400	128	300	AMB.	
ELEVATION OF RELEASE FT		75	150	200	1	100	250	250	100	40

NO.	REVISIONS



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

NOTES:

1. BOILER DESIGN MEETS EPA CODE OF FEDERAL REGULATIONS-TITLE 40 EMISSION LIMITS:
SO₂ = 1.2 LB/AMBTU
NO_x = 0.5 LB/AMBTU
PARTICULATES = 0.05 LB/AMBTU
2. BOILER FEED COAL = 933.3 T/HR (AS RECEIVED).
GASIFIER FEED COAL = 440 T/HR (AS RECEIVED).
3. COMPOSITION AND DURATION OF GASIFIER START-UP VENT ARE CONFIDENTIAL LUMP INFORMATION.
MAXIMUM EMISSIONS:
SO₂? 180 LBS/HR
HYDROCARBONS? 356 LBS/HR
4. CATALYST REDUCTION REQUIRES FUEL GAS. FLOW SHOWN IS OF SHORT DURATION.
5. SO₂ VENTED IS BASED ON FID REMOVAL EFFICIENCY OF 96%.
6. PARTICULATES VENTED ARE BASED ON AN EXIT CONCENTRATION OF 0.013 GR/SCF. OVERALL REMOVAL EFFICIENCY IS 95.4%.
7. HEATER FLUE GAS EMISSIONS BASED ON THE FOLLOWING HEATER DUTY:
TAR DISTILLATION 20.5 MM BTU/HR
8. HYDROCARBON EMISSIONS FROM STORAGE TANKS BASED ON FLOATING ROOF DESIGN WITH SECONDARY SEALS AND VAPOR RECOVERY SYSTEMS UTILIZED ON CONE ROOF TANKS.
9. THE TEMPERATURES, FLOW QUANTITIES AND COMPOSITIONS SHOWN ARE TO BE USED SOLELY FOR PROCESS DESIGN PURPOSES AND ARE NOT NECESSARILY THE CONDITIONS WHICH WILL BE ATTAINED DURING ACTUAL OPERATIONS.

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

		BLOCK FLOW DIAGRAM AIR EMISSIONS CASE: SHELL COAL - 40% FINES - SNG SYNTHESIS FEASIBILITY STUDY	
PROJECT: SHELL COAL - 40% FINES - SNG DRAWN BY: R. LANG CHECKED BY: R. LANG DATE: 10/1/83		PROJECT: SHELL COAL - 40% FINES - SNG DRAWN BY: R. LANG CHECKED BY: R. LANG DATE: 10/1/83	
APPROVED BY: D.P. HALVORSON G. G. ABATAY W.D. BELMOTO R. MCCARTHY R. LANG		NONE 835704-00-4-405 1	

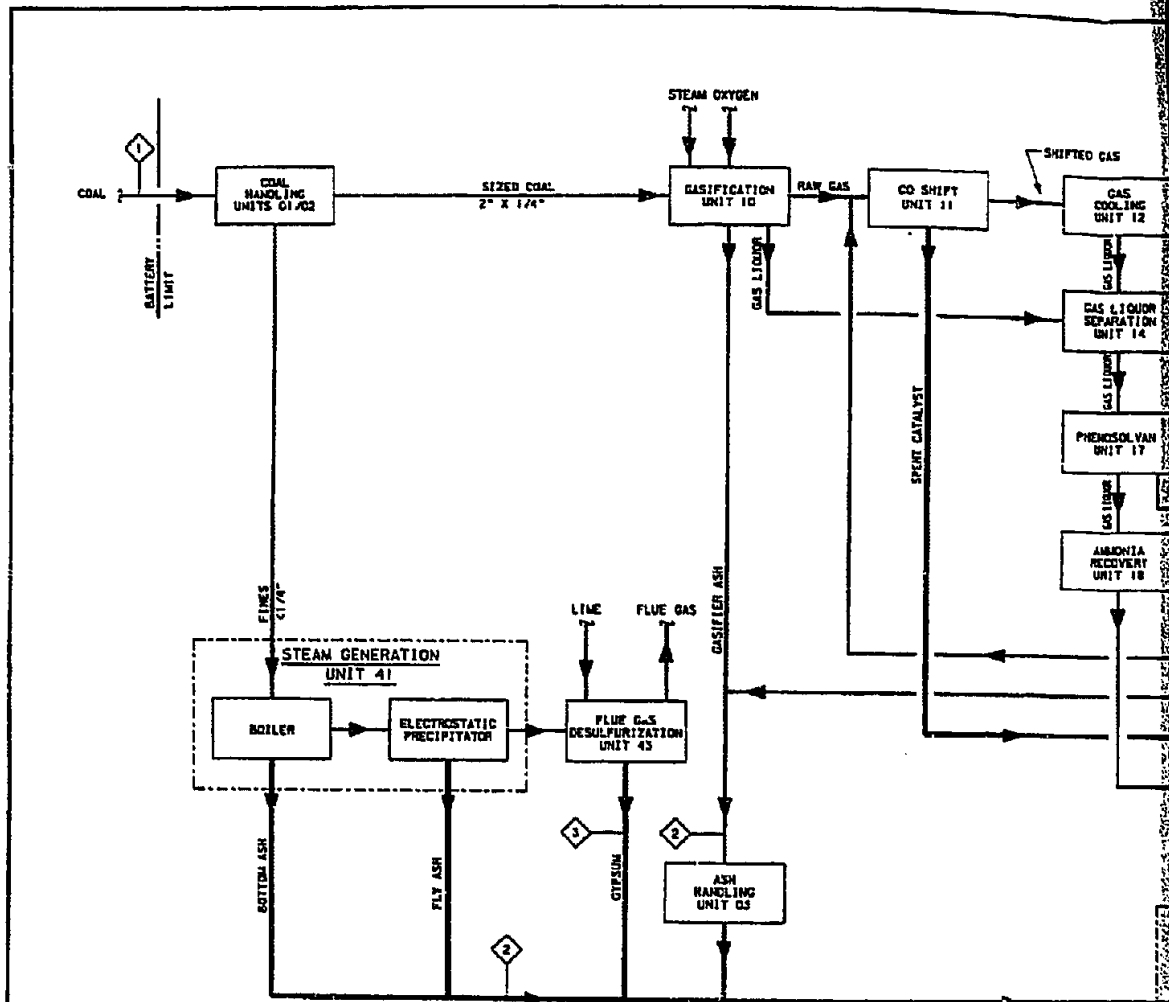
50100100

6.6.8.5 SOLID EFFLUENT

The solid effluent diagram for the Shell Coal Case is shown on Drawing No. 835704-00-4-406. The description given in Section 6.1.8 also applies to this case.

6.6.8.6 STEAM BALANCE

The steam balance for the Shell Coal Case is shown on Drawing No. 835704-00-R-407. The description given in Section 6.1.8 also applies to this case.

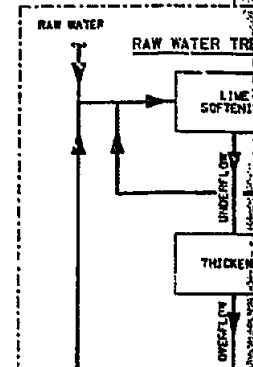


1 (NOTE 1) COAL		2 (NOTES 2 - 4) ASH		3 (NOTE 3) FGD GYPSUM		4 RAW WATER TREATMENT SLUDGE		5 WATER TREATING	
TRACE ELEMENTS		MINERAL ASH ANALYSIS							
ppm		WT%		WT%		WT%		WT%	
ANTIMONY	0.69	SiO ₂	28.4	H ₂ O	23.0	CaCO ₃	55.5	SPENT ACTIVATED CARBON	41.3
ARSENIC	3.19	Al ₂ O ₃	16.1	CaSO ₄ ·2H ₂ O	75.0	H ₂ CO ₃	0.9		
BARIUM	89.05	Fe ₂ O ₃	6.2	CaCl ₂	0.8	H ₂ O	49.0	SPENT ION EXCHANGE RESIN	26.1
BERYLLIUM	0.21	MgO	0.35	INERT SOLIDS	1.5	MISCELLANEOUS	3.6		
BORON	44.09	K ₂ O	0.36	Ca(OH) ₂	TRACE				
BROMINE	1.06	CaO	21.8	Ca(COOH) ₂	TRACE				
CADMIUM	0.38	MnO	7.3						
CERIUM	3.52	TiO ₂	1.6						
CHROMIUM	3.86	P ₂ O ₅	0.3						
COBALT	0.75	SO ₃	13.8						
COPPER	11.57	INDETERMINATE	2.69						
FLUORINE	95.29								
LEAD	1.87								
LITHIUM	8.89								
MANGANESE	20.46								
MERCURY	0.66								
NICKEL	2.19								
SELENIUM	0.52								
SILVER	0.14								
STRONTIUM	168.65								
THALLIUM	0.36								
URANIUM	1.45								
VANADIUM	11.83								
ZINC	5.76								
ZIRCONIUM	48.04								

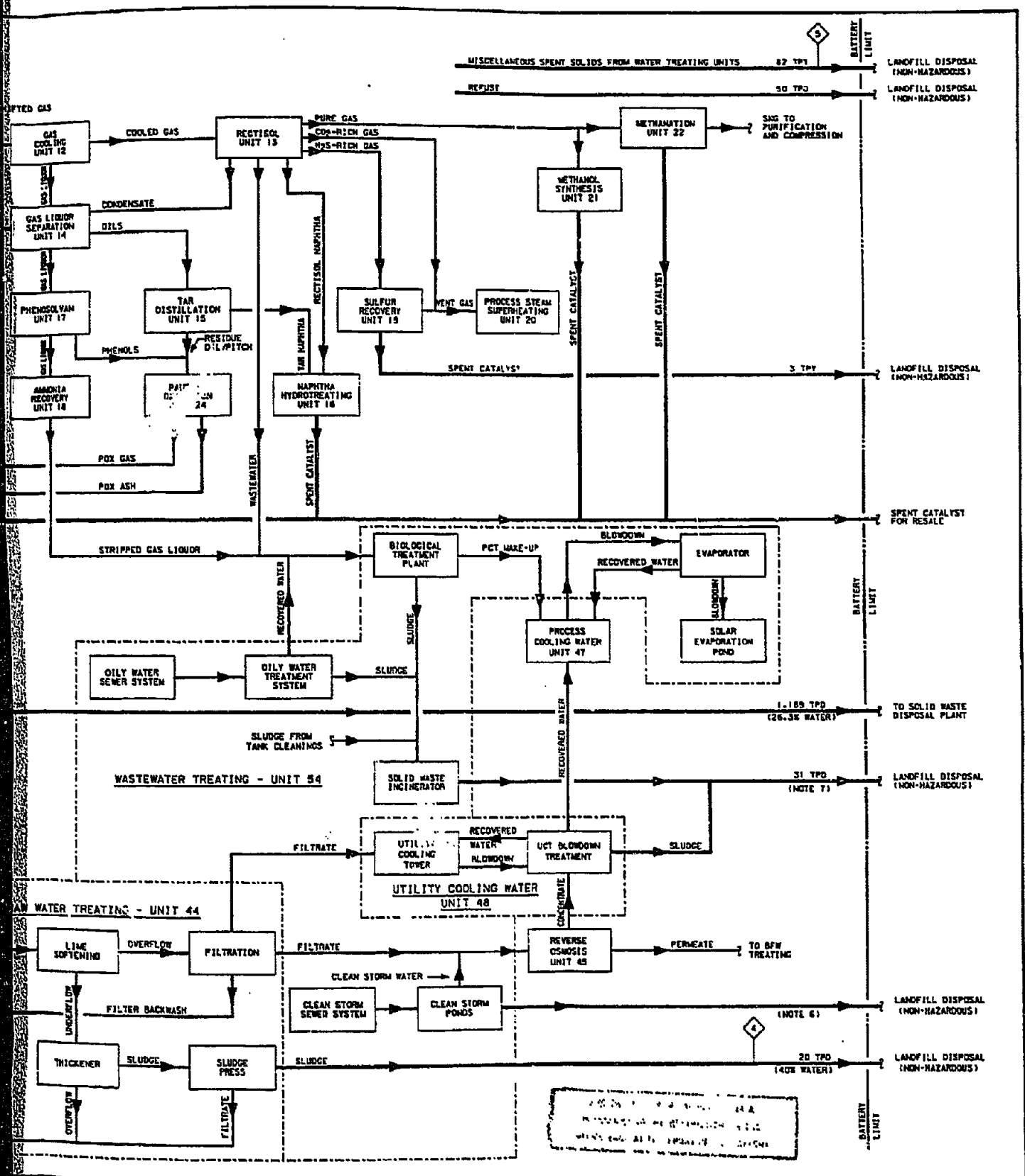
NOTES:

- TRACE ELEMENT ANALYSIS FROM YOUNG'S CREEK AREA COAL.
- MINERAL ASH ANALYSIS BASED ON LURCI DATA- SHELL RESERVE. GASIFIER ASH ALSO CONTAINS 4.5% CARBON.
- AMOUNT OF GASIFIER ASH CALCULATED BASED ON 400 T/HR GASIFIER COAL CONSUMED.
- AMOUNT OF BOILER ASH CALCULATED BASED ON 253 T/HR BOILER COAL CONSUMED.
- TOTAL GYPSUM PRODUCED BASED ON FGD LICENSOR INFORMATION.
- THE CLEAN STORM WATER PONDS ARE CLEANED AS NECESSARY. THE AMOUNT OF SOLIDS REMOVED FROM THESE PONDS IS INDETERMINATE.
- THE COMPOSITIONS OF THE INCINERATOR WASTE & DUCT BLOWDOWN TREATMENT SLUDGE ARE NOT AVAILABLE.
- THE FLOW QUANTITIES AND COMPOSITIONS SHOWN ARE TO BE USED SOLELY FOR PROCESS DESIGN PURPOSES AND ARE NOT NECESSARILY THE CONDITIONS WHICH WILL BE ATTAINED DURING ACTUAL OPERATIONS.

