APPENDIX F

SLURRY REACTOR DESIGN STUDIES

FISCHER-TROPSCH DESIGN DATA SHEETS

Tables

Figures

Table F-1

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-SLURRY REACTOR CASE

STREAM NO				21	22	23	24	25	26	27	28	29	30
DESCRIPTION	NET FT YIELD	NET FISHER TROPSCH YIELD	LT ENDS TO FUEL GAS	ALCOHOLS	RAW F-T LIQUIDS	WAX TO HYDRO-CRACKER	H2 TO WAX H/C	WAX H/C PROD	CAT POLY FEED	CAT POLY OFF GAS PROD	CAT POLY LT GASOL	CAT POLY HEAVY GASOL	FT PROD HTU FEED
COMPONENT	MPH	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2	0.00	0	0				1397	0					
C1	446.36	7161	7161					136					
C2=	142.73	4004	4004					0					
C2	45.93	1381	1382					136					
C3=	153.44	6457	3572		2885			0	2885	263			
C3	25.86	1140	413		728			817	728	728			
IC4	1.51	88	3		85			0	85	85			
NC4	19.96	1160	225		935			4355	935	402	533		
C4=	107.77	6047	340		5707			0	5707	288			
C5	31.60	2280	21		2259			5444					2259
C5=	130.07	9122	125		8997			0					8997
C6	22.40	1930	4		1927			5444					1927
C6=	91.85	7714	19		7695			0					7695
C7-C11	226.26	27457			27457			19597					27457
C12-C18	83.54	16803			16803			43548					16603
C19-C24	12.44	3569			0	3569		29395					
C25+	131.31	103904			0	103904							
ALCOHOLS	157.60	10678		10678									
C7H14											4106		
C10H20												3938	
C6 REFORM													
C7 ALKY													
C8 ALKY													
HVY POLYGAS													
TOTAL	1830.4	210696	17267	10678	75278	107474	1397	108871	10340	1763	4639	3938	64938
BPD(M/MSCFD)		20004	2486	896	7507	8508	(8.31)	10099	1249	223	464	356	6257
SG@60F		0.7227	0.4766	0.8182	0.6681	0.8668		0.7397	0.5680	0.5424	0.6857	0.7590	0.7121

NOTES NOTE 1

(1) ALCOHOL CONTAINS AN ADDITIONAL 3529.3 LBS/HR OF WATER

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Table F-1 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-SLURRY REACTOR CASE

STREAM NO.	31	32	33	34	35	36	37	38	39	40	27+39	42
DESCRIPTION	H2 TO PROD HTU	FT PROD HTU PROD	HTU PROD FRACT FEED	HTU PROD FRACT OFF GAS	HTU PROD FRACT C5/C6	HTU PROD FRACT TO CAT REFORM	HTU PROD FRACT TO DIESEL	CAT REFORM PROD H2	CAT REFORM PROD LT ENDS	CAT REFORM PROD REFORMATE	HF ALKY FEED	HF ALKY OFF GAS
COMPONENT	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2	1077	0	0	0			0	751	0	0	0	0
C1		158	294	294				615	0	0	0	0
C2=		0	0	0				0	0	0	0	0
C2		580	716	716				1539	0	0	0	0
C3=		0	0	0					0	0	263	26
C3		0	817	817					4018	0	4746	4746
IC4		0	0	0					2921	0	3006	2413
NC4		747	5102	5102					2444	0	2847	2847
C4=		0	0							0	286	29
C5		11515	16959		16959					5739	0	0
C5=		0	0		0							
C6		9606	15249		15249							
C6=		0	0		0							
C7-C11		26927	46524		0	46524						
C12-C18		16282	59831				59831					
C19-C24			29395				29395					
C25+												
ALCOHOLS												
C7H14												
C10H20										28495		
C8 REFORM												
C7 ALKY												
C8 ALKY												
HVY POLYGAS												
TOTAL	1077	66015	174666	6928	32208	46524	89226	2906	9384	34234	11147	10060
BPD(MMSCFD)	(4.87)	6503	16601	914	3421	4415	7851	(4.21)	1136	3170	1409	1276
SG@60F		0.6966	0.7226	0.5199	0.6460	0.7230	0.7798		0.5429	0.7409	0.5428	0.5408

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Table F-1 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-SLURRY REACTOR CASE

STREAM NO	43	44	45	46	47
DESCRIPTION	ALKY GASO-LINE	HVY POLYGAS HTU FD	HVY POLY GASOL	LT ENDS MAKE	GASOL
COMPONENT	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2		57		0	
C1				909	
C2=				0	
C2				2255	
C3=					
C3					
IC4					
NC4					533
C4=					
C5					22697
C5=					
C6					15249
C6=					
C7-C11					
C12-C18					
C19-C24					
C25+					
ALCOHOLS					
C7H14					4106
C10H20		3938			
C6 REFORM					28495
C7 ALKY	563				563
C8 ALKY	523				523
HVY POLYGAS	0		3995		3995
TOTAL	1086	3995	3995	3164	76162
BPD(MMSCFD)	106.464	358.019	373		7535
SG@60	0.7001	0.7699	0.7342		0.6935

Table F-1 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-SLURRY REACTOR CASE

	FEED			PRODUCT							
COMPONENT	FT FEED LB/HR	H2 LB/HR	TOTAL FEED LB/HR	H2 LB/HR	LT ENDS LB/HR	C3/C4 LB/HR	GASOL LB/HR	DIESEL LB/HR	ALCOHOLS LB/HR	FT BLEED GAS LB/HR	TOTAL PRODUCTS LB/HR
H2	0	2531	2531	751	0	0	0	0			751
C1	7161	0	7161	0	909	0	0	0		7161	8070
C2=	4004	0	4004	0	0	0	0	0		4004	4004
C2	1381	0	1381	0	2255	0	0	0		1382	3637
C3=	6457	0	6457	0		26	0	0		3572	3598
C3	1140	0	1140	0		5563	0	0		413	5975
IC4	88	0	88	0		2413	0	0		3	2416
NC4	1160	0	1160	0		7949	533	0		225	8707
C4=	6047	0	6047	0		29	0	0		340	368
C5	2280	0	2280	0	0	0	22697	0		21	22718
C5=	9122	0	9122	0	0	0	0	0		125	125
C6	1930	0	1930	0	0	0	15249	0		4	15253
C6=	7714	0	7714	0	0	0	0	0		19	19
C7-C11	27457	0	27457	0	0	0	0	0			0
C12-C18	16603	0	16603	0	0	0	0	59831			59831
C19-C24	3569	0	3569	0	0	0	0	29395			29395
C25+	103904	0	103904	0	0	0	0	0			0
ALCOHOLS	10678	0	10678	0	0	0	0	0	10678		10678
C7H14	0	0	0	0	0	0	4106	0			4106
C10H20	0	0	0	0	0	0	0	0			0
C8 REFORM	0	0	0	0	0	0	28495	0			28495
C7 ALKY	0	0	0	0	0	0	563	0			563
C8 ALKY	0	0	0	0	0	0	523	0			523
HVY POLYGAS	0	0	0	0	0	0	3995	0			3995
TOTAL	210696	2531	213227	751	3164	15979	76162	89226	10678	17267	213227
FUEL,MMBTU/HR					65.6					626.4	

H2CONSUMED	LB/HR	MPH	H2 MAKE	LB/HR	MPH
WAX H/C	1397	693.03	CAT REFORMER	751	372.37
F-T HTU	1077	534.21	FT PURGE	1780	882.95
H CP GAS HTU	57	28.08	TOTAL	2531	1255.32
TOTAL	2531	1255.32			

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Table F-2

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

COS HYDROLYSIS AND COOLING
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	COS HYDROLYSIS REACTOR	VERT	1	380	500	CS W/304SS CLAD	304L	18	19	W/ HEMI HEADS 6100FT3 CAT
C-2	COLD SEPARATOR	VERT	1	380	250	CS W/304SS CLAD	304SS	11	8	W/MESH PAD

Table F-2

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

COS HYDROLYSIS AND COOLING
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP.F SHELL	TEMP.F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	AREA. FT2	REMARKS
E-1	FEED HEATER	S&T	1	380	650	500	650	CS	304L	3000	
E-2	EFFLUENT AIR COOLER	AIR	1	N/A	380	N/A	500	N/A	304L	18550	FAN BHP=275
E-3	EFFLUENT TRIM COOLER	S&T	1	380	75	250	250	CS	304L	5030	

Table F-3

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
SELEXOL ACID GAS REMOVAL PLANT

VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIAMENSIONS DIAM. FT	DIAMENSIONS T-T FT	REMARKS
C-1	FEED GAS SEPARATOR	VERT	1	550	250	CS	316 SS	8.5	7.5	W/SS MESH PAD
C-2	ABSORBER	VERT	1	550	250	CS	410 SS	12	127	
C-3	RICH SOLUTION FLASH DRUM	HORIZ	1	50	250	SS	316 SS	7.5	24	W/SS MESH PAD
C-4	REGENERATOR	VERT	1	50	350	CS W/SS CLAD TOP	410 SS	8	143	
C-5	REGENERATOR OVHD RECEIVER	HORIZ	1	50	250	CS W/SS CLAD	316 SS	2.5	7	W/SS MESH PAD
C-6	1ST STG COMPRESSOR KO DRUM	VERT	1	200	300	CS	316 SS	2.5	7	W/SS MESH PAD
C-7	PROPYLENE ACCUMULATOR	HORIZ	1	260	250	CS		4.5	15	
C-8	LOW LEVEL PROPYLENE KO DRUM	HORIZ	1	100	250	CS	316 SS	4.5	11.5	W/SS MESH PAD
D-1	SELEXOL STORAGE	VERT	1	ATM	250	CS				55000 BBLS

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Table F-3

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
SELEXOL ACID GAS REMOVAL PLANT

HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS,PSIG SHELL	PRESS,PSIG TUBE	TEMP,F SHELL	TEMP,F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA FT2	REMARKS
E-1	FEED GAS/TREATED GAS	S&T	1	550	550	250	250	CS	CS	13620	
E-2	LEAN SOLUTION CHILLER	KETTLE	1	550	550	250	250	CS	CS	13175	
E-3	LEAN/RICH EXCHANGER	S&T	1	550	550	250	250	CS	CS	116400	
E-4	REGEN OVHD CONDENSER	S&T	1	50	550	250	250	304SS	304SS	1235	
E-5	REGENERATOR REBOILER	KETTLE	1	50	550	250	250	304SS	304SS	7500	
E-6	1ST STG COMPR AFTERCOOLEF	DBL PIPE	1	200	75	260	250	CS	CS	40	
E-7	2ND STG COMPR AFTERCOOLEF	DBL PIPE	1	550	75	260	360	CS	CS	40	
E-8	PROPYLENE DESUPERHEATER	S&T	1	260	75	340	400	CS	CS	800	
E-9	PROPYLENE CONDENSER	S&T	1	260	75	260	400	CS	CS	4920	

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Table F-3

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
SELEXOL ACID GAS REMOVAL PLANT

PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER	BHP
G-1	LEAN SOLUTION PUMP	CENTRIF	2	1600	1600		CS	CI	MOTOR	750
G-2	REGENERATOR REFLUX	CENTRIF	2	8	210		CS	SS	MOTOR	2
G-3	REGENERATOR FEED	CENTRIF	2	1375	250		CS	SS	MOTOR	110
K-1	RECYCLE COMPRESSOR	RECIP	2						MOTOR	225
K-2	REFRIGERATION COMPRESSOR	CENTRIF	2						STEAM TURBINE	1000

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Table F-4

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

SYNGAS COMPRESSION PLANT
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	FEED GAS KO DRUM	VERT	1	345	250	CS	316 SS	13.5	9.5	W/ SS MESH PAD
C-2	COMPR DISCHARGE KO DRUM	VERT	1	560	250	CS	316 SS	12	9	W/ SS MESH PAD

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Table F-4

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

SYNGAS COMPRESSION PLANT
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS,PSIG SHELL	PRESS,PSIG TUBE	TEMP, F SHELL	TEMP, F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA, FT2	REMARKS
E-1	COMPRESSOR AFTERCOOLER	AIR	1	N/A	560	N/A	250	N/A	CS	6600	FAN BHP=98
E-2	COMPRESSOR TRIM COOLER	S&T	1	560	75	250	250	CS	CS	5640	
E-3	COMPRESSOR SURFACE COND	S&T	1	50	75	250	250	CS	CS	10000	

Table F-4

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

SYNGAS COMPRESSION PLANT
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
K-1	SYNGAS COMPRESSOR	CENTRIF	1	(326900)			CI		STEAM TURBINE	16500	

Table F-5

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T REACTION SECTION
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	STEAM DRUM	HORIZ	6	700	650	CS	CS	6.5	30	
C-2	SLURRY REACTOR	VERT	6	460	550	CS	CHROMIZED TUBES	15.75	46.3	W/2500 TUBES
C-3	WAX SURGE DRUM	VERT	1	50	510	CS	CS	15	50	W/ MIXER
C-4	PRODUCT SEPARATOR	HORIZ	1	450	250	304 SS	316 SS	13	42	
C-5	FILTER PRECOAT DRUM	VERT	1	50	250	CS	CS	4	12	
C-6	SPENT WAX OFFGAS DRUM	HORIZ	1	50	250	304 SS	316 SS	4	12	
C-7	SLURRY PREPARATION DRUM	VERT	1	50	350	CS	CS	17	22	W/MIXER
C-8	CATALYST PRETREATER	VERT	1	250	600	CS	CS CHROMIZED TUBES	15	40	W / INTERNAL COILS
C-9	CAT PRETREATER CIRC. KO DRUM	HORIZ	1	250	250	304 SS	316 SS	7	14	
C-10	PRETREATED CATALYST FEED DRUM	VERT	1	50	600	CS	CS CHROMIZED TUBES	15	40	W / INTERNAL COILS & MIXER
T-1	SPENT WAX STORAGE		1	ATM	250	CS	CS	23	26	1600 BBLS
T-2	CLEAN WAX STORAGE		1	ATM	250	CS	CS	23	26	1600 BBLS
T-3	CATALYST STORAGE BIN		1	ATM	250	CS	CS	16	27	60 CONE BTM

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Table F-5

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T REACTION SECTION
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP. F SHELL	TEMP. F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	AREA FT2	REMARKS
E-1	REACTOR FEED/EFFL EXCH	S&T	1	500	460	550	550	CS	CS	11220	
E-2	EFFLUENT AIR COOLER	AIR	1		460		350		304 SS	7800	116 HP FAN
E-3	EFFLUENT TRIM COOLER	S&T	1	460	75	250	250	304 SS	304 SS	6150	
E-4	SPENT CAT COOLER	S&T	1	100	75	550	350	CS	CS	750	
E-5	SPENT WAX OFF GAS CONDENSER	S&T	1	50	75	400	350	304 SS	304 SS	200	
E-6	SPENT WAX HEATER	S&T	1	75	600	650	400	CS	CS	350	
E-7	CLEAN WAX HEATER	S&T	1	600	50	650	400	CS	CS	350	
E-8	CATALYST PRETREATER HEATER	S&T	1	600	200	650	400	CS	CS	210	
E-9	PRETREATER CIRC. GAS COOLER	S&T	1	250	75	600	350	304 SS	CS	3000	
F-1	PRETREATER CIRC. GAS HEATER	FIRED	1	NA	250	NA	650		CS	23MMBTU/HR	

Table F-8

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T REACTION SECTION
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM(SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
G-1	BFW PUMP	CENTRIF	6	2760	69	39	CS	CI	MOTOR	49	
G-2	WAX WITHDRAWAL PUMP	CENTRIF	2	66	110	1.7	CS	CI	MOTOR	4	
G-3	SPENT WAX RECIRC. PUMP	CENTRIF	2	600	670	36	CS	CI	MOTOR	66	
G-4	FILTER AID PUMP	CENTRIF	2	10	100	0.3	CS	CI	MOTOR	1	
G-5	RECOVERED LIQUIDS PUMP	CENTRIF	2	10	1500	2.6	CS	CI	MOTOR	10	
G-6	SPENT WAX PUMP	CENTRIF	2	150	90	2.6	CS	CI	MOTOR	5	
G-7	CLEAN WAX FEED	CENTRIF	2	300	115	6.8	CS	CI	MOTOR	10	
G-8	CAT PRETREATER FEED	CENTRIF	2	340	590	54	CS	CI	MOTOR	95	
G-9	CAT PRETREATER PRODUCT	CENTRIF	2	393	75	6.9	CS	CI	MOTOR	10	
G-10	CATALYST MAKEUP	CENTRIF	2	9	1275	2.7	CS	CI	MOTOR	14	
K-1	RECYCLE COMPRESSOR	CENTRIF	1	(45000)						1200	

