APPENDIX E

SLURRY REACTOR DESIGN STUDIES

METHANOL AND MIXED ALCOHOLS DESIGN DATA SHEETS

Contents

Table E-1

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

METHANOL 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	1	580	650	CS	CS	5.0	21.0	PROP. INTERNALS
C-2	SLURRY REACTOR	VERT	1	1600	650	2 1/4 Cr W/304 SS CL	304 SS	15.8	49.5	W/ 1250 TUBES
C-3	HP SEPARATOR	HORIZ	1	1600	250	CS W/304 SS CL	316 SS	6.5	14.0	W/ SS MESH PAD
C-4	LP SEPARATOR	HORIZ	1	150	250	CS	316 SS	5.5	14.0	W/ SS MESH PAD
C-5	PURGE LETDOWN SEP	VERT	1	450	250	CS	316 SS	4.5	8.0	W/ SS MESH PAD
C-6	CONDENSED OIL SURGE DRUM	VERT	1	1600	250	304 SS		3.5	7.0	
C-7	SLURRY HOLD TANK	VERT	1	60	350	CS	CS	15.0	47.5	W/ INTERNAL COILS
C-8	REDUCTION REACTOR	VERT	1	175	600	CS	CS	7.5	9.5	JACKETED REACTOR W 18 HP AGITATOR
C-9	KO DRUM	HORIZ	1	150	250	304 SS	316 SS	7.0	14.0	W/ SS MESH PAD
C-10	FEED GAS COMPRESSOR KO DRUM	VERT	1	875	250	CS	316 SS	5.0	8.0	W/ SS MESH PAD
C-11	SPENT CATALYST SURGE DRUM	VERT	1	50	250	CS	316 SS	4.5	11.5	W/ SS MESH PAD
D-1	OIL TANK	VERT	1	ATM	250	CS	CS	20.0	24.0	1140 BBLS
D-2	CATALYST STORAGE BIN	VERT	1	ATM	250	CS	CS	11.0	14.0	W/ 60 BTM CONE
D-3	SPENT CATALYST HOPPER	VERT	1	ATM	250	CS	CS	4.0	4.0	W/ 60 BTM CONE

Table E-1

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

METHANOL 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	TUBE	BARE TUBE AREA FT2	REMARKS
E-1	REACTOR FEED/EFFL EXCH	S&T	1	1650	1600	550	550	CS	304 SS	3950	
E-2	REACTOR EFFL/BFW HEATER	S&T	1	580	1600	500	550	CS	304 SS	2385	
E-3	EFFLUENT AIR COOLER	AIR	1	N/A	1600	N/A	400	N/A	304 SS	14900	220 HP FAN
E-4	EFFLUENT TRIM COOLER	S&T	1	1600	75	550	250	CS	CS	5660	
E-5	GAS COOLER	S&T	1	150	75	400	250	CS	304 SS	2550	
E-6	SPENT CATALYST COOLER	S&T	1	50	75	550	250	CS	CS	300	

Table E-1

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

METHANOL 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	2	1660	69	24	CS	CI	MOTOR	29	
G-2	CONDENSATE OIL PUMPS	CENTRIF	2	120	200		304SS	CI	MOTOR	12	
G-3	OIL CHARGE PUMPS	CENTRIF	2	2.4	100	0.06	CS	CI	MOTOR	0.3	
G-4	OIL RETURN PUMPS	RECIP	2	1	3620		CS	CI	MOTOR	1.5	
G-5	SLURRY HOLD TANK PUMP	CENTRIF	2	4800	60		CS	CI	MOTOR	120	
G-6	CATALYST ADDITION PUMP	CENTRIF	2	84	3355		CS	CI	MOTOR	150	
G-7	RECOVERED LIQUIDS PUMP	CENTRIF	2	2	150		CS	CI	MOTOR	0.3	
G-8	SPENT CATALYST PUMP	CENTRIF	2	90	350	4	CS	CI	MOTOR	8	
K-1	RECYCLE COMPRESSOR	CENTRIF	1	(196000)					STEAM TURBINE	6043	
K-2	SYNGAS COMPRESSOR	CENTRIF	1	(89400)					STEAM TURBINE	1050	
K-3	PURGE GAS EXPANDER	CENTRIF	1	(5100)					MOTOR	475	
K-4	REDUCTION GAS COMPRESSOR	CENTRIF	1	(7000)					MOTOR	180	

