

DOE/FE/05121--T4

The Design, Construction, and Operation
of a
Process-Development Unit
for the
High-Rate, Entrained-Flow Coal-Gasification Process

DOE/FE/05121--T4

DE83 001280

Quarterly Technical Progress Report No. 5

April - June 1982

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Prepared for
United States Department of Energy
under
Contract No. DE-AC01-81FE05121

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MASTER

Submitted by

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- A. Revised P&ID
- B. Equipment List

1.0 INTRODUCTION AND SUMMARY

1.1 Introduction

Mountain Fuel Resources, Inc., a subsidiary of Mountain Fuel Supply Company, Salt Lake City, Utah, is under contract with the U. S. Department of Energy for a program to design, construct and operate a high-rate, entrained flow coal gasification process development unit (PDU). The objective of the program is to develop equipment components for gasification of coal to form a clean, intermediate-Btu fuel gas or synthesis gas that may be converted to methyl alcohol, gasoline, synthetic natural gas or many other desirable products. Ford, Bacon & Davis Utah, Inc., is the principal subcontractor on the program, and will be largely responsible for design, construction and operation of the PDU.

The design of the coal gasification PDU is based on earlier DOE-supported work at the Eyring Research Institute, Provo, Utah. Pulverized coal is fed to an entrained flow reactor where it is gasified by reaction with steam and oxygen. The ash in the coal is removed as an inert slag and the product gas may be cleaned to remove sulfur-containing compounds and carbon dioxide to yield a clean fuel gas with a heating value near 300 Btu/standard cubic foot.

The PDU is to be located adjacent to a brick plant operated by Interstate Brick Company in West Jordan, Utah. Interstate Brick is also a subsidiary of Mountain Fuel Supply Company. Because of the developmental nature of the program, the PDU will contain only those components and features necessary to develop the gasifier and to operate it safely. The PDU will be operated intermittently, with test durations ranging from a few hours up to a maximum of four weeks. During later tests, the gas will be used in firing the brick kilns in the brick plant.

A low-sulfur, Utah bituminous coal will be used for most of the testing. Near the end of the planned effort, several tests up to 100 hours each will be made with alternate coals: a high-sulfur bituminous coal, a low-sulfur subbituminous coal, a lignite, and a coal char or residue.

1.2 Summary

Detailed design was essentially completed during this reporting period. Fabrication of 2-inch and larger diameter piping was completed. Fabrication of structural steel was completed and the erection was completed with the exception of the process tower fifth floor, the roof and sidings. The syngas cooler and steam superheater internal and shell fabrication was started. Drafts of the Operating Procedure and the Hazard Analysis Report were prepared. The general mechanical subcontract was awarded in May and unloading, receiving, and placement of the mechanical equipment was continued throughout this period. The electrical subcontract was awarded and the work started in June. As of the end of June, the overall field construction was about 75 percent complete. Figures 1 and 2 show the PDU and the site as of the end of this period.



Figure 1. Process Tower, Coal Preparation Area, Service/Shop Building, and Control Room.

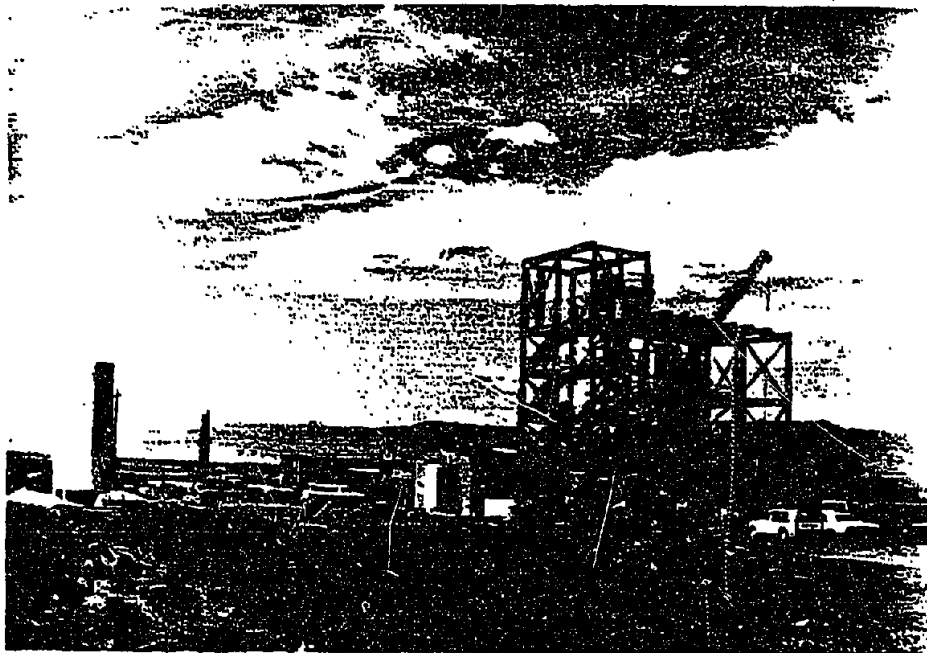


Figure 2. PDU Site as of the End of June 1982.

2.0 ENGINEERING AND DESIGN

2.1 Reactor Design

Detailed design of the reactor was completed during this period. The maximum diameter of the reaction chamber is 16 inches and the overall length is 30 inches. The reaction chamber volume is 2.30 cubic feet.

A coal injection nozzle, oxygen-steam mixture injection nozzles, a sight port, and an ignition port are all located in the injector head at the top of the reaction chamber. The head will be bolted to the top of a 30-inch blind flange which will be bolted to a 48-inch blind flange of the reactor/radiant cooler vessel.

The reaction chamber is lined with 3 inches of dense refractory backed up by 2 1/8 inches of insulating refractory. The whole assembly is supported by a water cooled 27 1/4-inch diameter cylinder which will be bolted to the bottom of a 30-inch blind flange. The bottom section of the injector head will slide into the top opening of the gasifier. One thermocouple will be imbedded in the refractory to measure the refractory temperature and three will penetrate through the refractory to measure the exit gas temperature.

2.2 High Temperature Heat Exchanger Design

Detailed design of the radiant syngas cooler, steam superheater and transition pipe by Deutsche Babcock was completed. After review by MFR and FB&DU in May revisions were made and fabrication of the internals was started in the later part of the month.

2.3 Revised Process and Instrument Drawings

The process and instrument drawings were revised and issued for electrical and mechanical subcontracts. Copies of the revised P&ID drawings are attached (see Attachment A).

P

3.0 PROCUREMENT OF MAJOR EQUIPMENT

As of the end of this quarter, purchase orders have been issued for all major equipment. The attached equipment list (see Attachment B) shows the equipment procurement status. The radiant heat exchanger and steam superheater were being fabricated and are expected to be shipped to the site during August. Purchase orders were issued also for essentially all the valves and control instruments.