Table F-5

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T REACTION SECTION
PACKAGE EQUIPMENT

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	CAPACITY	OPERATING CONDITIONS	POWER KW	REMARKS
Y-1	SPENT CAT CENTRIFUGE	CENTRIFUGE	1	360 GPM 29 TONS/HR SOLIDS	300-500 F, 5 PSIG	250	
Y-2	HYDROCLONES	CYCLONES	12	85 GPM 5 TONS/HR SOLIDS	500 F,410 PSIG		
Y-3	WAX FILTERS	TANK VERTICAL LEAF FILTER	3		300 F,5 PSIG		
Y-4	AXIAL CYCLONE	SEPARATOR	6	2350 ACFM VAPOR	500 F, 410 PSIG		
Y-5	CAT PRETREATMENT HEATER	HOT OIL SYSTEM	1	20 MMBTU/HR DUTY	700 F HOT OIL	50	

Table F-8

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T GAS PLANT
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM. FT	DIMENSIONS T-T FT	REMARKS
C-1	DEETHANIZER	VERT	1	450	450	CS	410 SS	5.5	101	
C-2	DEETHANIZER REFLUX DRUM	HORIZ	1	450	250	CS	304 SS	3	12	W/SS MESH PAD
C-3	STABILIZER	VERT	1	90	400	CS	410 SS	4	84	
C-4	STABILIZER REFLUX DRUM	HORIZ	1	90	250	CS	304 SS	4	15	W/SS MESH PAD
C-5	RECYCLE GAS KO DRUM	VERT	1	550	250	LT CS	CS	7	9	W/SS MESH PAD
C-6	PROPYLENE ACCUMULATOR	HORIZ	1	250	250	LT CS	304 SS	4.5	16.5	
C-7	LOW LEVEL PROPYL KO DRUM	VERT	1	100	250/-50	LT CS	304 SS	4	15	W/SS MESH PAD
C-8	HI LEVEL PROPYL KO DRUM	VERT	1	100	250/-50	LT CS	304 SS	4.5	16	W/SS MESH PAD

Table F-6

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T GAS PLANT
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP. F SHELL	TEMP. F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA FT2	REMARKS
E-1	RECYCLE COMP AFTERCOOLER	AIR	1	N/A	575	N/A	250	N/A	304 SS	1440	FAN BHP=40
E-2	RECYCLE COMP TRIM COOLER	S&T	1	575	75	250	250	304 SS	304 SS	2310	
E-3	DEETHANIZER CONDENSER	S&T	1	440	150	250	250	CS	CS	840	
E-4	DEETHANIZER REBOILER	KET	1	440	650	550	450	CS	CS	680	
E-5	DEETHANIZER SIDE REBOILER	S&T	1	440	440	500	450	CS	CS	970	
E-6	STABILIZER REBOILER	KET	1	100	650	550	450	CS	CS	490	
E-7	STABILIZER CONDENSER	S&T	1	100	75	250	250	304 SS	304 SS	5425	
E-8	STABILIZER BOTTOM COOLER	AIR	1	N/A	120	N/A	450	N/A	CS	1515	FAN BHP=22
E-9	FEED/OFFGAS EXCH	S&T	1	525	500	250	250/-50	CS	LTCS	8520	
E-10	FEED/LIQUID EXCH	S&T	1	525	500	250	250/-50	CS	LTCS	11230	
E-11	RECYCLE GAS CHILLER	S&T	1	150	525	250/-50	250/-50	LTCS	LTCS	5080	
E-12	PROPYLENE DESUPERHEATER	S&T	1	250	75	250	250	CS	CS	1240	
E-13	PROPYLENE CONDENSER	S&T	1	250	75	250	250	CS	CS	6230	
E-14	RECYCLE COMPR. SURF. COND.	S&T	1	5	75	250	250	CS	CS	2900	

Table F-8

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

F-T GAS PLANT
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM/SCFM	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
G-1	DEETHANIZER REFLUX	CENTRIF	2	36	205	1	CS	CI	MOTOR	3	
G-2	STABILIZER REFLUX	CENTRIF	2	159	185	4.1	CS	CI	MOTOR	7	
G-3	STABILIZER BOTTOMS	CENTRIF	2	348	90	4	CS	CI	MOTOR	5	
K-1	RECYCLE COMPRESSOR	CENTRIF	1	(105000)					STM TURB	4000	
K-2	REFRIGERATION COMPRESSOR	CENTRIF	1						STM TURB	1740	

Table F-7

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIAMENSIONS DIAM. FT	DIAMENSIONS T-T FT	REMARKS
C-1	FEED GAS KO DRUM	VERT	1	400	250	CS	316 SS MESH	8	7	S3 MESH PAD
C-2	ABSORBER	VERT	1	400	250	CS	410 SS TRAYS	14.5	94	
C-3	TREATED GAS KO DRUM	VERT	1	400	250	CS	316 SS MESH	10	30	SS MESH PAD
C-4	RICH SOLUTION FLASH DRUM	HORIZ	1	50	250	SS	316 SS MESH	7.5	24	SS MESH PAD
C-5	REGENERATOR	VERT	1	50	350	CS W/SS CLAD TOP	304 SS PACK.	19.5	83	
C-6	REGENERATOR OVHD RECEIVER	VERT	1	50	250	CS W/SS CLAD	316 SS MESH	12	9	SS MESH PAD
D-1	SOLUTION STORAGE TANK	VERT	1	ATM	250	CS				7000 BBLS

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Table F-7

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS,PSIG SHELL	PRESS,PSIG TUBE	TEMP,F SHELL	TEMP,F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA, FT2	REMARKS
E-1	LEAN SOLUTION COOLER	S&T	1	400	75	250	250	CS	CS	30400	
E-2	LEAN SOLUTION AIR COOLER	AIR	1	N/A	400	250	250	N/A	CS	27600	FAN BHP=785
E-3	LEAN/RICH EXCHANGER	S&T	1	50	400	250	250	CS	CS	59600	
E-4	REGEN OVHD CONDENSER	AIR	1	N/A	50	250	250	N/A	304SS	16500	FAN BHP=460
E-5	REGENERATOR REBOILER	KETTLE	1	50	75	350	400	304SS	304SS	48200	
E-6	RECLAIMER	KETTLE	1	50	250	650	650	304SS	304SS		

Table F-7

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER	BHP
G-1	LEAN SOLUTION PUMP	CENTRIF	2	6700	110	176	CS	CI	MOTOR	215
G-2	LEAN SOLUTION BOOSTER PUMP	CENTRIF	2	6360	850	1390	CS	SS	MOTOR	1700
G-3	REGENERATOR REFLUX	CENTRIF	2	280	140	10	CS	SS	MOTOR	15

Table F-6

SLURRY REACTOR DESIGN STUDIES
FISCHER-TROPSCH SLURRY REACTOR CASE
UTILITY SUMMARY

PLANT DESCRIPTION NO	ELEC. PWR MW	STEAM, M LB/HR HIGH PR 1650 PSIG 966 F	MED PR 635 PSIG 600 F	MED PR 635 PSIG 476(SAT)	MED PR 398 PSIG 448(SAT)	200 PSI 200 PSIG 382(SAT)	LOW PR 50 PSIG 287(SAT)	COND	BFW	WATER, GPM WASTE WATER	C.W. CIRC.	FUEL, MMBTU/HR HEAT ABS	TOTAL FIRED DUTY
GAS PREP. AND SYNTHESIS													
101 SHELL GASIFIER		(702.8)							1017	133			
102 SHIFT CONVERSION													
103 COS HYDROLYSIS	440				232					481	80		
104 GAS COMPRESSION	81	164.9									810		
105 SOUR WATER STRIPPING	87						39.1	(39.1)			1410		
106 ACID GAS REMOVAL	1609	16.6					27.1	(27.1)			3929		
107 SULFUR RECOVERY & TGT	1150			2.4		(37.6)	65.8	(65.8)	122		101		40.6
108 SULFUR POLISHING													
109 F-T SYNTHESIS	1373			67.6	(1,227.3)				2604		2095	19.1	24.0
110 CO2 REMOVAL	7450						1250.1	(1,250.1)			68400		
111 DEHYDRATION	62										100	7.5	10.0
112 F-T GAS PLANT	368	74.0		29.7				(29.7)			3540		(628.4)
113 H2 RECOVERY													
F-T PRODUCT REFINING													
200 ALCOHOL RECOVERY	168			0.2		21.8				7	260		
201 F-T PRODUCT HTU	126			0.0							218		8.4
202 HTU PROD FRACT.	730			74.2			1.6	(1.6)		5	1581		82.6
203 CAT REFORMER	218			13.3							560		18.8
204 C5/C6 ISOMERIZATION	392			0.0		70.8	1.2	(81.0)			170		1.7
205 CAT POLYMERIZATION	102			13.3							118		
206 HF ALKYLATION	83			3.7			1.8	(1.8)			229		
207 HVY GASOLINE HTU	98			1.8							34		0.3
208 LT ENDS RECOVERY	812			0.0		6.3		(6.3)			810		(65.3)
209 H2 PURIFICATION	346			0.0							50		
210 WAX HYDROCRACKING	848			8.7		3.0		(3.0)			242		48.4
OFFSITE UNITS													
300 OXYGEN PLANT	1703	695.6	80								135805		
301 INSTRUMENT/PLANT AIR													
302 COAL HANDLING	16881			67.1									
303 POWER DISTRIBUTION													
304 BFW PREPARATION	1630												
306 COOLING WATER TREATMENT													
306 CW TOWER	6639												
307 POWER GEN	(81410)	518.6							1376				1118.3
308 WW TREATMENT	1148												
309 BLOWDOWN													
310 STORAGE													
311 INTERCONN PIPING													
312 REFRIGERATION													
313 GASOLINE BLENDING	80												
MISCELLANEOUS	266												
TOTAL	(19070)	874.8	80	266.8	(695.3)	72.9	1388.3	(1501.1)	5618	604	210105	26.6	631.2

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Table F-10

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-FIXED BED CASE

STREAM NO				21	22	23	24	25	26	27	28	29	30
DESCRIPTION	NET FT YIELD	NET FISHER-TROPSCH YIELD	LT ENDS TO FUEL GAS	ALCOHOLS	RAW F-T LIQUIDS	WAX TO HYDRO-CRACKER	H2 TO WAX H/C	WAX H/C PROD	CAT POLY FEED	CAT POLY OFF GAS PROD	CAT POLY LT GASOL	CAT POLY HEAVY GASOL	FT PROD HTU FEED
COMPONENT	MPH	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2	0.00	0	0	0	0	0	1174	0	0	0	0	0	0
C1	503.56	8079	8078	0	0	0	0	136	0	0	0	0	0
C2=	30.97	869	869	0	0	0	0	0	0	0	0	0	0
C2	151.84	4560	4559	0	0	0	0	136	0	0	0	0	0
C3=	74.59	3139	669	0	2470	0	0	0	2470	225	0	0	0
C3	102.40	4516	647	0	3869	0	0	815	3869	3869	0	0	0
IC4	4.42	257	7	0	250	0	0	0	250	250	0	0	0
NC4	58.78	3417	93	0	3324	0	0	4345	3324	2951	373	0	0
C4=	65.49	3874	118	0	3556	0	0	0	3556	178	0	0	0
C5	76.45	5518	29	0	5487	0	0	5432	0	0	0	0	5487
C5=	85.23	5977	48	0	5930	0	0	0	0	0	0	0	5930
C6	53.00	4567	5	0	4563	0	0	5432	0	0	0	0	4563
C6=	61.18	5149	7	0	5142	0	0	0	0	0	0	0	5142
C7-C11	226.67	27670	0	0	27670	0	0	19554	0	0	0	0	27670
C12-C18	83.48	16727	0	0	16727	0	0	43453	0	0	0	0	16727
C19-C24	12.49	3597	0	0	0	3597	0	29331	0	0	0	0	0
C25+	130.97	103861	0	0	0	103861	0	0	0	0	0	0	0
ALCOHOLS	158.84	10762	0	10762	0	0	0	0	0	0	0	0	0
C7H14	0.00	0	0	0	0	0	0	0	0	0	2670	0	0
C10H20	0.00	0	0	0	0	0	0	0	0	0	0	2753	0
C8 REFORM	0.00	0	0	0	0	0	0	0	0	0	0	0	0
C7 ALKY	0.00	0	0	0	0	0	0	0	0	0	0	0	0
C8 ALKY	0.00	0	0	0	0	0	0	0	0	0	0	0	0
HVY POLYGAS	0.00	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1660.15	212336	15129	10762	78986	107458	1174	108632	13469	7473	3243	2753	65518
BPD(MMSCFD)		20474	3062	903	7011	8507	(5.3)	10077	1874	950	324	249	6328.57
SG@60F		0.7444	0.3390	0.8182	0.7730	0.8668		0.7397	0.5520	0.5399	0.6857	0.7590	0.7104

NOTE 1

NOTES

(1) ALCOHOL CONTAINS AN ADDITIONAL 243857 LB/HR OF WATER

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Table F-10 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-FIXED BED CASE

STREAM NO	31	32	33	34	35	36	37	38	39	40	27+39	42
DESCRIPTION	H2 TO PROD HTU	FT PROD HTU PROD	HTU PROD FRACT FEED	HTU PROD FRACT OFF GAS	HTU PROD FRACT C5/C6	HTU PROD FRACT TO CAT REFORM	HTU PROD FRACT TO DIESEL	CAT REFORM PROD H2	CAT REFORM PROD LT ENDS	CAT REFORM PROD REFORMATE	HF ALKY FEED	HF ALKY OFF GAS
COMPONENT	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2	678	0	0	0	0	0	0	751	0	0	0	0
C1	0	159	295	295	0	0	0	616	0	0	0	0
C2=	0	0	0	0	0	0	0	0	0	0	0	0
C2	0	584	720	720	0	0	0	1540	0	0	0	0
C3=	0	0	0	0	0	0	0	0	0	0	225	22
C3	0	0	815	815	0	0	0	0	4019	0	7888	7888
IC4	0	0	0	0	0	0	0	0	2921	0	3171	2726
NC4	0	753	5098	5098	0	0	0	0	2445	0	5396	5396
C4=	0	0	0	0	0	0	0	0	0	0	178	18
C5	0	11587	17019	0	17019	0	0	0	0	5740	0	0
C5=	0	0	0	0	0	0	0	0	0	0	0	0
C6	0	9828	15259	0	15259	0	0	0	0	0	0	0
C6=	0	0	0	0	0	0	0	0	0	0	0	0
C7-C11	0	26977	46531	0	0	46531	0	0	0	0	0	0
C12-C18	0	16308	59761	0	0	0	59761	0	0	0	0	0
C19-C24	0	0	29331	0	0	0	29331	0	0	0	0	0
C25+	0	0	0	0	0	0	0	0	0	0	0	0
ALCOHOLS	0	0	0	0	0	0	0	0	0	0	0	0
C7H14	0	0	0	0	0	0	0	0	0	0	0	0
C10H20	0	0	0	0	0	0	0	0	0	0	0	0
C8 REFORM	0	0	0	0	0	0	0	0	0	28500	0	0
C7 ALKY	0	0	0	0	0	0	0	0	0	0	0	0
C8 ALKY	0	0	0	0	0	0	0	0	0	0	0	0
HVY POLYGAS	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	678	66196	174828	6927	32278	46531	89092	2906	9385	34239	16858	16050
BPD(MMSCFD)	(3.06)	6522	16598	915	3428	4416	7839	(4.21)	1188	3171	2136	2037
SG@60F		0.6985	0.7227	0.5197	0.6460	0.7230	0.7798		0.5429	0.7409	0.5416	0.5407

