LARGE PILOT PLANT ALTERNATIVES
FOR SCALEUP OF THE
CATALYTIC COAL GASIFICATION PROCESS

APPENDIX III

DETAILS OF STUDY DESIGN FOR
THE MINIMUM SYNTHANE REVAMP CASE

APPENDIX III

DETAILS OF STUDY DESIGN FOR THE MINIMUM SYNTHANE REVAMP CASE

APPENDIX III (Cont'd.)

APPENDIX III (Cont'd.)

APPENDIX III-A

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

ONSITES FACILITIES - STAGE 1

This section presents the onsite facilities for a study design of a minimum revamp of the Synthane Large Pilot Plant to the Catalytic Coal Gasification Process. The Stage 1 specifications are presented in Appendix III-A, while Stage 2 specifications are presented in Appendix III-B.

The first stage would involve making the minimum modifications to the existing facilities that would permit operation of the gasifier in a technically meaningful catalytic mode. Operation would be once-through, that is without the recycle of catalyst or synthesis gas. The second construction stage would consist of adding catalyst recovery and recycle facilities. No provisions are included for adding facilities to recycle synthesis gas to the gasifier as provided in the previous study design for a major Synthane revamp.

Design Basis

The minimum revamp case of the Large Pilot Plant study is designed to gasify 55 ST/SD of Illinois No. 6 bituminous coal, on an as-received basis.

Process Description for 1st Stage of the Synthane Minimum Modification Case

During first-stage operation, feed coal is crushed, dried, impregnated with catalyst solution, and finally dried. The catalyzed coal is then fed via a lockhopper system to the fluidized bed gasifier which operates at 1300°F and 500 psia. The coal is gasified with a mixture of steam and synthesis gas which is produced via the partial oxidation of LPG with steam and oxygen. It was determined that the preferred approach to generating the high temperature synthesis gas needed for once-through operation is to use partial oxidation of LPG. Relative to the steam reforming route specified in the earlier major Synthane revamp study design, partial oxidation has the potential advantages of requiring fewer plant layout modifications and allowing a shorter construction schedule.

The product gas is then quenched in a venturi scrubber and cooled before going to acid gas removal. The existing Benfield system will be reused to remove H_2S and CO_2 from the product gas before incineration so as to reduce SO_2 emissions. The existing Stretford plant will be used for the recovery of elemental sulfur from the acid gas stream.

Gasifier spent char will be withdrawn, quenched, and filtered using Synthane's existing char withdrawal equipment. Gasifier overhead fines, collected in the venturi scrubber water will be combined with the char slurry and filtered.

TABLE III-A-1

ONSITE UTILITIES AND CHEMICAL REQUIREMENTS

Cooling Water

Requirements, GPM		Normal	Maximum
New			
E-104	Slurry Stripper Overhead Condenser	230	230*
E-203	Ammonia Scrubber Feed Gas Cooler	360	360*
E-208	Partial Oxidation Burner Cooler	17	17*
E-207	Injection Gas Trim Cooler	40	40*
Existing Reused			
EA-205	Benfield Lean Solution Cooler	120	255*
EA-207	Benfield Regenerator Condenser	230	230*
EA-309	Stretford Offgas Cooler	32	32*
EA-401	Filter Feed Cooler	145	145*
	Sample Coolers	10	10*
	Miscellaneous	75	75*
	Total	1259	
	Simultaneous Maximum		1394
Existing Removed from Service, GPM			
EA-206	Benfield Absorber Overhead Cooler		9
EA-203	Gasifier Effluent Final Cooler		290
EA-402	Alternate Char Quench Cooler		55
EA-209	Methanator Effluent Cooler		4
EA-213	Sour Water Cooler		77
EA-214	Alt. Methanator Effluent Cooler		70
EA-215	Final Methanator Effluent Cooler		8
EA-220	Alt. Final Methanator Effluent Cooler		8
EA-311	55 psi Steam Condenser		328
DC-202	Gasifier Shell Cooling Coils		60
	Total		909

Boiler Feed Water

Requirements, GPM			
D-203	Onsite BFW Degasser	5	21*
D-205	POX Burner Cooling Water Tank	1	1
FA-401	Char Slurry Tank	0	9*
	Total	6	
	Simultaneous Maximum		31

Industrial Water

Requirements, GPM			
DA-201	Ammonia Scrubber	22	22*
DC-202B	Char Quench Drum	0	2*
	Total	22	
	Simultaneous Maximum		24

TABLE III-A-1 (Cont'd)

Steam - 600 (Note 1)

Requirements, lb/hr		Normal	Maximum
New			
E-204	LPG Feed Preheater	1520	1520*
E-205	Oxygen Feed Preheater	425	425*
R-201	Partial Oxidation Reactor (Note 2)	1520	1520*
Existing Reused			
DC-202A	Gasifier (Notes 2, 3)	7475	7475*
DC-202B	Char Quench Drum	2440	2440*
FA-401	Char Transport Steam	460	460*
	Total	13,840	
	Simultaneous Maximum		13,840
Existing Removed from Service, lb/hr			
EA-217	Alt. Methanator Feed Heater		493
EA-211	Methanator Startup Heater		680
EA-215	Final Methanator Feed Heater		528
EA-219	Alt. Final Methanator Feed Heater		4100
FE-408	Char Lock Hoppers		510
	Total		6311

Notes:

(1) Existing steam system is 1100 psi; however, maximum pressure requirement for services listed is 600 psig.

(2) This is a process requirement similar to a steam reformer. Therefore, it should not be included in load growth calculations.

(3) New gasifier steam requirements are substantially less than the original design because of the lower coal feed rate and differences in process conditions.

TABLE III-A-1 (Cont'd)

Steam - 55

Requirements, lb/hr		Normal	Maximum
New			
E-126	CO_2 Vaporizer	150	700*
E-122	Slurry Stripper Reboiler	5100	5100*
D-203	Onsite BFW Degasser	150	180*
Existing			
EA-204	Benfield Reboiler	3750	5030*
DA-203	Benfield Regenerator	2230	3350*
PA-202	Stretford Sulfur Plant	300	500*
	Steam Tracing (Note 1)		6000*
	Total Simultaneous Maximum	11,680	20,860
Production, lb/hr			
New			
E-201	Secondary Venturi Circ. W.H. Boiler	8360	8360*
E-206	Injection Gas Cond. W.H. Boiler	2330	2330*
Existing			
EA-218	Primary Venturi Circ. W.H. Boiler	100*	2200
	Total Simultaneous Maximum	10,790	10,790
Existing Removed from Service			
DC-204	Carbon Reactor		250
FD-202	Steam Filters		200
FE-403	Char Lock Hopper		170
EA-223	Dowtherm W.H. Boiler		(510) (Note
EA-201	Scrubber Circ. W.H. Boiler		(3680)
	High Pressure Let Down		(1736)
	Total		(5306)

Notes:

(1) Winter load only. Rate is an estimate of current usage.

(2) Numbers in parentheses represent steam production.

TABLE III-A-1 (Cont'd)

Electric Power

Requirements, kW		Service	Operating Load	Reacceleration
New				
E-202	Onsite Steam System Condenser	N	12	A
F-202	Injection Gas Resistance Heater	N	160*	
P-104A	Slurry Stripper Reflux Pump	N	0.5*	A
P-104B	Slurry Stripper Reflux Pump	S	0.5	A
P-105	Sulfuric Acid Metering Pump	N	0.3	B
P-106A	Neutralization Circulating Pump	N	1*	A
P-106B	Neutralization Circulating Pump	S	1	A
P-119A	Scrubbing Water Booster Pump	N	25*	A
P-119B	Scrubbing Water Booster Pump	S	25	A
P-201A	Stripper Feed Pump	N	6*	A
P-201B	Stripper Feed Pump	S	6	A
P-202A	Degasser Bottoms Pump	N	5*	A
P-202B	Degasser Bottoms Pump	S	5	A
P-203A	Ammonia Scrubber Bottoms Pump	N	6*	A
P-203B	Ammonia Scrubber Bottoms Pump	S	6	A
P-204A	Burner Cooling Circ. Pump	N	23*	A
P-204B	Burner Cooling Circ. Pump	S	23	A
M-101	Neutralization Drum Mixer	N	1*	A
M-102	Char Slurry Tank Mixer	N	4*	A
M-201	Sour Slurry Drum Mixer	N	2*	A
Existing (Connected Load)				
GA-202	Benfield Semi-lean Solution Pump	N	201*	
GA-2025	Benfield Semi-lean Solution Pump	S	201	
GA-203	Benfield Solution Makeup Pump	I	3*	
GA-204	Benfield Regenerator Reflux Pump	N	9*	
GA-2045	Benfield Regenerator Reflux Pump	S	9	
GA-207	Venturi Water Circ. Pump	N	42*	
GA-207S	Venturi Water Circ. Pump	S	42	
GA-212	Benfield Lean Solution Pump	N	161*	
GA-212S	Benfield Lean Solution Pump	S	161	
GA-401	Char Quench Recycle H.P. Water Pump	N	11*	
GA-406	Slurry Filter Feed Pump	N	9*	
GA-406S	Slurry Filter Feed Pump	S	9	
GA-408	L.P. Filtrate Pump	S	4	
GA-411	Char Quench Recycle L.P. Water Pump	N	7*	
PA-201	Tail Gas Scrubber	I	20	
PA-202	Stretford Sulfur Plant		(Note 1)	
JD-401	Filter Cake Conveyor	N	9*	
PA-402	Slurry Filter	N	9*	
PA-402S	Slurry Filter	S	9	
GB-401X	Slurry Filter Vacuum Pump	N	17*	
GB-401XS	Slurry Filter Vacuum Pump	S	17	
GD-401	Slurry Filter Feed Tank Mixer	N	7*	
Existing Removed from Service (Connected Load)				
GA-201	Scrubber Recycle Water Pump		21	
GA-205	Waste Water Pump		7	
GA-205S	Waste Water Pump		7	
GA-206	Oxidized Tar Pump		1	
GA-206S	Oxidized Tar Pump		1	

TABLE III-A-1 (Cont'd)

GA-208	Wash Oil Pump	4
GA-208S	Wash Oil Pump	4
GA-209	Makeup Oil Pump	7
GA-210	Makeup Oil Pump	7
GA-211	Gasifier Tar Recycle Pump	2
GA-214	Caustic Circulating Pump	1
GA-407X	Tar Pump	1
GA-407XS	Tar Pump	1
GA-408S	L.P. Filtrate Pump Spare	4
GB-201	Methanator Recycle Gas Compressor	7
GB-202	Alt. Methanator Recycle Gas Compressor	13

Note:

(1) Stretford unit has its own motor control center.

TABLE III-A-1 (Cont'd)

	Normal	Maximum
Chemicals		
Propane LPG (650 psig Vapor)		
Requirement, GPM		
R-201 Partial Oxidation Burner Feed	7.7	7.7*
Sulfuric Acid (98 wt% H_2SO_4)		
Requirement, lb/hr		
D-107 Neutralization Mix Drum	315	315*
Carbon Dioxide (Liquid)		
Requirement, lb/hr		
E-126 CO_2 Vaporizer	1000	5000*
Oxygen (750 psig Vapor)		
Requirement, lb/hr	3870	3870*

TABLE III-A-2

ONSITES EQUIPMENT LIST - HEAT EXCHANGERS

- Shell and Tube Exchangers

Equipment No.	Service	Duty, MBtu/hr	Total Surface, ft^2	No. Shells	Comments
EA-204	Benfield Reboiler	3.2	500	1	Existing
EA-205	Lean Sol'n Cooler	1.8	400	1	Existing
EA-218 and S	Scrubbing Water Cooler	2.3	1560	2	Existing
EA-401	Char Slurry Cooler	2.1	265	1	Existing
E-104	Slurry Stripper O'H Cond.	3.5	520	1	
E-122	Slurry Stripper Reboiler	4.6	1350	1	
E-201	LP Waste Heat Boiler	7.6	1490	1	
E-203	Product Gas Cooler	5.3	970	1	
E-204	LPG Preheater	1.1	65	1	
E-205	Oxygen Preheater	0.35	30	1	
E-206	Injection Gas W. H. Boiler	2.3	150	1	
E-207	Injection Gas Trim Cooler	0.6	160	1	
E-208	Burner Cooling Water Cooler	0.23	50	1	
E-209	Regenerator Overhead Cond.	5.77	1500	1	

- Air Fin Exchangers

E-202	Excess Steam Condenser	9.0	600		

TABLE III-A-3

ONSITES EQUIPMENT LISTS - PUMPS

Equipment No.	Service	Type	Capacity, gpm	ΔP, Psi	BHP	Comments
GA-202 and S	Bulk Removal Section Solution Pumps	Centrifugal	286	500	200	Existing
GA-203	Benfield Solution Sump Pump	Reciprocal	2	20	0.5	Existing
GA-204 and S	Benfield Reflux Pump	Centrifugal	10	75	3.0	Existing
GA-207 and S	Scrubbing Water Circ. Pumps	Centrifugal	125	100	50	Existing
GA-212 and S	Cleanup Section Solution Pumps	Centrifugal	32	500	30	Existing
GA-401	Filtrate Booster Pump	-	-	-	-	Existing
GA-406 and S	Slurry Filter Feed Pumps	-	-	-	-	Existing
GA-411, 408	Slurry Filter Filtrate Pumps	-	-	-	-	Existing
GB-401 and SX	Slurry Filter Vacuum Pumps	-	-	-	-	Existing
P-104 A and B	Slurry Stripper Reflux Pumps	Centrifugal	7	25	1	
P-105	Sulfuric Acid Metering Pump	Metering	0.3	60	0.5	
P-106 A and B	Neutralization Circ. Pumps	Centrifugal	37	20	1.5	
P-119 A and B	Scrubbing Water Booster Pump	Centrifugal	22	570	40	
P-201 A and B	Stripper Feed Pumps	Centrifugal	35	100	7.5	
P-202 A and B	Low Pressure Boiler Circ. Pumps	Centrifugal	21	90	7.5	
P-203 A and B	Ammonia Scrubber Bottoms Pump	Centrifugal	22	100	7.5	
P-204 A and B	Burner Cooling Water Circ. Pump	Centrifugal	35	615	30	

TABLE III-A-4

ONSITES EQUIPMENT LISTS - PROCESS VESSELS

Equipment No.	Service	Diam., Ft	Length, Ft	Position	Comments
FA-203	Product Gas Flash Drum	2'6"	6'6"	Vertical	Existing, Relocate
FA-204	Benfield Absorber Ovh'd K.O. Drum	2'6"	6'0"	Vertical	Existing
FA-205	Acid Gas K.O. Drum	2'6"	6'0"	Vertical	Existing
FA-215	Scrubber Surge Drum	5'0"	14'0"	Horizontal	Existing
FA-218	Low Pressure Steam Drum	4'6"	15'0"	Horizontal	Existing
FA-222	Char Quench Drum Dump Pot	-	-	Vertical	Existing
FA-401	Char Slurry Tank	2'0"	10'0"	Vertical	Existing Add Agitator
FA-403	Slurry Filter Feed Tank	6'6"	10'0"	Vertical	Existing
FA-404X	Filtrate Receiver	5'0"	7'0"	Vertical	Existing
FA-405X	Vacuum Pump Discharge Silencer/ Separator	-	-	Vertical	Existing
FB-201	Benfield Solution Tank	10'0"	8'0"	Vertical	Existing
FD-201	Benfield Solution Filter	1'0"	3'0"	Vertical	Existing
FE-104 AX, BX	Storage Injectors	3'6"	6'6"	Vertical	Existing
FE-105X	Primary Injector	6'0"	11'0"	Vertical	Existing
FE-106	Weigh Hopper	5'3"	4'2"	Vertical	Existing
DA-201	Ammonia Scrubber	2'6"	39'0"	Vertical	Existing
DA-202	Acid Gas Absorber	2 6"	67'0"	Vertical	Existing, Replace Packing
DA-203	Absorbent Regenerator	4'0"	112'0"	Vertical	Existing, Replace Packing
D-107	Neutralization Mix Drum	2'7"	7'0"	Vertical	
D-106	Stripper Distillate Drum	3'0"	6'0"	Vertical	

TABLE III-A-4 (Cont'd)

Equipment No.	Service	Diam., Ft	Length, ft	Position	Comments
D-201	Secondary Scrubber K.O. Drum	3'0"	8'0"	Vertical	
D-202	Sour Slurry Surge Drum	7'6"	10'0"	Vertical	
D-203	Onsite BFW Degasser	3'6"	11'0"	Horizontal	10" Diam. x 15' Packed Tower Above Drum
D-204	Injection Gas K.O. Drum	1'6"	8'0"	Vertical	
D-205	Burner Cooling Water Surge Tank	3'0"	6'0"	Vertical	
T-102	Slurry Stripper	2'6"	62'0"	Vertical	
DC-202 A	Gasifier	3'6" I.D.,	11'0"	New Gasifier Inlet Section	
		5'0" O.D.	62'0"	Existing Reactor Vessel	
			60'0"	New Reactor Section	
			-	Existing Ellip. Outlet Section	
DC-202 B	Char Quench Drum	4'6" I.D. (top)	20'2"	Existing Char Cooler Zone of Gasifier	
		2'6" I.D. (btm)		DC-202 With New Ellip. Head	
CYC-104	Char Quench Drum Cyclone	5"	1'3"	Vertical	
EE-201	Gas Venturi Scrubber	-	-	-	Existing
EE-202	Gas Venturi Scrubber	-	-	-	Existing

TABLE III-A-5

ONSITE EQUIPMENT LIST - FURNACES

Equipment No.	Service	Type	Rating, kw	Comments
F-201	Injection Gas Preheat Furnace	Radiant Electric Heater	160	Electro - Applications Furnace or Equivalent

