FOSSIL ENERGY

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DOE/ET/13060-T3(Vol.8)
(DE81025503)

PHASE I: THE PIPELINE GAS DEMONSTRATION PLANT

Demonstration Plant Engineering and Design

Volume 8. Plant Section 600—CO_2 Removal

Rec-205
NTIS-25
Bins-124
Spec-25

May 1981

Work Performed Under Contract No. AC01-77ET13060

Conoco Inc.
Stamford, Connecticut

and

Foster Wheeler Energy Corporation
Livingston, New Jersey

U. S. DEPARTMENT OF ENERGY

DISCLAIMER

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DOE/ET/13060-T3(Vol.8)
(FE-2542-38(Vol.8))
(DE81025503)
Distribution Category UC-89

PHASE I: THE PIPELINE GAS DEMONSTRATION PLANT

DEMONSTRATION PLANT ENGINEERING AND DESIGN

Volume 8
Plant Section 600 - CO_2 Removal

Conoco Inc.
High Ridge Park
Stamford, Connecticut 06904

and

Foster Wheeler Energy Corporation
110 South Orange Avenue
Livingston, New Jersey 07039

Prepared for the
United States Department of Energy
Division of Fossil Fuel Processing
Under Contract EF-77-C-01-2542

VOLUME INDEX
FOR DEMONSTRATION PLANT ENGINEERING & DESIGN REPORT

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6	Plant Section 400 - Rectisol
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9	Plant Section 800 - Product Gas Compression and Drying
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ABSTRACT

Contract No. EF-77-C-01-2542 between Conoco Inc. and the U.S. Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981.

One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. A report of the design effort is being issued in 24 volumes. This is Volume 8 which reports the design of Plant Section 600 - CO_2 Removal.

The CO_2 Removal unit removes carbon dioxide from the gas exiting the shift/methanation primary reactors (Plant Section 500). The removal of the carbon dioxide increases the gross heating value of the methanated gas from 404 to 880 Btu per standard cubic foot. The CO_2 free gas feeds the final methanator in Plant Section 500 which further upgrades the heating content of the SNG to pipeline quality standards.

The carbon dioxide is removed from the methanated gas via absorption into a circulating solution of hot potassium carbonate. A Benfield process is employed for CO_2 Removal.

A portion of the CO_2 product from Plant Section 600 is used to pressurize the lock hoppers of the gasifier in Plant Section 300; the balance is vented to the atmosphere (26 million SCFD).

8.0 PLANT SECTION 600 - CO_2 REMOVAL

Contract No. EF-77-C-01-2542 between Conoco Inc. and the U.S. Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas.

Work under the contract is to proceed in three phases:

Phase I - Demonstration Plant Engineering and Design
Phase II - Demonstration Plant Construction
Phase III- Demonstration Plant Operation

One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed.

The Demonstration Plant consists of the following plant sections:

Section		Name
100	-	Feedstock Preparation
200	-	Air Separation
300	-	Gasification
400	-	Rectisol
500	-	Shift/Methanation
600	-	CO_2 Removal
800	-	Product Gas Compression and Drying
900	-	Sulfur Recovery
1000	-	Slag Handling
1100	-	Gas Liquor Separation
1200	-	Phenol Extraction
1300	-	Ammonia Recovery
2000	-	Water Treatment and Steam Plant
2400	-	Cooling Water
2500	-	Plant and Instrument Air
2700	-	Waste Water Treatment
3000	-	Flare
3200	-	Miscellaneous Offsites and Tank Farm
3300	-	County Road
4000	-	Electrical and Communications
4100	-	Buildings

A report of the design effort of the Demonstration Plant is being issued in 24 volumes. This is Volume 8 which reports the design of Plant Section 600 - CO_2 Removal.

This report contains the following information on Plant Section 600:

a. Process Operation
b. Design Basis
c. Heat and Material Balance
d. Stream Compositions
e. Utility, Chemical, and Catalyst Summary
f. Major Equipment and Machinery List
g. Process Flow Diagram
h. Section Plot Plan

8.1 Process Operation

The CO_2 Removal unit is designed to remove carbon dioxide from synthesis gas. Product gas from the primary methanation loop of Section 500 - Shift/Methanation is scrubbed in a packed tower with a hot potassium carbonate solution and water. CO_2 absorption is aided by the aqueous phase reaction:

$$K_2CO_3 + CO_2 + H_2O = 2KHCO_3$$

The low CO_2 and water content of the product gas enables production of a pipeline quality gas in the final methanator of Section 500.

Regeneration of potassium carbonate is achieved by pressure letdown and by steam stripping. A portion of the carbon dioxide released during regeneration is compressed and supplied for use in Section 300 - Gasification, Section 500 - Shift/Methanation, and Section 1300 - Ammonia Recovery.

CO_2 Removal from Synthesis Gas

Raw product gas from shift/methanation is cooled by reboiling lean carbonate solution in carbonate reboiler, E-1601. Condensate from the process gas stream is collected in process condensate receiver, D-1601, for use in Section 500, as well as Section 600.

The gas stream exiting D-1601 enters CO_2 absorber, T-1601, where it is scrubbed with a potassium carbonate solution by counter-current flow over packing. The top section of T-1601 contains bubble cap trays which allow the gas to be washed with condensate. The wash water removes any entrained potassium carbonate and further cools the gas.