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Table F-10 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-FIXED BED CASE

STREAM NO	43	44	45	46	47
DESCRIPTION	ALKY GASO-LINE	HVY POLYGAS HTU FD	HVY POLY GASOL	LT ENDS MAKE	GASOL
COMPONENT	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
H2	0	40	0	0	0
C1	0	0	0	910	0
C2=	0	0	0	0	0
C2	0	0	0	2259	0
C3=	0	0	0		0
C3	0	0	0		0
IC4	0	0	0		0
NC4	0	0	0		373
C4=	0	0	0		0
C5	0	0	0		22758
C5=	0	0	0		0
C6	0	0	0		15259
C6=	0	0	0	0	0
C7-C11	0	0	0	0	0
C12-C18	0	0	0	0	0
C19-C24	0	0	0	0	0
C25+	0	0	0	0	0
ALCOHOLS	0	0	0	0	0
C7H14	0	0	0	0	2870
C10H20	0	2753	0	0	0
C8 REFORM	0	0	0	0	28500
C7 ALKY	482	0	0	0	482
C8 ALKY	326	0	0	0	326
HVY POLYGAS	0	0	2793	0	2793
TOTAL	808	2793	2793	3170	73361
BPD	79	249	261		7264
SG@60F	0.6983	0.7699	0.7342		0.6930

Table F-10 Continued

MATERIAL BALANCE -BASIS 3 SHELL GASIFIERS 2500 T/D M/F COAL EACH-FIXED BED CASE

	FEED			PRODUCTS							
DESCRIPTION / COMPONENT	FT FEED LB/HR	H2 LB/HR	TOTAL FEED LB/HR	H2 LB/HR	LT ENDS LB/HR	C3/C4 LB/HR	GASOL LB/HR	DIESEL LB/HR	ALCOHOLS LB/HR	FT BLEED GAS LB/HR	TOTAL PRODUCTS LB/HR
H2	0	1891	1891	751	0	0	0	0	0	0	751
C1	8079	0	8079	0	910	0	0	0	0	8078	8989
C2=	869	0	869	0	0	0	0	0	0	869	869
C2	4560	0	4560	0	2259	0	0	0	0	4559	6819
C3=	3139	0	3139	0	0	22	0	0	0	669	692
C3	4516	0	4516	0	0	8702	0	0	0	647	9349
IC4	257	0	257	0	0	2726	0	0	0	7	2732
NC4	3417	0	3417	0	0	10494	373	0	0	92	10959
C4=	3674	0	3674	0	0	18	0	0	0	118	136
C5	5516	0	5516	0	0	0	22758	0	0	29	22787
C5=	5977	0	5977	0	0	0	0	0	0	48	48
C6	4567	0	4567	0	0	0	15259	0	0	5	15264
C6=	5149	0	5149	0	0	0	0	0	0	7	7
C7-C11	27670	0	27670	0	0	0	0	0	0	0	0
C12-C18	18727	0	18727	0	0	0	0	59761	0	0	59761
C19-C24	3597	0	3597	0	0	0	0	29331	0	0	29331
C25+	103881	0	103881	0	0	0	0	0	0	0	0
ALCOHOLS	10762	0	10762	0	0	0	0	0	10762	0	10762
C7H14	0	0	0	0	0	0	2870	0	0	0	2870
C10H20	0	0	0	0	0	0	0	0	0	0	0
C8 REFORM	0	0	0	0	0	0	28500	0	0	0	28500
C7 ALKY	0	0	0	0	0	0	482	0	0	0	482
C8 ALKY	0	0	0	0	0	0	326	0	0	0	326
HVY POLYGAS	0	0	0	0	0	0	2793	0	0	0	2793
TOTAL	212336	1891	214227	751	3170	21963	73361	89092	10762	15129	214227
FUEL,MMBTU/HR					65.7					514.1	

H2CONSUMED	LB/HR	MPH	H2 MAKE	LB/HR	MPH
WAX H/C	1174	582.2	CAT REFORMER	751	372.4
F-T HTU	678	336.4	FT PURGE	1141	565.8
H CP GAS HTU	40	19.8	TOTAL	1891	938.2
TOTAL	1891	938.2			

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Table F-11

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

SHIFT CONVERSION AND COOLING
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP. F SHELL	TEMP. F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA FT2	REMARKS
E-1	EFF/LMP STEAM GENERATOR	S&T	1	650	380	650	930	CS	321 SS	8440	
E-2	FEED/EFFLUENT EXCHANGER	S&T	1	400	380	500	600	CS W/321 CL	321 SS	6650	
E-3	EFF/LP STEAM GENERATOR	S&T	1	75	380	500	500	CS	304L	4325	
E-4	EFF/LMP BFW PREHEATER	S&T	1	380	650	500	500	CS	304L	3365	
E-5	EFF/LP BFW PREHEATER	S&T	1	380	75	500	500	CS	304L	600	
E-6	EFFLUENT AIR COOLER	AIR	1	N/A	380	N/A	500	N/A	304L	39750	FAN BHP=585
E-7	EFFLUENT TRIM COOLER	S&T	1	380	75	250	250	CS	304L	8400	
F-1	STARTUP HEATER		1		650		380		321 SS		19MM BTU/HR FIRED DUTY

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Table F-11

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

SHIFT CONVERSION AND COOLING
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	SHIFT CONVERTER	VERT	1	360	930	1.25Cr .5Mo W/321 SS CLAD	321 SS	15.0	12.5	
C-2	COLD SEPARATOR	VERT	1	360	250	CS W/ 304SS CLAD	304 L	11.5	9.5	

Table F-12

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
ACID GAS REMOVAL PLANT

VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	FEED GAS SEPARATOR	VERT	1	550	100/-50	LOW TEMP CS	316 SS	8.5	10	W/SS MESH PAD
C-2	ABSORBER	VERT	1	550	100/-100	3% NI	410 SS	13	217	
C-3	CO2 RICH FLASH DRUM	HORIZ	1	200	100/-50	LOW TEMP CS	316 SS	12	36	W/SS MESH PAD
C-4	H2S RICH FLASH DRUM	HORIZ	1	200	100/-50	LOW TEMP CS	316 SS	8	24	W/SS MESH PAD
C-5	H2S CONCENTRATION COL	VERT	1	60	100/-100	3% NI	410 SS	17	144	
C-6	HOT REGENERATOR	VERT	1	60	250	CS	410 SS	17	102	
C-7	HOT REGEN REFLUX DRUM	HORIZ	1	60	150	CS		5	12	
C-8	CONDENSATE DRUM	HORIZ	1	60	100/-50	LOW TEMP CS		6.5	13	
C-9	METHANOL SURGE DRUM	HORIZ	1	60	150	CS		16	42	
C-10	METHANOL/H20 COLUMN	VERT	1	75	320	CS	410 SS	6	79	TOP
								9	7	BTM
C-11	PROPYLENE ACCUMULATOR	HORIZ	1	320	150	CS		7	20	
C-12	LOW LEVEL PROPYLENE KO	VERT	1	150	100/-50	LOW TEMP CS	316 SS	9.5	8	W/SS MESH PAD
C-13	MED LEVEL PROPYLENE KO	VERT	1	150	100/-50	LOW TEMP CS	316 SS	8	14	W/SS MESH PAD
C-14	HIGH LEVEL PROPYLENE KO	VERT	1	150	100/-50	LOW TEMP CS	316 SS	9	14	W/SS MESH PAD
D-1	METHANOL STORAGE	VERT	1	ATM		CS				11000 BBLS

Table F-12

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
ACID GAS REMOVAL PLANT

HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	TUBE	TEMP. F SHELL	TUBES	MATERIALS OF CONSTRUCTION SHELL	TUBE	BARE TUBE AREA FT2	REMARKS
E-1	FEED GAS/CO2 VENT	S&T	1	60	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	6140	
E-2	FEED GAS/TREATED GAS	S&T	1	550	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	17130	
E-3	FEED GAS CHILLER	S&T	1	150	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	5965	
E-4	ABSORBER INTERCOOLER	S&T	1	150	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	11600	
E-5	LEAN METHANOL CHILLER	S&T	1	150	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	9000	
E-6	HOT REGEN FEED/BOTTOMS	S&T	1	185	550	200/-100	200/-100	3%NI	3%NI	144000	
E-7	HOT REGEN FEED/BOTTOMS	S&T	1	185	75	260	250	CS	CS	130300	
E-8	HOT REGEN REBOILER	S&T	1	60	75	260	360	CS	CS	7400	
E-9	METHANOL/H20 REBOILER	S&T	1	75	150	340	400	CS	CS	1170	
E-10	METHANOL H2O FD/REFLUX	S&T	1	75	180	260	400	CS	CS	100	
E-11	METHANOL/H20 BTM COOL	S&T	1	75	150	260	200	CS	CS	70	
E-12	HOT REGEN CONDENSER	S&T	1	60	150	260	200	CS	CS	11300	
E-13	H2S REHEAT EXCHANGER	S&T	1	60	60	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	400	
E-14	HOT REGEN OVHD CHILLER	S&T	1	150	60	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	1500	
E-15	PROPYLENE DESUPERHEATER	S&T	1	320	150	320	200	CS	CS	3170	
E-16	PROPYLENE CONDENSER	S&T	1	320	150	260	200	CS	CS	19300	
E-17	ABSORBER INTERCOOLER	S&T	1	100	550	150/-50	150/-50	LOW TEMP C.S	LOW TEMP C.S	23180	
E-18	REFRIG COMP SURF. COND.	S&T	1	50	75	250	250	CS	CS	8500	

Table F-12

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
ACID GAS REMOVAL PLANT

PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
G-1	HOT REGENERATOR FEED	CENTRIF	2		286	339	3% NI	3% NI	MOTOR	410	
G-2	LEAN METHANOL	CENTRIF	2	6300	1670	2350	CS	CI	MOTOR	2940	
G-3	HOT REGENERATOR COND	CENTRIF	2	5	225	0.25	LOW TEMP CS	LOW TEMP CS	MOTOR	1/2	
G-4	HOT REGENERATOR REFLUX	CENTRIF	2	301	194	11	CS	CI	MOTOR	25	
G-5	METHANOL/H2O REFLUX	CENTRIF	2	50	250	3	CS	CI	MOTOR	10	
G-6	METHANOL MAKEUP	CENTRIF	2	300		4	CS	CI	MOTOR	6	
K-1	RECYCLE COMPRESSOR	RECIP	1			275	LOW TEMP CS		STM TURB	370	SINGLE STAGE
K-2	REFRIGERATION COMPRESS	CENTRIF	1			6160	LOW TEMP CS		STM TURB	8000	MULTIPLE SIDE LOAD

Table F-13

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

SYNGAS COMPRESSION PLANT
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM., FT	DIMENSIONS T-T FT	REMARKS
C-1	FEED GAS KO DRUM	VERT	1	320	250	CS	316 SS	16	10.5	W/ SS MESH PAD
C-2	COMPR DISCHARGE KO DRUM	VERT	1	570	250	CS	316 SS	13.5	10	W/ SS MESH PAD

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Table F-13

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

SYNGAS COMPRESSION PLANT
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP. F SHELL	TEMP. F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	AREA FT2	REMARKS
E-1	COMPRESSOR AFTERCOOLER	AIR	1	N/A	570	N/A	250	N/A	CS	10330	FAN BHP=155
E-2	COMPRESSOR TRIM COOLER	S&T	1	570	75	250	250	CS	CS	7820	
E-3	COMPRESSOR SURFACE COND	S&T	1	50	75	250	250	CS	CS	14760	

Table F-13

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

SYNGAS COMPRESSION PLANT
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
K-1	SYNGAS COMPRESSOR	CENTRIF	1	(423000)			CI		STEAM TURBINE	25000	

Table F-14

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T REACTION SECTION
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM. FT	DIMENSIONS T-T FT	REMARKS
C-1	STEAM DRUM	HORIZ	6	700	650	CS	CS	5.5	27	
C-2	FISCHER-TROPSCH REACTOR	VERT	6	460	550	CS	CS	15.75	48	W/3606 TUBES
C-3	WAX FLASH DRUM	HORIZ	1	50	510	CS	CS	5.5	15	
C-4	PRODUCT SEPARATOR	HORIZ	1	450	250	CS	CS	20	63	
C-5	SPENT WAX OFF GAS DRUM	VERT	1	50	250	CS	CS	3	8	
D-1	CATALYST STORAGE BIN	VERT	2	ATM.	250	CS	CS	25	28	W/ 60 CONE

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Table F-14

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T REACTION SECTION
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS.PSIG SHELL	PRESS.PSIG TUBE	TEMP. F SHELL	TEMP. F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	BARE TUBE AREA FT2	REMARKS
E-1	REACTOR FEED/EFFL EXCH	S&T	1	500	460	550	550	CS	CS	111250	
E-2	EFFLUENT AIR COOLER	AIR	1	N/A	460	N/A	350	N/A	CS	48000	710 HP FANS
E-3	EFFLUENT TRIM COOLER	S&T	1	460	75	250	250	CS	CS	24200	
E-4	WAX OFF GAS CONDENSER	AIR	1	N/A	50	N/A	500	N/A	CS	60	2 HP FANS
E-5	WAX PRODUCT COOLER	AIR	1	N/A	50	N/A	500	N/A	CS	1300	25 HP FANS

Table F-14

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T REACTION SECTION
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
G-1	BFW PUMP	CENTRIF	16	1650	70	48	CS	CI	MOTOR	60	
G-2	WAX PRODUCT PUMP	CENTRIF	2	442	110	17	CS	CI	MOTOR	22	
G-3	WAX CONDENSATE PUMP	CENTRIF	2	5	2000	1	CS	CI	MOTOR	7	
K-1	OFFGAS COMPRESSOR	RECIP	1						MOTOR	10	

Table F-18

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T GAS PLANT
VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIMENSIONS DIAM. FT	DIMENSIONS T-T FT	REMARKS
C-1	DEETHANIZER-TOP	VERT	1	450	450	CS	410 SS	5.5	101	40 VALVE TRAYS
C-2	DEETHANIZER REFLUX DRUM	HORIZ	1	450	250	CS	304 SS	3	12	W/ SS MESH PAD
C-3	STABILIZER	VERT	1	100	400	CS	410 SS	4	84	34 VALVE TRAYS
C-4	STABILIZER REFLUX DRUM	HORIZ	1	100	250	CS	304 SS	3.5	13.5	W/ SS MESH PAD
C-5	RECYCLE GAS KO DRUM	VERT	1	550	250	LT CS	CS	7.5	15	W/ SS MESH PAD
C-6	PROPYLENE ACCUMULATOR	HORIZ	1	250	250	LT CS	304 SS	5.5	19.5	
C-7	LOW LEVEL PROPYL KO DRUM	HORIZ	1	150	250/-50	LT CS	304 SS	6	21	W/ SS MESH PAD
C-8	HI LEVEL PROPYL KO DRUM	HORIZ	1	150	250/-50	LT CS	304 SS	5	18	W/ SS MESH PAD

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Table F-15

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T GAS PLANT
HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS,PSIG SHELL	PRESS,PSIG TUBE	TEMP,F SHELL	TEMP,F TUBES	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION TUBE	AREA, FT2	REMARKS
E-1	RECYCLE COMP AFTERCOOLER	AIR	1	N/A	675	N/A	250	N/A	304 SS	10800	FAN BHP=307
E-2	RECYCLE COMP TRIM COOLER	S&T	1	675	75	250	250	304 SS	304 SS	15540	
E-3	DEETHANIZER CONDENSER	S&T	1	440	150	250	250	CS	CS	1190	
E-4	DEETHANIZER REBOILER	S&T	1	440	650	440	625	CS	CS	1340	
E-5	DEETHANIZER SIDE REBUILER	S&T	1	440	440	440	300	CS	CS	1050	
E-6	STABILIZER REBOILER	S&T	1	100	650	400	625	CS	CS	410	
E-7	STABILIZER CONDENSER	S&T	1	100	75	250	250	304 SS	304 SS	4570	
E-8	STABILIZER BOTTOM COOLER	AIR	1	N/A	120	N/A	400	N/A	CS	1515	FAN BHP=22
E-9	FEED/OFFGAS EXCH	S&T	1	625	500	250	250/-50	CS	CS /LTCS	100950	
E-10	FEED/LIQUID EXCH	S&T	1	625	500	250	250/-50	CS	CS /LTCS	1360	
E-11	RECYCLE GAS CHILLER	S&T	1	150	625	250/-50	250/-50	LT CS	LT CS	15220	
E-12	PROPYLENE DESUPERHEATER	S&T	1	300	75	250	250	CS	CS	2560	
E-13	PROPYLENE CONDENSER	S&T	1	300	75	250	250	CS	CS	13500	
E-14	RECYCLE COMPR SURF. COND.	S&T	1	50	75	250	250	CS	CS	17400	
E-15	REFRIG. COMPR SURF. COND.	S&T	1	50	75	250	250	CS	CS	2315	