TABLE III-A-6

ONSITE EQUIPMENT LIST - SPECIAL EQUIPMENT

Equipment No.	Service	Comments
JD-401	Slurry Filter Cake Conveyor	Existing
PA-402 S & SX	Char Slurry Filters	Existing

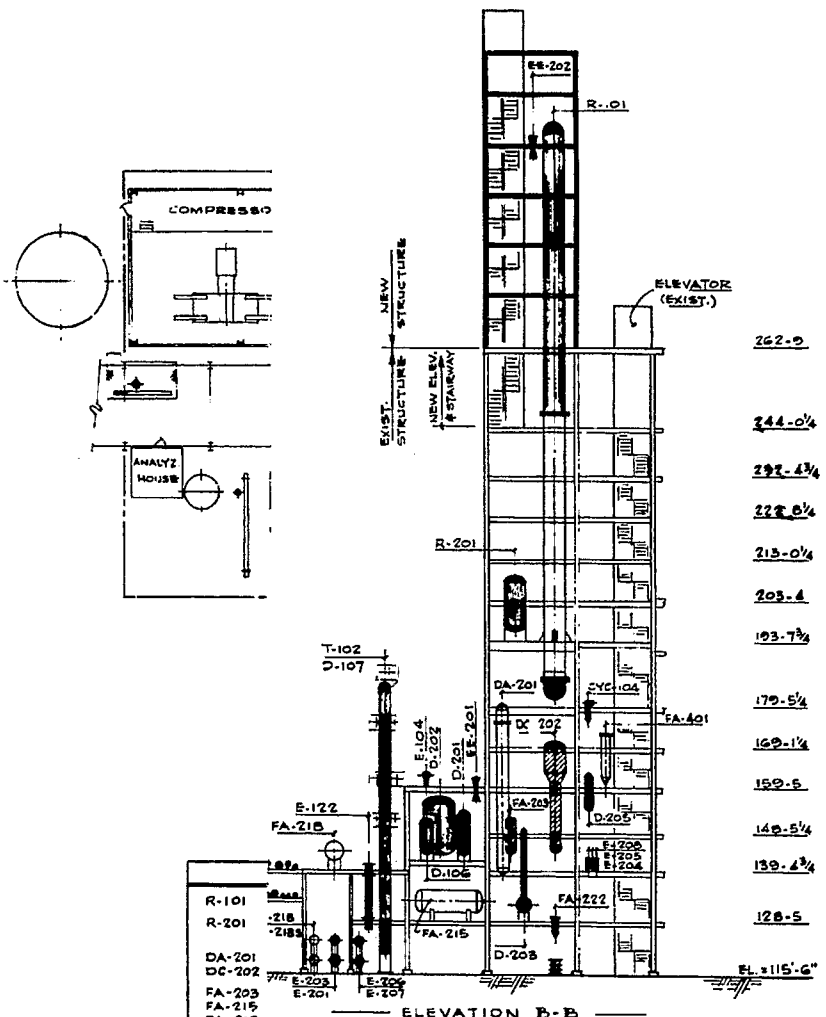

FIGURE III-A-1

EXXON RESEARCH & ENGINEERING CO.
EXXON ENGINEERING · P.O. BOX 101 · FLORHAM PARK, N.J. 07932

ONSITE PLOT PLAN

CCG - LPP

SYNTHANE MINIMUM MODIFICATION REVAMP

PRINCETON, PENNA.

DATE	SHEET	DRAWING NO
MAY 10, 1978	1 OF 1	PP-1323-4

F.T. Conway

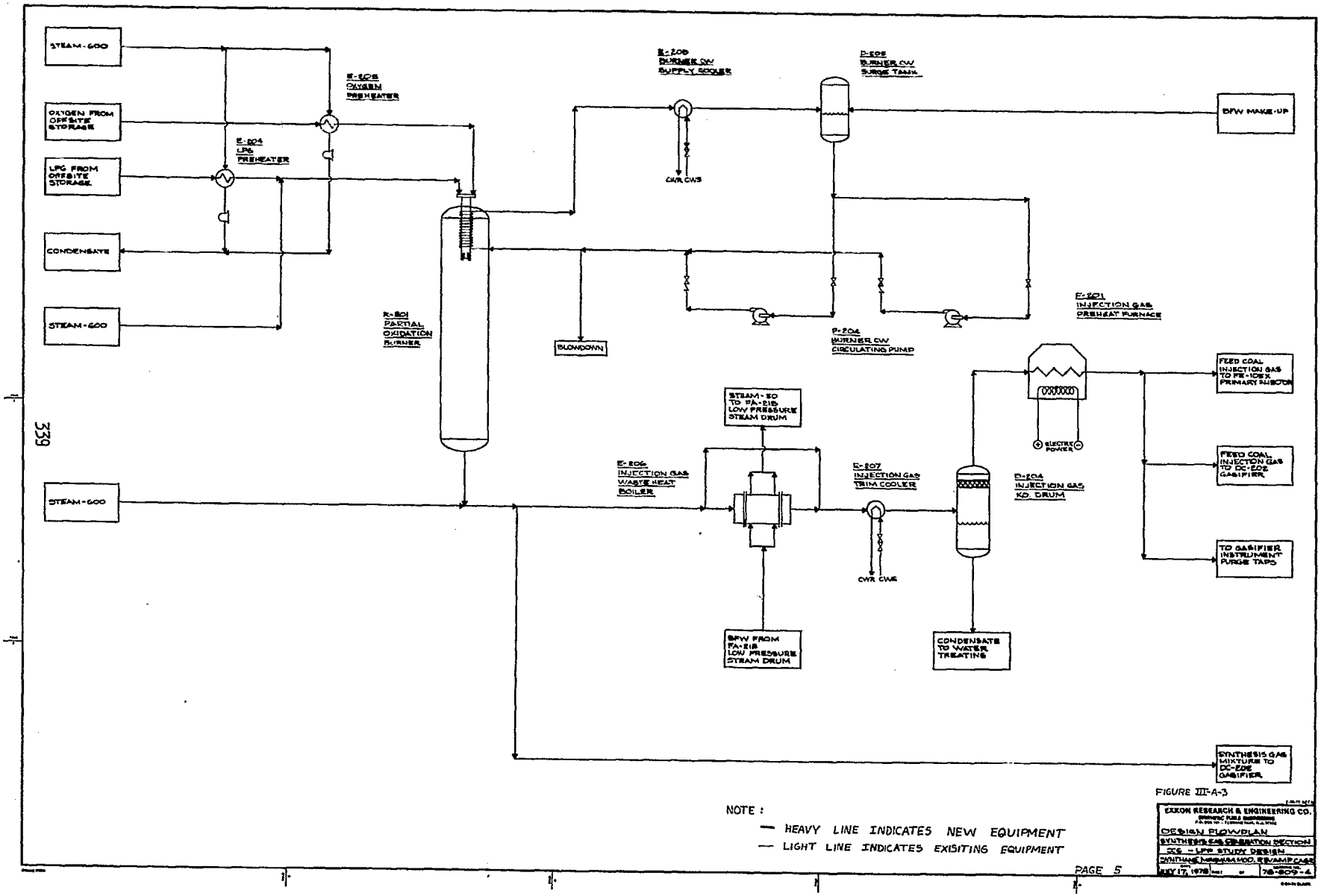

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FIGURE III-A-3

NOTE :

— HEAVY LINE INDICATES NEW EQUIPMENT

— LIGHT LINE INDICATES EXISITING EQUIPMENT

EXXON RESEARCH & ENGINEERING CO.

DESIGN FLOWPLAN

SYNTHESIS GAS GENERATION SECTION

DC - LPP STUDY DESIGN

SYNTHANE MAGNUM MOD. REVAMP CASE

MAY 17, 1978 — 78-809-4

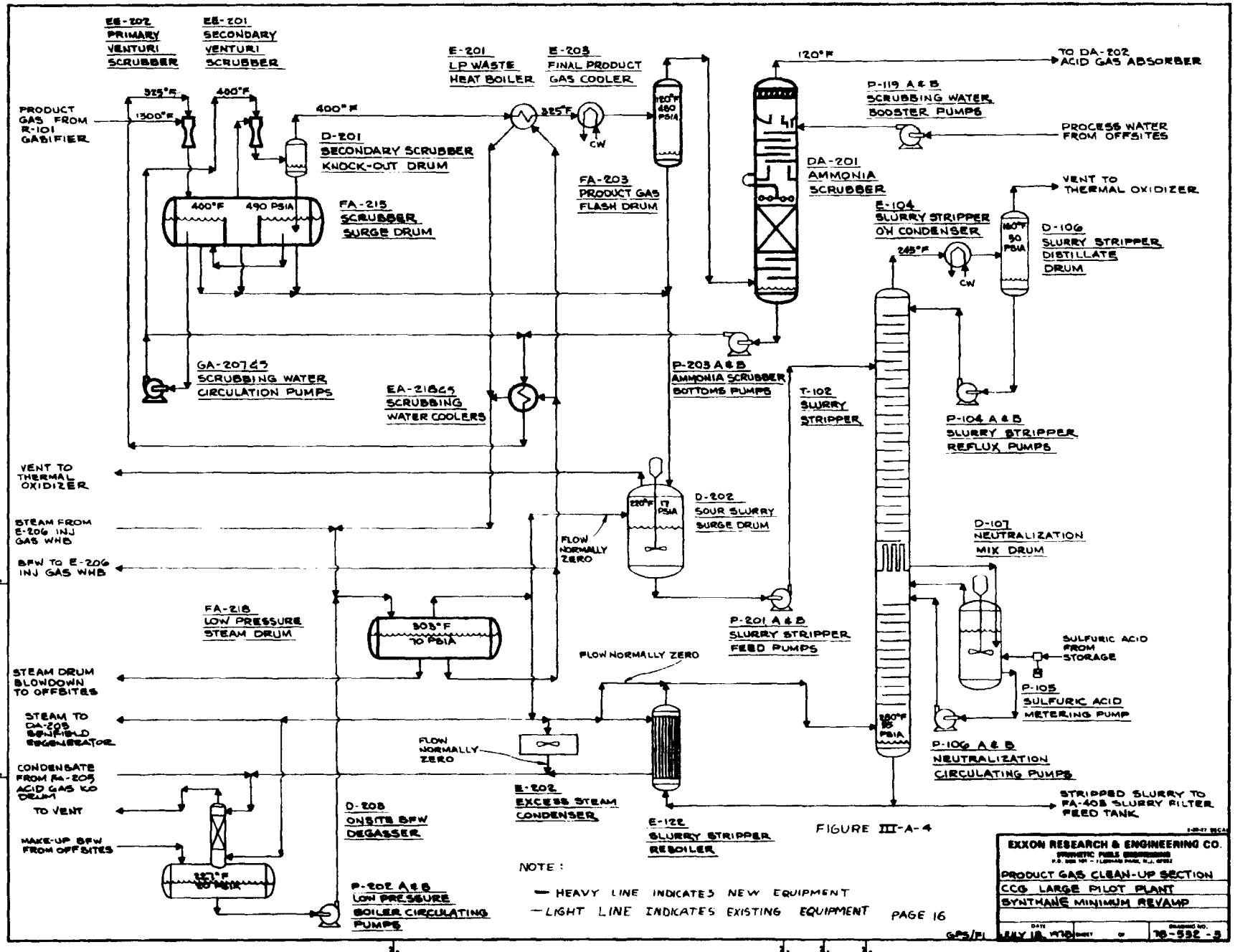
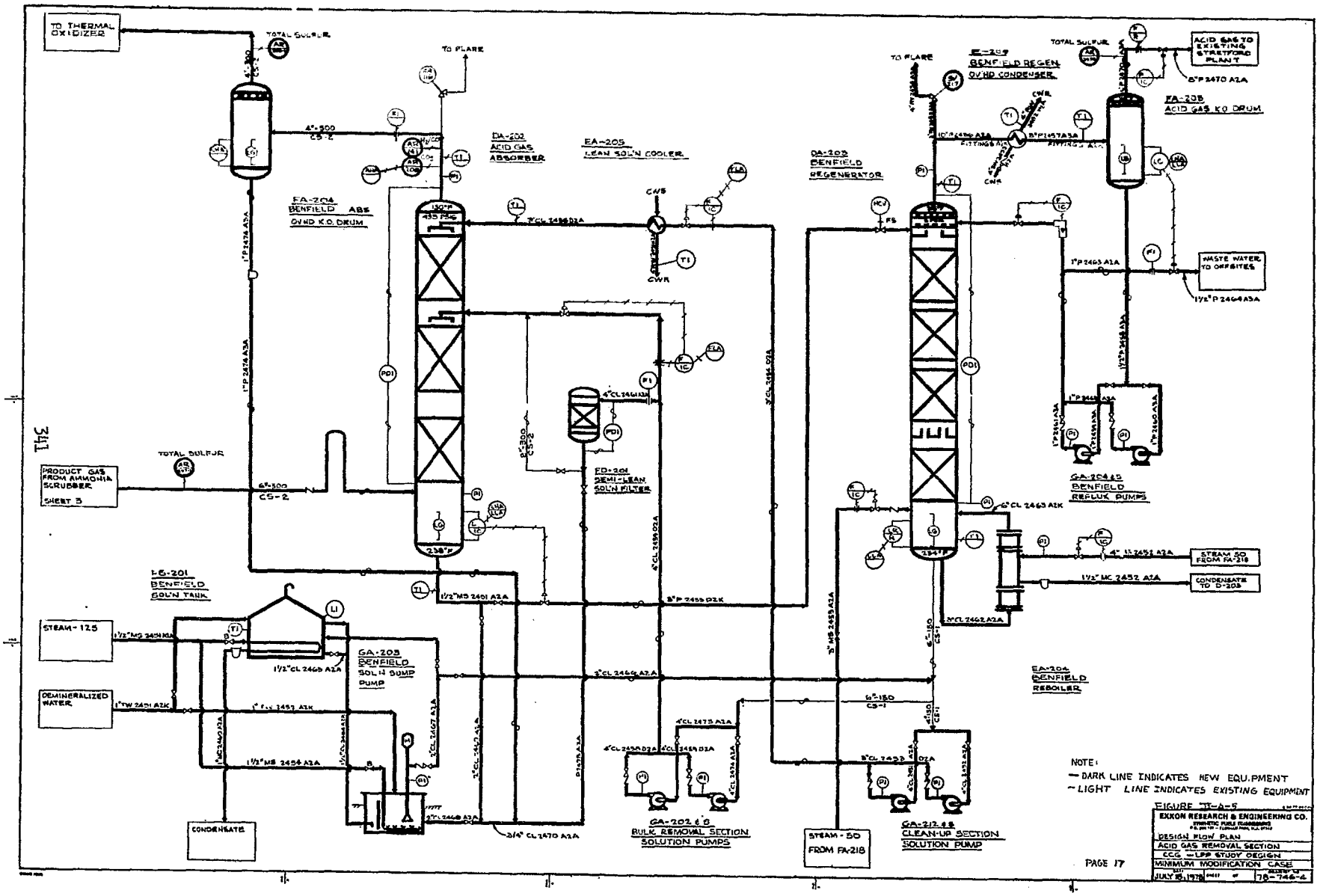


FIGURE III-A-4


TO THERMAL OXIDIZER
TOTAL SULFUR
TO FLARE
FA-204 BENFIELD ABS OVHD K.O. DRUM
DA-202 ACID GAS ABSORBER
EA-205 LEAN SOLN COOLER
CWS
CWR
FD-201 SEMI-LEAN SOLN FILTER
PRODUCT GAS FROM AMMONIA SCRUBBER SHEET 3
TOTAL SULFUR
LS-201 BENFIELD SOLN TANK
STEAM - 125
DEMINERALIZED WATER
GA-203 BENFIELD SOL'N SUMP PUMP
CONDENSATE
GA-202 A/B BULK REMOVAL SECTION SOLUTION PUMPS
DA-203 BENFIELD REGENERATOR
E-209 BENFIELD REGEN OVHD CONDENSER
TO FLARE
TOTAL SULFUR
ACID GAS TO EXISTING STRETFORD PLANT
FA-205 ACID GAS K.O. DRUM
WASTE WATER TO OFFSITES
GA-204 A/B BENFIELD REFLUX PUMPS
STEAM 50 FROM FA-218
CONDENSATE TO D-203
EA-206 BENFIELD REBOILER
STEAM - 50 FROM FA-218
GA-213 A/B CLEAN-UP SECTION SOLUTION PUMP
NOTE:
— DARK LINE INDICATES NEW EQUIPMENT
— LIGHT LINE INDICATES EXISTING EQUIPMENT
FIGURE II-A-5
EXXON RESEARCH & ENGINEERING CO.
DESIGN FLOW PLAN
ACID GAS REMOVAL SECTION
CCG — LPP STUDY DESIGN
MINIMUM MODIFICATION CASE
JULY 15, 1978
78-746-4

APPENDIX III-B

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

ONSITES FACILITIES - STAGE 2

This specification presents the onsite facilities for the second stage of a study design for a minimum revamp of the Synthane Large Pilot Plant for conversion to the Catalytic Coal Gasification Process.

This second construction stage would consist of adding catalyst recovery and recycle facilities to the plant, thus closing the catalyst loop. Operation would then consist of once-through synthesis gas loop and a closed catalyst loop.

Process Description for the Second Stage of the Synthane Minimum Modification Revamp Case

The catalyst recovery and recycle loop recovers water soluble potassium catalyst through a series of countercurrent water washes. Unconverted char from the gasifier char withdrawal stream and recovered fines from the gasifier overhead product gas are slurried and sent to a $Ca(OH)_2$ digestor. Here, a mixture of $Ca(OH)_2$, makeup KOH, and water are added. In this digestor, insoluble potassium species are converted to water soluble potassium species by the calcium hydroxide. The slurry leaving the digestor then goes to a counter-current water wash system which produces a water soluble catalyst solution for catalyst addition, and a high concentration solids stream which is purged from the system. To provide operating flexibility, the stream to catalyst addition can be further concentrated in an evaporator before being sprayed on the dried, crushed, feed coal. The high concentration solids stream is sent to offsite filtration facilities.

