SPRINGER MINING COMPANY

SPRINGER MINE REVIEW

OCTOBER 25, 26, 1983

SPRINGER MINE

3070 0076

Item 77

282

SPRINGER MINING COMPANY

HISTORY

PRE GENERAL ELECTRIC

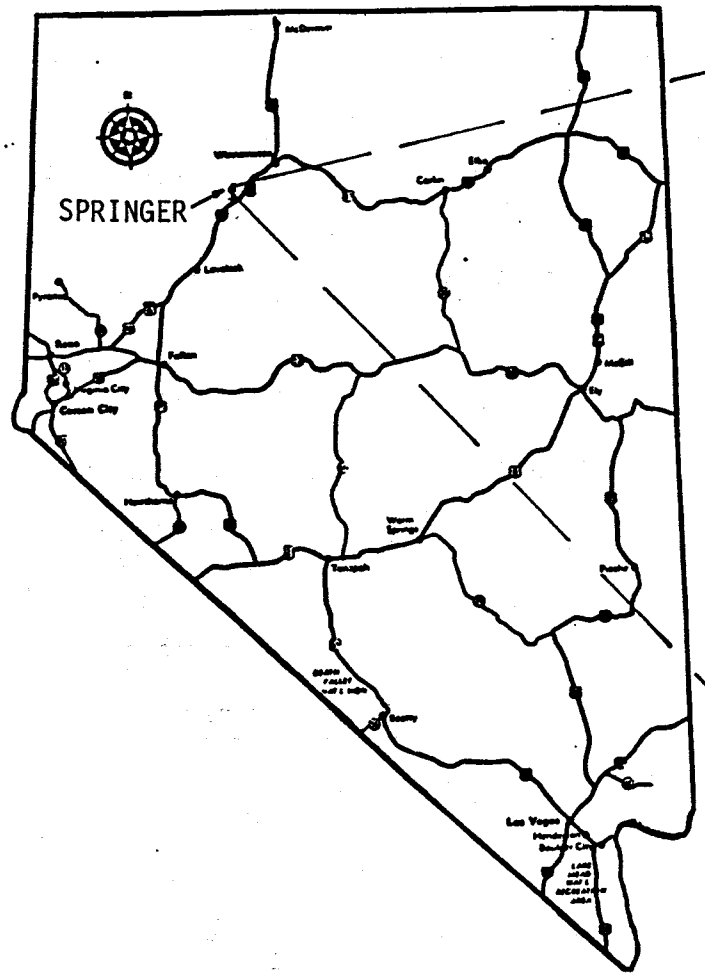
1914	DISCOVERY BY EMIL STANK
1917	MINING BEGUN BY THREE COMPANIES
1919	MINES CLOSED AT END OF WORLD WAR I
1925	NEVADA MASSACHUSETTS FORMED; PRODUCTION RESTARTED
1958	OPERATIONS SHUTDOWN DUE TO LOW PRICES. PRODUCTION THROUGH 1958 - 1786M STU
1970	TUNGSTEN PROPERTIES LTD. (SEGERSTROM FAMILY) TAKES POSSESSION