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



NO.	DATE	REVISION

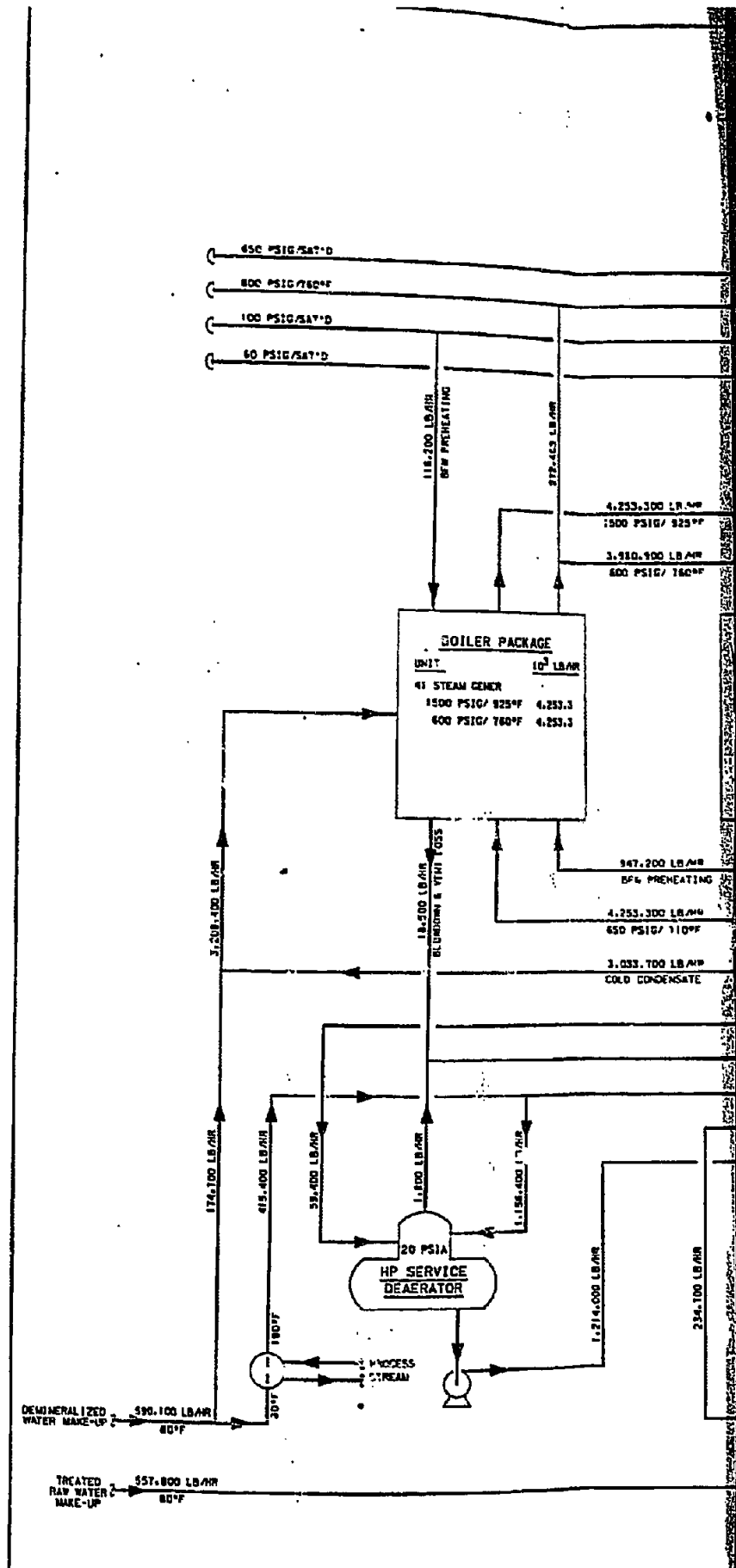


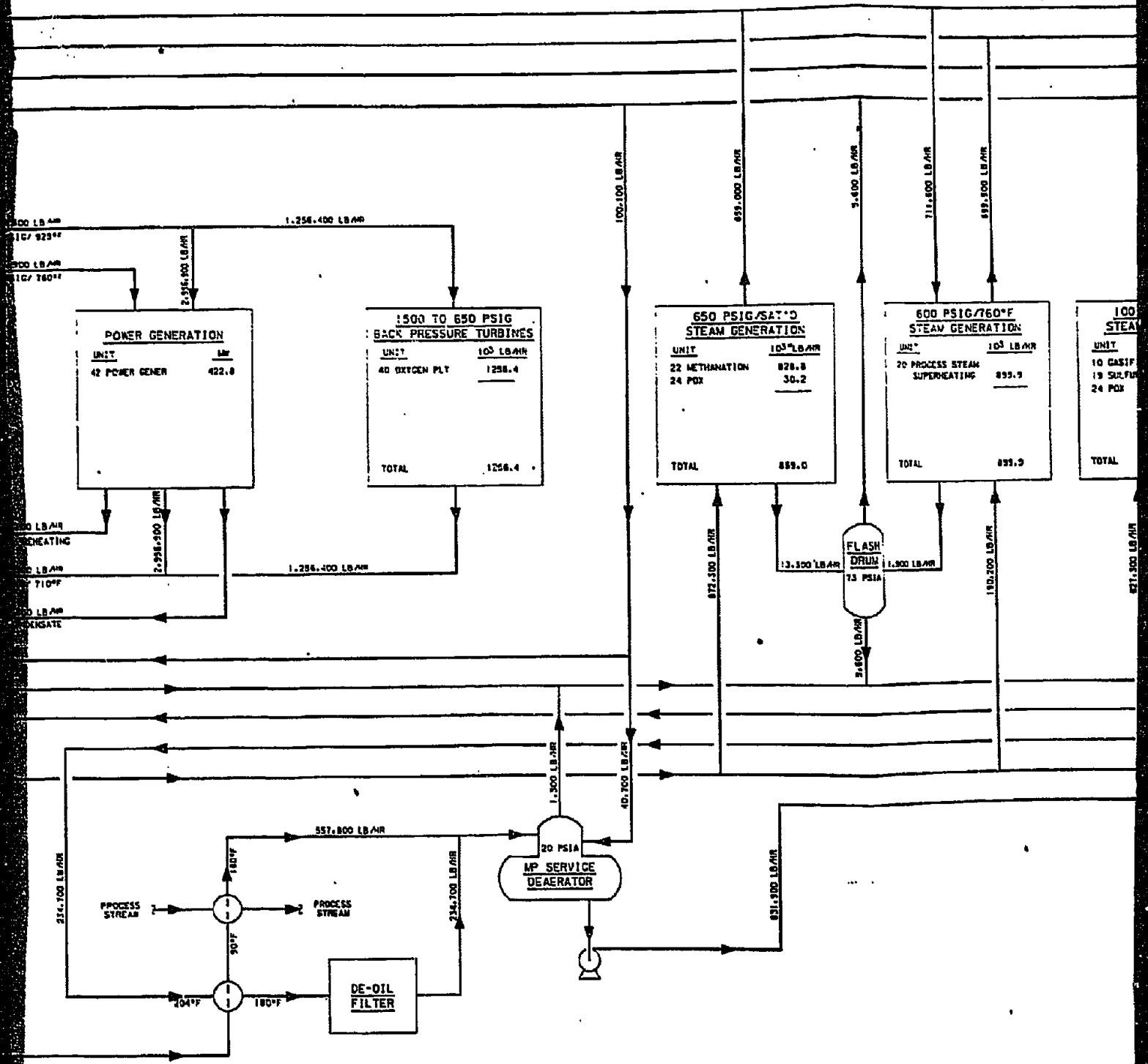
R. WHITE
 C. C. ARATAY
 W. O'NEILL
 R. McARTHUR
 R. LANG

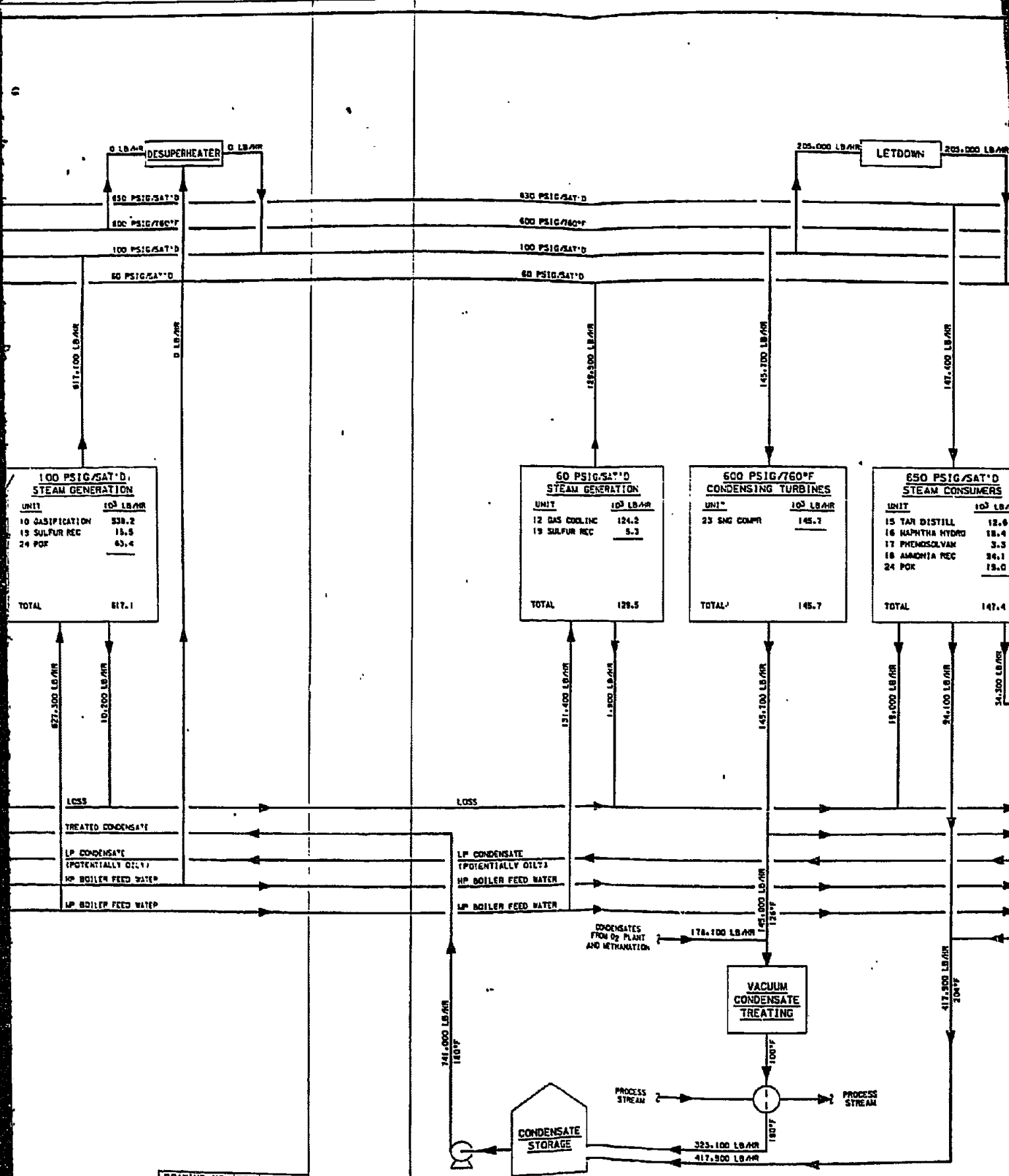
BLOCK FLOW DIAGRAM
SOLID EFFLUENT
CASE: SHELL COAL - 40% FINES - SNG
 SYMPLS FEASIBILITY STUDY
 NONE 835704-00-4-406 1

THIS DOCUMENT HAS BEEN PUBLISHED AND IS THE SOLE PROPERTY OF FLUOR CORP. AND SUBSIDIARIES. IT IS TO BE USED ONLY FOR THE PROJECT AND FOR THE USES AND LIMITATIONS SPECIFIED IN THE CONTRACT. THE COMPANY MAKES NO WARRANTY OR REPRESENTATION AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN. IT IS THE USER'S RESPONSIBILITY TO OBTAIN NECESSARY PERMITS AND TO COMPLY WITH ALL APPLICABLE REGULATIONS.