TABLE III-B-1

ONSITES UTILITIES AND CHEMICAL REQUIREMENTS

Cooling Water

Requirements, GPM		Normal	Maximum
E-120	Evaporator Overhead Condenser	160	160*
		160	160
	Simultaneous Maximum		160

Industrial Water

Requirements, GPM		Normal	Maximum
D-121N	Hydroclone Mix Drum	10	10*
		10	10
	Simultaneous Maximum		10

Steam

Steam-600

Requirements, #/Hr		Normal	Maximum
J-101	Evaporator Ejector	3320	3320*
		3320	3320
	Simultaneous Maximum		3320

Steam-55

Requirements, #/Hr		Normal	Maximum
R-202	Lime Digestor	275	275*
		275	275
	Simultaneous Maximum		275

TABLE III-B-1 (Cont'd)

Electric Power Requirements, KW		Service	Operating Load	Reacceleration
GA-208	Make-up Water Booster Pump	N	0.7*	A
GA-208S	Make-up Water Booster Pump	S	0.7	A
P-110A	Cat Solution Surge Pump	N	7*	A
P-110B	Cat Solution Surge Pump	S	7	A
P-111A	Slurry Feed Pump	N	2.3*	A
P-111B	Slurry Feed Pump	S	2.3	A
P-112A	Recycle Cat Solution Pump	N	1.5*	A
P-112B	Recycle Cat Solution Pump	S	1.5	A
P-113A	Spent Char and Ash Pump	N	1.5*	A
P-113B	Spent Char and Ash Pump	S	1.5	A
P-114A	Hydroclone Pump	N	2.3*	A
P-114B	Hydroclone Pump	N	2.3*	A
P-114C	Hydroclone Pump	N	2.3*	A
P-114D	Hydroclone Pump	N	2.3*	A
P-114E	Hydroclone Pump	N	2.3*	A
P-114F	Hydroclone Pump	N	2.3*	A
P-114G	Hydroclone Pump	N	2.3*	A
P-114H	Hydroclone Pump	N	2.3*	A
P-114I	Hydroclone Pump	N	2.3*	A
P-114J	Hydroclone Pump	N	2.3*	A
P-114K	Hydroclone Pump	N	2.3*	A
P-114L	Hydroclone Pump	N	2.3*	A
P-114M	Hydroclone Pump	N	2.3*	A
P-114N	Hydroclone Pump	N	2.3*	A
P-115A	Evaporator Circulation Pump	N	11*	A
P-115B	Evaporator Circulation Pump	S	11	A
P-116A	Concentrated Solution Pump	N	0.3*	A
P-116B	Concentrated Solution Pump	S	0.3	A
P-205A	Lime Slurry Addition Pump	N	0.7*	A
P-205B	Lime Slurry Addition Pump	S	0.7	A

TABLE III-B-2

ONSITES EQUIPMENT LIST - HEAT EXCHANGERS

- Shell and Tube Exchangers

Equipment No.	Service	Duty, MBtu/hr	Total Surface, ft^2	No. Shells	Comments
E-120	Evaporator Ov'hd Condenser	3.3	170	1	
E-124	Evaporator Heater	4.5	470	1	
E-126	CO_2 Vaporizer	0.65	-	1	

TABLE III-B-3

ONSITES EQUIPMENT LIST - PUMPS

Equipment No.	Service	Type	Capacity, gpm	ΔP, Psi	BHP	Comments
GA-208 and S	Makeup Water Booster Pumps	Centr.	11	50	2.0	Existing
P-110 A and B	Cat. Solution Surge Pumps	Recip.	18	480	7.5	
P-111 A and B	Slurry Feed Pumps	Centr.	21	50	2.0	
P-112 A and B	Recycle Cat. Solution Pumps	Centr.	10	65	2.0	
P-113 A and B	Spent Char and Ash Pumps	Centr.	10	70	2.0	Contains 35 wt% coal solids
P-114 A-N	Hydroclone Pumps	Centr.	30	0.45	2.5	Contains 20 wt% coal solids
P-115 A and B	Evaporator Circ. Pumps	Centr.	1365	5	25.0	
P-116 A and B	Concentrated Solution Pumps	Centr.	5	50	1.0	
P-205 A and B	Lime Slurry Addition Pumps	Centr.	6	110	1.0	Contains 16 wt% solids

TABLE III-B-4

ONSITES EQUIPMENT LIST - PROCESS VESSELS

Equipment No.	Service	Diam., Ft	Length, ft.	Position	Comments
D-118	Recycle Cat. Solution Drum	2'0"	6'0"	Vertical	Top Mounted Agitator
D-119	Spent Char and Ash Drum	2'0"	4'0"	Vertical	Top Mounted Agitator
D-120	Cat. Solution Surge Drum	2'6"	4'0"	Vertical	Top Mounted Agitator
D-121 A - N	Hydroclone Mix Drum	3'6"	6'0"	Vertical	Top Mounted Agitator
D-128	Evaporator	4'6"	7'0"	Vertical	
D-129	Condensate Surge Drum	2'6"	8'0"	Horizontal	
D-206	Lime Slurry Drum	3'0"	7'0"	Vertical	Top Mounted Agitator
D-207	Digestor Flash Drum	3'0"	7'0"	Vertical	Top Mounted Agitator
R-202	Lime Digestor	5'0"	18'0"	Vertical	

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TABLE III B-5

ONSITES EQUIPMENT LIST - SPECIAL EQUIPMENT

Equipment No.	Service	Comments
J-101	Ejector	Suction pressure = 10 in. Hg., back pressure = 40 in. Hg., fluid = steam Rate = 1395 lb/hr.
SCRN-101 A & B	Solids Separators	Remove particles larger than 1000 microns from slurry feed to D-117 slurry feed tank, 9 wt% KOH aequeous solution; maximum flow rate 21 gpm.

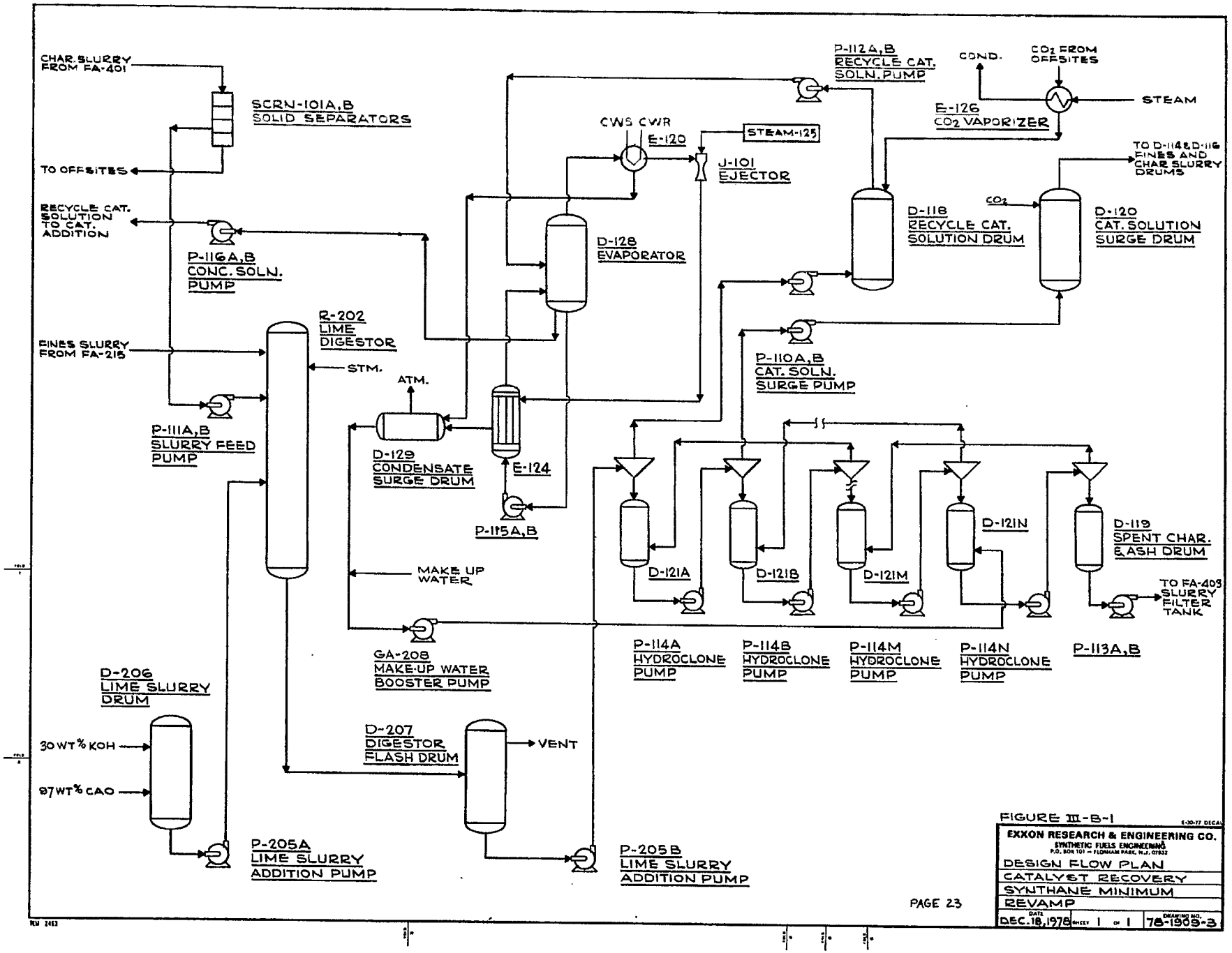


FIGURE III-B-1

EXXON RESEARCH & ENGINEERING CO.	
SYNTHETIC FUELS ENGINEERING P.O. BOX 101 – FLORHAM PARK, N.J. 07932	
DESIGN FLOW PLAN	
CATALYST RECOVERY	
SYNTHANE MINIMUM	
REVAMP	
DATE DEC. 18, 1978	SHEET 1 OF 1
DRAWING NO. 78-1909-3	

APPENDIX III-C

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

COAL RECEIPT AND COAL PREPARATION FACILITIES

This section covers the minimum modifications and additions to the Synthane Pilot Plant coal receipt and coal preparation facilities required to convert the Synthane Pilot Plant to the Catalytic Coal Gasification Process.

Design Basis

- General

  The coal preparation facilities are designed for the same coal and catalyst feed rates as those reached in the previous major Synthane Revamp Case.

  The raw coal properties, the prepared coal properties, the gasification process flow rates, and the coal preparation system flow rates are summarized below:

  + Raw Coal Properties

    The coal preparation equipment is designed to process Illinois No. 6 Bituminous coal.

	Illinois No. 6
- Moisture Content	
Total (wt%)	16.6
Surface (wt%)	3.6
- Bulk Density (lb/ft^3)	45-50
- Hardgrove Index	56
- Angle of Repose (Degrees)	40
- Particle Size Distribution	98% less than 3/4 inches

  + Prepared Coal Properties

- Moisture Content (total wt%)	4
- Particle Size Distribution (98% less than)	8 mesh
- Catalyst	
Type	KOH
Loading (wt%)	13.4

+ Gasification Process Flow Rates

	STPH
- Moisture Free Coal	2.1
- As Received Coal (Illinois No. 6, 16.6 wt% moisture)	2.5
- Catalyst	0.3

+ Coal Preparation Plant Flow Rates

	STPH
- Moisture Free Coal	4.8
- As Received Coal (Illinois No. 6, 16.6 wt% moisture)	5.8
- Catalyst	0.8

The coal preparation plant flow rates are based on the maximum throughput of the existing plant. All new equipment is designed to be compatible with the existing equipment design flow rates.

The coal preparation plant operating schedule is as follows:

+ Six days/week, 12 hours/day at medium rate

The coal preparation plant flow rates allow ample maintenance time (1 shift/day) and avoids operating the preparation plant on Sundays.

The existing prepared coal storage bin has a capacity of 150 tons. This is sufficient to bridge Sunday. 150 tons is 65 hours of storage at the coal rate expected.

- Coal Receipt

Synthane has a subcontractor, located 12 miles from the site, who receives coal by rail, stockpiles the coal and delivers it to Synthane. in 20 ton trucks. These same facilities will be utilized without modification. However, arrangements will be required to change the present coal delivery schedule to account for an increase in raw coal feed rate from 85 to 94 tons per day. Synthane's raw coal handling facilities are sized for 119 ton/day.

- Coal Preparation

The existing coal preparation equipment will be modified and new equipment will be added to accomplish the following three processing steps: (1) crushing and drying the raw coal, (2) adding catalyst, and (3) final drying.

Data from Synthane indicate that the existing hot-gas swept mill is adequate for the first processing step of crushing and drying the raw coal. The only modification required is the replacement of the screen cloth to meet the 8 mesh top size.

New equipment has been specified for the catalyst addition and final drying steps. Catalyst addition is accomplished by spraying a 30 wt% solution of the catalyst on the coal in a zig-zag mixer. An entrained dryer which operates on the same principle as the hot-gas swept mill has been specified for the final drying step.

TABLE III-C-1

COAL RECEIPT AND COAL PREPARATION

UTILITIES AND CHEMICALS

ELECTRIC POWER
Requirements, KW

Symbol	Service	Duty	Load	
			Operating	Connected
• Existing Equipment				
JD-102	Raw Coal Conveyor	N	-	1.9
JD-103	Raw Coal Bucket Elevator	N	-	13.0
JD-105	Raw Coal Weigh Feeder	N	-	1.9
PA-102	Flash Drying Mill	N	-	62.1
GB-101X	Drying Air Heater	N	-	1.9
GB-102X	Drying System Fan	N	-	62.1
PA-104X	Drying System Bag Filter	N	-	1.9
FD-101X	Vibrating Screen	N	-	2.8
PA-114X	Vibrating Bin Discharge	N	-	1.9
• New Equipment				
DC-1	Entrained Dryer Dust Collector Outlet Feeder	N	1.9	1.9
DC-2	Inert Gas Dust Collector Outlet Feeder	N	1.9	1.9
	Shaker Motor		1.0	1.0
DR-1	Entrained Dryer Dispersion Device	N	1.9	1.9
	Cyclone Outlet Rotary Valve	N	1.4	1.4
FAN-1	Entrained Dryer Circulation Fan	N	2.1	33.5
FAN-2	Combustion Air Fan	N	5.2	17.0
FAN-3	Dust Collector Fan	N	0.5	1.0
FDR-1	Rotating Vane Feeder	N	1.4	1.4
FDR-2	Rotating Vane Feeder	N	1.9	1.9
FDR-3	Weigh Belt Feeder	N	1.9	1.9
MA-1	Mixer	N	4.4	4.4
P-1	Coal Receiving Pit Sump Pump	I	1.5	1.9
	Instruments		By Contractor	
	Lighting		By Contractor	

TABLE III-C-1 (Cont'd)

LP STEAM

Requirements

- Steam tracing of firewater line

COMPRESSED AIR

Requirements, SCFM

• Instrument	50
• Utility	50

INERT GAS--LOW PRESSURE

Requirements, SCFM

• Existing	40
• Additional	40

INERT GAS--HIGH PRESSURE

Requirements, SCFM

• Existing	30
• Additional	30

FUEL--NO. 2 FUEL OIL

Requirements, 10^6 BTU/hr.

• Existing Flash Drying Impact Mill	3.6
• New Entrained Dryer	6.0

TABLE III-C-2

EQUIPMENT LISTS-COAL PREPARATION AND STORAGE

DR-1 Entrained Dryer System

The entrained dryer system will be used to dry the catalyst/coal mixture and to convey it to the prepared coal storage bin. The system will consist of a closed gas circuit containing a drying column, cyclone separator, and ducts as shown on Figure III-C-1. Also associated with the flash dryer is a gas heater furnace, secondary gas cleaner (bag filter), and fans.

- Drying Column

Service	Reduce the total moisture in the coal/ catalyst mixture from 27 wt% moisture to 4 wt%.
Design Capacity	
• Coal (STPH)	5.0 (includes 4 wt% moisture)
• Catalyst Solution (STPH)	2.6 (30 wt% solution of KOH)
Dimensions	Diameter--2'9" I.D. Height--50'

(1) Provide a hopper and two 12" slide valves at the bottom of the entrained dryer for the collection and withdrawal of any lumps which may be formed during the mixing or flash-drying operations.

(2) Coal inlet shall be equipped with a dispersion device to uniformly distribute the catalyst/coal mixture into the hot gas stream.

TABLE III-C-2 (Cont'd)

- Cyclone Separator

Service	Separate dry, catalyzed coal from inert gas stream
Gas Flow Rate (ACFM)	8760
Solids Flow Rate (STPH)	5.8 (includes 4 wt% moisture)
Operating Conditions	
• Temperature (°F)	350
• Pressure (inches of water)	20

Notes:

(1) Provide rotary valve with drive and motor on outlet.

- 100 feet of 20 inch diameter duct
- 200 feet of 12 inch diameter duct

TABLE III-C-2 (Cont'd)

Pumps

Equipment No.	P1
Service	Coal Receiving Pit
Type	Vertical Sump
Capacity, gpm	50
ΔP, Psia	20

Compressors

Equipment No.	FAN-1	FAN-2
Service	Entrained Dryer Circulation Fan	Combustion Air Fan
Flow Rate	6000	1200
Gas Mol. Wt.	23.4	29
Fan ΔP, in H_2O	30	57
Inlet Temp. °F	350	Ambient
Inlet Press, in H_2O	0	Ambient
Fan Type	Centrif.	Centrif.

Equipment No.	FAN-3
Service	Dust Collector Fan
Flow Rate	50
Gas Mol. Wt.	28
Fan ΔP, in H_2O	5
Inlet Temp. °F	300
Inlet Press, in H_2O	-5
Fan Type	Centrif.

