DOE/ET/12307-T1

DESIGN, CONSTRUCTION, OPERATION AND EVALUATION OF A PROTOTYPE CULM COMBUSTION BOILER/HEATER UNIT

Final Design of Prototype Unit

October 1980

Work Performed Under Contract AC21-78ET12307

Curtiss-Wright Corporation
Wood-Ridge, New Jersey

and

Dorr-Oliver Incorporated
Stamford, Connecticut

and

Stone & Webster Engineering Corporation
New York, New York

U. S. DEPARTMENT OF ENERGY

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FINAL DESIGN OF PROTOTYPE UNIT

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October 1980

Prepared for:

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Under Contract No. ET-78-C-01-3269
with the
Shamokin Area Industrial Corporation

ABSTRACT

A final design of a prototype anthracite culm combustion boiler has been accomplished under Phase I of DOE Contract ET-78-C-01-3269. The prototype boiler has been designed to generate 20,000 pounds per hour of 150 psig saturated steam using low Btu (4,000 Btu per pound) anthracite culm as a fuel. This boiler will be located at the industrial park of the Shamokin Area Industrial Corporation (SAIC). This program is directed at demonstrating the commercial viability of anthracite culm fueled FBC steam generation systems.

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Reference 1 - Construction Bid Package Specification SP-N-901

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1.0 INTRODUCTION

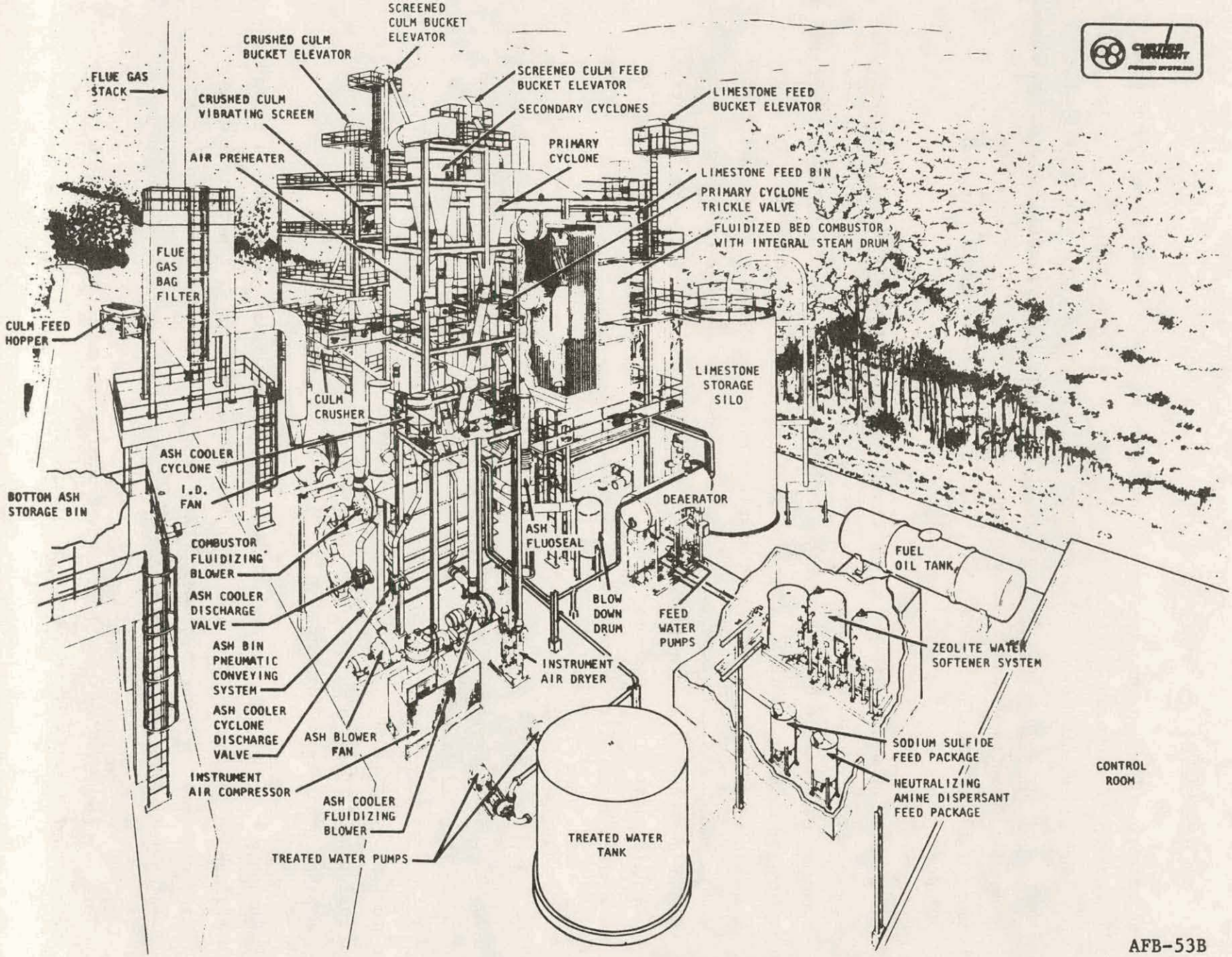
Anthracite culm is a generic term for any non-salable by-product resulting from production of marketable anthracite coal. It contains an appreciable amount of coal and is essentially a low cost, poor quality fuel reserve. About 910 million cubic yards of refuse is found in Northeastern Pennyslvania. The refuse banks are eyesores which not only occupy valuable land, but pollute the air, land, and water of the region as a result of spontaneous combustion and acid runoff.

The burning of anthracite culm in a fluidized bed combustion boiler is considered to be a feasible, cost effective way of utilizing this fuel in an environmentally acceptable manner. The fluidized bed combustion is essentially a furnace which can burn a variety of fuels including culm at relatively low temperature (1400°F - 1700°F). The sulfur dioxide release can be controlled within environmentally acceptable levels by use of limestone or dolomite as a sulfur sorbent. The relative low combustion temperatures also keep the nitrogen oxide level low. The use of boiler tubes in the fluidized bed to extract heat is a very efficient method of steam generation due to the high heat transfer coefficient.

Toward this goal an anthracite-culm-fueled fluidized bed boiler to produce 20,000 pounds per hour of steam has been designed under the sponsorship of the DOE. This boiler will be located at an industrial park of the Shamokin Area Industrial Corporation (SAIC) in Paxinos, Pennsylvania. The boiler will be fueled by anthracite culm having a heat content of 4,000 Btu per pound. The boiler will supply 150 psig saturated steam for the manufacturing processes of a paper products manufacturer at the industrial park.

The objectives of this contract are to design, construct and operate a boiler utilizing anthracite culm in a fluidized bed combustion system for the generation of steam for industrial use. Data from this plant will be used for the evaluation of larger FBC steam generating units.

This report describes the final design for the Shamokin FBC Boiler. An artist's conceptual drawing is presented in Figure 1.1.



ATMOSPHERIC FLUIDIZED BED BOILER

DEPARTMENT OF ENERGY PLANT – SHAMOKIN, PA

Figure 1.1

2.0 PROCESS DESCRIPTION

The prototype boiler system is to furnish 20,000 lb/hr of 150 psig steam using anthracite culm as the fuel. The process flow diagrams are shown in Drawings 75-D1 (Figure 2.1), F2 (Figure 2.2), and F3 (Figure 2.3). The flows presented are based on using a culm with a HHV of 4000 Btu/lb. However, all the equipment are sized to handle culms with heating values ranging from 3000 to 5000 Btu/lb.

The normal range of operating conditions possible with this unit are:

Fluidization Velocity	3.5 to 6 fps
Combustion Temperature	1450 to 1650°F
Excess Air	20 - 50%
Bed Height	3 - 6 ft
Steam Turndown	2.5 to 1
Culm Feed Rate Turndown	5 to 1
Limestone Feed Rate Turndown	10 to 1

2.1 Feed Preparation and Storage

The anthracite culm fuel will be delivered by truck in the size range from 1 to 4 inches. It will be deposited into an unloading area from which a front end loader will transfer the culm to a conveying system. This will transport the culm to a crushing and classifying system. Here it will be sized to 4 mesh x 0 material. From this operation, it will be conveyed to the prepared culm hopper. The prepared culm hopper is sized to store a 32-hour feed supply (for 4000 Btu/lb culm). From this hopper it will be transported to the culm feed bin which holds approximately 4 hours of feed.

Sized limestone (minus 1/4 inch size) will be delivered to the site via truck and pneumatically conveyed to a limestone storage silo. This silo will store approximately a week's supply of stone. From the silo the material will pass through a screw feeder and bucket elevator and then into the limestone feed hopper. This feed hopper is designed to hold a day's supply of material.

The feed preparation and filling of feed hoppers will occur during day shifts only. Therefore all the equipment has been sized accordingly.

2.2 Feeding

Both culm and limestone will be fed to the boiler via screw feeders. Two feeders will be used for the culm, and one for the limestone. The designs of these feeders are based on Dorr-Oliver's extensive experience in feeding fluidized beds. Variable speed motor drives will be used on each feeder to permit culm feed rate to follow steam demand in accordance with combustion control system and combustion temperature, and to allow limestone feed rate to vary with the SO_2 emission control feedback signal.

2.3 Fluidized Bed Boiler System

A fluidized bed combustor boiler of water wall design with in-bed boiler tubes and a convection section for the generation of steam is used. The bed contains 100 square feet of fluidizing area.

This boiler application calls for the delivery of 20,000 lb/hr of 150 psig saturated steam to battery limit. The fluidized bed boiler is designed to generate this steam capacity with in-bed, water wall and convection section tubes. The steam generated will be at 200 psi and saturated but will be reduced in pressure before delivery to the user.

To aid in start-up and turndown, the air plenum chamber is divided into three zones, each with its own air supply. One zone covering 64% of the bed area will not contain in-bed tubes. This area is always fluidized when steam is being generated and is the first bed section to be fluidized during start-up. The other two bed sections split the remaining 36% of the bed equally. These each contain in-bed boiler tubes and can be defluidized during turndown conditions.

An oil fired burner is also included to serve as a start-up burner. This burner will bring the bed up to culm combustion temperature.

2.4 Primary and Secondary Cyclones

Flue gas effluent from the boiler system enters the primary cyclone which is a refractory lined cyclone of conventional design. It serves as the primary combustion gas cleanup stage and recycles the collected ash and unreacted particulates back to the combustor. This recycle ensures high combustion efficiency, high limestone utilization, high heat transfer and good fluidization. Provision has also been made to purge off some of the cyclone catch, in lieu of 100% recycle. This permits greater operating flexibility in the boiler system.

The flue gases leaving the primary cyclone are further cleaned in twin cyclones. The dust collected here is exhausted to the ash cooler. When the boiler is turned down, one cyclone is bypassed to maintain a high cyclone efficiency in the other cyclone.

2.5 Ash Cooler

The ash cooler receives ash from the FBC boiler and the primary and secondary cyclones, and cools the ash to approximately 250°F. The ash cooler is a fluidized bed containing in-bed cooling coils. The cooling coils utilize boiler feed water permitting this system to recover some of the sensible heat from the hot ash and transmits it to the boiler feed water. Over 1×10^6 Btu/hr are recovered in this equipment item.

The ash cooler has its own air supply system and cyclone. The ash for this system is discharged through rotary valves to a pneumatic transfer system to ash storage and disposal.

2.6 Air Preheater

The flue gases exit the twin cyclones at 660°F. To improve the energy efficiency of the boiler system, additional energy is extracted from these gases in the air preheater before they are vented to the atmosphere. The hot flue gases flow inside the tubes of an air to gas shell and tube preheater and exit at 350°F.

On the shell side, combustion air from the fluidizing blower is heated to 425°F before entering the combustor. The design of this preheater is similar to those conventionally used in FluoSolids operations.

2.7 ID Fan

An induced draft fan is located between the air preheater and bag filter. This fan is used to control the pressure above the fluidized bed at a slightly negative level (i.e., -0.2 inches water).

2.8 Bag Filter

A conventional blow-back bag filter system is used to provide the final removal of particulates from the combustion gases before they are vented to the atmosphere. This system is designed to meet the federal and local particulate emissions codes.

2.9 Steam/Water Circuit

The design condition calls for 20,000 lb/hr of feed water to be vaporized as the exported steam. Besides this amount, approximately 10% more feed water is used in blowdown, and as steam is released from the deaerator and blowdown drum.

City water is used as the source of boiler feed water. This water is softened with a zeolite system. The treated water is fed through the ash cooler cooling circuit where it is heated, and then passes through the deaerator for oxygen removal. Oxygen in the feed water is further scavenged in the deaerator by the addition of sodium sulfite. From the deaerator, the feed water is pumped to the steam drum. A neutralizing amine treatment is used to further prevent chemical attack of the boiler metallurgy.

Two boiler feed water pumps are used. One pump is electrically driven and the second is turbine driven. The turbine drive is used in the event of a power outage and as a back-up for the electrically driven pump. Both pumps are interchangeable as the primary pump to facilitate maintenance rotation.

Water from the steam drum feeds the three steaming circuits of the boiler:

1. The Water Walls
2. The In-Bed Tubes
3. The Convection Section

This boiler is designed with all natural circulation circuits.

The steam/water mixtures from the three circuits exhaust to the steam drum where the water and steam are separated. The drum is at 200 psig.

Some of the steam produced is used within the system for the deaerator and turbine driven BPW pump. The bulk of the steam, 20,000 lb/hr, is reduced in pressure to 150 psig and sent to the user.

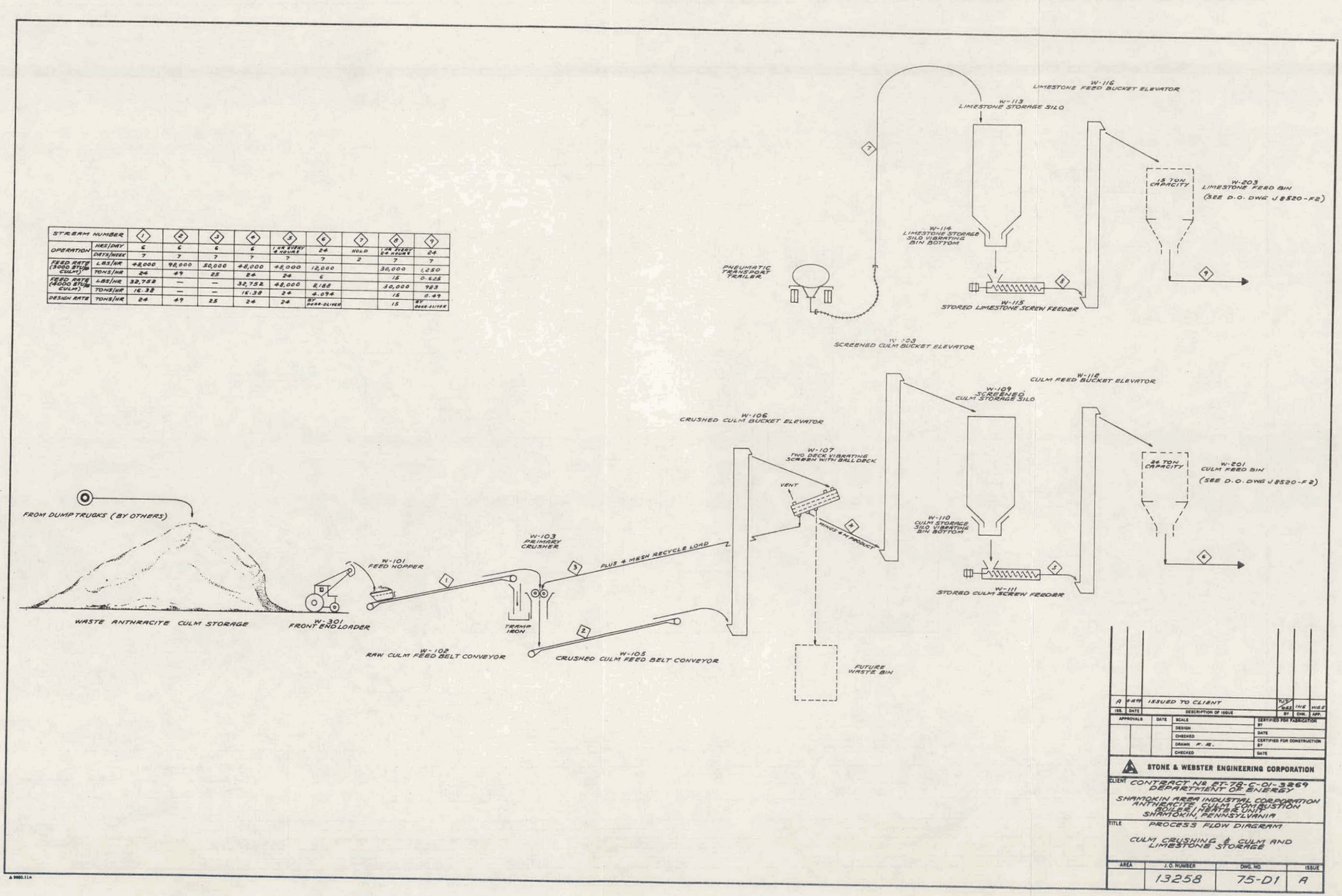
3.0 MASS AND ENERGY BALANCES

Based on a laboratory combustion study, flow diagrams for both the solids and gas, and water and steam sides of the plant were drawn and shown in Figures 2.1, 2.2 and 2.3. Mass and energy balances were generated on the following process basis:

Steam Delivered, Saturated	20,000 lbs/hr at 150 psig
Combustion Temperature	1550°F
Fluidization Velocity	5.5 ft/sec
Culm Fuel - HHV	4012 Btu/lb
Excess Air	30%

Mass and energy balances are shown in Tables 1 and 2. This design is directed toward achieving an overall efficiency of 69.5%. Culm with a heating value of 4012 Btu/lb was used for design purposes. Culm analysis is given in Table 3. Anthracite culm ash analysis is given in Table 4. A Ca/S ratio of 5.8 will be used to achieve an 88% sulfur capture. Meckley limestone will be used as a sorbent and its analysis is given in Table 5.

