6.3.9.1 (Continued)

The unit is designed for continuous operation without turnaround.

Turndown capability is designed as needed.

Process Specificaticns

The Utility Cooling Water unit is designed to circulate 71,400 gpm based on 110 percent capacity. The total utility cooling water heat removal is 974.4×10^6 Btu/hr. The Utility Cooling Tower is designed for a 17°F approach to design wet bulb temperature based on the five percent corresponding summer dry bulb temperature. The feed stream to the Utility Cooling Tower is comprised of the following flows:

Unit	Flow (gpm)
Oxygen Production	10,400
Power Generation	54,100
Air & Nitrogen Supply	400

The inlet water temperature to the tower is 110°F.

Makeup to Unit 48 is 3451 gpm of treated raw water. Additives to the system include dispersant chemicals, acid for pH control, biocides and corrosion inhibitors.

The output of the Utility Cooling Tower is 64,900 gpm at a temperature of 80°F. Circulating water is pumped to 75 psig for distribution to the Utility Units.

Utility Requirements

Power	3900 kW
Treated Water Makeup	3451 gpm

6.3.9.2 PROCESS DESCRIPTION

Drawing No. 835704-48-4-101 and 835704-48-4-102 are the Flow Diagrams for Unit 48. The unit material balance (Table 6.3.9-1) follows the drawings. The plot plan is Drawing No. 835704-48-4-050 and the equipment is listed in Table 6.3.9-2.

Utility Cooling Tower

The Utility Cooling Tower is a conventional induced draft design that provides cooling for the Oxygen Production unit, Air and Nitrogen unit, and one turbine surface condenser in the power plant. Maintenance of the cold water temperature is by computer control which supervises fan operation, hot water bypass, and cooling cell isolation. Makeup to this tower consists of 3451 gpm raw water and low TDS waste water from water treating.

Protection of the tower against fire is an important consideration. The design incorporates a deluge system, and firestops to prevent propagation of fire between cells.

Cooling Water Distribution

A centralized cooling water distribution system is provided to supply one turbine condenser in the Power Generation unit and the cooling water requirements for the Oxygen Production unit. Selection of a central system versus individual units is based on cost and operating considerations.

Circulation of Cooling Water is provided by vertical mixed flow impeller pumps. Three 32,450 gpm motor driven pumps are provided, each rated at 75 psig discharge. Normally, two pumps operate with the third pump at standby. The pumps are arranged in a central pump pit which receives, by gravity, cold water from the cooling tower basins. The pump pit is equipped with trash racks and screens which are periodically manually cleaned. Vortex breakers are provided.

6.3.9.2 (Continued)

Due to the large cooling water circulation, consideration must be given to dynamic changes in the piping system as a result of pump tripout, etc. To accommodate sudden surges, the pumps are equipped with hydraulically operated auto-closing valves at each pump discharge. The valve is designed to close in two stages upon pump failure to prevent excessive pressures from developing in the distribution system as a result of sudden shutoff. The first stage is a rapid closure to approximately 75 percent of travel with the second stage set at a lower rate to achieve complete closure.

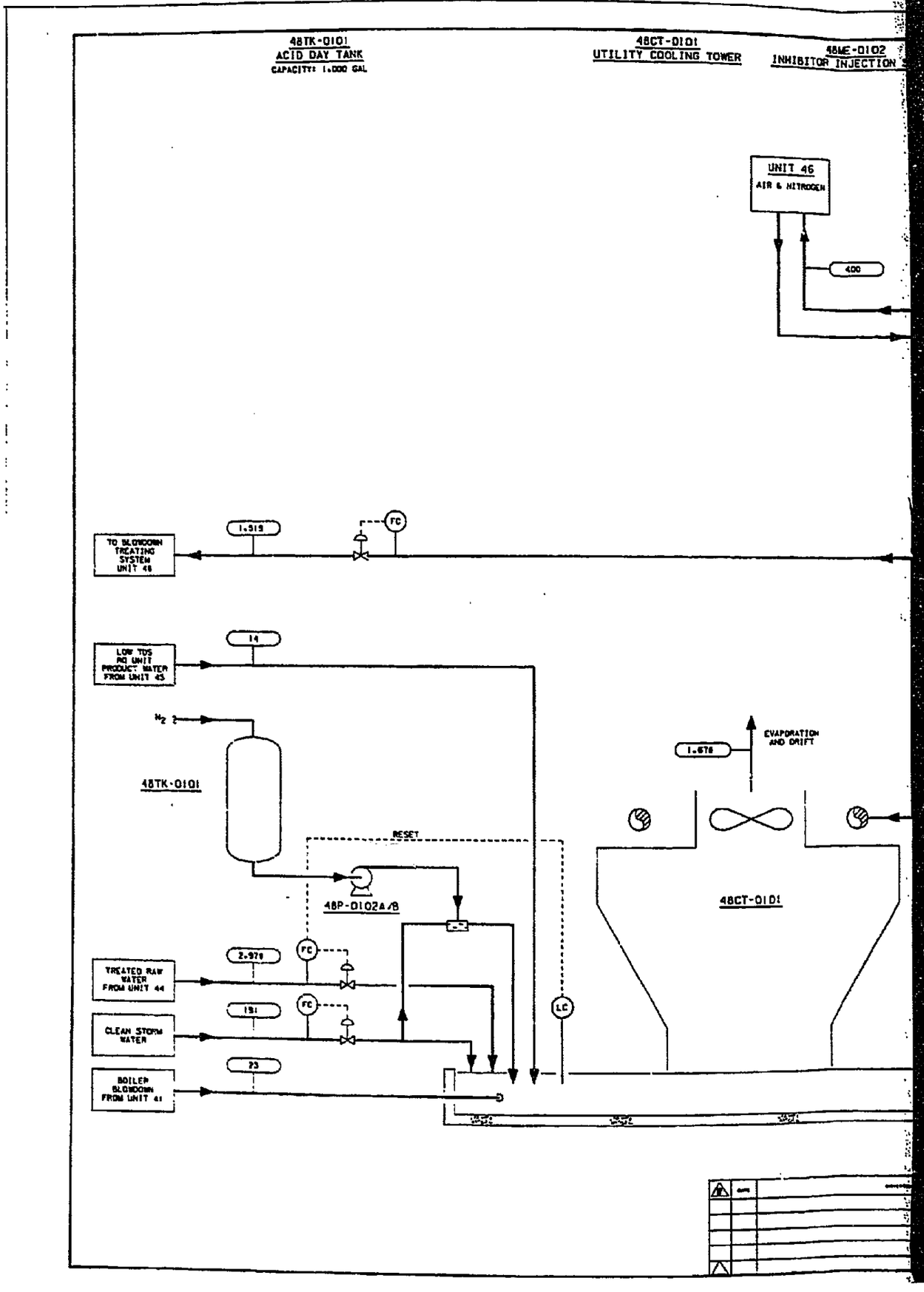
Chemical Treatment

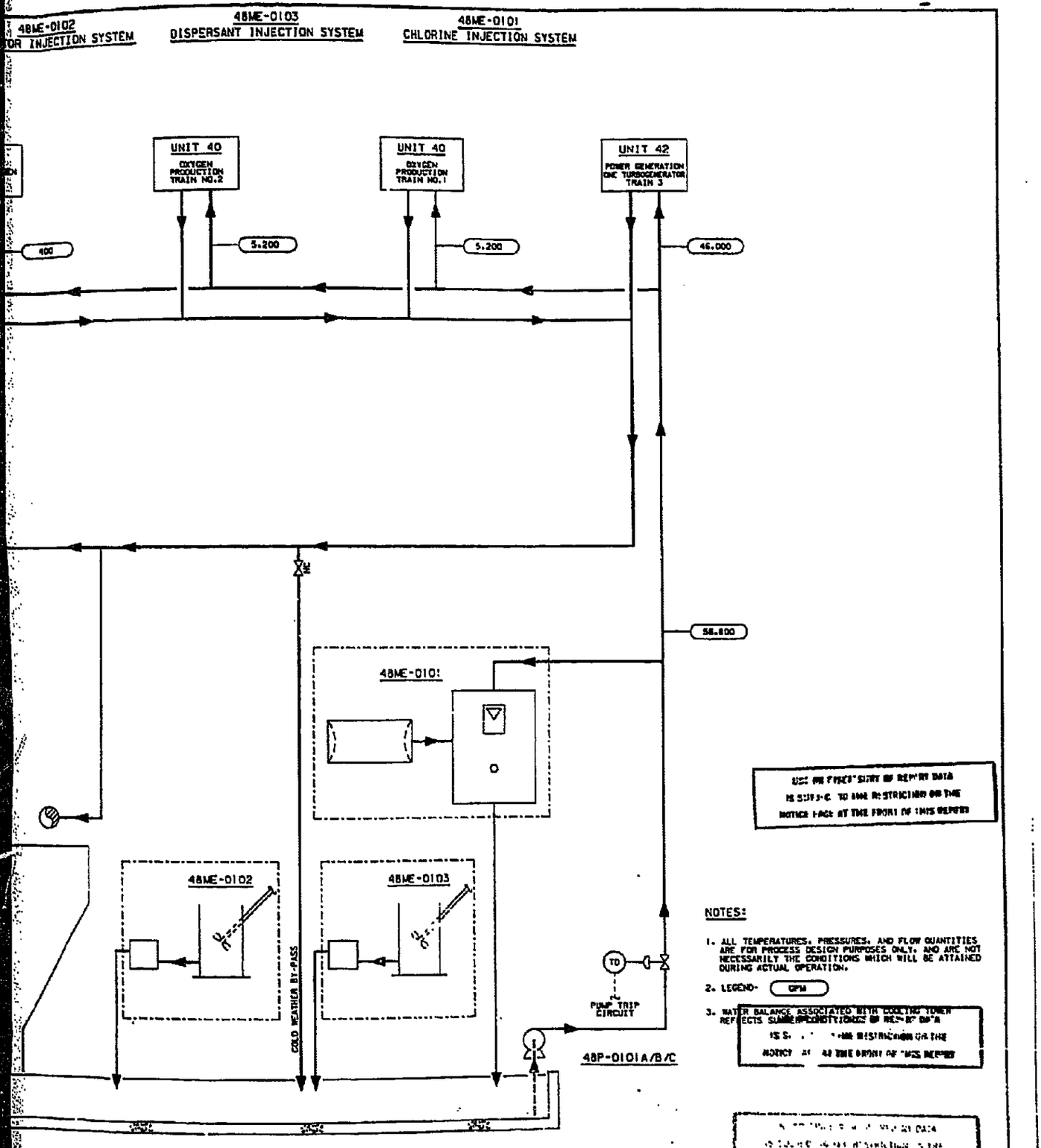
The following chemical addition systems are considered essential to provide the flexibility required to develop a successful cooling water treatment program and are included in the utility cooling tower design:

Dispersant chemical injection
pH control
Biocide injection
Corrosion inhibitor

The blowdown from the cooling tower is combined with other streams from the water treating area and treated by a system of softeners and filters. After chlorination the stream is lime softened, and filtered through four filters and sodium zeolite softened by four units. This water is recycled to the Process Cooling Tower.

Sludge from the lime softener is dewatered and disposed of by landfill. Treated water is recycled.


48TK-0101
ACID DAY TANK
CAPACITY: 1,000 GAL
48CT-0101
UTILITY COOLING TOWER
48ME-0102
INHIBITOR INJECTION
UNIT 46
AIR & NITROGEN
400
1,519
FC
TO BLOWDOWN TREATING SYSTEM UNIT 46
14
LOW TDS RO UNIT PRODUCT WATER FROM UNIT 45
H_2
48TK-0101
1,678
EVAPORATION AND DRIFT
RESET
48P-0102A/B
48CT-0101
2,979
TREATED RAW WATER FROM UNIT 44
191
CLEAN STORM WATER
23
BOILER BLOWDOWN FROM UNIT 41
LC



USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

NOTES:

1. ALL TEMPERATURES, PRESSURES, AND FLOW QUANTITIES ARE FOR PROCESS DESIGN PURPOSES ONLY, AND ARE NOT NECESSARILY THE CONDITIONS WHICH WILL BE ATTAINED DURING ACTUAL OPERATION.
2. LEGEND- GPM
3. WATER BALANCE ASSOCIATED WITH COOLING TOWER REFLECTS SUMMER CONDITIONS OF RELIEF DATA

USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

FLUOR

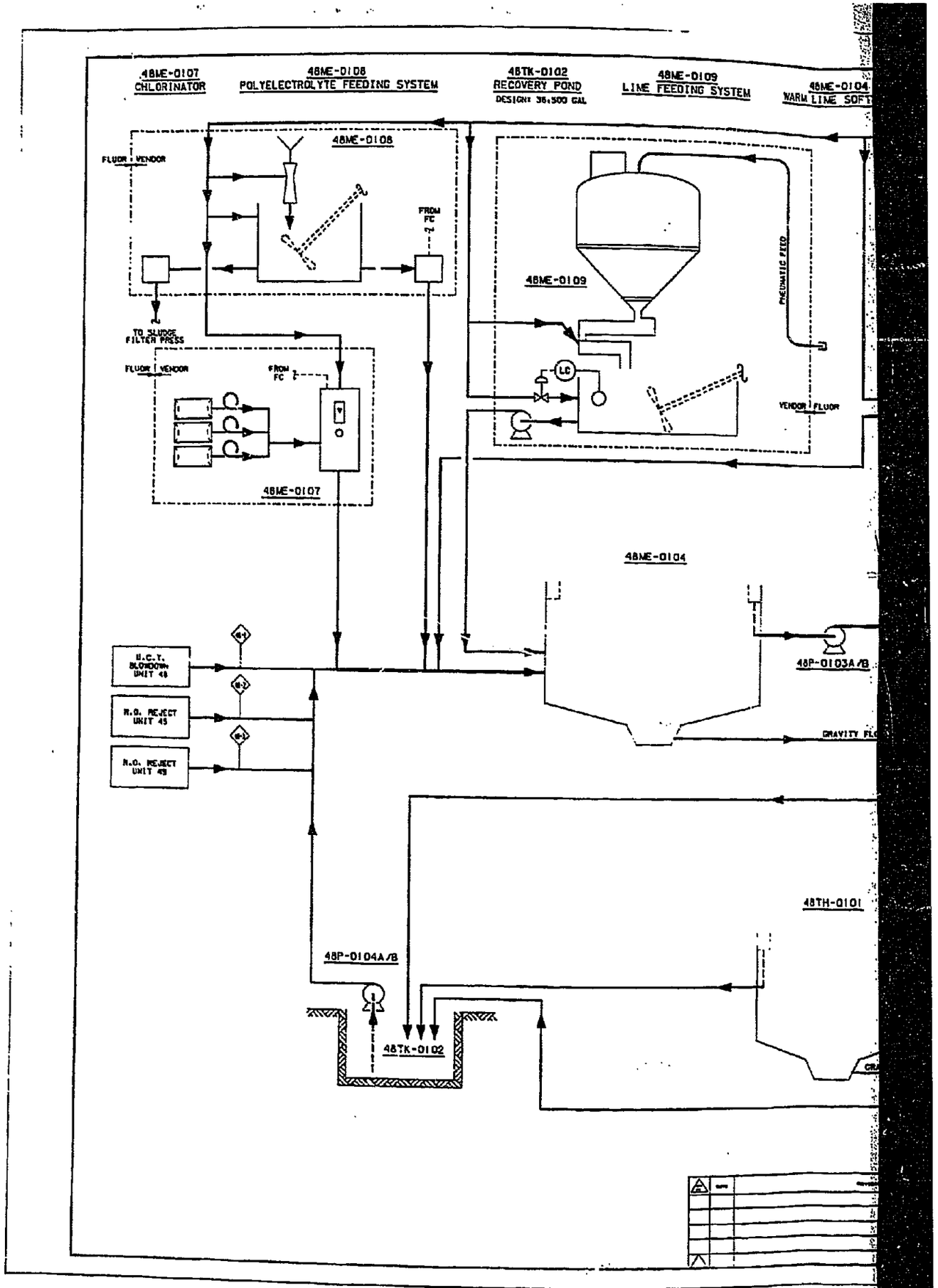
DRAWN BY	R. WHITE
DESIGNED BY	C.C. ABATAY
APPROVED BY	W.O'DELMETO
	P. McCARTHY
	J. LAND