Table F-15

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

F-T GAS PLANT
PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM/SCFM	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER TYPE	POWER BHP	REMARKS
G-1	DEETHANIZER REFLUX	CENTRIF	2	58	216	1.5	CS	CI	MOTOR	4	
G-2	STABILIZER REFLUX	CENTRIF	2	116	186	2.9	CS	CI	MOTOR	5	
G-3	STABILIZER BOTTOMS	CENTRIF	2	348	90	4.1	CS	CI	MOTOR	6	
K-1	RECYCLE COMPRESSOR	CENTRIF	2	(33000)			CS	CI	STM TURB	29400	
K-2	REFRIGERATION COMPRESSOR	CENTRIF	2				LT CS	CI	STM TURB	3600	
K-3	WAX OFF GAS COMPRESSOR	RECIP	1				CS	CI	MOTOR	100	

Table F-16

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

VESSELS,DRUMS & TANKS

ITEM NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN COND. PRESS PSIG	DESIGN COND. TEMP. F	MATERIALS OF CONSTRUCTION SHELL	MATERIALS OF CONSTRUCTION INTERNALS	DIAMENSIONS DIAM. FT	DIAMENSIONS T-T FT	REMARKS
C-1	FEED GAS KO DRUM	VERT	1	400	250	CS		15	9	
C-2	ABSORBER	VERT	1	400	250	CS	410 SS TRAYS	15	74	
C-3	TREATED GAS KO DRUM	VERT	1	400	250	CS	316 SS MESH	13	8.5	MIST ELIM
C-4	RICH SOLUTION FLASH DRUM	HORIZ	1	50	250	SS		5.5	17	
C-5	REGENERATOR	VERT	1	50	350	CS W/SS CLAD TOP	304SS PACKING	14.5	75	2" PALL RINGS
C-6	REGENERATOR OVHD RECEIVER	VERT	1	50	250	CS W/SS CLAD	316 SS MESH	5	8	MIST ELIM
D-1	SOLUTION STORAGE TANK	VERT	1	ATM	250	CS				1500 BBLS

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Table F-16

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

HEAT EXCHANGERS

ITEM NO	EQUIPMENT NAME	TYPE	NO. PER TRAIN	DESIGN CONDITIONS PRESS,PSIG SHELL	TUBE	TEMP, F SHELL	TUBES	MATERIALS OF CONSTRUCTION SHELL	TUBE	BARE TUBE AREA, FT2	REMARKS
E-1	LEAN SOLUTION COOLER	S&T	1	400	75	250	250	CS	CS	5900	
E-2	LEAN SOLUTION AIR COOLER	AIR	1	N/A	400	250	250	N/A	CS	4830	FAN BHP=133
E-3	LEAN/RICH EXCHANGER	S&T	1	50	400	250	250	CS	CS	22900	
E-4	REGEN OVHD CONDENSER	AIR	1	N/A	50	250	250	N/A	304SS	16500	FAN BHP=95
E-5	REGENERATOR REBOILER	KETTLE	1	50	75	350	400	304SS	304SS	9930	
E-6	RECLAIMER	KETTLE	1	50	250	650	650	304SS	304SS	7000	

Table F-16

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
EQUIPMENT LIST
CO2 REMOVAL PLANT

PUMPS AND COMPRESSORS

ITEM NO.	EQUIPMENT NAME	TYPE	NO PER TRAIN	DESIGN CONDITIONS FLOW GPM (SCFM)	HEAD FT	HYDRAULIC HP	MATERIALS OF CONSTRUCTION CASE	ROTATING UNIT	DRIVER	BHP
G-1	LEAN SOLUTION PUMP	CENTRIF	2	1440	110	40	CS	CI	MOTOR	50
G-2	LEAN SOLUTION BOOSTER PUMP	CENTRIF	2	1520	875	650	CS	SS	MOTOR	400
G-3	REGENERATOR REFLUX	CENTRIF	2	60	134	2	CS	SS	MOTOR	3

Table P-17

SLURRY REACTOR DESIGN STUDIES
FISCHER-TROPSCH FIXED BED REACTOR CASE
UTILITY SUMMARY

PLANT DESCRIPTION NO	ELEC. PWR MW	STEAM, M LB/HR HIGH PR 1650 PSIG 966 F	MED PR 636 PSIG 700 F	MED PR 636 PSIG 476(SAT)	MED PR 307 PSIG 424(SAT)	200 PSI 200 PSIG 382(SAT)	LOW PR 60 PSIG 287(SAT)	COND	BFW	WATER, GPM WASTE WATER	C.W. CIRC.	FUEL, MM BTU/HR HEAT ABS	TOTAL FIRED DUTY
GAS PREP. AND SYNTHESIS													
101 SHELL GASIFIER		(792.8)								133			
102 SHIFT CONVERSION	970			21.8	536.1		(78.8)		711		3010		
103 COS HYDROLYSIS													
104 GAS COMPRESSION	127	146.4									8120		
105 SOUR WATER STRIPPING	123						87.8	(87.8)		1034	3170		
106 ACID GAS REMOVAL	2936	82.8				18.1	141.2	(157.4)		7	20280		
107 SULFUR RECOVERY & TGT	1148			2.4		(37.8)	66.4	(66.4)	122				40.4
108 SULFUR POLISHING													
109 F-T SYNTHESIS	666				(1014.0)				2069		3910		(814.1)
110 CO2 REMOVAL	1060						171.6	(171.6)			8360		
111 DEHYDRATION	196										1340	66.7	69.6
112 F-T GAS PLANT	268	183.1		28.1				(28.1)			15878		
113 H2 RECOVERY													
F-T PRODUCT REFINING													
200 ALCOHOL RECOVERY	0			0.0		0.0		(0.0)		488	0		
201 F-T PRODUCT HTU	127			0.0				(0.0)			217		0.5
202 HTU PROD FRACT.	737			74.1			1.0	(75.7)		88	1659		52.4
203 CAT REFORMER	218			13.3				(13.3)			660		10.8
204 C5/C6 ISOMERIZATION	302			0.0		78.8	1.2	(81.0)			170		1.7
205 CAT POLYMERIZATION	103			13.3				(13.3)			116		
206 HF ALKYLATION	122			8.8			2.8	(9.1)			338		
207 HVY GASOLINE HTU	30			1.0				(1.0)			18		0.2
208 LT ENDS RECOVERY	763			0.0		7.7		(7.7)			628		(65.7)
209 H2 PURIFICATION	345			0.0				(0.0)			60		
210 WAX HYDROCRACKING	850			8.7		3.0		(9.7)			242		48.4
OFFSITE UNITS													
300 OXYGEN PLANT	1703	888.8	80.0								135808		
301 INSTRUMENT/PLANT AIR													
302 COAL HANDLING	15861			87.1									
303 POWER DISTRIBUTION													
304 BFW PREPARATION	1500												
305 COOLING WATER TREATMENT													
306 CW TOWER	8232												
307 POWERGEN	(42232)	486.7	(80.0)	(107.4)									1231.7
308 WW TREATMENT	3320												
309 BLOWDOWN													
310 STORAGE													
311 INTERCONN PIPING													
312 REFRIGERATION													
313 GASOLINE BLENDING	60												
MISCELLANEOUS	280												
TOTAL	0	809.8	0.0	32.8	(478.8)	69.0	395.7	(717.1)	2802	1760	204268	66.7	691.9

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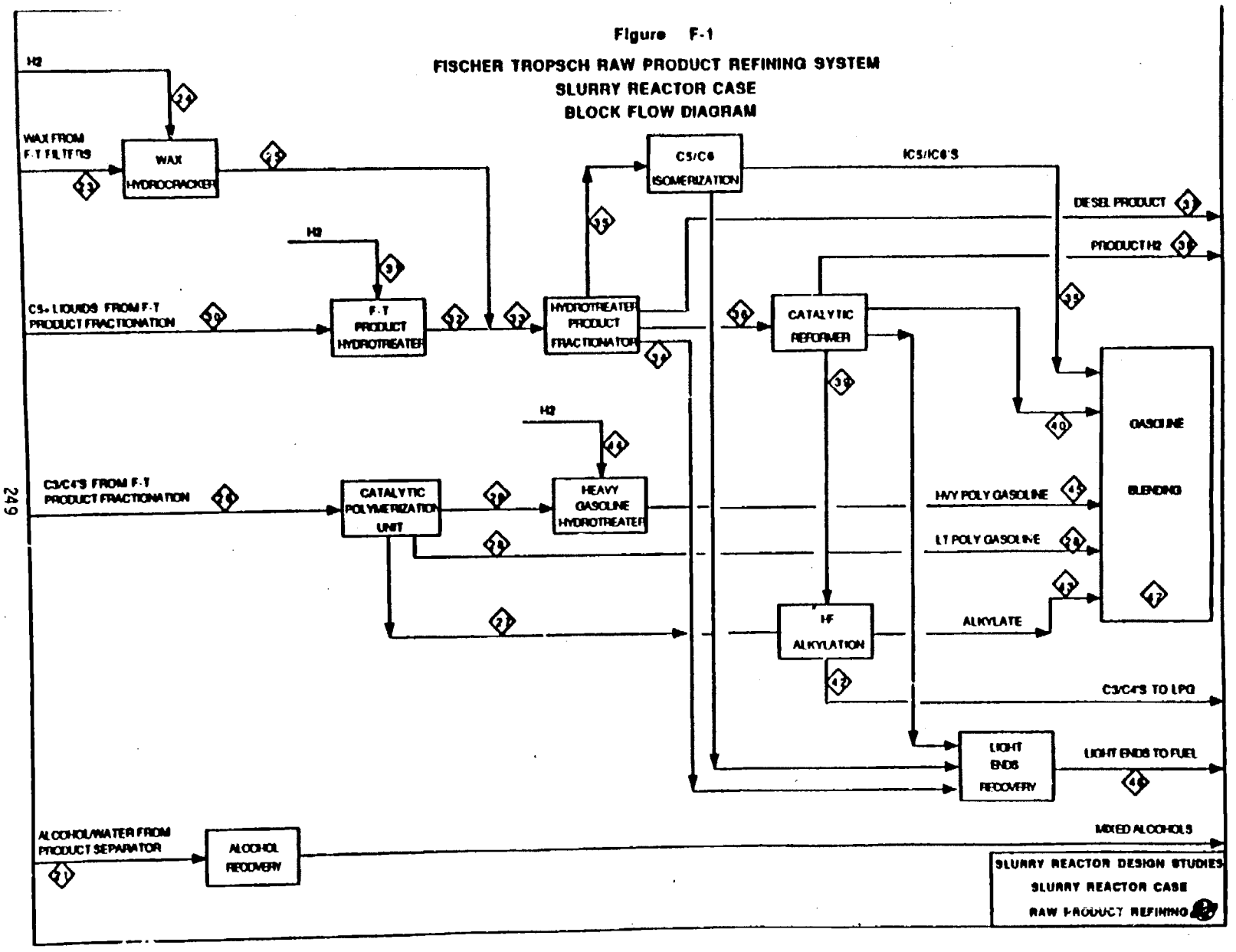
Figure F-1

FISCHER TROPSCH RAW PRODUCT REFINING SYSTEM
SLURRY REACTOR CASE
BLOCK FLOW DIAGRAM



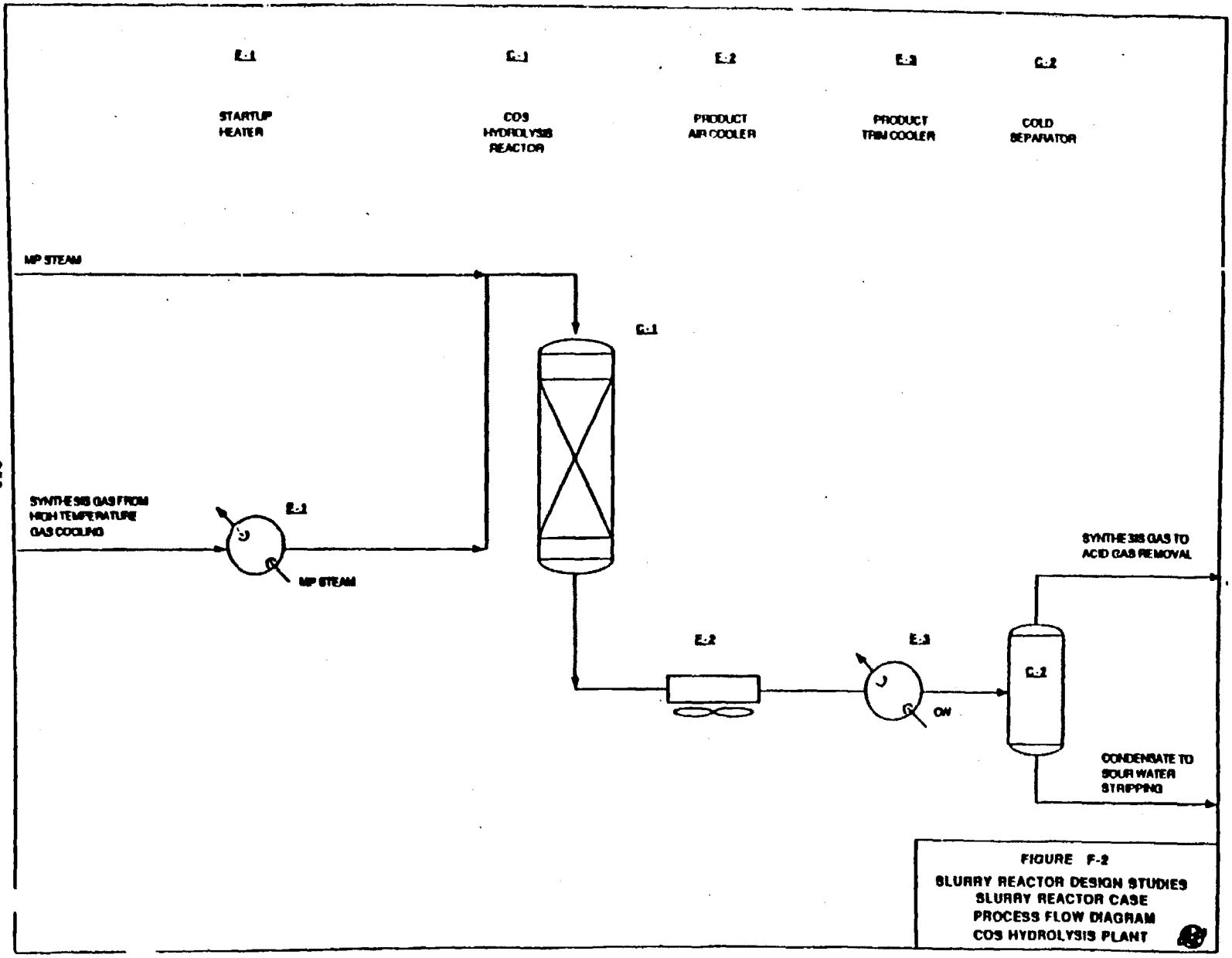


FIGURE F-2
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
COS HYDROLYSIS PLANT