STREAM NUMBER		1	2	3	4	5	6	7	8	9
OPERATION	HRS/DAY	6	6	6	6	1 HR EVERY 4 HOURS	24	HOLD	1 HR EVERY 24 HOURS	24
	DAYS/WEEK	7	7	7	7	7	7	2	7	7
FEED RATE (5000 BTU/lb COAL)	LBS/HR	48,000	98,000	50,000	48,000	48,000	12,000		30,000	1,250
	TONS/HR	24	49	25	24	24	6		15	0.625
FEED RATE (4000 BTU/lb COAL)	LBS/HR	32,752	—	—	32,752	48,000	8,188		30,000	983
	TONS/HR	16.38	—	—	16.38	24	4.094		15	0.49
DESIGN RATE	TONS/HR	24	49	25	24	24	BY OTHER-SLIVER		15	BY OTHER-SLIVER



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STONE & WEBSTER ENGINEERING CORPORATION

CLIENT CONTRACT No ET-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION
BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA

TITLE PROCESS FLOW DIAGRAM
CULM CRUSHING & CULM AND LIMESTONE STORAGE

AREA	J.O. NUMBER	DWG. NO.	ISSUE
	13258	75-D1	A

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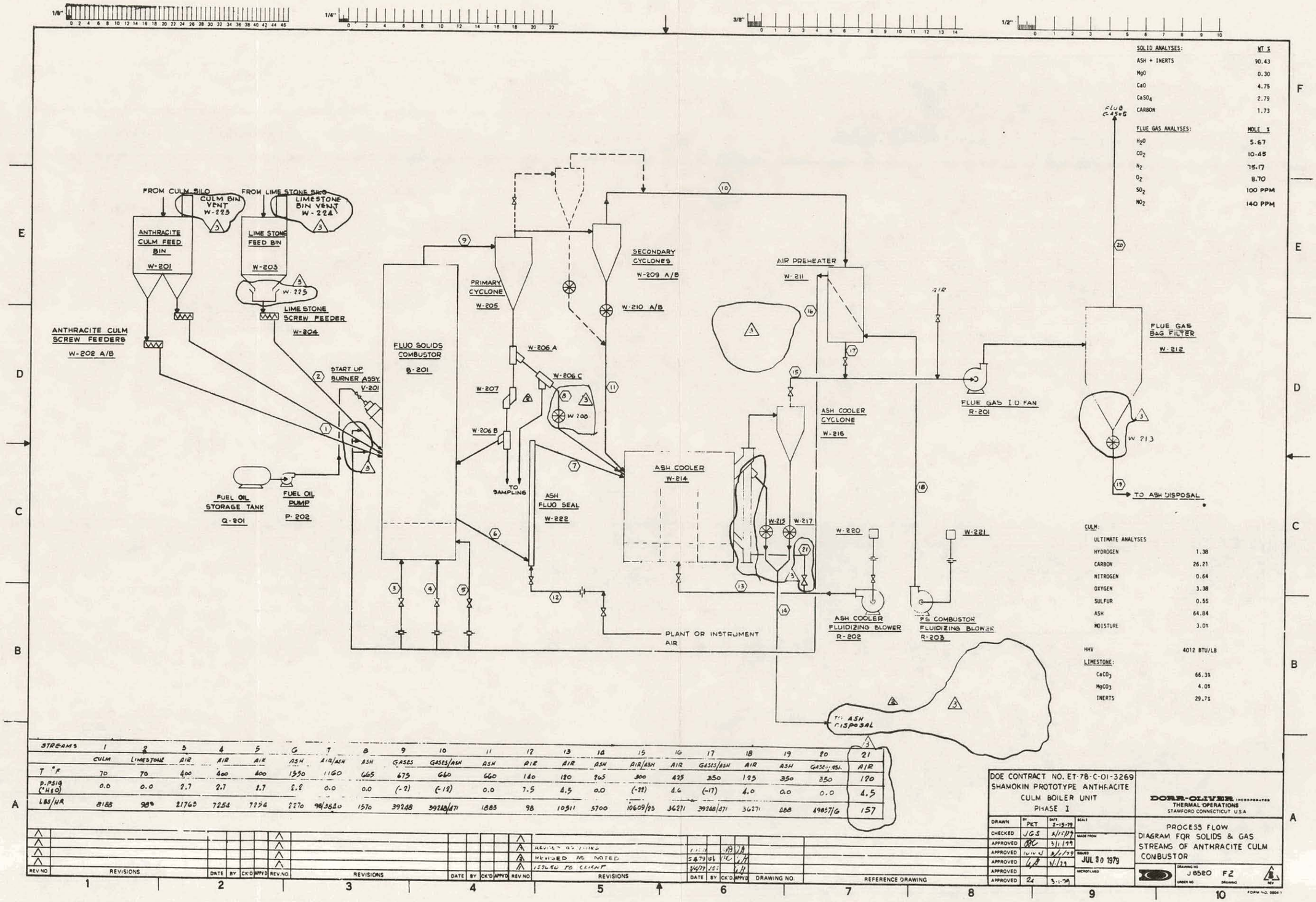
Figure 2.1



SOLID ANALYSES:	WT %
ASH + INERTS	90.43
MgO	0.30
CaO	4.75
$CaSO_4$	2.79
CARBON	1.73

FLUE GAS ANALYSES:	MOLE %
H_2O	5.67
CO_2	10.45
N_2	75.17
O_2	8.70
SO_2	100 PPM
NO_2	140 PPM

CULM:

ULTIMATE ANALYSES	
HYDROGEN	1.38
CARBON	26.21
NITROGEN	0.64
OXYGEN	3.38
SULFUR	0.55
ASH	64.84
MOISTURE	3.0%
HHV	4012 BTU/LB

LIMESTONE:

$CaCO_3$	66.3%
$MgCO_3$	4.0%
INERTS	29.7%

STREAMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	CULM	LIMESTONE	AIR	AIR	AIR	ASH	AIR/ASH	ASH	GASES	GASES/ASH	ASH	AIR	AIR	ASH	AIR/ASH	AIR	GASES/ASH	AIR	ASH	GASES/ASH	AIR
T °F	70	70	400	400	400	1550	1160	665	675	660	660	180	180	965	300	425	350	125	350	350	180
P.PSIG (*H₂O)	0.0	0.0	7.7	2.7	2.7	2.2	0.0	0.0	(-2)	(-18)	0.0	7.5	4.5	0.0	(-22)	4.6	(-17)	4.0	0.0	0.0	4.5
LBS/HR	8188	988	21765	7254	7254	2270	98/3810	1570	39248	39248/471	1883	98	10311	5700	10609/23	36271	39248/471	36271	488	49857/6	157

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SHAMOKIN PROTOTYPE ANTHRACITE CULM BOILER UNIT
PHASE I

DORR-OLIVER INCORPORATED
THERMAL OPERATIONS
STAMFORD CONNECTICUT U.S.A.

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APPROVED	RC	3-1-79

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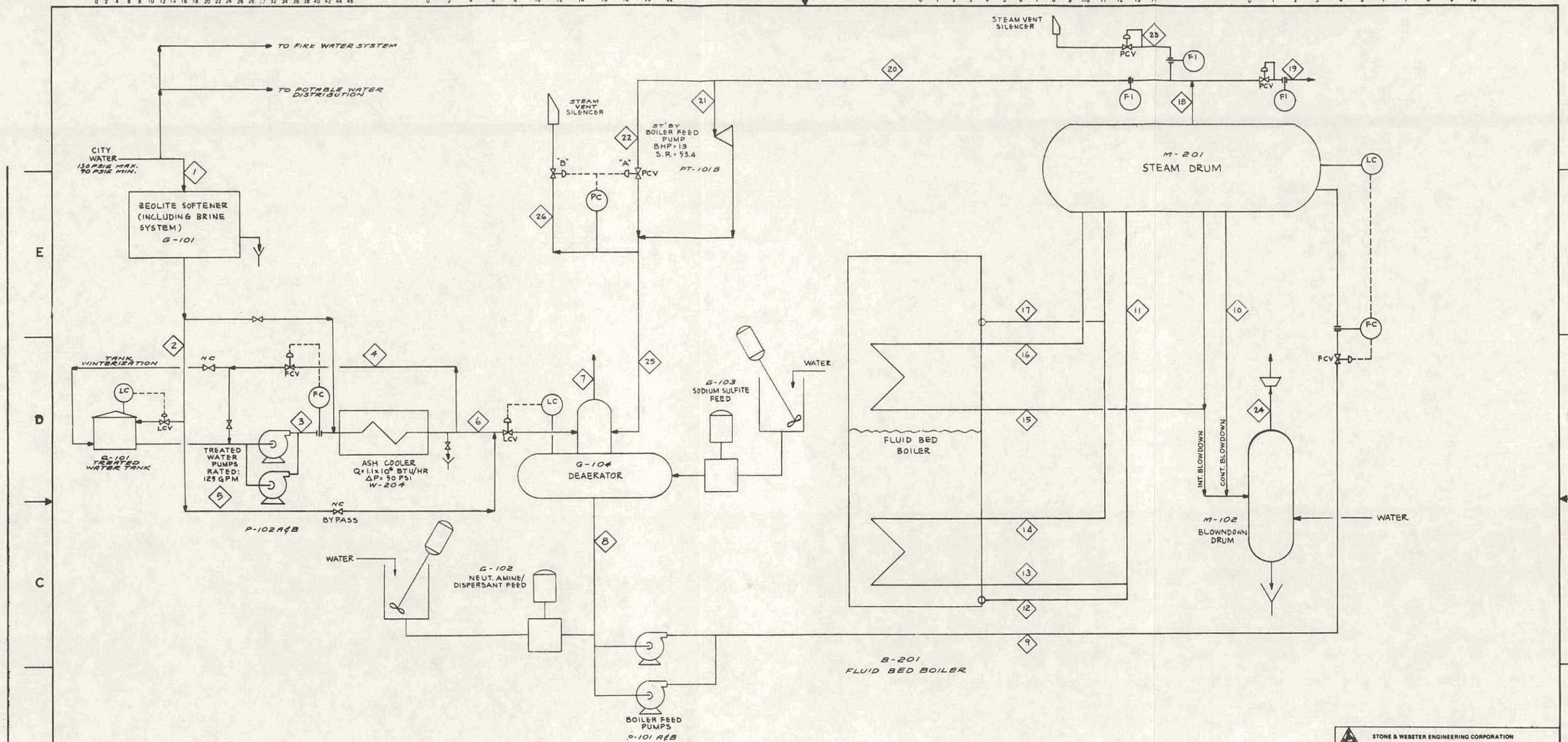
PROCESS FLOW DIAGRAM FOR SOLIDS & GAS STREAMS OF ANTHRACITE CULM COMBUSTOR

79-081

Figure 2.2



STREAMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	W	W	W	W	W	W	S	W	W	W	W	W	W	S/W	W	S/W	S/W	S	S	S	S	S	S	S	S	S
TEMP°F	40	40	70	90	40	90	228	228	228	388	381	381	381	388	381	388	388	388	378	388	388	388	386	212	316	316
PRESSURE PSIG	75	55	100	40	55	40	5	5	280	200	200	200	200	200	200	200	200	200	150	200	200	200	200	0	5	5
DESIGN FLOW, LBS/HR	22,100	22,100	62,500	40,400	22,100	22,100	100	25,410	25,410	2,000								23,410	20,000	3410	1020	3410	23,410	2,660	3410	1020
NORMAL FLOW, LBS/HR	20,530	20,530	52,500	31,970	0	20,530	100	22,880	22,880	430								22,450	(DEMAND)	2450	0	2,450	0	80	2,450	0

W = WATER S = STEAM
NC = NORMALLY CLOSED.

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A	ISSUED TO CLIENT	5/15/79	WJ/JNS	JNS	WGS
B	ISSUED TO CLIENT	3/12/79	JGS		

STONE & WEBSTER ENGINEERING CORPORATION
CLIENT CONTRACT NO. ET-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION
BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
PROCESS FLOW DIAGRAM
WATER TREATMENT & STEAM GENERATION

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DORR-OLIVER INCORPORATED
THERMAL OPERATIONS
STAMFORD CONNECTICUT U.S.A.

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APPROVED		
APPROVED	RJS	3-1-79

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PROCESS FLOW DIAGRAM FOR WATER AND STEAM STREAM OF ANTHRACITE COAL COMBUSTOR

DRAWING NO. J8520 F3 2
ORDER NO. DRAWING REV.

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Figure 2.3

TABLE 1

GENERAL MATERIAL BALANCE

IN:

	LBS/HR
Culm	8,188
Limestone	983
Air	46,880
Water	22,100
Total	78,151

OUT:

Ash	6,194
Gases	49,857
Steam	20,100
Blowdown	2,000
Total	78,151

TABLE 2

GENERAL ENERGY BALANCE

HEAT IN:

	BTU/HR
Culm	32.85×10^6
Sulfation	0.33×10^6
	33.18×10^6

HEAT OUT:

Gases	5.31×10^6
Steam	22.84×10^6
Blowdown	0.61×10^6
Calcination	0.50×10^6
Solids	0.31×10^6
Losses	3.61×10^6
	33.18×10^6

TABLE 3

ULTIMATE ANALYSIS - ANTHRACITE CULM

	% (DRY BASIS)
Carbon	27.02
Hydrogen	1.42
Nitrogen	0.66
Oxygen	3.48
Sulfur	0.57
Ash	66.85
Heating Value, HHV	4,198 Btu/lb

TABLE 4

ANTHRACITE CULM ASH ANALYSIS

Total CaO, %	0.133
Na, ppm	1,495
K, ppm	12,500
Fe, %	1.96
Al_2O_3, %	27.51
SiO_2, %	59.25
Sulfate Sulfur, %	0.085
Cl, ppm	100

TABLE 5

LIMESTONE ANALYSIS

Total CaO, %	37.15
Available CaO, %	0.095
MgO, %	1.92
Na, ppm	248
K, ppm	242
Fe, %	1.37
Al_2O_3, %	2.31
SiO_2, %	15.86
Acid Insolubles, %	22.55
Cl, ppm	200
Acid Evolution CO_2, %	31.73
LOI at 1000°C, %	32.22

4.0 OPERATING AND TURNDOWN CONDITIONS

4.1 Operating Conditions

The culm boiler is designed to operate at 1550°F and 5.5 ft/sec superficial fluidization velocity during full load operation. The fluidizing air will be supplied to the boiler at the rate of 36,271 lbs/hr. At this design condition, the boiler will utilize culm and limestone at the rate of 8,188 lbs/hr and 983 lbs/hr, respectively. The boiler will be operated at 30% excess air. Complete performance at design condition is shown in Table 6.