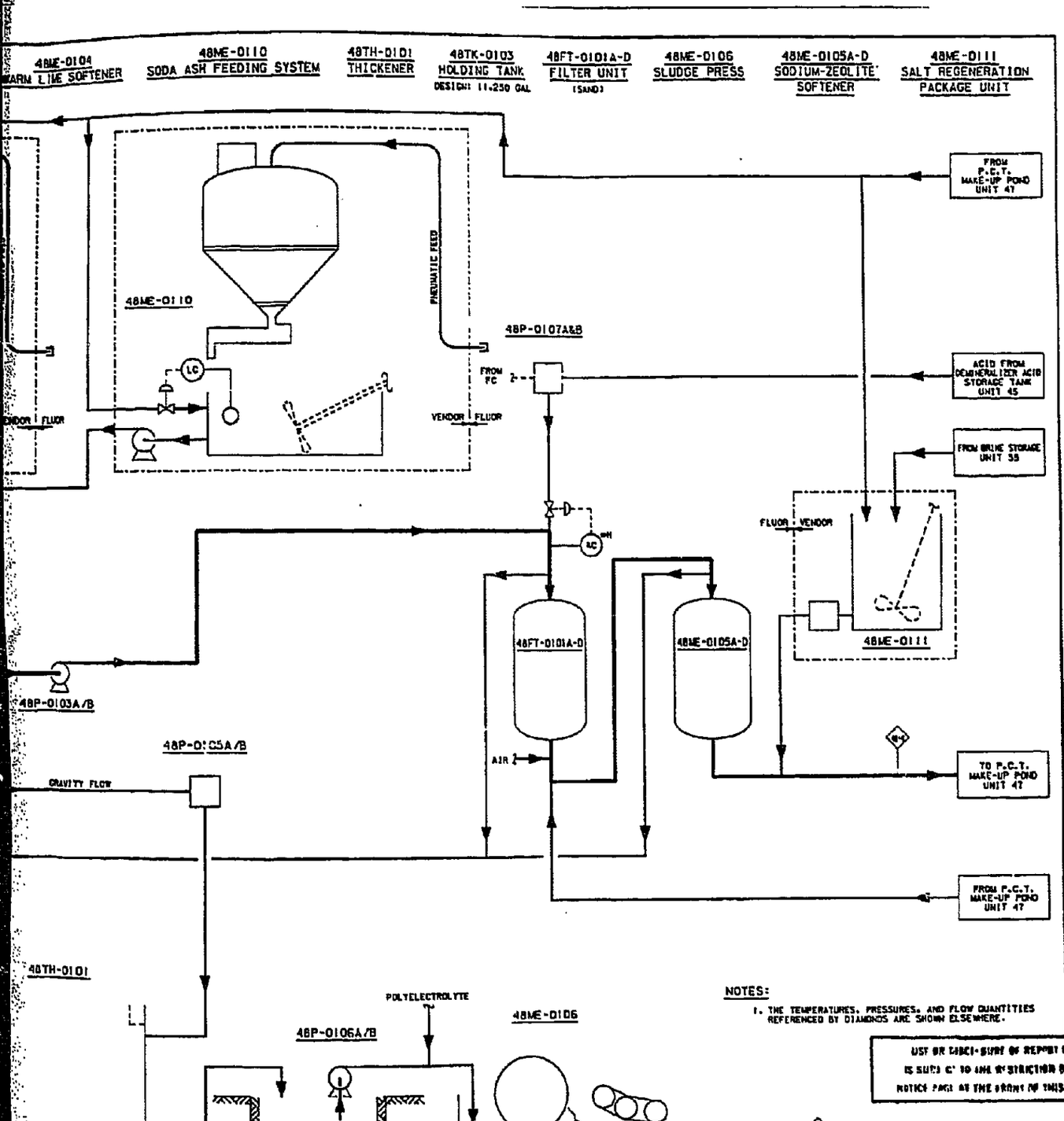
PROCESS FLOW DIAGRAM
UTILITY COOLING WATER SYSTEM
UNIT 48

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE	835704-48-4-101	1

003 3574810I


48ME-0107
CHLORINATOR
48ME-0108
POLYELECTROLYTE FEEDING SYSTEM
48TK-0102
RECOVERY POND
DESIGN: 36,500 GAL
48ME-0109
LIME FEEDING SYSTEM
48ME-0104
WARM LIME SOFT
48ME-0108
FLUOR - VENDOR
FROM FC
TO SLUDGE FILTER PRESS
48ME-0109
PNEUMATIC FEED
LC
VENDOR - FLUOR
FLUOR - VENDOR
FROM FC
48ME-0107
48ME-0104
48P-0103A/B
U.C.Y. BLOWDOWN UNIT 48
R.O. REJECT UNIT 45
R.O. REJECT UNIT 49
GRAVITY FL
48TH-0101
48P-0104A/B
48TK-0102



USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

FLUOR

R. WHITE
C.C. ABATAY
W.D. GETMAN
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
UTILITY COOLING WATER BLOWDOWN TREATMENT SYSTEM
UNIT 48
CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-48-4-102 | 1

003 3574B102

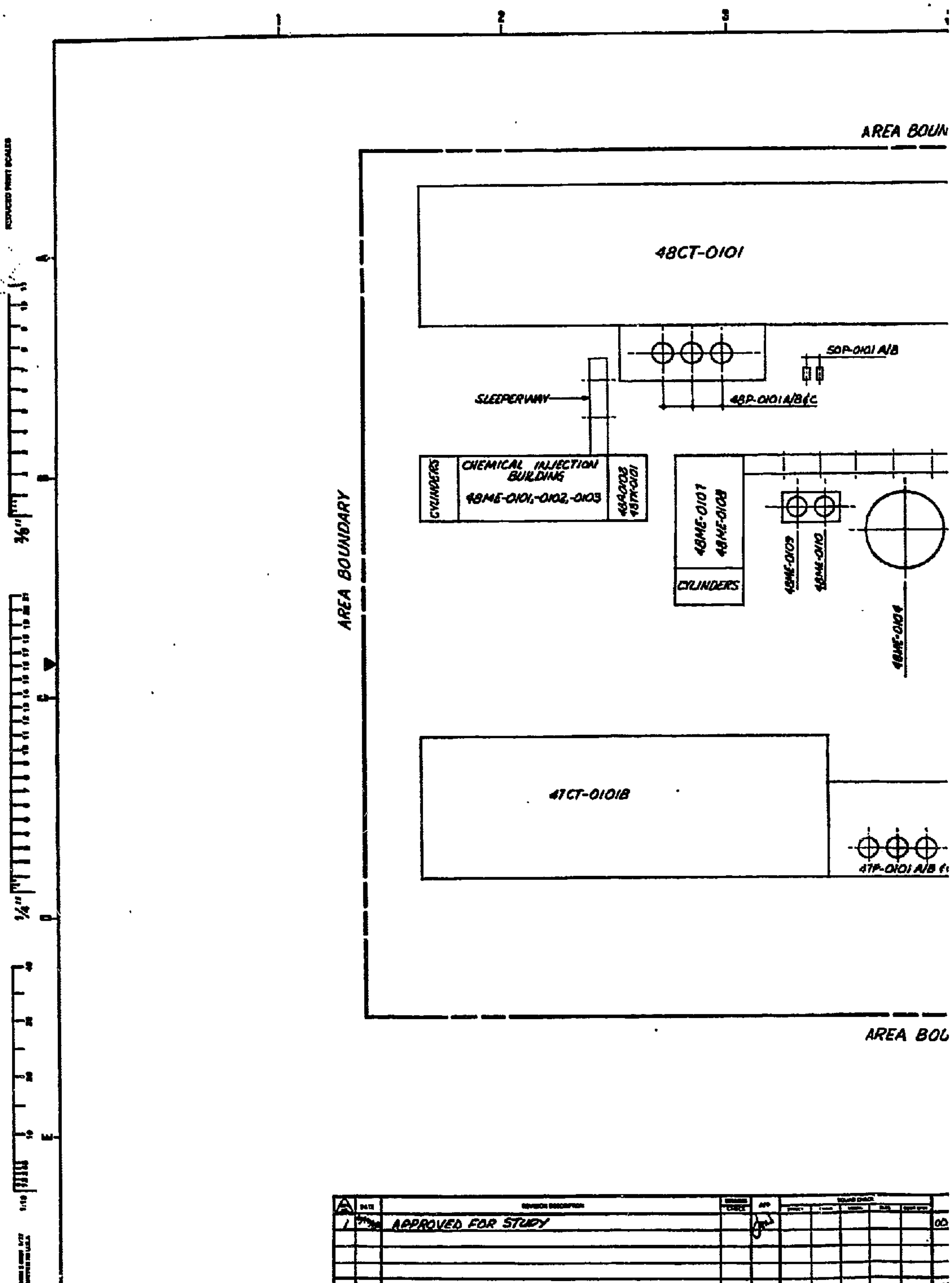
TABLE 6.3.9-1

MATERIAL BALANCE

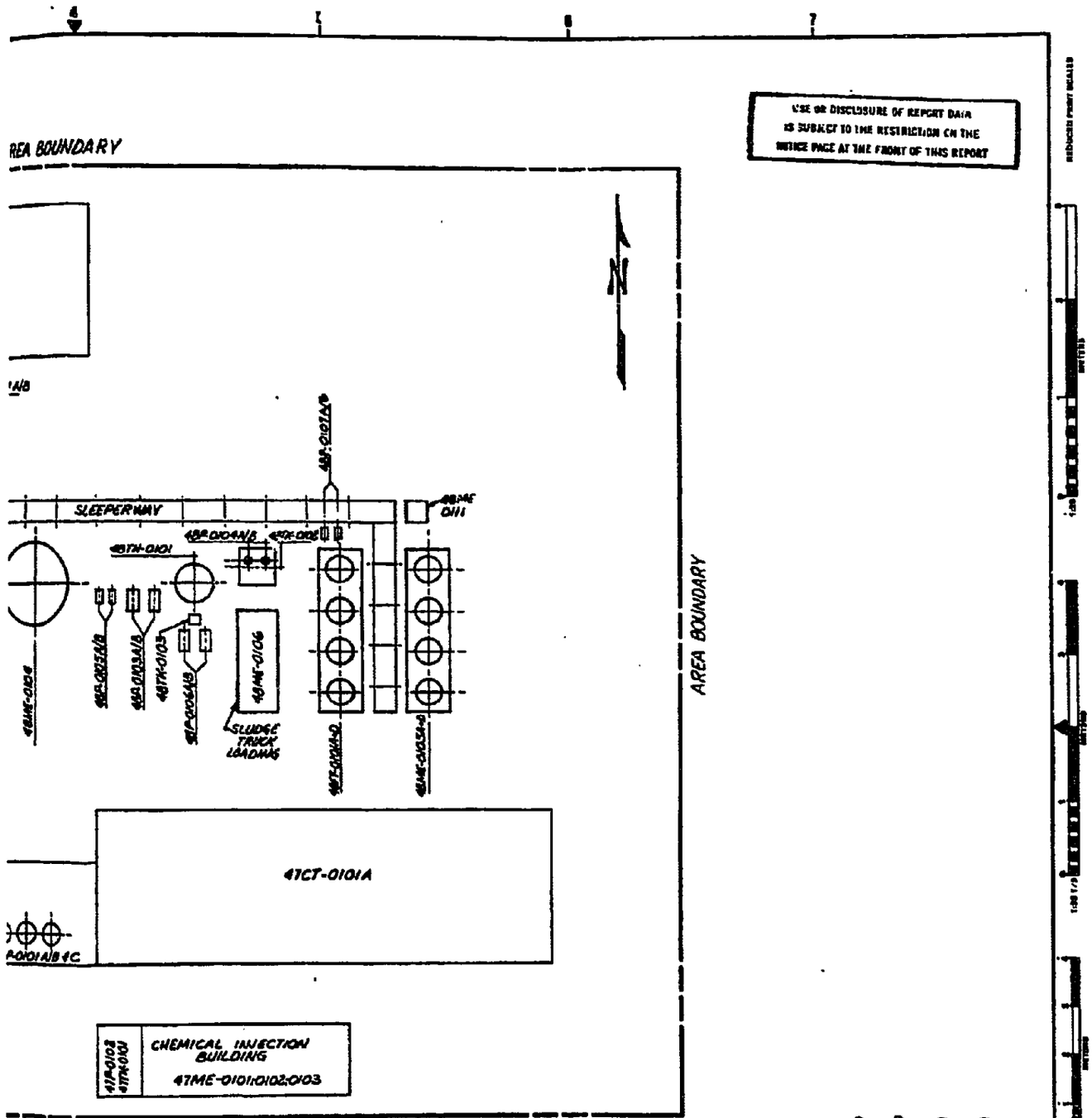
UTILITY COOLING WATER - UNIT 48

Stream Number		48-1	48-2	48-3	48-4	48-5
Stream Name		UCT Blowdown	RO Reject from Unit 45	RO Reject from Unit 49	Treated Water to PCT Makeup	Sludge to Landfill
Solids	lb/hr					750
Water	lb/hr	868,500	192,500	1500	992,000	4500
	(gpm)	(1737)	(385)	(3)	(1984)	(9)
Total	lb/hr	868,500	192,500	1500	992,000	5250
Pressure, psia		13.7	300	300	15.7	13.7
Temperature °F		110	80	80	80	70

NOTE: Flow quantities, pressures, and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.


AREA BOUNDARY
48CT-0101
50P-0101 A/B
48P-0101A/B&C
SLEEPERWAY
CYLINDERS
CHEMICAL INJECTION BUILDING
48ME-0101,-0102,-0103
48ME-0107
48ME-0108
CYLINDERS
48ME-0109
48ME-0110
48ME-0104
47CT-0101B
APPROVED FOR STUDY

USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT



REDUCED PRINT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE

	00-5-050	SITE "1" PLOT PLAN	FLUOR	J.PARODI / E.MOERTL / T.CONTI / J.SMETS / R.LANG	PLOT PLAN-UNITS 47,48 & 50 PROCESS & UTILITY COOLING TOWERS AND UTILITY WATER	
					CROW TRIBE OF INDIANS — MONTANA	
					1"-30'-0"	835704-48-4-050 / 1

TABLE 6.3.9-2

EQUIPMENT LIST

UTILITY COOLING WATER - UNIT 48

Item No.	Equipment Name	Number Required	
		Operating	Spare
48TK-0101	Acid Day Tank	1	0
48TK-0102	Blowdown Recovery Sump	1	0
48TK-0103	Sludge Holding Tank	1	0
48P-0101 A/B/C	Cooling Water Pumps	2	1
48P-0102 A/B	Acid Pump	1	1
48P-0103 A/B	Filtered Feed Pump	1	1
48P-0104 A/B	Recovery Pump	1	1
48P-0105 A/B	Softener Sludge Pump	1	1
48P-0106 A/B	Press Feed Pump	1	1
48P-0107 A/B	Acid Injection Pump	1	1
48FT-0101 A-D	Sand Filter Unit	3	1
48CT-0101	Utility Cooling Tower	1	0
48ME-0101	Chlorine Injection System	1	0
48ME-0102	Inhibitor Injection System	1	0
48ME-0103	Dispersant Injection System	1	0
48ME-0104	Hot Lime Softener	1	0
48ME-0105 A-D	Sodium Zeolite Softener	3	1
48ME-0106	Sludge Press	1	0
48ME-0107	Chlorination	1	0
48ME-0108	Polyelectrolyte Feed System	1	0

TABLE 6.3.9-2 (Continued)

EQUIPMENT LIST

UTILITY COOLING WATER - UNIT 48

Item No.	Equipment Name	Number Required	
		Operating	Spare
48ME-0109	Lime Feed System	1	0
48ME-0110	Soda Ash Feed System	1	0
48TH-0101	Thickener	1	0

6.3.10 POTABLE WATER - UNIT 49

6.3.10.1 DESIGN BASIS

Purpose of Unit

The Potable Water unit is designed to provide potable water for consumption and other sanitary uses by the work force and such miscellaneous uses as laboratories, safety showers, etc.

Scope of Unit

Unit 49 includes chlorination equipment; sand, activated carbon, and cartridge filtration; Reverse Osmosis (RO) purification with associated chemical additives; and decarbonation for CO_2 removal. The product potable water is stored in a 70,000 gal tank. Potable water is chlorinated as it is pumped from the storage tank to the distribution system.

General Design Criteria

The Potable Water unit is designed as a single train and sized for maximum plant staffing.

All pumps and mixers are spared. Filters are designed with at least one unit on regeneration/standby during normal operations.

The unit is designed for operation 365 days/year and is compatible with the overall plant stream factor of 332 days/year.

All equipment are motor driven.

6.3.10.1 (Continued)

The unit is designed for continuous operation without shutdown to change filter media.

Turndown capability is designed as needed.

Process Specifications

The Potable Water Unit 49 is designed to treat 50 gpm based on 50 gal/day per person with a maximum plant population of 1250. A fifteen percent additional capacity for miscellaneous uses is included in the design. The treatment is to reduce the Total Dissolved Solids (TDS) to less than 500 ppm and the fluoride level to less than one ppm maximum. This reduction requires RO purification of a portion of the water in addition to chlorination and filtration.

Feed

Feed to the Potable Water unit comes from the Raw Water Pond. The design analysis of this water is as follows:

Component	PPM as $CaCO_3$
Ca	185
Mg	124
Na	190
K	14
Cation Total	513

6.3.10.1 (Continued)

Component	PPM as $CaCO_3$
HCO_3	164
CO_3	0
OH	0
SO_4	317
Cl	27
NO_3	3
F	2
Anion Total	513
Fe	0.2
Mn	0.1
B	0.2
SiO_2	13
CO_2	9

Battery Limit Conditions

pH	7.6
Turbidity	118 Turbidity Units
TSS	20 ppm
TDS	748 ppm
Temp	60°F

Additives to the Potable Water Treatment include chlorination and RO preparation chemicals.

6.3.10.1 (Continued)

Products

The product potable water from Unit 49 meets the Federal Water Standards[1] listed below:

Metals	Required ppm (max)	Design ppm (max)
As	0.5	<0.5
Ba	1.00	<1.0
Cd	0.1	<0.1
Cr	0.5	<0.5
Pb	0.5	<0.5
Hg	0.002	<0.002
N (as NO_3)	10.0	<10.0
Se	0.1	<0.1
Ag	0.5	<0.5
Fluoride	2.2 (at 58.3°F Avg. Annual Daily Maximum Temperature)	1.0

Secondary Standards:

Metals	Required ppm (max)	Design ppm (max)
Cl	250	26
Cu	1	1
Fe	0.3	0
Mn	0.05	0
SO_4	250	167
Zn	5	5
Color	15 units	-

6.3.10.1 (Continued)

Metals	Required ppm (max)	Design ppm (max)
pH	6.5 - 8.5	7.0 - 7.2
Foaming Agents	0.5 ppm	-
Odor	3 threshold odor number	-
TDS	500 ppm	404

(1) CFR 40, sec. 141, 143

Utilities Required

Power 30 kW

6.3.10.2 PROCESS DESCRIPTION

Drawing Numbers 835704-49-4-101 and 835704-49-4-102 are the Flow Diagrams for Unit 49. The unit material balance (Table 6.3.10-1) and equipment list (Table 6.3.10-2) follow the drawings.