P

4.0 FIELD CONSTRUCTION

4.1 Pipe Fabrication

Fabrication of the 2-inch and larger diameter pipe was completed. Fabrication of the double wall transfer pipe between the radiant syngas cooler and steam superheater, and the superheater and the scrubber was completed except attaching the end flanges. These flanges will be attached after the syngas cooler, 2E-1, and steam superheater, 2E-3, vessels are put in place.

4.2 Structure

The structural steel was fabricated. Erection of the structure was started in May and was completed except for the fifth floor of the process tower, the roof and the sidings.

4.3 Other Field Construction

All equipment in the service shop building was installed and the piping inside this building was completed. The tie-in for the sewer was made, and the major part of the water supply system and fire hydrants were also placed underground. The electrical subcontract was awarded and the work started in June.

5.0 OPEN ISSUES

5.1 Plant Visit

An instrument engineer from FB&DU visited the Synthoil Pilot Plant on April 6 to check available equipment and instruments to be shipped to the PDU.

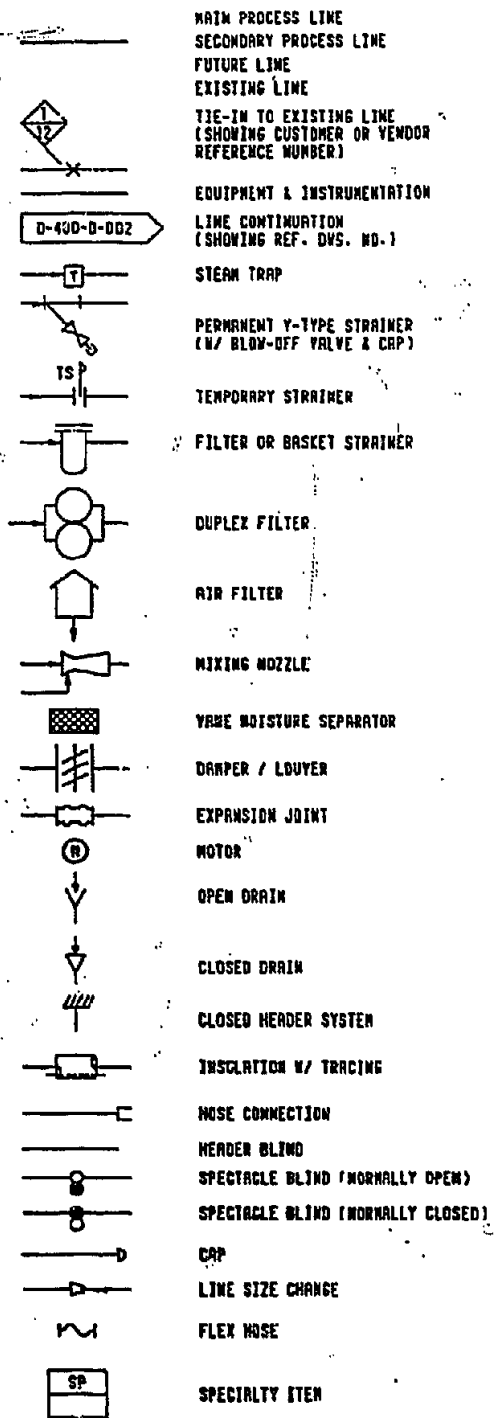
5.2 Meetings

- . Charles Baetens (Frumerman Associates, Inc.) visited MFR and FB&DU on May 18, 19 and 20 to review the design status, especially the steam superheater design and assembly.
- . J. Taylor, J. Kennedy, and J. Linn (Sandia National Laboratory) and W. Reed (Oak Ridge National Laboratory) met at MFR with R. Coates and C. Chen (MFR) on June 4 to review and discuss the PDU Hazard Analysis conducted by Sandia.
- . Project status review meetings were held on June 28 and 29 at MFR and FB&DU, attended by H. D. Shoemaker (DOE, Project Manager), R. Frumerman (Frumerman Associates, Inc.), R. L. Coates and C. L. Chen (MFR), L. Valentine and S. T. Shary (FB&DU). The meeting concluded with a visit to the PDU site.
- . The FB&DU Project Manager visited Deutsche Babcock the week of June 7 to review the design drawings, coordinate the delivery, and inspect the fabrication of the syngas cooler and steam superheater internals.

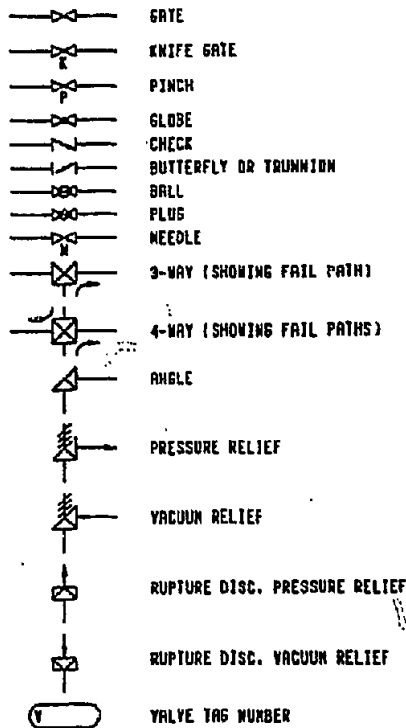
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ATTACHMENT A

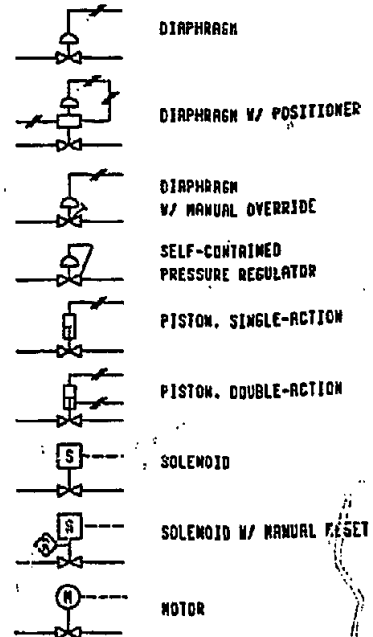
MISC. PIPING SYMBOLS



VALVES



ACTUATORS



ABBREVIATIONS

AS	20" AIR SUPPLY	SD	SHUTDOWN
CSC	CAR SEAL CLOSED	S/F	SEAM TO FLANGE
CSO	CAR SEAL OPEN	SP	SAMPLE POINT
DFR	DESIGN FLOW RATE	SS	SELECTOR SWITCH
ESD	EMERGENCY SHUTDOWN	S/S	SEAM-TO-SEAM
"F"	FURN. BY EQUIPMENT VENDOR	TDM	TOTAL DIFFERENTIAL HEAD
FC	FAIL CLOSED		
FI	FAIL INDETERMINATE		
FL	FAIL LOCKED		
FM	FROM		
FO	FAIL OPEN		
GPM	GALLONS PER MINUTE		
HDR	HEADER		
HDA	HAND-OFF-AUTOMATIC		
IP	INJECTION POINT		
I/P	ELECTRIC TO PNEUMATIC SIGNAL		
LC	LOCK CLOSED		
LO	LOCK OUT		
NC	NORMALLY CLOSED		
NO	NORMALLY OPEN		
PB	PUSH BUTTON		
RED	REDUCER		