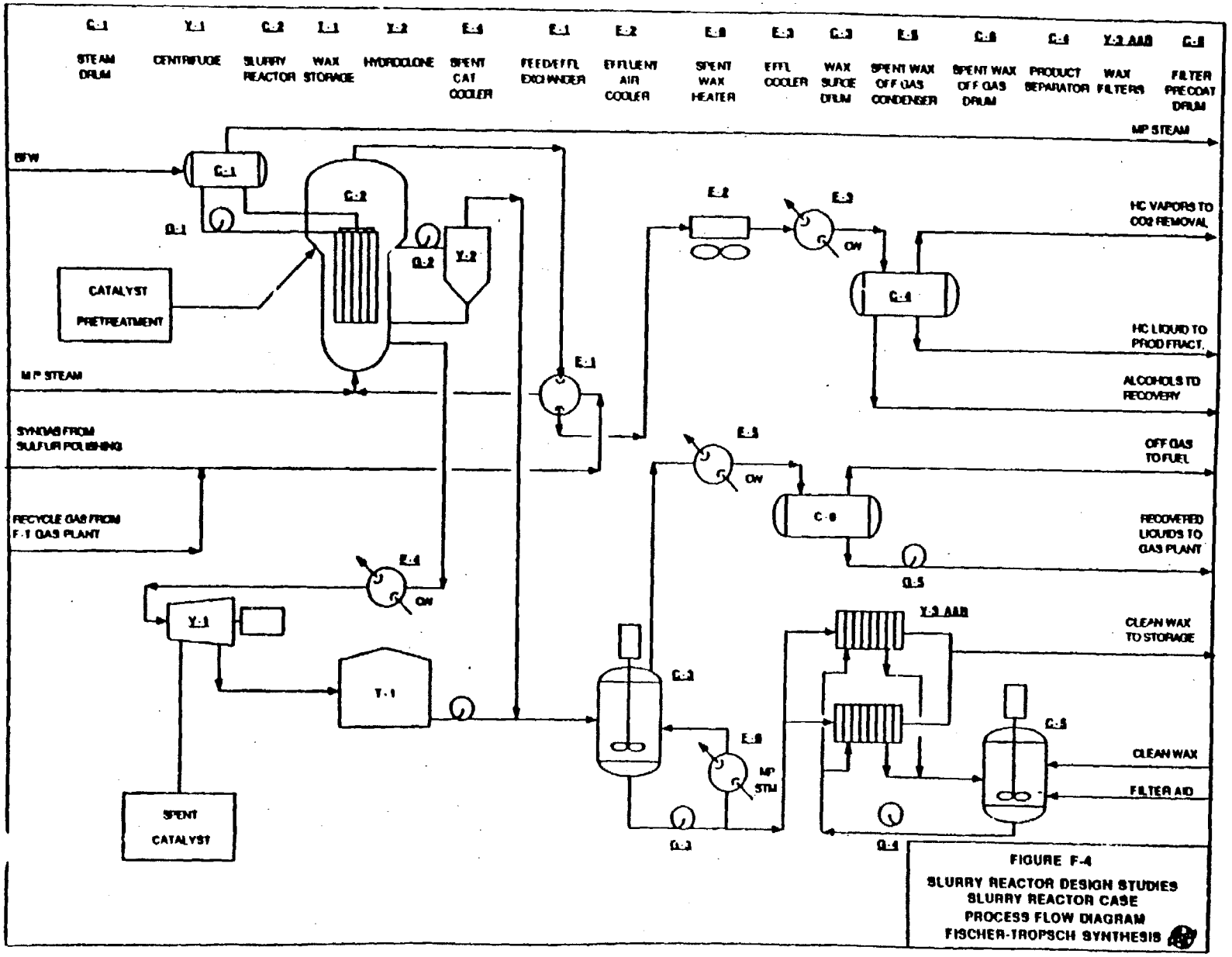


FIGURE F-4
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
FISCHER-TROPSCH SYNTHESIS

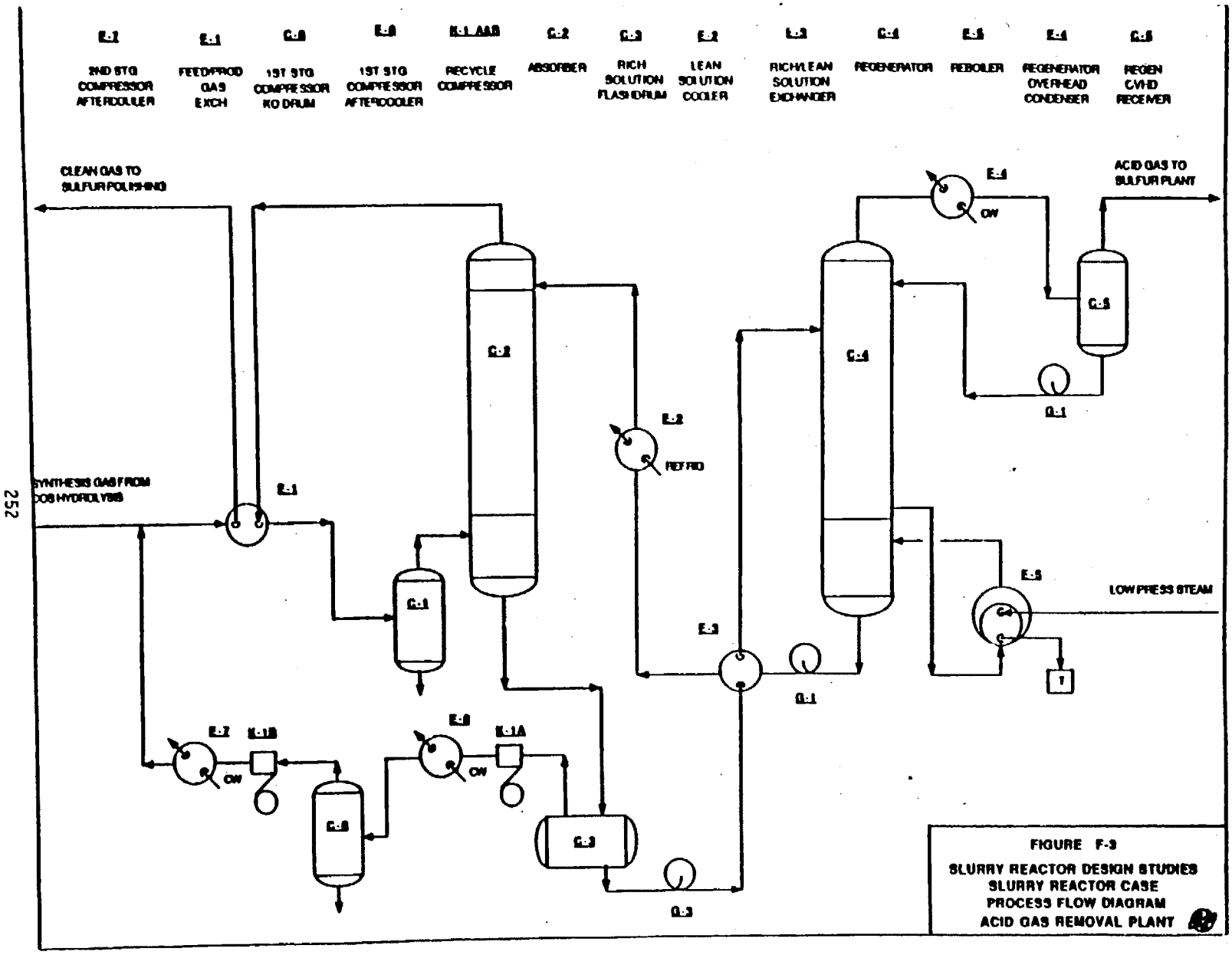


FIGURE F-9
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
ACID GAS REMOVAL PLANT

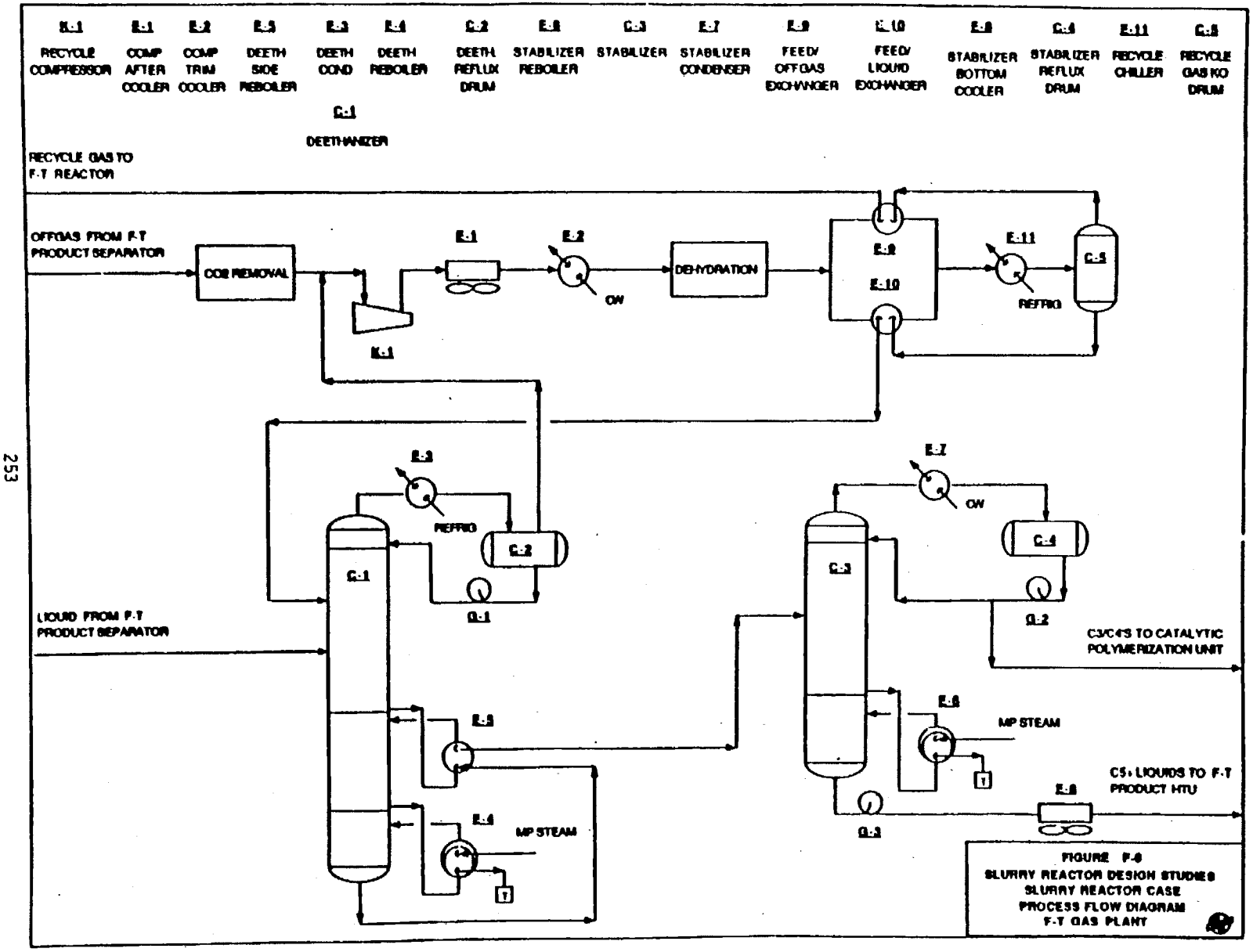


FIGURE F-9
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
F-T GAS PLANT

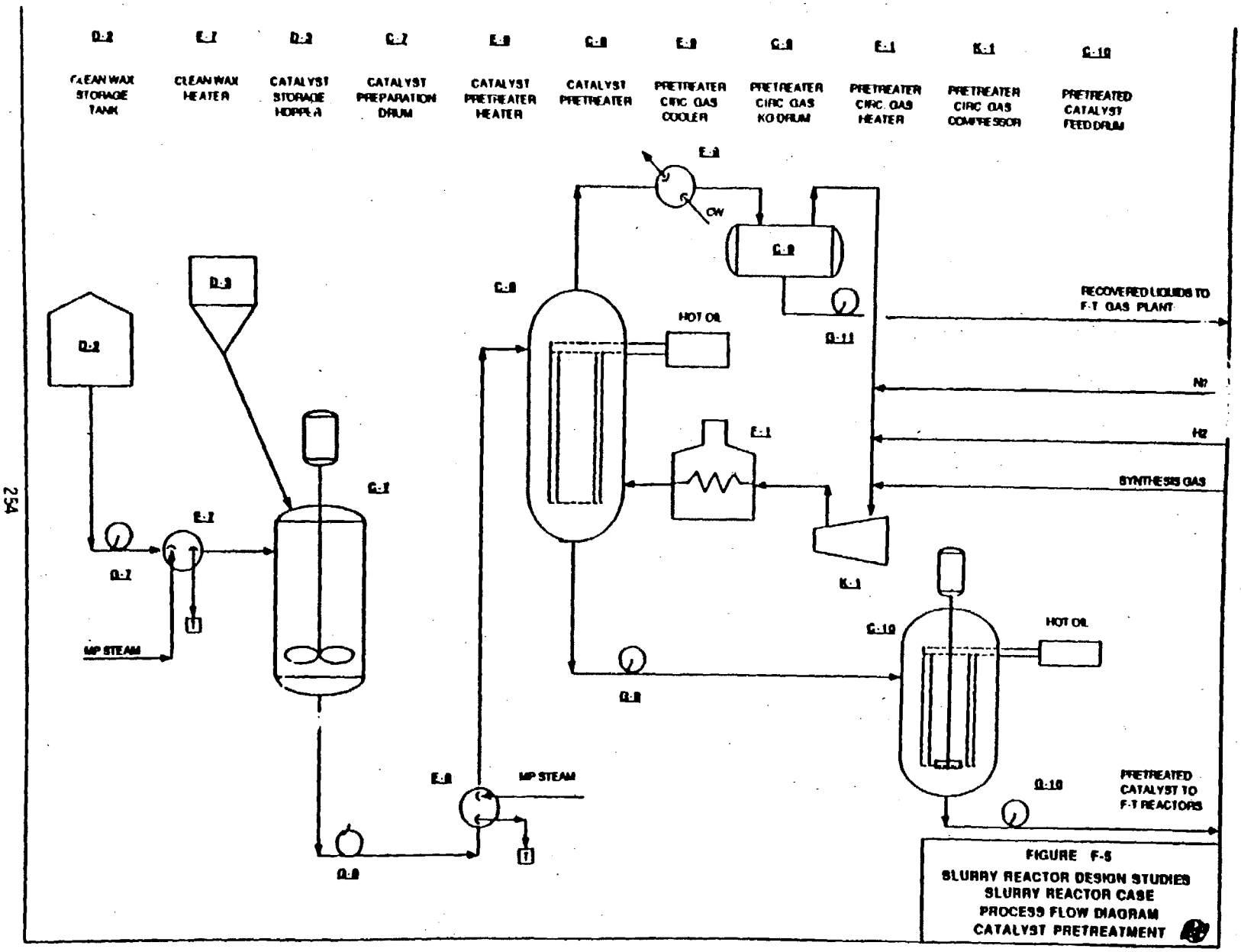


FIGURE F-5
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
CATALYST PRETREATMENT