Table E-1

SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE

METHANOL REACTION SECTION
PACKAGE EQUIPMENT

EQUIP. NO.	EQUIPMENT NAME	TYPE	NO. PER TRAIN	CAPACITY	OPERATING CONDITIONS	POWER, KW	REMARKS
Y-1	AXIAL CYCLONE	SEPARATOR	6	4350 ACFM VAPOR	500 F,1450 PSIA	50	
Y-2	OIL FILTER	CARTRIDGE FILTER	1	120 GPM	150 F,1600PSIG		
Y-3	SPENT CATALYST FILTER	TANK VERTICAL LEAF FILTER	1	45 GPM	150F,150 PSIG		

Table E-2

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

METHANOL 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	1	725	650	CS	CS	5.5	23	PROP INTERNALS
C-2	METHANOL REACTOR	VERT	1	870	650	CS	304 SS	15.8	25.5	W/INTERNAL TUBES
C-3	HP SEPARATOR	VERT	1	870	250	CS W/SS CL	CS	8.5	14	W/ SS MESH PAD
C-4	LP SEPARATOR	HORIZ	1	150	250	CS	CS	5.5	14	W/ SS MESH PAD
C-5	PURGE GAS LETDOWN DRUM	VERT	1	450	250	CS	CS	4.5	8	W/ SS MESH PAD

Table E-2

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

METHANOL 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	870	870	550	550	CS	CS	38615	
E-2	EFFLUENT AIR COOLER	AIR	1	N/A	870	N/A	500	N/A	CS	15200	225 HP FANS
E-3	EFFLUENT TRIM COOLER	S&T	1	870	75	250	250	CS	CS	7065	

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Table E-2

SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE

METHANOL 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	2	2030	70	30	CS	CI	MOTOR	36	
K-1	RECYCLE GAS COMPRESSOR	CENTRIF	1	(268000)			304 SS	304 SS	STEAM TURBINE	2500	