Synthesis gas from T-1601 passes through absorber overhead knockout drum, D-1609, to remove any liquid before returning to Section 500.

Carbonate Solution Circulation and CO_2 Compression

Carbonate solution flows from T-1601 on level control. The solution is rich in CO_2 and other gases. This liquid is flashed in rich solution flash drum, D-1602. The gas passes through the recycle compressor knockout drum, D-1612, is compressed in recycle compressor, C-1602, and returned to the gas stream entering T-1601.

Carbonate solution flows from D-1602 to the top section of regenerator, T-1602. Here the solution is flashed at an intermediate pressure to recover CO_2. The wet gas from this flash is cooled in H.P. CO_2 cooler, E-1604, to remove some of the water. H.P. condensate receiver, D-1604, and CO_2 compressor suction K.O. drum, D-1610, separate the water from this CO_2 stream, and provide protection for CO_2 compressor, C-1603.

The CO_2 compressor is a two-stage reciprocating compressor used to pressurize CO_2 for use in other plant sections. Interstage cooling is provided by CO_2 intercooler, E-1605, in conjunction with intercooler separator, D-1606.

CO_2 leaving the second stage is cooled in CO_2 exchanger, E-1607, and CO_2 aftercooler, E-1606. Condensate is removed in CO_2 aftercooler separator, D-1607. The gas stream from D-1607 provides spill-back to C-1603 suction on pressure control, as well as supplying downstream users. The gas leaving this section is heated in the shell side of E-1607 by the hot compressor discharge.

Carbonate solution flows from the upper section of T-1602 and is flashed at lower pressure in the bottom section. The solution flows down the column counter-current to stripping steam.

Wet CO_2 liberated in the bottom section is cooled in L.P. CO_2 cooler, E-1603, and vented to the atmosphere from L.P. CO_2 condensate receiver, D-1605. Condensate from the CO_2 stream is combined with condensate from D-1604. The water is pumped from D-1605 by absorber wash pump, P-1603, to the wash trays in T-1601 and to D-1602.

The solution leaving the bottom of T-1602 enters carbonate reboiler, E-1601. Steam produced is returned to T-1602.

Carbonate solution is pumped back to the CO_2 absorber by lean solution pump, P-1601A. Pump drive is by power recovery turbine, RT-1601, and an electric motor on a common drive shaft. Carbonate solution from T-1601 to D-1602 can be let down through RT-1601 to reduce the load on the electric motor.

A slip stream is removed from the carbonate solution pumped to T-1601 for filtration in carbonate solution filter, F-1601.

Solution Preparation and Storage

The carbonate loop make-up and storage capacity is supplied by carbonate solution storage tank, TK-1601, and carbonate solution sump, TK-1602. Fluid transfer is by carbonate transfer pump, P-1604, and carbonate sump pump, P-1605. So-

lution is prepared by mixing dry potassium carbonate with water in TK-1602 using carbonate mixer, M-1601.

Antifoam injection package, A-1601, is used to maintain carbonate solution fluid properties. This package includes an antifoam storage tank and an injection pump. Injection points are in the carbonate solution circulation loop.

Start-up Procedure

The detailed start-up procedure of the various equipment items (pumps, compressors, etc.) is subject to the operating instructions issued by the manufacturer. The following start-up sequence is utilized.

Potassium carbonate solution is prepared in sump, TK-1602, by mixing with water. This solution is pumped into the circulating system and T-1602 and E-1601 are filled to the appropriate levels. Cooling water circulation in the heat exchangers and air circulation in E-1603 are started. The carbonate solution is heated to just below boiling using the steam coils in E-1601.

CO_2 absorber, T-1601, is pressurized with nitrogen, and carbonate solution circulation through the absorber is started at 50 percent of the normal flow rate.

Gas from the shift/methanation primary methanation loop is fed to the system. Condensate from the CO_2 streams is collected in D-1605 and after a sufficient quantity is available, pump P-1603 is started. Compressors C-1602 and C-1603 are started and after stable operation is obtained, the carbonate solution flow rate is increased to the normal rate.

Shutdown Procedure

Compressors C-1602 and C-1603 are isolated and shut down. Gas feed to the absorber is slowly reduced and simultaneously the carbonate circulation rate is reduced. Gas input is reduced to zero, but carbonate circulation is held at 65 percent of normal flow.

Steam input to carbonate reboiler, E-1601, is continued until most of the CO_2 has been removed.

After temperature in the regenerator falls below 210^{o}F, the cooling water to the heat exchangers and fans in the air cooler are shut off. Condensate pump, P-1603, and carbonate circulation pump, P-1601, are shut down.

Condensate and carbonate solution are drained from the system. Carbonate solution drained to the sump, TK-1602, is pumped to the storage tank, TK-1601.

8.2 Design Basis for Plant Section 600

Capacity of the Unit

The CO_2 removal unit is designed to remove 119,582 lb/hr of CO_2 from 2,270.1 lb mol/hr (dry, CO_2 free basis) of feed gas from shift/methanation. The carbon dioxide content of treated gas leaving the unit is 1.82 percent (dry basis).