TABLE III-C-2 (Cont'd)

Furnaces	
Equipment No.	F-1
Service	Heating air and recycle gas to provide hot flue gases for the entrained dryer DR-1.
Duty (MBtu/hr)	60
Fuel	No. 2 Fuel Oil
Outlet Temp., °F	1200
Bins	
Equipment No.	BN-1
Service	Bins
Type	Circular, conical outlet
Diameter, ft.	4.5
Straight side hgt., ft.	7
Tape height, ft.	4.75
Capacity, tons	2.5
Dust Collectors	
Equipment No.	DC-1
Service	Entrained dryer dust collector to remove the dust from the gas stream leaving the entrained dryer cyclone
Type	Continuous, self-cleaning
Design gas rate (ACFM)	8760
Gas	Combustion gas and water
Net bag area (ft^2)	3000
Design temperature, °F	450

TABLE III-C-2 (Cont'd)

Dust Collectors (Cont'd)	
Equipment No.	DC-2
Service	Inert gas dust collector
Type	Continuous, self-cleaning
Design gas rate (ACFM)	73
Gas	Inert gas
Net bag area (ft^2)	25
Design temp., (°F)	300
Feeders	
Equipment No.	FDR-1
Service	Dried coal feeder
Type	Rotating vane
width (ft)	By contractor
Diameter (in)	By contractor
Design capacity (STPH)	5.0
Equipment No.	FDR-2
Service	Wet, catalyzed coal feeder
Type	Rotating vane
Width	By contractor
Length	By contractor
Design capacity (STPH)	15.2

TABLE III-C-2 (Cont'd)

Feeders (Cont'd)

Equipment No.	FDR-3
Service	Dried, crushed coal feeder
Type	Weight belt
Width (ft)	1.5
Length (ft)	5
Design Capacity (STPH)	5.0
Equipment No.	MA-1
Service	Mix coal and catalyst solution
Design capacity	
Coal (STPH)	5.0
Catalyst solution (GPM)	8.0 (30 wt% aqueous solution of KOH)
Design temp., (°F)	300

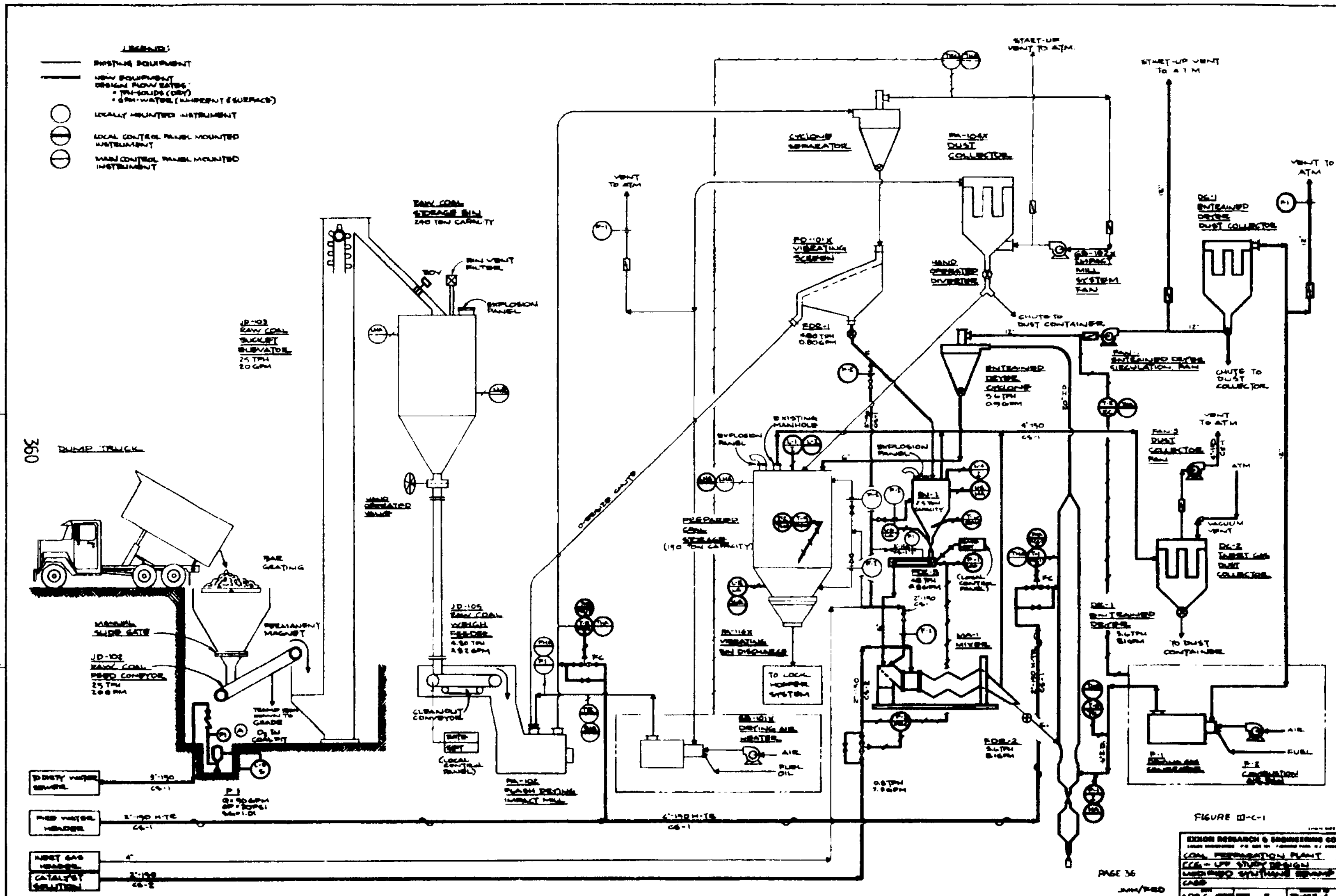
TABLE III-C-2 (Cont'd)

VIBRATING SCREEN

The existing vibrating screen appears to be adequate for the new system. However, new screen cloth is required to meet the 8 mesh top size. (Present system design is 20 mesh top size.)

COAL PREPARATION EQUIPMENT STRUCTURE

A new 10' x 25' equipment bay adjacent to the present coal preparation structure which contains the cyclone, screen, bag house, prepared coal bin, etc. is required. The new bay shall be located on the east side of the existing bay. The existing enclosed room housing the screen and existing bag filter shall be expanded to make room for the new bag filter and fan. Platforms shall be provided in the new bay to support the new equipment.


LEGEND:
EXISTING EQUIPMENT
NEW EQUIPMENT
LOCALLY MOUNTED INSTRUMENT
LOCAL CONTROL PANEL MOUNTED INSTRUMENT
MAIN CONTROL PANEL MOUNTED INSTRUMENT
DUMP TRUCK
BAR GRATING
PERMANENT MAGNET
RAW COAL STORAGE BIN
240 TON CAPACITY
BIN VENT FILTER
EXPLOSION PANEL
HAND OPERATED VALVE
CLEANOUT CONVEYOR
CYCLONE SEPARATOR
START-UP VENT TO ATM.
VENT TO ATM
CHUTE TO DUST CONTAINER
CHUTE TO DUST COLLECTOR
TO DUST CONTAINER
EXISTING MANHOLE
TO LOCK HOPPER SYSTEM
AIR
FUEL
FUEL OIL
VACUUM VENT
ATM
FIGURE III-C-1
COAL PREPARATION PLANT
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APPENDIX III-D

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

CATALYST HANDLING FACILITIES

This section covers the Gasification Process Catalyst Handling Facilities for the minimum modification case of the Synthane Pilot Plant. Grass roots facilities are required since the Synthane Plant does not have any similar facilities. Major equipment covered in this section include the receipt and storage facilities for the KOH catalyst, transfer pump to transfer the catalyst solution to one of two day tanks, and feed pumps which deliver the catalyst to the catalyst/coal blending facilities.

Design Basis

The catalyst handling facilities are designed for the same catalyst feed rate as those reached in the previous Synthane Revamp Study Design.

The catalyst receipt and storage facilities have been designed to receive and store a 45 wt.% solution of KOH. A hose connection has been provided to facilitate the receipt of catalyst by truck. The unloading operation utilizes the unloading equipment of the truck. The storage tank has been sized for 4 days of storage at maximum usage rate. The maximum usage rate occurs when the catalyst recovery unit is not operating.

A transfer pump will be provided to transfer the catalyst solution to one of two day tanks. The transfer will take a maximum of 4 hours. The recovered catalyst solution will be combined with the 45 wt.% solution in the day tanks. The day tanks will be provided with mixers, sample outlets, a connection for industrial water, and a connection to the sewer. The day tanks allow for the checking of the catalyst before it is added to the coal.

TABLE III-D-1

CCG-LARGE PILOT PLANT STUDY
CATALYST HANDLING FACILITIES

UTILITIES AND CHEMICALS

ELECTRIC POWER

Requirements, kW

Symbol	Service	Duty	Load	
			Operating	Connected
P-1	KOH Transfer Pump	I	0.4	1.0
P-2A	Catalyst Feed Pump	N	1.0	1.0
P-2B	Catalyst Feed Pump	S	1.0	1.0
M-1A	TK-2A Mixer	N	1.9	1.9
M-1B	TK-2B Mixer	N	1.9	1.9

INDUSTRIAL WATER

Requirements, GPM

	Normal	Maximum
Diluting KOH solution	0	20
Wash Down		

CHEMICALS

Requirements, GPD

KOH (45 wt% solution)

LP STEAM

Requirements

Industrial Water Line Steam Tracing

TABLE III-D-2

CCG-LARGE PILOT PLANT STUDY
CATALYST HANDLING FACILITIES

EQUIPMENT LIST

Pumps

Equipment No.	P-1	P-2 A & B
Service	KOH Transfer Pump	Catalyst Feed Pump
Type	Centrifugal	Centrifugal
Capacity, gpm	20	8
ΔP, PSI	9	36
Solids	None	Small amount of ash

TABLE III-D-2 (Cont'd)

Process Vessels

Tank No.	Service	Type	Size		Insul.	Heaters	Temp.(°F)	Mixers	Material
			Dia.(ft)	Ht.(ft)					
TK-1	KOH Solution Storage	CR(1)	15	16	No	No	Ambient	No	CS
TK-2A&B	Day Tanks	CR(1)	11.5	12	No	No	Ambient	Yes(2)	CS

Notes:

(1) Cone roof tanks with cone bottom, apex down.

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(2) A 2 HP mechanical agitator shall be provided.

(3) For instrumentation see flow plan.

(4) Each tank shall be provided with a water/bottoms drawoff connection, gage hatch, and a manway for possible maintenance requirements.

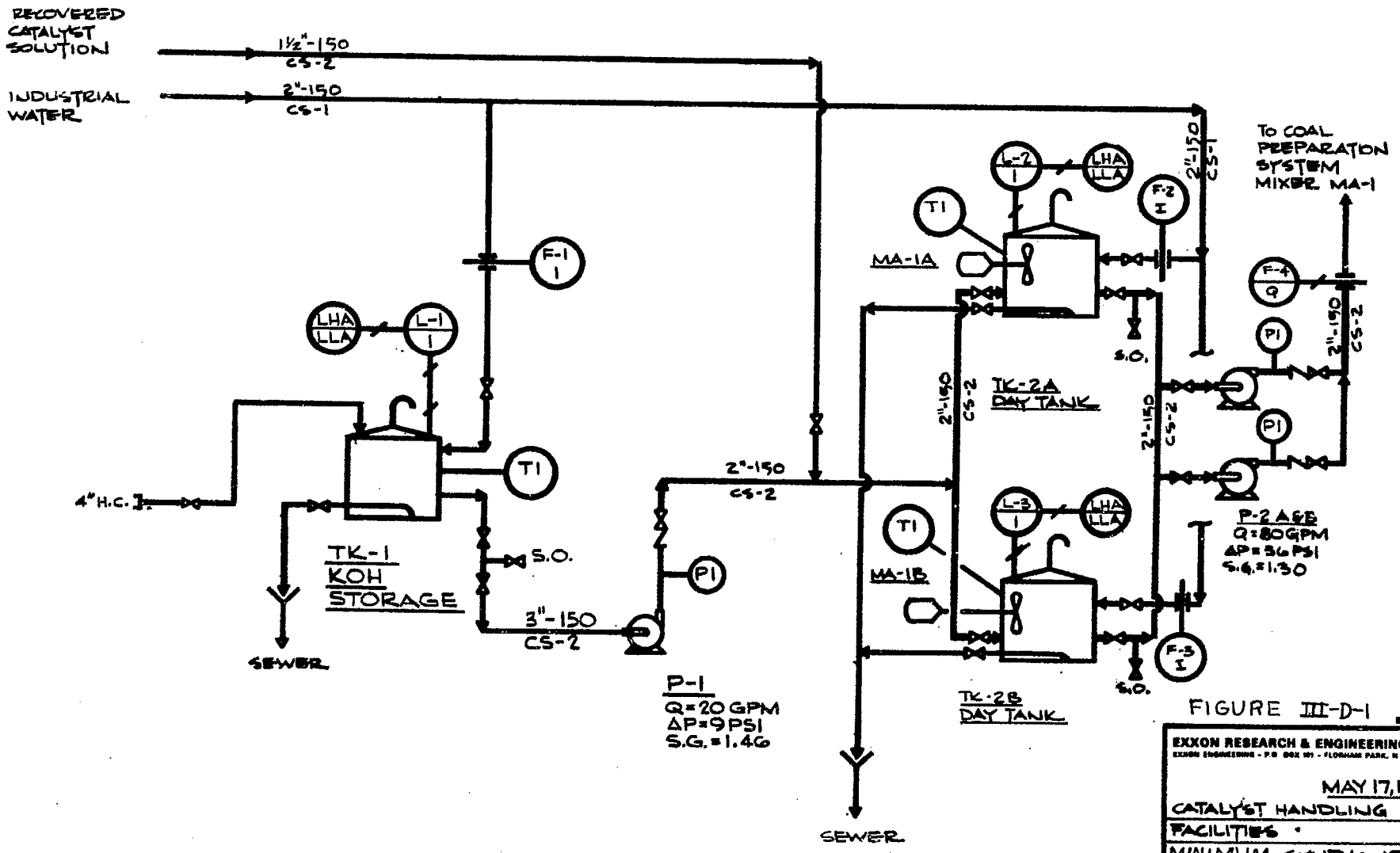

FIGURE III-D-1

E-48-74

EXXON RESEARCH & ENGINEERING CO.
EXXON ENGINEERING - P.O. BOX 101 - FLORHAM PARK, N.J. 07932

MAY 17, 1978

CATALYST HANDLING FACILITIES
MINIMUM SYNTHANE REVAMP CASE

JMH/FRD NO. 78-222-2

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APPENDIX III-E

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

CO_2 AND INERT GAS FACILITIES

This section covers the process design for the CO_2 and inert gas facilities serving the onsite and offsite systems of the Synthane Minimum Modification Case.

Design Basis

Reuse of existing CO_2 and inert gas facilities has been emphasized in this study design. Synthane CO_2 and inert gas facilities will not be relocated as they were in the major Synthane Revamp Case. A design flow plan is shown on Figure III-E-1.

Liquid CO_2 will be provided at 600 psig to the process unit where it will be vaporized for onsite use. Inert gas will normally be provided at 3 psig to the offsite users. In the event of a breakdown of the inert gas generators, gaseous CO_2 will be provided to the offsite users.

The existing liquid CO_2 storage vessels, vaporizers, and superheater will be reused in their present locations. Two new pumps will be provided to pump liquid CO_2 to the process unit. New piping will tie the CO_2 system into the inert gas system and will provide liquid CO_2 to the process unit.

The existing inert gas generators, air blowers, inert gas knockout drums, and inert gas blowers will be reused in their present locations. The existing low pressure inert gas receiver, high pressure inert gas receiver, and inert gas compressors will not be reused. These unused facilities will remain at their present locations except for one inert gas compressor (GB 303S) which will be removed from the utility room to provide space for a new air compressor.

The existing CO_2 compression facilities will be reused as onsite facilities to compress CO_2 from the onsite Stretford unit.

TABLE III-E-1

UTILITIES

ELECTRIC POWER

Requirements, kW

Symbol		Duty	Load Operating	Load Connected
• Existing Equipment				
GB 310X	Air Blower	N	-	2.8
GB 310SX	Air Blower	S	-	2.8
GB 302	Inert Gas Blower	N	-	4.4
GB 302S	Inert Gas Blower	S	-	4.4
-	CO_2 Refrigeration Unit (east)	N	-	8.4
-	CO_2 Refrigeration Unit (west)	S	-	8.4
• New Equipment				
P1A	Liquid CO_2 Pump	N	16	21
P1B	Liquid CO_2 Pump	S	16	21

LP STEAM

Requirements, lb/HR

	Normal	Max
CO_2 vaporizer	540	600
CO_2 vaporizer (spare)	540	600
CO_2 superheater	120	130

TABLE III-E-2

EQUIPMENT LIST

Pumps P-1A&B

Two new motor driven centrifugal pumps will be provided to supply liquid CO_2 to the process block. Each pump will have a capacity of 15 GPM and a ΔP of 325 psi. A pump selector switch will be provided for greater system reliability.

