12.0 WATER MANAGEMENT

12.1 PROCESS DESCRIPTION

12.1.1 Raw Water Treatment

Raw water from the Ohio River is pumped through a clarifier for removal of suspended solids. 10,447 gpm of raw water is taken from the Ohio River and chlorinated during clarification to remove organic material. The clarified water is collected at the clarified water reservoir for use as cooling tower makeup, utility water, process water, firewater, and solids handling systems makeup water. Clarified water is diverted prior to the clarified water reservoir and pumped through a sand filter for use as boiler feedwater make-up.

Consideration was also given to using a Ranney Well System instead of an intake structure. If a Ranney Well is used, a clarifier won't be needed but there will be more treatment required for the boiler feed water due to the higher TDS level of the Ranney Well water. Refer to Section 12.1.3 for a description of the boiler feedwater treatment scheme for a Ranney Well System. A full description, including an overall block flow diagram, unit block flow diagrams and material balances are contained in this section.

A full description, including an overall block flow diagram and ionic balance, and unit block flow diagram and corresponding ionic balances, is contained in Appendix 1 for case 15. The system design given in this Appendix is based on a ground water system with a flow rate of 19,553 gpm from the Ranney Well structure.

12.1.2 Potable Water

The potable water supply, 31 gpm, is drawn upstream from the raw water clarifier and treated in the following manner prior to distribution within the plant:

1. Chlorination
2. Clarification
3. Filtration (sand)
4. Filtration (activated carbon)
5. Post Chlorination

If a Ranney Well system is used, a potable water clarifier will not be required.

12.1.3 Boiler Feed Makeup Treatment System (Demineralizer)

The boiler feedwater treatment system encompasses activated carbon filtration and demineralization by ion exchange. The treatment system for raw water from an intake structure proceeds as follows:

1. Filtration (activated carbon)
2. Cation Exchange
3. Anion Exchange
4. Mixed bed polishing

The ion exchange demineralizers consist of strong acid cation exchangers, and strong basic anion exchangers which contain a mixture of strong acid cation resin and strong basic anion resin. The water initially flows through activated carbon filters before flowing through the cation exchanger where the cations are exchanged with hydrogen ions. The water is then pumped through the anion unit for the removal of the anions, CO_2, and silica in exchange for hydroxyl ions. A mixed bed polisher is then provided for removal of remaining cations and anions. The demineralized water is then routed to a storage tank for boiler makeup.

The treatment system for ground water from a Ranney Well system includes a reverse osmosis unit (R.O.) prior to the cation exchanger. The reverse osmosis units reduces the cation and anion concentrations of the water. Polishing would not be required with this system that utilizes the R.O. unit.

12.1.4 Condensate Mixed Bed Polishing

Condensate will be treated in a mixed bed ion exchange polishing system. The condensate polishing system is a high flow rate, externally regenerated mixed bed design sized to treat 100 percent of the boiler condensate flow on a continuous basis. Each mixed bed polisher contains a mixture of strong acid cation resin and strong basic anion resin. The condensate polishers perform a dual function:

- By retaining suspended material, mainly corrosion products,
- By exchanging dissolved ions against hydrogen and hydroxyl ions, they function as demineralizers.

The condensate is then sent to the treated condensate storage tank for reuse as boiler makeup.

12.1.5 Raw Water/Condensate Treatment System Wastes

Various wastes are generated in operating the raw water and condensate treatment systems. The individual wastes from these systems are handled with a sludge thickener that is provided to receive the blowdown, backwash, the rinse water from the potable and raw water clarifiers, activated carbon filters, and sand filters. The clean supernatant from the thickener is routed to the supernatant collection sump where it is pumped back to the clarification system. Regeneration and waste from the demineralizer and mixed bed polishers are combined and neutralized in a neutralization sump. This neutralized water is then pumped to a monitoring pond before discharging to the Ohio River.

Sludge resulting from the operation of the potable water treatment system and the raw water pretreatment system is classified non-hazardous and will be sent to landfill following dewatering.

12.1.6 Utility and Process Cooling Tower Makeup

Makeup requirement for the cooling towers is clarified river water and is drawn from the clarified water reservoir. Blowdown from the cooling tower is discharged to the effluent treatment pond or, for minor leakage from the process side, the blowdown will be diverted directly to the oily water sewer. For major leakage, cooling water return will be diverted to the oily water sewer.

12.1.7 Effluent Treatment

Oily water is initially treated in API separators and dissolved Air Flotation Units (DAF) to remove free oil and suspended material. The DAF effluent is then combined with the other process plant waste streams in the equalization pond. Other process plant waste streams include stripped gas liquor, Mobil MTG reaction water, Lurgi liquid POX water, SNG condensate, and miscellaneous plant process effluents such as equipment leakage, wash water, etc. The pond serves to absorb any flow and chemical composition swings prior to the biological treatment. Off-spec waste is diverted to the off-spec collection pond and recycled back to the equalization pond. The collected water is initially pumped to a primary aeration basin, where Biological Oxygen Demand of the water is reduced. Phosphate is added at the aeration tank, then the aerated waste is pumped into a clarifier where suspended solids are collected. Next, the partially treated waste flows to a secondary aeration basin, where it will be further aerated. After extended aeration/contact time, the water is pumped to a secondary clarifier unit, where polyelectrolyte is added to obtain more efficient suspended solids removal.

Effluent from the second clarifier will be recycled to the off-spec collection pond if it is not acceptable. The clarifier overflow is routed through sand filters for the removal of residual suspended material. The waste water is then treated by activated carbon filters for further removal of residual organics and toxic substances. Then it is pumped to the effluent treatment pond where it is blended with other plant wastes for ph adjustment, monitoring, and eventual discharge to the Ohio River. Part of the biosludge from the primary and secondary clarifier is routed to a sludge thickener for concentration. The balance of the sludge is recycled to the aeration tanks.

12.1.8 Sanitary Wastewater Treatment

The sanitary sewage, comprised primarily of human liquid and solid wastes, is discharged to a biological treatment facility. The solid wastes are ground to pulp prior to biological aeration in which the sewage is decomposed by an aerobic digestion process. A portion of the biological sludge is dewatered and incinerated and the remaining is recycled. The final effluent after sand filtration and post chlorination is discharged to the effluent treatment pond.

12.1.9 Unit 46 - FGD Unit

The sludge from the Flue Gas Desulfurization system is concentrated in the thickener. The slurry from the bottom of the thickener is pumped to vacuum filters where a filter cake of approximately 60 percent solids is discharged to the Fly Ash Stabilization system of the Boiler Ash Handling Unit (Unit 03).

Blowdown from the scrubbing water surge tank is combined with the blowdown from ash handling and discharged to the front end of the biological treatment unit.

12.1.10 Coal Wet Screening and Wash Water Handling (Unit 20)

Several wet screens are employed to wash down any fines (minus 1/4") from the coarse coal (2" x 1/4") which is fed directly to Lurgi gasifiers.

The minus 1/4" size fines are dewatered in a centrifuge. The coal fines, after being dried, are stored in the fines silo. The fines can either be used for power and steam generation or sold to customers.

Overflow from the centrifuge is collected in clarified water head tank for recirculation. Makeup water is added to the system to compensate for water retained with the coal particulates and blowdown.

12.1.11 Ash Handling Effluent Treatment

12.1.11.1 Gasifier Effluent Treatment - The quenched gasifier ash and its sluiced water are screened to remove large ash particles and the remainder is collected in a holding sump. The coarse ash is directly conveyed to landfill.

The slurry is pumped to dewatering cyclones and then to plate thickeners for further clarification. The thickened sludge is filtered and discharged to landfill. The clarified water from the plate clarifier and dewatering cyclone is recirculated. Make-up water is added for water losses due to evaporation by quenching and for retained water in sludge and blowdown.

12.1.11.2 <u>Boiler Effluent Treatment</u> - The fly ash from the boilers is discharged dry to stabilize the sludge from the FGD unit before disposing to a landfill.

The bottom ash is pumped to the ash dewatering plant and combined with the gasifier ash slurry.

The effluent water from the clarifier and dewatering press is recycled back to the system. Make-up water is continuously added due to water losses and blowdown.

12.1.12 Utility Water

The utility water requirements for the plant are drawn from the clarified water reservoir. Utility water is primarily required for area washdown water. Utility water so used will be collected by the oily water runoff system and eventually returned to the biological treatment system.