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EXAMPL

REVISIONS

NO.	DESCRIPTION	DATE	BY	CHK'D.	APP'D.	NO.
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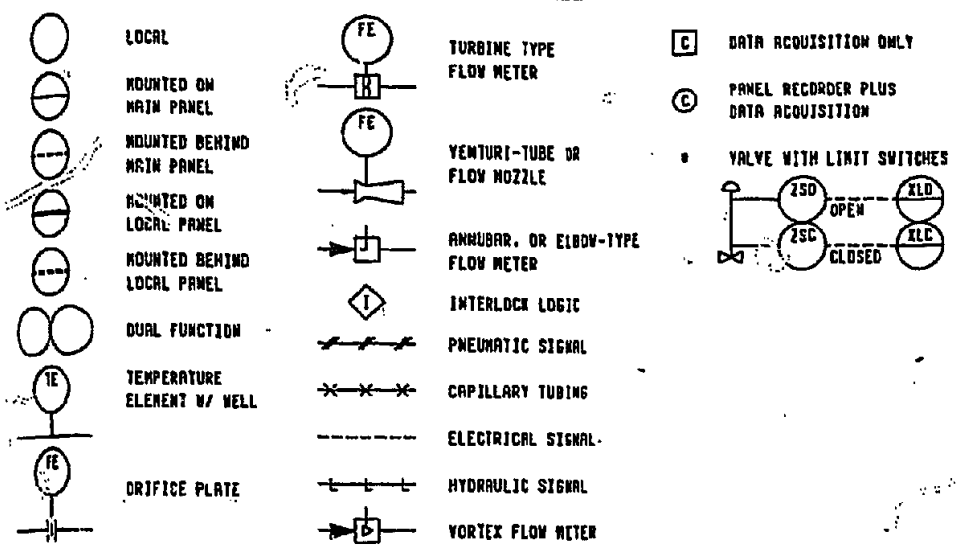
REVISIONS

NO.	DESCRIPTION	DATE	BY	CHK'D.	APP'D.	NO.

REFERENCE DRAWINGS

DRAWING NO.	TITLE

INSTRUMENTATION



LINE IDENTIFICATION

XX"-XXX-XXI-XXX-1"-XXX
(1) (2) (3) (4) (5) (6)

- NOMINAL LINE SIZE IN INCHES.
- SERVICE/COMMODITY DESIGNATION (SEE BELOW).
- LINE SPECIFICATION (SEE BELOW).
- LINE NUMBER
- INSULATION THICKNESS IN INCHES.
- SPECIAL INSULATION REQUIREMENTS:
PP = PERSONNEL PROTECTION
ST = STEAM TRACING
ET = ELECTRICAL TRACING
GW = GLYCOL / WATER TRACING
STC = STEAM TRACING PLUS HEAT TRANSFER CEMENT

EXAMPLE:

INSTRUMENT IDENTIFICATION

FIRST LETTER		SUCCEEDING LETTERS		
MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
ANALYSIS		ALARM	USER'S CHOICE	USER CHOICE
BURNER FLAME		USER'S CHOICE	USER'S CHOICE	USER CHOICE
CONDUCTIVITY (ELECTRICAL)			CONTROL	
DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
VOLTAGE (EMF)	RATIO (FRACTION)	PRIMARY ELEMENT		
FLOW RATE		CLASS		HIGH
AGING (DIMENSIONAL)		INDICATE		
HAND (MANUALLY INITIATED)	SCAN		CONTROL STATION	
CURRENT (ELECT.)				LOW MIDDLE OR INTERMEDIATE
POWER				USER'S CHOICE
LINE OR TIME-SCHEDULE				
LEVEL				
MOISTURE OR HUMIDITY				
USER'S CHOICE				
USER'S CHOICE				
PRESSURE OR VACUUM	INTEGRATE OR TOTALIZE			
QUANTITY OR EVENT	RESTRICTING SAFETY	RECORD OR PRINT	RELIEF SWITCH	REGULATING SOLENOID
RADIOACTIVITY			TRANSMIT	
SPEED OR FREQUENCY			MULTIFUNCTION	MULTIFUNCTION
TEMPERATURE			VALVE, DAMPER OR LOUVER	
MULTIVARIABLE				
VISCOSITY				
WEIGHT OR FORCE		WELL		
UNCLASSIFIED		UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
USER'S CHOICE			RELAY OR COMPUTE DRIVE, ACTUATE OR UNCLASSIFIED	
POSITION			FINAL CONTROL ELEMENT	

PIPING SPECIFICATIONS

- 1CA 150# ANSI CLASS. CARBON STEEL MAT'L. SCREWED. BUTT WELDED AND FLANGED. FOR WATER SERVICE.
- 1CB 150# ANSI CLASS. CARBON STEEL MAT'L. SOCKET WELD. BUTT WELD AND FLANGED. FOR FLAMMABLE GASES, STEAM, CONDENSATES, AND HYDROCARBON LIQUIDS.
- 1CC 150# ANSI CLASS. CARBON STEEL AND COPPER TUBING. SCREWED. BUTT WELDED AND FLANGED. FOR AIR AND INERT GASES.
- 1PE 150# ANSI CLASS. PLASTIC AND PLASTIC LINED PIPE. GLUED AND FLANGED. FOR CORROSIVE LIQUID SERVICE.
- 3CB 300# ANSI CLASS. CARBON STEEL MAT'L. SOCKET WELD. BUTT WELD AND FLANGED. FOR FLAMMABLE GASES, STEAM CONDENSATE, AND HYDROCARBON LIQUIDS.
- 3SB 300# ANSI CLASS. STAINLESS STEEL MAT'L. SOCKET WELD. BUTT WELD AND FLANGED. FOR OXYGEN GAS, CRYOGENIC LIQUIDS.