A stream of fifty-four gpm of raw water undergoes chlorination and filtration. The unit feed water is split approximately into halves. One half is purified by Reverse Osmosis and Decarbonation and the other by passed straight through to the storage tank. The recombined streams are chlorinated before use.

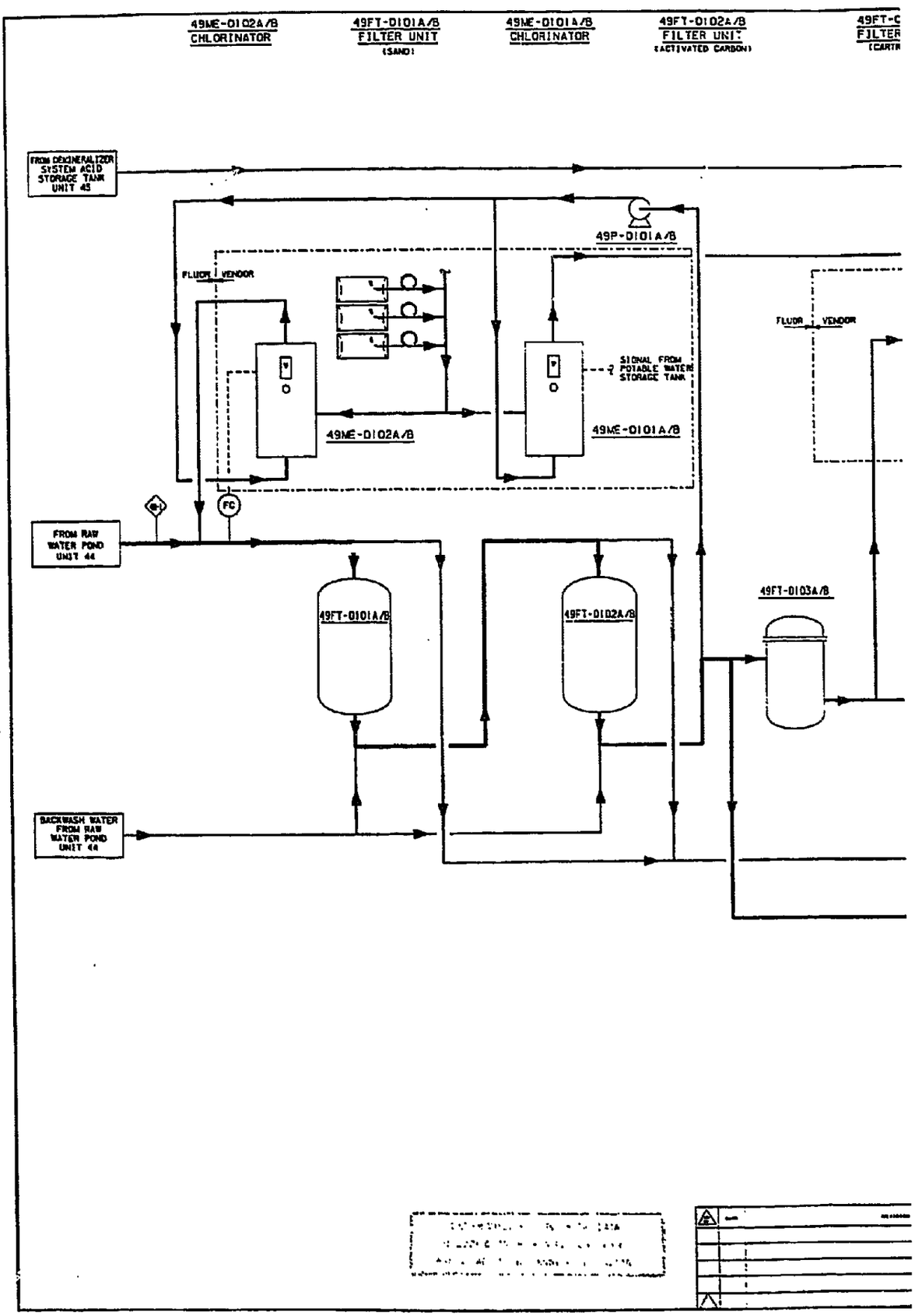
Raw water is pumped from the raw water storage pond, chlorinated and sent through dual media sand filters, activated carbon filters and micron cartridge filters to remove suspended solids and organic contaminants.

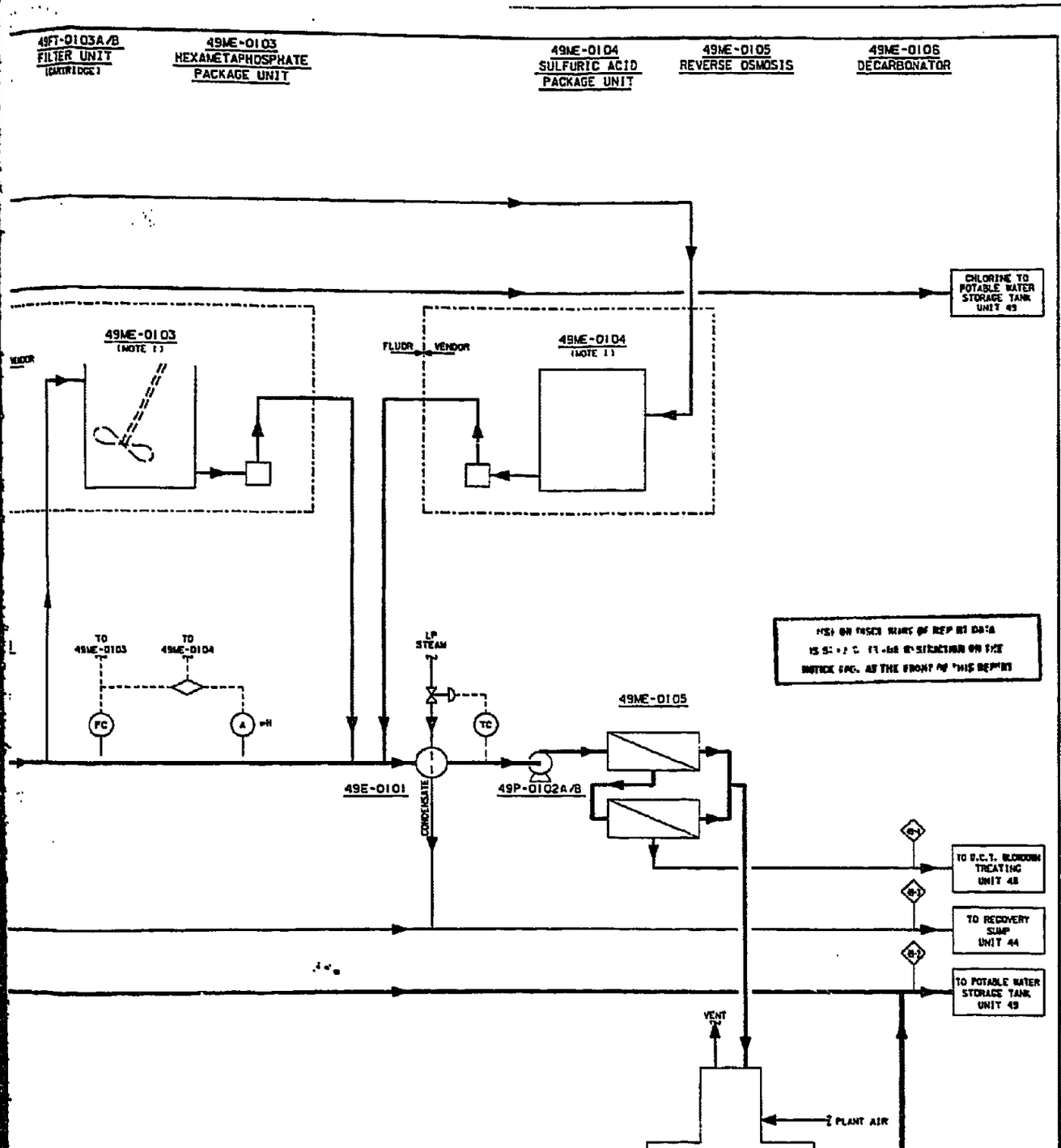
The stream is divided by a TDS controller on the final product storage tank. About half of the filtered water flows directly to the storage tank, and the other half to the Reverse Osmosis (RO) Unit where chemical

6.3.10.2 (Continued)

additives are injected, the temperature is adjusted and the pressure increased by pumping to about 450 psig for RO purification. The RO product flows to a decarbonator where air blown through it carries away CO_2, and on to the storage tank. The RO reject flows to the Utility Cooling Water blowdown treatment system in Unit 48.

The water is chlorinated as it exits storage to eliminate any biological contamination. The potable water lines are kept at continuous pressure by a recirculating pump system.


49ME-0102A/B
CHLORINATOR
49FT-0101A/B
FILTER UNIT
(SAND)
49ME-0101A/B
CHLORINATOR
49FT-0102A/B
FILTER UNIT
(ACTIVATED CARBON)
49FT-C
FILTER
(CARTR
FROM DEMINERALIZER SYSTEM ACID STORAGE TANK UNIT 45
49P-0101A/B
FLUOR VENDOR
SIGNAL FROM POTABLE WATER STORAGE TANK
49ME-0102A/B
49ME-0101A/B
FC
FROM RAW WATER POND UNIT 44
49FT-0101A/B
49FT-0102A/B
49FT-0103A/B
BACKWASH WATER FROM RAW WATER POND UNIT 44
FLUOR VENDOR



NOTES:

1. SUPPLIED AS VENDOR PACKAGE.
2. THE TEMPERATURES, PRESSURES, FLOW QUANTITIES AND COMPOSITIONS REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

R. WHITE
C.C. ABATAY
W.D. MCLMITO
R. McCARTNEY
R. LANG

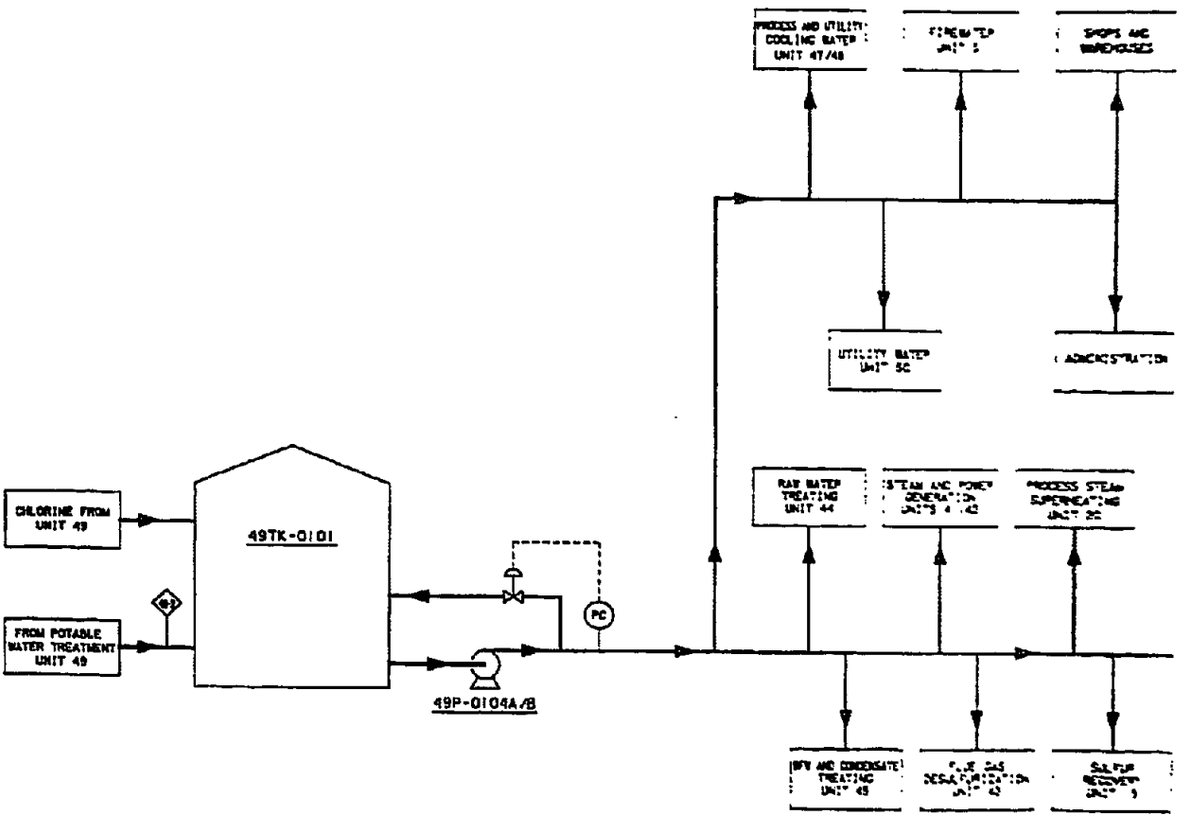
PROCESS FLOW DIAGRAM
POTABLE WATER TREATMENT SYSTEM
UNIT 49

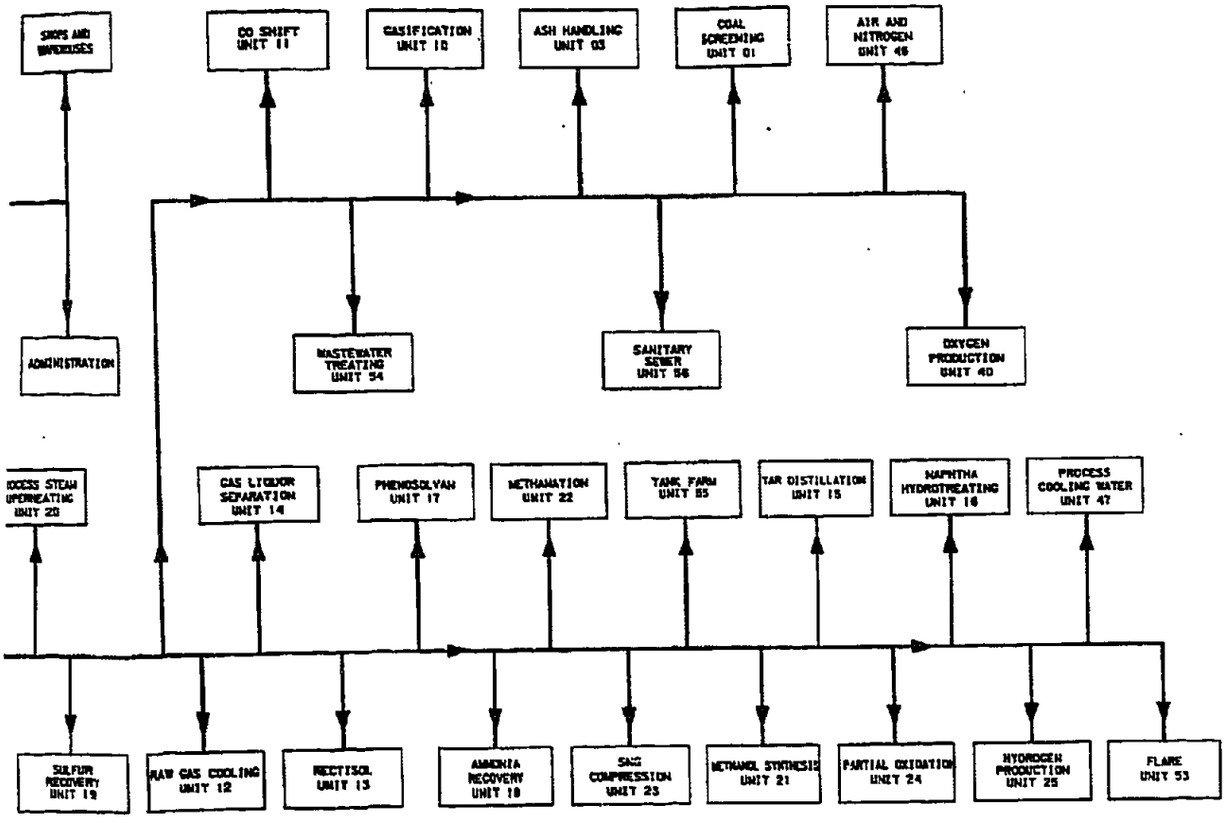
CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-49-4-101 | 1

003 3574910 1

49TK-0101
POTABLE WATER STORAGE TANK
WORKING CAPACITY: 70,000 GAL
1 DAY STORAGE





NOTE:

1. THE TEMPERATURES, PRESSURES, FLOW QUANTITIES AND COMPOSITIONS REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

DESIGNED BY	R. WHITE
DRAWN BY	C. C. ABATAY
CHECKED BY	W. D'ELMITO
APPROVED BY	R. McCARTHY
PROJECT MGR.	R. LANG

PROCESS FLOW DIAGRAM
POTABLE WATER DISTRIBUTION SYSTEM
UNIT 49

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE	835704-49-4-102	1	003 35749102

TABLE 6.3.10-1

MATERIAL BALANCE

POTABLE WATER - UNIT 49

Stream Number		49-1	49-2	49-3	49-4
Stream Name		Feed From Raw Water Storage	Treated Water to Storage Tank	Backflush to Recovery Sump in Unit 44	To UCT Blowdown
H_2O	lb/hr	27,000	24,500	1,000	1,500
	(gpm)	(54)	(49)	(2)	(3)
Total	lb/hr	27,000	24,500	1,000	1,500
Pressure, psia		63.7	28.7	15.7	300
Temperature, °F		60	80	65	80

NOTE: Flow quantities, pressures and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes, and are not necessarily the conditions which will be attained during actual operations.