12.1.13 Storm and Oily Water Separation System

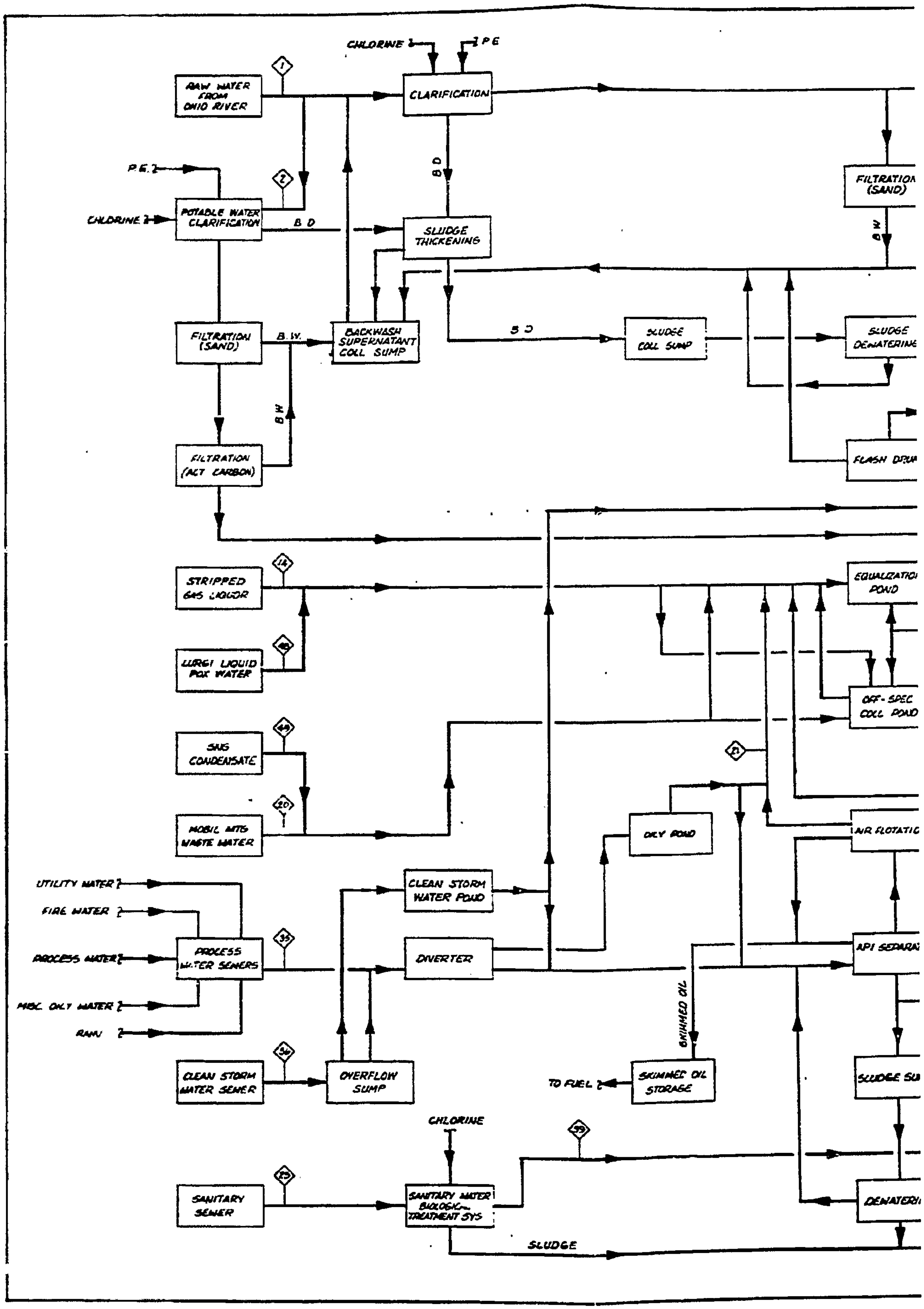
The plot is divided into clean and contaminated drainage areas for the purpose of collecting and segregating clean and contaminated storm runoff.

The clean storm sewer (OWS) collects oily storm runoff and washdown from contaminated process areas and tankage. The oily water process sewer (OPS) collects equipment drains and washdown. Oily water from both sewers flows to the oily water separation system where free oil is skimmed off and sludge is collected and removed. The overflow from the oily water separator is routed through an air flotation unit for final oil removal prior to being pumped to biological treatment. Two oily water ponds are provided to impound oily water during a storm event. The ponds are sized to impound the runoff resulting from a 25-year frequency, one day duration, storm event equivalent to 5.7 inches total rainfall collected over the surface of the oily water storm sewer watershed plus 30 minutes flush from the clean storm sewer for the same storm event.

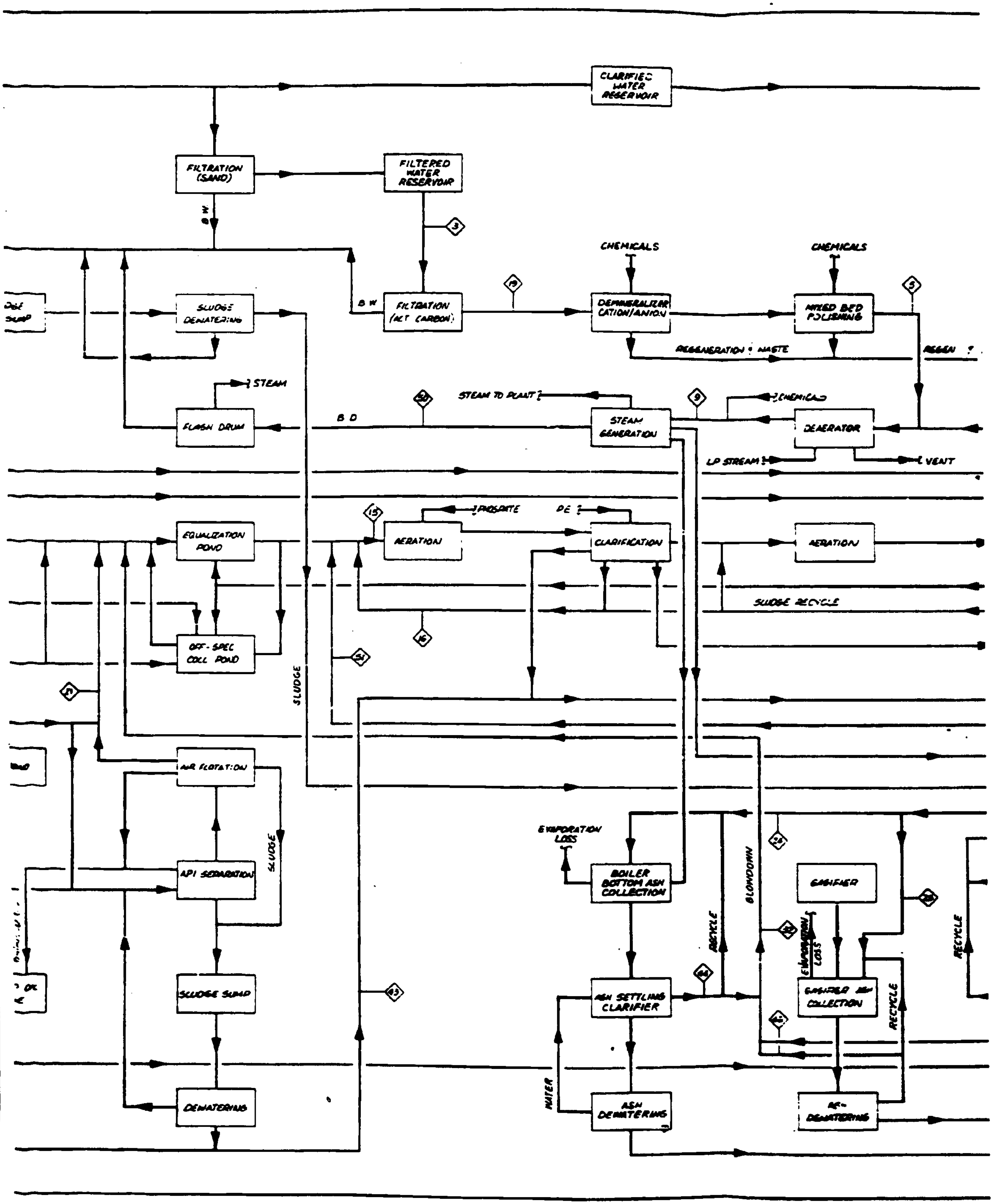
Normally, under dry weather conditions, the OWS flow is to the oily water separator. During a storm event, the initial flush of the CSS is automatically diverted to the oily water ponds. During an extended storm event, the OWS may be manually diverted to the clean storm ponds. Oily water impounded in the oily water ponds during a storm event is pumped to biotreating through the oily water separator and air flotation unit.