SERVICE / COMMODITY DESIGNATIONS

- AWB ASH WATER SLURRY
- BFW BOILER FEEDWATER
- BFWC BOILER FEEDWATER CHEMICALS
- C COAL
- CON STEAM CONDENSATE
- CW COOLING WATER
- CWC COOLING WATER CHEMICALS
- IA INSTRUMENT AIR
- N NITROGEN
- NG NATURAL GAS
- O OXYGEN
- OW OILY WATER
- PA PLANT AIR
- PG PRODUCT GAS
- PW POTABLE WATER
- RG RECYCLE GAS
- RW PROCESS WATER
- SN STEAM MEDIUM PRESSURE
- WV WASTE WATER



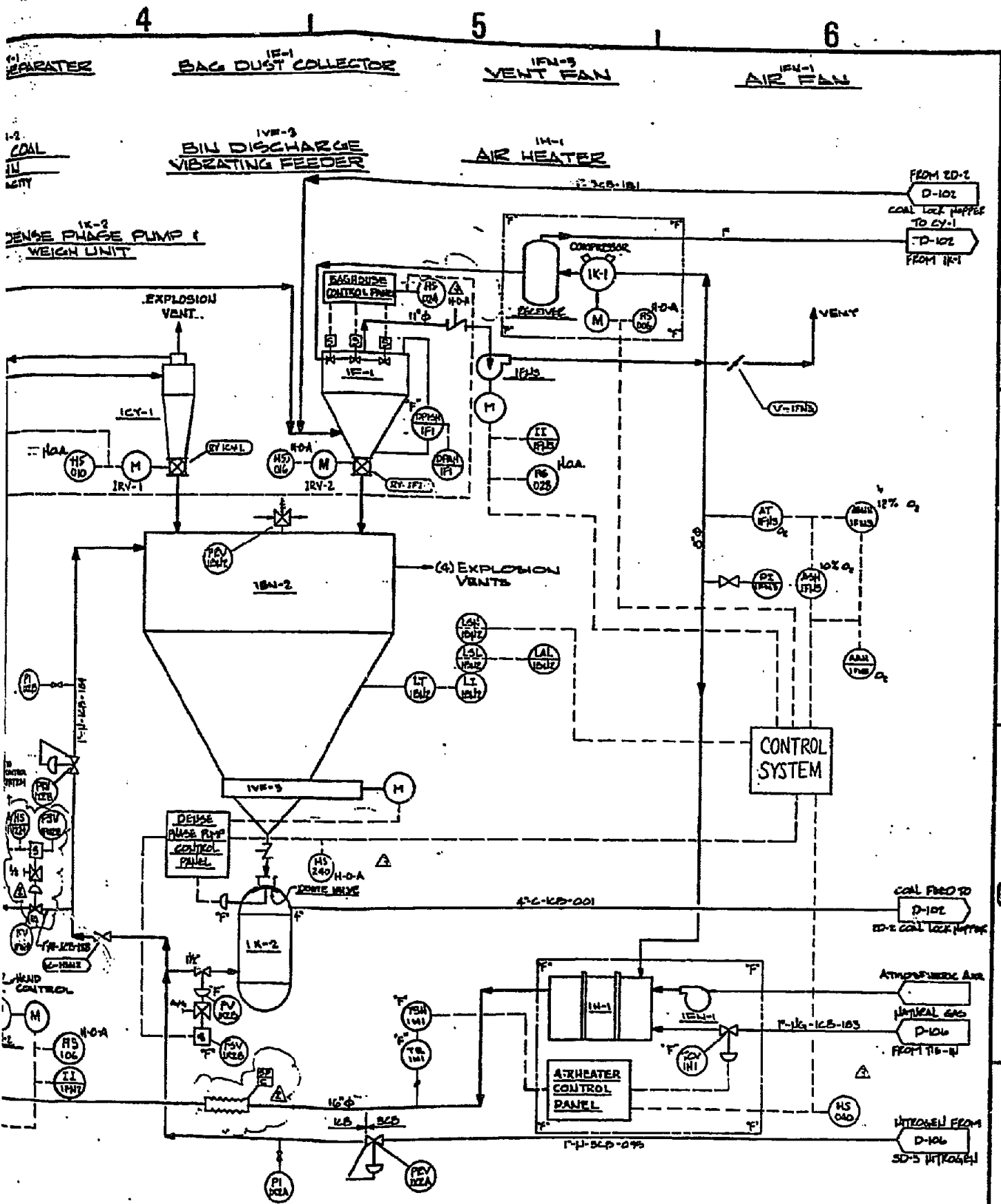
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8/1/82	4	D	Instrumentation	Construction			WCS	8/1/82
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Ford, Bacon & Davis Utah Inc.
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

TITLE: **PIPING & INSTRUMENT DIAGRAM
ENTRAINED-BED COAL GASIFICATION
PILOT PLANT - LEGEND AND SYMBOLS**

FOR MOUNTAIN FUEL RESOURCES

SCALE: JOB NO. FB&DU DWG. NO. UC-389 0-869-D-100 OWNERS DWG. NO. REV. 0



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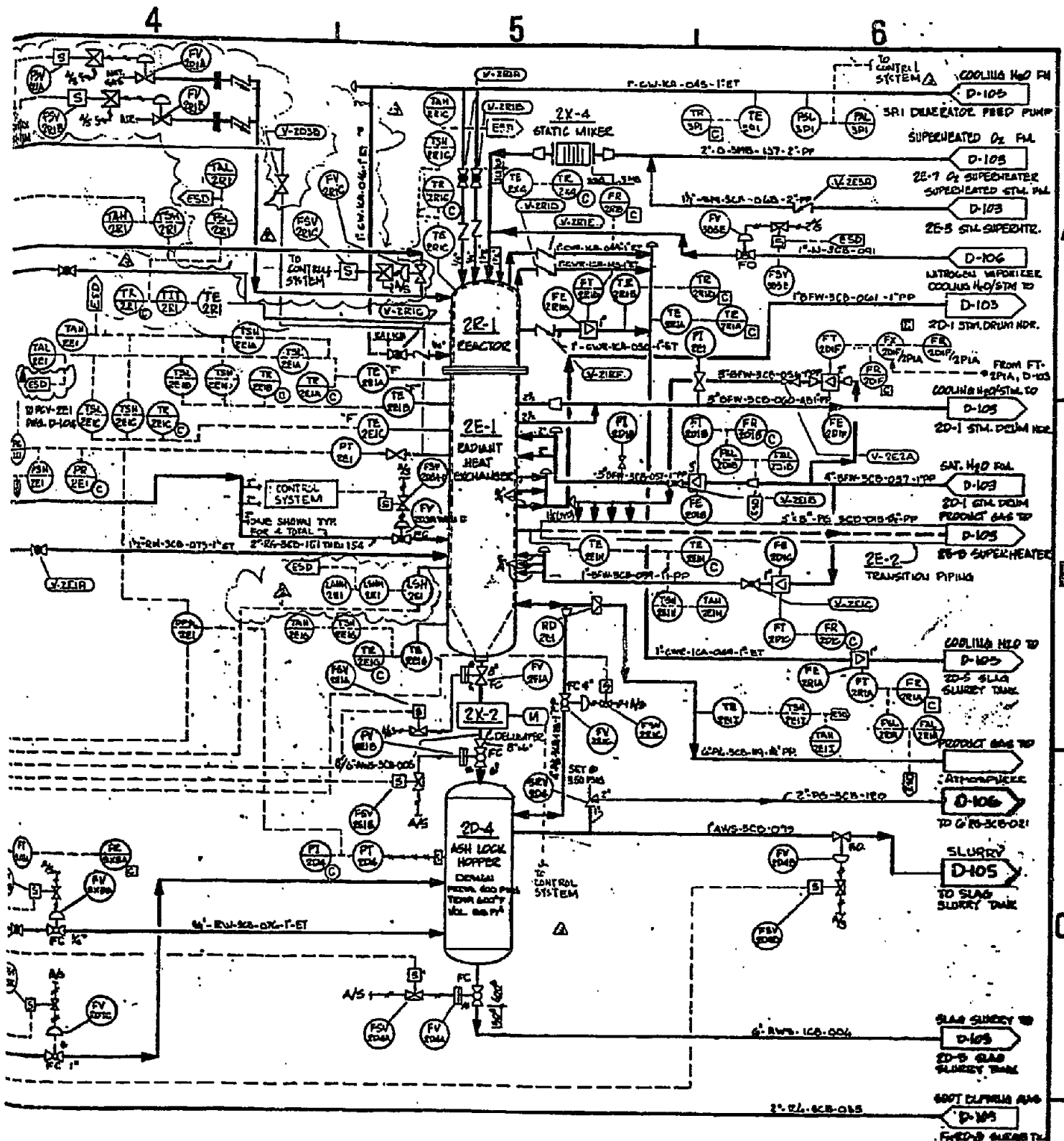
Ford, Bacon & Davis Utah Inc.
 ENGINEERS-CONSTRUCTORS
 SALT LAKE CITY, UTAH