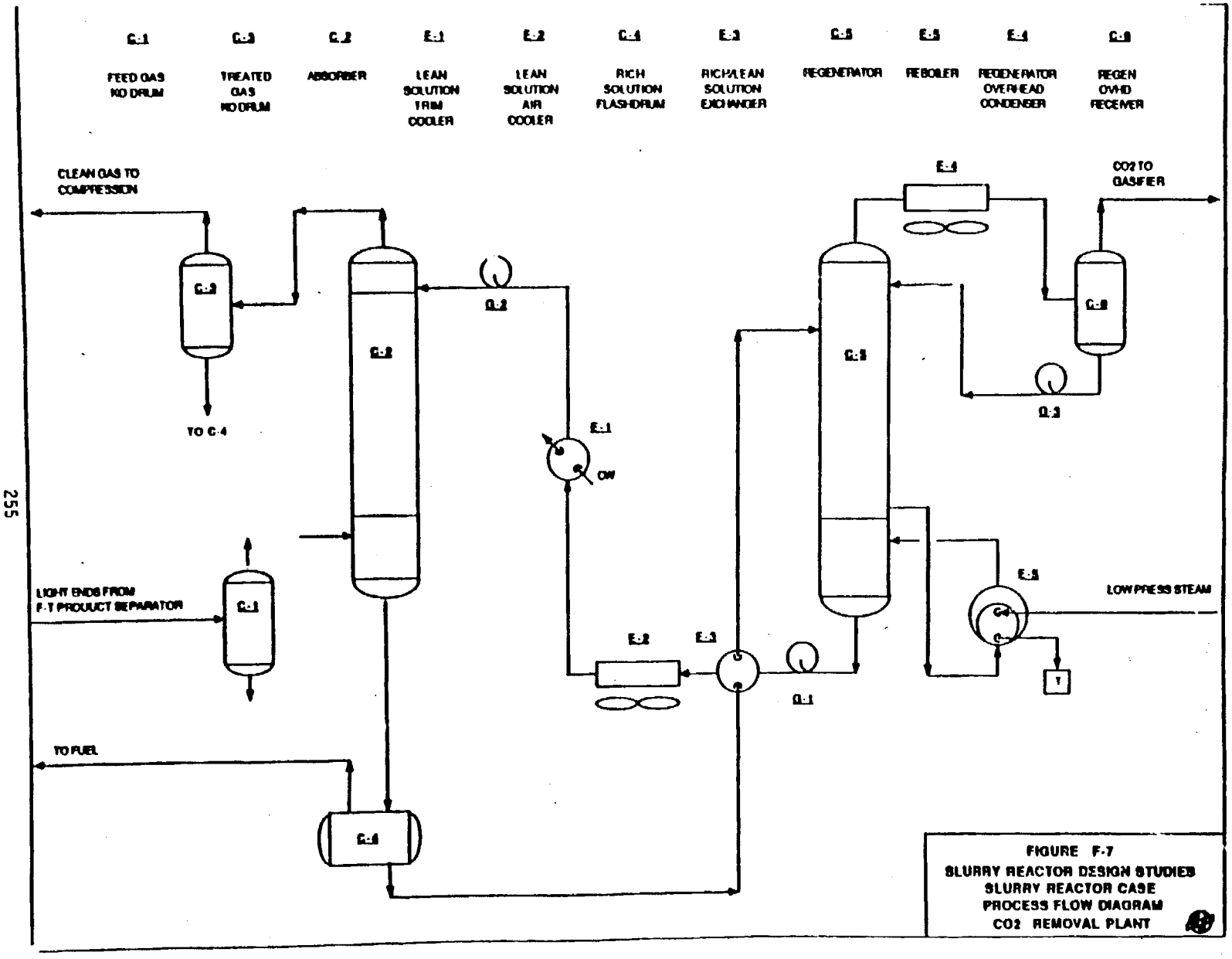
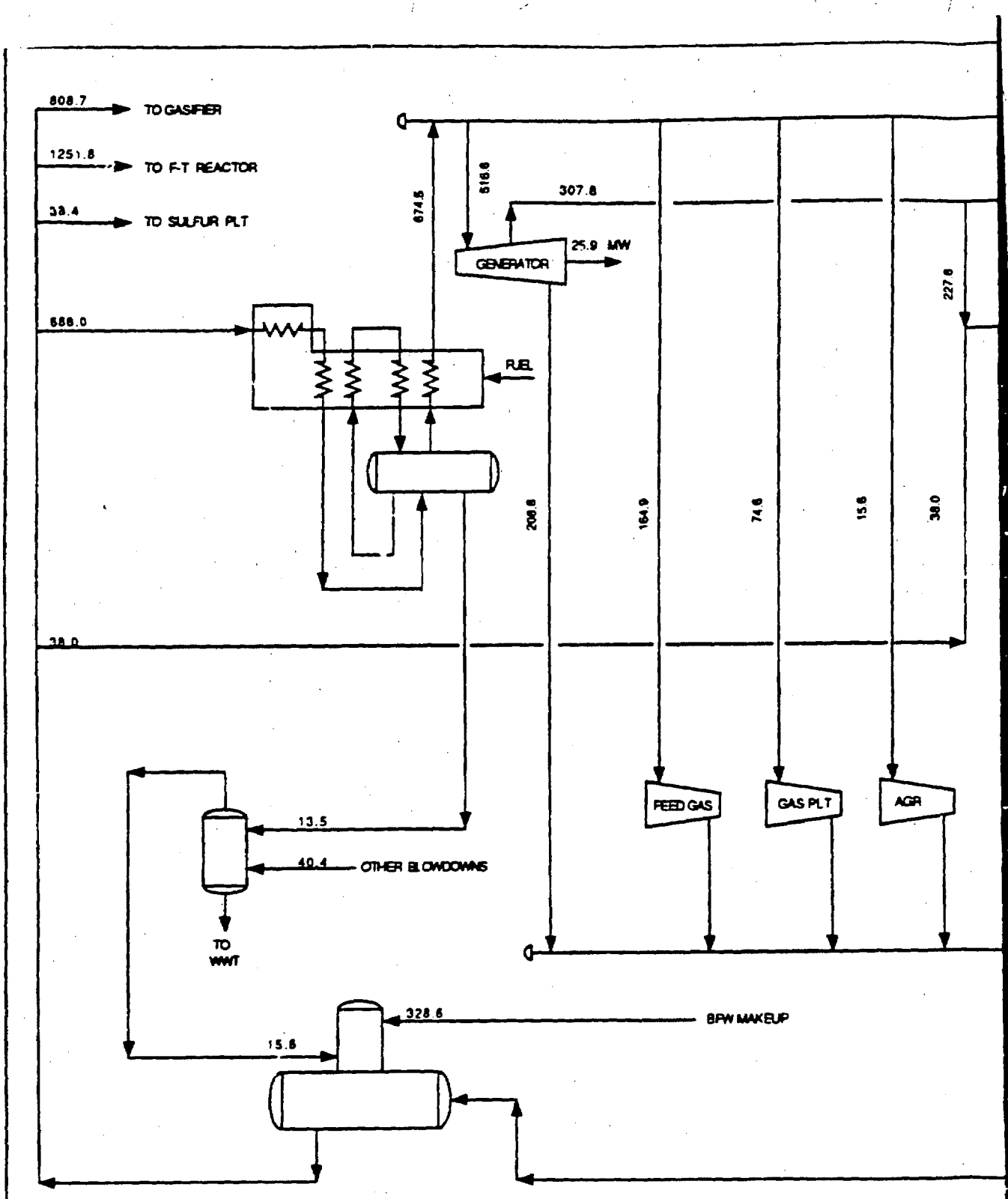


FIGURE F-7
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
CO2 REMOVAL PLANT



NOTES:

(1) RATES ARE M LB/HR

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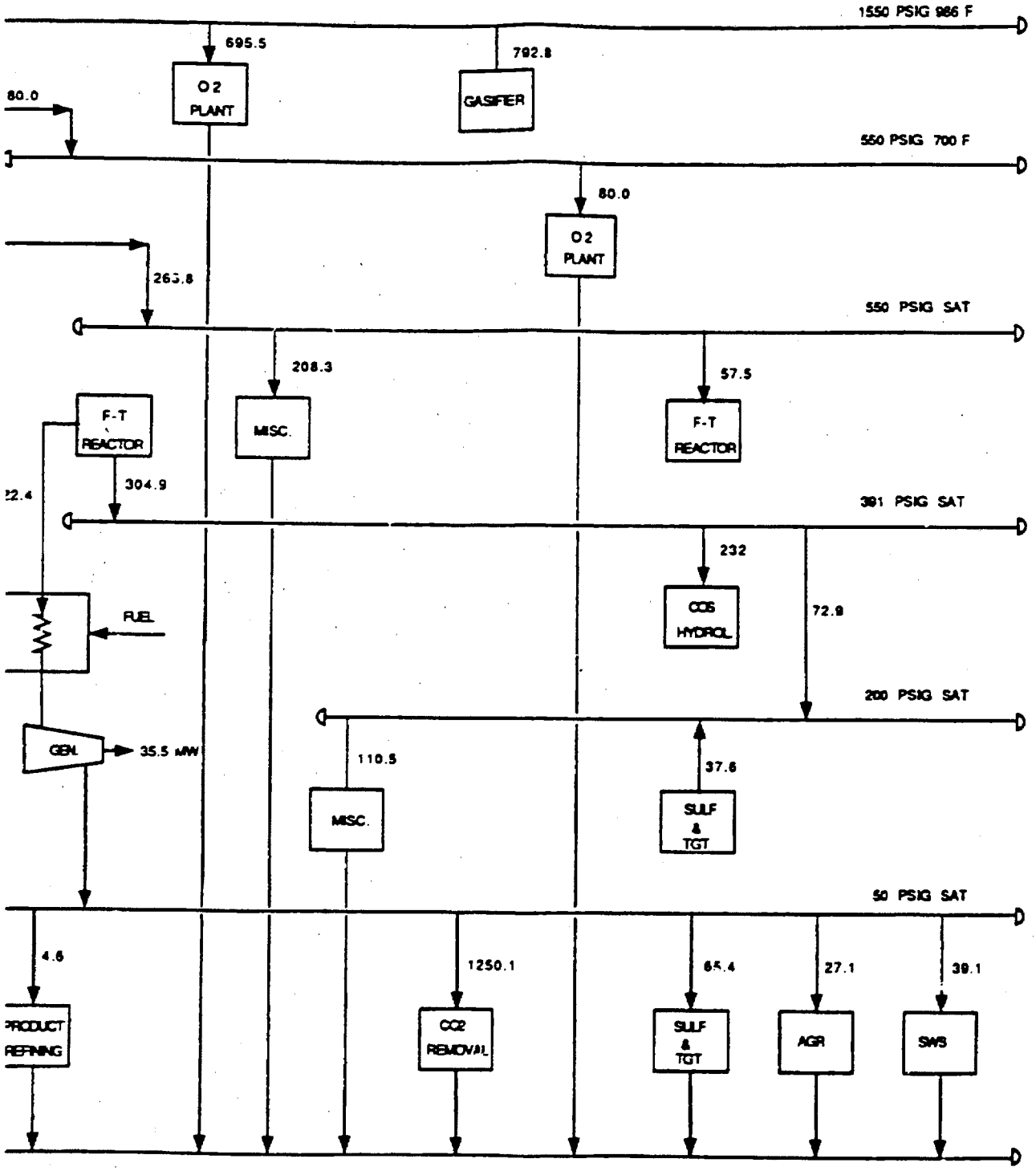
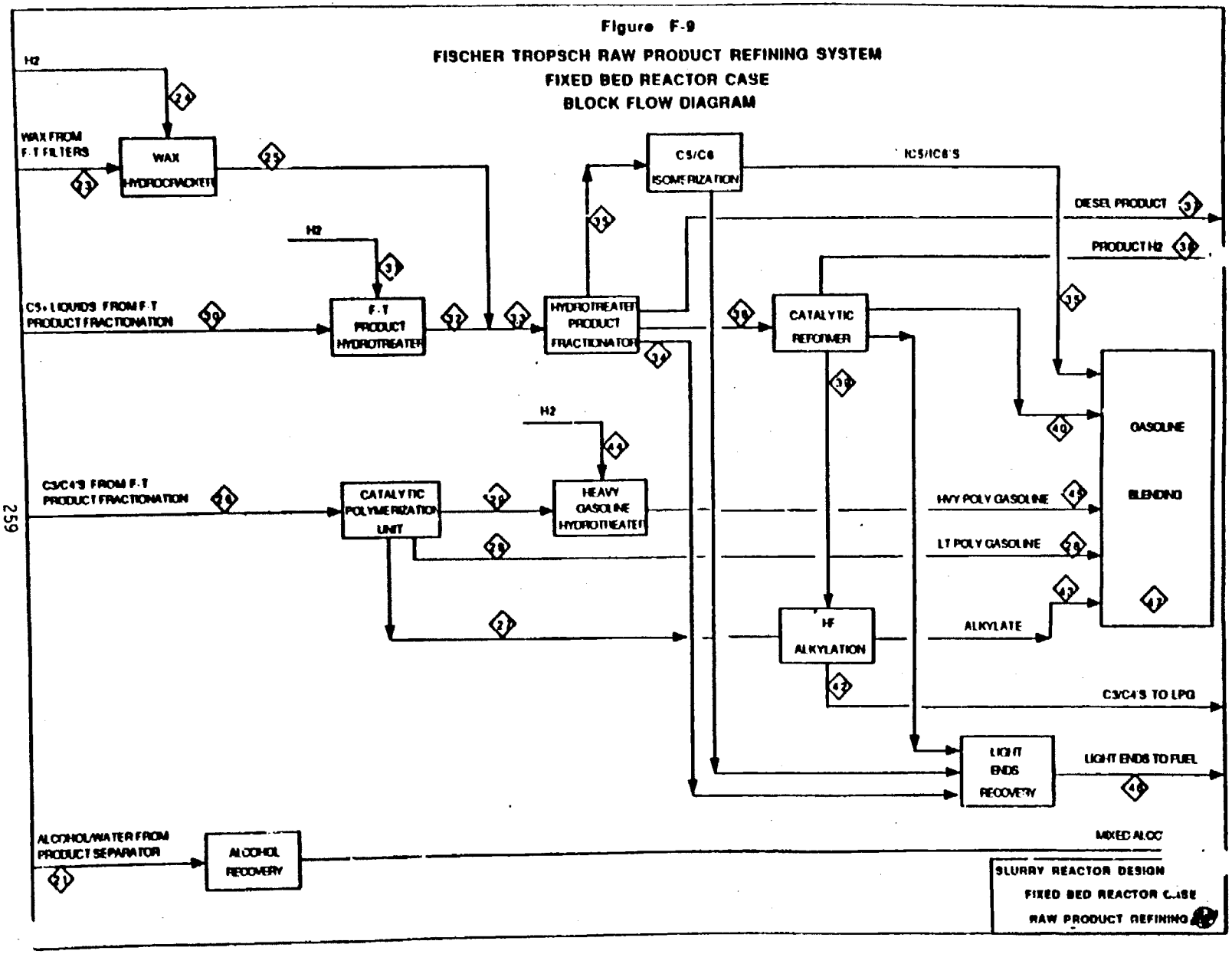