12.2 FLOWSHEETS

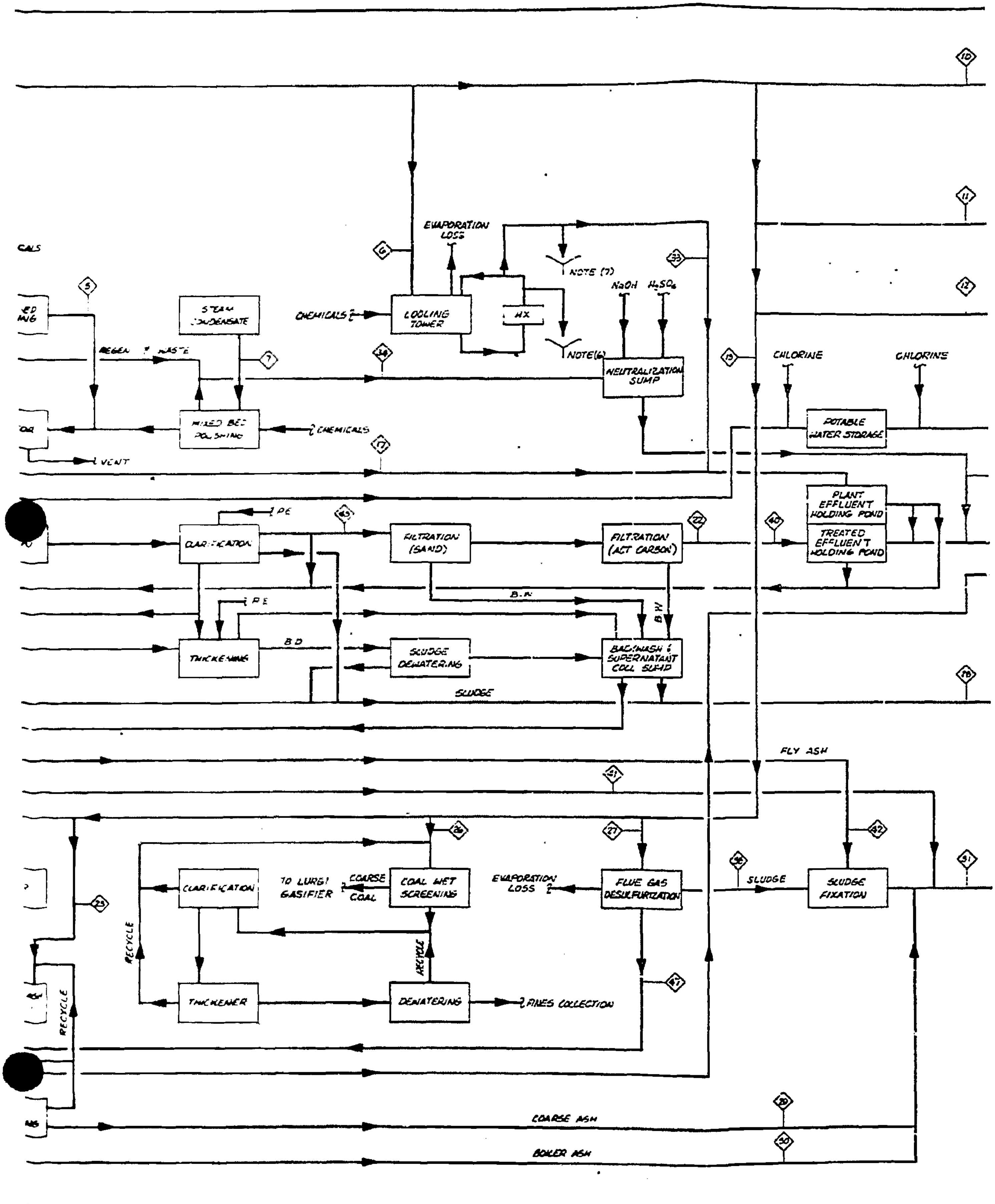
Attached is Drawing No. 835504-00-12-043 Rev. B - Block Flow Diagram - Water and Solid Waste Management.



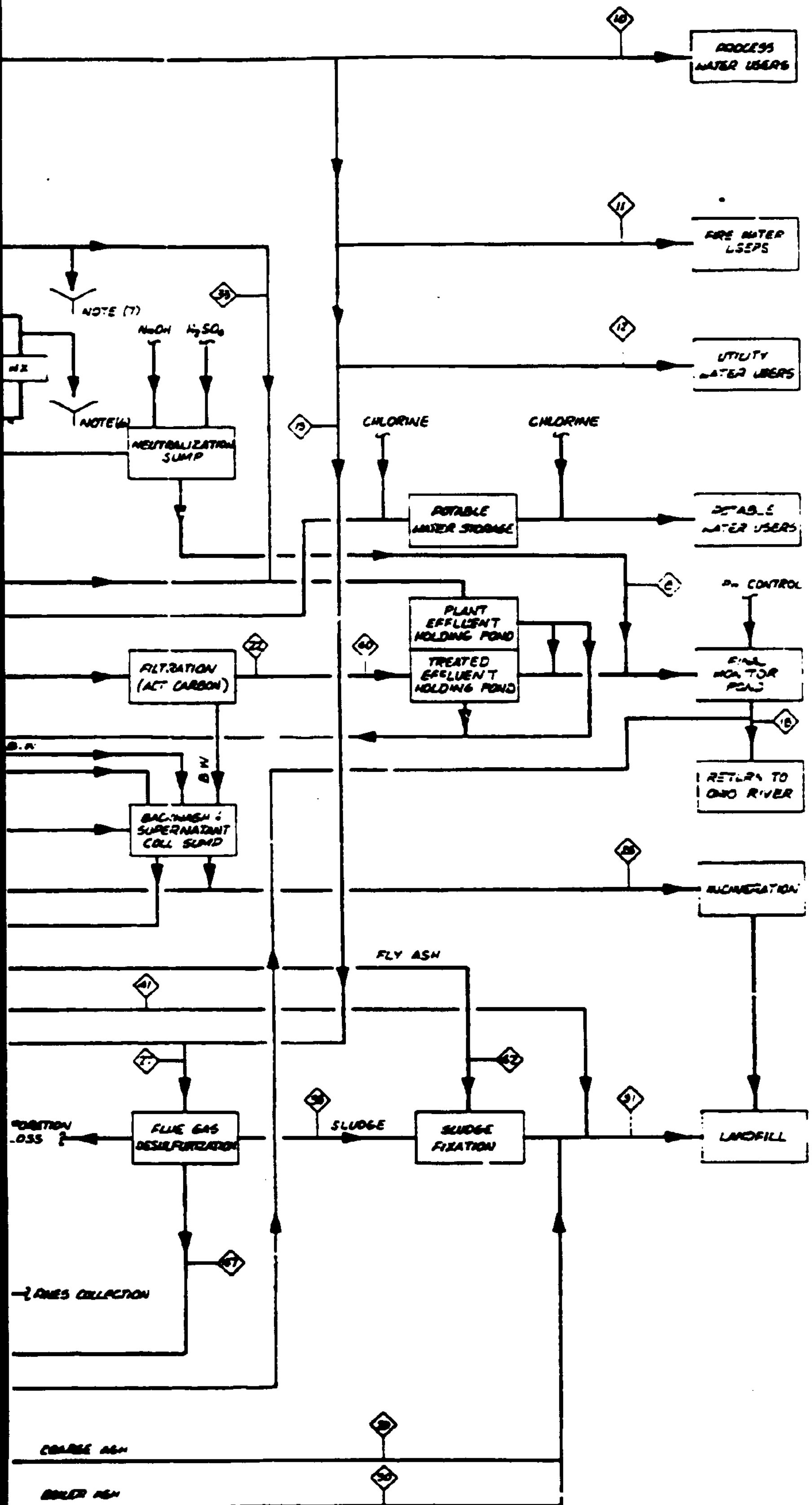
CHLORINE
PE
RAW WATER FROM OHIO RIVER
CLARIFICATION
P.E.
CHLORINE
POTABLE WATER CLARIFICATION
B D
SLUDGE THICKENING
FILTRATION (SAND)
B.W.
BACKWASH SUPERNATANT COLL SUMP
S D
SLUDGE COLL SUMP
SLUDGE DEWATERING
B W
FILTRATION (ACT CARBON)
FLASH DRUM
STRIPPED GAS LIQUOR
EQUALIZATION POND
LURGI LIQUID POX WATER
OFF-SPEC COLL POND
SNG CONDENSATE
MOBIL MTG WASTE WATER
OILY POND
AIR FLOTATION
UTILITY WATER
FIRE WATER
CLEAN STORM WATER POND
PROCESS WATER
PROCESS WATER SEWERS
DIVERTER
API SEPARATOR
MISC OILY WATER
RAIN
SKIMMED OIL
CLEAN STORM WATER SEWER
OVERFLOW SUMP
TO FUEL
SKIMMED OIL STORAGE
SLUDGE SUMP
CHLORINE
SANITARY SEWER
SANITARY WATER BIOLOGICAL TREATMENT SYS
DEWATERING
SLUDGE