001 35104106



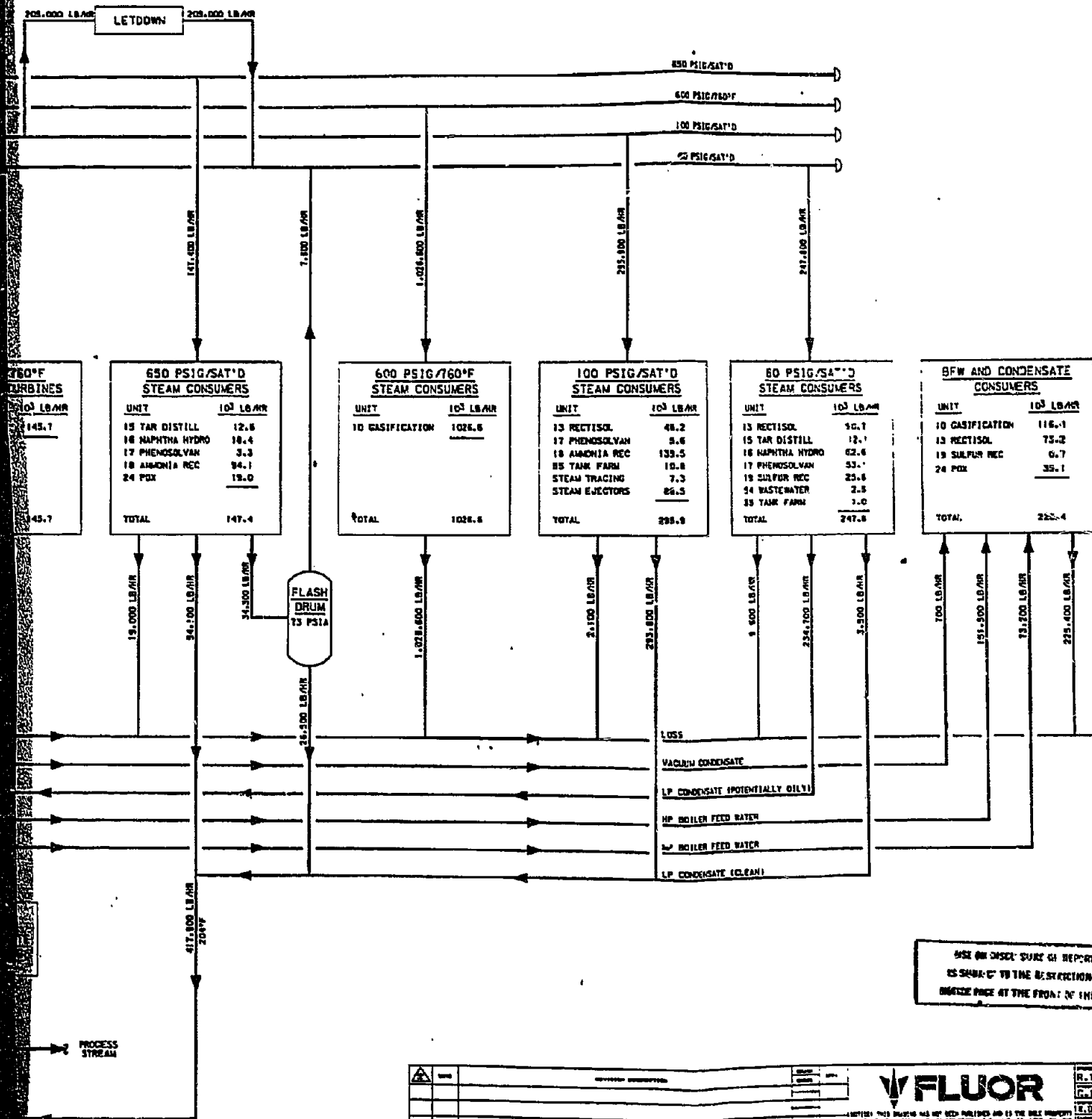




DRAWING NO. REV. FRAME
1835704-00-R-407 1 2 OF 2

4

3



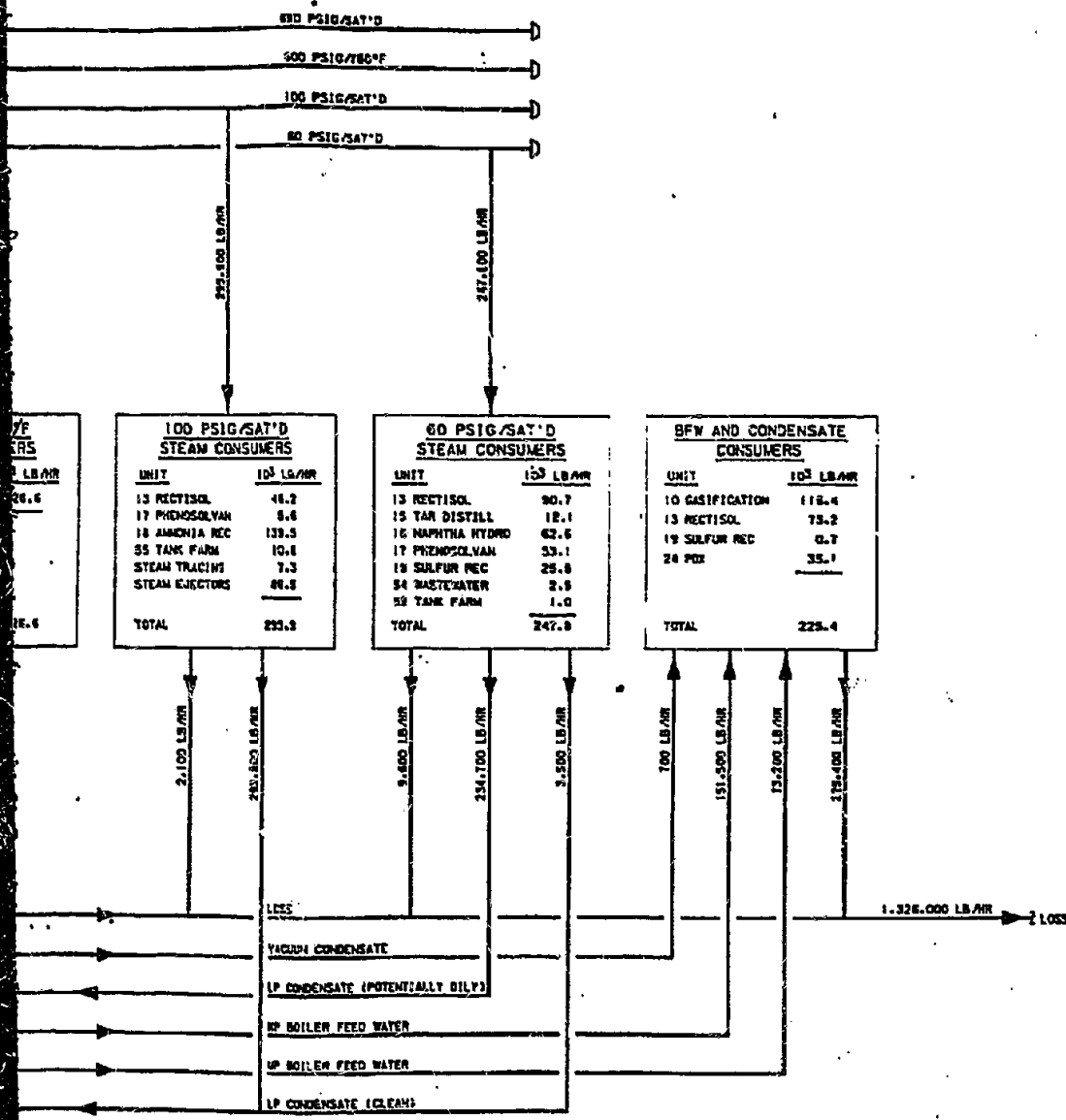
USE ON CASE STUDY REPORT DATA
AS SHOWN TO THE RESPECTIVE CHART
INDICATE PRICE AT THE FRONT OF THIS REPORT

NO.	DESCRIPTION	DATE	BY

FLUOR

APPROVED BY
R. WHIT
G. F. AR
R. B. BELL
R. McGRAN
ROLL AND

NOTICE: THIS DRAWING HAS BEEN REVISED AND IS THE ONLY PROPERTY OF FLUOR ENGINEERING AND CONSTRUCTION, INC. AND IS LOANED TO THE COMPANY FOR ITS CONSTRUCTION AND ONLY TO BE USED IN CONNECTION WITH THE PROJECT AND SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISSEMINATED WITHOUT THE WRITTEN CONSENT OF FLUOR ENGINEERING AND CONSTRUCTION, INC. ANY VIOLATION OF THIS NOTICE SHALL BE CONSIDERED A BREACH OF CONTRACT AND SHALL BE SUBJECT TO LEGAL ACTION.



USE ON DISCUSSION OF REPORT DATA
AS SHOWN IN THE RESERVATIONS ON THE
COVER PAGE AT THE FRONT OF THIS REPORT

NOTES:
1. THE TEMPERATURES, PRESSURES, FLOW QUANTITIES SHOWN
ARE TO BE USED SOLELY FOR PROCESS DESIGN PURPOSES.

FOR THE DESIGN OF THE PLANT
AND THE REACTION OF THE
ADVICE PAGE AT THE FRONT OF THIS REPORT

	R. WHITE G. E. ARATAY R. D. SMITH R. L. MCCARTHY R. L. LANG	BLOCK FLOW DIAGRAM PLANT STEAM BALANCE CASE: SHELL COAL - 40% FINES - SNG CROW TRIBE OF INDIANS 835704-00-R-407 NONE	SYMUELS FEASIBILITY STUDY 835704-00-R-407 MICROFILM FRAME NO. 1 OF 2	
	<small> THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF FLUOR CORP. AND IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED HEREIN. NO PART OF THIS DOCUMENT IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF FLUOR CORP. </small>	PROJECT NO. 835704-00-R-407 SHEET NO. 1 OF 2	DATE: 11/1/77	DRAWN BY: J. L. LANG
	CHECKED BY:	APPROVED BY:	DATE:	SCALE:
	DESIGNED BY:	DRAWN BY:	DATE:	SCALE:

6.6.9 UTILITY SUMMARY

Table 6.6.9-1 indicates the utilities generated or consumed by each process or utility unit in the Shell Coal - 40% Fines - SNG Case.

UNIT		STEAM		
NO.	NAME	1500 lb 925°F	650 lb Sat'd	600 lb 760°F
01	Coal Screening			
02	Coal Distribution			
03	Ash Handling			
10	Coal Gasification			
11	CO Shift			-1026.6
12	Gas Cooling			
13	Rectisol			
14	Gas Liquor Separation			
15	Tar Distillation		-12.6	
16	Naphtha Hydrotreating		-18.4	
17	Phenosolvan		-3.3	
18	Ammonia Recovery		-94.1	
19	Sulfur Recovery			
20	Process Steam Superheating		-711.6	+899.9
21	Methanol Synthesis		(+2.8)	
22	Methanation		+828.8	
23	SNG Compression & Purification			-145.7
24	Partial Oxidation		+11.2	
25	PSA Hydrogen Production			
40	Oxygen Production	-1256.4	+1256.4	
41	Steam Generation	+4253.3	-4253.3 ⁽¹⁾	+4253.3
42	Power Generation	-2996.9	+2996.9 ⁽¹⁾	-3980.9
43	Flue Gas Desulfurization			
44	Raw Water Treating			
45	BFW & Condensate Treating			
46	Air & Nitrogen Systems			
47	Process Cooling Water			
48	Utility Cooling Water			
49	Potable Water			
50	Utility Water			
51	Fire Water			
52	Fuel Gas			
53	Flare			
54	Waste Water Treating			
55	Tank Farm & Dispatch			
56	Sanitary Sewer Steam Tracing Export			
Total (Process Units)		0	0	-272.4
Total (Utility Units)		0	0	+272.4
TOTAL		0	0	0

Legend: () indicates intermittent use. Not included in totals
+ indicates production.
- indicates consumption.