Carbon dioxide required by the gasifiers is supplied at an average rate of 11,873 lb/hr. Low pressure nitrogen is available to supplement the CO_2 to C-1603 if demand requires it.

Flexibility

The CO_2 removal unit can be operated at flows as low as 30 percent of design.

8.3 Heat And Material Balance For Plant Section 600

INPUT	RATE LB/HR	TEMP °F	HEAT OF COMBUSTION MMBTU/HR	SENSIBLE + LATENT HEAT MMBTU/HR	TOTAL HEAT MMBTU/HR
Raw Product Gas From Section 500	197,563	324	771.03	61.69	832.72
Low Pressure Steam To Carbonate Reboiler E-1601	-	-	-	29.70	29.70
Electric Power As Heat	-	-	-	4.13	4.13
TOTAL INPUT	197,563		771.03	95.52	866.55
OUTPUT					
Final Methanator Feed To Section 500	36,097	169	769.84	3.11	772.95
CO_2 To Section 300	11,783	212	-	0.35	0.35
CO_2 To Section 1200	336	105	-	0.00	0.00
L.P. CO_2 To Vent	115,631	134	1.19	10.57	11.76
Process Condensate To Section 500	33,643	230	-	5.73	5.73
Process Condensate To Oily Water Sewer	73	115	-	0.00	0.00
C.W. Duty	-	-	-	3.64	3.64
Air Duty	-	-	-	72.12	72.12
TOTAL OUTPUT	197,563		771.03	95.52	866.55

8.4 Stream Composition For Plant Section 600

STREAM NUMBER:		(1505) 1600			(1501) 1601		
STREAM NAME:		Raw Product Gas From Shift/Methanation			Final Methanator Feed To Shift/Methanation		
COMPONENT	MOL WT	LB-MOL/HR	MOL%	LB/HR	LB-MOL/HR	MOL%	LB/HR
Hydrogen	2.016	281.1	5.59	567	280.5	12.15	566
Carbon Monoxide	28.011	37.7	0.75	1,056	37.7	1.63	1,056
Carbon Dioxide	44.011	2,759.0	54.86	121,426	41.9	1.82	1,844
Methane	16.043	1,909.7	37.97	30,637	1,906.8	82.60	30,591
Nitrogen	28.014	41.6	0.83	1,165	41.6	1.80	1,165
TOTAL DRY GAS		5,029.1	100.00	154,851	2,308.5	100.00	35,222
Water	18.016	2,370.8	-	42,712	48.6	-	875
TOTAL WET GAS		7,399.9	-	197,563	2,357.1	-	36,097
Other Components		-	-	0	-	-	0
TOTAL STREAM				197,563			36,097

8.4 Stream Composition For Plant Section 600 (Continued)

STREAM NUMBER:		(308) 1602			(1202) 1603		
STREAM NAME:		CO_2 To Gasification			CO_2 To Phenol Extraction		
COMPONENT	MOL WT	LB-MOL/HR	MOL%	LB/HR	LB-MOL/HR	MOL%	LB/HR
Hydrogen	2.016	- -	TRACE	TRACE	-	TRACE	TRACE
Carbon Monoxide	28.011	- -	TRACE	TRACE	-	TRACE	TRACE
Carbon Dioxide	44.011	267.6	100.0	11,783	7.6	100.0	336
Methane	16.043	- -	TRACE	TRACE	-	TRACE	TRACE
Nitrogen	28.014	- -	TRACE	TRACE	-	-	-
TOTAL DRY GAS		267.6	100.0	11,783	7.6	100.0	336
Water		-	-	-	-	- -	- -
TOTAL WET GAS		267.6		11,783	7.6		336
Other Components		-		0	-		0
TOTAL STREAM				11,783			336

8.4 Stream Composition For Plant Section 600 (Continued)

STREAM NUMBER:		1604			(1504) 1605		
STREAM NAME:		L. P. CO_2 Vent			Process Condensate To Shift/Methanation		
COMPONENT	MOL WT	LB-MOL/HR	MOL%	LB/HR	LB-MOL/HR	MOL%	LB/HR
Hydrogen	2.016	0.6	.02	1	-	-	-
Carbon Monoxide	28.011	-	TRACE	TRACE	-	-	-
Carbon Dioxide	44.011	2,441.9	99.86	107,463	-	-	-
Methane	16.043	2.9	0.12	46	-	-	-
Nitrogen	28.014	-	TRACE	TRACE	-	-	-
TOTAL DRY GAS		2,445.4	100.0	107,510	-	-	0
Water	18.016	450.8	-	8121	1867.4	-	33,463
TOTAL WET GAS		2,896.2		115,631			
Other Components				0	-		0
TOTAL STREAM				115,631			33,643

8.4 Stream Composition For Plant Section 600 (Continued)

STREAM NUMBER: 1606
STREAM NAME: Condensate To Oily Water Sewer

COMPONENT	MOL WT	LB-MOL/HR	MOL%	LB/HR
Hydrogen	2.016	-	-	-
Carbon Monoxide	28.011	-	-	-
Carbon Dioxide	44.011	-	-	-
Methane	16.043	-	-	-
Nitrogen	28.014	-	-	-
TOTAL DRY GAS		-	-	-
Water	18.016	4.0		73
TOTAL WET GAS				
Other Components		-		0
TOTAL STREAM				73