CLARIFIED WATER RESERVOIR
FILTRATION (SAND)
FILTERED WATER RESERVOIR
B W
CHEMICALS
CHEMICALS
SLUDGE DEWATERING
FILTRATION (ACT CARBON)
DEMINERALIZER CATION/ANION
MIXED BED POLISHING
REGENERATION ? WASTE
STEAM
STEAM TO PLANT
CHEMICALS
FLASH DRUM
B D
STEAM GENERATION
DEAERATOR
LP STREAM
VENT
PHOSPHATE
DE
EQUALIZATION POND
AERATION
CLARIFICATION
AERATION
SLUDGE RECYCLE
OFF-SPEC COLL POND
SLUDGE
AIR FLOTATION
EVAPORATION LOSS
BOILER BOTTOM ASH COLLECTION
GASIFIER
API SEPARATION
SLUDGE
RECYCLE
BLOWDOWN
EVAPORATION LOSS
RECYCLE
SLUDGE SUMP
ASH SETTLING CLARIFIER
GASIFIER ASH COLLECTION
RECYCLE
WATER
DEWATERING
ASH DEWATERING
RE-DEWATERING



EVAPORATION LOSS
NOTE (7)
NOTE (6)
NaOH
H_2SO_4
STEAM CONDENSATE
CHEMICALS
COOLING TOWER
HX
REGEN. & WASTE
NEUTRALIZATION SUMP
CHLORINE
CHLORINE
MIXED BED POLISHING
CHEMICALS
POTABLE WATER STORAGE
VENT
PLANT EFFLUENT HOLDING POND
TREATED EFFLUENT HOLDING POND
PE
CLARIFICATION
FILTRATION (SAND)
FILTRATION (ACT CARBON)
B.W.
B.W.
PE
THICKENING
BD
SLUDGE DEWATERING
BACKWASH & SUPERNATANT COLL. SUMP
SLUDGE
FLY ASH
CLARIFICATION
TO LURGI GASIFIER
COARSE COAL
COAL WET SCREENING
EVAPORATION LOSS
FLUE GAS DESULFURIZATION
SLUDGE
SLUDGE FIXATION
RECYCLE
RECYCLE
THICKENER
DEWATERING
FINES COLLECTION
RECYCLE
COARSE ASH
BOILER ASH



LEGEND

P.E. – POLYELECTROLYTE
B.W. – BACK WASH
B.D. – BLOW DOWN

NOTES:

1. DESIGN BASES IS BASED ON CASE 13.
2. STREAM FLOWRATES ARE BASED ON DRY WEATHER CONDITION
3. WATER MANAGEMENT SCHEME IS BASED ON DISCHARGING TREATED EFFLUENT TO THE OHIO RIVER
4. ALL FLOWRATES IN THE MATERIAL BALANCE ARE GPM UNLESS OTHERWISE INDICATED.
5. ALL FLOWRATES ARE FOR NORMAL OPERATING CONDITIONS.
6. FOR MAJOR LEAKAGE, COOLING WATER RETURN FROM A HEAT EXCHANGER OR HEAT EXCHANGERS WILL BE DIVERTED TO OILY WATER SEWER
7. FOR MINOR LEAKAGE, COOLING WATER BLOWDOWN WILL BE DIVERTED DIRECTLY TO OILY WATER SEWER.

TRI-STATE SYNFUELS PROJECT

BLOCK FLOW DIAGRAM
WATER AND SOLID WASTE
MANAGEMENT

85506-00-R-043

12.3 MATERIAL BALANCE

Attached is a Material Balance for Water Management.

UNIT 02 - COAL WASH HANDLING UNIT

Date 3/24/82

Cont. No. 835504

By F. Hung

CASE 13

STREAM
- 2 - COAL FINES
- 3 - COARSE COAL
- 4 - RECYCLE WATER
- 5 - MAKE-UP WATER

CONSTITUENT	PPM	STREAM NO. 2	3	4	5	
Total Dissolved Solids				607	143	
Total Alkalinity	$CaCO_3$			54	54	
Total Hardness	$CaCO_3$			332	332	
PH				6.6	6.6	
Total Suspended Solids				—	—	
Calcium (Ca++)	$CaCO_3$			216	216	
Magnesium (Mg++)	$CaCO_3$			116	116	
Sodium (Na+)	$CaCO_3$			143	—	
Hydrogen (H+)	$CaCO_3$			—	—	
Potasium (K+)	$CaCO_3$			60	—	
Ammonia (NH_4+)	$CaCO_3$			—	—	
TOTAL CATIONS	$CaCO_3$			475	332	
Bicarbonate (HCO_3)	$CaCO_3$			54	54	
Carbonate (CO_3^{--})	$CaCO_3$			—	—	
Hydroxide (OH-)	$CaCO_3$			—	—	
Chloride (Cl-)	$CaCO_3$			161	21	
Sulfate (SO_4^{--})	$CaCO_3$			250	254	
Nitrate (NO_3)	$CaCO_3$			1	1	
Fluoride (F-)	$CaCO_3$			1.9	1.9	
Phosphate (PO_4^{--})	$CaCO_3$			0.14	0.14	
Sulfite ($SO_3^{=}$)	$CaCO_3$			<0.1	—	
Thiocyanide (CNS^-)	$CaCO_3$			—	—	
ORGANIC ACIDS	$CaCO_3$			1.8	—	
TOTAL ANIONS	$CaCO_3$			475	332	
Iron Total	Fe			0	0	
Carbon Dioxide, Free	CO_2			25	25	
Silica	SiO_2			2.1	2.1	
Residual Chlorine	Cl_2			—	1.5	
Organic CHEMICALS				0.2	—	
Manganese	Mn			<0.15	<0.15	
Copper	Cu			<0.01	<0.01	
Hydrogen Sulfide	H_2S			—	—	
Other Trace Metals				26.28	—	
Phenol	C_6H_6			600	—	
Sulfur	S			110	—	
TKN	N			120	—	
SLUDGE	LBS./HR.			—	—	
COAL	LBS./HR.	41670	517585	—	—	
ASH	LBS./HR.			—	—	
COD				43	—	
BOD				30	—	
Flow Rate	GPM	60	75	1810	135	

UNIT 02 - COAL WET [illegible] UNIT

STREAM	
4 - P[illegible] [illegible] WATER	

Date 3/25/82
Cont. No. 83.77[illegible]
By [illegible]

CASE - 13

TRACE METAL, PPM	STREAM NO.					
	4					
Aluminum	<0.05					
Antimony	0.001					
Arsenic	0.02[illegible]					
Barium	0.22					
Beryllium	<0.0005					
Boron	11					
Cadmium	<0.002					
Chromium	3.4					
Cobalt	<0.006					
Copper	0.019					
Lead	<0.002					
Lithium	[illegible].23					
Molybdenum	<0.002					
Mercury	0.0071					
Nickel	0.009					
Phosphorous	<0.2					
Selenium	0.14					
Silicon	8.6					
Silver	<0.002					
Strontium	0.45					
Thallium	<0.002					
Titanium	0.07[illegible]					
Vanadium	0.18					
Yttrium	<0.002					
Zinc	<0.003					
Total Trace Metal	26.28					