4.2 Turndown Conditions

The bed area is divided into three segments to achieve maximum turndown capability of 2.5/1. Various steam demands can be met by controlling the following variables:

1. Operating Temperature

   Reducing bed operating temperature from 1550°F to 1450°F can reduce the steam production by 10%.

2. Fluidization Velocity

   Fluidization velocity in the bed can be reduced from 5.5 ft/sec to 3.5 ft/sec. This can reduce the steam production by 20%.

3. Bed Area

   Defluidizing the 36% bed zones can reduce the steam production to 64%. This reduction can be achieved in two stages; by defluidizing 18% of bed area which reduces the steam production to 82%, and then by defluidizing the other 18% of bed area which will bring the steam production to 64%.

4. Bed Depth

Over a longer period the steam production from the bed coils can be varied by changing the bed depth.

Steam production can be reduced to 40% of design rate by a combination of the above variables.

A schedule of load following turndown is presented in Table 7, and schematically in Figure 5.1.

TABLE 6

PERFORMANCE ANALYSIS

Combustion Efficiency, %	95
Sulfur Capture, %	88
Excess Air, %	30
Fluidization Velocity, fps	5.5
Combustion Temperature, °F	1,550
Culm Heating Value, HHV, Btu/lb	4,012
Culm Rate, lbs/hr	8,188
Limestone Rate, lbs/hr	983
Ca/S Ratio	5.8

TABLE 7

LOAD FOLLOWING TURNDOWN SCHEDULE

Load Range	Bed Temperature	Space Rate	Zones Fluidized	Bed Height
100-110%	1550-1650°F	5.5 FPS	1,2,3	5 Ft
90-100%	1450-1550°F	5.5 FPS	1,2,3	5 Ft
70-90%	1450°F	3.5-5.5 FPS	1,2,3	5 Ft
65-70%	1450-1550°F	5.5 FPS	1,2	5 Ft
58-65%	1450°F	3.5-5.5 FPS	1,2	5 Ft
58-58%	1450-1550°F	5.5 FPS	1	5 Ft
45-50%	1450°F	3.5-5.5 FPS	1	5 Ft
40-45%	1450°F	3.5 FPS	1	3-5 Ft

5.0 PROCESS CONTROL AND INSTRUMENTATION

As is true for most steam generators, steam drum pressure is the primary controlled variable. The amount of fuel feed is controlled to maintain the boiler pressure at the control setpoint. The fuel flow is regulated by the control in order to maintain drum pressure. Bed temperature, space rate, fluidizing zones and bed height are also varied in accordance with turndown schedule shown on Figure 5.1. The process control computer provides the logic and loop controls necessary to accomplish this capability for turndown. The instrumentation to achieve this control is fully defined in the P&ID's and the strategy is defined in Figure 5.2, Control System Schematic Diagram.

At varying culm feed rates, the limestone feed rate will be roughly controlled according to a preset ratio. This ratio will depend on the limestone activity. The limestone feed rate will be fine tuned within controlled limits by feedback from the SO_2 analyzer.

For a given steam flow either one, two or all three windboxes will be used. Again, which ones used will be predetermined in the digital computer. In no case will the excess air level in the combustion gases fall below 15%. This low limit will be controlled by feedback from the oxygen analyzer.

In order to achieve maximum turndown, reduced bed heights will be used. Signals from the digital computer will control the bed height setpoint. Bed height is adjusted by the rate of ash removal from the bed to the ash cooler. The actual bed height is determined by measurement of the Δp across the bed.

For efficient dust removal prior to the air preheater, either one or both of the secondary cyclones will be used, depending on airflow rates. Therefore, at a given minimum airflow rate one cyclone is isolated.

The baghouse filter is protected from overheating by a temperature controller. This controller adjusts the bleed rate of ambient air into the hot gases flowing to the filter.

LOAD-FOLLOWING TURN-DOWN SCHEDULE

INCREASING VS DECREASING LOAD

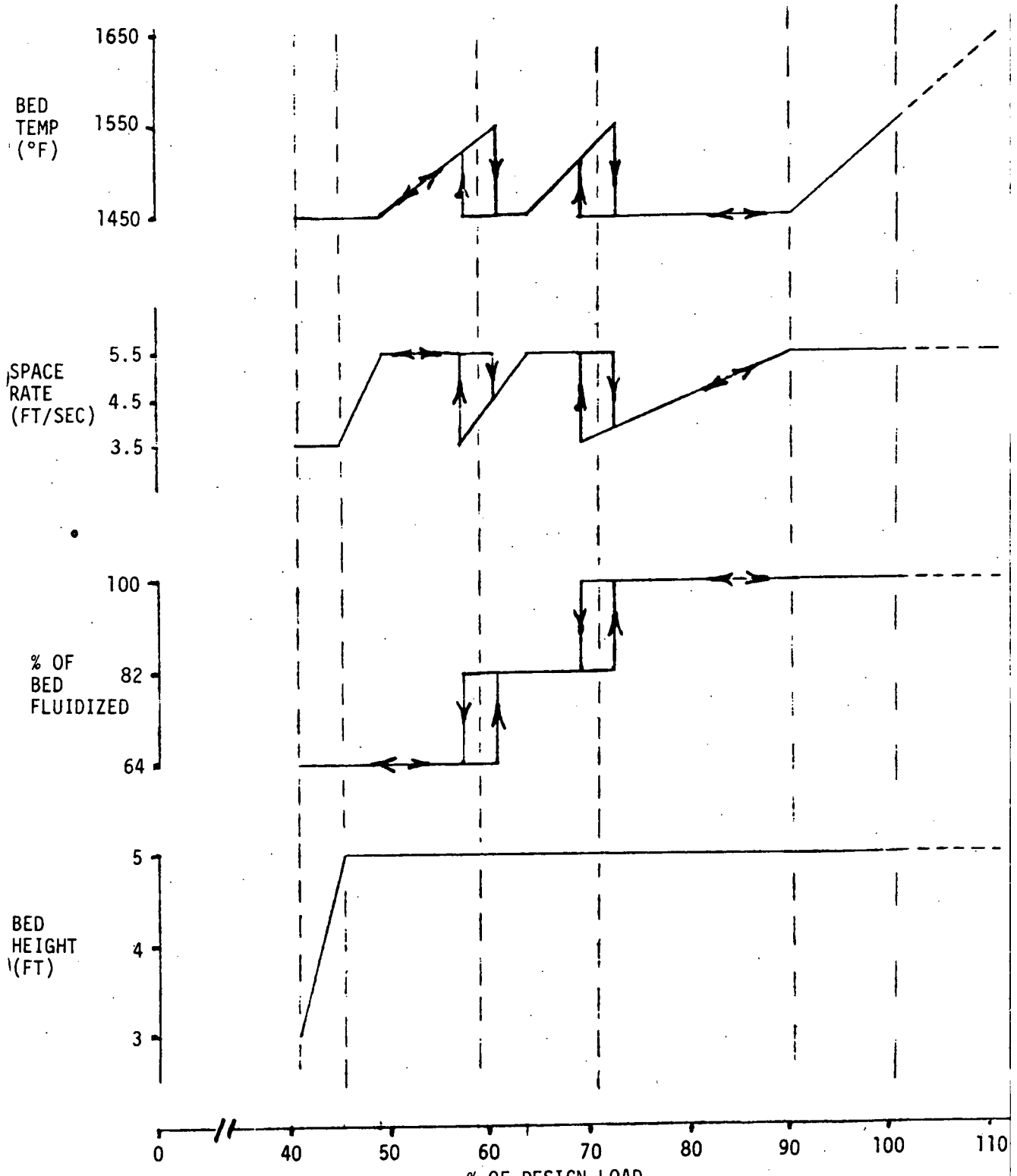

Figure 5.1

Besides these controls, standard steam/water side controls are used. Controls to switch from the electrically driven boiler feed water pump to the turbine driven pump in the event of a pump failure or power outage are also provided.

Analyses of the flue gases will be performed on line and continuously. The analyses include CO, CO_2, O_2, NO_x, and SO_2 determinations. The gases will be sampled downstream of the secondary cyclone. Provision has also been included for the addition of flue gas stack sampling and further opacity monitoring.

In addition to these controls, numerous temperature, pressure, differential pressure, flow rate and level sensing devices will be used to permit heat and material balance calculations, performance calculations and to aid in trouble-shooting.

Necessary alarms and interlocking have been provided to permit safe operation.

Key interlocks provided are as follows:

1. Interlock culm feed with bed temperature to prevent feed of culm below the proper ignition temperature or operation at excessively high bed temperature.

2. Interlock the fuel feed system with the drum water level.

3. Interlocking fuel feed with fluidizing air.

Other interlocking systems are as schematically indicated on the P&I Diagrams and as specifically detailed on the Electrical Elementary Wiring Diagrams and Figure 5.2, Control System Schematic Diagram.

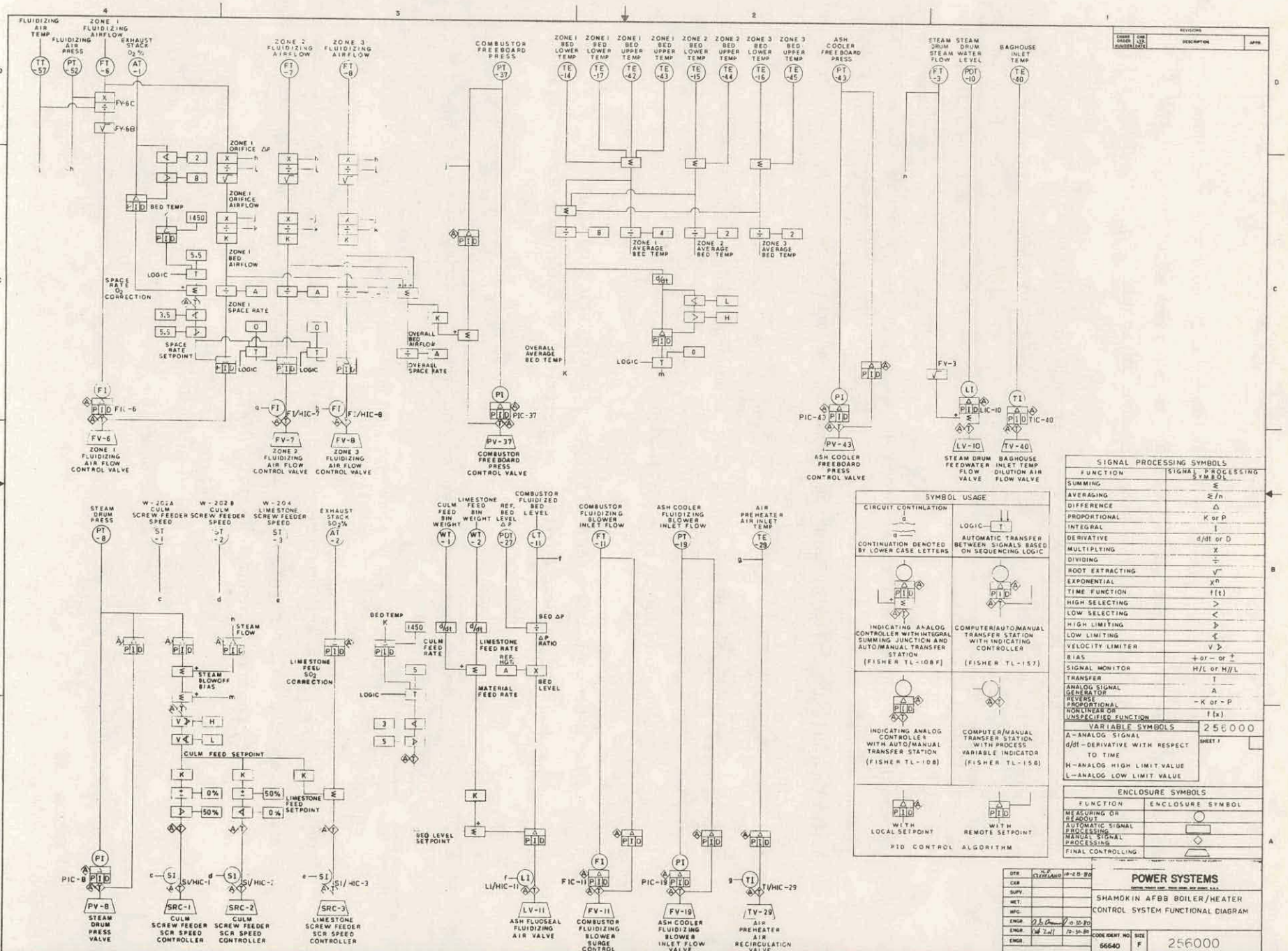
FLUIDIZING AIR TEMP
FLUIDIZING AIR PRESS
ZONE 1 FLUIDIZING AIRFLOW
EXHAUST STACK O2 %
ZONE 2 FLUIDIZING AIRFLOW
ZONE 3 FLUIDIZING AIRFLOW
COMBUSTOR FREEBOARD PRESS
ZONE 1 BED LOWER TEMP
ZONE 1 BED LOWER TEMP
ZONE 1 BED UPPER TEMP
ZONE 1 BED UPPER TEMP
ZONE 2 BED LOWER TEMP
ZONE 2 BED UPPER TEMP
ZONE 3 BED LOWER TEMP
ZONE 3 BED UPPER TEMP
ASH COOLER FREEBOARD PRESS
STEAM DRUM STEAM FLOW
STEAM DRUM WATER LEVEL
BAGHOUSE INLET TEMP
FY-6C
FY-6B
ZONE 1 ORIFICE ΔP
ZONE 1 ORIFICE AIRFLOW
BED TEMP
1450
ZONE 1 BED AIRFLOW
LOGIC
SPACE RATE O2 CORRECTION
ZONE 1 SPACE RATE
SPACE RATE SETPOINT
OVERALL BED AIRFLOW
OVERALL SPACE RATE
OVERALL AVERAGE BED TEMP
ZONE 1 AVERAGE BED TEMP
ZONE 2 AVERAGE BED TEMP
ZONE 3 AVERAGE BED TEMP
PIC-43
PV-43
ASH COOLER FREEBOARD PRESS CONTROL VALVE
FV-3
LIC-10
LV-10
STEAM DRUM FEEDWATER FLOW VALVE
TIC-40
TV-40
BAGHOUSE INLET TEMP DILUTION AIR FLOW VALVE
FIC-6
FV-6
ZONE 1 FLUIDIZING AIR FLOW CONTROL VALVE
FI/HIC-7
FV-7
ZONE 2 FLUIDIZING AIR FLOW CONTROL VALVE
FI/HIC-8
FV-8
ZONE 3 FLUIDIZING AIR FLOW CONTROL VALVE
PIC-37
PV-37
COMBUSTOR FREEBOARD PRESS CONTROL VALVE
STEAM DRUM PRESS
W-202A CULM SCREW FEEDER SPEED
W-202B CULM SCREW FEEDER SPEED
W-204 LIMESTONE SCREW FEEDER SPEED
EXHAUST STACK SO2%
CULM FEED BIN WEIGHT
LIMESTONE FEED BIN WEIGHT
REF. BED LEVEL ΔP
COMBUSTOR FLUIDIZED BED LEVEL
COMBUSTOR FLUIDIZING BLOWER INLET FLOW
ASH COOLER FLUIDIZING BLOWER INLET FLOW
AIR PREHEATER AIR INLET TEMP
STEAM FLOW
STEAM BLOWOFF BIAS
LIMESTONE FEED SO2 CORRECTION
CULM FEED SETPOINT
LIMESTONE FEED SETPOINT
CULM FEED RATE
LIMESTONE FEED RATE
MATERIAL FEED RATE
BED ΔP
ΔP RATIO
BED LEVEL
BED LEVEL SETPOINT
PIC-8
PV-8
STEAM DRUM PRESS VALVE
SI/HIC-1
SRC-1
CULM SCREW FEEDER SCR SPEED CONTROLLER
SI/HIC-2
SRC-2
CULM SCREW FEEDER SCR SPEED CONTROLLER
SI/HIC-3
SRC-3
LIMESTONE SCREW FEEDER SCR SPEED CONTROLLER
LI/HIC-11
LV-11
ASH FLUOSEAL FLUIDIZING AIR VALVE
FIC-11
FV-11
COMBUSTOR FLUIDIZING BLOWER SURGE CONTROL
PIC-19
FV-19
ASH COOLER FLUIDIZING BLOWER INLET FLOW VALVE
TI/HIC-29
TV-29
AIR PREHEATER AIR RECIRCULATION VALVE
SYMBOL USAGE
CIRCUIT CONTINUATION
CONTINUATION DENOTED BY LOWER CASE LETTERS
LOGIC
AUTOMATIC TRANSFER BETWEEN SIGNALS BASED ON SEQUENCING LOGIC
INDICATING ANALOG CONTROLLER WITH INTEGRAL SUMMING JUNCTION AND AUTO/MANUAL TRANSFER STATION (FISHER TL-108F)
COMPUTER/AUTO/MANUAL TRANSFER STATION WITH INDICATING CONTROLLER (FISHER TL-157)
INDICATING ANALOG CONTROLLER WITH AUTO/MANUAL TRANSFER STATION (FISHER TL-108)
COMPUTER/MANUAL TRANSFER STATION WITH PROCESS VARIABLE INDICATOR (FISHER TL-156)
WITH LOCAL SETPOINT
WITH REMOTE SETPOINT
PID CONTROL ALGORITHM
SIGNAL PROCESSING SYMBOLS
FUNCTION
SIGNAL PROCESSING SYMBOL
SUMMING
AVERAGING
DIFFERENCE
PROPORTIONAL
INTEGRAL
DERIVATIVE
MULTIPLYING
DIVIDING
ROOT EXTRACTING
EXPONENTIAL
TIME FUNCTION
HIGH SELECTING
LOW SELECTING
HIGH LIMITING
LOW LIMITING
VELOCITY LIMITER
BIAS
SIGNAL MONITOR
TRANSFER
ANALOG SIGNAL GENERATOR
REVERSE PROPORTIONAL
NONLINEAR OR UNSPECIFIED FUNCTION
VARIABLE SYMBOLS
A—ANALOG SIGNAL
d/dt—DERIVATIVE WITH RESPECT TO TIME
H—ANALOG HIGH LIMIT VALUE
L—ANALOG LOW LIMIT VALUE
256000
SHEET 1
ENCLOSURE SYMBOLS
FUNCTION
ENCLOSURE SYMBOL
MEASURING OR READOUT
AUTOMATIC SIGNAL PROCESSING
MANUAL SIGNAL PROCESSING
FINAL CONTROLLING
REVISIONS
CHANGE ORDER NUMBER
CHK
DATE
DESCRIPTION
APPR
DTR
CKR
SUPV.
MET.
MFG.
ENGR.
ENGR.
ENGR.
CLEVELAND 10-28-80
10-30-80
10-30-80
POWER SYSTEMS
SHAMOKIN AFBB BOILER/HEATER
CONTROL SYSTEM FUNCTIONAL DIAGRAM
CODE IDENT. NO. 66640
SIZE F
256000