TABLE 6.3.10-2

EQUIPMENT LIST

POTABLE WATER - UNIT 49

Item No.	Equipment Name	Number Required	
		Operating	Spare
49TK-0101	Potable Water Storage Tank	1	0
49E-0101	RO Influent Heat Exchanger	1	0
49FT-0101 A/B	Filter Unit (Sand)	1	1
49FT-0102 A/B	Filter Unit (Activated Carbon)	1	1
49FT-0103 A/B	Filter Unit (Cartridge)	1	1
49P-0101 A/B	Chlorinator Injection Pump	1	1
49P-0102 A/B	RO Influent Pump	1	1
49P-0103 A/B	Decarbonator Pump	1	1
49P-0104 A/B	Potable Water Distribution Pump	1	1
49ME-0101 A/B	Chlorinator	1	1
49ME-0102 A/B	Chlorinator	1	1
49ME-0103	Hexametaphosphate Package	1	0
49ME-0104	Sulfuric Acid Package Unit	1	0
49ME-0105	Reverse Osmosis	1	0
49ME-0106	Decarbonator	1	1

6.3.11 UTILITY WATER - UNIT 50

6.3.11.1 DESIGN BASIS

Purpose of Unit

The Utility Water unit provides water (from the utility cooling tower blowdown) to the plant for maintenance use and area washdown.

Scope of Unit

Unit 50 consists of two 100 percent capacity pumps and associated piping.

General Design Criteria

Utility water is a single train unit.
The base case plant requires two 100 percent capacity pumps.
The unit is designed for operation compatible with an overall plant stream factor of 332 days/year.
The pumps are motor driven.
The unit is designed for continuous operation without a major turnaround.
Turndown capability is 0 to 100 percent for this unit.

Process Specifications

The unit takes water from the utility cooling tower blowdown and delivers it to the process and utility units at a flow rate up to 500 gpm and at a pressure of 75 psig.

Feed

The utility water is taken from the utility cooling tower blowdown for use in the plant. The design flow rate is 500 gpm. The operating flow is variable to a maximum of 500 gpm.

6.3.11.1 (Continued)

Products

Delivery conditions are 75 psig and 80°F.

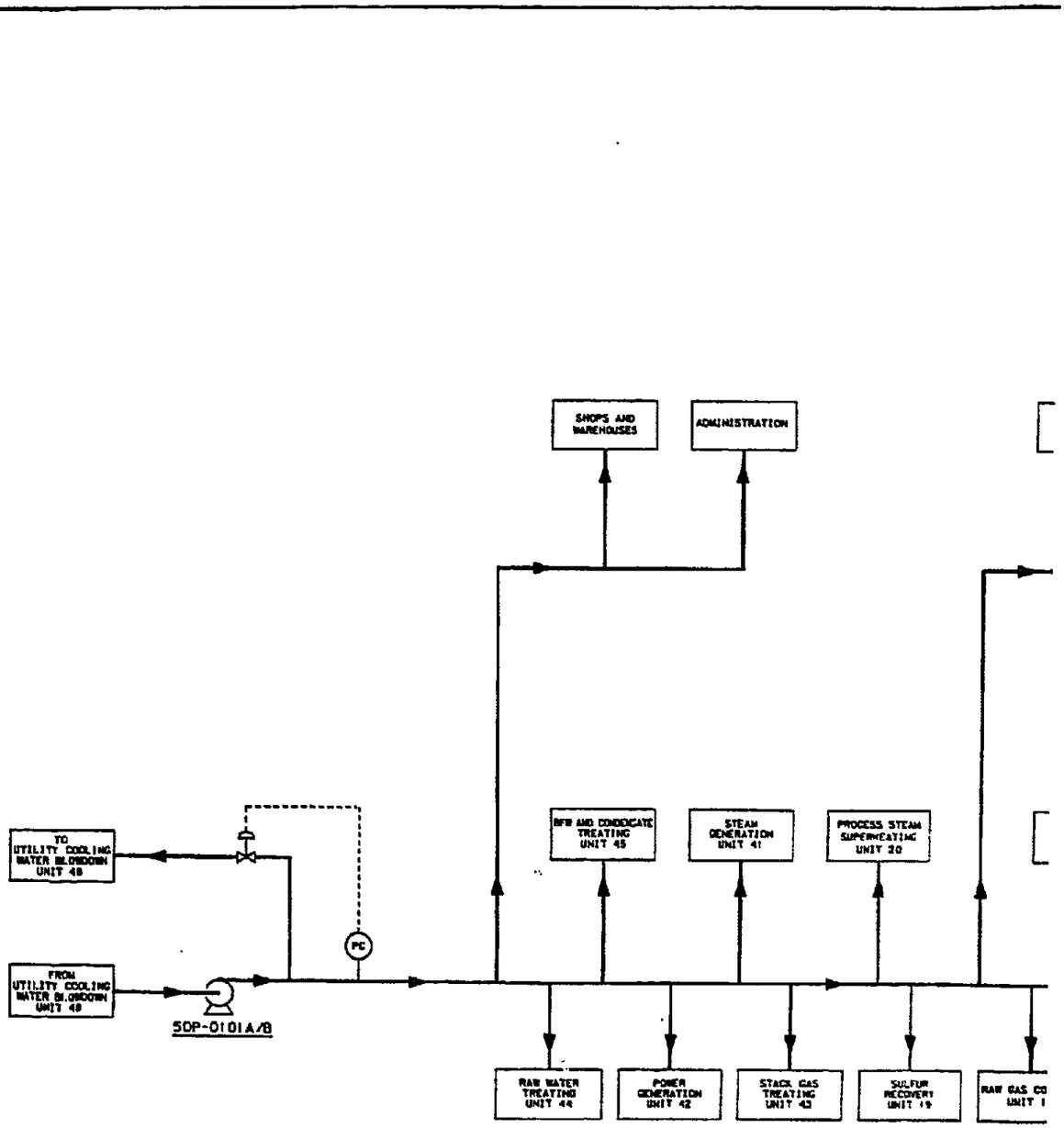
Utilities

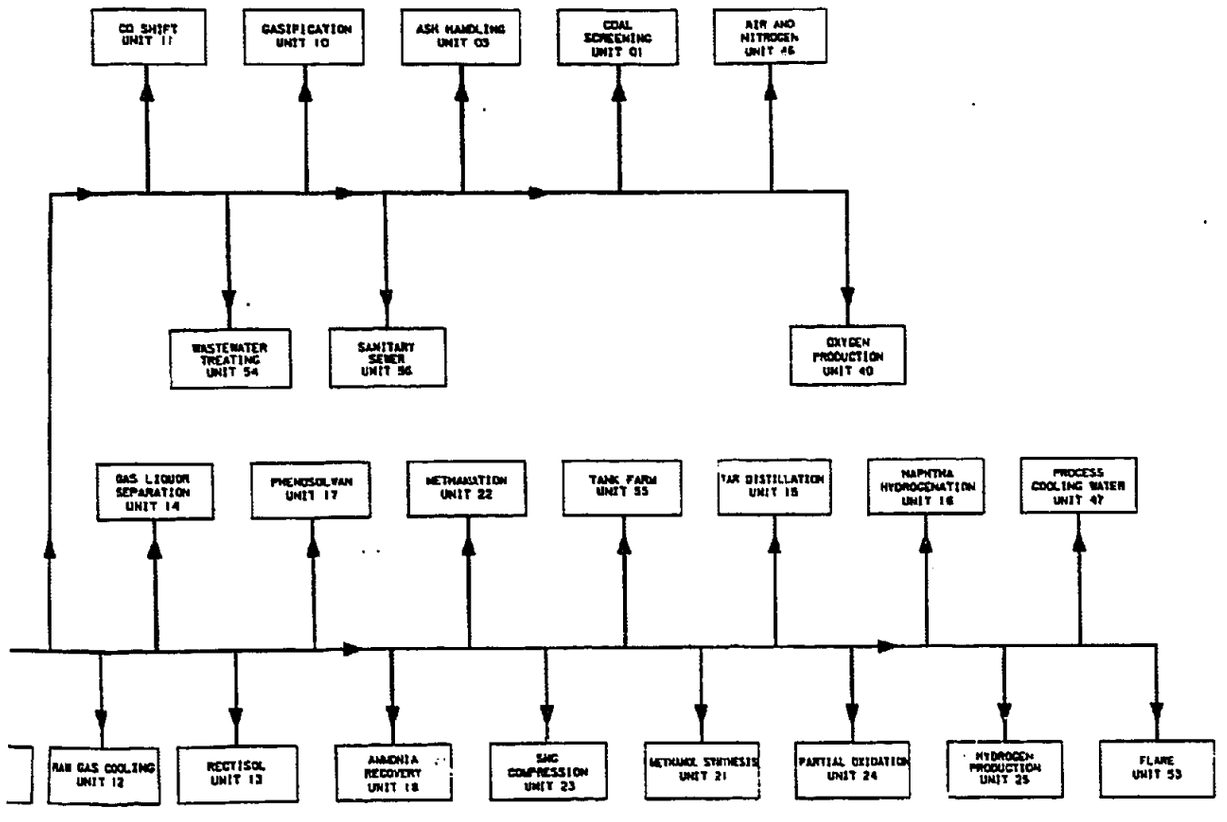
Power 25 kW

6.3.11.2 PROCESS DESCRIPTION

Drawing Number 835704-50-4-101 is the Flow Diagram for Unit 50. Table 6.3.11-1 lists equipment.

A pump, fed by Utility Cooling Tower blowdown water, delivers up to 500 gpm at 75 psig to the washdown and maintenance stations in every unit of the plant.


SHOPS AND WAREHOUSES
ADMINISTRATION
TO UTILITY COOLING WATER BLOWDOWN UNIT 48
FROM UTILITY COOLING WATER BLOWDOWN UNIT 48
PC
SOP-0101A/B
BFW AND CONDOCATE TREATING UNIT 45
STEAM GENERATION UNIT 41
PROCESS STEAM SUPERHEATING UNIT 20
RAW WATER TREATING UNIT 44
POWER GENERATION UNIT 42
STACK GAS TREATING UNIT 43
SULFUR RECOVERY UNIT 19



NOTES:

1. UTILITY WATER FLOW IS INTERMITTENT. FLOW RATE IS AVERAGE. SUPPLY DESIGNED FOR PEAK FLOW OF 500 GPM.
2. THE TEMPERATURES, PRESSURES, FLOW QUANTITIES AND COMPOSITIONS REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

R. WHITE
C.G. ABATAY
W.O. AETMITO
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
UTILITY WATER SYSTEM
UNIT 50

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE | 835704-50-4-101 | 1

003 3575010101

TABLE 6.3.11-1

EQUIPMENT LIST

UTILITY WATER - UNIT 50

Item No.	Equipment Name	Number Required	
		Operating	Spare
50P-0101 A/B	Utility Water Pump	1	1

6.3.12 FIREWATER - UNIT 51

6.3.12.1 DESIGN BASIS

Purpose of Unit

The Firewater unit provides a constant supply of water to protect the plant in the event of a major fire. Other fire fighting equipment is also included in this unit.

Scope of Unit

Unit 51 includes permanent storage, redundant pumping systems with automatic start, and a multipath loop for firewater delivery to any site in the plant. Fire fighting equipment includes spray systems, monitors, hoses, extinguishers, and trucks.

General Design Criteria

The Firewater unit is a single train.

A portion of the raw water pond is dedicated to fire water storage. A jockey pump maintains pressure in the header throughout the plant. The three main pumps consist of one 2500 gpm capacity electric motor-driven and two 2500 gpm capacity diesel-driven pumps. The firewater header is designed and valved to provide water to each area of the plant via multiple paths in the event of a failure in any one area.

The unit is on standby 365 days/year and is compatible with an overall plant stream factor of 332 days/year.

One firewater pump is electrically driven. In the event of power failure or a major fire, two spare pumps operating on frequently tested diesel engines are used.

6.3.12.1 (Continued)

The unit is designed for eight (8) hours of operation based on the dedicated raw water storage.

Turndown capability is 0 to 100 percent for the firewater system.

Process Specifications

The Firewater unit is designed to supply up to 7500 gpm at 125 psig to the design case fire through fixed spray systems, fixed and portable monitors, and hoses. A truck mounted foam generating system is included within the unit for Class B and C fires. Firewater storage capacity in the raw water pond is 3.6 million gallons based on a flow of 7,500 gpm for eight hours.

Utilities Required

Power 20 kW Normal
200 kW Emergency

6.3.12.2 PROCESS DESCRIPTION

Drawing No. 835704-51-4-101 is the flow diagram for Unit 51 and Drawing No. 835704-51-4-050 is the plot plan. Table 6.3.12-1 lists the equipment.

The firewater system includes a reliable water supply, pumping facilities, automatic fire pump start system, and distribution piping.

Firewater Supply

The bottom portion of the raw water pond is dedicated to firewater storage. Based on eight hours at a 7500 gpm pumping rate, the stored volume is 3.6 million gallons.

6.3.12.2 (Continued)

Firewater Pumps

To ensure a dependable firewater supply at all times, three 2500 gpm capacity (each) approved firewater pumps are provided. Two are diesel driven with the remaining one on motor drive. Operation of the pumps is automatically controlled by the firewater pump auto-start system. Operation of the unit consists of starting the pumps in a cascade manner as a function of low pressure in the supply header. The diesel pumps, when in the standby mode, are periodically tested automatically to ensure each pump is operable. Pump discharge pressure is 150 psig. A diesel day tank is provided for the diesel pumps.

During normal operation, the firewater header pressure is maintained by a jockey pump. Two motor driven pumps are provided. Each is designed to supply 200 gpm at a discharge pressure of 150 psig.

The firewater pumps are housed in a Type IV insulated heated prefab building for winterization.

Fixed Spray Systems

Fixed spray systems are provided as necessary for surface cooling of process equipment, pressure storage, coal storage, tankage, etc. Equipment within the process areas is protected by fixed water spray systems, fixed and portable monitors, hose reels and fire extinguishers. Additional back up is provided by two fire trucks, one a triple agent truck and the other a squirt foam truck.