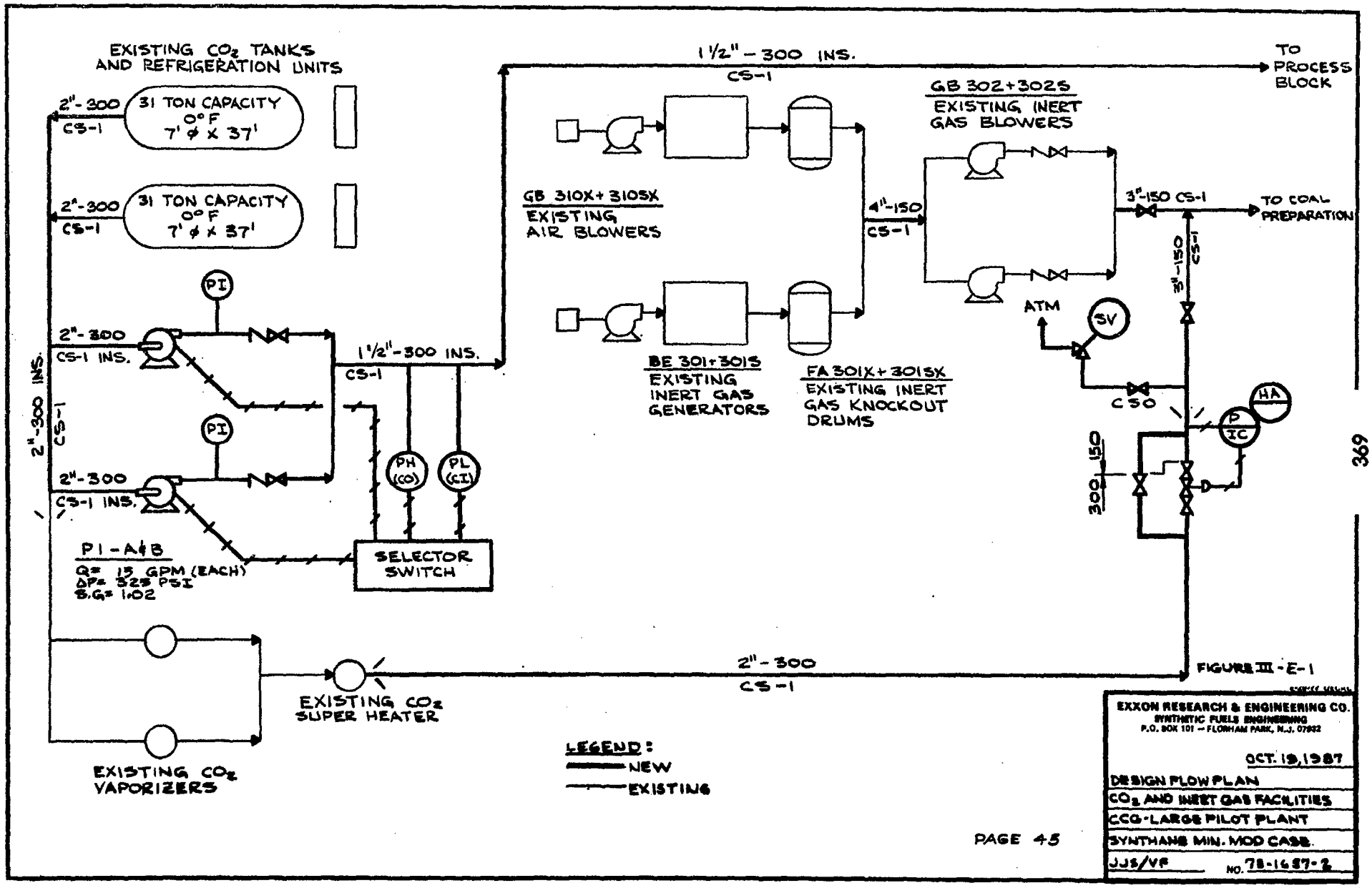

FIGURE III-E-1

EXXON RESEARCH & ENGINEERING CO.
SYNTHETIC FUELS ENGINEERING
P.O. BOX 101 — FLORHAM PARK, N.J. 07932

OCT. 19, 1987

DESIGN FLOW PLAN
CO_2 AND INERT GAS FACILITIES
CCG-LARGE PILOT PLANT
SYNTHANE MIN. MOD CASE.

JJS/VF NO. 78-1487-2

APPENDIX III-F

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

PLANT FUEL SYSTEMS

This section covers the Plant Fuel Systems for the Minimum Modification Case of the Synthane Pilot Plant. Fuel oil storage and pumping facilities to onsite and offsite consumers will remain unchanged. New offsite LPG storage and distribution facilities are described in this section.

Design Basis

LPG-C_3 Facilities

Vaporized LPG will be supplied at low pressure (i.e., vapor pressure of LPG at ambient temperature) to the laboratory and inert gas generators, and to the pilots for the flare, thermal oxidizer and low pressure boilers. High pressure (650 psig) liquid LPG will be supplied to the new onsite partial oxidation unit. New LPG facilities are shown on Figure III-F-1.

TABLE III-F-1

UTILITIES

ELECTRIC POWER

Requirements, kW

Pump Number	Service	Duty	Load	
			Operating	Connected
P-1A	LPG	N	11	13
P-1B	LPG	S	11	13

L.P. STEAM (50 psig)

Requirements, lb/hr

Vaporizer (relocated)	160
Steam tracing of vapor lines (new)	-

TABLE III-F-2

EQUIPMENT LISTS

Pumps

- LPG-C_3 (P1A & B)

Two new motor driven reciprocating pumps will be provided to supply LPG to the onsite partial oxidation unit. Each pump will have a capacity of 9 GPM and a ΔP of 700 psi.

- FUEL OIL

The existing pumping facilities will be sufficient to meet the new fuel oil requirements.

- LPG-C_3 (TK-1, 2, 3)

Five days of LPG-C_3 storage will be provided. The existing 30,000 gal. storage drum (TK-1), 10,000 gal. storage drum (TK-3) and LPG-C_3 vaporizer will be reused after relocation to a new plant area. It is assumed that TK-1 and TK-3 have instrumentation and safety valves suitable for reuse. A new 30,000 gal. (48.6 ft. O.A.L.; 131 in. diameter; hemispherical heads) storage drum (TK-2) will be added to meet the new storage requirements. Instrumentation and controls on TK-2 will include safety valves, level gauge, and pressure/temperature indicators. These three drums will be located in a new concrete enclosed area as indicated on the plot plan.

- FUEL OIL

The existing storage tank will be sufficient to meet the new fuel oil requirements.

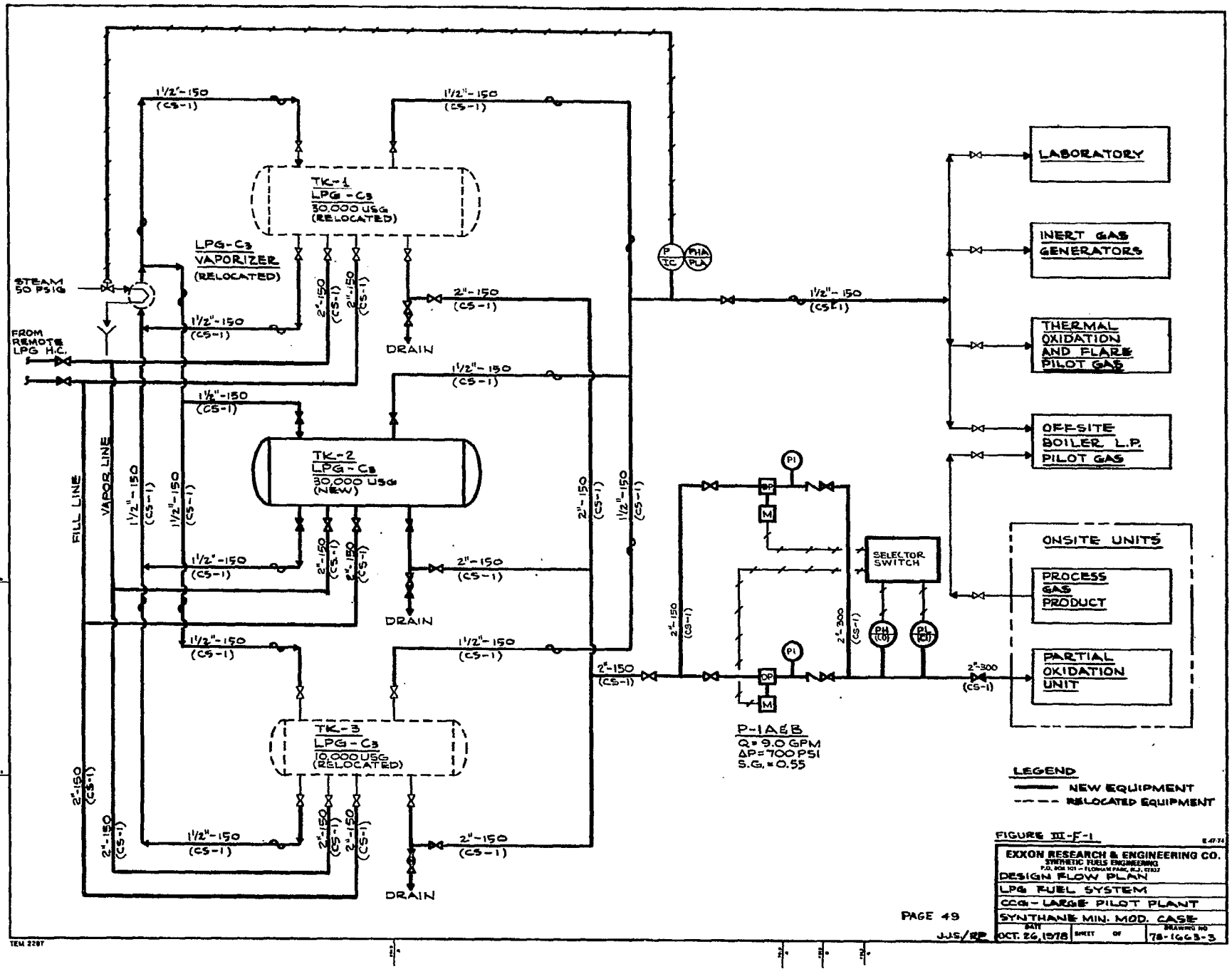

FIGURE III-F-1

EXXON RESEARCH & ENGINEERING CO.
SYNTHETIC FUELS ENGINEERING
P.O. BOX 101 - FLORHAM PARK, N.J. 07932

DESIGN FLOW PLAN
LPG FUEL SYSTEM
CCG - LARGE PILOT PLANT
SYNTHANE MIN. MOD. CASE

DATE	SHEET	OF	DRAWING NO
OCT. 26, 1978			78-1663-3

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JJS/RP

TEM 2287

APPENDIX III-G

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

BOILER FEEDWATER, STEAM AND COOLING WATER FACILITIES

Steam requirements for the Synthane Pilot Plant - Minimum Modification Case were estimated for normal and maximum operating conditions. The steam balance shows that normal requirements can be satisfied with the two existing low pressure (55 psig) boilers operating at design capacity and the high pressure (1100 psig) boiler operating at 60% of design. Since there is no spare boiler and all boiler auxiliaries have electric motor drives, a loss of power will cause an interruption in the steam supply and force a plant shutdown.

Maximum steam demand cannot be met even with all boilers operating at design capacity. Low pressure steam consumption in the existing plant is much higher than anticipated because of additional line tracing and building heating required for winter operation. During periods when steam requirements exceed boiler capacity, the only alternative will be to reduce coal feed rate to the plant.

The only modification to the existing steam system will be the installation of a pressure control valve in the 1100 psig steam header. The purpose of this valve is to reduce steam pressure from 1100 psig to 600 psig before it is distributed to onsite process units. Desuperheating water will not be required since the piping was designed for steam at 1100 psig and 800°F.

Low pressure steam can be produced thru an existing letdown station between the 1100 psig and 50 psig headers. Material specifications indicate that the piping was designed for steam at 55 psig and 700°F but other equipment in the system may not be designed for these conditions. This should be checked at the design stage to determine if desuperheating water is required.

The existing demineralization plant rated at 50 GPM has sufficient capacity to meet BFW requirements for the Synthane Minimum Modification Case. Therefore, no additional water treating facilities have been provided.

The existing cooling tower and associated facilities have adequate capacity to satisfy cooling water requirements for the Synthane Pilot Plant - Minimum Modification Case. Ten existing onsite coolers which required a total of 909 GPM will be removed from service and four new onsite coolers with a requirement of 647 GPM will be added. The offsite demand will increase by 28 GPM for the new air compressor coolers. Design capacity of the cooling water system is 2,400 GPM and total requirements are approximately 2,100 GPM.

APPENDIX III-H

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

COMPRESSED AIR FACILITIES

This section covers the process design for compressed air facilities serving the onsite and offsite systems of the Minimum Synthane Revamp Case.

Design Basis

Compressed air for process and offsite consumers will be provided by three motor driven air compressors. Two compressors are existing and will remain in service in the same location. One new compressor will be located adjacent to the two existing machines in the utility room. In order to provide space for the new unit, inert gas compressor, GB-303S will be removed. A flow plan of the compressed air system is shown on Figure III-H-1.

Compressors and Drivers

The new reciprocating compressor will be identical to the existing machines. It is described as Joy Manufacturing Co. Model WN 112 EHDL, Size 13-8 x 7 two-stage double action. An appropriate intercooler, after cooler, pulsation bottle, and related equipment will be provided with the new compressor.

The three compressors will be operated in parallel. The new header pressure control scheme shown on the flow plan will be integrated with the control systems of the three compressors.

Air Receivers

Each of the existing reciprocating air compressors has an 80 ft^3 receiver mounted on the skid and the new compressor will also have a receiver of this capacity. In addition, there is a 225 ft^3 receiver located outside the utility building. These receivers have sufficient volume for 2 minutes instrument air holdup (lower pressure limit = 50 psig). Therefore, a new air receiver is not needed.

Instrument Air Dryer

The existing prefilter, air dryer, and after filter have a capacity of 700 SCFM. This is sufficient to meet instrument air requirements in the Synthane Minimum Modification Case.

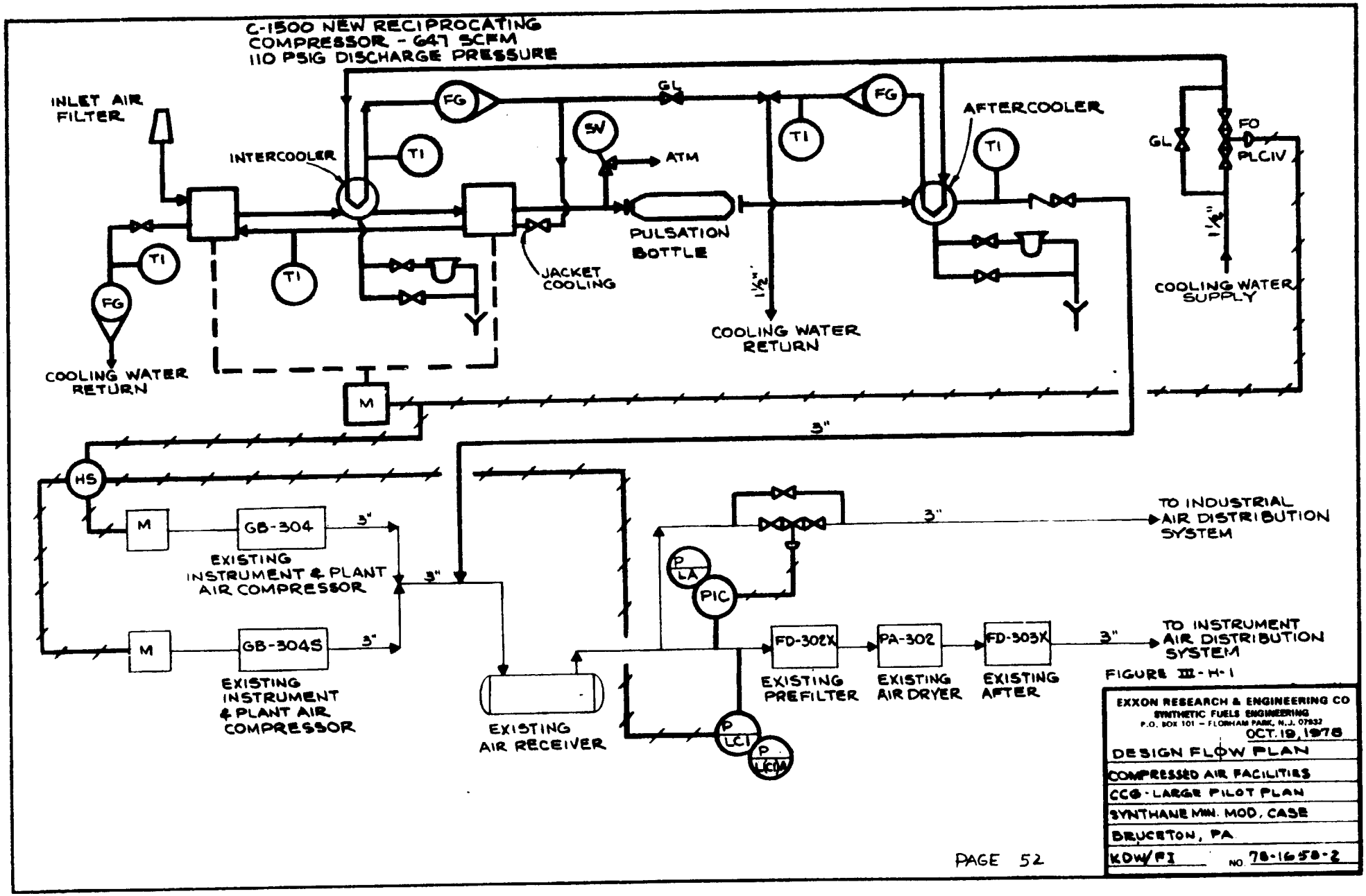


FIGURE III-H-1

EXXON RESEARCH & ENGINEERING CO
SYNTHETIC FUELS ENGINEERING
P.O. BOX 101 – FLORHAM PARK, N.J. 07932
OCT. 19, 1978

DESIGN FLOW PLAN
COMPRESSED AIR FACILITIES
CCG - LARGE PILOT PLAN
SYNTHANE MIN. MOD. CASE
BRUCETON, PA
KDW/FI NO. 78-1650-2

APPENDIX III-I

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY-MINIMUM SYNTHANE REVAMP CASE

ELECTRICAL POWER SYSTEM

This section of the study design covers the electrical power supply and distribution system for the Synthane Pilot Plant, Minimum Modification Case.