TITLE
 COAL HANDLING
 ENTRAINED BED COAL GASIFICATION PILOT PLANT
 P. & I. D.

SHEET 1

FOR SCALE JOB NO. FB&D DWG. NO. OWNERS DWG. NO. REV.

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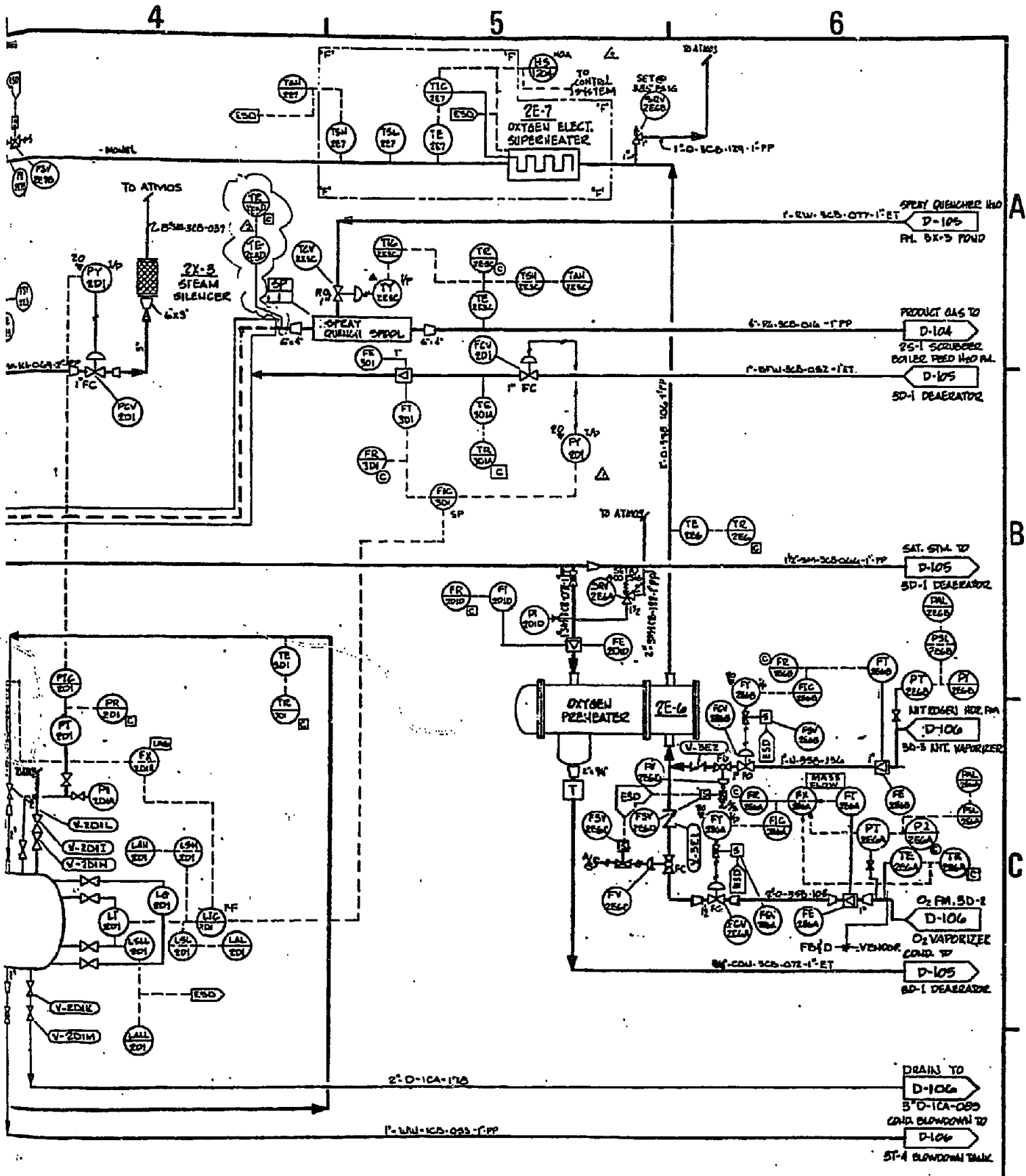


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7/1/78	6	O	Structural Contractor	Construction	WBS	7/1/78	APPROVED FOR CONSTRUCTION
7/1/78	7	1	Mechanical/Field	Construction	WBS	7/1/78	APPROVED FOR CONSTRUCTION
7/1/78	8	3	Mechanical/Field	Construction	WBS	7/1/78	APPROVED FOR CONSTRUCTION