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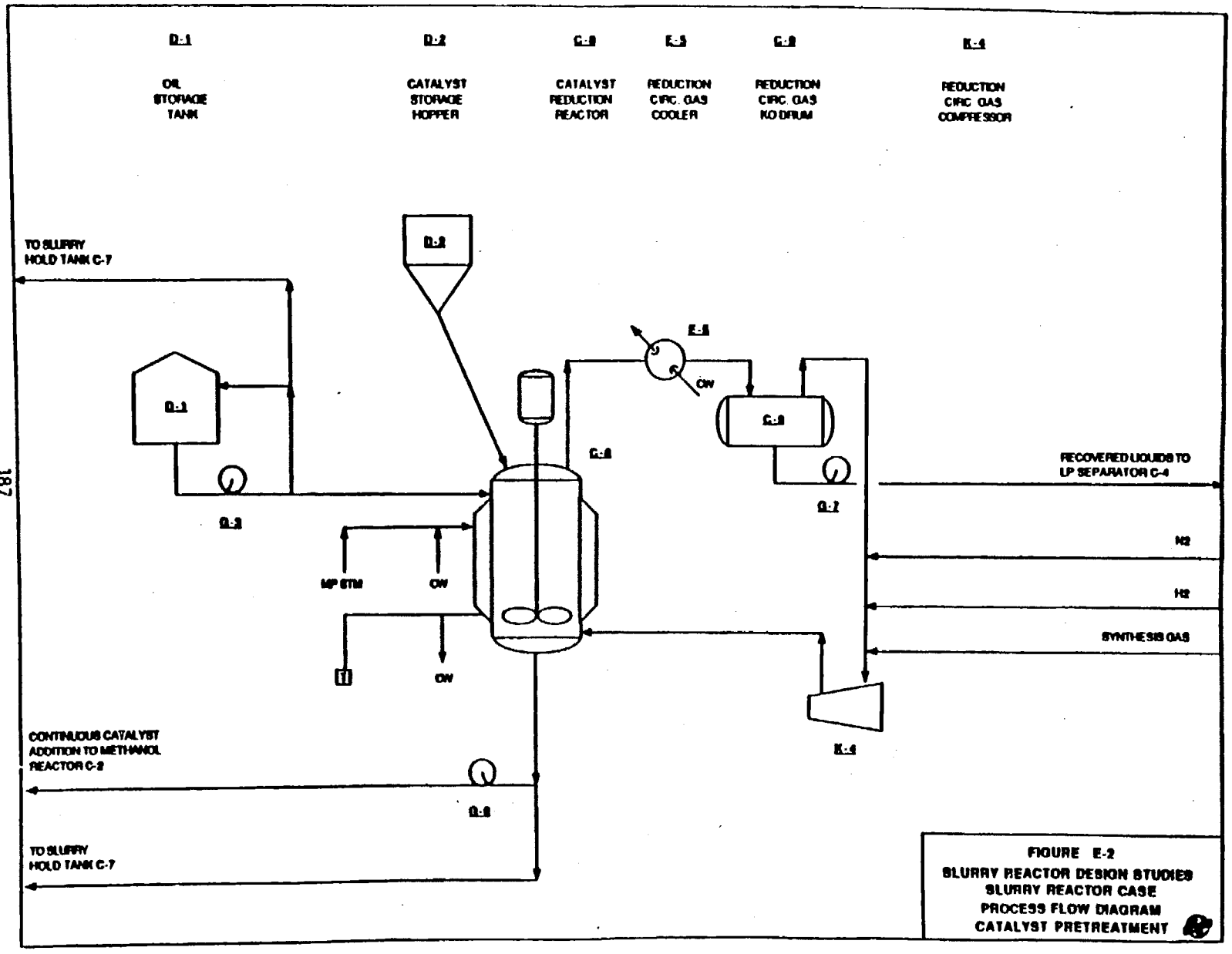
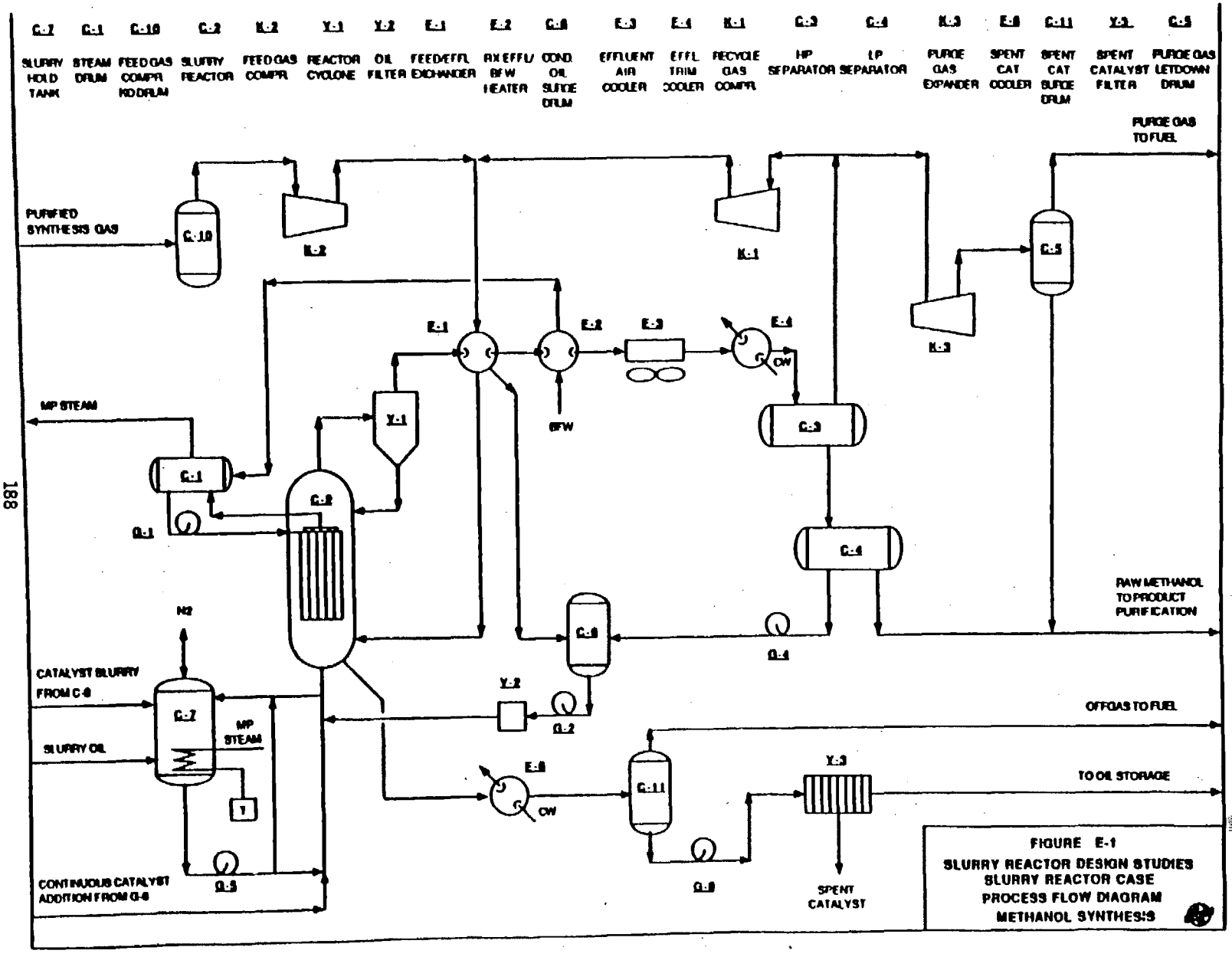