FIGURE F-8
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
STEAM DIAGRAM

Figure F-9

FISCHER TROPSCH RAW PRODUCT REFINING SYSTEM
FIXED BED REACTOR CASE
BLOCK FLOW DIAGRAM



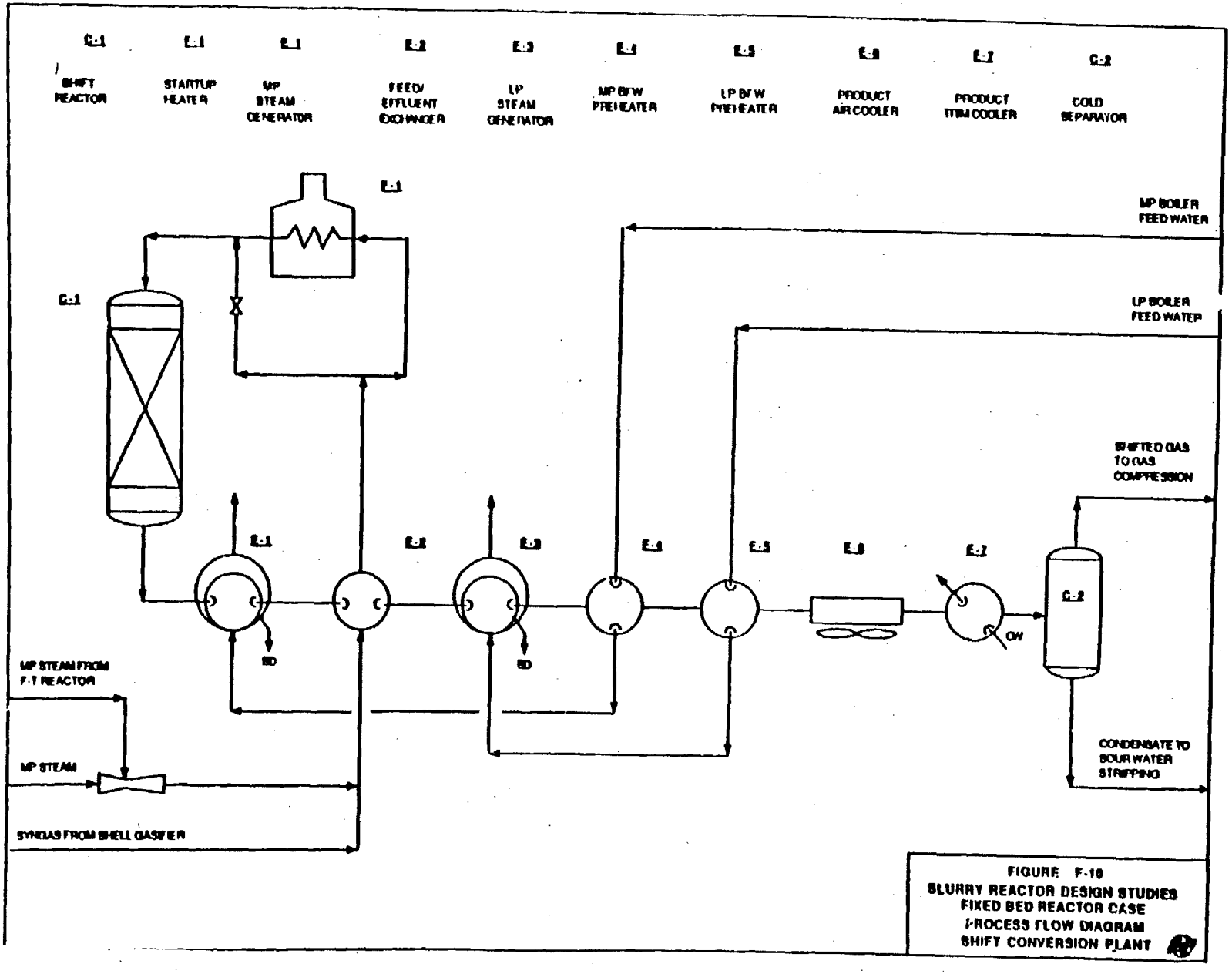
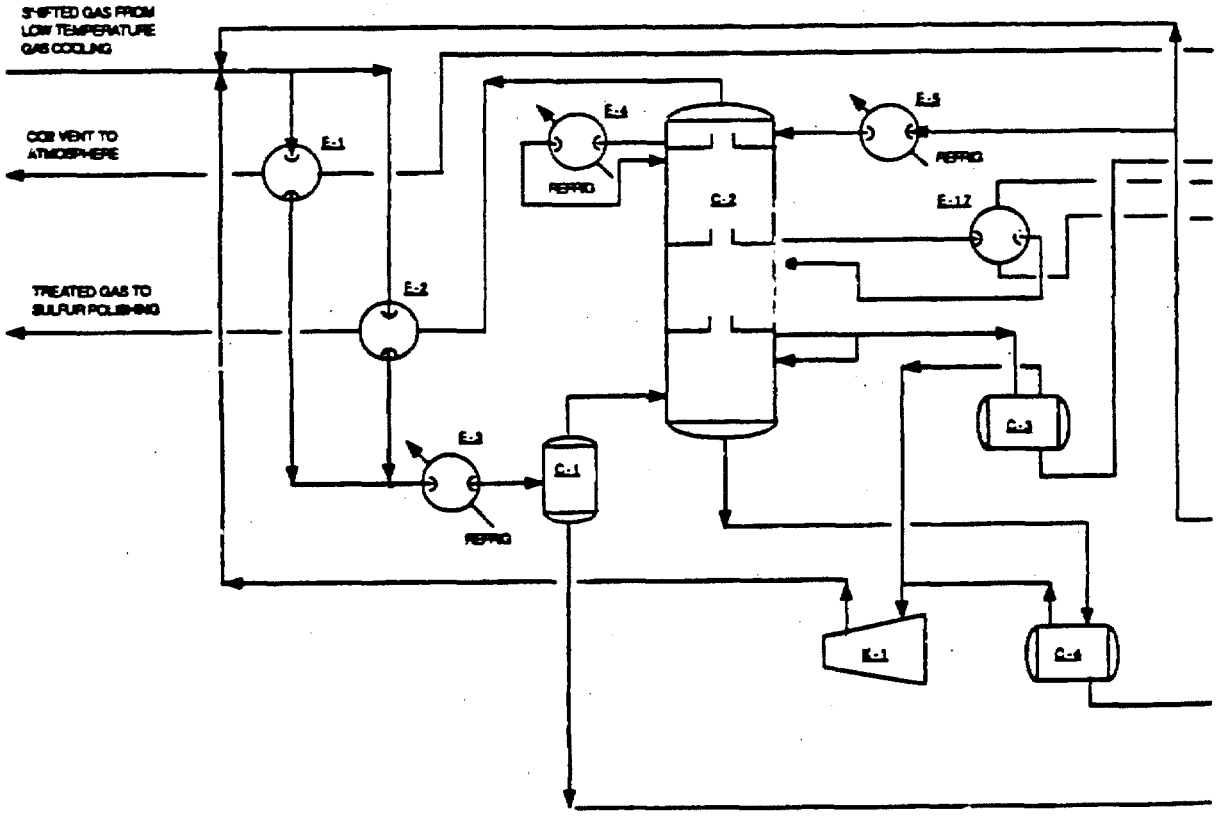


FIGURE F-10
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
SHIFT CONVERSION PLANT

E-1	E-2	E-3	E-4	C-2	E-5	E-6
FEED GAS/ CO2 VENT	FEED GAS/ TREATED GAS	FEED GAS CHILLER	ABSORBER INTERCOOLER	ABSORBER	LEAN METHANOL CHILLER	H2S RICH FLASH DRUM
		C-1		K-1	C-3	E-12
		FEED GAS SEPARATOR		RECYCLE COMPRESSOR	CO2 RICH FLASH DRUM	ABSORBER INTERCOOLER



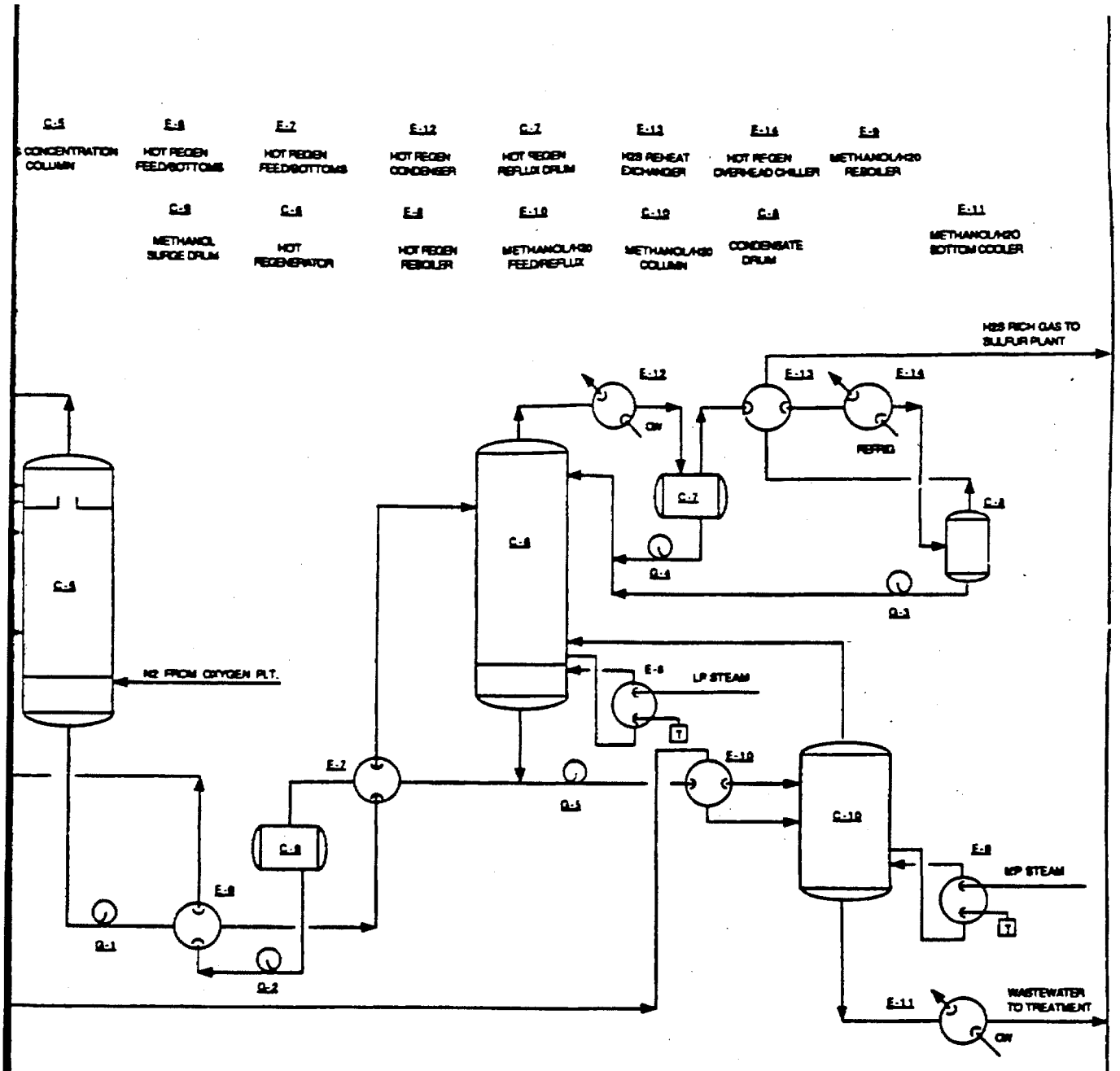


FIGURE F-11
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
ACID GAS REMOVAL PLANT

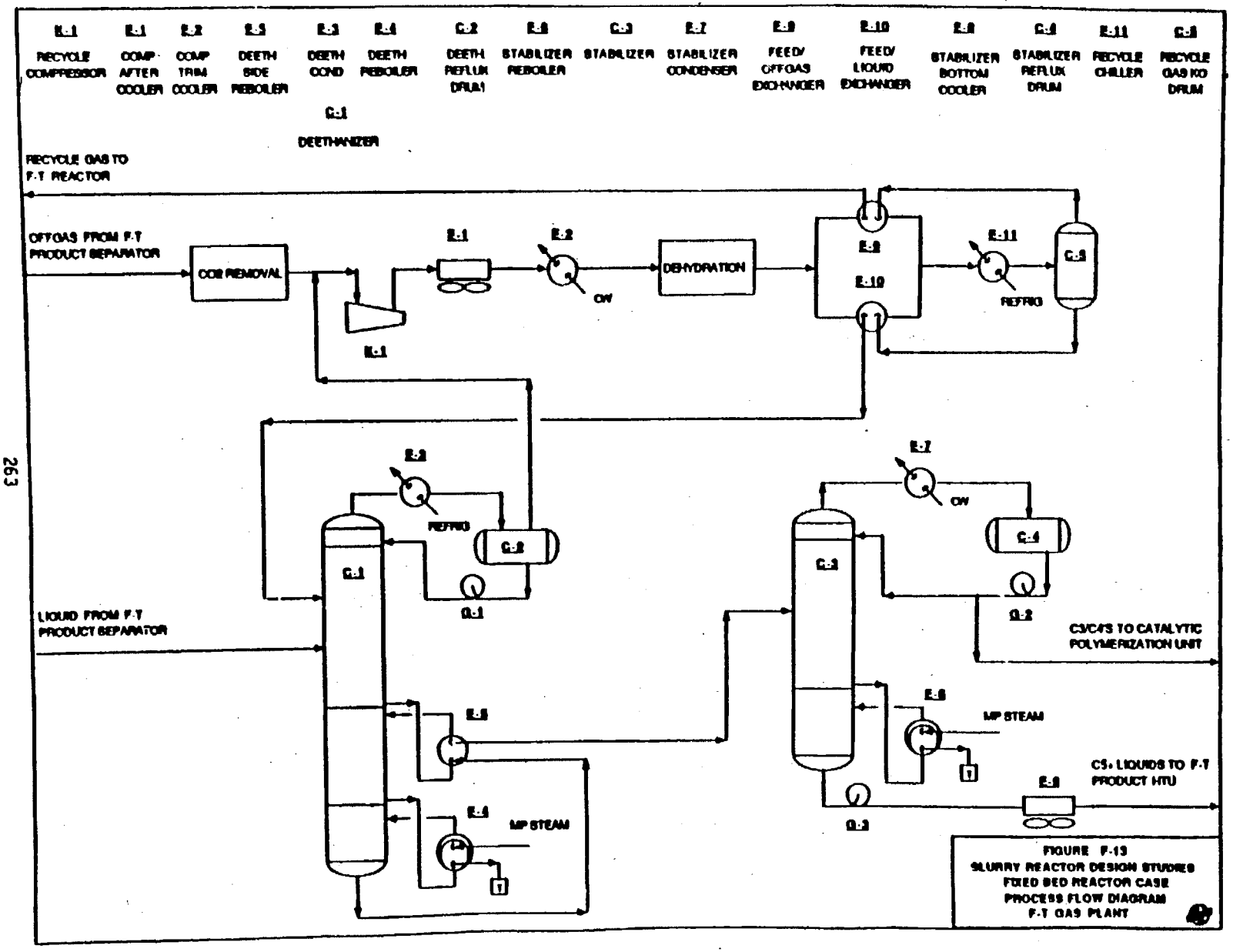
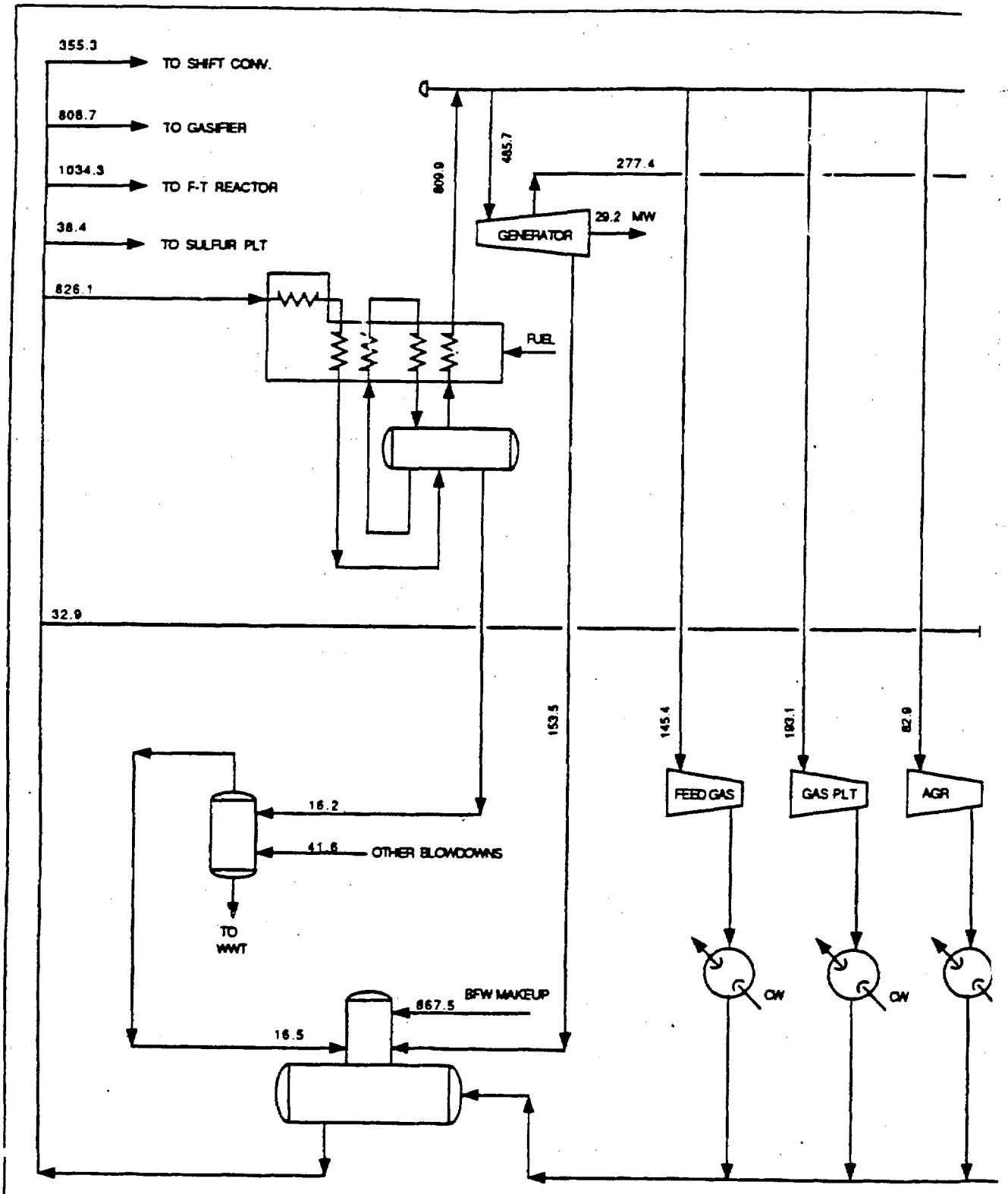