8.5 Utility, Catalyst and Chemical Summary For Plant Section 600

Utility Consumption	Battery Limit Conditions	Units	Normal Demand
Electrical Power		KW	2390
Steam			
Low Pressure	40 psig, 310°F	MLB/HR	31.826
Cooling Water	60 psig, 85°F	GPM	335
Air			
Instrument	100 psig, 100°F	SCFM	35
Additives	—	LB/HR	10.43
Utility Production			
Condensate			
Low Pressure	30 psig, 287°F	MLB/HR	31.826
Cooling Water	35 psig, 107°F	GPM	335

8.6 Major Equipment and Machinery List

FORM NO. 135-904

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION	CONTRACT: 15-1910	EQUIPMENT LIST	NAME OF UNIT	PAGE 1 OF 2
	SECTION: 600		CO_2 REMOVAL	

CLIENT: CONOCO/DOE
LOCATION: NOBLE COUNTY, OHIO

	REVISION	ORIGINAL	1	2	3	4	5
	DATE	22 Apr.'80	8 May'80	11 July'80	22 July'80	17 Oct'80	26 Jan 81

CLASS	ITEM NO.	DESCRIPTION	EFD	REQ'N. NO.	P. O. NO.	REV
TOWERS	T-1601	CO_2 Absorber	002	1111A		
	T-1602	Regenerator	001	1112A		
	T-1601	CO_2 Absorber Trays	002	1111B/BA		
	T-1602	Regenerator Trays	001	1112B		
DRUMS	D-1601	Process Condensate Receiver	001	1131A		
	D-1602	Rich Solution Flash Drum	002	1131B		
	D-1604	H.P. CO_2 Condensate Receiver	002	1131D		
	D-1605	L.P. CO_2 Condensate Receiver	002	1131E		
	D-1606A/B	CO_2 Intercooler Separator	003	1131F		
	D-1607	CO_2 Aftercooler Separator	003	1131G		
	D-1609	Absorber Overhead Drum	002	1131H		
	D-1610	CO_2 Compressor Suction K.O. Drum	003	1131J		
	D-1611	Stm Comp Knockout Drum	001	1131K		
	D-1612	Recycle Comp K.O. Drum	002	1131L		
TANKS	TK-1601	Carbonate Solution Storage Tank	004	2142A		
	TK-1602	Carbonate Solution Sump	004	—		
EXCHANGERS	E-1601A/B	Carbonate Reboiler	001	1211A		
	E-1603	L.P. CO_2 Cooler	001	1231A		
	E-1604	H.P. CO_2 Cooler	001	1211C		
	E-1605A/B	CO_2 Intercooler	003	1221A		
	E-1606	CO_2 Aftercooler	003	1221B		
	E-1607	CO_2 Exchanger	003	1211D		

DWG. 1910-5-43-06001

Note: REQUISITION NUMBERS SHOWN ABOVE ARE PRECEDED BY 06-1910

FORM NO. 135-904

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION	CONTRACT: 15-1910 SECTION: 600	EQUIPMENT LIST	NAME OF UNIT: CO_2 REMOVAL	PAGE 2 OF 2