UNIT 03A - GASIFIER ASH HANDLING UNIT

Date 3/24/82
Cont. No. 835504
By P. Hung
CASE 13

STREAM	
1 -	DRY COARSE ASH DISCHARGE
2 -	RECYCLE WATER
3 -	EVAPORATION LOSS
4 -	MAKE-UP WATER
5 -	BLOWDOWN

CONSTITUENT	PPM	STREAM NO. 1	2	3	4	5
Total Dissolved Solids			2654		443	2654
Total Alkalinity	$CaCO_3$		54		54	54
Total Hardness	$CaCO_3$		1600		332	1600
PH			6.6		6.6	6.6
Total Suspended Solids			—		—	—
Calcium (Ca++)	$CaCO_3$		880		216	880
Magnesium (Mg++)	$CaCO_3$		650		116	650
Sodium (Na+)	$CaCO_3$		338		—	338
Hydrogen (H+)	$CaCO_3$		—		—	—
Potasium (K+)	$CaCO_3$		110		—	110
Ammonia (NH_4+)	$CaCO_3$		--		—	—
TOTAL CATIONS	$CaCO_3$		1978		332	1978
Bicarbonate (HCO_3)	$CaCO_3$		54		54	54
Carbonate ($CO_3^{=}$)	$CaCO_3$		—		—	—
Hydroxide (OH-)	$CaCO_3$		—		—	—
Chloride (Cl-)	$CaCO_3$		21		21	21
Sulfate (SO_4^{--})	$CaCO_3$		1900		254	1900
Nitrate (NO_3)	$CaCO_3$		1.0		1	1
Fluoride (F-)	$CaCO_3$		1.9		1.9	1.9
Phosphate (PO_4^{--})	$CaCO_3$		0.14		0.14	0.14
Sulfite ($SO_3^{=}$)	$CaCO_3$		—		—	—
Thiocyanide (CNS^-)	$CaCO_3$		—		—	—
TOTAL ANIONS	$CaCO_3$		1978		332	1978
Iron Total	Fe		—		—	—
Carbon Dioxide, Free	CO_2		25		25	25
Silica	SiO_2		70		2.1	70
Residual Chlorine	Cl_2		—		1.5	—
Organic Acids			—		—	—
Manganese	Mn		<0.15		<0.15	<0.15
Copper	Cu		<0.01		<0.01	<0.01
Hydrogen Sulfide	H_2S		—		—	—
Other Trace Metals			5.5		—	5.5
Phenol	C_6H_6				—	
Sulfur	S				—	
TKN	N				—	
SLUDGE	LBS./HR.				—	
COAL	LBS./HR.				—	
ASH	LBS./HR.	81910			—	
COD					—	
BOD					--	
Flow Rate	GPM		2574	15	200	115

UNIT 03A - GASIFIER ASH HANDLING UNIT

STREAM	6 - WET COARSE ASH DISPOSED

Date 3/29/82
Cont. No. 835504
By P. HUNG
CASE 13

CONSTITUENT	PPM	STREAM NO. 6				
Total Dissolved Solids		/				
Total Alkalinity	$CaCO_3$	/				
Total Hardness	$CaCO_3$	/				
PH		/				
Total Suspended Solids		/				
Calcium (Ca^{++})	$CaCO_3$	/				
Magnesium (Mg^{++})	$CaCO_3$	/				
Sodium (Na^+)	$CaCO_3$	/				
Hydrogen (H^+)	$CaCO_3$	/				
Potassium (K^+)	$CaCO_3$	/				
Ammonia (NH_4^+)	$CaCO_3$	/				
TOTAL CATIONS	$CaCO_3$	/				
Bicarbonate (HCO_3^-)	$CaCO_3$	/				
Carbonate (CO_3^{--})	$CaCO_3$	/				
Hydroxide (OH^-)	$CaCO_3$	/				
Chloride (Cl^-)	$CaCO_3$	/				
Sulfate (SO_4^{--})	$CaCO_3$	/				
Nitrate (NO_3^-)	$CaCO_3$	/				
Fluoride (F^-)	$CaCO_3$	/				
Phosphate (PO_4^{--})	$CaCO_3$	/				
Sulfite ($SO_3^=$)	$CaCO_3$	/				
Thiocyanide (CNS^-)	$CaCO_3$	/				
TOTAL ANIONS	$CaCO_3$	/				
Iron Total	Fe	/				
Carbon Dioxide, Free	CO_2	/				
Silica	SiO_2	/				
Residual Chlorine	Cl_2	/				
Organic Acids		/				
Manganese	Mn	/				
Copper	Cu	/				
Hydrogen Sulfide	H_2S	/				
Other Trace Metals		/				
Phenol	C_6H_6	/				
Sulfur	S	/				
TKN	N	/				
SLUDGE	LBS./HR.	/				
COAL	LBS./HR.	/				
ASH	LBS./HR.	21910				
COD		/				
BOD		/				
Flow Rate	GPM	70				

UNIT 03A - GASIFIER ASH HANDLING UNIT

Date	3/29/82
Cont. No.	835504
By	P. HUNG

CASE 13

STREAM
- 2 - RECYCLE WATER
- 5 - BLOWDOWN

TRACE METAL PPM	STREAM NO. 2	5				
Aluminum	—	—				
Antimony	—	—				
Arsenic	2.5	2.5				
Barium	—	—				
Beryllium	0.4	0.4				
Boron	1.42	1.42				
Cadmium	0.08	0.82				
Chromium						
Cobalt						
Copper						
Lead						
Lithium						
Molybdenum						
Mercury						
Nickel						
Phosphorous						
Selenium						
Silicon	0.1	0.1				
Silver						
Strontium						
Thallium						
Titanium						
Vanadium						
Yttrium						
Zinc	1.0	1.0				
Total Trace Metal	5.5	5.5				

UNIT 03B - BOILER ASH HANDLING UNIT

Date	3/24/82
Cont. No.	835504
By	P. Hung
CASE 13	

STREAM
- 1 - FLY ASH DISCHARGED
- 5 - FGD SLUDGE
- 6 - TOTAL STABILIZED SLUDGE
- 7 - BOILER BOTTOM ASH DISCHARGED
- 8 - EVAPORATION LOSS (BOTTOM ASH QUENCHING)

CONSTITUENT	PPM	STREAM NO. 1	5	6	7	8
Total Dissolved Solids						
Total Alkalinity	$CaCO_3$					
Total Hardness	$CaCO_3$					
PH						
Total Suspended Solids						
Calcium (Ca++)	$CaCO_3$					
Magnesium (Mg++)	$CaCO_3$					
Sodium (Na+)	$CaCO_3$					
Hydrogen (H+)	$CaCO_3$					
Potasium (K+)	$CaCO_3$					
Ammonia (NH_4^+)	$CaCO_3$					
TOTAL CATIONS	$CaCO_3$					
Bicarbonate (HCO_3^-)	$CaCO_3$					
Carbonate (CO_3^{--})	$CaCO_3$					
Hydroxide (OH-)	$CaCO_3$					
Chloride (Cl-)	$CaCO_3$					
Sulfate (SO_4^{--})	$CaCO_3$					
Nitrate (NO_3^-)	$CaCO_3$					
Fluoride (F-)	$CaCO_3$					
Phosphate (PO_4^{--})	$CaCO_3$					
Sulfite ($SO_3^=$)	$CaCO_3$					
Thiocyanide (CNS^-)	$CaCO_3$					
TOTAL ANIONS	$CaCO_3$					
Iron Total	Fe					
Carbon Dioxide, Free	CO_2					
Silica	SiO_2					
Residual Chlorine	Cl_2					
Organic Acids						
Manganese	Mn					
Copper	Cu					
Hydrogen Sulfide	H_2S					
Other Trace Metals						
Phenol	C_6H_6					
Sulfur	S					
TKN	N					
SLUDGE	LBS./HR.		27728	58690		
COAL	LBS./HR.		—			
ASH	LBS./HR.	30962	—		7740	
COD			—			
BOD			—			
Flow Rate	GPM		43	43		2

UNIT 03B - BOILER ASH HANDLING UNIT

Date 3/24/82
Cont. No. 835504
By P. HUNG
CASE 13

STREAM
9 - MAKE-UP WATER
10 - RECYCLE WATER
11 - BLOWDOWN
12 - BOTTOM ASH DISPOSED

CONSTITUENT	PPM	STREAM NO. 9	10	11	12	
Total Dissolved Solids		443	2654	2654		
Total Alkalinity	$CaCO_3$	54	54	54		
Total Hardness	$CaCO_3$	332	1530	1530		
PH		6.6	6.6	6.6		
Total Suspended Solids		—	—	—		
Calcium (Ca++)	$CaCO_3$	216	880	880		
Magnesium (Mg++)	$CaCO_3$	116	650	650		
Sodium (Na+)	$CaCO_3$	—	338	338		
Hydrogen (H+)	$CaCO_3$	—	—	—		
Potasium (K+)	$CaCO_3$	—	110	110		
Ammonia (NH_4+)	$CaCO_3$	—	—	—		
TOTAL CATIONS	$CaCO_3$	332	1978	1978		
Bicarbonate (HCO_3)	$CaCO_3$	54	54	54		
Carbonate ($CO_3^{=}$)	$CaCO_3$	—	—	—		
Hydroxide (OH-)	$CaCO_3$	—	—	—		
Chloride (Cl-)	$CaCO_3$	21	21	21		
Sulfate ($SO_4^{=}$)	$CaCO_3$	254	1900	1900		
Nitrate (NO_3)	$CaCO_3$	1	1	1		
Fluoride (F-)	$CaCO_3$	1.9	1.9	1.9		
Phosphate ($PO_4^{=}$)	$CaCO_3$	0.14	0.14	0.14		
Sulfite ($SO_3^{=}$)	$CaCO_3$	—	—	—		
Thiocyanide (CNS^-)	$CaCO_3$	—	—	—		
TOTAL ANIONS	$CaCO_3$	332	1978	1978		
Iron Total	Fe	—	—	—		
Carbon Dioxide, Free	CO_2	25	25	25		
Silica	SiO_2	2.1	70	70		
Residual Chlorine	Cl_2	1.5	—	—		
Organic Acids		—	—	—		
Manganese	Mn	<0.15	<0.15	<0.15		
Copper	Cu	<0.01	0.01	0.01		
Hydrogen Sulfide	H_2S	—	—	—		
Other Trace Metals		—	5.5	5.5		
Phenol	C_6H_6	—				
Sulfur	S	—				
TKN	N	—				
SLUDGE	LBS./HR.	—				
COAL	LBS./HR.	—				
ASH	LBS./HR.	—			7740	
COD		—			—	
BOD		—			—	
Flow Rate	GPM	22	250	13	7	