FIGURE F-13
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
F-T GAS PLANT



NOTES:

(1) RATES ARE IN M LB/HR

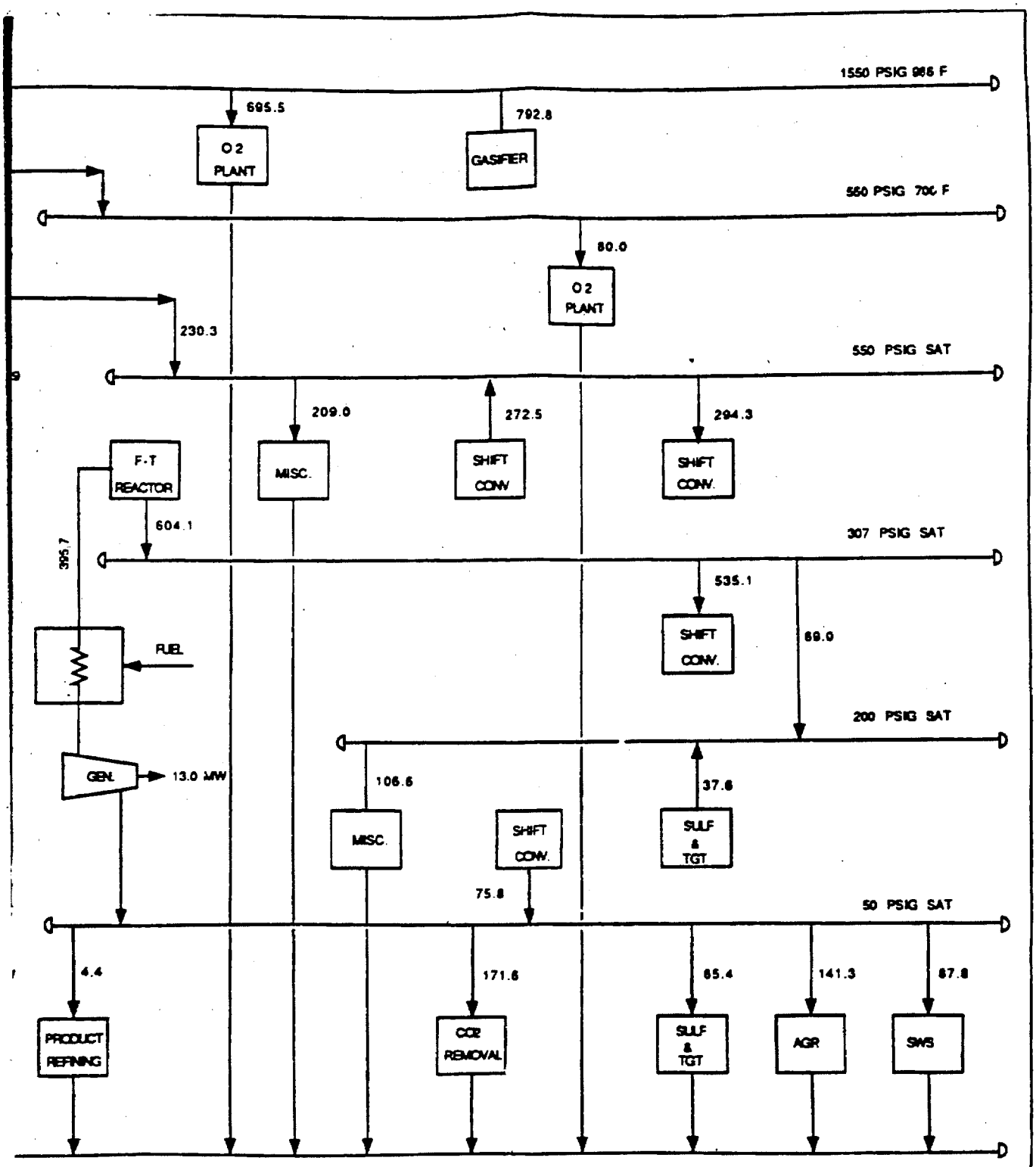


FIGURE F-15
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
STEAM DIAGRAM

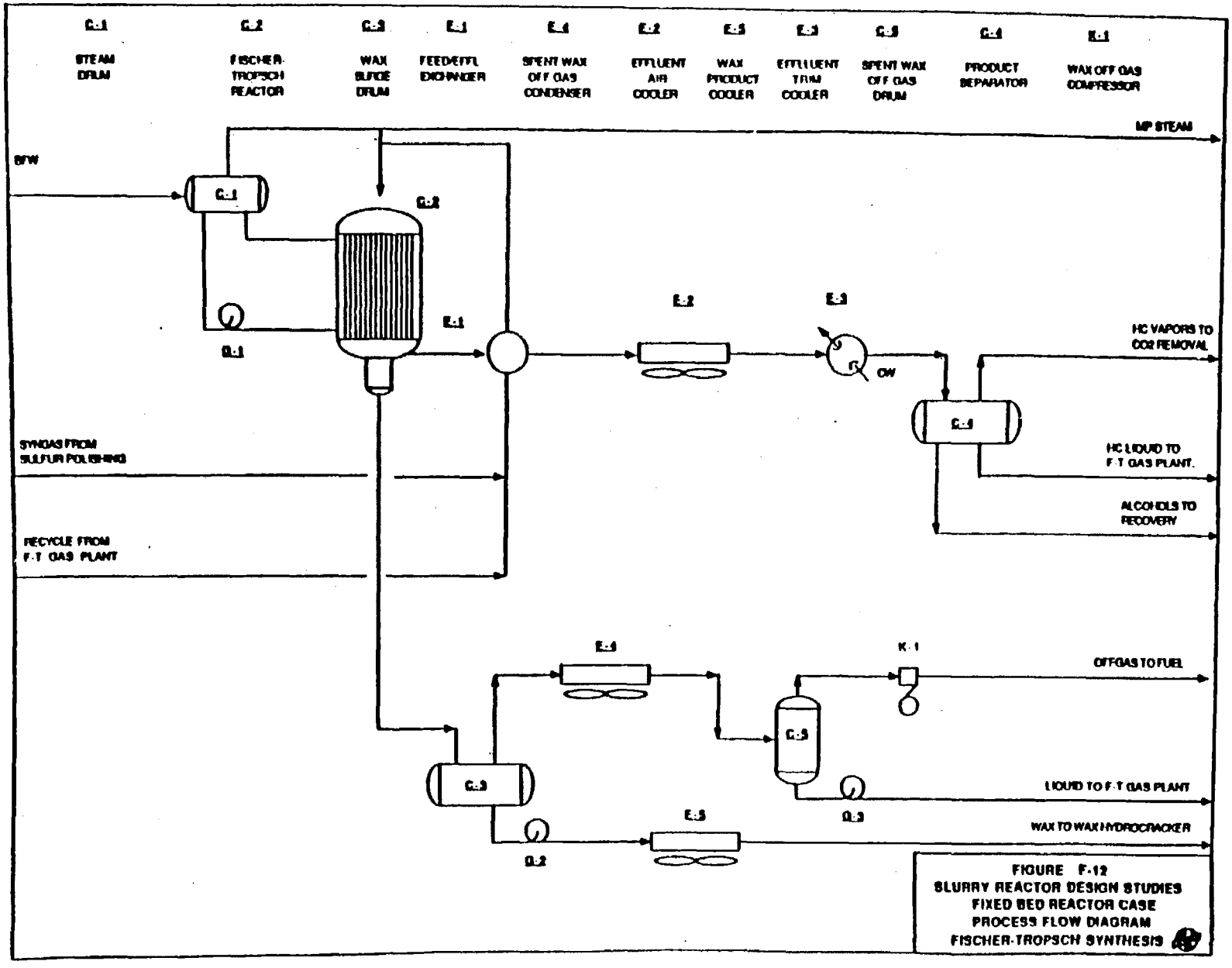


FIGURE F-12
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
FISCHER-TROPSCH SYNTHESIS

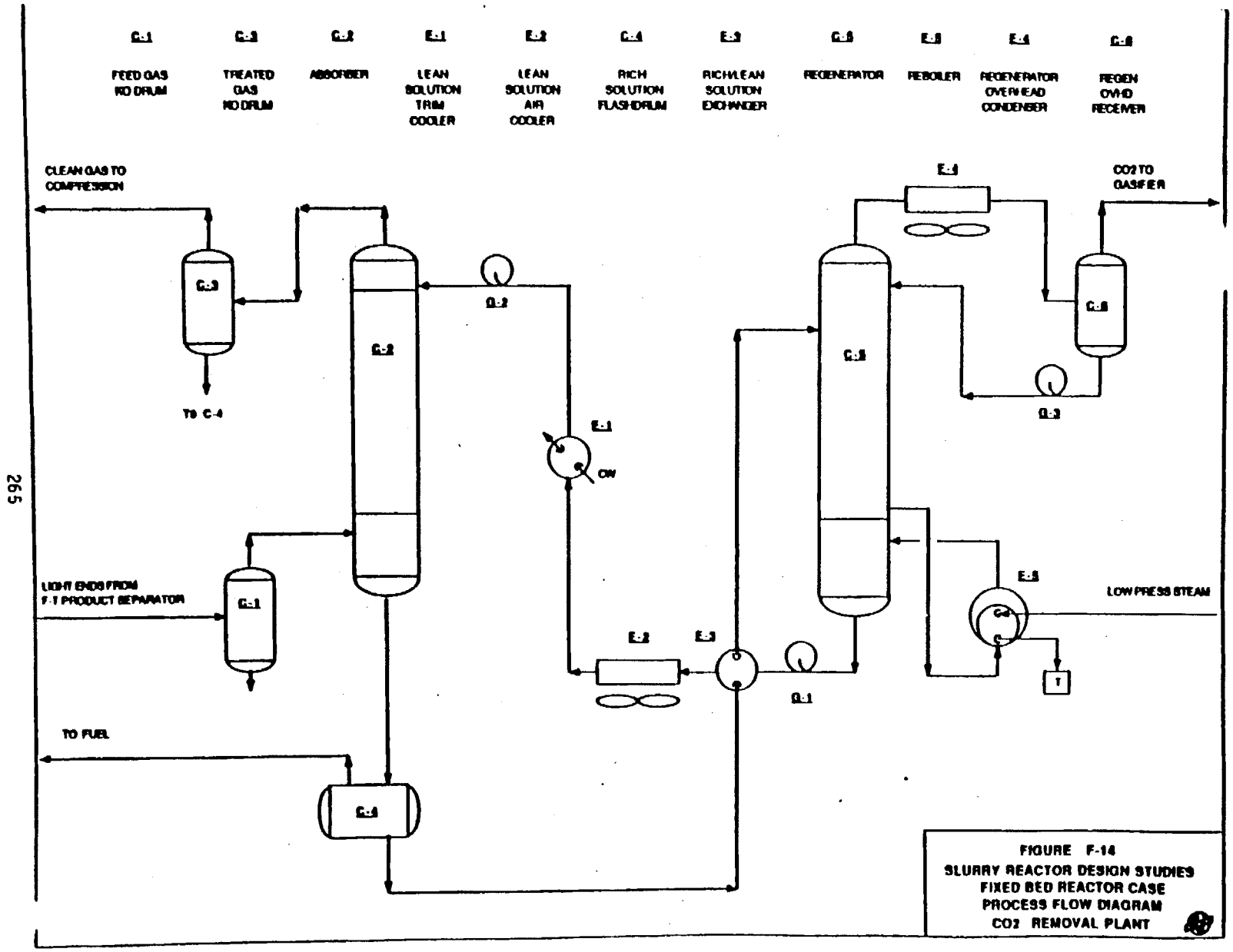


FIGURE F-14
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
CO2 REMOVAL PLANT

INSERT

SLURRY REACTOR DESIGN STUDIES
CONTRACT NO. DE-AC22-89PC89867

ADDITIONAL CLARIFICATION AND ERRATA

ANSWERS TO QUESTIONS FROM DOE PERSONNEL

1. What is the basis used for choosing the plant size at 20,000 BPSD? The gasifiers have three trains, but some of the downstream sections only have one train.

Answer: The basis was three Shell gasifiers of the largest size currently being considered (2500 TPD of coal). The resulting production of roughly 20000 BPD of products was deemed to be a reasonable commercial scale operation. The number of trains in each case are as follows:

Number of Trains

Plant Section/Case	Slurry	Fixed-Bed
Coal Gasification	3	3
Shift Conversion or COS Hydrolysis	2	2
Acid Gas Removal	2	2
Syngas Compression	1	1
Fischer-Tropsch Synthesis	1	1
F-T Gas Plant	1	1
CO2 Removal	3	2
Upgrading Units	1	1

2. If an iron catalyst pellet is used in the fixed bed reactor, it should have some silica (inert) as a binder. Were Satterfield's data on the fixed bed reactor based on catalyst weight including silica, if pellets were used? What were the catalysts used by Satterfield; fused or precipitated iron?

Answer: Satterfield and coworkers at Exxon used fused-magnetite catalyst with 64.4 wt% Fe. At MIT (slurry) it was crushed to 270-325 mesh, at Exxon (fixed-bed) it was 170-230 mesh. In the fixed-bed reactor the catalyst was diluted 10:1 by volume with silica sand of the same particle size. Results were correlated in each case per unit weight of catalyst (not inert). The pressure drop in the fixed bed reactor was 0.05 to 0.22 MPa, but the authors calculated that this did not affect their results (see Satterfield, et al, I.E.C.Fund., 24, pp 450-454, 1985).

3. What does 30°F mean in the discussion on Page 25 (last paragraph) under 4.1.2 Reactor Design?

Answer: In the context cited, 30°F refers to the approach to equilibrium used to calculate the conversion in a fixed-bed methanol reactor operating at a given outlet temperature.

4. What is the ultimate conversion in the slurry F-T reactor case, when compared to the 97% ultimate conversion in the fixed bed case?

Answer: Single pass and ultimate conversions may be back-calculated from Tables 4.3 and 4.4. The following values are obtained for H_2, CO and syngas conversion:

	Fixed-Bed		Slurry	
	Per Pass	Ultimate	Per Pass	Ultimate
CO Conversion	37.17	96.32	82.93	95.67
H_2 Conversion	36.74	94.52	72.28	87.58
H_2 + CO Conversion	36.89	95.15	79.63	93.25

Differences between actual ultimate conversion and 100% conversion have to do with losses to the bleed stream and the amount of hydrogen product removed for treating the products.

ERRATA

Section	Paragraph	Line	Page	Correction
Title Page				Add the name "Elaine Chang, Process Engineer".
2.4.1	5	3	12	Change "31000 cm/s" to "31000 cm^2/s".
2.4.2	1	4&5	12	Should read "(2) is required in most expressions for predicting mass transfer coefficient."
2.4.2	4	last	13	Change "$e_G^{1.1}$" to "$\varepsilon_G^{1.1}$".
4.3.3	5	7	40	Change "increased" to "increase".
4.7	1	last	57	Change "0,7 m/s" to "0.07 m/s".
Appendix C - CSTR Model - page 3				Change equation under Assumption 8 to read: "$k'_H = 3.3 \cdot 10^9 \cdot e^{(-130,000/RT)} \cdot (1100/P)^{0.5}$".
Appendix D - last paragraph - page 4				Change "15 m/s" to "0.15 m/s".

Insert Dated 9/28/90