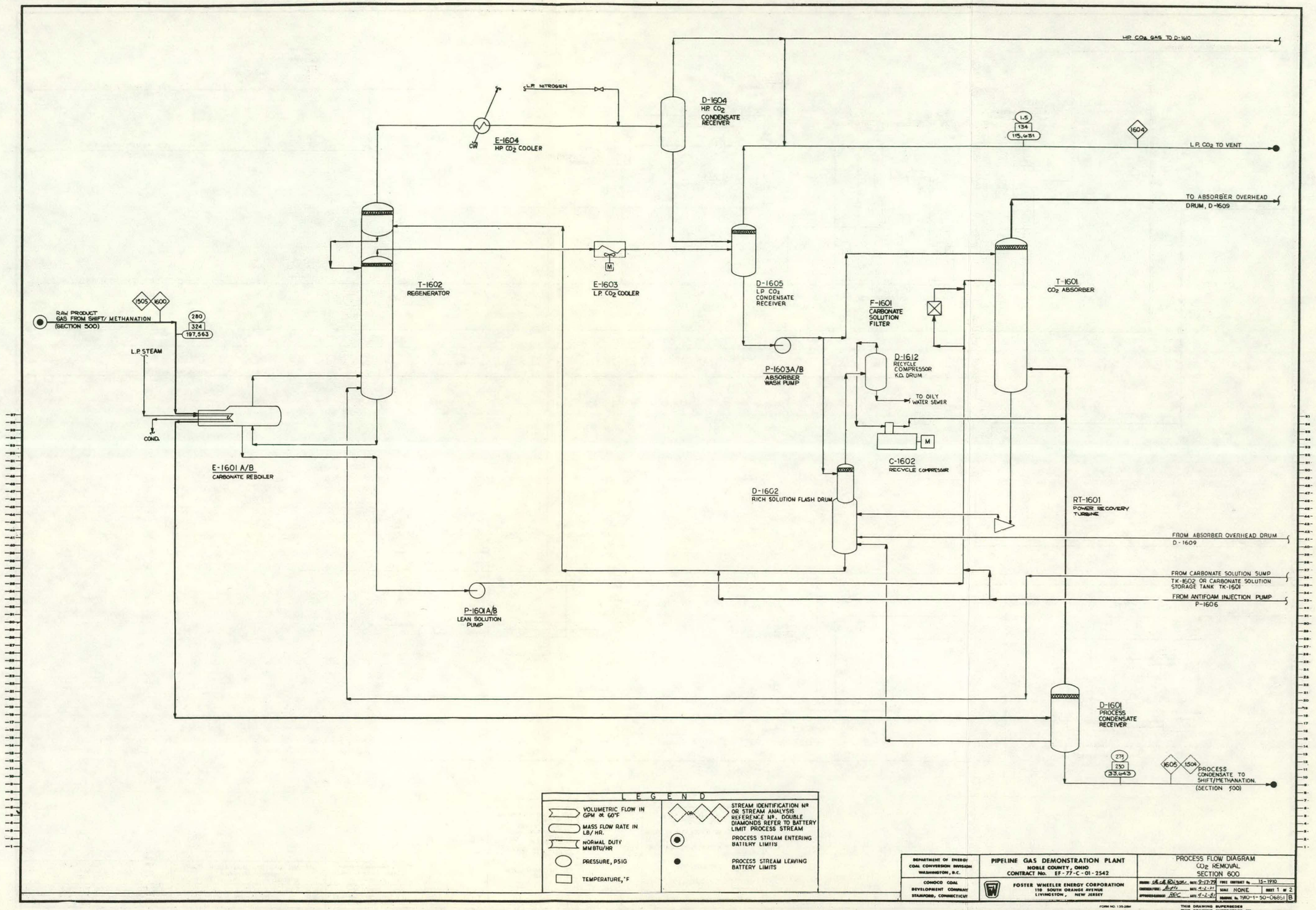
CLIENT: CONOCO/DOE			REVISION		ORIGINAL	1	2	3	4	5	
LOCATION: NOBLE COUNTY, OHIO			DATE		22 Apr '80	8 May '80	11 July '80	22 July '80	17 Oct '80	26 Jan 81	
CLASS	ITEM NO.	DESCRIPTION	EFD	REQ'N. NO.	P. O. NO.						REV.
PUMPS	P-1601A	Lean Solution Pump	001	1311A							
	P-1601B	Spare for P-1601A	001	1311A							
	P-1603A	Absorber Wash Pump	002	1311B							
	P-1603B	Spare for P-1603A	002	1311B							
	P-1604	Carbonate Transfer Pump	004	1311C							
	P-1605	Carbonate Sump Pump	004	1311D							
COMPRESSORS											
	C-1602	Recycle Compressor	002	1322A							
	C-1603A	CO_2 Compressor	003	1322B							
	C-1603B	Spare for C-1603A	003	1322B							
MISC.	F-1601	Carbonate Solution Filter	002	1593A							
	M-1601	Carbonate Mixer	004	1391A							
	RT-1601	Power Recovery Turbine (Drives P-1601A)	002	1389A							
	A-1601	Antifoam Injection Package	004	1919A							
MOTORS	CM-1602	Motor For C-1602	002	1381A							
	PM-1604	Motor For P-1604	004	1381A							
	EM-1603	Motors For E-1603	001	1381A		No. of Motors to be determined in Phase II					

Note: REQUISITION NUMBERS SHOWN ABOVE ARE PRECEDED BY 06-1910.

8.7 PROCESS FLOW DIAGRAM

The following Process Flow Diagrams are included in this section:

Drawing No.	Title
1910-1-50-06851	CO_2 Removal - Section 600
1910-1-50-06852	CO_2 Removal - Section 600


HP CO2 GAS TO D-1610
L.P. NITROGEN
E-1604
HP CO2 COOLER
CW
D-1604
HP CO2
CONDENSATE
RECEIVER
1.5
134
115,631
1604
L.P. CO2 TO VENT
TO ABSORBER OVERHEAD
DRUM, D-1609
T-1602
REGENERATOR
E-1603
L.P. CO2 COOLER
M
D-1605
LP CO2
CONDENSATE
RECEIVER
T-1601
CO2 ABSORBER
F-1601
CARBONATE
SOLUTION
FILTER
1505
1600
280
324
197,563
RAW PRODUCT
GAS FROM SHIFT/ METHANATION
(SECTION 500)
L.P. STEAM
COND.
E-1601 A/B
CARBONATE REBOILER
P-1603A/B
ABSORBER
WASH PUMP
D-1612
RECYCLE
COMPRESSOR
K.O. DRUM
TO OILY
WATER SEWER
M
C-1602
RECYCLE COMPRESSOR
D-1602
RICH SOLUTION FLASH DRUM
RT-1601
POWER RECOVERY
TURBINE
FROM ABSORBER OVERHEAD DRUM
D-1609
FROM CARBONATE SOLUTION SUMP
TK-1602 OR CARBONATE SOLUTION
STORAGE TANK TK-1501
FROM ANTIFOAM INJECTION PUMP
P-1606
P-1601A/B
LEAN SOLUTION
PUMP
D-1601
PROCESS
CONDENSATE
RECEIVER
271
230
33,643
1605
1504
PROCESS
CONDENSATE TO
SHIFT/METHANATION.
(SECTION 500)
LEGEND
VOLUMETRIC FLOW IN GPM @ 60°F
MASS FLOW RATE IN LB/HR.
NORMAL DUTY MMBTU/HR
PRESSURE, PSIG
TEMPERATURE, °F
STREAM IDENTIFICATION Nº OR STREAM ANALYSIS REFERENCE NR. DOUBLE DIAMONDS REFER TO BATTERY LIMIT PROCESS STREAM
PROCESS STREAM ENTERING BATTERY LIMITS
PROCESS STREAM LEAVING BATTERY LIMITS
DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.
CONOCO COAL
DEVELOPMENT COMPANY
STAMFORD, CONNECTICUT
PIPELINE GAS DEMONSTRATION PLANT
NOBLE COUNTY, OHIO
CONTRACT No. EF-77-C-01-2542
FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE
LIVINGSTON, NEW JERSEY
PROCESS FLOW DIAGRAM
CO2 REMOVAL
SECTION 600
DRAWN: DATE: 9-17-79
CHECKED/FWE: DATE: 9-21-81
APPROVED/DOE: DATE: 9-21-81
FWEC CONTRACT No. 15-1910
SCALE NONE
SHEET 1 of 2
DRAWING No. TRW-1-50-0685
B
THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