Figure 5.2

6.0 EQUIPMENT SPECIFICATIONS AND DETAILED DESIGN

6.1 Equipment List, Instrumentation and Control System

Relevant equipment is herein identified on Pages 27 thru 34 by Equipment Number and Description. The 300 Series Equipment (Curtiss-Wright) relates to a conventional front loader. The make and model is to be determined at time of purchase.

The Instrument and Control System is identified in the Construction Bid Package, Specification SP-N-90, Section J. The Control Panel is identified by Curtiss-Wright Specification E-90085. The related Instrument Loop Diagrams are identified on the following Curtiss-Wright Drawings:

Loop Number
2301 - 2339
2401 - 2421
3101 - 3106
3201 - 3204
3206 - 3209

Total number of loops are 74.

The Data Acquisition, Control and Gas Analysis Systems can be described in general terms as follows:

Process Computer System - Curtiss-Wright Specification E-90080

Vendor - Fisher Controls Co.

1. DC^2 Process Computer System - W/Accessories:
    a. Input/Output Subsystems
    b. CRT
    c. Printer
    d. Provox Application Software Package for Data Acquisistion and Process Control

Analog Control System - Curtiss-Wright Specification E-90081

Vendor - Fisher Controls Co.

1. TL-Series Instruments
    a. Computer/Manual Transfer Station
    b. Computer/Auto/Manual Controllers
    c. Analog Controllers
2. KM-Series Instruments
    a. Computing Modules
    b. Alarm Modules
3. Power Supplies
4. Cabinets

Gas Analysis System - Curtiss-Wright Specification E-90082

Vendor - Pace Associates, Inc.

1. CO_2 Analyzer
2. NO_x Analyzer
3. CO Analyzer
4. SO_2 Analyzer
5. O_2 Analyzer
6. Self-Cleaning Filter Purge System
7. Calibration Accessories

Annunciator - Curtiss-Wright Specification E-90084

Vendor - Ronan, Inc.

1. Multipoint Annunciator
    a. First Alert Logic
    b. Horn for Audible Annunciation

Digital Temperature Monitoring System - Curtiss-Wright Specification E-90086

Vendor - Omega

1. Digital Panel Meter with Thermocouple Signal Conditioning
2. Multipoint Selector Switch

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

EQUIPMENT LIST INDEX

ANTHRACITE CULM FLUIDIZED BED BOILER UNIT

J.O. NO. 13258

DATE MAR. 16, 1979

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA. | TYPE OF UNIT ACFB | PAGE 1 OF 8

ACCOUNT CODE	DESCRIPTION	PAGE	REV. NO.	PAGE REV. (~)
100 SERIES	STONE & WEBSTER EQUIPMENT			
G	GENERAL EQUIPMENT	2		
M	DRUMS	2		
P	PUMPS	2		
Q	TANKS	2		
N	SOLIDS HANDLING EQUIPMENT	3,4&5	4	
V	SPECIAL EQUIPMENT	4	1	
S	STACKS	5	5	
200 SERIES	DORR-OLIVER EQUIPMENT			
B	FLUID BED BOILER	6	4	
G	GENERAL EQUIPMENT	6	4	
M	DRUMS	6	4	
P	PUMPS	6	4	
Q	TANKS	6	4	
R	FANS	6	4	
V	SPECIAL EQUIPMENT	6	4	
W	SOLIDS HANDLING EQUIPMENT	7&8	4	
300 SERIES	CURTISS-WRIGHT EQUIPMENT			
W	SOLIDS HANDLING EQUIPMENT	9	4	

CHECK (~) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	9-14-79	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - STONE & WEBSTER EQUIP.

DATE MAR. 16 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA. | TYPE OF UNIT ACFB | PAGE 2 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
G-101	ZEOLITE SOFTENER SYSTEM		
G-102	NEUTRALIZING AMINE/DISPERSANT FEED PKG.		
G-102-V1	AGITATOR		
GM-102-V1	AGITATOR MOTOR		
G-102-P1	FEED PUMP		
GM-102-P1	FEED PUMP MOTOR		
G-102-Q1	FEED TANK		
G-103	SODIUM SULFITE FEED PACKAGE		
G-103-V1	AGITATOR		
GM-103-V1	AGITATOR MOTOR		
G-103-P1	FEED PUMP		
GM-103-P1	FEED PUMP MOTOR		
G-103-Q1	FEED TANK		
G-104	DEAERATOR	1	
M-102	BLOW DOWN DRUM		
P-101 A&B	BOILER FEEDWATER PUMPS		
PM-101A	MOTOR		
PT-101B	TURBINE		
P-102 A&B	TREATED WATER PUMPS		
PM-102A	MOTOR		
PM-102B	MOTOR		
Q-101	TREATED WATER TANK		

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	9-14-79	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST – STONE & WEBSTER EQUIP. | DATE MAR. 16, 1979 | ACCOUNT CODE –

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA. | TYPE OF UNIT ACFB | PAGE 3 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
W-101	FEED HOPPER WITH VIBRATING PAN		
WM-101	PAN MOTOR	1	
W-102	RAW CULM FEED BELT CONVEYOR		
WM-102	RAW CULM FEED BELT CONVEYOR MOTOR		
W-103	CRUSHER	4	
WM-103	CRUSHER MOTOR	4	
W-104	deleted	4	
W-105	deleted	4	
W-106	CRUSHED CULM BUCKET ELEVATOR		
WM-106	CRUSHED CULM BUCKET ELEVATOR MOTOR		
W-107	CRUSHED CULM VIBRATING SCREEN		
WM-107	CRUSHED CULM VIBRATING SCREEN MOTOR		
W-108	SCREENED CULM BUCKET ELEVATOR		
WM-108	SCREENED CULM BUCKET ELEVATOR MOTOR		
W-109	SCREENED CULM STORAGE SILO		
W-110	SCREENED CULM STR. SILO VIBRATING BIN BOTTOM		
WM-110	VIBRATING BIN BOTTOM MOTOR		
W-111	SCREENED CULM SCREEN CONVEYOR		
WM-111	SCREENED CULM SCREEN CONVEYOR MOTOR		

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	9-14-79	1-10-80	2-20-80			

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STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - STONE & WEBSTER EQUIP.

DATE MAR. 16, 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA | TYPE OF UNIT ACFB | PAGE 4 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
W-112	SCREENED CULM FEED BUCKET ELEVATOR		
WM-112	SCREENED CULM FD. BUCKET ELEVATOR MOTOR		
W-113	LIMESTONE STORAGE SILO		
W-114	LIMESTONE STG. SILO VIBRATING BIN BOTTOM		
WM-114	VIBRATING BIN BOTTOM MOTOR		
W-115	STORED LIMESTONE SCREW FEEDER		
WM-115	STORED LIMESTONE SCREW FEEDER MOTOR		
W-116	LIMESTONE FEED BUCKET ELEVATOR		
WM-116	LIMESTONE FD. BUCKET ELEV. MOTOR		
W-117	deleted	4	
W-118	deleted	6	
W-119	ASH PNEUMATIC CONVEYING SYSTEM	3	
W-119M	BLOWER MOTOR		
W-120	ASH BIN	3	
W-121	ASH BIN ACTIVATOR	3	
W-121M	MOTOR		
W-122	BIN VENT DUST COLLECTION	3	
W-123	POWER AIR SLIDE GATE VALVE	3	
	TELESCOPING CHUTE		
V-101	deleted	4	

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	illegible	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - STONE & WEBSTER EQUP

DATE JULY 2, 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA | TYPE OF UNIT ACFB | PAGE 5 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
W-124	deleted	16	
WM-124	deleted	13	
W-125	deleted	16	
W-126	deleted	16	
WM-126	deleted	16	
W-127	deleted	16	
W-128	deleted	16	
W-129	CULM & LIMESTONE DUST COLLECTION SYSTEM	16	
WM-129-1	DUST COLLECTOR BLOWER MOTOR	16	
WM-129-2	DUST COLLECTOR ROTARY AIR LOCK MOTOR	16	
W-130	FLY ASH DISCHARGE POWER AIR SLIDE GATE		
	VALVE & TELESCOPING CHUTE SYSTEM	16	
WM-130-1	HOIST MOTOR	16	
WM-130-2	FAN MOTOR	16	
MM-104	STEAM VENT SILENCER	16	
S-101	FLUE GAS STACK	15	

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	—	—	—	7-2-79	9-14-79	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - DOZIT-OLIVER EQUIP.

DATE MAR. 16, 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA. | TYPE OF UNIT ACFB | PAGE 5 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
B-201	FLUO-SOLIDS COMBUSTOR	1	
	WITH INTEGRAL STEAM DRUM	3	
V-201	START-UP BURNER ASSEMBLY (WITH B-201)		
VM-201	BURNER BLOWER MOTOR	1	✓
G-201	INSTRUMENT AIR DRYER		
P-201	deleted	2	
M-201	deleted	3	
P-201	deleted	2	
P-202	FUEL OIL PUMP	1	
PM-202	MOTOR		
T-201	FUEL OIL STORAGE TANK	1	
R-201	FLUE GAS I.D. FAN		
RM-201	MOTOR		
R-202	ASH COOLER FLUIDIZING BLOWER		
RM-202	MOTOR		
R-203	F.S. COMBUSTOR FLUIDIZING BLOWER		
RM-203	MOTOR		
R-204	deleted	5	
RM-204	deleted	5	
R-205	INSTRUMENT AIR COMPRESSOR		
RM-205	MOTOR		
V-202	CO_2 FIRE PROTECTION SYSTEM FOR W-211	1	✓
V-203	WATER SEAL	1	✓

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-13-79	7-2-79	9-[illegible]-79	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - DORR-OLIVER EQUIP.

DATE MAR. 16, 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA. | TYPE OF UNIT ACFB | PAGE 7 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
W-201	ANTHRACITE CULM FEED BIN		
W-202 A&B	ANTHRACITE CULM SCREEN FEEDERS		
WM-202 A&B	MOTORS		
W-203	LIMESTONE FEED BIN		
W-204	LIMESTONE SCREW FEEDER		
WM-204	MOTOR		
W-205	PRIMARY CYCLONE	1	
W-206 A,B&C	PRIMARY CYCLONE SPLITTER VALVES	3	
W-207	PRIMARY CYCLONE TICKLE VALVE	1	
W-208	PRIMARY CYCLONE DISCHARGE VALVE	1	
WM-208	MOTOR		
W-209 A&B	SECONDARY CYCLONES	1	
W-210 A&B	SECONDARY CYCLONE DISCHARGE VALVES	1	
WM-210 A&B	MOTORS		
W-211	AIR PREHEATER		
W-212	FLUE GAS BAG FILTER		
W-213	FLUE GAS BAG FILTER DISCHARGE VALVE	5	
WM-213	MOTOR	5	

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	9-11-79	1-10-80	2-20-80			

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

J.O. NO. 13258

EQUIPMENT LIST - DORR-OLIVER EQUIP.

DATE MAR. 16, 1979

ACCOUNT CODE —

CLIENT CURTISS-WRIGHT | LOCATION SHAMOKIN, PA | TYPE OF UNIT ACFB | PAGE 8 OF 8

EQUIPMENT NUMBER	DESCRIPTION	REV. NO.	ITEM REV. (✓)
W-214	ASH COOLER		
W-215	ASH COOLER DISCHARGE VALVE		
WM-215	MOTOR		
W-216	ASH COOLER CYCLONE		
W-217	ASH COOLER CYCLONE DISCHARGE VALVE		
WM-217	MOTOR		
W-218	deleted	3	
W-219	deleted	3	
W-220	ASH COOLER FLUIDIZING BLOWER INLET FILTER		
W-221	F.S COMBUSTOR FLUIDIZING BLOWER INLET FILTER		
W-222	ASH FLUO SEAL	4	
W-223	ANTHRACITE CULM FEED BIN VENT	4	
W-224	LIMESTONE FEED BIN VENT	4	
W-225	LIMESTONE FEED BIN VIBRATING BOTTOM	4	
WM-225	MOTOR	4	

CHECK (✓) INDICATES ITEM WAS CHANGED IN LATEST REVISION.