NOTES: (1) 650 psig/710°F steam
(2) Included in Wastewater Treating (Unit 54)

TABLE 6.6.9-1

CASE: SHELL COAL - 40% FINES - SNG
UTILITY SUMMARY

STEAM (M lb/hr)				Steam & Condensate Loss (M lb/hr)	Cooling Water		Electric Power (MW)	Fuel Gas (MM Btu/hr)	
lb	100 lb Sat'd	60 lb Sat'd	Condensate (M lb/hr)	BFW (M lb/hr)	(MM Btu/hr)	(gpm)	(MW)	(MM Btu/hr)	
							-1.00		
							-0.10		
							-0.70		
6.6	+538.2			-662.7	1,151.1	-7.86	-524	-2.40	-0.7
		+124.2		-126.1	1.9	-9.23	-615	-0.35	
	-46.2	-90.7	+136.9	-73.2	73.2	-202.4	-13,500	-22.70	+257.7
						-83.4	-5,560	-0.69	
		-12.1	+24.7			-6.0	-400	-0.32	-20.3
		-62.6	+81.0			-5.5	-367	-0.34	(-2.5)
	-5.6	-53.1	+53.4		8.6	-11.5	-767	-0.66	
	-139.5		+233.6			-144.2	-9,613	-0.57	
	+15.5	-20.5	+24.1	-21.0	1.9	-31.5	-2,100	-1.80	-4.8
9.9				-190.2	1.9			-2.08	-284.6
				(-2.9)	(0.1)	-1.2	-80	-0.07	+9.1
				-841.4	12.6	-4.4	-293	-4.65	(-43.0)
5.7	-4.4		+150.1			-153.2	-10,200	-0.25	
	+63.4			-131.3	56.7	-11.9	-794	-0.22	-0.2
						-0.6	-40	-0.97	+48.3
						-161.5	-11,000	-11.60	
1.3	-321.2	+210.6	-947.2	-3,208.4	12.9			-33.60	
0.9	-82.1		+4063.0			-2577.0	-171,900	+422.50	
								-2.50	
								-1.67	
		-92.3	-5165.1	+5254.3	3.1			-5.77	
						-6.5	-433	-3.50	
						+2392.0	+159,553	-10.50	
						+1027.1	+68,707	-4.63	
								-0.03	
								-0.03	
								-0.02	
								-	
								-0.03	-2.0
		-2.5	+2.5					-6.30	-2.5
	-10.8	-1.0	+9.7		2.1	-1.1	-74	-0.73	
								(2)	
	-7.3		+7.3						
								+301.72	
4	+421.4	-114.8	+703.8	-2045.9	1307.9	-673.0	-44,853	-39.87	+4.5
4	-421.4	+114.8	-2029.8	+2045.9	18.1	+673.0	+44,853	+341.59	-4.5
	0	0	-1326.0	0	+1326.0	0	0	+301.7	0

totals.

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

6.6.10 CATALYST AND CHEMICAL SUMMARY

The catalysts and chemicals required for each unit in the Shell Coal - 40% Fines - SNG Case are shown in Table 6.6.10-1.

TABLE 6.6.10-1

CASE: SHELL COAL - 40% FINES - SNG

CATALYST AND CHEMICAL SUMMARY

<u>Unit</u>	<u>Item</u>	<u>Initial Cost, \$</u>	<u>Annual Cost, \$</u>
03	Ash Handling Flocculent	80	960
11	CO Shift Conversion Sour Shift Catalyst	1,555,200	1,555,200
13	Rectisol Propylene Caustic	36,000 -	50,800 88,000
16	Naphtha Hydrotreating Dimethyl Sulfide Confidential Catalyst	2,550 104,700	1,020 35,000
17	Phenosolvan Isopropylether Solvent Gravel Sand Filtrilur	172,200 1,420 3,160 69,400	59,700 180 400 8,670
18	Ammonia Recovery Phosphoric Acid (100%) Sodium Hydroxide (50% soln)	162,100 502,000	77,400 167,300

TABLE 6.6.10-1 (Continued)

CASE: SHELL COAL - 40% FINES - SNG

CATALYST AND CHEMICAL SUMMARY

<u>Unit</u>	<u>Item</u>	<u>Initial Cost, \$</u>	<u>Annual Cost, \$</u>
19	Sulfur Recovery		
	Diisopropanolamine	4,650	2,290
	Claus Catalyst	8,820	2,950
	Shell 634 Catalyst	40,300	13,400
	Citric Acid	2,660	5,730
	ADA	26,700	57,100
	Caustic (50%)	2,610	(25,400) ⁽¹⁾
	Vanadium	21,100	-
21	Methanol Synthesis		
	Synthesis Catalyst	411,840	137,300
22	Methanation		
	Synthesis Catalyst	2,500,000	2,500,000
41	Steam Generation		
	Hydrazine Hydrate	900	9,870
	Sodium Phosphate	90	930
	Morpholine	7,700	85,200
43	Flue Gas Desulfurization		
	Lime (90% CaO)	10,500	477,100
	Formic Acid (90% soln.)	15,200	140,600
	Anti-Foulant (Nalco 7319)	140	1,450
	HCl (30% soln.)	2,630	-

TABLE 6.6.10-1 (Continued)

CASE: SHELL COAL - 40% FINES - SNG

CATALYST AND CHEMICAL SUMMARY

<u>Unit</u>	<u>Item</u>	<u>Initial Cost, \$</u>	<u>Annual Cost, \$</u>
44, 45	Raw Water, BFW Treating & Potable Water		
& 49	Poly-electrolyte	3,790	45,200
	Chlorine	3,770	45,500
	Quick Lime	3,150	7,570
	Soda Ash (Dense Bulk)	27,400	1,036,300
	Alum	3,030	4,960
	Hexametaphosphate	7,650	89,500
	Sulfuric Acid (93%)	20,300	88,400
	Caustic (50% soln.)	113,100	449,500
	Activated Carbon	58,500	28,500
	Hydrazine Hydrate	420	4,590
	Morpholine	3,450	38,100
	Chelant (EDTA)	790	8,790
46	Air & Nitrogen System		
	Activated Alumina	1,150	320
47	Process Cooling Water		
	Chlorine	5,370	63,400
	Sulfuric Acid (93%)	1,050	336,600
	Inhibitor	13,100	157,600
	Dispersant	3,580	42,900
	Biocide	14,700	70,900
	Nalprep	95,200	250
	Activated Carbon	55,500	27,000
	Hexametaphosphate	3,830	41,300

TABLE 6.6.10-1 (Continued)

CASE: SHELL COAL - 40% FINES - SNG

CATALYST AND CHEMICAL SUMMARY

<u>Unit</u>	<u>Item</u>	<u>Initial Cost, \$</u>	<u>Annual Cost, \$</u>
48	Utility Cooling Water		
	Chlorine	3,630	43,500
	Sulfuric Acid (93%)	16,300	195,000
	Inhibitor	6,230	74,700
	Dispersant	1,710	20,500
	Biocide	4,980	25,800
	Nalprep	34,100	90
	Poly-electrolyte	1,400	16,700
	Quick Lime	1,170	2,800
	Soda Ash (Dense Bulk)	9,980	384,000
54	Wastewater Treating		
	Caustic (50%)	150,800	3,385,500
	Sulfuric Acid (93%)	4,840	117,000
	Poly-electrolyte	210	24,700
	Phosphoric Acid (100%)	3,650	40,200
55	Tank Farm & Dispatch		
	SNG Odorant (Ethyl/ Amyl Mercaptan)	140	1,590
	NaCl	1,600	424,800
		<u>1,600</u>	<u>424,800</u>
TOTAL		\$6,344,220	\$12,822,710

(1) First year only, not included in total

6.6.11 OPERATING MANPOWER

The operating manpower for the Shell Coal - 40% Fines - SNG Case is 416.
The process is the same for this case as for the Base Case.

6.6.12 MAINTENANCE MANPOWER

Annual maintenance cost is estimated as a percentage of the plant installed cost. The same procedure for determining maintenance cost as used on the Base Case (Section 6.1.12) was followed for the Shell Coal - 40% Fines - SNG Case yielding a cost of \$36,400,000, which is 60 percent materials and 40 percent labor.

The labor portion of \$14,600,000 is equivalent to 416 maintenance staff positions using the same assumptions as the Base Case.

6.6.13 PROCESS UNITS ENGINEERING DATA

6.6.13.1 DIFFERENCES

All aspects of the process units in the Shell Coal Case are identical to the Base Case except the unit material balances caused by the different characteristics of the coal. The main differences are high volatiles and low sulfur content of the coal which result in higher throughput in Tar Distillation, Naphtha Hydrotreating, and Partial Oxidation units and reduced sulfur production respectively. Detailed material balances for all process units are included in this section (See Tables 6.6.13-1 through 6.6.13-19 for Units 01 through 03 and Units 10 through 25).

TABLE 6.6.13-1

MATERIAL BALANCE
COAL SCREENING - UNIT 01

Stream Number	1-1	1-2	1-3
Stream Name	Total Coal Feed	Sized Coal to Gasification	Coal Fines to Boilers
DAF Coal, lb/hr	1,020,800	612,480	408,320
Moisture, lb/hr	385,734	231,440	154,294
Ash, lb/hr	60,133	36,080	24,053
TOTAL, lb/hr	1,466,667	880,000	586,667
ST/SD	17,600	10,560	7,040

NOTE: Flow quantities 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 operation.

TABLE 6.6.13-2

MATERIAL BALANCE
COAL DISTRIBUTION - UNIT 02

Stream Number	2-1	2-2
Stream Name	Sized Coal to Gasification	Coal Fines to Boilers
DAF Coal, lb/hr	612,480	408,320
Moisture, lb/hr	231,440	154,294
Ash, lb/hr	36,080	24,053
TOTAL, lb/hr	880,000	586,667
ST/SD	10,560	7,040

NOTE: Flow quantities 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 operation.

Stream Number	3-1	3-2
Stream Name	Gasifier Ash ⁽²⁾	POX Ash ⁽²⁾
Dry Solids, lb/hr	37,300	30
Water, lb/hr		
Sludge, lb/hr		
ST/SD		
Wt% Solids		

NOTES: (1) Flow quantities shown are for the total unit and are not necessarily the conditions which will be used.

(2) Only dry solids flows are shown.

TABLE 6.6.13-3
MATERIAL BALANCE
ASH HANDLING - UNIT 03

3-2 Ash ⁽²⁾	3-3 Boiler Bottom Ash ⁽²⁾	3-4 Boiler Fly Ash ⁽²⁾	3-5 Makeup Water	3-6 FGD Sludge	3-7 Solid Waste to Disposal
30	4,811	19,094	-	10,588	71,823
			22,440	3,162	25,602
			-	13,750	97,425
			-	165	1,169.1
			-0-	77.0	73.7

total unit on a stream-day basis, are to be used solely for process design purposes, and are
 h will be attained during actual operations.