Design Basis

Power for the Synthane Pilot Plant shall be obtained at 2400 V from the West Penn Power Company substation within the plant battery limits.

Power shall be distributed radially from one existing 2400 V substation and two existing 480 V substations.

The estimated maximum simultaneous demand for the Synthane Pilot Plant is approximately 3.3 MVA. The loads are summarized by distribution center in Table III-I-1.

No planned pre-investment for future expansion shall be included in the electrical distribution system.

Power Source

Power for the Synthane Pilot Plant shall be supplied at 2400 V, 60 Hz, 3 phase from the West Penn Power Company substation existing at the Synthane Plant. A zig-zag grounding transformer and neutral resistor shall be added to the existing 2400 V system. This system, according to West Penn Power, is capable of supplying the Synthane Pilot Plant estimated load of 3300 kVA.

The interrupting capability of the equipment at the 2400 V level shall be 36 kA symmetrical at 2400 V which is equivalent to 250 MVA interrupting duty at 4160 V.

The contractor's responsibilities shall include, but are not limited to:

- Removal of existing SUB 1-A switchgear and replacement with new switchgear as indicated on one-line drawing Figure III-I-1.
- Installation of the new zig-zag grounding transformer and neutral resistor.
- Disconnection and reconnection of power cables, control wires, meters and relays at the SUB 1-A switchgear.
- Installation of the new locked rotor and instantaneous ground fault relays on all existing 2400 V motors.

Distribution System

Figure III-I-1 is the simplified one-line diagram of the electrical power distribution system for the Synthane Pilot Plant.

The location of the existing substations are indicated on plant layout drawing Figure III-N-1 included in the Layout and Building Study Design.

The distribution voltage level is 2400 V. The medium voltage loads will be supplied at 2400 V and the low voltage loads will be supplied at 480 V.

Switchgear units are numbered the same as for the existing Synthane Pilot Plant and are located in the main electrical room.

The new SUB 1-A, 2400 V switchgear is supplied radially from the West Penn Power Company's main transformer and the existing main 2400 V circuit breaker located in the yard.

The two existing 480 V substations 1-B and 1-C, and the existing 2400 V motor control center MCC 1-E are served radially from SUB 1-A.

SUB 1-B serves three existing MCCs and two existing power panels.

SUB 1-C serves four existing MCCs.

The new 2400 V, 0.82 ohms per phase zig-zag grounding transformer shall be connected to the load side terminals of the main 2400 V circuit breaker. The transformer and associated neutral resistor shall be capable of supplying approximately 1200 amps of ground fault current for 10 seconds.

The two existing 2400/480 V transformers have delta connected primary windings, and wye connected secondary windings with a solidly grounded neutral.

Metering

West Penn Power Company have their own revenue metering at their incoming transformer:

The 2400 V transformer secondary is presently equipped with:

- An indicating watthour meter with a demand register.
- One single phase indicating ammeter with selector switch for three phases.
- One voltmeter with selector switch for three phases.

The 480 V transformer secondaries are presently equipped with:

- One single phase indicating ammeter with selector switch for three phases.

Protection

The West Penn Power Company's main transformer has secondary phase overcurrent protection, undervoltage protection, and anti-single phasing protection as shown on Figure III-I-1. A new backup ground overcurrent relay shall be added to the new zig-zag grounding transformer neutral and shall be wired to trip the main 2400 V circuit breaker.

The outgoing SUB 1-A feeders shall have phase instantaneous and time overcurrent protection, and instantaneous ground fault protection.

The existing medium voltage motor starters have fuses and thermal overload relays. Locked rotor and instantaneous ground fault protection shall be added. All new motor starters shall be supplied with the same protection.

Protection for SUB 1-B and SUB 1-C consists of existing breakers with direct acting trip devices, and with ground sensing relays which shall be rewired to trip the source breaker at SUB 1-A.

General

The estimated maximum simultaneous demand for the Synthane Pilot Plant, Minimum Modification Case is approximately 3300 kVA. The loads are summarized by distribution center in Table III-I-1. The contractor is responsible for finalizing all loads and for assuring compatibility of all equipment both new and existing throughout the system.

The contractor shall utilize existing motor starters wherever possible. Where new starters are required, they shall be added to the existing MCCs in the main electrical equipment room.

Instrument Power Supply

The existing computer IPS (instrument power supply) is located in the boiler room of the utility building.

All new instruments shall be fed from existing lighting panels. Since any power failure will result in a complete shutdown of the pilot plant, including the instrument air compressors, no new IPS is planned.

Communications

The communication system for this project is not the responsibility of the contractor; however, the contractor shall supply conduits, raceways, etc. as required for the installation of the new equipment which will include dial telephones and a two-way radio system.

TABLE III-I-1

DISTRIBUTION CENTER LOAD SUMMARY

Distrib Center	Loading Area	Existing(1) Oper kW	Existing(1) Equiv kVA(2)	New Oper kW	New Equiv kVA(2)
SUB 1-A (2400 V)	MCC 1-E	746	838	313	352
	SUB 1-B	383	451	534	628
	SUB 1-C	534	628	332	391
	Total	1663	1917(3)	1179	1371(3)
SUB 1-B (480 V)	Onsite	122	144	300	353
	Coal Receiving & Storage	242	285	108	127
	Safety System	-	-	16	19
	Utilities/Water	19	22	110	129
	Total	383	451	534	628
SUB 1-C (480 V)	Onsite	-	-	106	125
	Catalyst & Chem Handling	-	-	9	11
	CO_2/O_2	15	18	108	127
	Admin. Bldg. & Lighting(4)	47	55	-	-
	Computer I.P. S.	17	20	-	-
	Utilities/Water	414	487	109	128
	Warehouse & Machine Shop	41	48	-	-
	Total	534	628	332	391

Notes :

(1) Existing loads are the sum of nameplate ratings (excluding spares).
(2) Assumed power factors are 0.89 for medium voltage loads, 0.85 for low voltage loads.
(3) Total SUB 1-A kVA is approximated by arithmetic rather than vector summation.
(4) These are estimated loads.

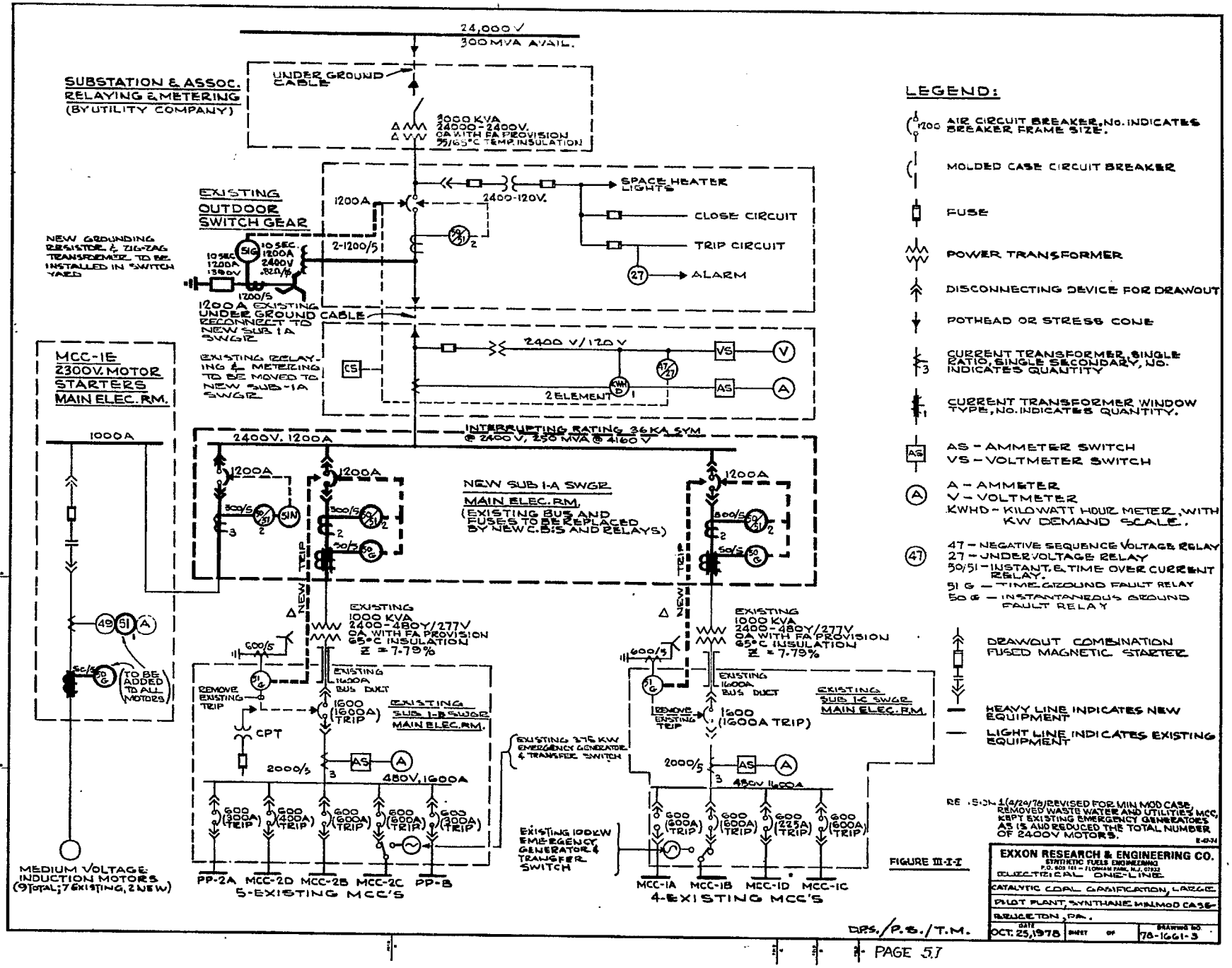


FIGURE III-I-I

APPENDIX III-J

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

NITROGEN AND OXYGEN FACILITIES

Nitrogen

For the Synthane Minimum Modification study design, nitrogen will be required for purging the Partial Oxidation Unit during a power failure. The onsite design will incorporate an emergency shutdown system whereby all feeds (C_3-LPG, Steam and Oxygen) are automatically cut out and nitrogen is cut in. A nitrogen supply of 20,000 SCF, at a pressure level above 500 psig, is sufficient to displace the contents of the Partial Oxidation Unit 50 times. This relatively small amount of N_2, which is used only intermittently, will be supplied by rental of a high pressure gas truck.

Oxygen

Oxygen requirements for the Synthane Minimum Modification Case have been estimated at 3,870 lb/hr. The existing "package system" leased from Air Products and Chemicals, Inc. must be expanded to satisfy the increased oxygen demand. New equipment to be provided by Air Products includes:

(1) Cryogenic liquid pump

(2) Vaporizer

(3) Gas storage vessels

The trim heater downstream of the gas storage vessels will be removed and vaporized oxygen will be sent directly to a new onsite superheater where it will be heated before going to the process units. All modifications to the existing oxygen plant will be handled by Air Products.

APPENDIX III-K

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

POTABLE, INDUSTRIAL, AND FIREWATER SYSTEMS

This section covers the process design for the potable water, industrial water and firewater facilities serving onsite and offsite facilities of the Synthane Minimum Modification Study Design.

Design Basis

In general, the basis of this study design is to utilize the existing pilot plant facilities where possible and expand them as required to meet the process and safety requirements of a Catalytic Coal Gasification Pilot Plant.

- Potable Water

  The existing potable water distribution system can be used to meet the new pilot plant requirements by simply separating it from the existing industrial water system.

- Industrial Water

  Industrial water for process and offsite consumers shall be provided via a new industrial water system consisting of storage, pumping and distribution facilities.

- Firewater

  Firewater shall be provided to the pilot plant facilities by adding a new pumping system which takes suction from the industrial water tank. Additional fixed monitors, hydrants, and hosereels shall be added to the existing firewater network to serve the new areas of the plant.

Potable Water Distribution

Potable water is presently taken from the city water main at 160 psig and metered into the Synthane site at 30 psig. This pressure reducing system plus the existing distribution network shall be retained. The system is shown in Figure III-K-1.

Industrial Water Distribution

The industrial water distribution system shall be an entirely new facility consisting of storage tank, pumps and distribution lines. The storage tank shall also provide the necessary firewater inventory as required to meet safety standards.

Water shall be supplied to the tank via a new 8"Ø line which shall be tied into the existing city water main. For reliability and flexibility, the pumping facilities shall consist of 2-100% pumps. Each pump is driven by a 30 H.P. (25.1 kW) electric motor.

The water tank shall be heated by three (3) 5 tube heaters distributed at 120° intervals along the bottom of the tank.

In the event of a power failure, water shall be supplied to the seal drums via a 4"Ø emergency connection to the fire water system.

The industrial water distribution network is shown on Figure III-K-2 and the storage and pumping facilities are illustrated on Figure III-K-3.

Firewater System

Firewater shall be distributed throughout the plant via the existing piping system. Additional hose reels and fixed monitors are required for new or relocated facilities as shown on Figure III-K-4.

A 6 hour firewater supply shall be provided in the industrial water tank.

New pumping facilities shall be provided and tied into the firewater distribution network as shown on Figure III-K-3.

Firefighting Equipment

For the purposes of this study design it is assumed that the municipal mobile firefighting equipment is adequate to cover the needs of the minimum modification facility.