FIGURE E-2
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
CATALYST PRETREATMENT


C-7 SLURRY HOLD TANK
C-1 STEAM DRUM
C-10 FEED GAS COMPR KO DRUM
C-2 SLURRY REACTOR
K-2 FEED GAS COMPR
V-1 REACTOR CYCLONE
V-2 OIL FILTER
E-1 FEED/EFFL EXCHANGER
E-2 BFW HEATER
C-8 COND. OIL SURGE DRUM
E-3 EFFLUENT AIR COOLER
E-4 EFFL TRIM COOLER
K-1 RECYCLE GAS COMPR
C-9 HP SEPARATOR
C-4 LP SEPARATOR
K-3 PURGE GAS EXPANDER
E-5 SPENT CAT COOLER
C-11 SPENT CAT SURGE DRUM
V-3 SPENT CATALYST FILTER
C-5 PURGE GAS LETDOWN DRUM
PURGE GAS TO FUEL
PURIFIED SYNTHESIS GAS
MP STEAM
BFW
CW
RAW METHANOL TO PRODUCT PURIFICATION
N2
CATALYST SLURRY FROM C-8
SLURRY OIL
CONTINUOUS CATALYST ADDITION FROM C-8
OFF GAS TO FUEL
TO OIL STORAGE
SPENT CATALYST
FIGURE E-1
SLURRY REACTOR DESIGN STUDIES
SLURRY REACTOR CASE
PROCESS FLOW DIAGRAM
METHANOL SYNTHESIS