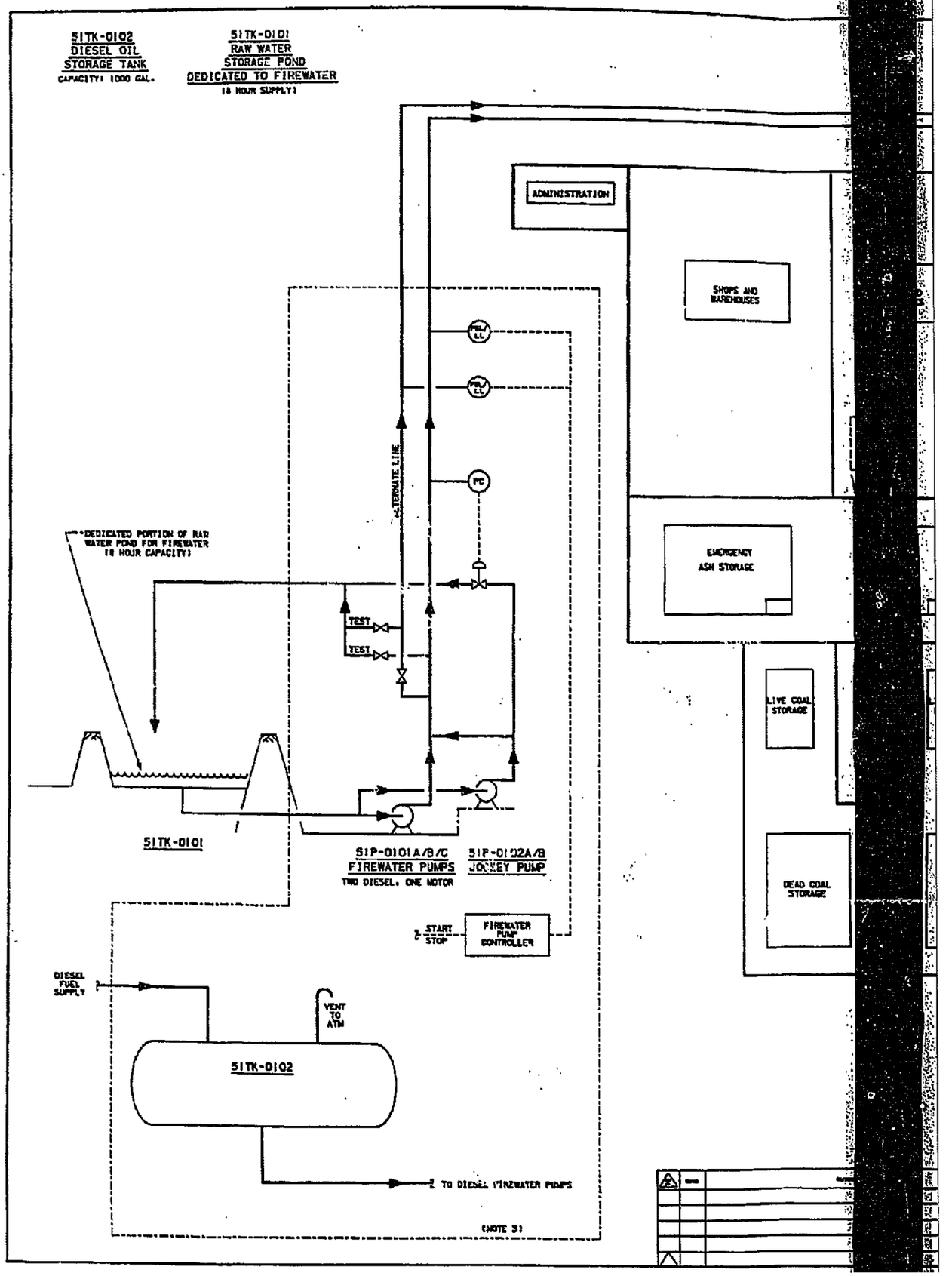
Foam Extinguishing System

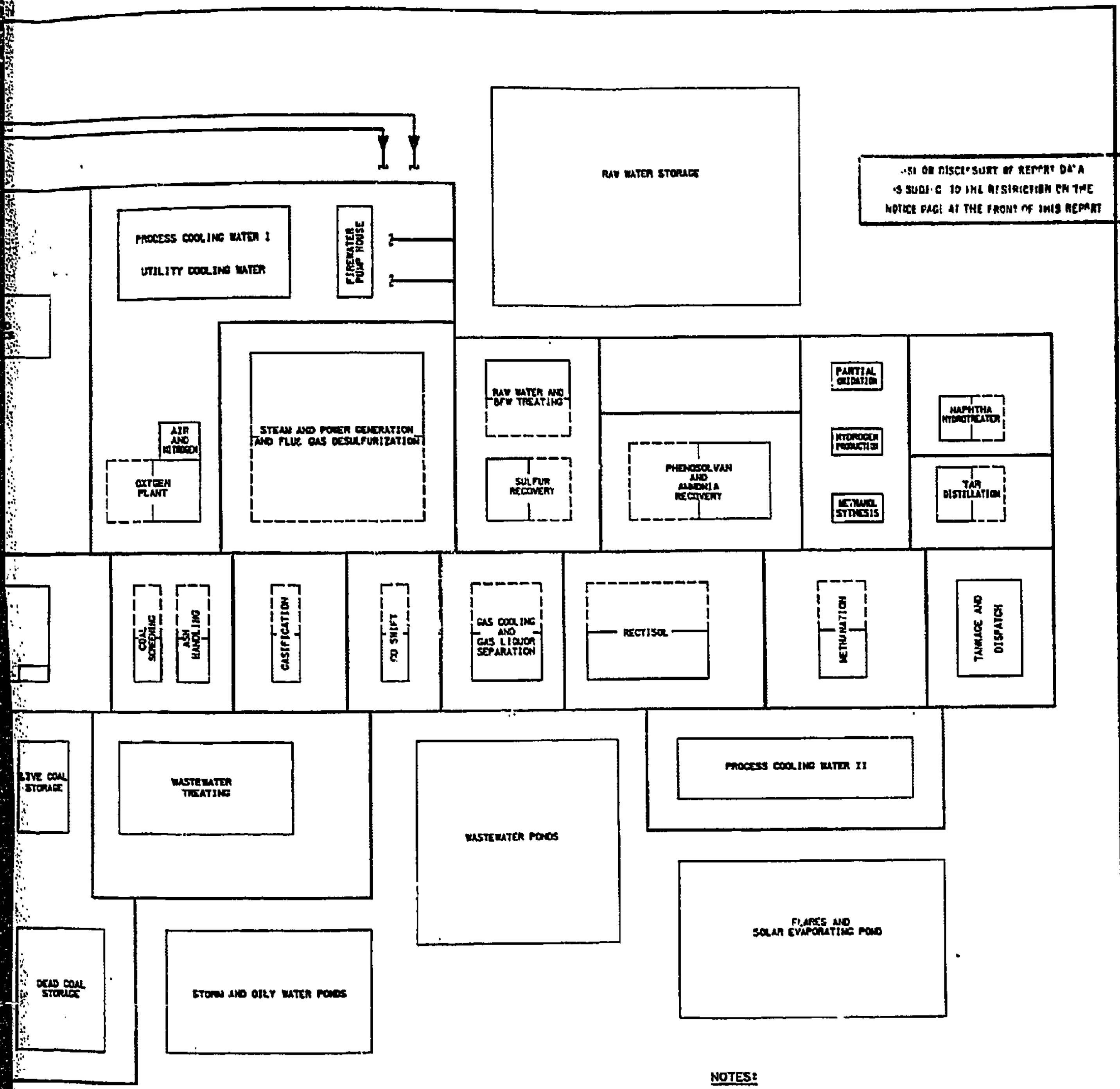
Fixed roof and floating roof tanks in the tank farm and dispatch area require foam protection. Water required to generate foam solution is

6.3.12.2 (Continued)

supplied from the firewater system. The foam solution is generated in proportioning equipment located on the foam truck. By connecting the truck's water inlet line to a fire hydrant, and the truck's foam solution outlet to the foam solution lines to a tank, the foam truck is able to receive water, generate foam solution and deliver it to a tank's foam pourers.

Open top floating roof tanks are protected against rim fires only. Cone roof tanks are protected by subsurface foam injection. A semi-fixed system is provided with foam connections on the product lines where feasible. These connections are provided outside the dike wall for hookup of the high back pressure foam makers carried on the fire truck.


51TK-0102
DIESEL OIL
STORAGE TANK
CAPACITY: 1000 GAL.
51TK-0101
RAW WATER
STORAGE POND
DEDICATED TO FIREWATER
(8 HOUR SUPPLY)
ADMINISTRATION
SHOPS AND WAREHOUSES
EMERGENCY ASH STORAGE
LIVE COAL STORAGE
DEAD COAL STORAGE
ALTERNATE LINE
PSL LL
PSL LL
PC
*DEDICATED PORTION OF RAW WATER POND FOR FIREWATER (8 HOUR CAPACITY)
TEST
TEST
51TK-0101
51P-0101A/B/C
FIREWATER PUMPS
TWO DIESEL, ONE MOTOR
51P-0102A/B
JOCKEY PUMP
START
STOP
FIREWATER PUMP CONTROLLER
DIESEL FUEL SUPPLY
VENT TO ATM
51TK-0102
TO DIESEL FIREWATER PUMPS
(NOTE 3)



NOTES:

1. FIREWATER SYSTEM DESIGN BASIS:
   - RAW WATER POND FIREWATER STORAGE DESIGNED FOR 8 HOURS FLOW AT 7,500 GPM.
   - MAIN HEADER SUPPLY LINE SIZES ARE BASED ON 2500 GPM EACH.
   - HYDRANT SPACING IS 150 TO 200 FEET AROUND PROCESS UNITS.
2. FIREWATER LINES SHALL BE UNDERGROUND. INSULATED BY COATED WRAPPING.
3. FIREWATER PUMPS. CONTROLS AND FUEL TANK SHOWN WITHIN THE DOT-DASH LINE ARE LOCATED INDOORS IN THE FIREWATER PUMP HOUSE.

USE OR DISCLOSURE OF REPORT DATA
IS SUBJECT TO THE RESTRICTION ON THE
NOTICE PAGE AT THE FRONT OF THIS REPORT

FLUOR

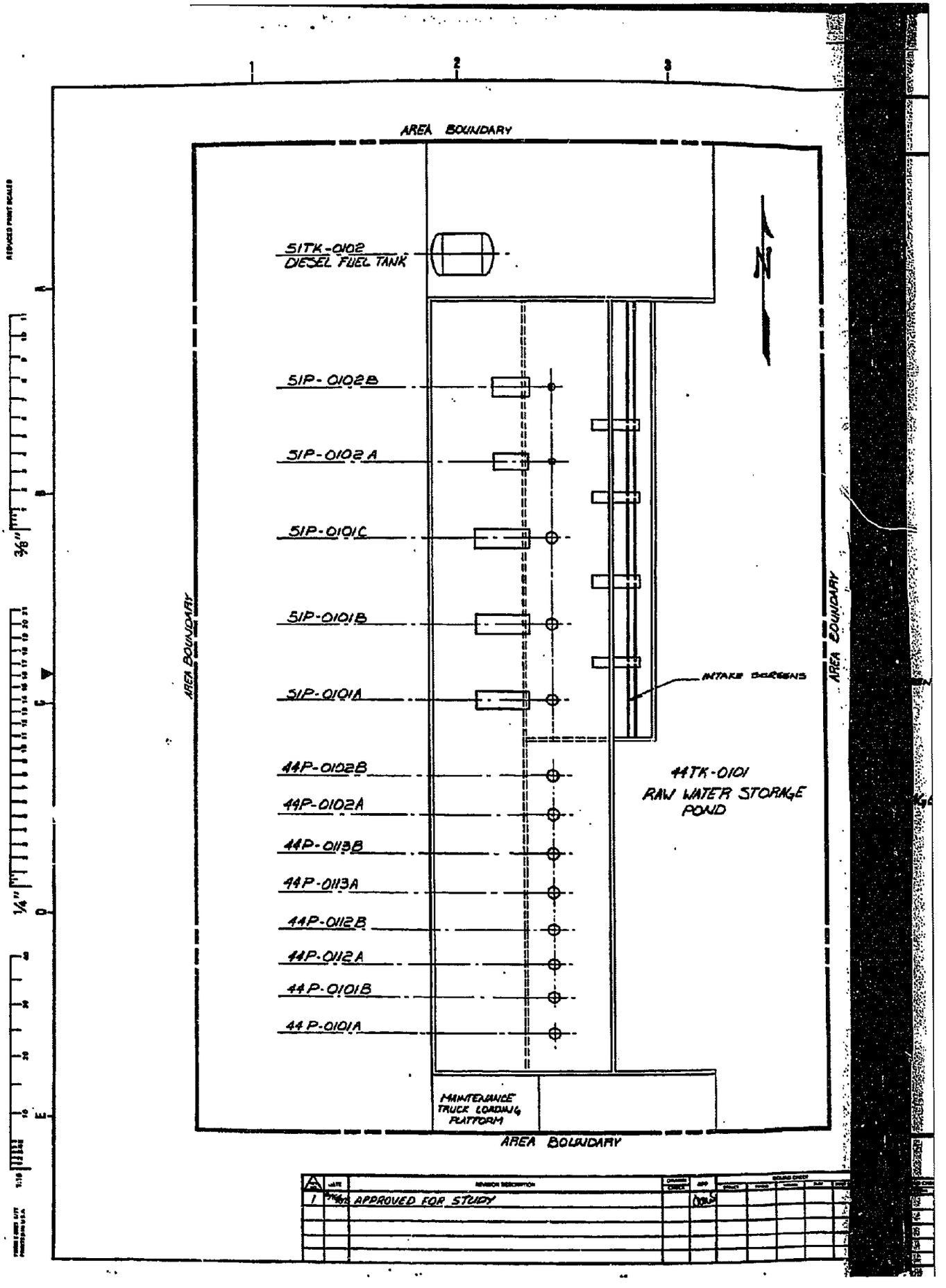
R. WHITE
C.C. ABATAY
E.D'BELMITO
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
FIREWATER SYSTEM
UNIT 51

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

Scale	Drawing Number	Revision
NONE	835704-51-4-101	1

003 357511 01


AREA BOUNDARY
51TK-0102
DIESEL FUEL TANK
51P-0102B
51P-0102A
51P-0101C
51P-0101B
51P-0101A
44P-0102B
44P-0102A
44P-0113B
44P-0113A
44P-0112B
44P-0112A
44P-0101B
44P-0101A
INTAKE SCREENS
44TK-0101
RAW WATER STORAGE
POND
MAINTENANCE
TRUCK LOADING
PLATFORM
AREA BOUNDARY
AREA BOUNDARY
N
1
2
3
APPROVED FOR STUDY

4 5 6 7

AREA BOUNDARY

N5

4E

NOTE:

51TK-0101 (RAW WATER STORAGE POND DEDICATED TO FIREWATER) IS THE BOTTOM 1 FT. OF 44TK-0101 (RAW WATER STORAGE POND)

10 5 0 10 20 30 40 50

REDUCED PRINT SCALE

ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE

			00-E-050	SITE #1 PLOT PLAN			

FLUOR

R. MILLER
AUSTIN
COUNTY
SHEETS
R. LANG

PLOT PLAN - UNITS 44 & 51
RAW WATER & FIREWATER PUMP BLDG.
CROW TRIBE OF INDIANS MONTANA

SCALE 1"=10'-0" | 835704-51-4-050 | 1

TABLE 6.3.12-1

EQUIPMENT LIST

FIREWATER - UNIT 51

Item No.	Equipment Name	Number Required	
		Operating	Spare
51TK-0101*	Dedicated Raw Water Storage	1	0
51TK-0102	Diesel Oil Storage Tank	1	0
51P-0101 A/B/C	Firewater Pumps	2	1
51P-0102 A/B	Jockey Pumps	1	1

* Part of raw water storage pond 44TK-0101

6.3.13 FUEL GAS - UNIT 52

6.3.13.1 DESIGN BASIS

Purpose of Unit

The Fuel Gas System receives, mixes, and distributes fuel gas produced and consumed within the plant.

Scope of Unit

The scope of Unit 52 includes collection piping from the fuel gas producers, a mixing drum, and distribution piping to the users of the fuel gas.

General Design Criteria

The Fuel Gas unit consists of a single train.

Feeds

The Fuel Gas unit collects the offgas generated in the Hydrogen Production unit and the Methanol Synthesis unit purge gas and mixes them with a bleed stream of pure gas to produce the plant fuel gas.

In the case of plant upset excess fuel gas is vented to the flare. Fuel gas is taken from the SNG product during startup.

6.3.13.1 (Continued)

Products

The normal flows and feed compositions to the Fuel Gas System are as follows:

lb-mol/hr	From Methanol Synthesis	From H_2 Production	From Pure Gas
Total lb-mol/hr	35.6	159.0	2050.3
Total lb/hr	477	2970	23,898
HHV, 10^6 Btu/hr	11.0	30.5	327.7

The product fuel gas distributed to the plant (see Table 6.3.13-1) is as follows:

Fuel Gas	lb-mol/hr
Total lb-mol/hr	2,244.9
Total lb/hr	27,345
HHV, 10^6 Btu/hr	369.2
Btu/SCF	433

Utility Requirements

None

6.3.13.2 PROCESS DESCRIPTION

Drawing Number 835704-52-4-101 is the Flow Diagram for Unit 52. The unit material balance and the equipment list follow the drawing (Tables 6.3.13-2 and 6.3.13-3).

6.3.13.2 (Continued)

Fuel gas is generated by the Methanol Synthesis Unit 21 and Hydrogen Production Unit 25. The combined flows from these two units are insufficient to supply the total requirement for the plant. Additional fuel gas is supplied by a sidestream of pure gas from the Rectisol Unit 13. Three streams flow to a mixing drum and are distributed to the fuel gas users in the plant at 75°F and 60 psig.

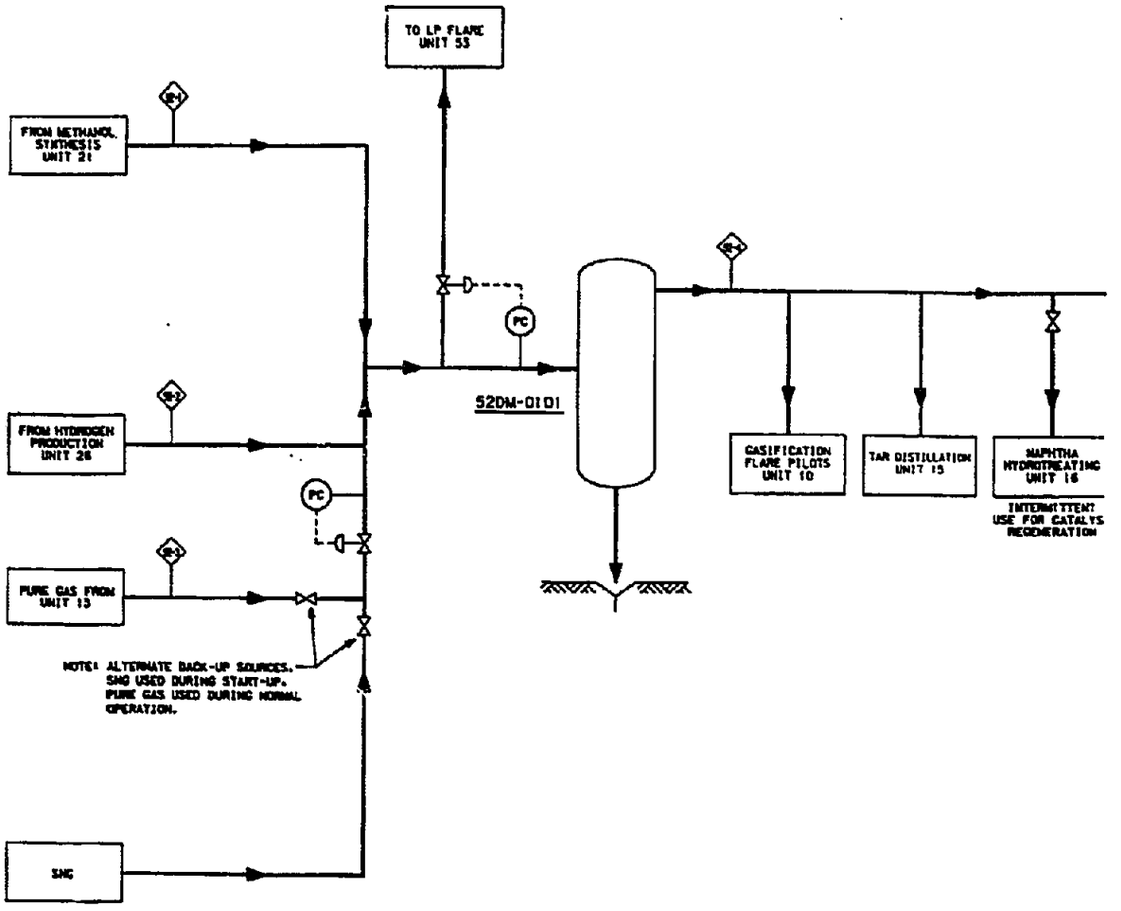
For startup natural gas from the product pipeline is used as fuel for the gasification pilots, flare pilots and steam superheater warmup. As pure gas becomes available, it replaces the SNG. SNG is used as emergency makeup fuel gas in the case of upset.