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

TABLE 6.6.13-4

MATERIAL BALANCE
GASIFICATION - UNIT 10

Stream Number	10-1	10-2	10-3	10-4
Stream Name	Sized Coal Feed	Oxidant	Crude Gas	Ash
		lb-mol/hr Mol%	lb-mol/hr Mol%	
H ₂			22,127.3	40.14
N ₂		100.8 1.5	121.3	0.22
CO			8,996.5	16.32
CH ₄			6,036.2	10.95
C ₂ H ₄			105.5	0.19
C ₂ H ₆			353.2	0.64
C ₃ H ₆			45.9	0.08
C ₃ H ₈			45.9	0.08
C ₄ H ₈			11.5	0.02
C ₄ H ₁₀			11.5	0.02
CO ₂			17,177.1	31.16
H ₂ S			93.7	0.17
COS			2.0	0.004
O ₂		6,622.6 98.5		
		100.00		100.00
Dry Gas, lb-mol/hr			55,127.6	66.99
H ₂ O Vapor, lb-mol/hr		-0- -0-	27,164.7	33.01
Wet Gas, lb-mol/hr		6,723.4 100.00	82,292.3	100.00
Dry Gas, lb/hr		214,735	1,174,990	
H ₂ O, lb/hr	231,440		489,399	
Tars, lb/hr			24,989	
Oils, lb/hr			29,460	
Naphtha, lb/hr			9,616	
Phenols, lb/hr			5,329	
Fatty Acids, lb/hr			1,225	
Org. Sulfur, lb/hr			94	
Ammonia, lb/hr			7,962	
HCl, lb/hr			189	
DAF Coal, lb/hr	612,480			
Ash, lb/hr	36,080			37,300*
TOTAL, lb/hr	880,000	214,735	1,748,253	37,300
Pressure, psia	Ambient	505	435	Ambient
Temperature, °F	Ambient	230	355	650

* Includes unburned carbon

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 6.6.13-5

MATERIAL BALANCE

CO SHIFT - UNIT 11

Stream Number	11-1		11-2		11-3	
Stream Name	Crude Gas		POX Gas		Shifted Gas	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H ₂	22,127.3	40.14	2,050.8	42.80	27,494.9	43.23
N ₂	121.3	0.22	26.4	0.55	147.7	0.23
CO	8,996.5	16.32	2,411.9	50.34	7,543.1	11.86
CH ₄	6,036.2	10.95	16.1	0.34	6,694.6	10.53
C ₂ H ₄	105.5	0.19				
C ₂ H ₆	353.2	0.64			229.4	0.36
C ₃ H ₆	45.9	0.08				
C ₃ H ₈	45.9	0.08			45.9	0.07
C ₄ H ₈	11.5	0.02				
C ₄ H ₁₀	11.5	0.02			11.5	0.02
CO ₂	17,177.1	31.16	281.5	5.87	21,330.1	33.54
H ₂ S	93.7	0.17	4.5	0.09	101.5	0.16
COS	2.0	0.004	0.3	0.006	1.7	0.003
		<u>100.00</u>		<u>100.00</u>		<u>100.00</u>
Dry Gas, lb-mol/hr	55,127.6	<u>66.99</u>	4,791.5	<u>68.09</u>	63,600.4	<u>71.33</u>
H ₂ O Vapor, lb-mol/hr	27,164.7	33.01	2,245.5	31.91	25,567.9	28.67
Wet Gas lb-mol/hr	82,292.3	100.00	7,037.0	100.00	89,168.3	100.00
Dry Gas, lb/hr	1,174,990		85,252		1,330,169	
H ₂ O, Vapor, lb/hr	489,399		40,455		460,631	
H ₂ O, Liquid, lb/hr	-				-	
Tars, lb/hr	24,989					
Oils, lb/hr	29,460				44,190	
Naphtha, lb/hr	9,616				21,014	
Phenols, lb/hr	5,329				3,571	
Fatty Acids, lb/hr	1,225				1,225	
Org. Sulfur, lb/hr	94				9	
Ammonia, lb/hr	7,962			17	7,979	
HCl	189				189	
TOTAL, lb/hr	1,743,253		125,724		1,868,977	
Pressure, psia	435		450		415	
Temperature, °F	355		355		432	

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 6.6.13-6

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	27,494.9	43.23	27,477.1	43.65	17.8	2.75
N ₂	147.7	0.23	147.7	0.23		
CO	7,543.1	11.86	7,534.4	11.97	8.7	1.35
CH ₄	6,694.6	10.53	6,687.2	10.62	7.4	1.14
C ₂ H ₆	229.4	0.36	229.4	0.36		
C ₃ H ₈	45.9	0.07	45.9	0.07		
C ₄ H ₁₀	11.5	0.02	11.5	0.02		
CO ₂	21,330.1	33.54	20,721.4	32.91	608.7	94.17
H ₂ S	101.5	0.16	97.7	0.16	3.8	0.59
COS	1.7	0.003	1.7	0.003		
		<u>100.00</u>		<u>100.00</u>		<u>100.00</u>
Dry Gas, lb-mol/hr	63,600.4	71.33	62,954.0	99.77	646.4	100.00
H ₂ O Vapor, lb-mol/hr	25,567.9	28.67	147.9	0.23	-	-
Wet Gas, lb-mol/hr	89,168.3	100.00	63,101.9	100.00	646.4	100.00
Dry Gas, lb/hr	1,330,169		1,302,852		27,317	
H ₂ O, Vapor, lb/hr	460,631		2,665		-	
H ₂ O, Liquid, lb/hr	-		-		457,966	
Tars/Oils, lb/hr	44,190		-		44,190	
Naphtha, lb/hr	21,014		21,014		-	
Phenols, lb/hr	3,571		-		3,571	
Fatty Acids, lb/hr	1,225		-		1,225	
Org. Sulfur, lb/hr	9		9		-	
Ammonia, lb/hr	7,979		-		7,979	
HCl, lb/hr	189		-		189	
TOTAL, lb/hr	1,868,977		1,326,540		542,437	
Pressure, psia	415		405		250	
Temperature, °F	432		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.

Stream Number	13-1		13-2		P
Stream Name	Raw Gas from Gas Cooling		Pure Gas to Methanation		M PS.
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-
H ₂	27,477.1	43.65	26,176.2	59.36	1.1
N ₂	147.7	0.23	140.9	0.32	
CO	7,531.4	11.97	7,165.8	16.25	
CH ₄	6,687.2	10.62	7,589.2	17.21	
C ₂ H ₆	229.4	0.36	123.5	0.28	
C ₃ H ₈	45.9	0.07			
C ₄ H ₁₀	11.5	0.02			
CO ₂	20,721.4	32.91	2,901.6	6.58	
H ₂ S	97.7	0.16			
COS	1.7	0.003			
Dry Gas, lb-mol/hr	62,954.0	<u>100.00</u> 99.77	44,097.2	<u>100.00</u> 100.00	2.1
H ₂ Vapor, lb-mol/hr	147.9	0.23	-0-	-0-	
Wet Gas, lb-mol/hr	63,101.9	100.00	44,097.2	100.00	2.1
Dry Gas, lb/hr	1,302,852		510,609		
H ₂ Vapor, lb/hr	2,665		-		
H ₂ Liquid, lb/hr	-				
Naphtha, lb/hr	21,014				
Org. Sulfur, lb/hr	9				
TOTAL, lb/hr	1,326,540		510,609		
Pressure, psia	405		360		
Temperature, °F	100		68		

NOTE: Flow quantities, pressures, and temperatures shown are for design purposes, and are not necessarily the conditions of the process.

TABLE 6.6.13-7

MATERIAL BALANCE

RECTISOL - UNIT 13

	13-3 Pure Gas to MeOH Synt., PSA & Fuel Gas		13-4 CO ₂ -Rich Gas to Stm. Superhtr.		13-5 H ₂ S Lean Gas to Stretford		13-6 H ₂ S Rich Gas to ADIP		13-7 Gas Liquor to Gas Liq. Separ.		13-8 Naphtha to Nap. HT	
#	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol %	lb-mol/hr	Mol %		
.36	1,269.6	59.36			31.3	0.35						
.32	6.8	0.32										
.25	347.8	16.25			20.8	0.23						
.21	368.1	17.21	24.4	0.25	25.2	0.28						
.28	6.0	0.28	64.2	0.65	35.2	0.39	0.5	0.06				
			5.7	0.06	26.9	0.30	13.3	1.66				
					2.3	0.02	9.2	1.15				
.58	140.7	6.58	9,794.6	99.04	8,898.8	98.13	706.0	88.23				
					27.3	0.30	70.4	8.80				
			0.2	0.00	0.7	0.01	0.8	0.10				
.00		100.00		100.00		100.00		100.00				
.00	2,139.0	100.00	9,889.1	100.00	9,068.5	100.00	800.2	98.15				
0-	-0-	-0-	-	-0-	-	-0-	15.1	1.85				
.00	2,139.0	100.00	9,889.1	100.00	9,068.5	100.00	815.3	100.00				
	24,770		433,655		396,046		34,655		-			
							273		-			
									2,359			
							397				20,617	
											9	
	24,770		433,655		396,046		35,325		2,359		20,626	
	360		25		23		25		230		40	
	68		100		75		80		56		113	

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

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

TABLE 6.6.13-8

MATERIAL BALANCE

GAS LIQUOR SEPARATION - UNIT 14

Stream Number	14-1 Oily 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	244				244
CH ₄ , lb/hr	119				119
CO ₂ , lb/hr	28,789		21,759		5,030
H ₂ S, lb/hr	129		82		47
H ₂ O, lb/hr	457,966	2,359	216,765		168
Tar/Oils, lb/hr	44,190		-	44,190	
Phenols, lb/hr	3,571		3,571		
Fatty Acids, lb/hr	1,225		1,225		
Ammonia, lb/hr	7,979		7,979		
HCl, lb/hr	189		189		
TOTAL, lb/hr	542,487	2,359	951,570	44,190	5,644
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 to Gas Liquor Separation.

(3) Net inflow to the unit of Dusty Gas Liquor from Gasification unit equals 456,608 lb/hr, assumed to be all water.

TABLE 6.6.13-9

MATERIAL BALANCE
TAR DISTILLATION - UNIT 15

Stream Number	15-1	15-2	15-3
Stream Name	Tar/Oil from Gas Liquor Separation	Tar Naphtha to Hydrotreating	Residue Oil to POX
Tar/Oils, lb/hr	44,190	-	35,352
Naphtha, lb/hr	-	8,838	-
TOTAL, lb/hr	44,190	8,838	35,352
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.

TABLE 6.6.13-10

MATERIAL BALANCE

NAPHTHA HYDROTREATING - UNIT 16

Stream Number	16-1	16-2	16-3	16-4
Stream Name	Naphtha from Rectisol	Tar Naphtha from Tar Dist.	Makeup Hydrogen	Naphtha Product
Component	lb mol/hr Mol%			
H ₂			177.0	99.5
N ₂			1.0	0.5
CO				
CH ₄				
C ₂ H ₆				
C ₃ H ₈				
C ₄ H ₁₀				
CO ₂				
H ₂ S				
Dry Gas, lb-mol/hr			178.0	100.00
H ₂ O Vapor, lb-mol/hr			-	-0-
Wet Gas, lb-mol/hr			178.0	100.00
Dry Gas, lb/hr	-	-	385	-
H ₂ O Vapor, lb/hr	-	-	-	-
H ₂ O Liquid, lb/hr	-	-	-	-
Naphtha, lb/hr	20,617	8,838	-	29,385
Org. Sulfur, lb/hr	9	-	-	-
TOTAL, lb/hr	20,626	8,838	385	29,385
Pressure, psia	35	50	890	50
Temperature, °F	113	158	380	108

- NOTES: 1. Flow quantities, pressures, and temperatures shown are on a stream-day basis, are to be used as design conditions and are not necessarily the conditions which will be attained during actual operations.
2. A slip stream of stripped gas liquor from Ammonia Recovery Unit flows to this unit at the rate of 100 lb/hr.

TABLE 6.6.13-10

MATERIAL BALANCE

NAPHTHA HYDROTREATING - UNIT 16

-2 Naphtha Dist.	16-3 Makeup 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%	
	177.0	99.5		11.1	48.05	
	1.0	0.5		2.7	11.69	
				0.2	0.86	
				3.7	16.02	
				1.7	7.36	
				1.0	4.33	
				0.7	3.03	
				0.2	0.87	
				1.8	7.79	
	178.0	100.00		23.1	100.00	
	-	-0-		-	-0-	
	178.0	100.00		23.1	100.00	
-	385		-			-
-	-		-			-
-	-		-			3,180
838	-		29,385	-		-
-	-		-	-		-
838	385		29,385	369		3,180
50	890		50	25		75
158	380		108	100		100

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

From Ammonia Recovery Unit flows to this unit at the rate of 3,085 lb/hr.

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

TABLE 6.6.13-11

MATERIAL BALANCE
PHENOSOLVAN - UNIT 17

Stream Number	17-1	17-2	17-3
Stream Name	Gas Liquor Feed	Gas Liquor to NH ₃ Recov.	Phenols to POX
CO ₂ , lb/hr	21,759	21,759	-
H ₂ S, lb/hr	82	82	-
H ₂ O, lb/hr	921,599	923,824	135
Phenols, lb/hr	3,571	315	3,256
Fatty Acids, lb/hr	1,335	1,190	35
Ammonia, lb/hr	7,979	7,979	-
HCl, lb/hr	189	189	-
TOTAL, lb/hr	956,404	955,338	3,426
Pressure, psia	55	100	72
Temperature, °F	95	120	180-285

NOTES: 1. Flow quantities, pressures, and temperatures shown 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. 2,360 lb/hr of stripping steam is added to the unit.

TABLE 6.6.13-12

MATERIAL BALANCE
AMMONIA RECOVERY - UNIT 18

Stream Number	18-1	18-2	18-3	18-4
Stream Name	Gas Liquor Feed	Ammonia Product	Stripped Gas Liquor	Acid Gas to Stretford
CO ₂ , lb/hr	21,759	-	13	21,746
H ₂ S, lb/hr	82	-	-	82
H ₂ O, lb/hr	928,824	38	922,853	933
Phenols, lb/hr	315	-	315	-
Fatty Acids, lb/hr	1,190	-	1,190	-
Ammonia, lb/hr	7,979	7,488	491	-
HCl, lb/hr	189	-	189	-
TOTAL, lb/hr	955,338	7,526	925,051	22,761
Pressure, psia	100	220	145	20
Temperature, °F	120	100	100	120

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.