REVISION	1	2	3	4	5	6	7	8	9	10
DATE	4-5-79	4-30-79	5-18-79	7-2-79	9-14-79	1-10-80	2-20-80			

6.2 P&I Diagrams

The following Drawings and Lists are provided herein:

Figure Number	Title
6.1	General Notes and Index
6.2	Culm Crushing and Culm and Limestone Storage
6.3	Fluid Bed Combustor System
6.4	Flue Gas and Ash Handling System
6.5	Water Treatment and Boiler Feed System
6.6	Fluid Bed Combustor System Steam Generation
6.7	Utility Distribution System and Details
6.8	Line Designation Table Index
6.9	Line Designation Table

80-200

GENERAL NOTES

1. EXCEPT AS OTHERWISE NOTED ON THE FLOW DIAGRAMS, THE FOLLOWING INFORMATION APPLIES:
2. WHILE NOT SHOWN ON THE DIAGRAMS, 3/4" VALVED VENT CONNECTIONS ARE TO BE PROVIDED FOR TRAPPED HIGH POINTS OF PIPING 2" NPS AND LARGER. 3/4" VALVED DRAIN CONNECTIONS SHALL BE FURNISHED FOR LOW POINTS OF LINES ABOVE GRADE.
3. ALL VALVED VENTS & DRAINS ARE FITTED WITH NIPPLE & CAPPED OR BLINDED. EXCEPT PUMP VENTS & DRAINS.
4. UNDESIGNATED PIPING & VALVING ON EQUIPMENT SHALL FOLLOW THE CLASS OF THE LOCAL PIPING.
5. IN GENERAL, INSTRUMENTATION IS PER I.S.A. STANDARD S5.1.
6. ALL PRESSURE INSTRUMENTS SHALL BE FURNISHED WITH A PROCESS BLOCK VALVE WITH INSTRUMENT END TO BE THREADED 3/4" NPT.
7. FLOW METER ORIFICE FLANGES ARE IN ACCORDANCE WITH THE PIPE LINE SPECIFICATION BUT WITH A MINIMUM RATING & FACING OF 300 RFLE
8. ORIFICE FLANGE VALVES ARE NOT SHOWN & ARE PART OF PIPING SUPPLY.
9. EXTERNAL FLOAT SWITCHES (1" NPT) SHALL BE PROVIDED WITH 1" SHUT-OFF VALVES & 3/4" DRAIN VALVE. THE VALVES WILL NOT BE SHOWN ON THE DIAGRAMS.
10. EXTERNAL CAGE TYPE LEVEL INSTRUMENTS SHALL BE PROVIDED WITH 2" SHUT-OFF VALVES & 3/4" DRAIN VALVE NOT SHOWN ON THE DIAGRAMS.
11. LEVEL GAGES WILL BE FURNISHED COMPLETE WITH VALVES BY INSTRUMENT.
12. ALL LEVEL COLUMNS (STANDPIPES) ARE TO BE 2", EXCEPT AS NOTED.
13. TEMPERATURE WELLS FOR OPERATING INSTRUMENTS ARE NOT SHOWN.
14. FOR FREEZE PROTECTION DURING COLD WEATHER, ALL UNHEATED WATER SYSTEMS WILL BE EMPTIED THROUGH LOW POINT DRAINS. DURING PERIODS OF NON-OPERATION, WATER WILL BE CIRCULATED THROUGH EQUIPMENT ON STAND BY. (SEE NOTE 18 BELOW)
15. TYPICAL FUNCTION SYMBOL FOR DIGITAL CONTROL SYSTEM (TAG XC-1) LOCATED IN CONTROL ROOM. SEE SPECIFICATION NO. K810 FOR FULL FUNCTIONAL DETAILS.
16. ALL ITEMS OF EQUIPMENT SHOWN INSIDE PACKAGE BOUNDERY LINES ARE INCLUDED WITH THE PARTICULAR PACKAGE.
17. ALL PUMP STRAINERS WILL HAVE THE FOLLOWING MESH SIZE EXCEPT WHERE NOTED OTHERWISE AS AN MM ITEM.
    SIZES 2" & SMALLER - "Y" TYPE STRAINER 20 MESH, OR .046" DIA. PERFORATED PLATE.
    SIZES 3" TO 6" INCLUSIVE - "Y" TYPE STRAINER MESH 8 X 8 .047" DIA. WIRE, 0.078" OPENING.
18. ALL ELECTRIC MOTOR DRIVERS IN SOLIDS HANDLING SERVICE TO HAVE LOCAL AMMETERS, NOT SHOWN ON EFD'S.
19. ELECTRICAL TRACING WILL BE APPLIED WHERE SHOWN ON THE DIAGRAMS. WHERE INDICATED WITHIN PACKAGE BOUNDARIES, TRACING WILL BE DONE BY OTHERS.
20. ALL THERMOWELL CONNECTIONS ON C.S. VESSELS & PIPING 3" & LARGER SHALL BE 1" THREADED. PIPING LESS THAN 3" SHALL BE SWAGED TO 3". ALLOY & S.S. PIPING TO HAVE 1 1/2" FLANGED THERMOWELL CONNECTIONS.

ABBREVIATIONS

ATM	ATMOSPHERE	IA	INSTRUMENT AIR
BA	BLOWER AIR	MM	MISCELLANEOUS MATERIAL
BL	BATTERY LIMIT	NC	NORMALLY CLOSED
CL	CLASS	NO	NORMALLY OPEN
CS	CHEMICAL SEWER	NOZ	NOZZLE
CSC	CAR SEAL CLOSED	OS	OILY SEWER
CSO	CAR SEAL OPEN	P	PURGE
D	DRAIN	RD	RUPTURE DISC
EBD	EMERGENCY SHUTDOWN	RO	RESTRICTION ORIFICE
FC	CLOSES ON AIR FAILURE	S	SAMPLE
FI	INDETERMINATE ON AIR FAILURE	SC	SAMPLE COOLER
FL	LOCKS ON AIR FAILURE	S/D	SHUT DOWN
FO	OPENS ON AIR FAILURE	SO	STEAM OUT
HC	HOSE CONNECTION	TT	TELL TALE
LC	LOCKED CLOSED	V	VENT
LO	LOCKED OPEN	WE	SUPPLIED WITH EQUIPMENT
MH	MANHOLE		
		PRB	PURGE AIR (EQUIPMENT)
		FP	FREEZE PROTECTION
		APCV	ANALYZER PRESS. REDUCING VALVE
		TSO	TIGHT SHUT OFF

SYMBOLS

- GATE VALVE
- GLOBE VALVE
- PLUG COCK
- BUTTERFLY VALVE
- CONTROL VALVE
- CONTROL VALVE WITH HANDWHEEL
- HAND CONTROL VALVE
- BALL VALVE
- CHECK VALVE
- NON-RETURN STOP & CHECK ANGLE VALVE
- ANGLE VALVE
- MOTOR OPERATED VALVE
- SOLENOID OPERATED VALVE
- THREE WAY VALVE
- HOSE CONNECTION
- UNDERGROUND LINE
- ELECTRICAL TRACING
- JACKETED PIPE
- ELECTRICAL SIGNAL
- PNEUMATIC
- CAPILLARY
- VACUUM RELIEF VALVE
- NEEDLE VALVE
- FLEXIBLE HOSE
- CYLINDER OPERATOR
- FLEXIBLE DUCT CONN.
- ELECTRIC MOTOR
- ROTARY VALVE
- SLIDE GATE
- PACKAGE BOUNDARY LINE (SEE GENERAL NOTE 15)
- PIPING REDUCER
- PRESSURE/VACUUM RELIEF VALVE
- DRAIN FUNNEL
- "Y" TYPE STRAINER (W/BLOWDOWN VALVE)
- PUMP SUCTION STRAINER (TEMPORARY)
- PERMANENT PUMP SUCTION STRAINER
- SPECTACLE BLIND
- RUPTURE DISC
- EXPANSION JOINT
- VENTURI
- EJECTOR
- TRAP
- PRESSURE SAFETY VALVE
- ROTAMETER
- SIGHT GLASS OR POSITIVE DISPLACEMENT FLOWMETER
- STEAM AND/OR ENTRAINMENT SEPARATOR
- STRAIGHTWAY TANDEM SEATLESS BLOWOFF VALVE SET
- LOCALLY MOUNTED INSTRUMENT
- INDICATES INSTRUMENT TAG NO. BY PACKAGE VENDOR
- MAIN PANEL MOUNTED INSTRUMENT
- LOCAL PANEL MOUNTED INSTRUMENT
- INSTRUMENT WITH CHEMICAL SEAL
- LINE SIZE ORIFICE RUN
- INCREASED ORIFICE RUN
- SEE GENERAL NOTE 14
- ELECTRICAL INTERLOCK
- POST INDICATOR VALVE
- AIR FILTER
- FLAME ARRESTER
- AIR PURGE ROTAMETER/ INTEGRAL NEEDLE VALVE
- STEAM EXHAUST HEAD
- WEATHER CAP
- MOUNTED ON BACK OF PANEL

EQUIPMENT LIST

ITEM	SHEET	ITEM	SHEET	ITEM	SHEET	ITEM	SHEET
G-101	73-D1	W-110	72-D2	R-202	73-D4	W-217	72-D4
		WM-110	72-D2	RM-202	72-D4	WM-217	72-D4
G-102	73-D1						
G-102-V1	73-D1						
GM-102-V1	73-D1	W-111	72-D2	R-203	73-D4	W-220	72-D4
G-102-P1	73-D1	WM-111	72-D2	RM-203	73-D4		
GM-102-P1	73-D1						
G-102-Q1	73-D1					W-221	72-D4
		W-112	72-D2				
G-103	73-D1	WM-112	72-D2				
G-103-V1	73-D1					W-222	72-D3
GM-103-V1	73-D1						
G-103-P1	73-D1	W-113	72-D2	R-205	73-D3		
GM-103-P1	73-D1			RM-205	73-D3	W-301	72-D2
G-103-Q1	73-D1					W-129	72-D2
				V-201	72-D3		
G-104	73-D1	W-114	72-D2	V-202	72-D3		
H-101	73-D3	WM-114	72-D2	V-203	72-D4	WM-129-1	72-D2
H-102	73-D3			W-201	72-D3		
M-102	73-D2						
MM-104	73-D2			W-202A & B	72-D3	WM-129-2	72-D2
		W-115	72-D2	WM-202A & B	72-D3		
P-101 A & B	73-D1	WM-115	72-D2			W-130	72-D4
PM-101 A	73-D1						
PT-101 B	73-D1			W-203	72-D3	WM-130-1	72-D4
		W-116	72-D2				
		WM-116	72-D2			WM-130-2	72-D4
P-102 A & B	73-D1			W-204	72-D3	W-223	72-D3
PM-102A	73-D1			WM-204	72-D3		
PM-102B	73-D1					W-224	72-D3
				W-205	72-D3		
Q-101	73-D1					W-225	72-D3
S-101	72-D4			W-206A,B &C	72-D3		
W-101	72-D2					WM-225	72-D3
WM-101	72-D2						
		W-119	72-D4	W-207	72-D3		
		WM-119	72-D4				
W-102	72-D2						
WM-102	72-D2			W-208	72-D3		
		W-120	72-D4	WM-208	72-D3		
W-103	72-D2						
WM-103	72-D2			W-209A & B	72-D3		
		W-121	72-D4				
		WM-121	72-D4				
				W-210A & B	72-D3		
		W-122	72-D4	WM-210A & B	72-D3		
				W-211	72-D4		
		W-123	72-D4				
				W-212	72-D4		
W-106	72-D2	B-201	72-D3				
WM-106	72-D2		73-D2				
				W-213	72-D4		
		G-201	73-D3	WM-213	72-D4		
W-107	72-D2						
WM-107	72-D2						
		P-202	72-D3	W-214	72-D4		
		PM-202	72-D3				
W-108	72-D2						
WM-108	72-D2			W-215	72-D4		
		G-201	72-D3	WM-215	72-D4		
W-109	72-D2						
		R-201	72-D4	W-218	72-D4		
		RM-201	72-D4				

EQUIPMENT LIST CATAGORIES

SERIES	SUPPLIER
100 SERIES	STONE & WEBSTER EQUIPMENT
G	GENERAL EQUIPMENT
M	DRUMS
P	PUMPS
Q	TANKS
W	SOLIDS HANDLING EQUIPMENT
V	SPECIAL EQUIPMENT
S	STACKS
200 SERIES	DORR-OLIVER EQUIPMENT
B	FLUID BED BOILER
G	GENERAL EQUIPMENT
M	DRUMS
P	PUMPS
Q	TANKS
R	FANS
V	SPECIAL EQUIPMENT
W	SOLIDS HANDLING EQUIPMENT
300 SERIES	CURTISS-WRIGHT EQUIPMENT
W	SOLIDS HANDLING EQUIPMENT

LINE DESIGNATIONS

PREFIX	SERVICE
BF	BOILER FEED WATER
CI	CHEMICAL INJECTION
D	DRAINS
DS	SANITARY SEWER
FA	ASH FLO SEAL AIR
FO	FUEL OIL
FW	FIRE WATER
IA	INSTRUMENT AIR
PA	PURGE AIR TO EQUIPMENT
SA	PLANT AIR
SCL	LOW PRESSURE STEAM CONDENSATE
SCM	MEDIUM PRESSURE STEAM CONDENSATE
SL	LOW PRESSURE STEAM
SM	MEDIUM PRESSURE STEAM
WC	WATER FOR COOLING
WCR	WATER RETURN AFTER COOLING
WP	POTABLE CITY WATER
WT	TREATED WATER
V	VENT

DRAWING INDEX

DWG. NO.	DESCRIPTION
72-D1	GENERAL NOTES & INDEX
72-D2	CULM CRUSHING & CULM & LIMESTONE STORAGE
72-D3	FLUID BED COMBUSTOR SYSTEM
72-D4	FLUE GAS & ASH HANDLING SYSTEM
73-D1	WATER TREATMENT & BOILER FEED SYSTEM
73-D2	FLUID BED COMBUSTOR SYSTEM STEAM GENERATION
73-D3	UTILITY DISTRIBUTION & LIQUID WASTE SYSTEMS

INSTRUMENT LEGEND

AAH	ANALYSIS ALARM HIGH	LAL	LEVEL ALARM LOW	SC	SPEED CONTROLLER
AE	ELEMENT	LAH	LEVEL ALARM HIGH	SFRC	RATIO RECORDER CONTROLLER
APCV	PRESSURE REGULATOR	LC	CONTROLLER	SRC	RECORDER CONTROLLER
AR	RECORDER	LCAH	CONTROLLER & HIGH ALARM	ST	TRANSMITTER
ARC	RECORDER CONTROLLER	LG	GAGE GLASS	SY	SIGNAL CONVERTER
AT	TRANSMITTER	LI	INDICATOR	SSL	SPEED ALARM LOW
		LS	SWITCH	TE	TEMPERATURE ELEMENT
BFAL	BURNER FLAME ALARM OFF	LT	TRANSMITTER	TI	INDICATOR
BFE	ELEMENT	LV	CONTROL VALVE	TT	TRANSMITTER
BFI	INDICATOR	LY	SIGNAL CONVERTER	TR	RECORDER
		OLS	OVERLOAD SWITCH		
FAL	FLOW ALARM LOW	PAL	PRESSURE ALARM LOW	WE	WEIGHT ELEMENT
FAH	ALARM HIGH	PAH	HIGH	WT	TRANSMITTER
FE	ELEMENT	PCV	CONTROL VALVE	WQR	TOTALIZER/RECORDER
FR	RECORDER	PDI	DIFFERENTIAL INDIC.		
FRC	RECORDER CONTROLLER	PDT	TRANSMT.	XC	MISCELLANEOUS CONTROLLER
FT	TRANSMITTER	PI	INDICATOR	XV	MISC. CONTROL VALVE
FV	CONTROL VALVE	PR	RECORDER	XS	SHUT DOWN SWITCH
FY	SIGNAL CONVERTER	PS	SWITCH	UA	COMMON ALARM
HIC	MANUAL LOADING STATION	PT	TRANSMITTER	XA	SHUT DOWN ALARM
HS	HAND SWITCH	PY	SIGNAL CONVERTER	ZS	LIMIT SWITCH

C	CONSTRUCTION ISSUE		INS	MJG
B	FINAL DESIGN		INS	MJG
A	INTERIM ISSUE		INS	MJG
A	PLANNING ISSUE		INS	MJG
INC.	DATE	DESCRIPTION OF ISSUE	BY	CHK.	APPR.