FROM CONDENSATE RECEIVER D-1604

FROM CO_2 ABSORBER T-1601

D-1610
CO_2 COMPRESSOR SUCTION KO DRUM

E-1605A/B
CO_2 INTERCOOLER

D-1606A/B
CO_2 INTERCOOLER SEPARATOR

E-1607
CO_2 EXCHANGER

E-1606
CO_2 AFTERCOOLER

D-1607
CO_2 AFTERCOOLER SEPARATOR

C-1603A/B
CO_2 COMPRESSOR

536 MIN.
643 MAX.
212
11,783
1602 308
CO_2 TO GASIFICATION SECTION 300

0
CO_2 TO SHIFT/METHANATION SECTION 500

0
115
73
1606
CONDENSATE TO OILY WATER SEWER

48
105
336
1603 1202
CO_2 TO PHENOL EXTRACTION (SECTION 1200)

269
169
36,097
1601 1501
FINAL METHANATOR FEED TO SHIFT / METHANATION (SECTION 500)

D-1609
ABSORBER OVERHEAD DRUM

TO D-1602

TO REGENERATOR, T-1602

TO T-1601 AND T-1602

A-1601
ANTIFOAM INJECTION PACKAGE

LIMITS OF A-1601

M-1601
CARBONATE MIXER

L.P. STEAM

CONDENSATE

P-1605
CARBONATE SUMP PUMP

TK-1602
CARBONATE SOLUTION SUMP

LP STEAM

COND.

TK-1601
CARBONATE SOLUTION STORAGE TANK

P-1604
CARBONATE TRANSFER PUMP

L E G E N D

- VOLUMETRIC FLOW IN GPM at 60°F
- MASS FLOW RATE IN LB/HR.
- NORMAL DUTY, MM BTU/HR.
- PRESSURE, PSIG
- TEMPERATURE, °F

STREAM IDENTIFICATION NO.
STREAM ANALYSIS REFERENCE NUMBER
DOUBLE DIAMONDS REFER TO BATTERY LIMIT PROCESS STREAM.

PROCESS STREAM ENTERING BATTERY LIMITS

PROCESS STREAM LEAVING BATTERY LIMITS

DEPARTMENT OF ENERGY COAL CONVERSION DIVISION WASHINGTON, D.C.	PIPELINE GAS DEMONSTRATION PLANT MORGAN COUNTY, OHIO CONTRACT No. EF-77-C-01-2542	PROCESS FLOW DIAGRAM CO_2 REMOVAL SECTION 600
CONOCO COAL DEVELOPMENT COMPANY STAMFORD, CONNECTICUT	FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVENUE LIVINGSTON, NEW JERSEY	DRAWN VC/BF DATE 10-18-79 FREE CONTRACT No. 15-1910 ENGINEERING [illegible] DATE 5-2-80 SCALE NONE SHEET 2 OF 2 APPROVED REC DATE 5-2-80 DRAWING No. 1910-1-50 0606 B