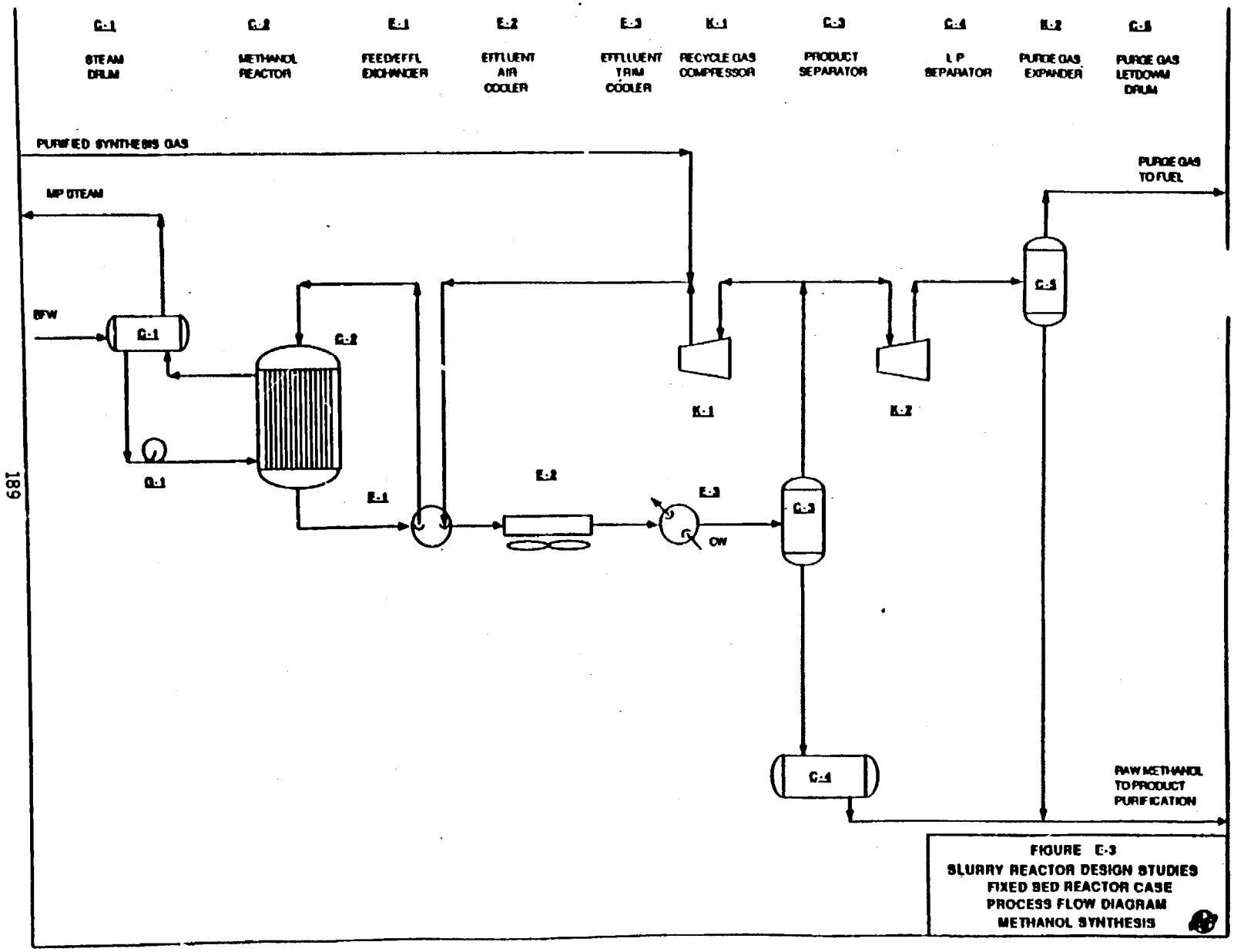
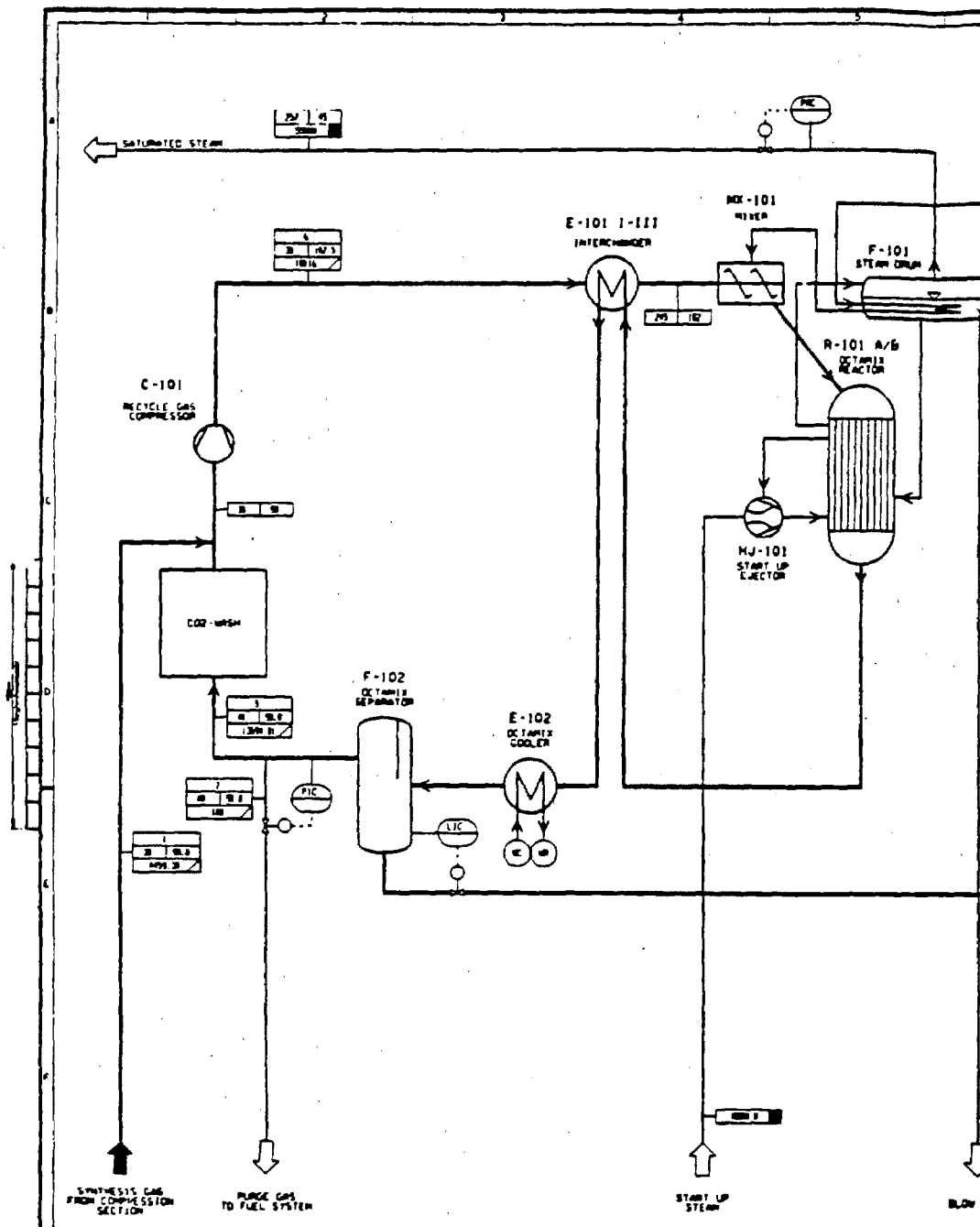