APPROVALS | DATE | SCALE | DESIGN | CHECKED | DRAWN | CHECKED | CERTIFIED FOR FABRICATION BY | DATE | CERTIFIED FOR CONSTRUCTION BY | DATE

STONE & WEBSTER ENGINEERING CORPORATION

CLIENT CONTRACT NO ET-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER HEATER UNIT
SHAMOKIN, PENNSYLVANIA

TITLE
ENGINEERING P&I DIAGRAMS
GENERAL NOTES & INDEX

AREA	J.O. NUMBER	DWG. NO.	ISSUE
	13258	72-D1	C

Figure 6.1

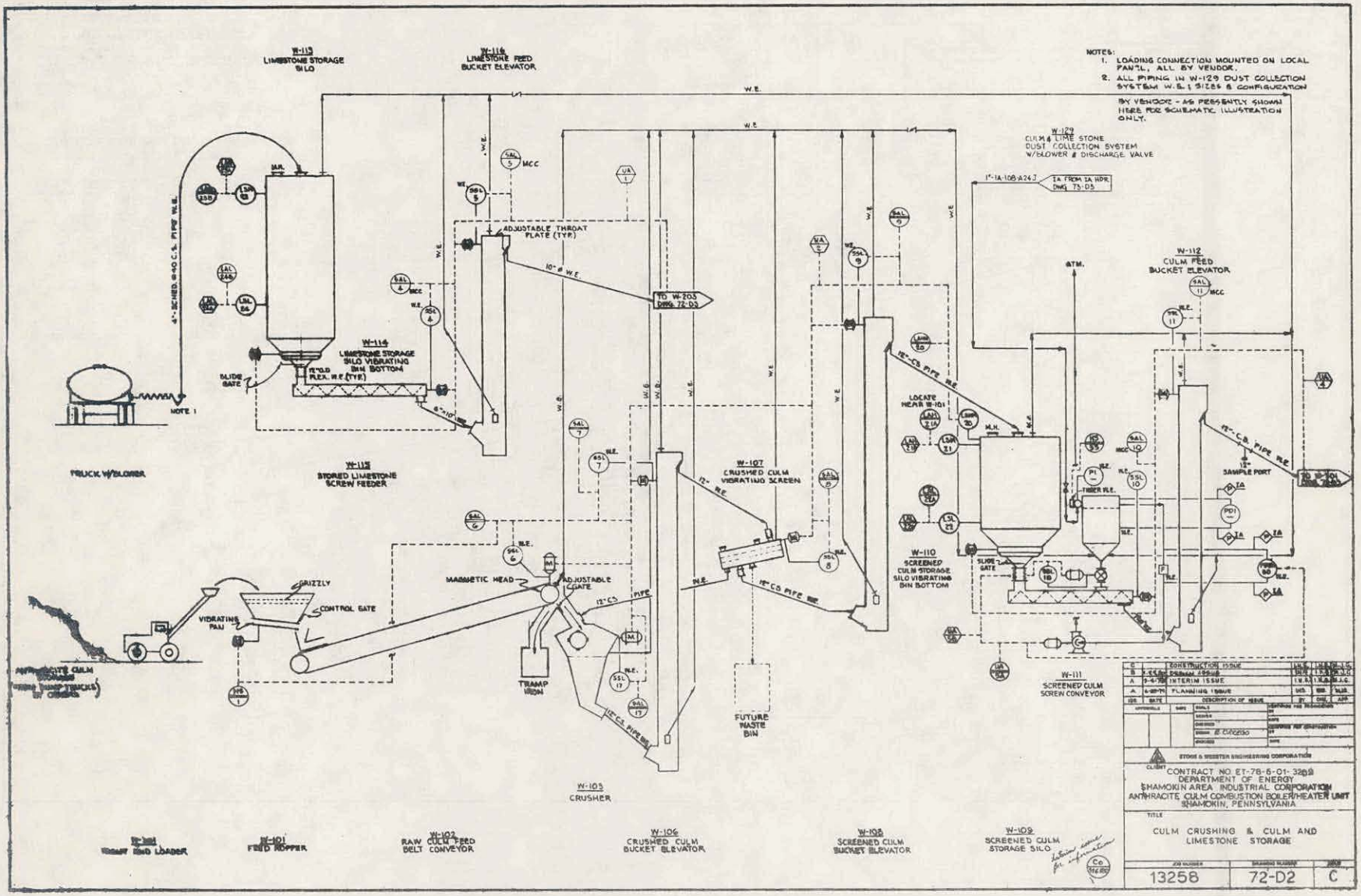
W-113 LIMESTONE STORAGE SILO
W-116 LIMESTONE FEED BUCKET ELEVATOR
NOTES:
1. LOADING CONNECTION MOUNTED ON LOCAL PANEL, ALL BY VENDOR.
2. ALL PIPING IN W-129 DUST COLLECTION SYSTEM W.S.I SIZES & CONFIGURATION BY VENDOR - AS PRESENTLY SHOWN HERE FOR SCHEMATIC ILLUSTRATION ONLY.
W-129 CULM & LIME STONE DUST COLLECTION SYSTEM W/BLOWER & DISCHARGE VALVE
W-112 CULM FEED BUCKET ELEVATOR
W-114 LIMESTONE STORAGE SILO VIBRATING BIN BOTTOM
W-115 STORED LIMESTONE SCREW FEEDER
W-107 CRUSHED CULM VIBRATING SCREEN
W-110 SCREENED CULM STORAGE SILO VIBRATING BIN BOTTOM
W-111 SCREENED CULM SCREW CONVEYOR
W-105 CRUSHER
W-104 W-101 FEED HOPPER
W-102 RAW CULM FEED BELT CONVEYOR
W-106 CRUSHED CULM BUCKET ELEVATOR
W-108 SCREENED CULM BUCKET ELEVATOR
W-109 SCREENED CULM STORAGE SILO
TRUCK W/BLOWER
VIBRATING PAN
GRIZZLY
CONTROL GATE
MAGNETIC HEAD
ADJUSTABLE GATE
TRAMP IRON
FUTURE WASTE BIN
SLIDE GATE
SAMPLE PORT
STONE & WEBSTER ENGINEERING CORPORATION
CONTRACT NO. ET-78-S-01-3259
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
CULM CRUSHING & CULM AND LIMESTONE STORAGE
13258
72-D2
C

Figure 6.2

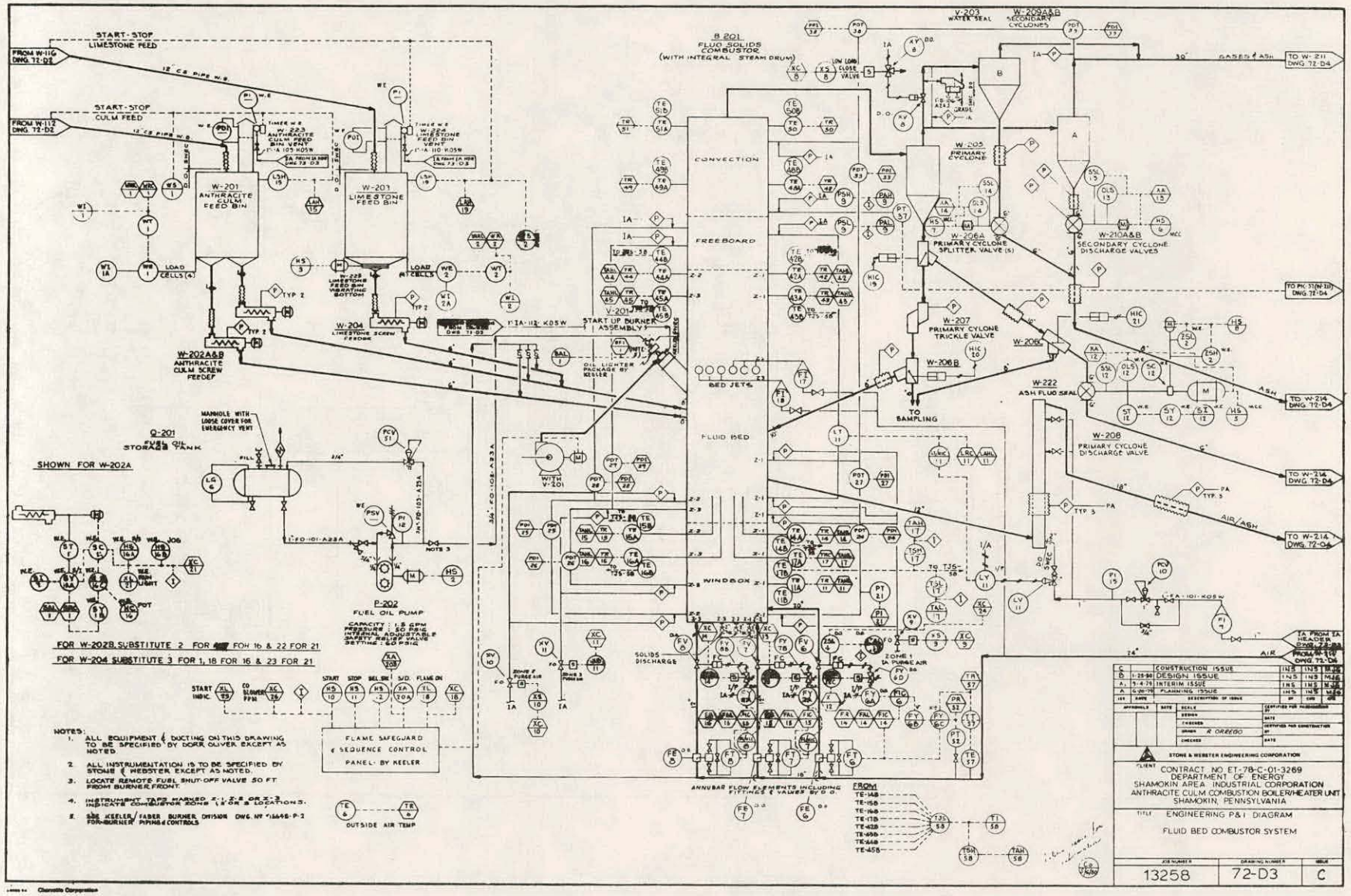
B-201
FLUID SOLIDS COMBUSTOR
(WITH INTEGRAL STEAM DRUM)
W-201
ANTHRACITE CULM FEED BIN
W-201
LIMESTONE FEED BIN
W-202A&B
ANTHRACITE CULM SCREW FEEDER
W-204
LIMESTONE SCREW FEEDER
V-201
START UP BURNER ASSEMBLY
V-203
WATER SEAL
W-209A&B
SECONDARY CYCLONES
W-205
PRIMARY CYCLONE
W-206A
PRIMARY CYCLONE SPLITTER VALVE (S)
W-206B
TO SAMPLING
W-207
PRIMARY CYCLONE TRICKLE VALVE
W-208
PRIMARY CYCLONE DISCHARGE VALVE
W-210A&B
SECONDARY CYCLONE DISCHARGE VALVES
W-222
ASH FLUO SEAL
CONVECTION
FREEBOARD
FLUID BED
WINDBOX
BED JETS
SOLIDS DISCHARGE
Q-201
STORAGE OIL TANK
P-202
FUEL OIL PUMP
FLAME SAFEGUARD & SEQUENCE CONTROL PANEL- BY KEELER
SHOWN FOR W-202A
FOR W-202B SUBSTITUTE 2 FOR
FOR W-204 SUBSTITUTE 3 FOR 1, 18 FOR 16 & 23 FOR 21
NOTES:
1. ALL EQUIPMENT & DUCTING ON THIS DRAWING TO BE SPECIFIED BY DORR OLIVER EXCEPT AS NOTED.
2. ALL INSTRUMENTATION IS TO BE SPECIFIED BY STONE & WEBSTER EXCEPT AS NOTED.
3. LOCATE REMOTE FUEL SHUT-OFF VALVE 50 FT FROM BURNER FRONT.
4. INSTRUMENT TAGS MARKED X-1, 2, 3 OR X-2, INDICATE COMBUSTOR ZONE (1 OR 2) LOCATIONS.
5. SEE KEELER/FABER BURNER DIVISION DWG. NO. 16648-P-2 FOR BURNER PIPING & CONTROLS.
TO W-211 DWG. 72-D4
TO W-214 DWG. 72-D4
TO PC 51 (W-217) DWG. 72-D4
TO W-214 DWG. 72-D4
TO W-214 DWG. 72-D4
FROM TA HEADER DWG. 72-D8
FROM W-116 DWG. 72-D2
FROM W-112 DWG. 72-D2
C CONSTRUCTION ISSUE
B 1-25-80 DESIGN ISSUE
A 9-4-79 INTERIM ISSUE
- 6-29-79 PLANNING ISSUE
STONE & WEBSTER ENGINEERING CORPORATION
CLIENT CONTRACT NO. ET-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
TITLE ENGINEERING P&I DIAGRAM
FLUID BED COMBUSTOR SYSTEM
13258
72-D3
C