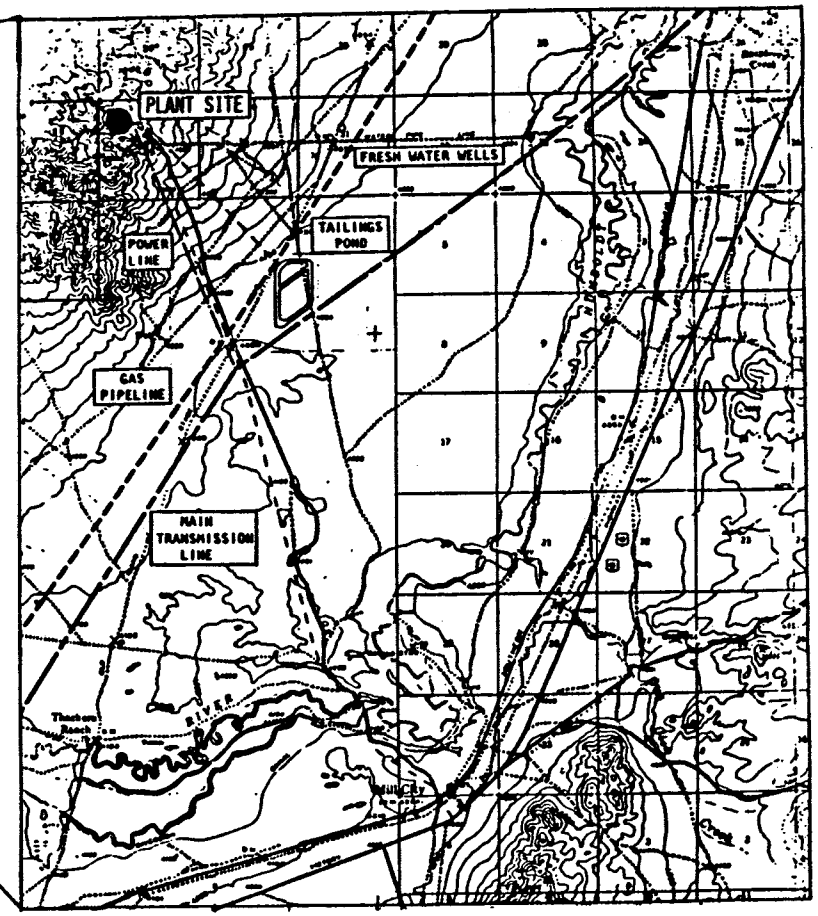
GENERAL ELECTRIC

1972	PROPERTY LEASED TO GENERAL ELECTRIC
1975	$4.5 MILLION DEVELOPMENT PROGRAM STARTED
1977	JOINT AGREEMENT WITH UTAH INTERNATIONAL
1979	PROPERTY PURCHASED. MINE REOPENING PROJECT INITIATED
1980	SPRINGER MINING COMPANY INCORPORATED
1982	OPERATIONS BEGUN AT REDUCED LEVEL
1982	OCTOBER. MINE PLACED ON STAND-BY DUE TO LOW DEMAND AND PRICES

SPRINGER MINING COMPANY

THE PROPERTY





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MILES

SPRINGER MINING COMPANY

PROPERTY DESCRIPTION

- LOCATION: SE SLOPE OF EUGENE MOUNTAINS
  PERSHING COUNTY, NEVADA
  30 MILES SW OF WINNEMUCCA

- OWNERSHIP: SPRINGER MINING COMPANY, A NEVADA CORPORATION
  WHICH IS 80% OWNED BY GENERAL ELECTRIC
  20% OWNED BY UTAH INTERNATIONAL

- PATENTED MINING CLAIMS 10 PARCELS TOTALING 2960 ACRES
  UNPATENTED MINING CLAIMS 243 LODE CLAIMS TOTALING 4480
  SOUTHERN PACIFIC LAND LEASE 320

  TOTAL LAND AREA 7760 ACRES

- WATER RIGHTS

  CERTIFICATED RIGHTS TOTALING 800 GPM
  PERMITTED RIGHTS TOTALING 4200 GPM
  (INCLUDES 450 GPM MINE WATER)

- PERMITS AND LICENCES
  - MSHA
  - EXPLOSIVES
  - RADIOACTIVE MATERIALS
  - MINE WATER DISCHARGE
  - AIR QUALITY

SPRINGER MINING COMPANY

ORE RESERVE CONVENTIONS

- DEVELOPED ORE:
  1. ORE EXPOSED BY TWO LEVELS WHERE DISTANCE BETWEEN LEVELS IS ≤ 200 FT.
  2. ORE EXPOSED BY ONE LEVEL ONLY, THE DISTANCE ABOVE AND BELOW DEPENDENT UPON THE HORIZONTAL LENGTH OF ORE EXPOSED:

HORIZONTAL EXTENSION	VERTICAL ALLOWANCE
0 - 100 FT.	20 FT.
101 - 200 FT.	40 FT.
OVER 200 FT.	50 FT.

- PARTIALLY DEVELOPED:
  1. ORE ESTIMATED BETWEEN TWO EXPOSED LEVELS AFTER DEDUCTING DEVELOPED ORE.
  2. ORE EXPOSED BY ONE LEVEL ONLY: A 45° TRIANGLE HAVING FOR ITS BASE THE ORE LIMITS DETERMINED BY PARAGRAPH 2 UNDER DEVELOPED ORE AND EXTENDING 200 FT. ABOVE AND BELOW THE LEVEL.
- INDICATED ORE: CONTINUATION OF KNOWN ORE SHOOTS WHERE DIAMOND DRILL HOLE INTERCEPTS OR CROSS CUTS JUSTIFY THE ASSUMPTION.
- PILLAR ORE: ORE CARRIED IN EXISTING AND AVAILABLE PILLARS.
- DILUTION:
  1. BASED ON MINING EXPERIENCE WHERE KNOWN
  2. ALL BLOCKS DILUTED TO A MINIMUM MINING WIDTH OF 3.5 FT.
  3. DILUTION FOR BEDS 2.5 FT WIDE OR WIDER SHALL BE THE GREATER OF 1.0 FT OR 15% OF BED WIDTH.
- CUTOFF: NO GRADE LESS THAN 0.2% WO_3 IS INCLUDED
- ORE DENSITY: EACH TON OF ORE IS ASSUMED TO OCCUPY 11 CUBIC FEET.