SULF

Stream Number	19-1	19-2
Stream Name	H ₂ S-Rich Gas from Rectisol	Condensate
Component	lb-mol/hr Mol%	lb-mol/hr Mol%
H ₂		
N ₂		
O ₂		
CO		
CH ₄		
C ₂ H ₆	0.5 0.06	
C ₃ H ₈	13.3 1.66	
C ₄ H ₁₀	9.2 1.15	
CO ₂	706.0 88.23	
H ₂ S	70.4 8.80	
COS	0.8 0.10	
SO ₂		
S ₆ -S ₈		
Total Dry Gas	800.2 <u>98.15</u>	<u>100.00</u>
H ₂ O	75.1 1.85	22.2
Total Wet Gas	815.3 100.00	100.00
Dry Gas, lb/hr	34,655	
H ₂ O, lb/hr	273	400
Naphtha	397	
Sulfur		
TOTAL, lb/hr	35,325	400
Pressure, psia	25	60
Temperature, °F	80	290

NOTE: Flow quantities, pressures, and temperatures are for purposes, and are not necessarily the conditions whi.

TABLE 6.6.13-13

MATERIAL BALANCE

SULFUR RECOVERY - UNIT 19

9-2 Sulfate	19-3 Off Gas to Stretford		19-4 Process Gas to Claus		19-5 Atmospheric Air		19-6 Air to SCOT	
/hr Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
					420.6	79.00	26.1	79.00
					111.8	21.00	7.0	21.00
	0.4	0.07	0.1	0.04				
	10.2	1.90	3.1	1.18				
	7.0	1.30	2.2	0.84				
	519.1	96.56	186.9	71.17				
	0.5	0.10	69.9	26.62				
	0.4	0.07	0.4	0.15				
<u>100.00</u>		<u>100.00</u>		<u>100.00</u>		<u>100.00</u>		<u>100.00</u>
	537.6		262.6		532.4		33.1	
	30.6		6.7		7.2		0.4	
100.00	568.2	100.00	269.3	100.00	539.6	100.00	33.5	100.00
	23,756		10,900		15,360		955	
400	551		121		130		7	
			397					
400	24,307		11,418		15,490		962	
60	22		28		24		24	
290	100		100		180		180	

These values are for the total unit on a stream-day basis, and are to be used solely for process design conditions which will be attained during actual operations.

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

TABLE 6.6.13-13 (Continued)

MATERIAL BALANCE

SULFUR RECOVERY - UNIT 19

Stream Number	19-7	19-8	19-9	19-10
Stream Name	Sulfur to Tank Farm	Tailgas to SCOT	Reducing Gas from Hydrogen Production	SCOT Tail gas to Stretford
Component	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr M
H ₂			14.1 100.00	8.9 1
N ₂		394.6 62.25		420.6 62
O ₂				
CO				
CH ₄				
C ₂ H ₆				
C ₃ H ₈				
C ₄ H ₁₀				
CO ₂		234.8 37.04		238.5 35
H ₂ S		2.4 0.38		5.1 0
COS		0.5 0.08		
SO ₂		1.5 0.24		
S ₆ -S ₈		0.1 0.01		
Total Dry Gas	<u>100.00</u>	633.9 <u>100.00</u>	14.1 <u>100.00</u>	673.1 <u>100</u>
H ₂ O		124.2		45.2
Total Wet Gas	100.00	758.1 100.00	14.1 100.00	718.3 100
Dry Gas, lb/hr		21,618	28	22,471
H ₂ O, lb/hr		2,238		814
Naphtha				
Sulfur	2,091			
TOTAL, lb/hr	2,091	23,856	28	23,285
Pressure, psia	50	18	900	20
Temperature, °F	285	280	380	100

NOTE: Flow quantities, pressures, and temperatures are for the total unit on a stream-day basis purposes, and are not necessarily the conditions which will be attained during actual operation.

TABLE 6.6.13-13 (Continued)

MATERIAL BALANCE

SULFUR RECOVERY - UNIT 19

19-8 Tailgas to SCOT		19-9 Reducing Gas from Hydrogen Production		19-10 SCOT Tail- gas to Stretford		19-11 Wastewater to Phenosolvan		19-12 Sour Gas from Naphtha Hydrotreating	
mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
194.6	62.25	14.1	100.00	8.9	1.32			11.1	48.05
				420.6	62.49			2.7	11.69
								0.2	0.86
								3.7	16.02
								1.7	7.36
								1.0	4.33
								0.7	3.03
334.8	37.04			238.5	35.43			0.2	0.87
2.4	0.38			5.1	0.76			1.8	7.79
0.5	0.08								
1.5	0.24								
0.1	0.01								
	<u>100.00</u>		<u>100.00</u>		<u>100.00</u>		<u>100.00</u>	23.1	<u>100.00</u>
633.9		14.1		673.1					
124.2				45.2		91.8		23.1	100.00
758.1	100.00	14.1	100.00	718.3	100.00		100.00		
									369
21,618		28		22,471					
2,238				814		1,654			
									369
23,856		28		23,285		1,654			
									20
18		900		26		65			100
280		380		100		100			

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

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

TABLE 6.6.13-13 (Continued)

MATERIAL BALANCESULFUR RECOVERY - UNIT 19

Stream Number	19-13		19-14		19-15		19-16	
Stream Name	Offgas from Ammonia Recovery		Expansion Gas from Gas Liquor Separation		H ₂ S Lean Gas from Rectisol		Oxidation Vent	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H ₂			17.9	11.96	31.3	0.34		
N ₂							161.9	82.2
O ₂							31.7	16.0
CO			8.7	5.81	20.8	0.23		
CH ₄			7.4	4.94	25.2	0.28		
C ₂ H ₆					35.2	0.39		
C ₃ H ₈					26.9	0.30		
C ₄ H ₁₀					2.3	0.02		
CO ₂	494.1	99.52	114.3	76.35	8,898.8	98.13	3.4	1.7
H ₂ S	2.4	0.48	1.4	0.94	27.3	0.30		
COS					0.7	0.01		
SO ₂								
S ₆ -S ₈								
Total Dry Gas	496.5	<u>100.00</u>	149.7	<u>100.00</u>	9,068.5	<u>100.00</u>	197.0	<u>100.0</u>
H ₂ O	51.8		9.3				2.9	
Total Wet Gas	548.3	100.00	159.0	100.00	9,068.5	100.00	199.9	100.0
Dry Gas, lb/hr	21,828		5,476		396,046		5,699	
H ₂ O, lb/hr	933		168				52	
Naphtha								
Sulfur								
TOTAL, lb/hr	22,761		5,644		396,046		5,751	
Pressure, psia	20		20		23		13.5	
Temperature, °F	120		135		75		104	

NOTE: Flow quantities, pressures, and temperatures are for the total unit on a stream-day basis purposes, and are not necessarily the conditions which will be attained during actual operation.

TABLE 6.6.13-13 (Continued)

MATERIAL BALANCE

SULFUR RECOVERY - UNIT 19

19-14 Expansion Gas Gas Liquor Separation		19-15 H ₂ S Lean Gas from Rectisol		19-16 Oxidation Vent		19-17 Sulfur to Tank Farm		19-18 Vent Gas to Process Steam Superheater	
lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
7.9	11.96	31.3	0.34					69.2	0.64
				161.9	82.20			423.3	3.88
				31.7	16.08				
8.7	5.81	20.8	0.23					29.7	0.27
7.4	4.94	25.2	0.28					36.3	0.34
		35.2	0.39					37.3	0.34
		26.9	0.30					38.1	0.35
		2.3	0.02					10.0	0.09
4.3	76.35	8,898.8	98.13	3.4	1.72			10,261.6	94.08
1.4	0.94	27.3	0.30					0.1	0.001
		0.7	0.01					1.1	0.01
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	
9.7	<u>100.00</u>	9,068.5	<u>100.00</u>	197.0	<u>100.00</u>		<u>100.00</u>	10,906.7	<u>100.00</u>
9.3				2.9				689.0	
9.0	100.00	9,068.5	100.00	199.9	100.00		100.00	1,595.7	100.00
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	
5,476		396,046		5,699				468,487	
168				52				12,413	
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	
						1,232			
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	
5,644		396,046		5,751		1,232		480,900	
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	
20		23		13.5		50		18	
135		75		104		285		100	
<hr/>		<hr/>		<hr/>		<hr/>		<hr/>	

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

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

TABLE 6.6.13-14

MATERIAL BALANCE

PROCESS STEAM SUPERHEATING - UNIT 20

Stream Number	20-1	20-2	20-3	20-4
Stream Name	CO ₂ -Rich Gas from Rectisol	Vent Gas from Sulfur Recovery	Oxidant	Flue Gas to Stack
Component	lb-mol/hr	lb-mol/hr	lb-mol/hr	lb-mol/hr
	Mol%	Mol%	Mol%	Mol%
H ₂		69.2		
N ₂		423.3		
CO		29.7	10,772.1	11,198.2
CH ₄	24.4	36.3		0.4
C ₂ H ₆	64.2	37.3		
C ₃ H ₈	5.7	38.1		
C ₄ H ₁₀		10.0		
CO ₂	9,794.6	10,261.6	3.4	21,292.4
H ₂ S		0.1		
COS	0.2	1.1		
SO ₂				1.4
O ₂			2,852.2	734.7
NO _x				4.8
Total Dry Gas	9,889.1	10,906.7	13,627.7	33,231.9
H ₂ O		689.0	183.5	3,205.9
Total Wet Gas	9,889.1	10,595.7	13,811.2	36,437.8
Dry Gas, lb/hr	433,655	468,487	343,179	1,274,627
H ₂ O, lb/hr		12,413	3,306	57,757
TOTAL, lb/hr	433,655	480,900	396,485	1,332,384
Pressure, psia	25	18	13	13.5
Temperature, °F	100	100	60	400

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 6.6.13-15

MATERIAL BALANCE
METHANOL SYNTHESIS - UNIT 21

Stream Number	21-1		21-2		21-3	
Stream Name	Syngas Feed ⁽²⁾		Methanol to Rectisol		Purge Gas to Fuel Gas	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H ₂	53.0	59.36			12.67	35.58
N ₂	0.3	0.32			0.40	1.12
CO	14.5	16.25			2.40	6.74
CH ₄	15.4	17.21	0.05		18.13	50.94
C ₂ H ₆	0.2	0.28			0.27	0.75
CO ₂	5.9	6.58	0.07		1.60	4.49
CH ₃ OH		-			0.13	0.37
Dry Gas, lb-mol/hr	89.3	<u>100.00</u>	0.12	<u>100.00</u>	35.6	<u>100.00</u>
H ₂ O Vapor, lb-mol/hr	-	-0-	-	-0-	-	-0-
Wet Gas, lb-mol/hr	89.3	100.00	0.12 ⁽³⁾	100.00	35.6	100.00
Dry Gas, lb/hr		1,034		4 ⁽³⁾		477
H ₂ O Vapor, lb/hr		-				-
H ₂ O Liquid, lb/hr		-		10		-
CH ₃ OH, liquid, lb/hr		-		543		-
TOTAL, lb/hr		1,034		557		477
Pressure, psia		355		75		75
Temperature, °F		68		100		100

- 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 syngas feed to the unit (total feed less purge gas recycle to Rectisol).
- (3) Represents dissolved gases in the methanol liquid stream.