Figure 6.3

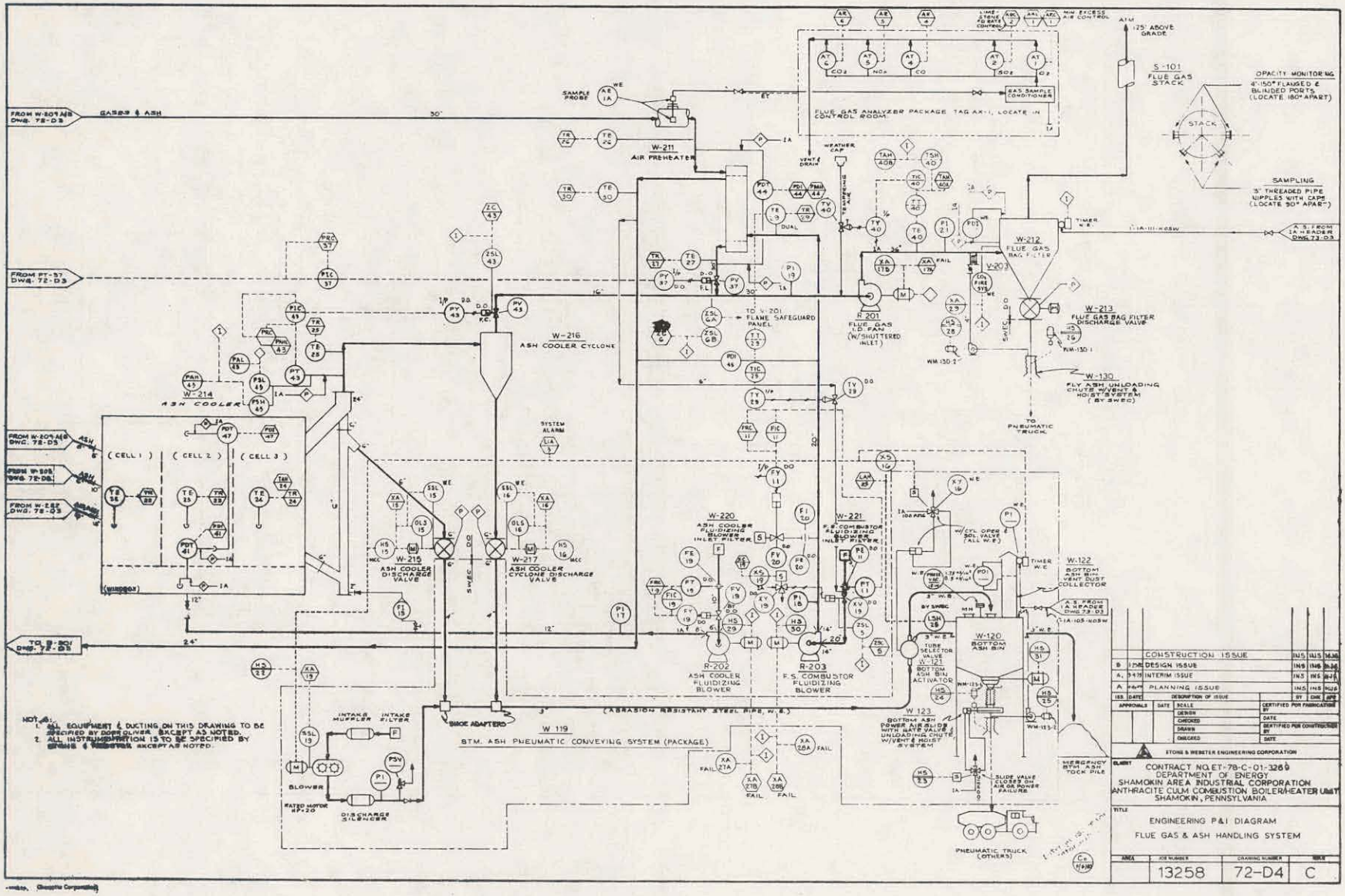
W-211 AIR PREHEATER
W-216 ASH COOLER CYCLONE
W-214 ASH COOLER
W-215 ASH COOLER DISCHARGE VALVE
W-217 ASH COOLER CYCLONE DISCHARGE VALVE
W-220 ASH COOLER FLUIDIZING BLOWER INLET FILTER
W-221 F.S. COMBUSTOR FLUIDIZING BLOWER INLET FILTER
R-201 FLUE GAS I.D. FAN (W/SHUTTERED INLET)
W-212 FLUE GAS BAG FILTER
W-213 FLUE GAS BAG FILTER DISCHARGE VALVE
W-130 FLY ASH UNLOADING CHUTE W/VENT & NOISE SYSTEM (BY SWEC)
S-101 FLUE GAS STACK
OPACITY MONITORING 4"-150# FLANGED & BLINDED PORTS (LOCATE 180° APART)
SAMPLING 3" THREADED PIPE NIPPLES WITH CAPS (LOCATE 90° APART)
FLUE GAS ANALYZER PACKAGE TAG AX-11, LOCATE IN CONTROL ROOM
GAS SAMPLE CONDITIONER
SAMPLE PROBE
W-122 BOTTOM ASH BIN VENT DUST COLLECTOR
W-120 BOTTOM ASH BIN
W-121 BOTTOM ASH BIN ACTIVATOR
W-123 BOTTOM ASH POWER AIR SLIDE WITH GATE VALVE UNLOADING CHUTE W/VENT & NOISE SYSTEM
R-202 ASH COOLER FLUIDIZING BLOWER
R-203 F.S. COMBUSTOR FLUIDIZING BLOWER
W 119 BTM. ASH PNEUMATIC CONVEYING SYSTEM (PACKAGE)
SHOE ADAPTER
(ABRASION RESISTANT STEEL PIPE, W.E.)
EMERGENCY BTM. ASH ROCK PILE
PNEUMATIC TRUCK (OTHERS)
TO PNEUMATIC TRUCK
TO W-201 FLAME SAFEGUARD PANEL
SYSTEM ALARM
(CELL 1) (CELL 2) (CELL 3)
INTAKE MUFFLER
INTAKE FILTER
BLOWER
DISCHARGE SILENCER
FROM W-209 A&B DWG. 72-D2
FROM PT-57 DWG. 72-D3
FROM W-209 A&B DWG. 72-D5
FROM W-209 DWG. 72-D6
FROM W-252 DWG. 72-D5
TO W-201 DWG. 72-D5
A.S. FROM 1A HEADER DWG. 72-D3
GASES & ASH
NOTES:
1. ALL EQUIPMENT & DUCTING ON THIS DRAWING TO BE SPECIFIED BY DOPPELMAYER EXCEPT AS NOTED.
2. ALL INSTRUMENTATION IS TO BE SPECIFIED BY STONE & WEBSTER EXCEPT AS NOTED.
CONSTRUCTION ISSUE
DESIGN ISSUE
INTERIM ISSUE
PLANNING ISSUE
STONE & WEBSTER ENGINEERING CORPORATION
CONTRACT NO. ET-78-C-01-3260
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CLUM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
ENGINEERING P&I DIAGRAM
FLUE GAS & ASH HANDLING SYSTEM
13258
72-D4
C

Figure 6.4

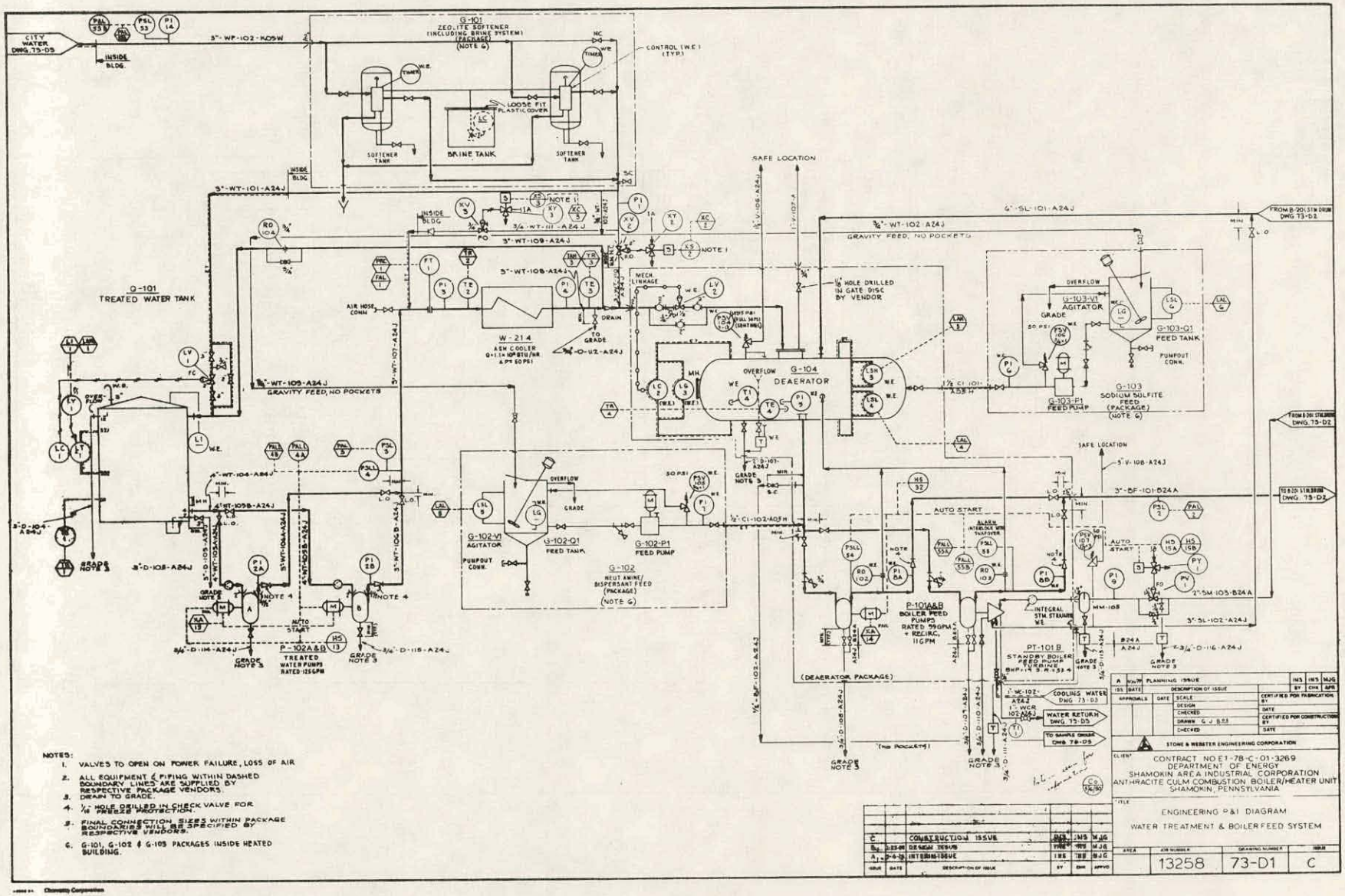
G-101
ZEOLITE SOFTENER (INCLUDING BRINE SYSTEM) (PACKAGE) (NOTE 6)
BRINE TANK
SOFTENER TANK
G-101 TREATED WATER TANK
W-21.4 ASH COOLER
G-104 DEAERATOR
G-102-V1 AGITATOR
G-102-Q1 FEED TANK
G-102-P1 FEED PUMP
G-102 NEUT AMINE/ DISPERSANT FEED (PACKAGE) (NOTE 6)
G-103-V1 AGITATOR
G-103-Q1 FEED TANK
G-103-P1 FEED PUMP
G-103 SODIUM SULFITE FEED (PACKAGE) (NOTE 6)
P-102A&B TREATED WATER PUMPS RATED 125GPM
P-101A&B BOILER FEED PUMPS RATED 990GPM + RECIRC. 11GPM
PT-101B STANDBY BOILER FEED PUMP TURBINE
(DEAERATOR PACKAGE)
CITY WATER DWG. 73-D5
TREATED WATER TANK
AUTO START
SAFE LOCATION
GRAVITY FEED, NO POCKETS
COOLING WATER DWG. 73-D3
WATER RETURN DWG. 73-D5
TO SAMPLE GRADE DWG. 78-D5
NOTES:
1. VALVES TO OPEN ON POWER FAILURE, LOSS OF AIR
2. ALL EQUIPMENT & PIPING WITHIN DASHED BOUNDARY LINES ARE SUPPLIED BY RESPECTIVE PACKAGE VENDORS.
3. DRAIN TO GRADE.
4. 1/16 HOLE DRILLED IN CHECK VALVE FOR FREEZE PROTECTION.
5. FINAL CONNECTION SIZES WITHIN PACKAGE BOUNDARIES WILL BE SPECIFIED BY RESPECTIVE VENDORS.
6. G-101, G-102 & G-103 PACKAGES INSIDE HEATED BUILDING.
CONTRACT NO E1-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
ENGINEERING P&I DIAGRAM
WATER TREATMENT & BOILER FEED SYSTEM
STONE & WEBSTER ENGINEERING CORPORATION
13258
73-D1
C

Figure 6.5

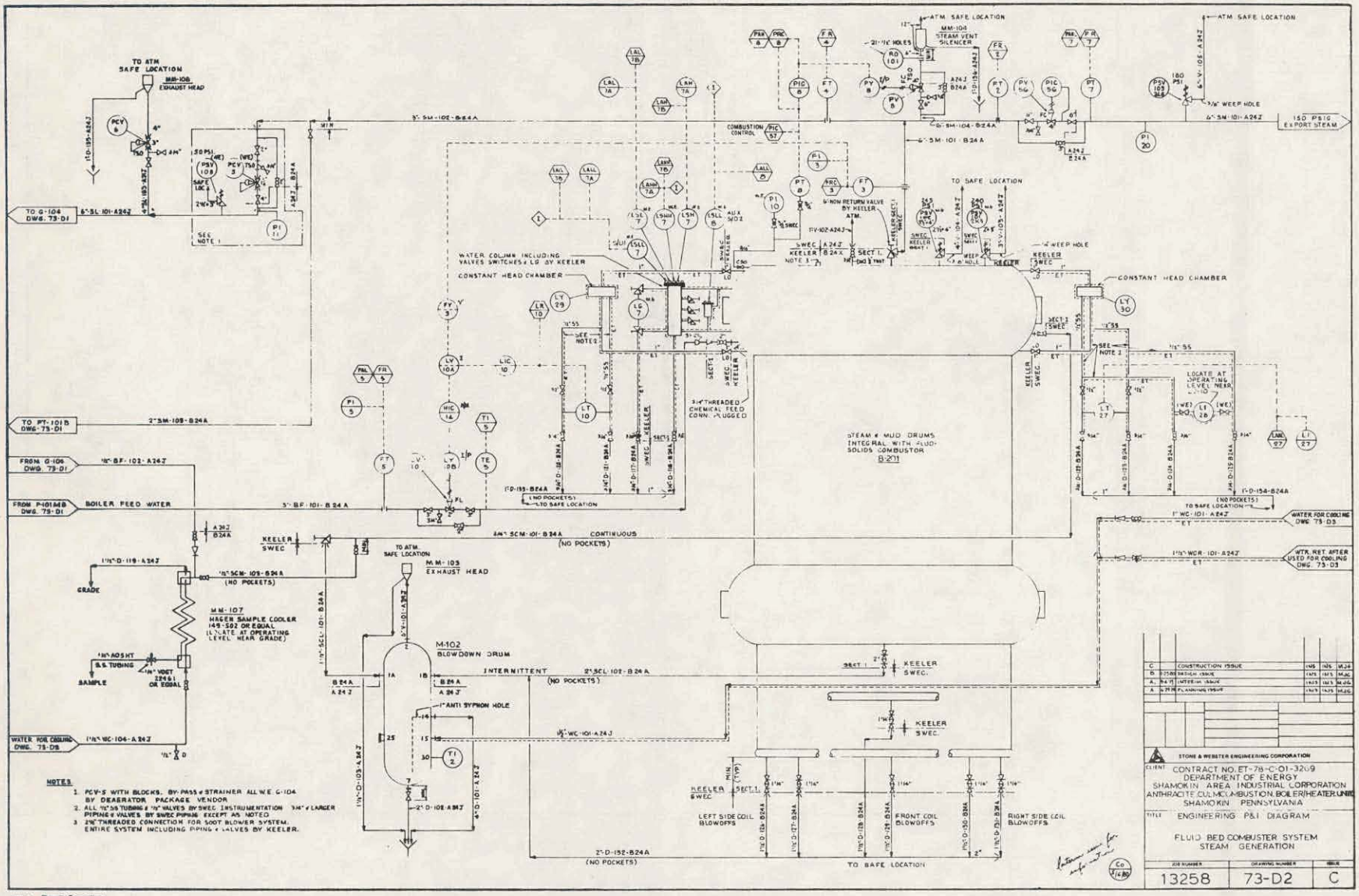
TO ATM SAFE LOCATION
MM-108 EXHAUST HEAD
ATM. SAFE LOCATION
MM-104 STEAM VENT SILENCER
150 PSIG EXPORT STEAM
TO G-104 DWG. 73-D1
TO SAFE LOCATION
WATER COLUMN INCLUDING VALVES SWITCHES & LG BY KEELER
CONSTANT HEAD CHAMBER
STEAM & MUD DRUMS INTEGRAL WITH FLUID-SOLIDS COMBUSTOR D-211
TO PT-101B DWG. 73-D1
FROM G-106 DWG. 73-D1
FROM P-101AB DWG. 73-D1
BOILER FEED WATER
MM-107 HAGER SAMPLE COOLER 149-502 OR EQUAL (LOCATE AT OPERATING LEVEL NEAR GRADE)
SAMPLE
GRADE
MM-103 EXHAUST HEAD
M-102 BLOWDOWN DRUM
INTERMITTENT
CONTINUOUS
(NO POCKETS)
KEELER SWEC.
WATER FOR COOLING DWG. 73-D3
WTR. RET. AFTER USED FOR COOLING DWG. 73-D3
LEFT SIDE COIL BLOWOFFS
FRONT COIL BLOWOFFS
RIGHT SIDE COIL BLOWOFFS
NOTES
1. PCV-5 WITH BLOCKS, BY-PASS & STRAINER ALL W.E. G-104 BY DEAERATOR PACKAGE VENDOR
2. ALL 1/2" SS TUBING & 1/2" VALVES BY SWEC INSTRUMENTATION 3/4" & LARGER PIPING & VALVES BY SWEC PIPING EXCEPT AS NOTED
3. 2" THREADED CONNECTION FOR SOOT BLOWER SYSTEM. ENTIRE SYSTEM INCLUDING PIPING & VALVES BY KEELER.
STONE & WEBSTER ENGINEERING CORPORATION
CLIENT
CONTRACT NO. ET-78-C-01-3209
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN PENNSYLVANIA
TITLE
ENGINEERING P&I DIAGRAM
FLUID BED COMBUSTER SYSTEM
STEAM GENERATION
JOB NUMBER 13258
DRAWING NUMBER 73-D2
ISSUE C