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 ENTRAINED BED COAL GASIFICATION
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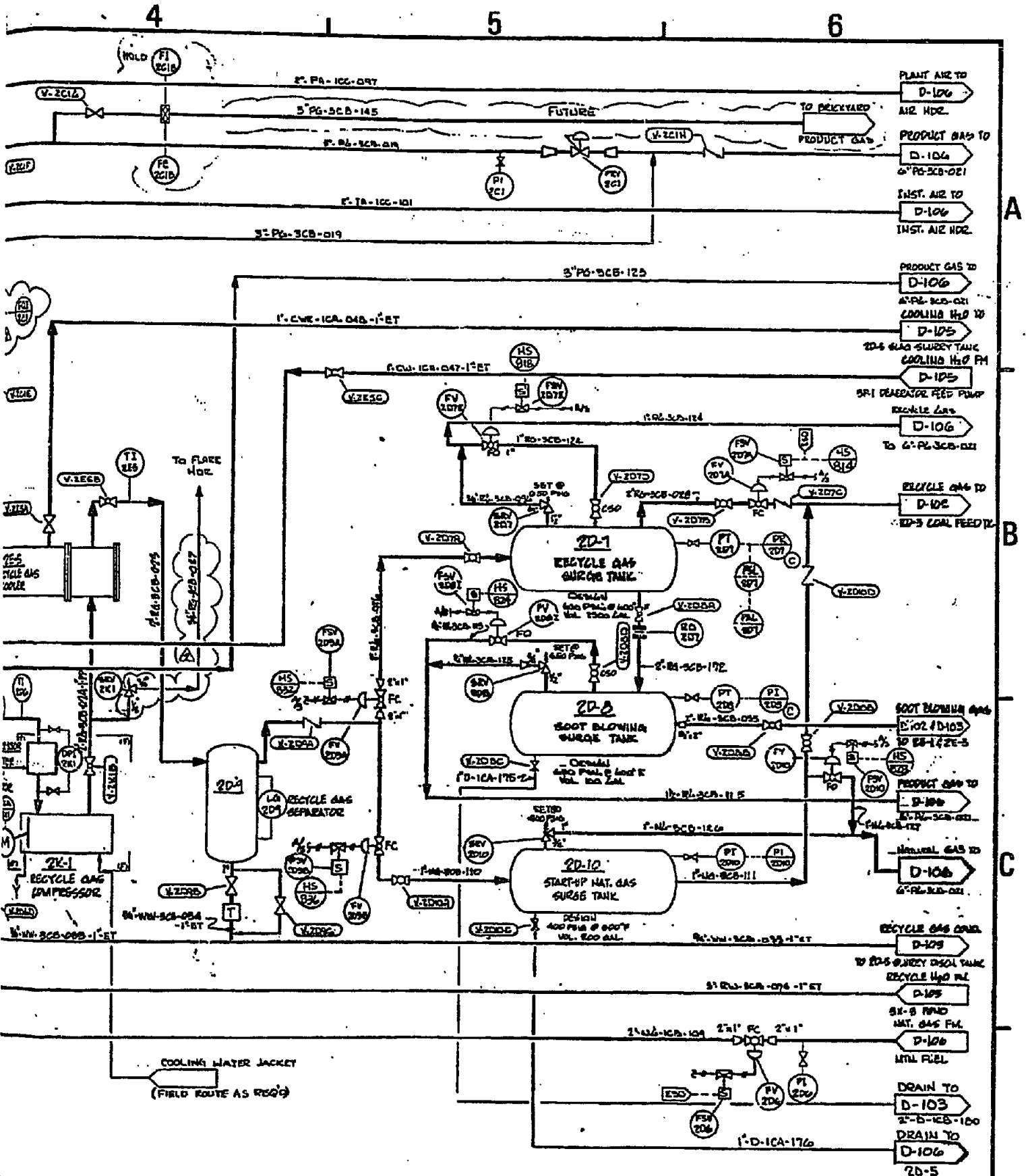


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					WJS	1-15-61		WJS	1-15-61	

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TITLE
 PIPING & INSTRUMENT DIAGRAM
 ENTRAINED BED COAL GASIFICATION
 PILOT PLANT - SHEET 3

FOR
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 FBDU DWG. NO.: D-106-D-105
 OWNERS DWG. NO.:
 REV. 3



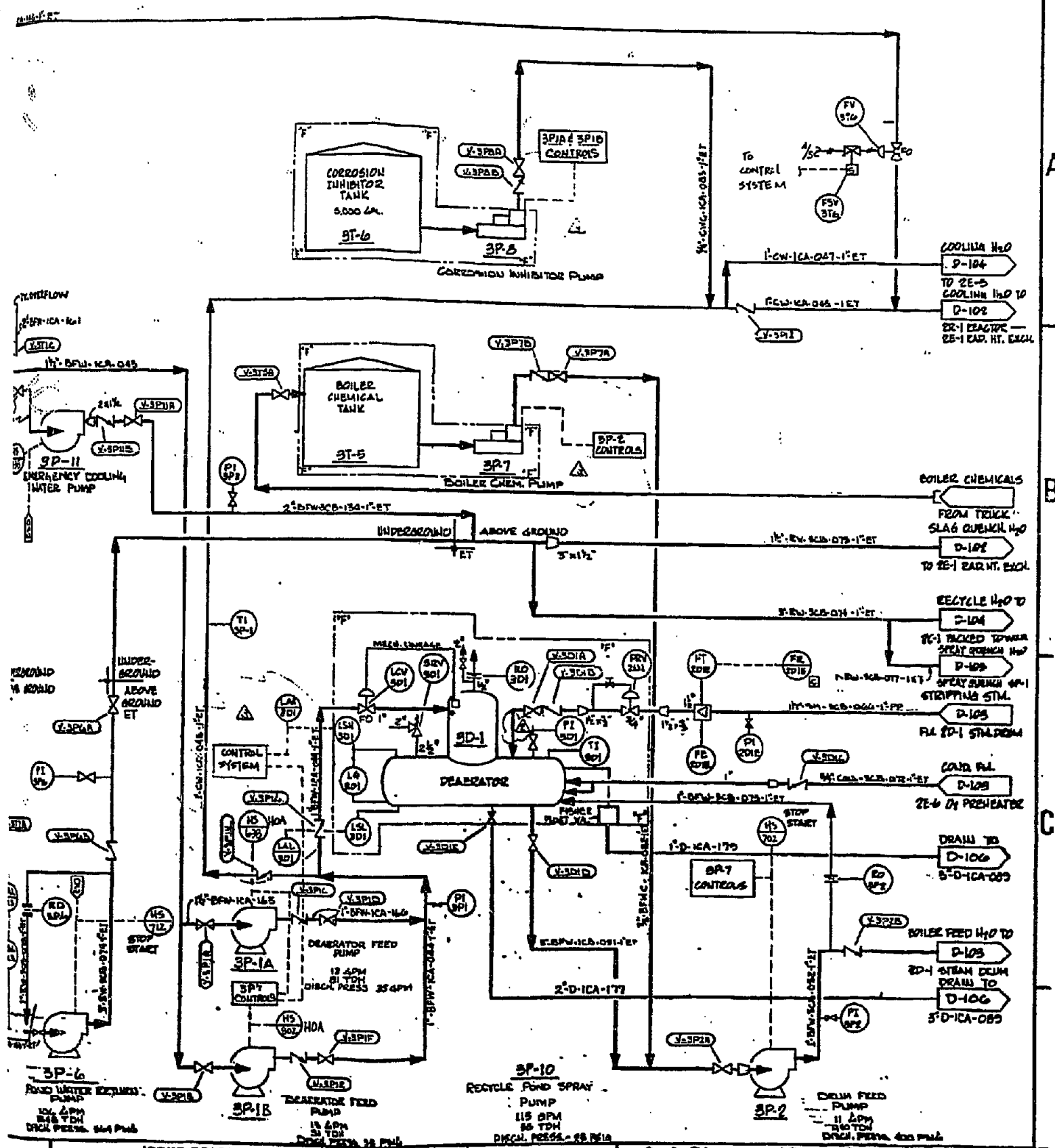
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10/1/81	8	3	Mechanical Cont./Rev.	CONSTRUCTION	WJS	10/1/81	WJS