TABLE 6.6.13-16

MATERIAL BALANCE

METHANATION - UNIT 22

Stream Number	22-1		22-2		22-3	22-4
	Syngas Feed lb-mol/hr	Mol%	Pur. & Comprn. lb-mol/hr	SNG to	Condensate	Recycle Gas
H ₂	26,176.2	59.36	226.9	1.25		2,177.0
N ₂	140.9	0.32	140.9	0.78		196.4
CO	7,165.8	16.25	9.1	0.05		73.3
CH ₄	7,589.2	17.21	15,869.7	87.48		21,639.7
C ₂ H ₄	123.5	0.28	-	-		-
CO ₂	2,901.6	6.58	1,894.0	10.44		3,058.8
		100.00		100.00		100.00
Dry Gas, lb-mol/hr	44,097.2	100.00	18,140.6	99.65		27,145.2
H ₂ Vapor, lb-mol/hr	-	-0-	64.0	0.35		12,099.0
Wet Gas, lb-mol/hr	44,097.2	100.00	18,204.6	100.00		39,244.2
Dry Gas, lb/hr	510,609		342,614			493,730
H ₂ Vapor, lb/hr			1,153			217,976
H ₂ O Liquid, lb/hr					166,842	
TOTAL, lb/hr	510,609		343,767		166,842	711,706
Pressure, psia	355		270		270	315
Temperature, °F	68		100		200	543

6-696

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 6.6.13-17

MATERIAL BALANCE
SNG PURIFICATION AND COMPRESSION - UNIT 23

Stream Number Stream Name	23-1 SNG from Methanation		23-2 SNG to Pipeline	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H ₂	226.9	1.25	226.9	1.50
N ₂	140.9	0.78	140.9	0.93
CO	9.1	0.05	9.1	0.06
CH ₄	15,869.7	87.48	14,550.0	96.36
CO ₂	1,894.0	10.44	173.7	1.15
Dry Gas, lb-mol/hr	18,140.6	<u>100.00</u> 99.65	15,100.6	<u>100.00</u>
H ₂ O Vapor, lb-mol/hr	64.0	0.35	-	-0-
Wet Gas, lb-mol/hr	18,204.6	100.00	15,100.6	100.00
Dry Gas, lb/hr	342,614		245,736	
H ₂ O Vapor, lb/hr	1,153		-	
TOTAL, lb/hr	343,767			
Pressure, psia	270		1,448	
Temperature, °F	100		115	

- 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. CO₂, CH₄, and H₂O removed from the SNG at a total rate of 97,336 lb/hr flow to the Rectisol Unit 13.
3. 695 lb/hr of water separated from SNG is sent to the BFW System.

TABLE 6.6.13-18
MATERIAL BALANCE
PARTIAL OXIDATION - UNIT 24

Stream Number	24-1	24-2	24-3	24-5	24-
Stream Name	Oily Feed	Oxidant	Steam	Makeup Condensate	Raw to Un
Component	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr
H ₂					2,050.8
N ₂		16.8			26.4
O ₂		1,106.3			2,411.9
CO					281.5
CO ₂					16.1
CH ₄					4.5
H ₂ S					0.3
COS					
Total Dry Gas	<u>100.00</u>	1,123.1	<u>100.00</u>	<u>100.00</u>	4,791.5
H ₂ O					2,245.5
Total Wet Gas					7,037.0
Dry Gas, lb/hr		35,869	18,974	35,184	85,
H ₂ O, lb/hr					40,
Tars, lb/hr	35,352				
Phenols, lb/hr	3,426				
Ammonia, lb/hr					
Ash, lb/hr					
TOTAL, lb/hr	38,778	35,869	18,974	35,184	125.
Pressure, psia	115	489	613	460	
Temperature, °F	350	284	489	212	

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

TABLE 6.6.13-18
MATERIAL BALANCE
PARTIAL OXIDATION - UNIT 24

24-3		24-5		24-6		24-7		24-8	
Steam		Makeup Condensate		Raw Gas to Unit 11		Blowdown to Unit 54		Ash	
mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr
				2,050.8	42.80				
				26.4	0.55				
				2,411.9	50.34				
				281.5	5.87				
				16.1	0.34				
				4.5	0.09				
				0.3					
<u>1.00</u>		<u>100.00</u>				<u>100.00</u>			
				4,791.5					
				2,245.5					
				7,037.0					
				85,252					
	18,974		35,184	40,455			3,051		
				17					30
	18,974		35,184	125,724			3,051		30
	613		460	450			69		
	489		212	355			269		

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

TABLE 6.6.13-19

MATERIAL BALANCE
PSA HYDROGEN PRODUCTION - UNIT 25

Stream Number	25-1		25-2		25-3	
Stream Name	Syngas Feed		Hydrogen Product		Purge Gas to Fuel Gas	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H ₂	265.3	59.36	191.1	99.5	74.2	29.12
N ₂	1.4	0.32	1.0	0.5	0.4	0.16
CO	72.6	16.25			72.6	28.49
CH ₄	76.9	17.21			76.9	30.18
C ₂ H ₆	1.3	0.28			1.3	0.57
CO ₂	29.4	6.58			29.4	11.54
TOTAL, lb-mol/hr	446.9	100.00	192.1	100.00	254.8	100.00
Pressure, psia	5,175		900		75	
Temperature, °F	68		380		100	

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.

6.6.14 UTILITY AND OFFSITE UNITS

6.6.14.1 GENERAL

An alternate site (Site 23 - minemouth) and coal were studied using coal from the Shell mine and designated the Shell Coal Case. The only difference between this case and the Base Case is the coal fed to the plant. The Shell coal, however, causes change, although generally minor, in almost every unit of the plant.

In the Utilities and Offsites area differences in capacity occur in the following units:

- Unit 40 - Oxygen Production
- Unit 41 - Steam Generation
- Unit 42 - Power Generation
- Unit 43 - Flue Gas Desulfurization
- Unit 44 - Raw Water Treatment
- Unit 45 - Boiler Feed Water and Condensate Treatment
- Unit 47 - Process Cooling Water
- Unit 48 - Utility Cooling Water
- Unit 52 - Fuel Gas
- Unit 53 - Flare
- Unit 54 - Waste Water Treatment
- Unit 55 - Tank Farm and Dispatch

6.6.14.2 OXYGEN PRODUCTION - UNIT 40

Increased oxygen requirements to the gasifiers and the Partial Oxidation Unit increases the oxygen produced in Unit 40 from 2,925 tons per day (TPD) to 3,007 tons per day. The material balance for Unit 40 for the Shell Coal Case follows as Table 6.6.14-1.

6.6.14.3 STEAM GENERATION - UNIT 41

Although the fines fed to the boiler in the Shell Coal Case decreased to 7,040 TPD from the Base Case rate of 7,200 TPD, the coal heating value is higher increasing the total steam generation from 4.12 million lb/hr in the Base Case to 4.25 million lb/hr in the Shell Coal Case. The material balance for Unit 41 for this case follows as Table 6.6.14-2.

6.6.14.4 POWER GENERATION - UNIT 42

Higher steam generation results in power generation of 422.8 MW total in the Shell Coal Case, 14.8 MW higher than the Base Case. The net export power from the Shell Coal Case plant increases to 301.7 MW from 283.2 MW in the Base Case. The material balance for Unit 41 for the Shell Coal Case follows as Table 6.6.14-3.

6.6.14.5 FLUE GAS DESULFURIZATION - UNIT 43

The Shell coal has lower sulfur content than the Base Case coal. This, added to the decreased coal rate to the boilers, lowers the sulfur removal requirement of the Flue Gas Desulfurization (FGD) Unit 43 from 53 TPD to 23 TPD. Because of the higher air requirement of the boilers, however, the total flue gas to the FGD unit rises to 1.24 million SCFM in the Shell Coal Case from 1.20 million SCFM in the Base Case. The material balance for Unit 43 for this case follows as Table 6.6.14-4.

6.6.14.6 RAW WATER TREATMENT - UNIT 44

Increased water requirements in the boilers and cooling water systems increase the raw water flow Unit 44 from the Big Horn River. The flow for the Shell Coal Case is 7,076 gpm, up from 6,813 gpm in the Base Case. The material balance for Unit 44 for the Shell Coal Case follows as Table 6.6.14-5.

6.6.14.7 BOILER FEED WATER AND CONDENSATE TREATMENT - UNIT 45

The Boiler Feed Water (BFW) and Condensate Treatment Unit is required to produce 10,000 gpm of BFW for the Shell Coal Case, 23 gpm more than the Base Case. The material balance for Unit 45 for this alternate case follows as Table 6.6.14-6.

6.6.14.8 PROCESS COOLING WATER - UNIT 47

Increased cooling load for the Power Generation surface condensers increases the P.C.T. circulation rate from 152,000 gpm to 159,600 gpm. The material balance for Unit 47 for the Shell Coal Case follows as Table 6.6.14-7.

6.6.14.9 UTILITY COOLING WATER - UNIT 48

The increased demands of the power plant and oxygen plant coolers raise the U.C.T. circulation from 64,900 gpm in the Base Case to 68,700 gpm in the Shell Alternate Case. The material balance for Unit 48 for this case follows as Table 6.6.14-8.

6.6.14.10 FUEL GAS - UNIT 52

The lower sulfur content of the Shell coal versus the Base Case coal results in a lower offgas rate to the Process Steam Superheater Unit 20, the major user of fuel gas in the plant. This significant reduction in requirement plus a reduction in Sulfur Recovery Unit 19 more than offset slight increases in fuel gas usage in Tar Distillation and POX. The total fuel gas heating value requirement decreases from 369.2 million to 314.1 million Btu/hr. The material balance for Unit 52 follows as Table 6.6.14-9.

6.6.14.11 WASTE WATER TREATMENT - UNIT 54

An increase of 70 gpm from the Rectisol Unit and a decrease of 40 gpm of stripped gas liquor yields a net increase of 30 gpm in influent to the Waste Water Treatment Unit 54 for a total of 2,566 gpm for the Shell Coal Case. The material balance for Unit 54 for the Shell Coal Case follows as Table 6.6.14-10.

6.6.14.12 TANK FARM AND DISPATCH - UNIT 55

Gasification of the alternate coal produces a higher amount of coal liquids than the Base Case. The intermediate tankage increases in size by 45 percent and the finished product naphtha and ammonia tanks by 80 percent and 18 percent respectively. The sulfur product tank is half the size of the Base Case tank for the Shell Coal Case. The material balance for Unit 55 for this case follows as Table 6.6.14-11.

TABLE 6.6.14-1

MATERIAL BALANCE

OXYGEN PRODUCTION - UNIT 40

Stream Number	40-1	40-2	40-3	40-4	40-5	40-6				
Stream Name	Oxygen Product	Nitrogen Product	Dry Instrument	Vent to Atmosphere	Process Condensate	HHP Steam				
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
N ₂	117.6	1	1679.9	100.0	374.9	78.0	28,387.5	97.4		
Ar					4.5	0.9	363.6	1.2		
O ₂	772.4	98.5			101.1	21.1	406.8	1.4		
Total Dry Gas	7846	100.0	1679.9	100.0	480.5	100.0	29,157.9	100.0		
H ₂ O										
Total Wet Gas	7846		1679.9		480.5		29,157.9			
Dry Gas	lb/hr	250,604	47,065	13,920	823,001					
H ₂ O	lb/hr								11,300	
Steam	lb/hr									1,256,400
Total	lb/hr	250,604	47,065	13,920	823,001				11,300	1,256,400

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

Pressure, psia 508 63 63 1,463
Temperature, °F 230 (max) 75 75 925

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 6.6.14-2

MATERIAL BALANCE

STEAM GENERATION - UNIT 41

Stream Number	41-1	41-2	41-3	41-4	41-5
Stream Name	Coal Fines	Demineralized Water	Cold Condensate	HP Exhaust Steam	Reheat Steam
H ₂ O lb/hr		174,700	3,033,700		
Steam lb/hr				4,253,300	4,253,300
Coal lb/hr	586,667				
Total lb/hr	586,667	174,700	3,033,700	4,253,300	4,253,300
Pressure, psia		88	88	663	613
Temperature, °F			80	80	710 760

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 6.6.14-2 (Continued)
MATERIAL BALANCE
STEAM GENERATION - UNIT 41

Stream Number	41-6		41-7		41-841-9		
Stream Name	Boiler Flue Gas		Process Steam Superheating Flue Gas		Flue Gas To Stack		
Component	HHP Steam	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	lb-mol/hr Mol%	
N ₂		140,085	80.39	11,198	33.70	152,568	72.98
O ₂		8369	4.80	735	2.21	9446	4.52
CO		11	0.01	Trace	-	11	0.01
CO ₂		25,672	14.73	21,292	64.07	46,964	22.46
SO ₂		70	0.04	1	-	12	0.01
HCl		3	-				
NO ₂		58	0.03	5	.02	63	0.02
Total Dry Gas		174,260	100.0	33,231	100.0	209,064	100.0
H ₂ O		21,457		3206		37,196	
Total Wet Gas		195,725		36,437		246,260	
Dry Gas lb/hr		5,327,317		1,274,627		6,645,343	
H ₂ O lb/hr		386,226		57,757		669,577	
Steam lb/hr	4,253,300						
Particulate lb/hr			148			148	
Total lb/hr	4,253,300	5,713,691		1,332,384		7,315,068	
Pressure, psia	1513	13.3		13.5		13.1	
Temperature, °F	930	300		400		175	

TABLE 6.6.14-3

MATERIAL BALANCE

POWER GENERATION - UNIT 42

Stream Number	42-1	42-2	42-3	42-4	42-5	42-10	
Stream Name	Reheat Steam	HHP Steam	HHP Exhaust Steam	Conden- sate from LP Heaters	Cold Condensate	Power Output	
H ₂ O	lb/hr			298,700	3,033,700		
Steam	lb/hr	3,980,900	2,996,900	2,996,900			
MW						422.8	
Total	lb/hr	3,980,900	2,996,900	2,996,900	298,700	3,033,700	422.8
Pressure, psia	563	1463	663	3.5	110		
Temperature, °F	756	925	710	9.0	125		