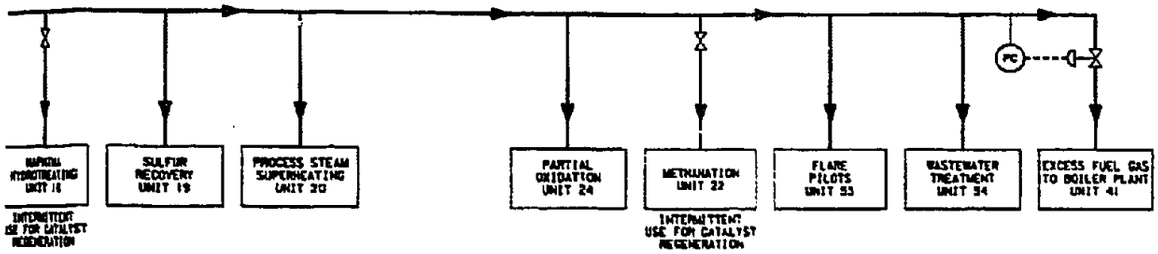
TABLE 6.3.13-1

FUEL GAS CONSUMERS

Consumer	Usage, 10^6 Btu/hr
Process Steam Superheater	340.1
Gasification	0.7
Tar Distillation	12.2
Sulfur Recovery	11.6
Partial Oxidation	0.1
Flare	2.0
Wastewater Treating	2.5
Naphtha Hydrotreating	Intermittent
Methanation	Intermittent

52DM-0101
FUEL GAS MIXING DRUM





NOTES:

1. THE TEMPERATURES, PRESSURES, AND FLOW QUANTITIES REFERENCED BY DIAMONDS ARE SHOWN ELSEWHERE.

FLUOR

DRAWN BY	R. WHITE
DESIGNED BY	C.C. ABATAY
CHECKED BY	R.O'BELMITO
APPROVED BY	R. McCARTHY
PROJECT MANAGER	R. LANG

PROCESS FLOW DIAGRAM
FUEL GAS SYSTEM
UNIT 52

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

NONE	835704-52-4-101	1

003 3515210I

TABLE 6.3.13-2

MATERIAL BALANCE

FUEL GAS - UNIT 52

Stream Number	52-1		52-2		52-3		52-4	
Stream Name	Purge Gas From Unit 21		Reject Gas From Unit 25		Makeup Gas From Unit 13		Pure Fuel Gas To System	
Component	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%	lb-mol/hr	Mol%
H_2	12.7	35.7	46.0	28.9	1209.0	59.0	1267.7	56.5
N_2	0.4	1.1	0.2	0.1	6.3	0.3	6.9	0.3
CO	2.4	6.7	44.9	28.2	334.0	16.3	381.3	17.0
CH_4	18.1	50.8	48.9	30.8	361.0	17.6	428.0	19.1
C_2H_6	0.3	0.8	0.6	0.4	2.8	0.1	3.7	0.2
CO_2	1.6	4.5	18.4	11.6	137.2	6.7	157.2	7.0
MeOH	0.1	0.4		-		-	0.1	-
Total Dry Gas	35.6	100.0	159.0	100.0	2050.3	100.0	2244.9	100.0
H_2O								
Total Wet Gas								
Dry Gas lb/hr	477		2970		23,898		27,345	
Total lb/hr	477		2970		23,898		27,345	
Pressure, psia	75		75		300		75	
Temperature °F	100		100		68		75	
10^6 Btu/hr	11.0		30.5		327.7		369.2	

NOTE: Flow quantities, pressures and temperatures shown are for the total unit on a stream-day basis, are to be used solely for process design purposes and are not necessarily the conditions which will be attained during actual operations.

TABLE 6.3.13-3

EQUIPMENT LIST

FUEL GAS - UNIT 52

Item No.	Equipment Name	Number Required	
		Operating	Spare
52DM-0101	Fuel Gas Mixing Drum	1	0

6.3.14 FLARE - UNIT 53

6.3.14.1 DESIGN BASIS

Purpose of Unit

The flare system collects, vents, and flares flammable gases from the process units during plant startup or upset conditions.

Scope of Unit

The flare system includes a collection network for vented process gases, liquid knockout facilities, and flare stacks with pilot and flame control devices, smokeless flare tips, and water sealed bases.

General Design Criteria

High pressure and low pressure flare collection networks terminate in two knockout drums and flow to two 50 percent capacity flares. The flares are controlled for sequential lighting based on feed rate. The tips have fuel gas fired pilots, automatic ignition, and steam injection for smokeless operation.

Process Specifications

The flares are designed to burn flammable gases released during startup or upset conditions safely and in an environmentally acceptable manner. The flare headers are sloped and continuously purged with nitrogen to prevent air intrusion. The radiant heat intensity is not to exceed 2000 Btu/ft^2 in the knockout drum area.

6.3.14.1 (Continued)

Feed

The flare design feed rate is based on blocked discharge of the combined flow from Gasification Unit 10 and the Partial Oxidation Unit 24. The composition of this stream is:

Component	Mixed Stream from Gasifiers & POX	
H_2	24,489.1	lb-mol/hr
N_2	142.7	
CO	10,689.9	
CH_4	6,331.5	
C_2H_4	72.4	
C_2H_6	289.5	
C_3H_6	36.2	
C_3H_8	36.2	
C_4H_8	9.0	
C_4H_{10}	9.0	
CO_2	18,494.7	
H_2S	220.2	
COS	4.7	
Total Dry Gas	60,825.1	lb-mol/hr
H_2O	29,898.7	lb-mol/hr
Total Dry Gas	1,291,027	lb/hr
H_2O	538,655	
Lurgi Liquids*	41,299	
Organic Sulfur	213	
NH_3	6,783	
HCl	185	
Total lb/hr	1,878,162	lb/hr

* Lurgi Liquids include Tar, Oil, Naphtha, Phenols, and Fatty Acids.

6.3.14.1 (Continued)

Component	Mixed Stream from Gasifiers & POX
Temperature	355°F
M.W. Dry Gas	21.2
SCFM	587,313
HHV Btu/SCF	223

Utility Requirements

Steam - 50 psig	100 lb/hr Intermittent
N_2	180 SCFM
Fuel Gas	2.0 MM Btu/hr
Power	40 kW

6.3.13.2 PROCESS DESCRIPTION

Drawing No. 835704-53-R-101 is the flow diagram for Unit 53. The plot plan (Drawing No. 835704-53-4-050) and equipment list (Table 6.3.14-1) follow.

The Flare System safety handles and discharges emergency and startup emissions of flammable gases in an environmentally acceptable manner. The system consists of a vapor collection network, liquid knockout facilities, and flare stacks with pilot and ignition systems.

Vapor Collection Network

Where a wide range of process pressure exists, a high and low pressure header system is preferred over a single header system. The high pressure header receives reliefs which have a process-side pressure of 200 psig or greater. The low pressure header receives those with pressures less than 200 psig.

6.3.14.2 (Continued)

The HP header is 48 inches in diameter. Units relieving into the HP header are:

Unit 11	CO Shift
Unit 12	Gas Cooling
Unit 13	Rectisol
Unit 16	Naphtha Hydrotreating
Unit 21	Methanol Synthesis
Unit 22	Methanation
Unit 23	SNG Compression & Purification
Unit 24	Partial Oxidation

The LP header is 42 inches in diameter. Units relieving into the LP header are:

Unit 13	Rectisol
Unit 17	Phenosolvan
Unit 19	Sulfur Recovery
Unit 59	Fuel Gas

The header system are sloped at 2.5 inches per 100 feet and are not pocketed. These precautions are taken to prevent liquid from accumulating in the header during a large relief. Accumulated liquids can result in unsafe forces on the piping system.

The isolation valves at unit battery limits utilize a lock and key procedure to minimize the event of accidental blockage or release.

Flare Stacks

Two 50 percent emergency flare stacks are provided to handle the maximum relief load of Shift/Gas Cooling in a blocked discharge condition. Water

6.3.14.2 (Continued)

diversion seal drums prevent air intrusion into the header system from the emergency flare stacks.

The equipment provided for ignition and maintenance of each flare consists of:

Multiple pilots on each tip with temperature sensors to alarm loss of flame.

Remote flame front generator to allow ignition of pilots from an operating area.

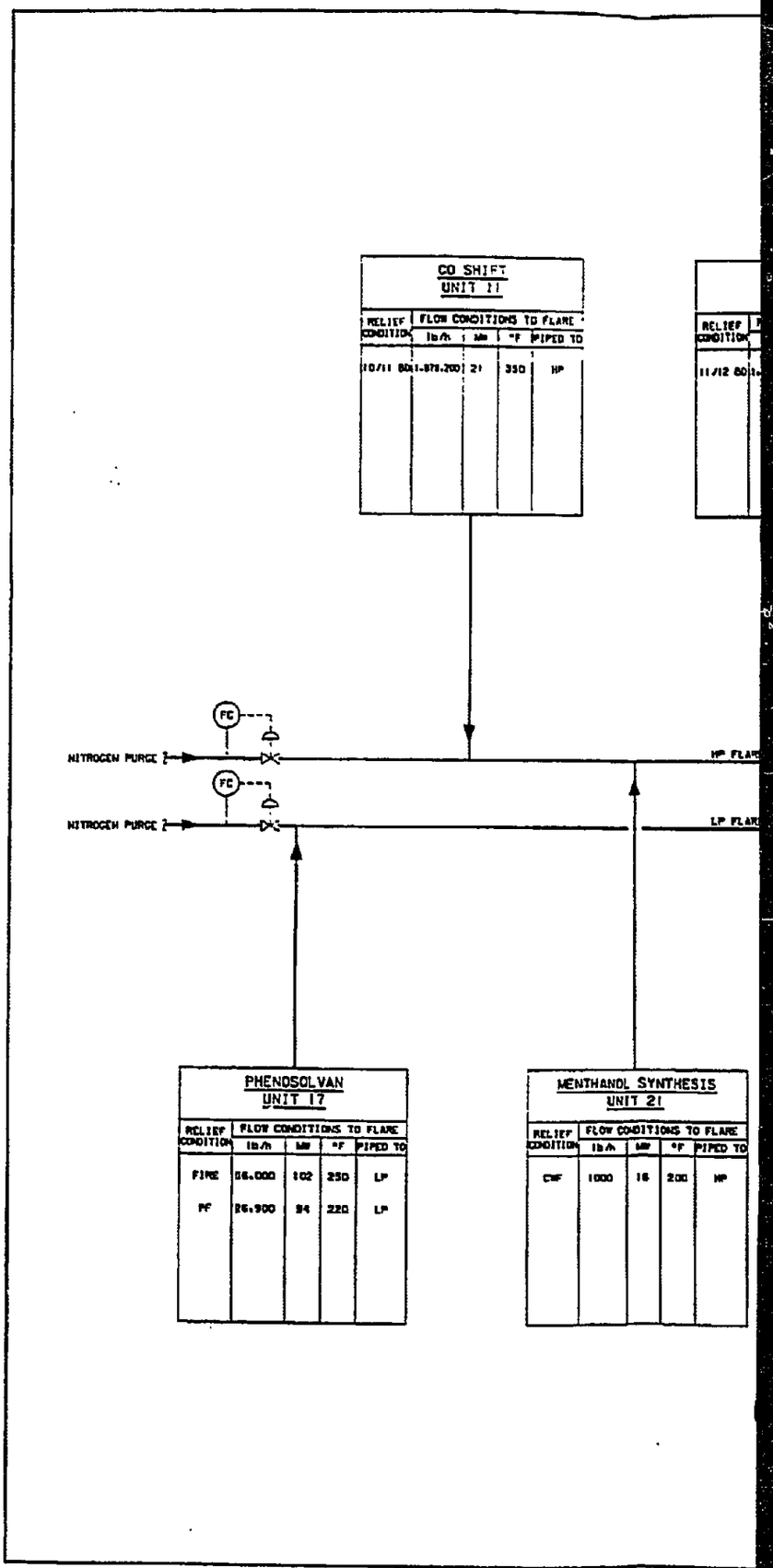
Prevention of explosive gas mixtures forming in the flare system is accomplished by flare tip seals, a continuous nitrogen purge of the header piping and stacks, and water diversion seal drums at the base of each emergency stack. The flare tips have molecular seals. To compensate for the shrinkage effect of a hot gas release, an additional purge is provided at the main headers upstream from the flare knockout drums. This purge is activated by high temperature and low pressure conditions at the flare header. Seal drums at the base of each emergency stack prevent air from entering the header system. The seal drums contain baffles to minimize fluctuations in water level caused by changes in vapor flow rate. The emergency flare stacks are 200 feet high and 48 inches in diameter: they have guyed support systems. The flare zone required, based on a minimum radiation intensity of 2000 Btu/hr-ft^2 at the flare knockout drum area, is 450 feet by 925 feet. To reduce overall plant plot area, the flare knockout drums and stacks are located in the wastewater evaporation pond area.

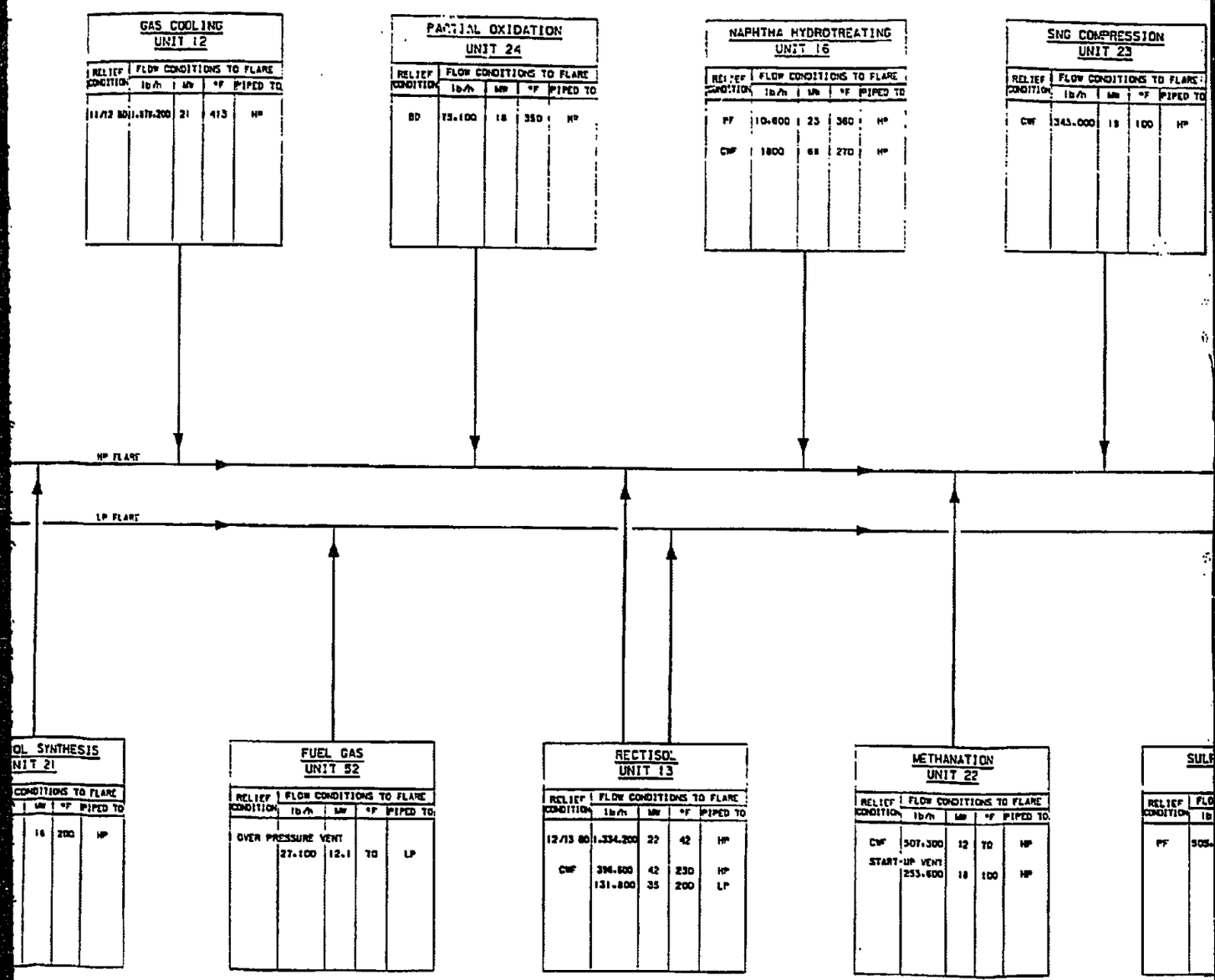
6.3.14.2 (Continued)

Liquid Knockout Facilities

Two horizontal knockout drums are provided for liquid de-entrainment. Drum size is based on allowable vapor velocities, a liquid level equal to 25 percent of the drum diameter. Vapor enters both ends and exits from the center.