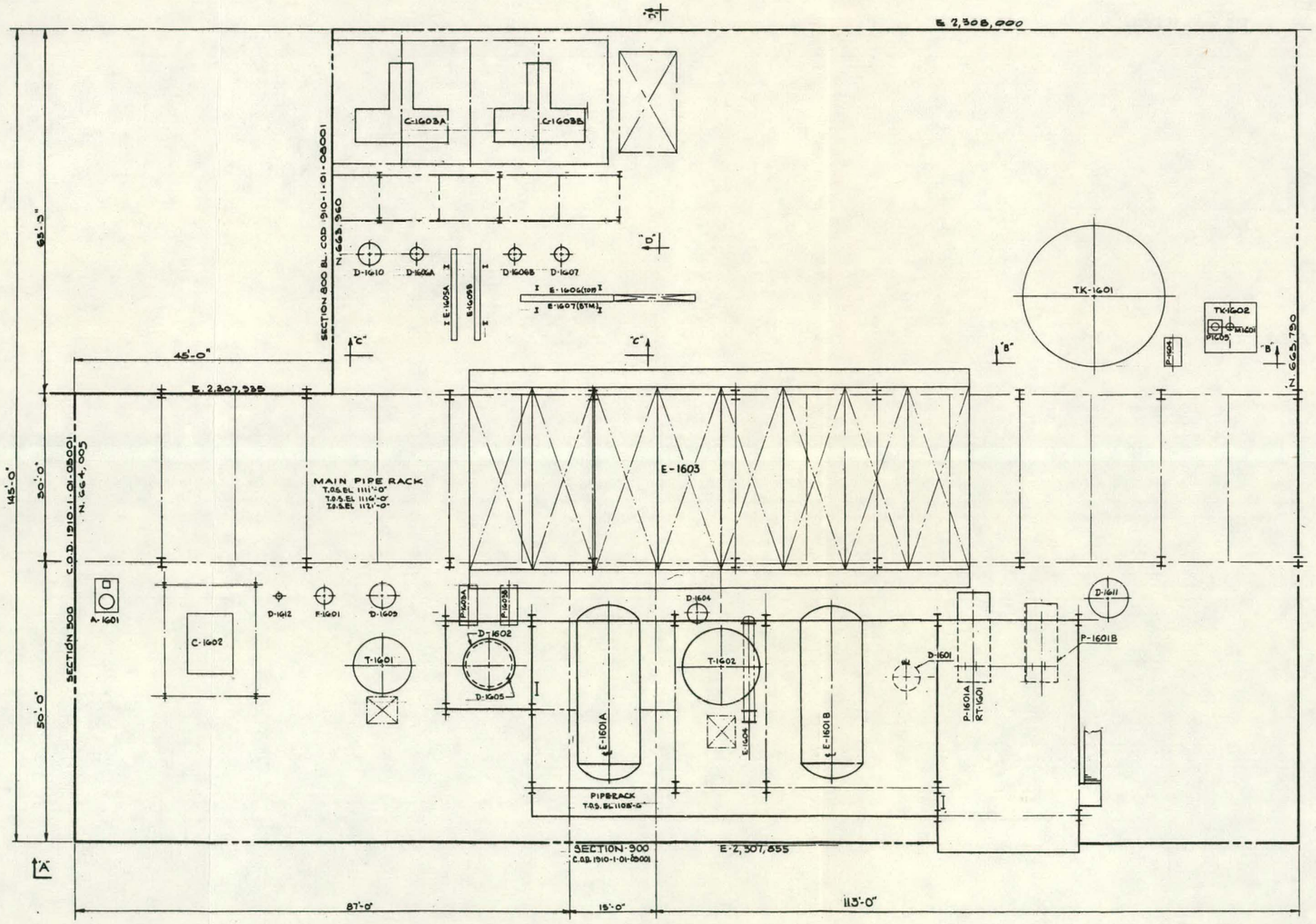
FORM NO. 130-28M

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

8.8 PLOT PLAN

The following Plot Plan Drawings are included in this section:

Drawing No.	Title
1910-1-01-06801	Plot Plan
1910-1-01-06802	Plot Plan - Elevation



GENERAL NOTES

GRADE ELEVATION 1090'-0" BASED ON ACTUAL ELEVATION ABOVE SEA LEVEL

REFERENCE DRAWINGS

KEY PLOT PLAN	1910-1-01-00001
ELEVATION	1910-1-01-06802
PLOT PLAN SECTION 900	1910-1-01-09001
PLOT PLAN SECTION 800	1910-1-01-08002
PLOT PLAN SECTION 500	1910-1-01-05001

PRELIMINARY PLOT PLAN
SUBJECT TO CHANGE IN PHASE II UPON SELECTION OF EQUIPMENT SUPPLIER

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

CONOCO COAL DEVELOPMENT COMPANY
STAMFORD, CONNECTICUT

PIPELINE GAS DEMONSTRATION PLANT
NOBLE COUNTY, OHIO
CONTRACT No. EF-77-C-01-2542

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE
LIVINGSTON, NEW JERSEY

PLOT PLAN
CO_2 REMOVAL
SECTION 900

DRWN LWK 2-19-80 PROJ ENGINEER M. 15-1910
DESIGNED JS 27 FEB 81 APPD 27 FEB 81 SCALE 1/8" = 1'-0" SHEET 1 OF 2
SUPERVISION REC FEB 27 81 DRAWING No. 1910-1-01-06501 A