UNIT 03B – BOTTOM ASH HANDLING

STREAM	
10 - RECYCLE WATER	
11 - BLOWDOWN	

Date MAR 25, 1982
Cont. No. 835504
By
Case 13

TRACE METAL CONSTITUENT	PPM	STREAM NO. 10	11			
Aluminum		—	—			
Antimony		—	—			
Arsenic		2.5	2.5			
Barium						
Beryllium		0.4	0.4			
Boron		1.42	1.42			
Cadmium		0.08	0.08			
Chromium		/	/			
Cobalt		/	/			
Copper		/	/			
Lead		/	/			
Lithium		/	/			
Molybdenum		/	/			
Mercury		/	/			
Nickel		/	/			
Phosphorous		/	/			
Selenium		/	/			
Silicon		0.1	0.1			
Silver		/	/			
Strontium		/	/			
Thallium		/	/			
Titanium		/	/			
Vanadium		/	/			
Yttrium		/	/			
Zinc		1.0	1.0			
TOTAL TRACE METAL		5.5	5.5			

FLUOR 2400.5R REV 2

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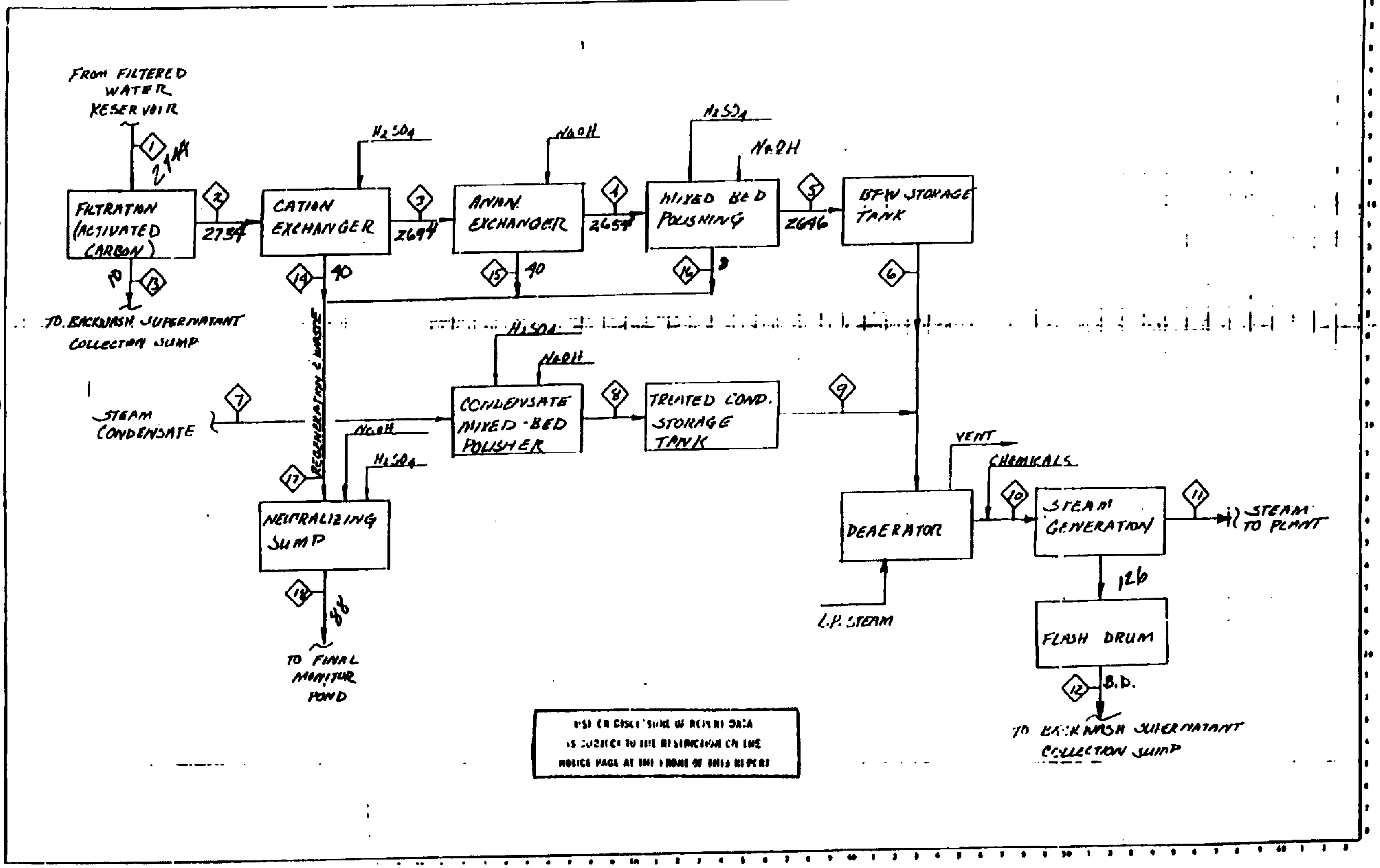
CONT. NO. 835374
BY MKM CHK'D
SHEET NO.