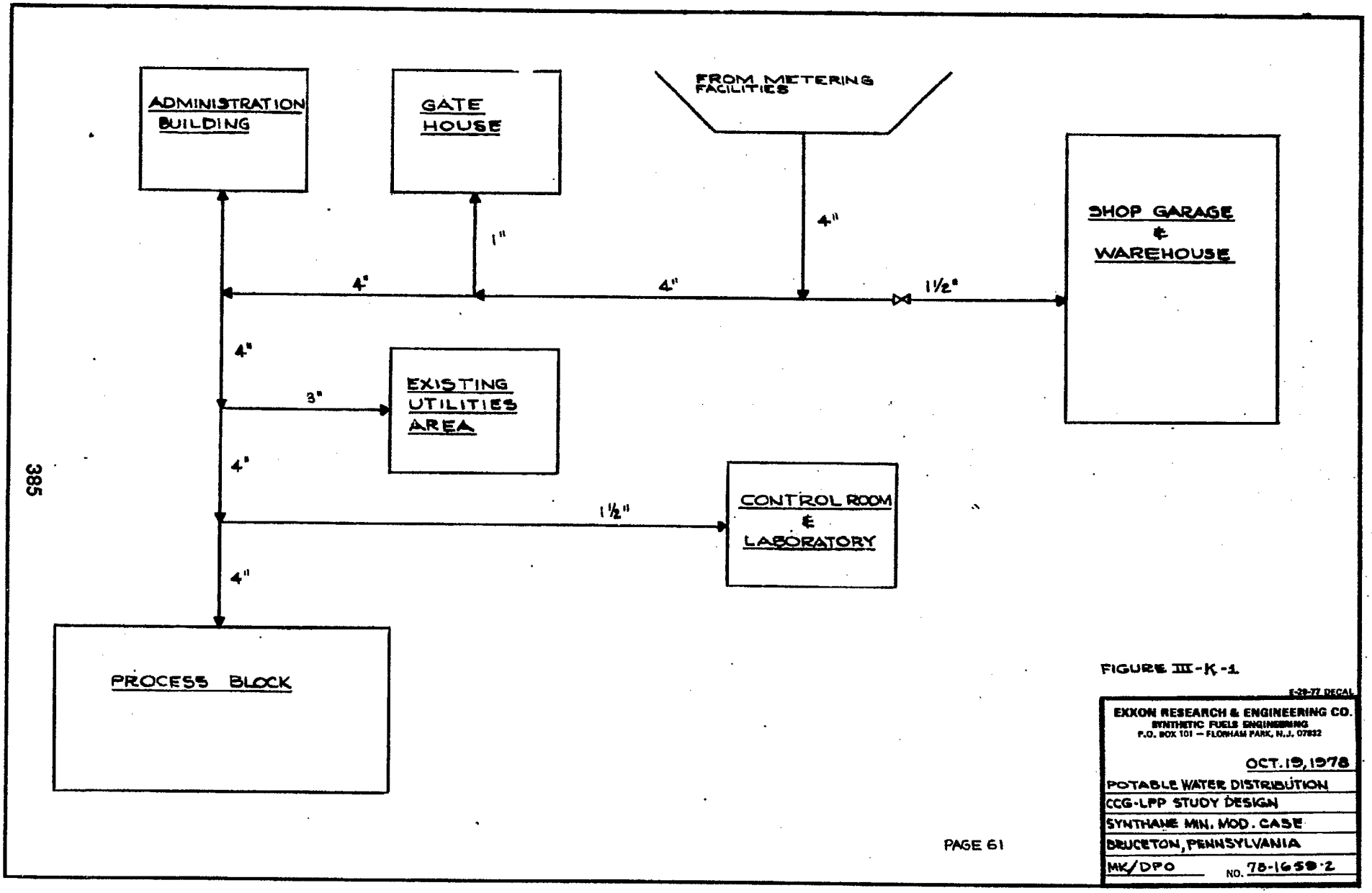


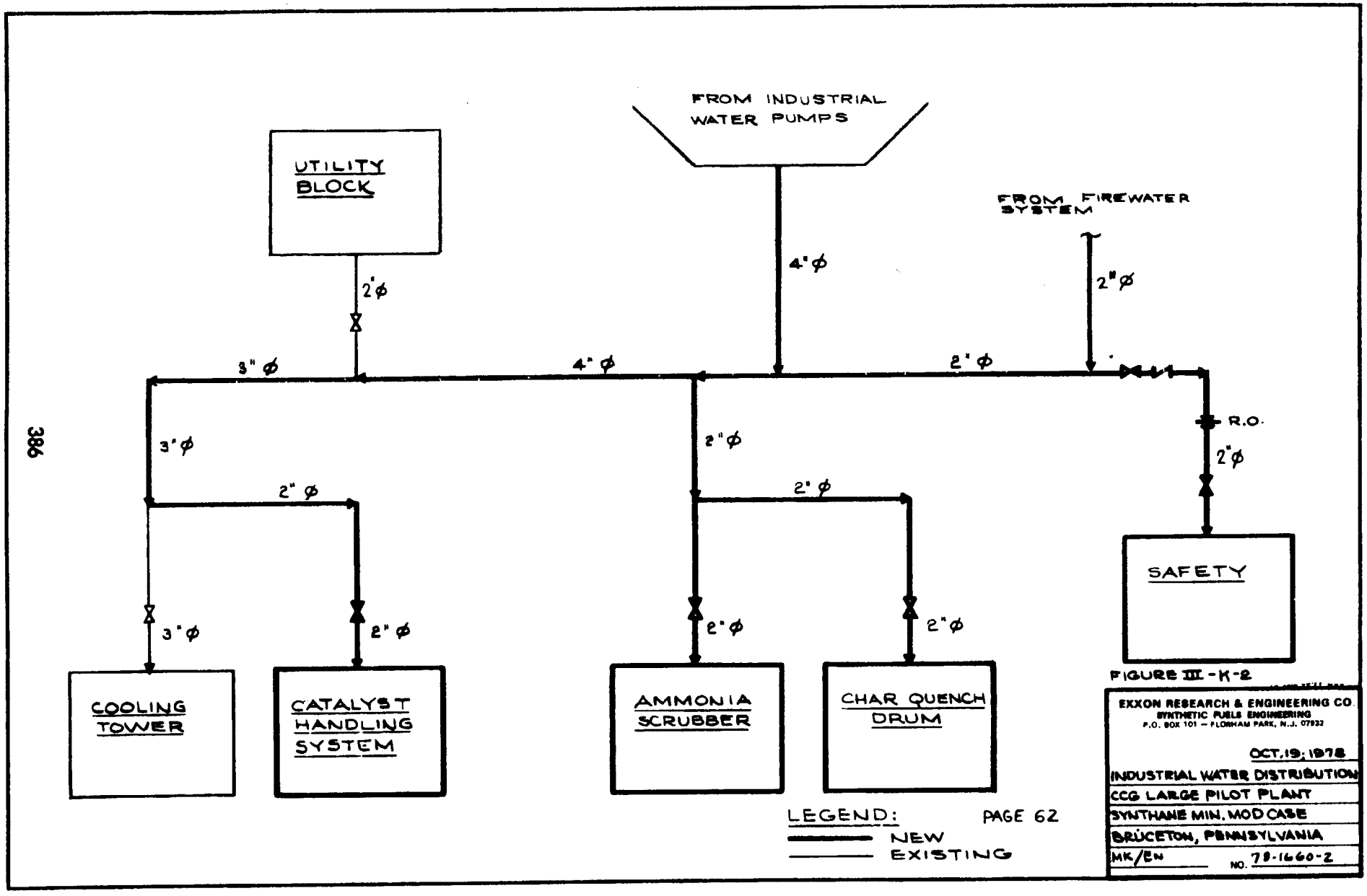
FIGURE III-K-1

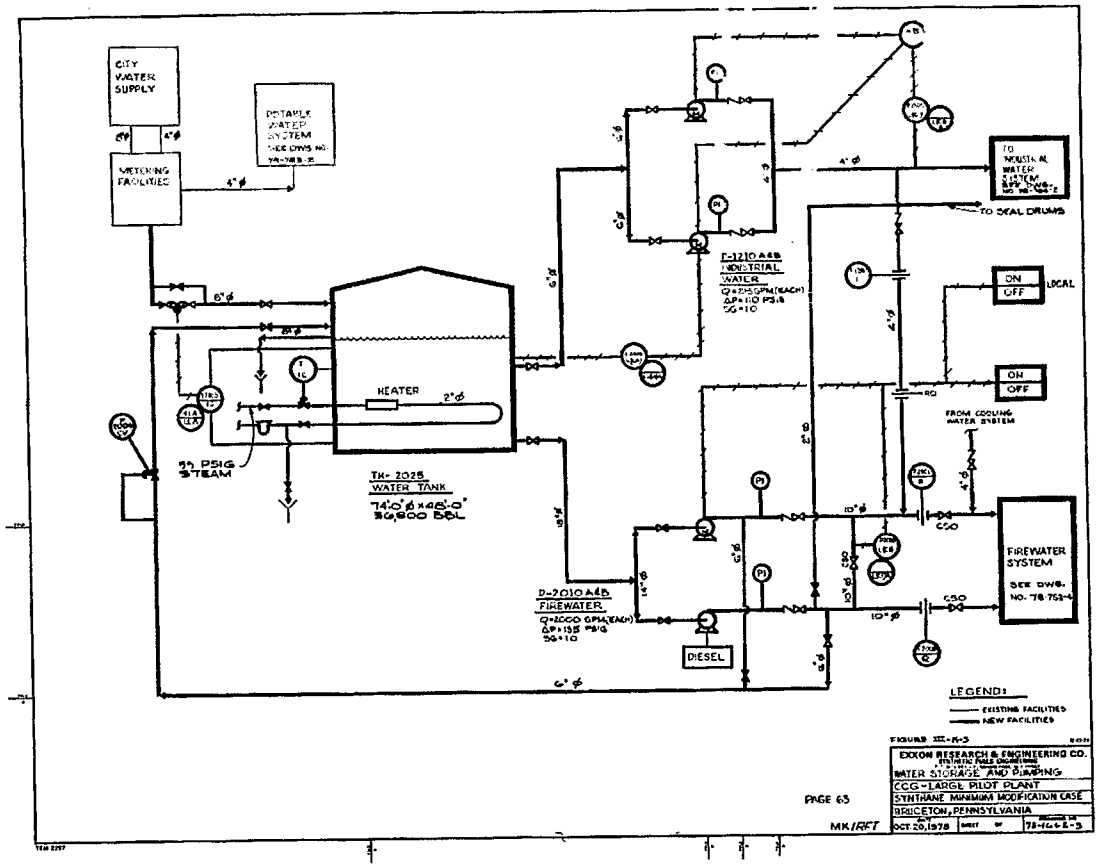
E-29-77 DECAL

EXXON RESEARCH & ENGINEERING CO.
SYNTHETIC FUELS ENGINEERING
P.O. BOX 101 — FLORHAM PARK, N.J. 07932

OCT. 19, 1978

POTABLE WATER DISTRIBUTION
CCG-LPP STUDY DESIGN
SYNTHANE MIN. MOD. CASE
BRUCETON, PENNSYLVANIA
MK/DPO NO. 78-1659-2


FROM INDUSTRIAL WATER PUMPS
UTILITY BLOCK
FROM FIREWATER SYSTEM
4"ϕ
2"ϕ
2"ϕ
3" ϕ
4" ϕ
2" ϕ
R.O.
2"ϕ
3"ϕ
2" ϕ
2"ϕ
2" ϕ
SAFETY
3"ϕ
2" ϕ
2"ϕ
2"ϕ
COOLING TOWER
CATALYST HANDLING SYSTEM
AMMONIA SCRUBBER
CHAR QUENCH DRUM
LEGEND:
NEW
EXISTING
PAGE 62
FIGURE III - K-2
EXXON RESEARCH & ENGINEERING CO.
SYNTHETIC FUELS ENGINEERING
P.O. BOX 101 — FLORHAM PARK, N.J. 07932
OCT. 19, 1978
INDUSTRIAL WATER DISTRIBUTION
CCG LARGE PILOT PLANT
SYNTHANE MIN. MOD CASE
BRUCETON, PENNSYLVANIA
MK/EN
NO. 79-1660-2


CITY WATER SUPPLY
POTABLE WATER SYSTEM
METERING FACILITIES
6"ϕ
4"ϕ
HEATER
2"ϕ
50 PSIG STEAM
TK- 2025
WATER TANK
74'0"ϕ x 48'-0"
50,900 BBL
P-1210 A&B
INDUSTRIAL WATER
Q=2450 GPM(EACH)
ΔP=110 PSIG
SG=1.0
TO INDUSTRIAL WATER SYSTEM SEE DWG. NO. 78-753-2
TO SEAL DRUMS
ON
OFF
LOCAL
FROM COOLING WATER SYSTEM
P-2010 A&B
FIREWATER
Q=4000 GPM(EACH)
ΔP=135 PSIG
SG=1.0
DIESEL
FIREWATER SYSTEM
SEE DWG. NO. 78-753-4
LEGEND:
EXISTING FACILITIES
NEW FACILITIES
EXXON RESEARCH & ENGINEERING CO.
SYNTHETIC FUELS ENGINEERING
WATER STORAGE AND PUMPING
CCG-LARGE PILOT PLANT
SYNTHANE MINIMUM MODIFICATION CASE
PRINCETON, PENNSYLVANIA
OCT 20,1978
78-164-E-3

MK/RFT

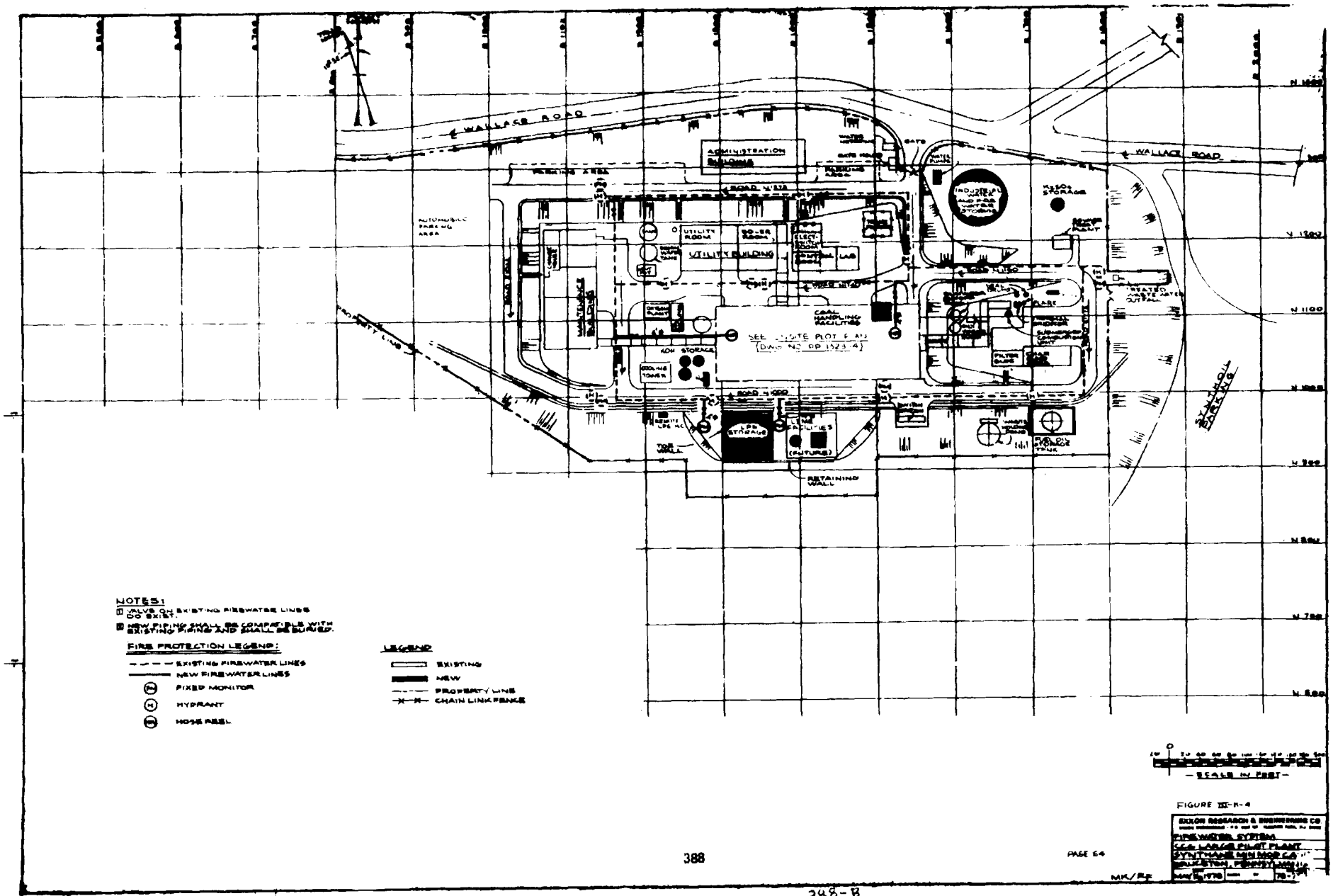


FIGURE III-A-4

EXXON RESEARCH & ENGINEERING CO
FIRE WATER SYSTEM
SCA LARGE PILOT PLANT
SYNTHANE MINERALS CO
KINGSTON, PENNSYLVANIA
MAY 15, 1978 — 78-7

APPENDIX III-L

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

WASTE DISPOSAL AND SAFETY

This section covers the process design for the waste disposal facilities of the Synthane Minimum Modification Case.

Design Basis

Reuse of existing waste handling and disposal facilities has been emphasized in this study design. Disposal of wastes is based primarily on incineration rather than on the biox type treatment basis of the Major Revamp and Grass-Roots Cases. This basis change has resulted in a significant decrease in equipment and space requirements, and the new offsite centralized chemical handling facilities have been eliminated. Note that the Safety and Waste Water Treating design studies for the Major Revamp and Grass-Roots Cases have been eliminated by this study design.

The existing vacuum filters, 160,000 gal. waste holding pond, flare, thermal oxidizer, oily water sump, and both 15,000 gal. retention tanks will be reused in their present locations. New equipment includes two submerged combustion units, storage vessels, seal drums, pumps, mixers, piping, control units and instrumentation. A design flow plan is shown Figure III-L-1.

Caustic (KOH) liquid wastes will be gravity fed from the existing vacuum filters to the existing retention tanks where it will be batch neutralized with 93% H_2SO_4. The neutralized 4% K_2SO_4 solution will be pumped to one of two new 100% submerged combustion units (S.C.U.) where it will be concentrated up to a 25% solution of K_2SO_4. Since this concentration level is higher than the K_2SO_4 solubility level, the effluent stream will take the form of a slurry. Concentrated K_2SO_4 will be pumped to a new K_2SO_4 holdup tank (TK-1) suitable for truck disposal. Steam from the submerged combustion unit and other sulfur free streams will be injected directly into the thermal oxidizer above the combustion chamber where the contaminants will be incinerated.

The existing thermal oxidizer will be reused to incinerate the continuous waste streams from onsite and offsite facilities. Based on existing Synthane practices, it has been assumed that this is acceptable from an environmental standpoint. Process product gas (CH_4, H_2, CO_2, H_2S, etc.) will be used as fuel for thermal oxidizer incineration and for S.C.U. firing. To prevent flashback in the product gas line, the product gas will first pass through a new seal drum (D-2). The existing combustion air, quench air, and fuel oil startup systems for the thermal oxidizer will be reused. LPG will be used as a backup fuel for the S.C.U.

The existing flare will be reused to burn safety valve releases from the process area. A new flare seal drum (D-3) will be provided to prevent flashback in the flare header. The potentially sour sealing water from D-2 and D-3 will be pumped to the thermal oxidizer for incineration.

The existing oily water sewers and sump will be reused without modification. New sump pumps will pump oily water to the existing waste holding pond. The existing oily water sump pumps to the retention tanks will remain in service for emergency use only. Oily water, injection gas condensate (from process area), and sealing water purge will be sent as liquids to the thermal oxidizer for incineration.

It is assumed for this study design that the existing practice of disposing of the "clean" water streams (boiler blowdown, cooling water blowdown, demineralizer regeneration effluent, etc.) to the storm sewer is acceptable from an environmental standpoint. The existing sanitary waste system will be reused without modification.

TABLE III-L-1

UTILITIES

ELECTRIC POWER

Requirements, kW

Symbol	Service	Duty	Load	
			Operating	Connected
------	S.C.U. Combustion Air Blower	N	-----	161.0
------	S.C.U. Combustion Air Blower	S	-----	161.0
M-1A	Retention Tank Mixer	N	2.0	2.76
M-1B	Retention Tank Mixer	S	2.0	2.76
M-2	K_2SO_4 Tank Mixer	N	2.0	2.76
P-1A	H_2SO_4 Metering Pump	N	<1	<1
P-1B	H_2SO_4 Metering Pump	S	<1	<1
P-2A	S.C.U. Feed Pump	N	<1	<1
P-2B	S.C.U. Feed Pump	S	<1	<1
P-3A	K_2SO_4 Holdup Pump	N	<1	<1
P-3B	K_2SO_4 Holdup Pump	S	<1	<1
P-4	Seal Water Pump	N	<1	<1
P-5	Seal Water Pump	N	<1	<1
P-6A	Oily Water Sump Pump	I	6.0	8.78
P-6B	Oily Water Sump Pump	I	6.0	8.78

INDUSTRIAL WATER

Requirements (normal), GPM

D-2 seal water	5
D-3 seal water	5

LPG

Requirements, GPH

S.C.U. Backup Fuel	190

L.P. STEAM

Requirements

An estimated 1500 lb/hr (max.) for winterization heating of TK-1, D-2, and D-3.