Figure 6.6

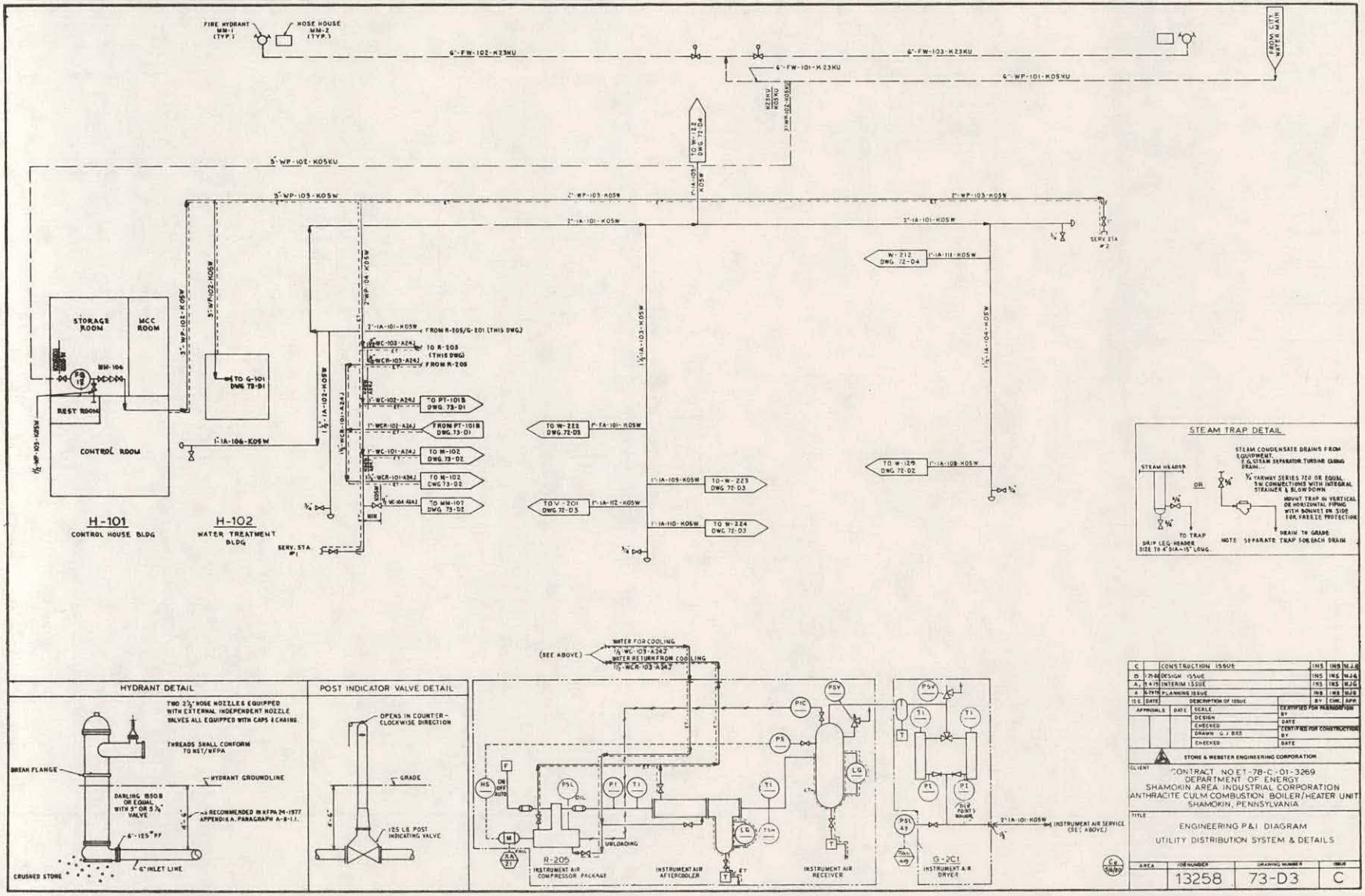
FIRE HYDRANT MM-1 (TYP.)
HOSE HOUSE MM-2 (TYP.)
6"-FW-102-K23KU
6"-FW-101-K23KU
6"-FW-103-K23KU
6"-WP-101-K05KU
FROM CITY WATER MAIN
5"-WP-102-K05KU
5"-WP-103-K05W
2"-WP-103-K05W
2"-1A-101-K05W
STORAGE ROOM
MCC ROOM
REST ROOM
CONTROL ROOM
MM-106
H-101
CONTROL HOUSE BLDG
H-102
WATER TREATMENT BLDG
SERV. STA. #1
SERV. STA. #2
TO G-101 DWG 73-01
TO R-205 (THIS DWG)
FROM R-205/G-201 (THIS DWG)
TO PT-101B DWG. 73-01
FROM PT-101A DWG. 73-01
TO M-102 DWG. 73-02
TO N-102 DWG 73-02
TO MM-107 DWG 73-02
TO W-222 DWG. 72-04
TO W-223 DWG. 72-03
TO W-224 DWG. 72-03
TO W-129 DWG. 72-02
TOV-201 DWG 72-05
W-212 DWG. 72-04
STEAM TRAP DETAIL
STEAM HEADER
OR
TO TRAP
DRIP LEG HEADER SIZE TO 4" DIA-15" LONG.
DRAIN TO GRADE
NOTE SEPARATE TRAP FOR EACH DRAIN
HYDRANT DETAIL
TWO 2½" HOSE NOZZLES EQUIPPED WITH EXTERNAL INDEPENDENT NOZZLE VALVES ALL EQUIPPED WITH CAPS & CHAINS
THREADS SHALL CONFORM TO NST/NFPA
BREAK FLANGE
HYDRANT GROUNDLINE
DARLING B50B OR EQUAL WITH 5" OR 5¼" VALVE
RECOMMENDED IN NFPA 24-1977 APPENDIX A, PARAGRAPH A-8-1.1.
6"-125# FF
6" INLET LINE
CRUSHED STONE
POST INDICATOR VALVE DETAIL
OPENS IN COUNTER-CLOCKWISE DIRECTION
GRADE
125 LB POST INDICATING VALVE
WATER FOR COOLING (SEE ABOVE)
WATER RETURN FROM COOLING
R-205
INSTRUMENT AIR COMPRESSOR PACKAGE
INSTRUMENT AIR AFTERCOOLER
INSTRUMENT AIR RECEIVER
G-2C1
INSTRUMENT AIR DRYER
INSTRUMENT AIR SERVICE (SEE ABOVE)
C CONSTRUCTION ISSUE
D 7-76 DESIGN ISSUE
A, B 4-76 INTERIM ISSUE
A 5-75 PLANNING ISSUE
STONE & WEBSTER ENGINEERING CORPORATION
CONTRACT NO ET-78-C-01-3269
DEPARTMENT OF ENERGY
SHAMOKIN AREA INDUSTRIAL CORPORATION
ANTHRACITE CULM COMBUSTION BOILER/HEATER UNIT
SHAMOKIN, PENNSYLVANIA
ENGINEERING P&I DIAGRAM
UTILITY DISTRIBUTION SYSTEM & DETAILS
AREA 13258
DRAWING NUMBER 73-D3
ISSUE C

Figure 6.7

LINE DESIGNATION TABLE INDEX

J.O. NO. 13258

CLIENT CURTISS-WRIGHT, SHAMOKIN

ISSUE (C₀) 5-6-83 6-20-79 PAGE 1

LINE DESIGNATION	FLOWING FLUID	PAGE NO.
BF	BOILER FEED WATER	2
CI	CHEMICAL INJECTION	3
D	DRAINS	4, 5, 5A
DS	SANITARY SEWER	
FA	ASH FLO SEAL AIR	6
FO	FUEL OIL	7
FW	FIRE WATER	8
IA	INSTRUMENT AIR	8A
PA	PURGE AIR TO EQUIPMENT	
SA	PLANT AIR	
SCL	LOW PRESSURE STM. CONDENSATE	9
SCM	MEDIUM PRESSURE STM. CONDENSATE	10
SL	LOW PRESSURE STEAM	11
SM	MEDIUM PRESSURE STEAM	12
V	VENT	13

LINE DESIGNATION	FLOWING FLUID	PAGE NO.
WC	WATER FOR COOLING	14
WCR	WATER RETURN AFTER COOLING	15
WP	POTABLE CITY WATER	16
WT	TREATED WATER	17, 18
BOILER	CODE (SYMBOL "X" SUFFIX ON CLASS ϕ	LINE NOS.)
BF	BOILER FEED WATER	19
SCM	MEDIUM PRESSURE STM CONDENSATE	20
SM	MEDIUM PRESSURE STEAM	21
V	VENT	22

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Figure 6.8

STONE & WEBSTER ENGINEERING CORPORATION
PROCESS INDUSTRIES GROUP

LINE DESIGNATION TABLE

ISSUE C_0 5-6-80

J.O. NUMBER 13258

CLIENT: CURTISS-WRIGHT, SHAMOKIN | PLANT NO. | BY: I N SCHOENWETTER | DATE: 6-20-79 | PAGE: 4

LINE						DESCRIPTION		DESIGN		FLEX TEMP. F	SHORT TERM CONDITIONS			FIELD TEST		INSULATION			FLOW DIAGRAM	REMARKS	REV
SERV. SYMB.	NUMBER	SIZE IN.	SPEC.	SCHEDULE	FLOW MED	FROM	TO	TEMP. F	PRESS. PSIG		CLASS	TEMP. F	PRESS. PSIG	MED.	PRESS. PSIG	CLASS	THICK IN.	TEMP. F			
D	101	4	A24J	40	L	M-102	DRAINS HUB.	200	ATM	—	—	—	—	—	—	N23A	1	200	73-D2	OVERFLOW	A_1
D	102	2	A24J	80	L	M-102	DRAINS HUB	200	ATM	—	—	—	—	—	—	N23A	1	200	73-D2		A_1
D	103	1½	A24J	80	L	M-103	DRAINS HUB	200	ATM	—	—	—	—	—	—	N23A	1	200	73-D2		B
D	104	3	A24J	40	L	Q-101	GRADE	100	ATM	—	—	—	—	—	—	N40A	0	—	73-D1	OVERFLOW	
D	105	3	A24J	40	L	Q-101	GRADE	100	ATM	—	—	—	—	—	—	N40A	0	—	73-D1	DRAIN	
D	106	1	A24J	80	L	V-203	GRADE	100	ATM	—	—	—	—	—		N10A	0	—	73-D3	WATER SEAL DRAIN	C_0
D	107	2	A24J	80	L	G-104 DRAIN	GRADE	212	ATM	—	—	—	—	—	—	N23A	1	212	73-D1		A
D	108	3/4	B24A	80	L	P-101A	SPEC BRK	228	290	—	B	228	350	H_2O	525	N20A	1	228	73-D1		B
		3/4	A24J	?	L	SPEC BRK	GRADE	212	ATM		—	—	—	—	—	N23A	1	212	73-D1		
D	109	3/4	B24A	80	L	P-101B	SPEC BRK	228	290	—	B	228	350	H_2O	525	N20A	1	228	73-D1		B
		3/4	A24J	80	L	SPEC BRK	GRADE	212	ATM	—	—	—	—	—	—	N23A	1	212	73-D1		A
D	110	3/4	B24A	80	L	P-101C	SPEC BRK	388	300	—	—	—	—	H_2O	300	N20A	1	388	73-D1	CASING DRAIN	
		3/4	A24J	80	L	SPEC BRK	GRADE	212	ATM	—	—	—	—	—	—	N23A	1	212	73-D1		A
D	111	3/4	A24J	80	L	PT-101B	STM TRAP	228	5	—	—	—	—	H_2O	100	N23A	1	228	73-D1		A_1
						STM TRAP	GRADE	212	ATM	—	—	—	—	—	—	N23A	1	212	73-D1		A
D	112	3/4	A24J	80	L	LINE WT-108	VALVE	90	95	—	—	—	—	H_2O	145	N40A	0	—	73-D1		B
					L	VALVE	GRADE	90	ATM	—	—	—	—	—	—	N40A	0	—	73-D1		B

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6.3 Plot Plan and Arrangement Studies

The following Drawings are provided herein:

Figure Number	Title
6.10	Plot Plan
6.11	Arrangement Study, Elevation - Sheet 1
6.12	Arrangement Study, Elevation - Sheet 2

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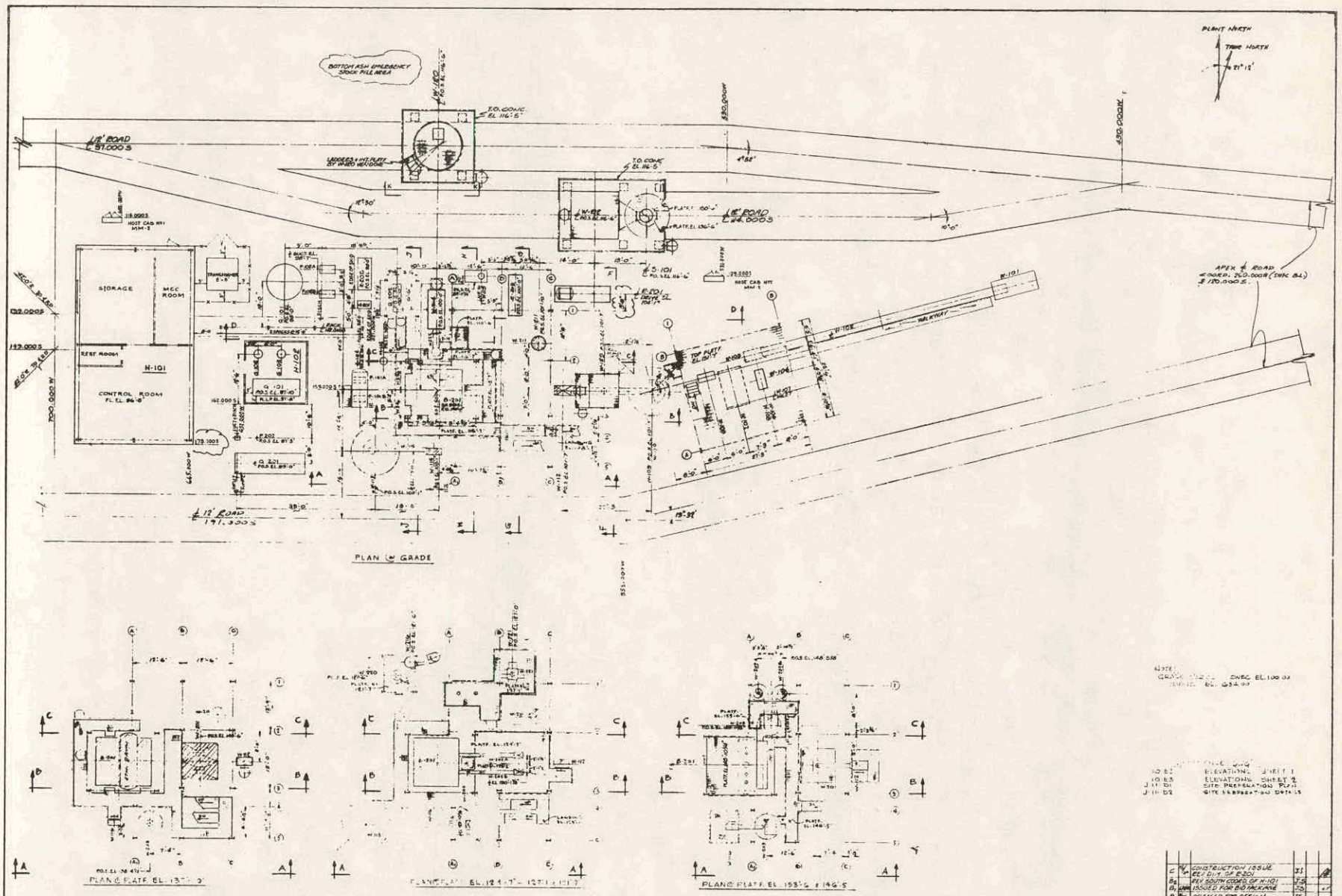

Figure 6.10