As the liquid level rises, the vapor velocity increases, and the size of particles remaining in the vapor increases. Therefore, a high level alarm and automatic pump circuit are provided to maintain the level in the drum. The liquids are pumped from the knockout drums to the plant slop system for processing.


CO SHIFT
UNIT 11
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
10/11 80
1-878,200
21
350
HP
11/12 80
1-
HP FLARE
LP FLARE
FC
NITROGEN PURGE
FC
NITROGEN PURGE
PHENOSOLVAN
UNIT 17
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
FIRE
56,000
102
250
LP
PF
26,900
94
220
LP
MENTHANOL SYNTHESIS
UNIT 21
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
CWF
1000
16
200
HP


GAS COOLING
UNIT 12
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
11/12 BD 1,879,200 21 413 HP
PARTIAL OXIDATION
UNIT 24
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
BD 73,100 18 350 HP
NAPHTHA HYDROTREATING
UNIT 16
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
PF 10,600 23 360 HP
CWF 1800 68 270 HP
SNG COMPRESSION
UNIT 23
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
CWF 343,000 18 100 HP
HP FLARE
LP FLARE
OL SYNTHESIS
NIT 21
CONDITIONS TO FLARE
MW
°F
PIPED TO
16 200 HP
FUEL GAS
UNIT 52
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
OVER PRESSURE VENT
27,100 12.1 70 LP
RECTISOL
UNIT 13
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
12/13 BD 1,334,200 22 42 HP
CWF 396,600 42 230 HP
131,800 35 200 LP
METHANATION
UNIT 22
RELIEF CONDITION
FLOW CONDITIONS TO FLARE
lb/h
MW
°F
PIPED TO
CWF 507,300 12 70 HP
START-UP VENT
253,600 18 100 HP
SULF
RELIEF CONDITION
FLO
lb
PF 505,

53DM-0101A/B
FLARE KNOCK OUT DRUM

PRESSION
T: 23

NDITIONS TO FLARE		
MW	°F	PIPED TO
18	100	HP

53ME-0101A

TO IGNITOR

FUEL GAS

PURGE CONTROL

NITROGEN PURGE

LP STEAM COND.

UTILITY WATER

HP FLARE

LP FLARE

53DM-0101A

LP STEAM COND.

TO SLOP SYSTEM

PUMP START/STOP

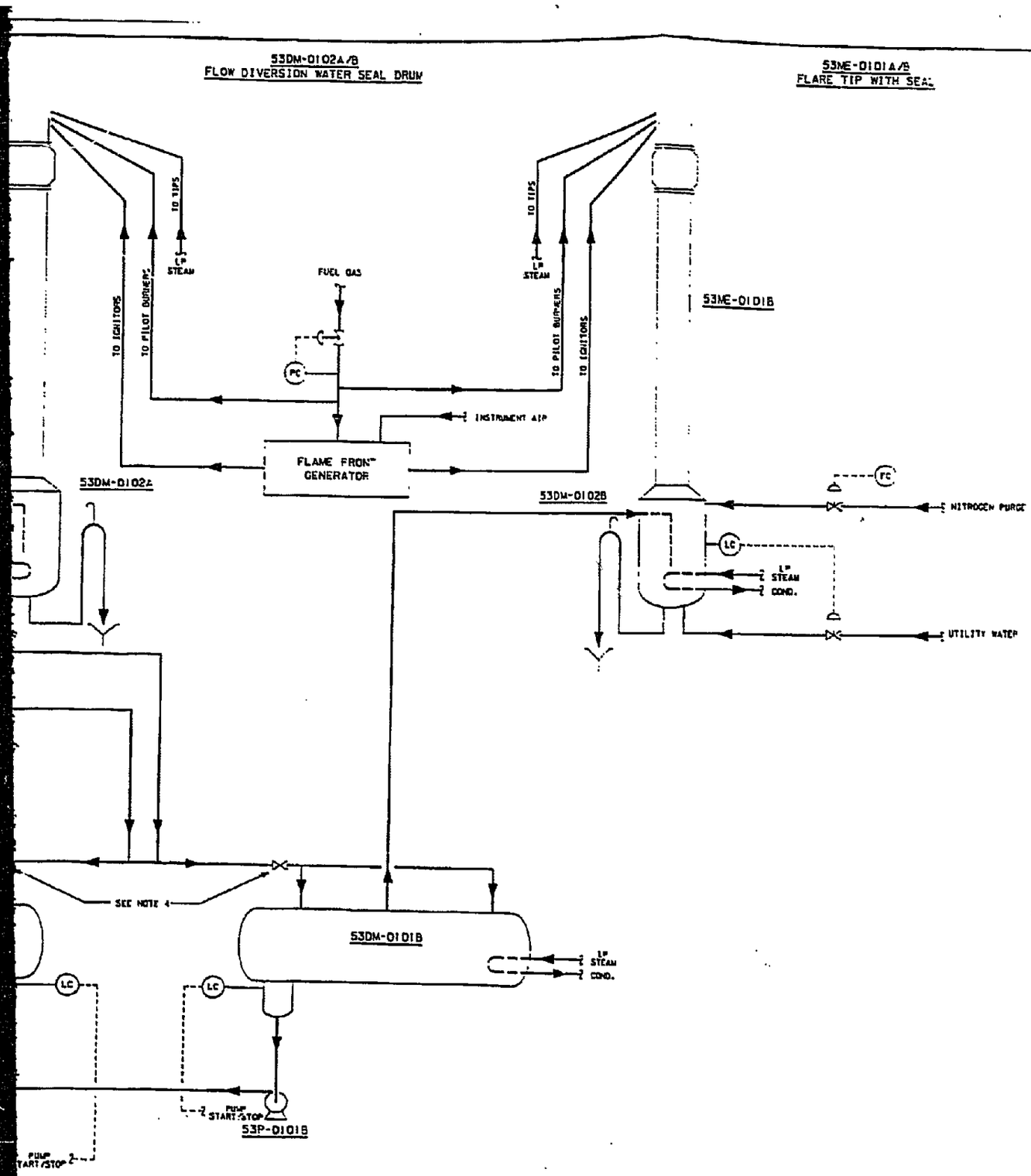
53P-0101A/C (COMMON SPARE)

SULFUR RECOVERY
UNIT 19

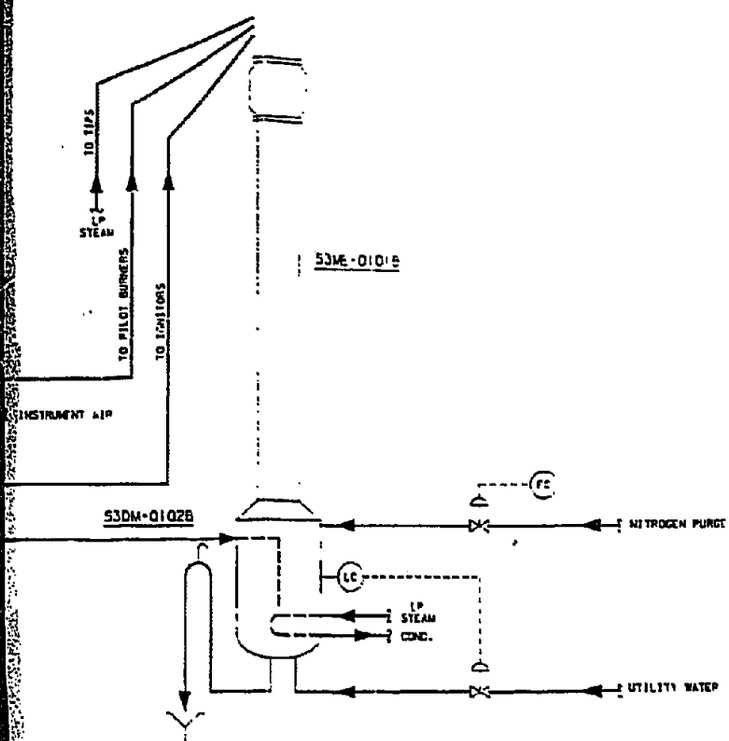
RELIEF CONDITION	FLOW CONDITIONS TO FLARE			
	lb/h	MW	°F	PIPED TO
PF	505,000	40	100	LP

DRAWING NO.	REV	FRAME
83S704-53-M-101	1	2 OF 2

4 3


53DM-0102A/B
FLOW DIVERSION WATER SEAL DRUM
53ME-0101A/B
FLARE TIP WITH SEAL
TO TIPS
LP STEAM
TO PILOT BURNERS
TO IGNITORS
FUEL GAS
PC
INSTRUMENT AIR
FLAME FRONT GENERATOR
53ME-0101B
53DM-0102A
53DM-0102B
FC
NITROGEN PURGE
LC
LP STEAM COND.
UTILITY WATER
SEE NOTE 4
53DM-0101B
LP STEAM COND.
PUMP START/STOP
53P-0101B
COMMON SPARE)
NOTES:
1. LEGEND
2. RELIABILITY
3. DESIGN CASES
(A) LP HEAD
(B) HP HEAD
(C) KNOCKOU
4. INTERLOCK SY
5. THE TEMPERATU
PROCESS DESI
FLUOR
R. WHITE
G.C. ABATAY
R. McCARTHY
R. LANG

53ME-01018/B
FLARE TIP WITH SEAL



NOTES:

1. LEGEND
   11/12 BD - BLOCKED DISCHARGE IN UNITS 11 AND 12
   CWF - COOLING WATER FAILURE
   PF - POWER FAILURE
   22 VENT - UNIT 22 START-UP VENT
2. RELIABILITY OF POWER SUPPLY AND COOLING WATER SYSTEMS IS SUFFICIENT TO PREVENT TOTAL POWER FAILURE OR TOTAL COOLING WATER FAILURE. DESIGN IS IN ACCORDANCE WITH API RP 520 AND API RP 521.
3. DESIGN CASES
   (A) LP HEADER - COOLING WATER FAILURE IN RECTISOL.
   (B) HP HEADER - UNITS 12/13 BLOCKED DISCHARGE (100% OF GAS PRODUCTION PLUS POX PRODUCTION)
   (C) KNOCKOUT DRUMS AND EMERGENCY FLARE STACKS - UNITS 12/13 BLOCKED DISCHARGE
4. INTERLOCK SYSTEM IS PROVIDED TO PREVENT DRUMS FROM SIMULTANEOUSLY BEING TAKEN OUT OF SERVICE.
5. THE TEMPERATURES, PRESSURES, FLOW QUANTITIES AND COMPOSITIONS SHOWN ARE TO BE USED SOLELY FOR PROCESS DESIGN PURPOSES.

FLUOR

R. WHITE
C. C. ABATAY
B. O'BLIMOTO
R. McCARTHY
R. LANG

PROCESS FLOW DIAGRAM
FLARE SYSTEM
UNIT 53

CROW TRIBE OF INDIANS — SYNFUELS FEASIBILITY STUDY

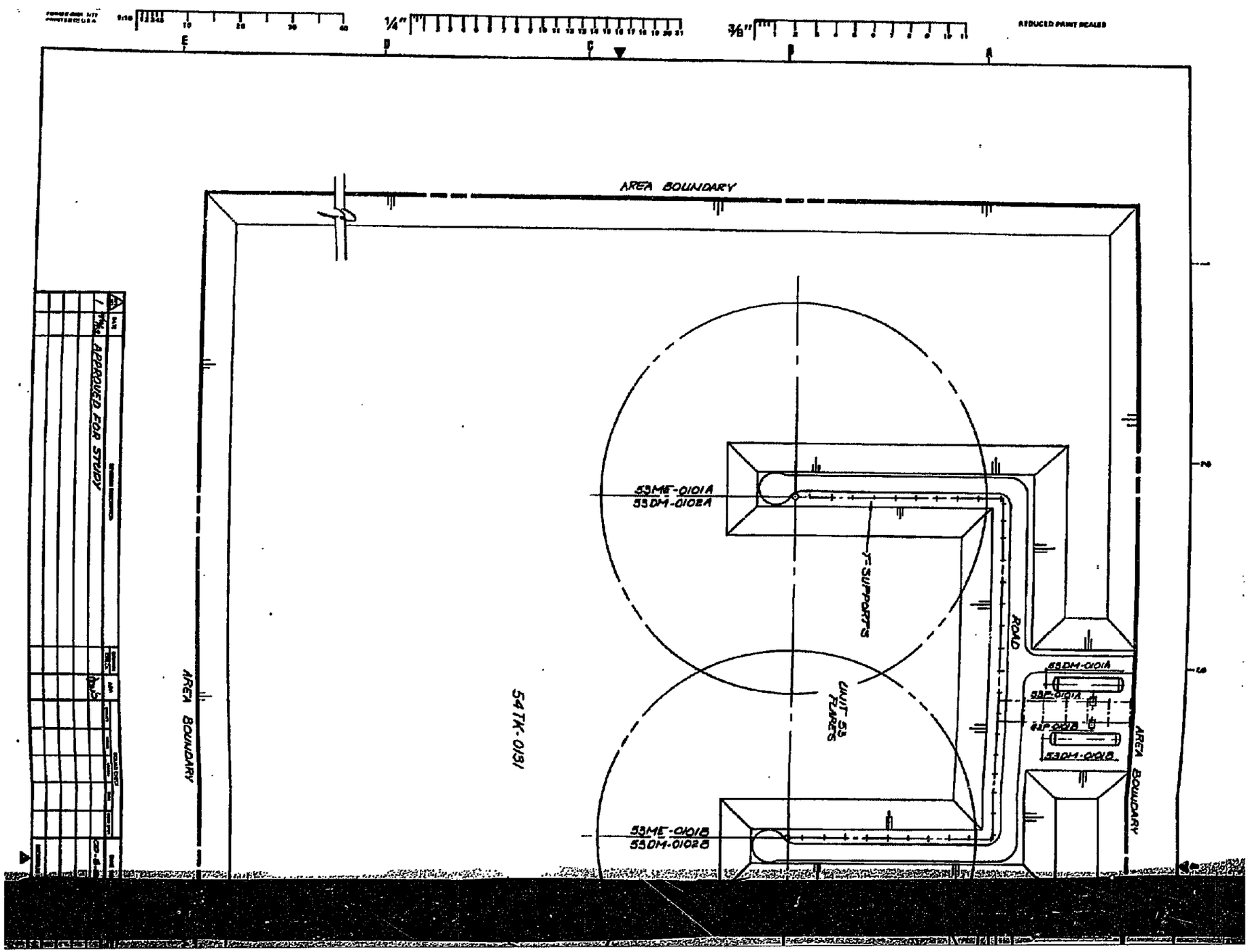
NONE

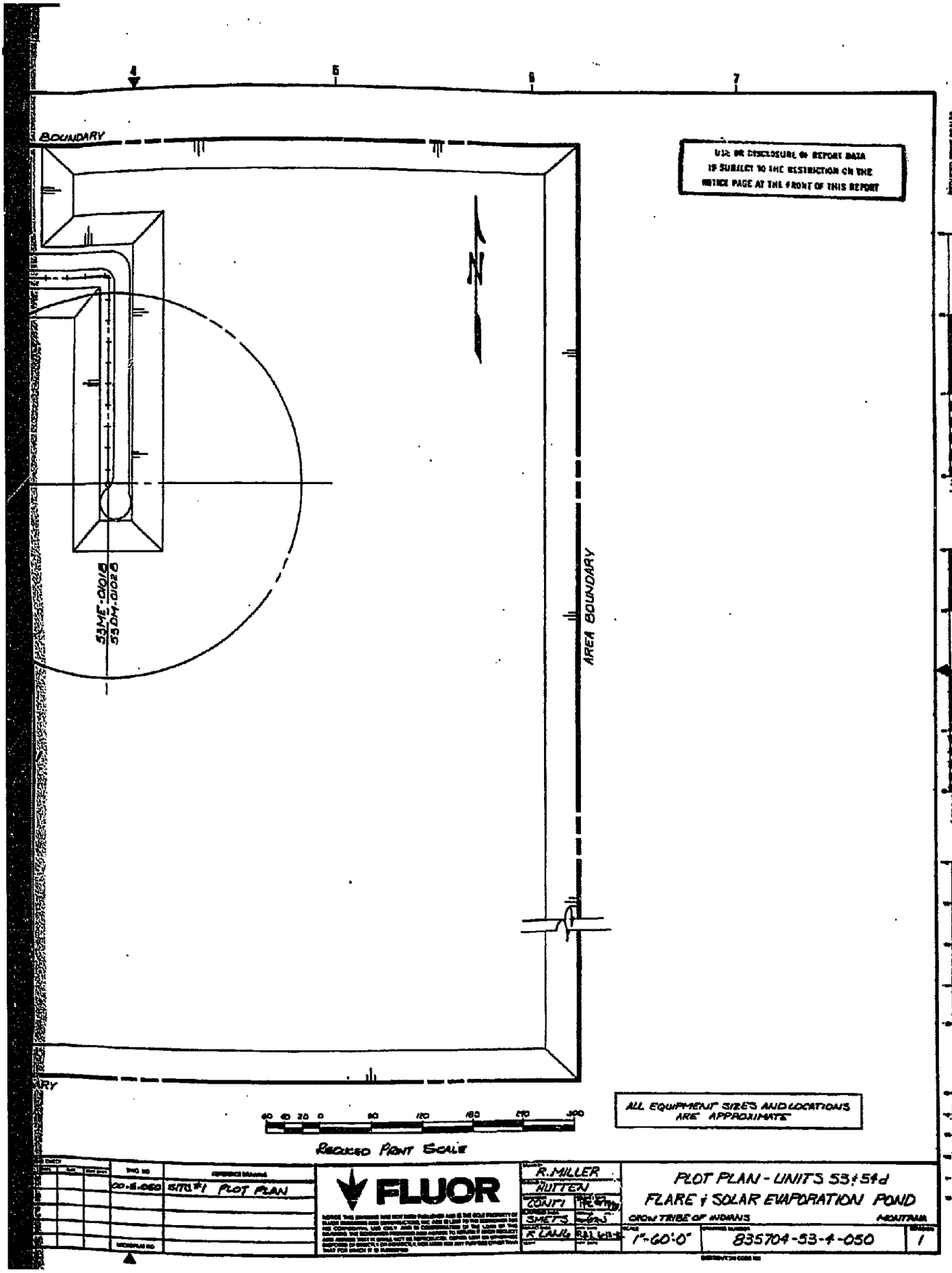
835704-53-R-101 — 1

MICROFILM FRAME NO. ' OF ?