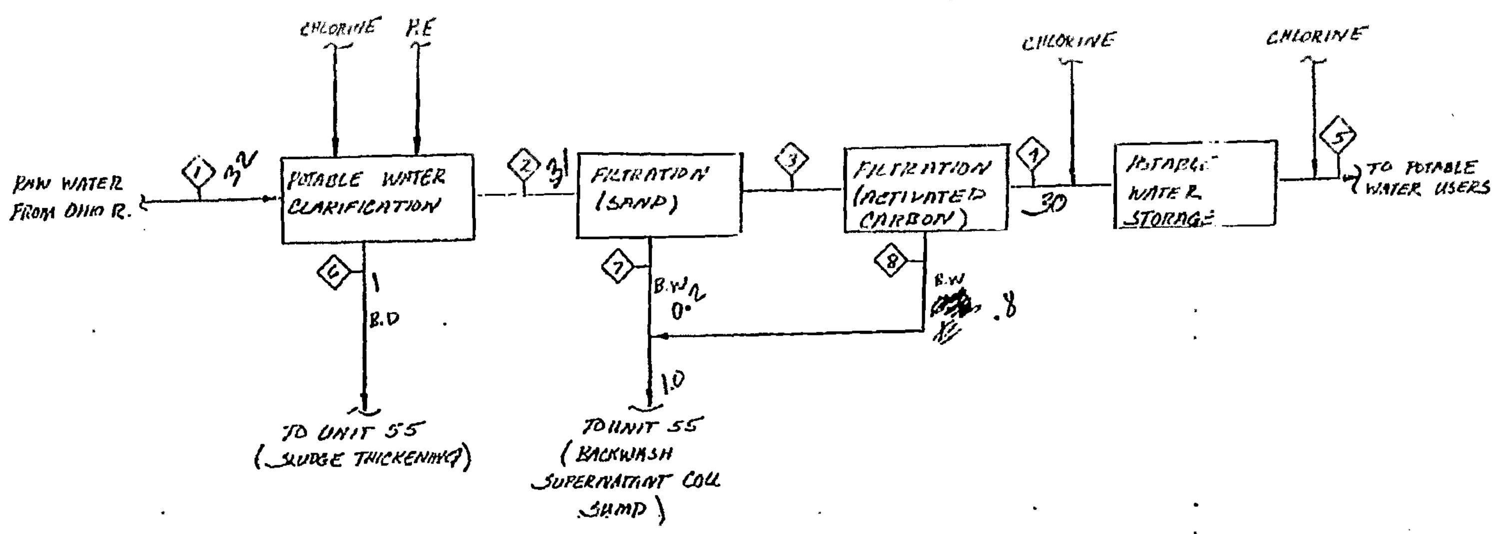
WATER MANAGEMENT BLOCK FLOW DIAGRAM
UNIT 44 - BOILER FEED WATER



FLUOR 2400.5R

REV. 2

WATER MANAGEMENT BLOCK FLOW DIAGRAM
UNIT 55 - POTABLE WATER



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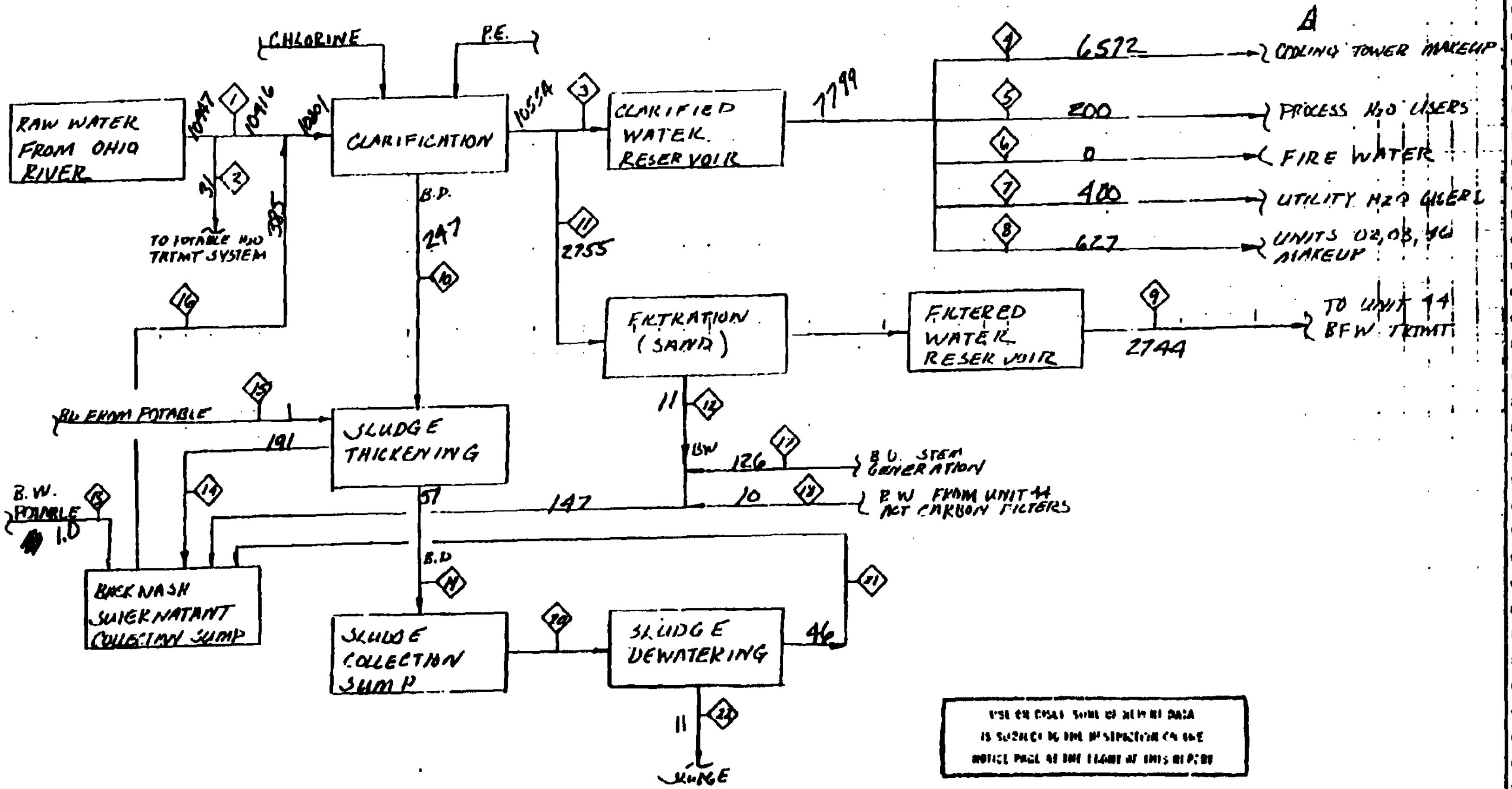
CONT NO 835504
BY MKh CHK'D
SHEET NO.

REV 2 4-5-82
REV 3 4-13-82

WATER MANAGEMENT BLOCK FLOW DIAGRAM
UNIT 55 - RAW WATER

CASE 13 - USING Y AI KIM'S WATER ... FOR ...



UNIT 52 - DISSOLVED SOLIDS AND SLUDGE DISPOSAL

Date 3/29/82
Cont. No. 835504
By P. HUNG
CASE 13

STREAM
1 - GASIFIER ASH BLOWDOWN
2 - BOILER BOTTOM ASH "
3 - FGD BLOWDOWN
4 - TOTAL BLOWDOWN
5 - WET COARSE ASH

CONSTITUENT	PPM	STREAM NO. 1	2	3	4	5
Total Dissolved Solids		2654	2654	1765	2579	
Total Alkalinity	$CaCO_3$	54	54	216	68	
Total Hardness	$CaCO_3$	1530	1530	1148	1498	
PH		6.6	6.6	8.5	6.8	
Total Suspended Solids		—	—	—	—	
Calcium (Ca^{++})	$CaCO_3$	880	880	774	871	
Magnesium (Mg^{++})	$CaCO_3$	650	650	374	627	
Sodium (Na^+)	$CaCO_3$	338	338	180	325	
Hydrogen (H^+)	$CaCO_3$	—	—	—	—	
Potasium (K^+)	$CaCO_3$	110	110	—	100	
Ammonia (NH_4^+)	$CaCO_3$	—	—	—	—	
TOTAL CATIONS	$CaCO_3$	1978	1978	1328	1923	
Bicarbonate (HCO_3^-)	$CaCO_3$	54	54	216	68	
Carbonate ($CO_3^{=}$)	$CaCO_3$	—	—	—	—	
Hydroxide (OH^-)	$CaCO_3$	—	—	—	—	
Chloride (Cl^-)	$CaCO_3$	21	21	180	34	
Sulfate (SO_4^{--})	$CaCO_3$	1900	1900	920	1817	
Nitrate (NO_3^-)	$CaCO_3$	1	1	4	1.5	
Fluoride (F^-)	$CaCO_3$	1.9	1.9	7.6	2.5	
Phosphate (PO_4^{--})	$CaCO_3$	0.14	0.14	0.56	0.18	
Sulfite ($SO_3^{=}$)	$CaCO_3$	—	—	—	—	
Thiocyanide (CNS^-)	$CaCO_3$	—	—	—	—	
TOTAL ANIONS	$CaCO_3$	1978	1978	1328	1923	
Iron Total	Fe	—	—	—	—	
Carbon Dioxide, Free	CO_2	25	25	—	—	
Silica	SiO_2	70	70	10	23	
Residual Chlorine	Cl_2	—	—	—	65	
Organic Acids		—	—	—	—	
Manganese	Mn	<0.15	<0.15	<0.15	<0.15	
Copper	Cu	<0.01	<0.01	<0.01	<0.01	
Hydrogen Sulfide	H_2S	—	—	—	—	
Other Trace Metals		5.5	5.5	—	5.04	
Phenol	C_6H_6	—	—	—	—	
Sulfur	S	—	—	—	—	
TKN	N	—	—	—	—	
SLUDGE	LBS./HR.	—	—	—	—	
COAL	LBS./HR.	—	—	—	—	
ASH	LBS./HR.	—	—	—	—	81,910
COD		—	—	—	—	—
BOD		—	—	—	—	—
Flow Rate	GPM	115	13	12	140	70