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 6.6.14-4

MATERIAL BALANCE

FLUE GAS DESULFURIZATION - UNIT 43

Stream Number	43-1		43-2	43-3	43-4	43-5
Stream Name	Flue Gas From Unit 41		Lime	Raw Water Makeup	Flue Gas To Unit 41	Gypsum To Unit 03
Component	lb-mol/hr	Mol%	lb-mol/hr		lb-mol/hr	Mol%
N ₂	140,085	80.39			141,370	80.40
O ₂	8,369	4.80			8,711	4.95
CO ₂	25,672	14.73			25,672	14.60
CO	11	0.01			11	0.01
NO ₂	58	0.03			58	0.03
HCl	3	0.002			-	
SO ₂	70	0.04			11	0.01
Total Dry Gas	174,268	100.00			175,833	100.00
H ₂ O	21,457				33,990	
Total Wet Gas	195,725				209,823	
Dry Gas, lb/hr	5,327,317				5,370,716	
H ₂ O, lb/hr	386,226			126,000	611,820	3,163
Lime, lb/hr			3,750			
Dry Gypsum, lb/hr						
Particulates, lb/hr	148				148	10,537
Total, lb/hr	5,713,691		3,750	126,000	5,982,584	13,700
Pressure, psia	13.3				13.1	
Temperature, °F	300				128	

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 6.6.14-5

MATERIAL BALANCE

RAW WATER TREATMENT - UNIT 44

Stream Number		44-1	44-2	44-3	44-4	44-5	44-6
Stream Name		Raw Water Makeup	To Potable Water Treatment Unit 49	To FGD Unit 43	RO Reject from Unit 49	To U.C.T. Makeup	To BFW Treat- ment Unit 45
Water	lb/hr (gpm)	3,538,000 (7076)	27,000 (54)	232,500 (465)	1000 (2)	1,884,500 (3769)	1,428,500 (2857)
Total	lb/hr	3,538,000	27,000	232,500	1000	1,884,500	1,428,500
Pressure, psia		13.7	63.7	88.7	300	43.7	33.7
Temperature, °F		60	60	60	80	80	80

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.

BOILER FEED WATER

Stream Number	45-1	45-2	45-3	45-4	
	BFW Feed from Unit 44	Demin. Water to Distri- bution	Cold Con- densate for Polishing	Polished Cold Condensate	
Water	lb/hr (gpm)	1,428,500 (2857)	657,500 (1315)	3,033,500 (6067)	3,033,500 (6067)
Total	lb/hr	1,428,500	657,500	3,033,500	3,033,500
Pressure, psia		33.7	88.7	40	88.7
Temperature, °F		80	100	285	100

NOTE: Flow quantities, pressures and temperatures shown are for design purposes, and are not necessarily the conditions which

TABLE 6.G.14-6

MATERIAL BALANCE

WATER AND CONDENSATE TREATMENT - UNIT 45

45-4	45-5	45-6	45-7	45-8	45-9	45-10
Polished Cold Condensate	Vacuum Condensate from Unit 21	Process Condensate from Unit 22 and Unit 40	Softened Vacuum and and Process Condensate	High TDS Reject to Ash Handling	Low TDS Reject to U.C.T. Makeup	Softened Water to LP Deaerator
33,500 (67)	145,000 (290)	178,000 (356)	323,000 (646)	22,500 (45)	10,500 (21)	558,000 (1116)
33,500	145,000	178,000	323,000	22,500	10,500	558,000
7	40	88.7	78.7	63.7	63.7	88.7
	285	100	100	100	100	100

own are for the total unit on a stream-day basis, are to be used solely for process design
ns which will be attained during actual operations.

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

PROCESS

Stream Number		47-1	47-2	47-3	47-4
Stream Name		P.C.T. to Side Stream Filtration	P.C.T. Blowdown	Side Stream Filtration to P.C.T.	High TDS Effluent to Evaporation Unit 54
Water	lb/hr (gpm)	4,074,000 (8148)	10,000 (20)	3,922,500 (7845)	147,500 (295)
Total	lb/hr	4,074,000	10,000	3,922,500	147,500
Pressure, psia		13.7	13.7	13.7	63.7
Temperature, °F		110	110	80	100

NOTE: Flow quantities, pressures and temperatures shown are for design purposes and are not necessarily the conditions which will occur.

TABLE 6.6.14-7

MATERIAL BALANCE

PROCESS COOLING WATER - UNIT 47

47-4	47-5	47-6	47-7	47-8	47-9	47-10
High TDS Effluent to Evaporation Unit 54	Treated Waste water to P.C.T. Makeup	From U.C.T. From Blowdown Treatment	From Evaporator To P.C.T.	From Makeup Water Treatment	Makeup to Process Cooling Tower	R.O. Reject to Evaporator :
1,500 (5)	1,200,500 (2401)	1,105,500 (2211)	423,500 (847)	896,000 (1792)	2,425,000 (4850)	298,500 (597)
1,500	1,200,500	1,105,500	423,500	896,000	2,425,000	298,500
	63.7 65	43.7 80	13.7 100	13.7 65	20.7 80	63.7 85

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

TABLE 6.6.14-8

MATERIAL BALANCE

UTILITY COOLING WATER - UNIT 48

Stream Number	48-1	48-2	48-3	48-4	48-5
Stream Name	U.C.T. Blowdown	RO Reject from Unit 45	RO Reject from Unit 49	Treated Water to F.C.T. Makeup Pond	Sludge to Landfill
Water	lb/hr (gpm)	982,000 (1964)	195,000 (390)	1,105,500 (2211)	4000 (8)
Solids	lb/hr				670
Total	lb/hr	982,000	195,000	1,105,500	4670
Pressure, psia	13.7	300	300	15.7	13.7
Temperature, °F	110	80	80	80	70

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 6.6.14-9

MATERIAL BALANCE

FUEL GAS - UNIT 52

Stream Number	52-1		52-2		52-3		52-4		
Stream Name	Fuel Gas from Unit 21		Fuel Gas from Unit 25		Fuel Gas Makeup From Pure Gas		Total Fuel Gas		
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	
H ₂	12.7	35.8	74.2	29.1	551.3	59.4	1038.2	54.9	
N ₂	.4	1.1	.4	.2	5.1	.3	5.9	.3	
CO	2.4	6.8	72.6	28.5	260.7	16.2	335.7	17.7	
CO ₂	1.6	4.5	29.4	11.5	105.4	6.6	136.4	7.2	
CH ₄	18.1	51.0	76.9	30.2	275.8	17.2	370.8	19.6	
C ₂ H ₆	.3	.8	1.3	.5	4.5	.3	6.1	.3	
Total Dry Gas	lb/hr	35.5	100.0	254.8	100.0	1602.8	100.0	1893.1	100.0
H ₂ O		-		.1				.1	
Total Wet Gas				254.9				1893.2	
Dry Gas	lb/hr	477		4762		18,583		23,822	
H ₂ O	lb/hr	1						1	
Total	lb/hr	478		4762		18,583		23,823	
Pressure, psia		1055		75		360		75	
Temperature, °F		100		100		68		80	
MM Btu		8.96		48.18		256.92		314.06	

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 6.6.14-10

MATERIAL BALANCE

WASTE WATER TREATMENT - UNIT 54

Stream Number	54-1	54-2	54-3	54-4
Stream Name	Storm Water	Oily Water	Oily Condensate	1500 lb Boiler Blowdown
Water lb/hr (gpm)	104,500 (209)	130,000 (260)	Normally 0	11,500 (23)
Solids lb/hr				
Total lb/hr	104,500	130,000		11,500
Pressure, psia	13.7	13.7		53.7
Temperature, °F	60	60		285

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 6.6.14-10 (Continued)

MATERIAL BALANCE

WASTE WATER TREATMENT - UNIT 54

Stream Number	54-5	54-6	54-7	54-8
Stream Name	U.C.T. Makeup Water	DAF Effluent to Riotreating	Stripped Gas Liquor	Waste Heat Boiler Blow- down
Water lb/hr	107,000	136,000	921,500	24,000
(gpm)	(214)	(272)	(1843)	(48)
Solids lb/hr				
Total lb/hr	107,000	136,000	921,500	24,000
Pressure, psia	38.7	13.7	145	53.7
Temperature, °F	80	65	100	285

TABLE 6.6.14-10 (Continued)

MATERIAL BALANCE

WASTE WATER TREATMENT - UNIT 54

Stream Number	54-9	54-10	54-11	54-12
Stream Name	Treated Water from Sanitary Unit 56	Water From Rectisol	Water From POX Unit 24	Ash to Landfill
Water lb/hr (gpm)	23,500 (47)	73,500 (147)	3000 (6)	
Solids lb/hr				1030
Total lb/hr	23,500	73,500	3000	1030
Pressure, psia	13.7	13.7	13.7	13.7
Temperature, °F	80	63	100	100

TABLE 6.6.14-10 (Continued)

MATERIAL BALANCE

WASTE WATER TREATMENT - UNIT 54

Stream Number	54-13	54-14	54-15	54-16
Stream Name	Incinerator Evaporation Loss	Effluent to P.C.T. Treating	Evap. Feed From NaZ Softener	Evaporator Fed From P.C.T.-RO Reject
Water lb/hr	2500	1,200,500	1500	298,500
(gpm)	(5)	(2401)	(3)	(597)
Solids lb/hr				
Total lb/hr	2500	1,200,500	1500	298,500
Pressure, psia	13.7	63.7	13.7	300
Temperature, °F	208	80	80	80

TABLE 6.6.14-10 (Continued)

MATERIAL BALANCE

WASTE WATER TREATMENT - UNIT 54

Stream Number	54-17	54-18	54-19	54-20
Stream Name	Evaporator Feed From P.C.T. Blowdown	Combined Evap- orator Load	Evaporator Brine To Solar Pond	Evaporator Effluent To P.C.T.
Water lb/hr (gpm)	147,500 (295)	447,500 (895)	24,000 (48)	423,500 (847)
Solids lb/hr				
Total lb/hr	147,500	447,500	24,000	423,500
Pressure, psia	15.7	13.7	13.7	13.7
Temperature, °F	80	80	100	100

TABLE 6.6.14-11

MATERIAL BALANCE

TANK FARM AND DISPATCH - UNIT 55

Stream Number	55-11	55-12	55-13	55-14
Stream Name	Raw Naphtha To Storage	Raw Naphtha To HDT Unit 16	Crude Tars To Storage	Crude Tars To Tar Dist.
H ₂ O lb/hr				
Tar lb/hr				
Oil lb/hr				
Naphtha lb/hr	29,455	29,455	44,190	44,190
Phenols lb/hr				
Fatty Acids lb/hr				
Org. Sulfur lb/hr	9	9		
Ammonia lb/hr				
HCl lb/hr				
Total lb/hr	29,464	29,464	44,190	44,190
Pressure, psia	40	63.7	85	88.7
Temperature, °F	127	120	104	150

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 6.6.14-11 (Continued)

MATERIAL BALANCE

TANK FARM AND DISPATCH - UNIT 55

Stream Number		55-15	55-16	55-21	55-22
Stream Name		Resids To Storage	Resids To POX Unit 24	Naphtha Product to Storage	Naphtha Product To Dispatch
H ₂ O	lb/hr	135	135		
Tar	lb/hr				
Oil	lb/hr	35,352	35,352		
Naphtha	lb/hr			29,385	29,385
Phenols	lb/hr	3256	3256		
Fatty Acids	lb/hr	35	35		
Org. Sulfur	lb/hr				
Ammonia	lb/hr				
HCl	lb/hr				
Lightends	lb/hr				
Total	lb/hr	38,778	38,778	29,385	29,385
Pressure, psia		55	88.7	50	63.5
Temperature, °F		300	200	108	100

TABLE 6.6.14-11 (Continued)

MATERIAL BALANCE

TANK FARM AND DISPATCH - UNIT 55

Stream Number	55-41	55-51	55-52
Stream Name	Molten Sulfur Product To Dispatch	Ammonia Product To Storage	Ammonia Product To Dispatch
H ₂ O lb/hr		38	971
Tar lb/hr			
Oil lb/hr			
Naphtha lb/hr			
Phenols lb/hr			
Fatty Acids lb/hr			
Sulfur lb/hr	3325		
Ammonia lb/hr		7488	7488
HCl lb/hr			
Total lb/hr	3325	7526	8459
Pressure, psia	88.7	220	210
Temperature, °F	300	43	100

6.6.15 CAPACITY FACTORS

The utility requirements and unit costs for all the units in the Shell Coal Case are capacity factored from the Base Case. The capacity factors used and their basis for this case are tabulated in Table 6.6.15-1.