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TITLE
**PIPING & INSTRUMENT DIAGRAM
ENTRAINED BED COAL GASIFICATION
PILOT PLANT**

SHEET-4

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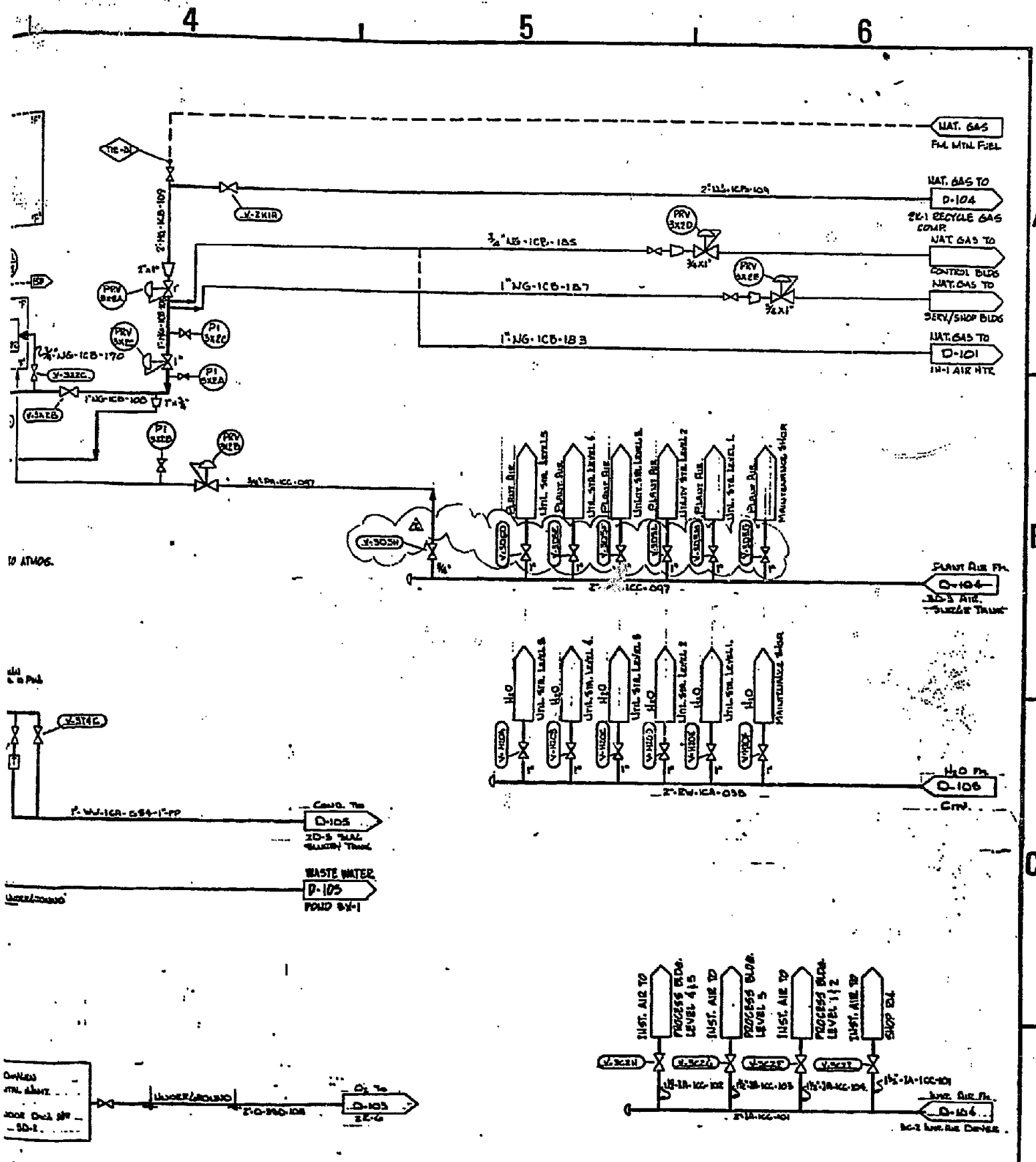


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8-10-81	8	H	Mechanical Dept.	Rev.	ELC	8-10-81	APPROVED FOR	WGS	8-2-81

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TITLE: **PIPING & INSTRUMENT DIAGRAM**
ENTRAINED BED COAL GASIFICATION
PILOT PLANT 645ET-6

FOR: SCALE: JOB NO. FBADU DWG. NO. OWNERS DWG. NO. REV. 3



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TITLE
PIPING & INSTRUMENT DIAGRAM
ENTRAINED BED COAL GASIFICATION
PILOT PLANT

SHEET - 6

FOR

SCALE: JOB NO./FBDU DWE. NO. OWNERS DWE. NO. REV.
1/8" = 1' 00-364-D-106 0-364-D-106 3

ATTACHMENT B

Equipment List

High Rate Entrained Coal Gasification PDU

Equipment Number	Description	Size and/or Capacity	Shipping Weight (lbs)	Vendor	Date Received
1BC-1	Belt Conveyor SP-369-P-135	18" x 55'		Pemco	
1BN-2	18 Ton Pulverized Coal Storage Bin SP-369-P-134	18 Ton	7,000	Dempco	6/07/82
1CR-1	Crusher SP-369-M-2	6,000 lbs/hr	1,300	Williams Patent Crusher Co.	4/23/82
1CY-1	Cyclone Separator SP-369-M-2	Height = 9'10", Dia. = 5'		Williams Patent Crusher Co.	4/23/82
1F-1	Baghouse Dust Collector SP-369-M-2	Maximum Discharge Rate, 2,000 lbs/hr		Williams Patent Crusher Co.	4/05/82
1FD-1	Pulverizer Rotary Feeder			Williams Patent Crusher Co.	5/05/82
1FN-1	Air Fan SP-369-M-2	250 CFM		Williams Patent Crusher Co.	6/02/82
1FN-2	Pulverizer Fan SP-369-M-2	3,600 ACFM @ 36" H ₂ O		Williams Patent Crusher Co.	4/23/82
1FN-3	Vent Fan SP-369-M-2	1,300 ACFM @ 12" H ₂ O		Williams Patent Crusher Co.	3/31/82
1H-1	Air Heater SP-369-M-2	2 MBTU/hr		Williams Patent Crusher Co.	6/02/82