003 3575310I

2


AREA BOUNDARY
53ME-0101A
53DM-0102A
T.S. SUPPORTS
ROAD
53DM-0101A
53P-0101A
53P-0102
53DM-0102
AREA BOUNDARY
54TK-0131
UNIT 53 FLARES
53ME-0101B
53DM-0102B
AREA BOUNDARY
APPROVED FOR STUDY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BOUNDARY
USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT
53ME-0018
53D4-0028
AREA BOUNDARY
ALL EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE
60 40 20 0 80 120 160 240 320
REDUCED PRINT SCALE
FLUOR
R. MILLER
HUTTEN
SHEETS
1"=60'-0"
PLOT PLAN - UNITS 53 & 54
FLARE & SOLAR EVAPORATION POND
CROW TRIBE OF INDIANS
MONTANA
835704-53-4-050
1

TABLE 6.3.14-1

EQUIPMENT LIST

FLARE - UNIT 53

Item No.	Equipment Name	Number Required	
		Operating	Spare
53DM-0101 A/B	Flare Knockout Drums	2	0
53DM-0102 A/B	Flow Diversion Water Seal Drums	2	0
53P-0101 A/B/C	Knockout Drum Slop Pumps	2	1
53ME-0101 A/B	Flare Tips w/Flame Generator	2	0

6.3.15 WASTEWATER TREATING - UNIT 54

6.3.15.1 DESIGN BASIS

Purpose of Unit

The Wastewater Treating unit collects waste water from the storm and oily process water sewers, sanitary sewers, and process units and treats it for re-use within the plant according to the zero-discharge water management plan.

High dissolved solids streams are processed in an evaporator and disposed to a solar evaporation pond.

Scope of Unit

Unit 54 includes clean storm water sewers, oily storm water and plant sewers, running into a storm and oily water pond sized for 30 minutes of a 25 year storm event. Oily water cleanup equipment includes an API separator and air flotation unit for oil separation. The product water from the flotation unit flows to the main treatment area, skimmed oil is burned in an incinerator.

Treatment for process waste water and oily water unit effluent includes pH equalization, two stages of aeration and clarification, biotreatment, filtration, chlorination, zeolite softening and reverse osmosis (RO). The purified water is returned to the process cooling tower as makeup. Back-flushing and RO effluents are concentrated in an evaporator and the high total dissolved solids (TDS) evaporator waste disposed to a solar evaporation pond. Clean condensate from the evaporator is returned to the process cooling tower makeup.

6.3.15.1 (Continued)

The sanitary sewage is treated in separate aeration, clarification, and filtration units and discharged to the wastewater treating equalization pond. Sludges from these processes are dewatered and burned.

General Process Criteria

The wastewater treatment unit is designed to operate 365 days per year without shutdown based on supporting a plant with an overall stream factor of 332 operating days per year.

The oily and storm water collection system consists of a single train and the treatment system consists of two trains. All pumps are spared.

The sanitary sewer biotreatment unit consists of two trains. The equipment in this unit are motor driven and each pump is spared.

The process wastewater treatment unit consists of two parallel operating trains. The equipment in this unit are motor driven and each pump has a spare.

Process Specifications

The product water of the Wastewater Treating unit is fed to the Process Cooling Tower Makeup Water Treatment System and used as makeup for the Process Cooling Tower. The specifications for this water are:

TDS	600 - 700 ppm
Sodium	80 ppm
pH	7 - 8

6.3.15.1 (Continued)

Feed

The feeds to the Wastewater Treating unit are collected from the oily water sewer, the sanitary sewer, the process plant stripped gas liquor, the Rectisol and POX Units, and the blowdown of the process boilers. Composition and flow are given below:

Component	Combined
Calcium (as Ca)	30 ppm
Magnesium (as Mg)	20 ppm
Sodium (as Na)	80 ppm
TDS	800 ppm
Fatty Acids	1000 ppm
Oil	10 ppm
BOD	900 ppm
COD	1500 ppm
pH	6.0
GPM Flow	2331

Product

The makeup stream to the Process Cooling Tower (PCT) has the following composition:

Component	to PCT Makeup	to Evaporator
TDS	55	2730
Sodium	0.3	575
pH	7.5	-
GPM	2371	590

6.3.15.1 (Continued)

Utilities

Power	1270 kW
Steam - 60 psig	2500 lb/hr (consumed)
Condensate (returned)	2500 lb/hr

6.3.15.2 PROCESS DESCRIPTION

The Wastewater Treatment System collects all of the waste water streams from the plant and treats them for re-use within the plant boundaries according to the zero-discharge water management plan. The streams include stripped gas liquor and other process waste streams, storm runoff, and oily plant water. The material balance is shown in Table 6.3.15-1. Drawing No. 835704-54-R-101, -54-R-102, and -54-4-103 show flow diagrams of the system. The plot plan (Drawing No. 835704-54-5-050) and equipment list (Table 6.3.15-2) follow.

The unit contains three major processing sections: Storm and Oily Water Treating, Biological Treating, and Wastewater Evaporation. Stormwater runoff consists of clean and oily water sections. The clean storm water is impounded and used while the oil is separated from the oily water portion by gravity separation and air flotation and disposed of.

The stripped gas liquor and other plant waste streams plus the oil-free water from the oily water separation are treated in a biological treating system to produce water for the Process Cooling Tower Makeup Treating System. This system includes equalization and aeration, clarification, and sludge handling.

Water containing high concentrations of total dissolved solids (TDS) are piped to an evaporator which concentrates the solids and returns product

water to the process cooling tower makeup. The brine that results is sent to the solar evaporization pond for crystalization by evaporation.

Biological Treatment

Process waste water effluent streams, which have a high biological/chemical oxygen demand, are treated in the biotreating system to produce a suitable makeup water to the process cooling water systems.

Neutralization and Equalization

Stripped gas liquor is fed to the neutralization tank and treated with caustic to allow for the partial removal of ammonia. The gas liquor is then mixed with other process wastewater from Rectisol, Partial Oxidation, boiler blowdown, and Sanitary Waste Treatment in the equalization tank where sulfuric acid is injected to control the pH to an optimum level for biological reaction.

Steam drum blowdowns and water from oily water separation are also discharged into this tank. The equalization tank has retention time of approximately four hours. This time is deemed sufficient for the relatively constant flow of the different waste water streams.

Air is utilized to facilitate mixing in the neutralization and equalization tanks. Static type aerators are selected for air sparging to preclude icing conditions which may exist with the use of a mechanical aeration system.

Aeration

Water from the equalization tank flows into two 50 percent aeration tanks; design retention time is five hours. Air is sparged through static type aerators to provide the oxygen for the biological process.

6.3.15.2 (Continued)

The activated sludge process removes biodegradable materials in the waste water by the action of aerobic microorganisms. The process varies with temperature, microorganism population, nutrient availability, oxygen, type/concentration of organics and the biological oxygen demand (BOD) in the waste water.

BOD removal efficiency is maximized by:

Maintaining process temperature between 70°F and 95°F.

Increasing aerobic microorganism concentration.

Maintaining uniform distribution of oxygen, microorganisms, and biodegradable materials throughout the basin.

Clarification and Filtration

The sludge water from the aeration tanks flows to two clarifiers which remove suspended solids (sludge) from the waste water to produce a clear supernatant liquid for cooling tower makeup water treating. The sludge is removed from the clarifier with a hydraulic sludge removal device which returns the biomass to the aeration tank.

Approximately 95 percent of the sludge from the clarifier is recycled to the aeration tank to replenish the microorganisms for biotreatment. A small purge stream is pumped to a gravity thickener for system blowdown to prevent buildup of dissolved solids. The thickener concentrates the sludge, returning the water to the equalization tank. The concentrated sludge is then fed to a sludge press filter for further dewatering. Sludge from the process cooling tower sidestream treating clarifier and sanitary water treatment is also dewatered in the press filter. The water filtrate is

6.3.15.2 (Continued)

returned to the equalization tank and the dewatered sludge cake is conveyed to the sludge incinerator.

The biological treatment effluent stream is filtered in four granular media filters incorporating anthracite and sand as the filter media. The filtration unit removes residual turbidity from the cooling water makeup stream. Fine particles which are washed and rinsed off the filter media are sent to the backwash recovery sump for recycle to the clarifier. The treated water is pumped to the process cooling tower makeup water treatment system.

The water from the filtration unit may be recycled to a diversion pond in case of a digester failure (killing of the microorganisms).

While diverting the effluent, the influent waste water is also sent to the diversion pond until the biological treatment unit is restored to working condition. The size of the diversion pond is 36.3 million gallons or seven days storage at full capacity. When the biotreating system is operating normally, the diverted waste water is gradually pumped into the system for treatment.

Sludge Handling

The filter cake, which is composed of sludge and dead microorganisms, is fed to the top section of the multiple hearth furnace where it passes through three separate zones, each of which is subjected to a different closely related controlled temperature and furnace atmosphere.

6.3.15.2 (Continued)

The furnace zones are described below:

Drying Zone - Water is evaporated by countercurrent flow of hot combustion gases. Temperature of the cake is raised to approximately 210°F.

Decomposition Zone - Temperature is increased to about 750°F in an oxygen free atmosphere. Under these conditions the organics are pyrolyzed and volatile materials are driven off.

Gasification Zone - Temperature is increased to about 1600°F to 1800°F. Organic material is completely combusted in this zone.

Combustion of fuel gas provides the required heat; carbon dioxide and steam, as part of the products of combustion, are the activating agents.

CLEAN STORM AND OILY WATER COLLECTION SYSTEM

The clean storm and oily water systems provide surge for rain runoff, remove oil and suspended solids from contaminated waters and provide a measure of quality control over waters released across the factory battery limits.

6.3.15.2 (Continued)

Principle parameters considered in the design of the storm and oil water collection systems include the following provisions:

Provision for three major collection systems as defined above:

Clean storm water sewer (CSS) - collects and impounds storm water runoff from noncontaminated areas within the facility plot.

Oily storm water sewer (OWS) - collects, impounds and treats storm water runoff from potentially contaminated areas within the facility plot.

Oily process sewer (OPS) - collects, impounds and treats oily water discharges from operating equipment within the facility plot.

Provision for the clean storm water pond sized on the basis of a 25-year frequency, one-day duration storm event (3 inches total accumulated rainfall) over a 17.85×10^6 ft^2 facility surface area assuming an average runoff coefficient of .8 (pond capacity = 26.7×10^6 gallons.)

Provision for the oily storm water pond sized on the basis of a 25-year frequency, one-day duration storm event (3 inches total accumulated rainfall) over a 2.03×10^6 ft^2 paved facility area assuming a runoff coefficient of 1.0. These ponds are also sized on the basis of one day's expected flow from the oily process sewer and the clean storm water sewer flow which corresponds to a 25-year storm event of 15 minutes duration (pond capacity = 3.79×10^6 gallons.)

One oily water gravity separator is provided. The separator is sized on the basis of the peak OWS dry flow of 18 gpm and the expected OPS normal flow of 260 gpm. These separators are designed to decrease the oil

6.3.15.2 (Continued)

concentration of the influent (assumed to be 1000 ppm) to 50 ppm in the effluent.

The unit has three feed streams: (1) the oily water storm sewer (OWS); (2) the oily water process sewer (OPS); and (3) the clean storm water sewer (CSS). These three sewers gravity-drain essentially all of the developed facility complex. The purpose of the OPS and the OWS is to collect process oily water as well as washdown and storm water from potentially contaminated process and utility areas. The purpose of the CSS is to collect noncontaminated water, primarily storm runoff, from clean process and utility areas.

The unit serves the following functions in processing the water from the three sewer systems:

Provides surge for rain runoff.

Removes oil from contaminated waters.

Removes suspended solids from contaminated waters.

Insures quality control over waters released across the facility battery limits.

Clean Storm Water Sewer (CSS)

The clean storm water sewer enters the unit through an open ditch. The dry weather flows are minimal. By isolating the CSS from waters known to be frequently contaminated and by automatically diverting the first 15 minutes of storm flow (CSS flush) to the oily water ponds, contamination of the clean storm water ponds is minimal. As a further safeguard, the CSS is also monitored (total carbon analyzer) to ensure

6.3.15.2 (Continued)

that the dry weather flow can be manually diverted in the event of contamination. During an extended storm event, the oily waters storm sewer flow is diverted to the clean storm water ponds once the OWS flow is clean. The terminus of the CSS is impoundment pond. The pond is lined only to the extent that is necessary to prevent seepage to groundwater. Normally, clean storm water impounded in the pond is pumped as makeup to the utility cooling tower. During excessive rainfall, overflow from the clean storm water ponds gravity-drains across the plant battery limits to natural drainage outside the plot.

Oily Water Storm Sewer (OWS) and Oily Water Process Sewer (OPS)

The OWS and the OPS both gravity-drain through pipes across the Unit 54 battery limits into the oily water sewer diversion box. Prior to entering this box, the OWS may be manually diverted to the CSS. The OWS dry weather flow is comprised of time-varying amounts of rain runoff, utility water (washdown), cooling water (loop and drift losses) and firewater. The OPS flow is comprised of selected oily process waters, equipment drains and washdown.

Dry weather flow gravity-drains from the diversion box to the oily water separators and then the air flotation units. Oil separated in the oily water separator is skimmed to a sump from where it is pumped to an intermediate storage tank for emulsion breaking and dewatering by gravity. Oil skimmed from the oil/water interface of the storage tank is pumped to the Tank Farm. Sludge which accumulates in the bottom of the oily water separator is gravity-drained to a sump from where it is pumped to the sludge tank for emulsion breaking and settling.

Flocculent is added to the influent of the air flotation units. The proper pH for floc formation is maintained by the addition of either acid or caustic, whichever is required. Sludge removed from the surface of the

6.3.15.2 (Continued)

air flotation units gravity-drains to a sump from where it is pumped to the sludge tank for emulsion breaking and settling. The combined sludge from the oil separators and the air flotation units is pumped from the sludge tank to a centrifuge for dewatering before incineration. Water from the centrifuge gravity-drains to a sump. Waters from the skimmed oil tank, sludge tank, and centrifuge sump are returned to the process upstream of the oily water separators. Oil skimmed from the oil/water interface in the sludge tank is pumped to the Tank Farm for reprocessing.

During a major storm event, oily water overflows the oily water diversion box-dry weather retainment weir and gravity-drains to the oily water impoundment pounds. The pond is lined to facilitate the removal of sludge which accumulates during the storm events. Following a storm event, the inventory of the ponds is pumped to biotreating by means of the oily water separators and air flotation units. As previously mentioned, the OWS flow during an extended storm event is diverted to the clean storm water ponds as soon as the OWS is clean. This scheme relieves the load on the smaller OWS ponds which are not permitted to overflow across the factory battery limits.

The effluent from the air flotation units is pumped to the equalization basin upstream of biotreating for further processing.

WASTEWATER EVAPORATION SYSTEM

To meet the zero effluent discharge design and minimize water loss, a vapor recompression evaporator system is provided to process high TDS inorganic waste water streams. Specifically, Reverse Osmosis reject brine from the process cooling tower makeup treatment system, plus the high TDS portion of the demineralizer regenerant wastes are sent to the unit. One

6.3.15.2 (Continued)

unit is provided with a capacity to handle approximately 873 gpm of feed water.

The evaporators are "package type" units provided by RCC (Resource Conservation Company). The process scheme consists of a feed effluent exchanger, deaerator and evaporator unit. Basically, the high TDS slurry is circulated in vertical tubes where thin film heat transfer occurs evaporating the water and concentrating the brine.

Steam produced is compressed in a vapor compression unit, condensed and distillate withdrawn as product. The concentrated brine from evaporation is sent to the solar evaporation pond. The pond is sized for 25 year accumulation of solids. No effluent leaves the solar evaporation pond except water vapor.