FIGURE E-3
SLURRY REACTOR DESIGN STUDIES
FIXED BED REACTOR CASE
PROCESS FLOW DIAGRAM
METHANOL SYNTHESIS



STREAM NO.	1	2	3	4	5	6
PROCESS STREAM	SYNTHESIS GAS	PURGE GAS	OCTAMIX	OFFGASES	RECYCLE GAS	REACTOR INLET GAS
PHASE STEAM/GAS - MOL% / LIQUID - WEIGHT%	GAS	GAS 1)	LIQUID	GAS 1)	GAS 1)	GAS 1)
CO2	1.00	4.50		40.78	4.50	1.00
CO	66.64	68.28		41.55	68.28	64.95
H2	31.30	8.14		2.64	8.14	19.01	
CH4	0.23	7.34		10.47	7.34	5.78
N2	0.83	11.56		4.82	11.56	9.26
METHANOL		SAT.	69.70	SAT.	SAT.	
OFFGASES		SAT.	30.00	SAT.	SAT.	
H2O		SAT.	0.30	SAT.	SAT.	
CATAMOD		0.18		SAT.	0.18	
FLOW RATE KMOL/H (G.C.V.)	6453	284	33400	91.30	14197	18116
TEMPERATURE °C	30	40	40	170	40	30
PRESSURE BAR	99	98.8	4.5	1.3	98.8	102.5