TABLE III-L-2

EQUIPMENT LIST

Pumps

Symbol	Description	Type	GPM	P (psi)	S.G.
P-1A	H_2SO_4 metering	positive disp.	0.4	10	1.83
P-1B	H_2SO_4 metering	positive disp.	0.4	10	1.83
P-2A	S.C.U. feed	centrifugal	31	15	1.0
P-2B	S.C.U. feed	"	31	15	1.0
P-3A	K_2SO_4 holdup	"	5	15	1.0
P-3B	K_2SO_4 holdup	"	5	15	1.0
P-4	seal water	"	10	5	1.0
P-5	seal water	"	10	5	1.0
P-6A	sump pump	"	600	15	1.0
P-6B	sump pump	"	600	15	1.0

All new pumps will be motor driven.

Process Vessels

TK-1

One cone roof tank (TK-1), 18 ft. high and 18 ft. diameter will be provided for K_2SO_4 holdup. A steam heater will be provided for winterization. TK-1 will be provided with mixing facilities.

D-1

Once carbon steel (CS-4) H_2SO_4 drum (D-1) will have a tangent to tangent length of 19.5 ft. and a diameter of 6.5 ft. (2:1 elliptical heads). Truck loading equipment will be provided.

D-2 and D-3

Two seal drums (D-2 and D-3) will have a tangent to tangent height of 6 ft. and a diameter of 4 ft. (2:1 elliptical heads). One winterization steam heater will be provided for each seal drum.

TABLE III-L-2 (Cont'd)

Instrumentation and Control Valves

- Two pH transmitter controllers will govern the new H_2SO_4 metering pumps. KOH will be batch neutralized and fine adjustments on pH will be performed by an operator.
- One pump control unit will govern the new oily water sump pumps. This control unit will be a three element type such that level 1 cuts out both pumps, level 2 cuts in one pump, and level 3 cuts in both pumps.
- All other instrumentation and control valves are shown on the flow plan.

Submerged Combustion Unit (S.C.U.)

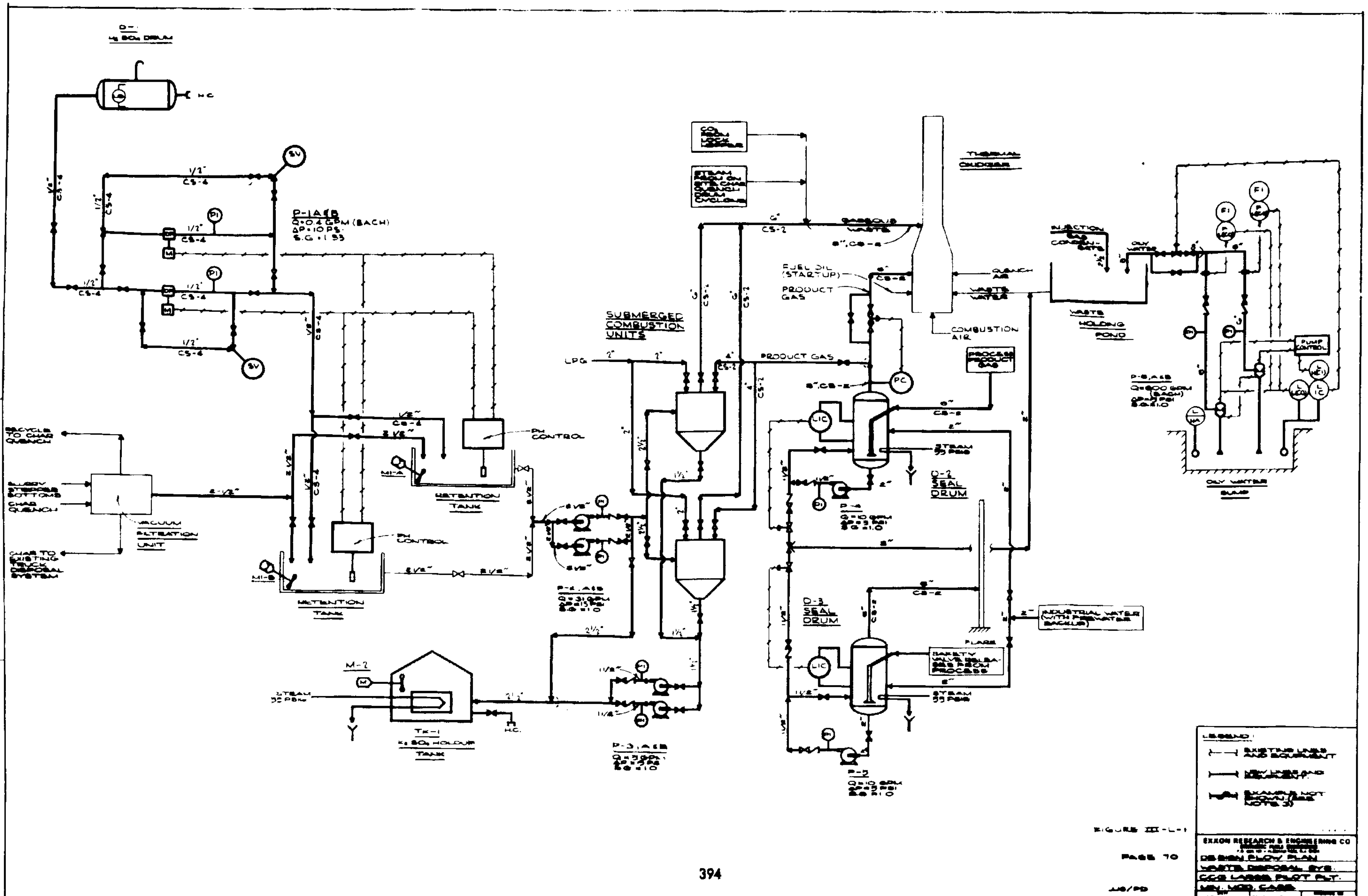
Two submerged combustion units will be supplied. Each unit will be a two-burner system capable of using product gas and/or LPG at a rate of 18 MBtu/hr. The burners will combust fuel below the liquid level in the vessel and evaporate water to the upper part of the chamber where it will be drawn off as a steam. A concentrated 25% solution of K_2SO_4 will flow from the bottom of the tank.

Mixers (M-1A & B, M-2)

Three 3 Hp mechanical mixers will be provided to aid KOH neutralization with H_2SO_4 in the existing retention tanks, and to mix the slurry solution in the K_2SO_4 holdup tank.

Mobile Equipment

For the purpose of this study design, it is assumed that existing mobile equipment in the Synthane Plant is adequate for the Minimum Modification Case.


D-1
K_2SO_4 DRUM
P-1A&B
Q=0.4 GPM (BACH)
ΔP=10 PSI
S.G.=1.53
SV
PI
CS-4
RECYCLE TO CHAR QUENCH
SLURRY STEPPED BOTTOMS
CHAR QUENCH
CHAR TO EXISTING TRUCK DISPOSAL SYSTEM
VACUUM FILTRATION UNIT
PH CONTROL
RETENTION TANK
MI-A
MI-B
P-2 A&B
STEAM 35 PSIG
M-2
TK-1
K_2SO_4 HOLDUP TANK
H.C.
P-3 A&B
SUBMERGED COMBUSTION UNITS
LPG
PRODUCT GAS
FUEL OIL (STARTUP)
PRODUCT GAS
CS-2
GASEOUS WASTE
THERMAL OXIDIZER
QUENCH AIR
WASTE WATER
COMBUSTION AIR
PROCESS PRODUCT GAS
PC
LIC
D-2 SEAL DRUM
D-3 SEAL DRUM
P-4
P-5
FLARE
SAFETY VALVE RELEASE GAS FROM PROCESS
INDUSTRIAL WATER (WITH FEEDWATER BACKUP)
INJECTION GAS CONDENSATE
OILY WATER
WASTE HOLDING POND
P-6 A&B
Q=600 GPM
OILY WATER SUMP
PUMP CONTROL
FI
LEGEND:
EXISTING LINES AND EQUIPMENT
NEW LINES AND EQUIPMENT
EXAMPLE NOT SHOWN (SEE NOTE 3)
FIGURE III-L-1
PAGE 70
EXXON RESEARCH & ENGINEERING CO
DESIGN FLOW PLAN
WASTE DISPOSAL SYS.
CCG LARGE PILOT PLT.
MIN. MOD. CASE

394-A 394-B

APPENDIX III-M

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

LIME HANDLING FACILITIES

This section covers the lime handling system for the Synthane Minimum Modification Case, Stage 2. Grass Roots facilities are required since the Synthane Plant does not have any similar facilities. Major equipment covered in this section include the receipt and storage facilities for the lime, and the delivery to the lime slurry makeup drum. Lime receipt, storage, and slurry makeup drum are located at the southern end of the facility next to the LPG storage area.

Design Basis

Lime for onsites catalyst recovery operations will be delivered by truck in 1/8" granular size. Delivery will be in 20 ton, self-unloading pneumatic trucks. The trucks will unload into a 50 ton bin located approximately 20' above grade. Total bin storage capacity is sized for a 4 day inventory plus one truck delivery. The bin shall be equipped with a vent and a dust collector capable of venting the maximum conveying rate. A screw feeder will deliver the lime, on a continuous basis, to the lime slurry makeup tank where a 30 wt% makeup solution of KOH and water are added.

TABLE III-M-1

UTILITIES

ELECTRIC POWER

Requirements, kW

Symbol	Service	Duty	Load	
			Operating	Connected
FE-100	Lime Screw Feeder	Normal	.5	1.00

TABLE III-M-2

EQUIPMENT LIST

DC-100 Bag Filter

Type	Continuous, self-cleaning
Design Gas Rate (ACFM)	500(4)
Gas	Air
Net Bag Area (ft^2)	100(4)
Gas Design Temperature (°F)	Ambient
Material Being Filtered	1/8" Granular Lime

Notes:

(1) To be located on top of BN-100.

(2) Bag filter shall be automatic self-cleaning type suitable for outdoor installation.

(3) Bag filter shall discharge into BN-100.

(4) Contractor shall verify size.

Bins

Number	BN-100
Name	Lime storage
General Type	Circular, conical outlet
Material Bulk Density	60 lbs/cu. ft.
Diameter	12'Ø
Straight Side Height	15 feet
Taper Height	10.4 feet
Net Capacity	50 short tons
Maximum Outlet Rate	8.0 short tons per day (666.7 lbs per hour)
Maximum Inlet Rate	By truck contractor
Design Temperature (°F)	Ambient
Material	CS-1

TABLE III-M-2 (Cont'd)

Notes:

(1) Bin shall be equipped with a vent and a dust collector capable of venting the maximum conveying air rate.

(2) The bin shall be elevated to allow the transfer of solids to the lime slurry make-up tank by gravity. The bin outlet will be approximately 20' above grade.

(3) Manual sliding gate at bin outlet required for maintenance on screw feeder.

Feeders

Number	FE-100
Service	Granular 1/8" lime
General Type	Screw
Material Handled	Lime
Material Bulk Density	60 lbs/cu. ft.
Length	10 ft.
Diameter	6 inches
Design Capacity (STPH)	0.33
cu. ft./hr	11.11
Speed (RPM)	2.23
Design Temperature	Ambient

Other Equipment

1. 4"Ø CS-2 150 pipe for pneumatic truck unloading	85 feet
2. Variable Speed Electric Motor 1 Horsepower .5 kW operating load 1.0 kW connected load	1
3. Triple Reduction Reducer (on screw feeder)	1
4. V Belt Drive including appropriate sheaves and V-Belt (on screw feeder)	1

APPENDIX III-N

CATALYTIC COAL GASIFICATION
LARGE PILOT PLANT STUDY - MINIMUM SYNTHANE REVAMP CASE

LAYOUT AND SITE PREPARATION

This section covers overall layout and site preparation for the Synthane Minimum Modification Case.

Design Basis

Modifications to the Synthane Pilot Plant in Bruceton, Pa. are described in various sections of this study. In order to minimize cost of the project, existing facilities have been reused to the maximum extent possible.

Some equipment in the existing plant does not meet spacing standards which ER&E would apply to new construction. Each of these areas has been carefully assessed and either judged acceptable or safety features have been provided to minimize the risk of fire and/or explosion. The only major equipment to be relocated for this modified case are the LPG drums.

A layout of the proposed Minimum Synthane Revamp Case is shown on Figure III-N-1.

Site Description

The proposed pilot plant site is the existing Synthane Coal Gasification Plant which is located in Bruceton, Pennsylvania. The plant is situated on a hilly, 15 acre tract and is graded on several different levels. The site is bounded by a public road (Wallace Road) on the north, by residential property on the west, by farmland on the south and by Synthoil, another DOE plant, on the east.

Site Preparation

As shown on the layout drawing, the LPG storage and lime handling facilities will be located in the area south of the existing plant. This will require excavation of approximately 1,500 Yd^3 of material to make the area at the same elevation as the existing process block. A 10 ft high retaining wall will be provided along the south side of these areas. The location of the industrial water tank will require only site grading.

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Contractor Staging Area

At present the Synthane site is not large enough to include a contractor staging area and a contractor parking area. For the purpose of the study design only, it is assumed that an adjacent DOE site would be used for staging and parking.

Buildings

The following buildings in the Synthane Plant will be reused without modification:

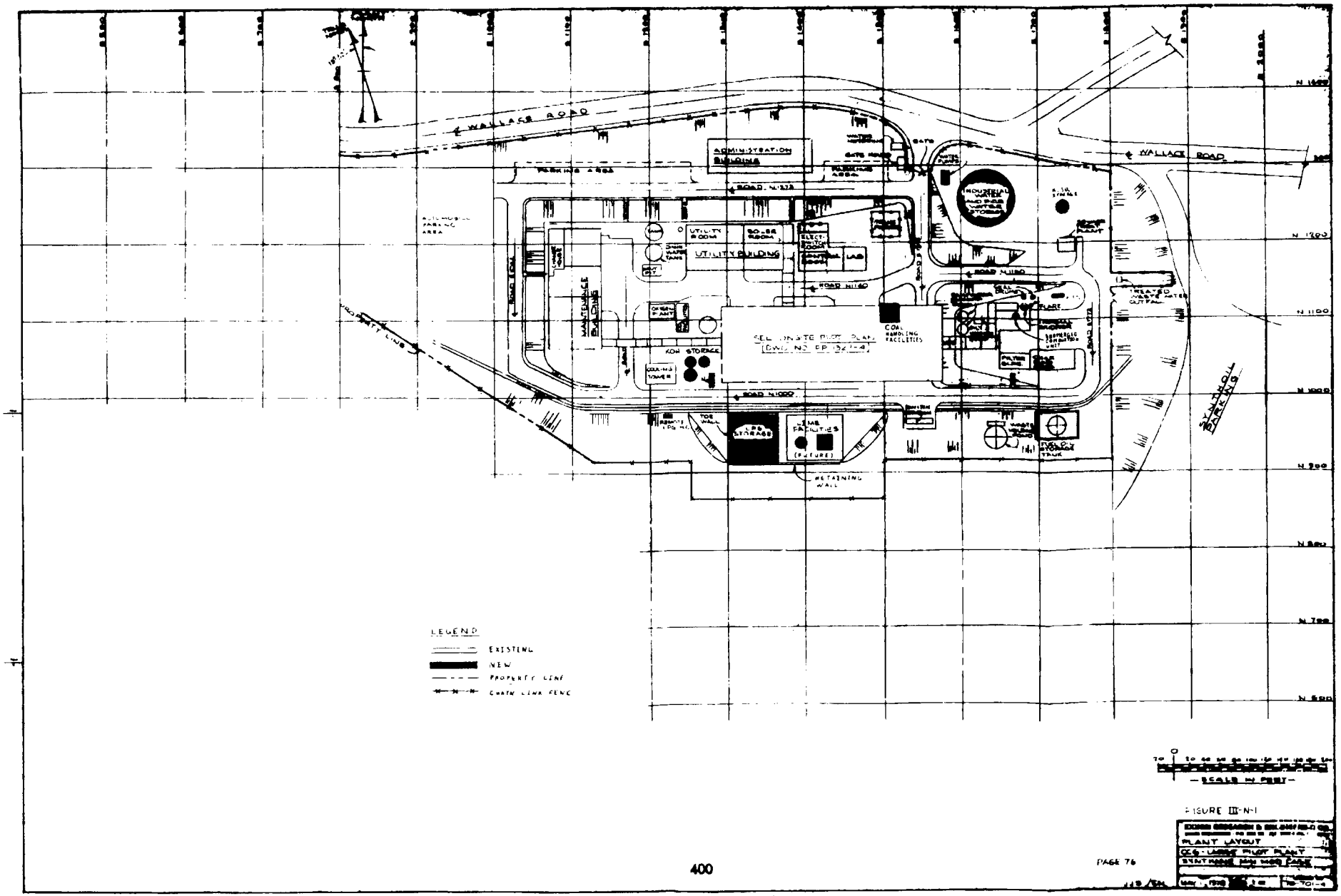
- Gatehouse
- Administration building
- Filter house
- Shop
- Garage
- Warehouse

The existing building housing the main control room, laboratory and electrical switch room will be modified as follows:

- Provide air conditioning
- Provide pressurization with air intake 40 ft. above roof.
- Replace existing glass partitions and windows with safety glass.
- Block off doorway between laboratory and control room. Provide separate outside entrance to laboratory.

Changes to the existing utility building will include:

- Pressurization with air intake 40 ft. above roof.
- New 3 ft. x 7 ft. door in partition between boiler and utility room.


WALLACE ROAD
ADMINISTRATION BUILDING
UTILITY BUILDING
MAINTENANCE BUILDING
COOLING TOWER
KOH STORAGE
LIME FACILITIES
(FUTURE)
COAL HANDLING FACILITIES
RETAINING WALL
SYNTHOIL PARKING
LEGEND
EXISTING
NEW
PROPERTY LINE
CHAIN LINK FENCE
SCALE IN FEET
FIGURE III-N-1
PLANT LAYOUT
CC-6 - LARGE PILOT PLANT

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