A 27 FEB 81 CLASS III ISSUE

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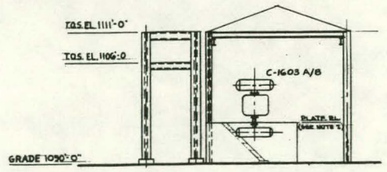
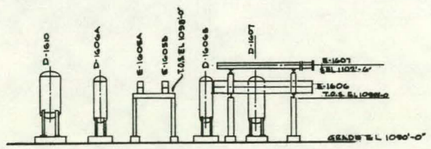
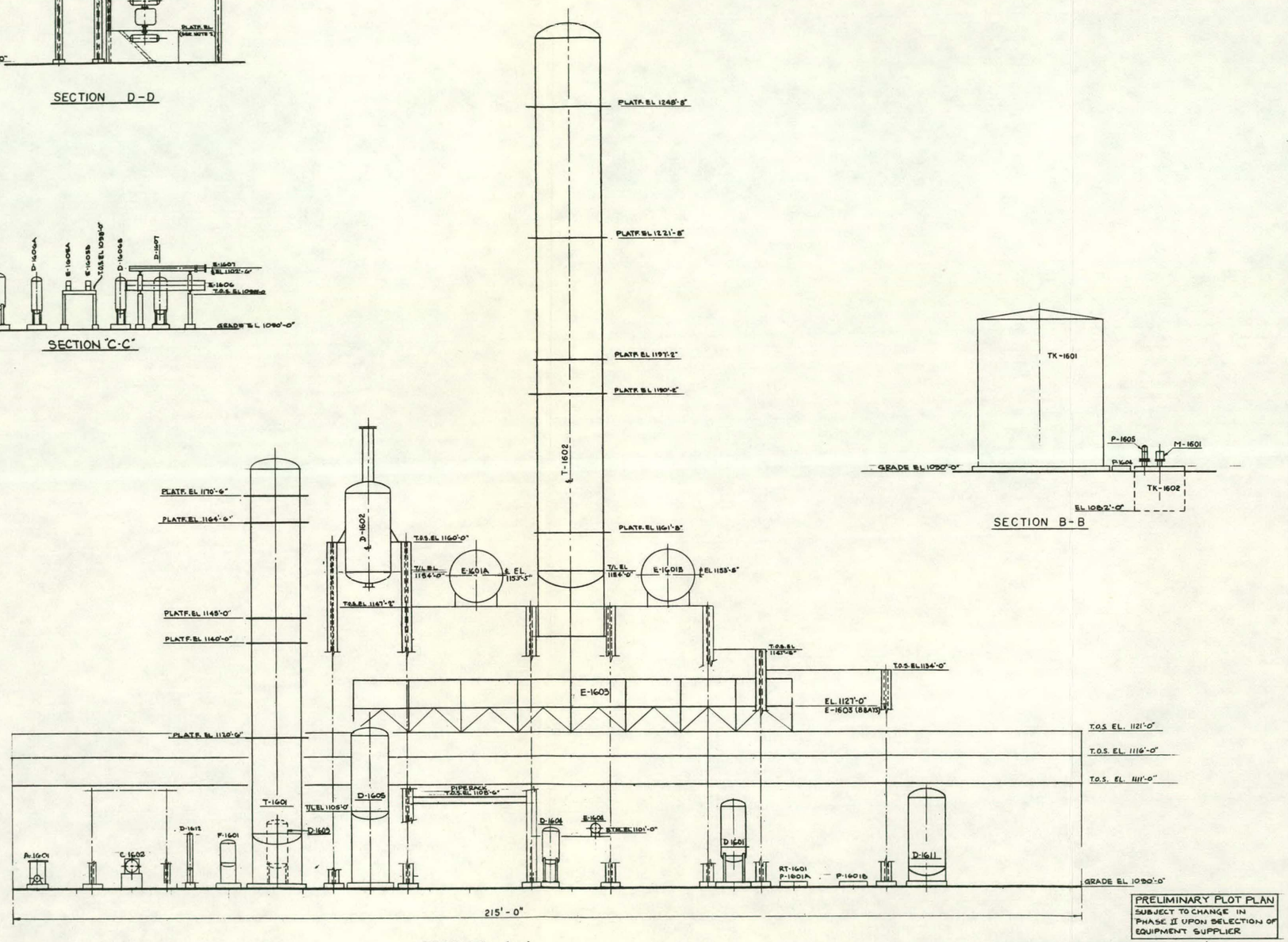


SECTION D-D



SECTION "C-C"



SECTION A-A

SECTION B-B

GENERAL NOTES

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE PLOT PLAN 1910-1-01-0680I
2. COMPRESSOR C-1603 A/B ELEVATIONS TO BE THE SAME AS COMPRESSORS IN SECTIONS 500 & 800. ELEVATIONS TO BE DETERMINED IN PHASE II

PRELIMINARY PLOT PLAN
SUBJECT TO CHANGE IN PHASE II UPON SELECTION OF EQUIPMENT SUPPLIER

DEPARTMENT OF ENERGY COAL LIQUEFACTION DIVISION WASHINGTON, D.C.	PIPELINE GAS DEMONSTRATION PLANT NOBLE COUNTY, OHIO CONTRACT NO. EF-77-C-01-2542	PLOT PLAN ELEVATION CO_2 REMOVAL SECTION 600
CONOCO COAL DEVELOPMENT COMPANY STAMFORD, CONNECTICUT	FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVENUE LIVINGSTON, NEW JERSEY	DRAWN L.S. DATE 10/26/80 · TREE DRAWING No. 15-1910 DESIGNED/CHECKED G.M.N. DATE 2/26/81 · SCALE 1/8" = 1'-0" · SHEET 2 of 2 APPROVED/RELEASED DRC DATE FEB 27-81 · DRAWING No. 1910-1-01-0680I A

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