UNIT 52 - DISSOLVED SOLIDS AND SLUDGE DISPOSAL

Date 3/30/82
Cont. No. 855504
By P. Hung
CASE 13

STREAM	
6	WET BOILER BOTTOM ASH
7	TOTAL ASH TO LANDFILL
8	DRY FLY ASH DISCHARGED
9	FGD SLUDGE
10	TOTAL STABILIZED SLUDGE

CONSTITUENT	PPM	STREAM NO. 6	7	8	9	10
Total Dissolved Solids						
Total Alkalinity	$CaCO_3$					
Total Hardness	$CaCO_3$					
PH						
Total Suspended Solids						
Calcium (Ca^{++})	$CaCO_3$					
Magnesium (Mg^{++})	$CaCO_3$					
Sodium (Na^+)	$CaCO_3$					
Hydrogen (H^+)	$CaCO_3$					
Potassium (K^+)	$CaCO_3$					
Ammonia (NH_4^+)	$CaCO_3$					
TOTAL CATIONS	$CaCO_3$					
Bicarbonate (HCO_3^-)	$CaCO_3$					
Carbonate (CO_3^{--})	$CaCO_3$					
Hydroxide (OH^-)	$CaCO_3$					
Chloride (Cl^-)	$CaCO_3$					
Sulfate (SO_4^{--})	$CaCO_3$					
Nitrate (NO_3^-)	$CaCO_3$					
Fluoride (F^-)	$CaCO_3$					
Phosphate (PO_4^{---})	$CaCO_3$					
Sulfite ($SO_3^=$)	$CaCO_3$					
Thiocyanide (CNS^-)	$CaCO_3$					
TOTAL ANIONS	$CaCO_3$					
Iron Total	Fe					
Carbon Dioxide, Free	CO_2					
Silica	SiO_2					
Residual Chlorine	Cl_2					
Organic Acids						
Manganese	Mn					
Copper	Cu					
Hydrogen Sulfide	H_2S					
Other Trace Metals						
Phenol	C_6H_6					
Sulfur	S					
TKN	N					
SLUDGE	LBS./HR.				27728	58690
COAL	LBS./HR.				—	—
ASH	LBS./HR.	7740	89650	30962	—	—
COD		—	—	—	—	—
BOD		—	—	—	—	—
Flow Rate	GPM	7	77	—	43	43

UNIT 52 - DISSOLVED SOLIDS AND SLUDGE DISPOSAL

Date 3/30/82
Cont. No. 835504
By P. HUNG
CASE 13

STREAM	
11 - SLUDGE FROM CYAM UNIT	
12 - WASTE SLUDGE FROM SANITARY TREATMENT	
13 - OILY SLUDGE FROM OILY WATER TREATMENT	
14 - SLUDGE FM. BIOLOGICAL TREATMENT	
15 - TOTAL SLUDGE TO INCINERATOR	

CONSTITUENT	PPM	STREAM NO.				
		11	12	13	14	15
Total Dissolved Solids						
Total Alkalinity	$CaCO_3$					
Total Hardness	$CaCO_3$					
PH						
Total Suspended Solids						
Calcium (Ca^{++})	$CaCO_3$					
Magnesium (Mg^{++})	$CaCO_3$					
Sodium (Na^+)	$CaCO_3$					
Hydrogen (H^+)	$CaCO_3$					
Potasium (K^+)	$CaCO_3$					
Ammonia (NH_4^+)	$CaCO_3$					
TOTAL CATIONS	$CaCO_3$					
Bicarbonate (HCO_3^-)	$CaCO_3$					
Carbonate (CO_3^{--})	$CaCO_3$					
Hydroxide (OH^-)	$CaCO_3$					
Chloride (Cl^-)	$CaCO_3$					
Sulfate (SO_4^{--})	$CaCO_3$					
Nitrate (NO_3^-)	$CaCO_3$					
Fluoride (F^-)	$CaCO_3$					
Phosphate (PO_4^{---})	$CaCO_3$					
Sulfite ($SO_3^{=}$)	$CaCO_3$					
Thiocyanide (CNS^-)	$CaCO_3$					
TOTAL ANIONS	$CaCO_3$					
Iron Total	Fe					
Carbon Dioxide, Free	CO_2					
Silica	SiO_2					
Residual Chlorine	Cl_2					
Organic Acids						
Manganese	Mn					
Copper	Cu					
Hydrogen Sulfide	H_2S					
Other Trace Metals						
Phenol	C_6H_6					
Sulfur	S					
TKN	N					
SLUDGE	LBS./HR.	0	10	85	800	895
COAL	LBS./HR.					
ASH	LBS./HR.					
COD						
BOD						
Flow Rate	GPM	0	0.5	2	14.5	17

12.4 ACCOMPLISHMENTS AND DECISIONS MADE AND FINALIZED

A preliminary decision was made to base the water management conceptual design on river water, then Ranney Well water, and finally again to river water due to high TDS levels in the Ranney Well water. This decision was based on the Ranney Well Water Analysis contained in Ranney's Preliminary Report, Fluor Contract 835504-0-K003. This water analysis misrepresented the water analysis data contained in the final Ranney Report. The final report was not received and evaluated until after the water management work contained in this report was completed. Comparison of a Ranney System (Section 2.6, Volume 11A) with a river water system showed the Ranney system was superior to a river water system in both cost and water quality. The decision to use a Ranney well will require that the water management design be revised to reflect the Ranney well water analysis. This should be incorporated into project restart.

Case 15 was the initial design case then the basis was changed to Case 13 for water management work. Major work has been completed on the Case 13 Water Management Block Flow Diagram and corresponding Material Balance. The ionic balance needs updating when the information for the final design water analysis is available. The current ionic balance (in Appendix 1) is based on Case 15 and Ranney Well water analysis.

Other decisions made concerning water management include changing the conceptual design basis from zero discharge to discharge to the Ohio River. It was also decided to eliminate the reverse osmossis unit in the boiler feed water system, the TDS concentrator, and two buffer tanks included in the effluent treatment system. In the final design, it was agreed to include tow landfill, hazardous for residue containing heavy metals, and nonhazardous for the remaining residue. A final design configuration for the oily water diverter system was also decided on. A detailed description of this system is included in Section 12.1.2.

12.5 WATER MANAGEMENT STATUS

Overall water and waste water treatment schemes for Case 13 have been established and incorporated in "Block Flow Diagram - Water and Solid Waste Management" (Drawing Number 835504-00-R-043 Rev. B, Section 12.2). The material balance for Case 13 is updated and complete, including overall raw water requirements. The current status of Case 13 water management does not include an ionic balance which needs to be updated when a design raw water analysis is available. Ionic and material balances have been prepared for Case 15. This information is included in Appendix 1.

Input information was prepared for a cost comparison estimate of a Ranney Well versus an intake structure. A copy of the rough installed cost and operating cost estimate is included in Volume 11A, Section 2.6.

12.6 LICENSORS AND EVALUATIONS

A detailed study was conducted comparing the use of ground water from a Ranney Well versus raw water from the intake structure. This study includes a cost estimate for treatment of Ohio River Water versus Well water, cost information from Ranney for the intake and well structures, and water analysis for river water and well water. Refer to Volume 11A, Section 2.6 for this information.

UNIT 52 - DISSOLVED SOLIDS AND SLUDGE DISPOSAL

Date 3/30/82

Cont. No. 835504

By P. Hung

CASE 13

STREAM: 16 - INCINERATOR ASH DISCHARGED

CONSTITUENT	PPM	STREAM NO. 16				
Total Dissolved Solids						
Total Alkalinity	$CaCO_3$					
Total Hardness	$CaCO_3$					
PH						
Total Suspended Solids						
Calcium (Ca^{++})	$CaCO_3$					
Magnesium (Mg^{++})	$CaCO_3$					
Sodium (Na^+)	$CaCO_3$					
Hydrogen (H^+)	$CaCO_3$					
Potasium (K^+)	$CaCO_3$					
Ammonia (NH_4^+)	$CaCO_3$					
TOTAL CATIONS	$CaCO_3$					
Bicarbonate (HCO_3^-)	$CaCO_3$					
Carbonate (CO_3^{--})	$CaCO_3$					
Hydroxide (OH^-)	$CaCO_3$					
Chloride (Cl^-)	$CaCO_3$					
Sulfate (SO_4^{--})	$CaCO_3$					
Nitrate (NO_3^-)	$CaCO_3$					
Fluoride (F^-)	$CaCO_3$					
Phosphate (PO_4^{--})	$CaCO_3$					
Sulfite ($SO_3^{=}$)	$CaCO_3$					
Thiocyanide (CNS^-)	$CaCO_3$					
TOTAL ANIONS	$CaCO_3$					
Iron Total	Fe					
Carbon Dioxide, Free	CO_2					
Silica	SiO_2					
Residual Chlorine	Cl_2					
Organic Acids						
Manganese	Mn					
Copper	Cu					
Hydrogen Sulfide	H_2S					
Other Trace Metals						
Phenol	C_6H_6					
Sulfur	S					
TKN	N					
SLUDGE	LBS./HR.					
COAL	LBS./HR.					
ASH	LBS./HR.	100				
COD		—				
BOD		—				
Flow Rate	GPM	—				