1) DRY ANALYSIS

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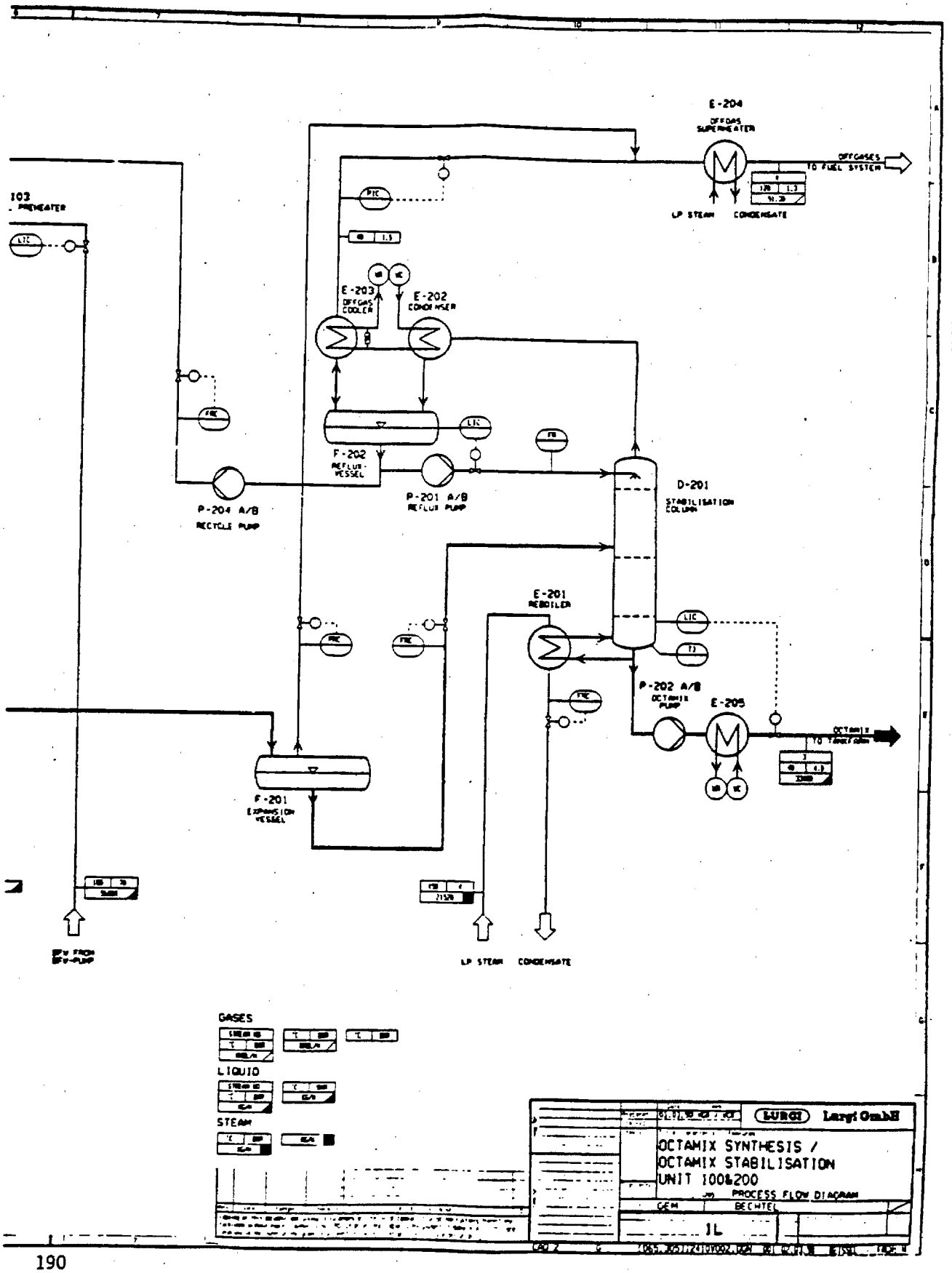
E-204
OFFGAS SUPERHEATER
OFFGASES TO FUEL SYSTEM
LP STEAM
CONDENSATE
E-203
OFFGAS COOLER
E-202
CONDENSER
F-202
REFLUX-VESSEL
P-204 A/B
RECYCLE PUMP
P-201 A/B
REFLUX PUMP
D-201
STABILISATION COLUMN
E-201
REBOILER
P-202 A/B
OCTAMIX PUMP
E-205
F-201
EXPANSION VESSEL
LP STEAM
CONDENSATE
GASES
LIQUID
STEAM
OCTAMIX SYNTHESIS /
OCTAMIX STABILISATION
UNIT 1006200
PROCESS FLOW DIAGRAM
BECHTEL
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