Equipment Number	Description	Size and/or Capacity	Shipping Weight (lbs)	Vendor	Date Received
1HP-1	Coal Grizzly/Receiving Hopper SP-369-P-134	10' x 8'5"	5,950	Dempco	7/06/82
1HP-2	Crusher Feed Hopper SP-369-M-2			Williams Patent Crusher Co.	4/23/82
1K-1	Pulse Air Compressor			Williams Patent Crusher Co.	6/02/82
1VF-3	Feeder (Pulverized Coal Storage Bin) SP-369-P-138	5'	1,111	Kinergy	5/10/82
1RV-1	Cyclone Rotary Air Lock			Williams Patent Crusher Co.	
1RV-2	Baghouse Rotary Air Lock			Williams Patent Crusher Co.	
1VF-2	Feeder (Receiving Hopper) SP-369-P-138	12" x 48" x 4"	458	Kinergy	5/10/82
1X-1	Pulverizer SP-369-M-2	5,800 lbs/hr		Williams Patent Crusher Co.	5/05/82
1X-1A	Pulverizer Spinner Separator			Williams Patent Crusher Co.	
1X-2	Dense Phase Pump & Weighing Unit SP-369-P-132	4.22 ft ³	2,530	Dependable Fordath	
2C-1	Packed Tower SP-369-P-103	18" Dia. - 175 ACFM		Ametek-Schutte & Koerting	7/23/82

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2CY-1	Bin Vent-Filter SP-369-P-132	162 ft ² Filter Area	450	Torit	
2D-1	Steam Drum SP-369-P-102	4,879 lbs/hr steam	5,200	Dyna Therm Corp.	5/18/82
2D-2	Coal Lock Hopper SP-369-P-105	4'0" O.D. x 13'0" T to T	8,202	Rocky Mountain Fabrication	5/18/82
2D-3	Coal Feed Tank SP-369-P-105	4'0" O.D. x 13'0" T to T	8,562	Rocky Mountain Fabrication	5/17/82
2D-4	Ash Lock Hopper SP-369-P-105	3'0" O.D. x 4'0" T to T	5,332	Rocky Mountain Fabrication	5/17/82
2D-5	Slurry Discharge Tank SP-369-P-105	4'0" O.D. x 9'0" T to T	2,126	Rocky Mountain Fabrication	5/17/82
2D-7	Recycle Gas Surge Tank SP-369-P-1267	4'6" O.D. x 21'8" T to T	17,102	Rocky Mountain Fabrication	6/29/82
2D-8	Soot Blowing Surge Tank SP-369-P-127	1'8" O.D. x 6'5" T to T	1,188	Rocky Mountain Fabrication	6/29/82
2D-9	Recycle Gas Separator SP-369-P-106	1,479 lbs/hr	50	Wright Austin	1/20/82
2D-10	Natural Gas Surge Drum SP-369-P-127	2'0" O.D. x 8'8" T to T	1,489	Rocky Mountain Fabrication	5/18/82
2E-1	Radiant Heat Exchanger SP-369-M-1			Deutsche Babcock/ Rocky Mountain Fabrication	
2E-2	Transition Pipe			Western Pipe Fabrication	

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2E-3	Steam Superheater SP-369-M-1			Deutsche Babcock/ Rocky Mountain Fabrication	
2E-5	Recycle Gas Cooler SP-369-P-104	90,700 BTU/hr	669	Brown Fintube Co.	5/06/82
2E-6	Oxygen Preheater SP-369-P-125	256,000 BTU/hr	685	Brown Fintube Co.	6/10/82
2E-7	Oxygen Superheater (Elec.) SP-369-P-116	75 KW	1,900	Watlow Industries	
2K-1	Recycle Gas Compressor SP-369-P-107	372 SCFM		Gardner-Denver	
2P-1	Drum Recirculation SP-369-P-101B	505 GPM	1,776	Goulds	6/28/82
2P-3	Slurry Pump SP-369-P-101D	113 GPM	850	Durco	4/02/82
2P-4	Scrubber Recirculation Pump SP-369-P-103	110 GPM		Ametek-Schutte & Koerting	7/23/82
2R-1	Reactor			To be fabricated by MFR	
2S-1	Venturi Scrubber SP-369-P-103	175 ACFM		Ametek-Schutte & Koerting	7/23/82
2X-1	Auger & Intromiter			To be fabricated by MFR	

Equipment Number	Description	Size and/or Capacity	Shipping Weight (lbs)	Vendor	Date Received
2X-2	DeLumper SP-369-P-128	8"		Franklin Miller Co.	5/17/82
2X-3	Steam Silencer SP-369-P-118	Length = 61" Dia. = 18"	190	Universal Silencer	3/04/82
2X-4	Static Mixer SP-369-P-130	Length = 11" Dia. = 3"	34	Kenics Corp.	3/04/82
3C-1	Water Softener SP-369-P-109	25 GPM	4,555	Alpine Technical Services	2/08/82
3C-2	Instrument Air Dryer SP-369-P-115	315 SCFM	873	Airtek	3/30/82
3CY-1	Hydroclone SP-369-P-113	110 GPM	225	Krebs Engineers	4/16/82
3D-1	Deaerator SP-369-P-110	10,000 lbs/hr	2,100	Cleaver Brooks	3/04/82
3D-3	Air Receiver SP-369-P-114	700 gallon		Ingersoll-Rand	2/11/82
3F-1	Slurry Filter SP-369-P-131			Ronpetco	6/11/82
3K-1	Plant Air Compressor SP-369-P-114	400 ACFM		Ingersoll-Rand	2/11/82
3P-1A,B	Deaerator Feed Pump SP-369-P-101A	16 GPM		MTH	4/20/82
3P-2	Drum Feed Pump SP-369-P-101A	15 GPM		MTH	4/20/82
3P-3	Caustic (NaOH) Pump SP-369-P-108	0-42 GPH		Milton-Roy - Alpine Technical Services	12/22/81

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3P-6	Recycle Water Pump SP-369-P-101C	111 GPM	1,325	Sunflo	3/30/82
3P-7	Boiler Chemical Pump SP-369-P-108	1 GPH		LMI - Alpine Technical Services	2/09/82
3P-8	Corrosion Inhibitor SP-369-P-108			Neptune - Alpine Technical Services	1/28/82
3T-1	Deaerator Feed Tank SP-369-P-111	10'0" Dia. x 9'6"	6,207	Rocky Mountain Fabrication	4/20/82
3T-2	Caustic (NaOH) Tank SP-369-P-109	1,100 gallon		Alpine Technical Services	1/19/82
3T-3	Salt Solution Tank SP-369-P-109			Alpine Technical Services	2/08/82
3T-4	Blowdown Tank SP-369-P-111	1'0" O.D. x 6'0" T to T	308	Rocky Mountain Fabrication	5/18/82
3T-5	Boiler Chemicals Tank SP-369-P-108	50 gallon		Alpine Technical Services	2/09/82
3T-6	Corrosion Inhibitor SP-369-P-108	50 gallon		Alpine Technical Services	2/09/82
3X-1	Waste Water Pond	N/A	N/A	N/A	
3X-2	Flare SP-369-P-112	Length = 12'		John Zink Co.	3/19/82
3X-3	Recycle Water Pond SP-369-C-103				
3P-11	Emergency Cooling Pump SP-369-P-101E	111 GPM		Goulds	3/30/82

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3T-7	Holding Tank SP-369-134	1,000 gallon	2,500	Dempco	
3P-10	Recycle Water Spray Pump SP-369-P-133	115 GPM	300	Durco	
3P-9	Sump Pump SP-369-P-129	30 GPM	300	Durco	1/27/82