SPRINGER MINING COMPANY

RESERVES - MARCH 1983

<---------- ABOVE 1125 FEET ---------->

	SUTTON I		SUTTON II		O'BYRNE		SURFACE STOCKPILE		TOTALS		% OF TOTAL	
	TONS	% WO_3	TONS	% WO_3	TONS	% WO_3	TONS	% WO_3	TONS	% WO_3	TONS	STU
BROKEN ORE	84,611	0.340	78,544	0.481	--	--	16,853	0.362	180,008	0.403	5.0	4.5
DEVELOPED ORE	194,119	0.393	951,629	0.485	30,953	0.868	--	--	1,176,701	0.480	32.8	35.3
PARTIALLY DEVELOPED	183,805	0.416	224,109	0.411	19,631	0.659	--	--	427,545	0.425	11.9	11.4
INDICATED ORE	1,232,483	0.429	471,052	0.414	37,545	0.660	--	--	1,741,080	0.431	48.6	46.9
PILLAR ORE	8,679	0.389	53,151	0.504	--	--	--	--	61,830	0.488	1.7	1.9
TOTAL IN TONS	1,703,697	0.419	1,778,485	0.457	88,129	0.733	16,853	0.362	3,587,164	0.446	100	
TOTAL IN STU	714,847		813,550		64,584		6,101		1,599,082		100	

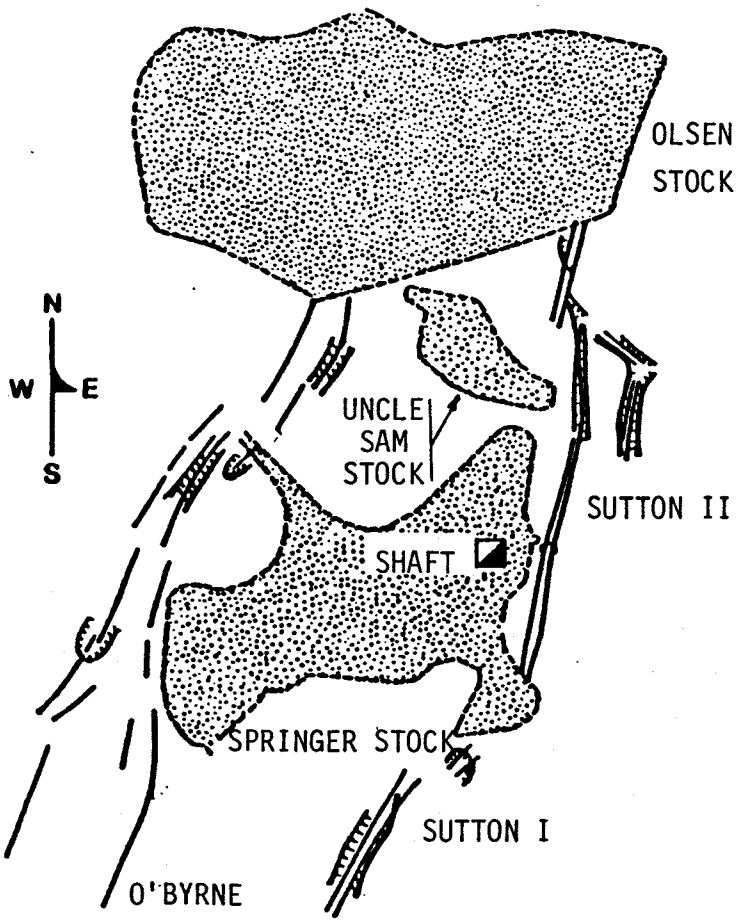
LIFE OF MINE BASED UPON ABOVE RESERVES: 12.6 YEARS

SPECULATIVE RESERVES REQUIRING FURTHER DEVELOPMENT ARE NOT INCLUDED:

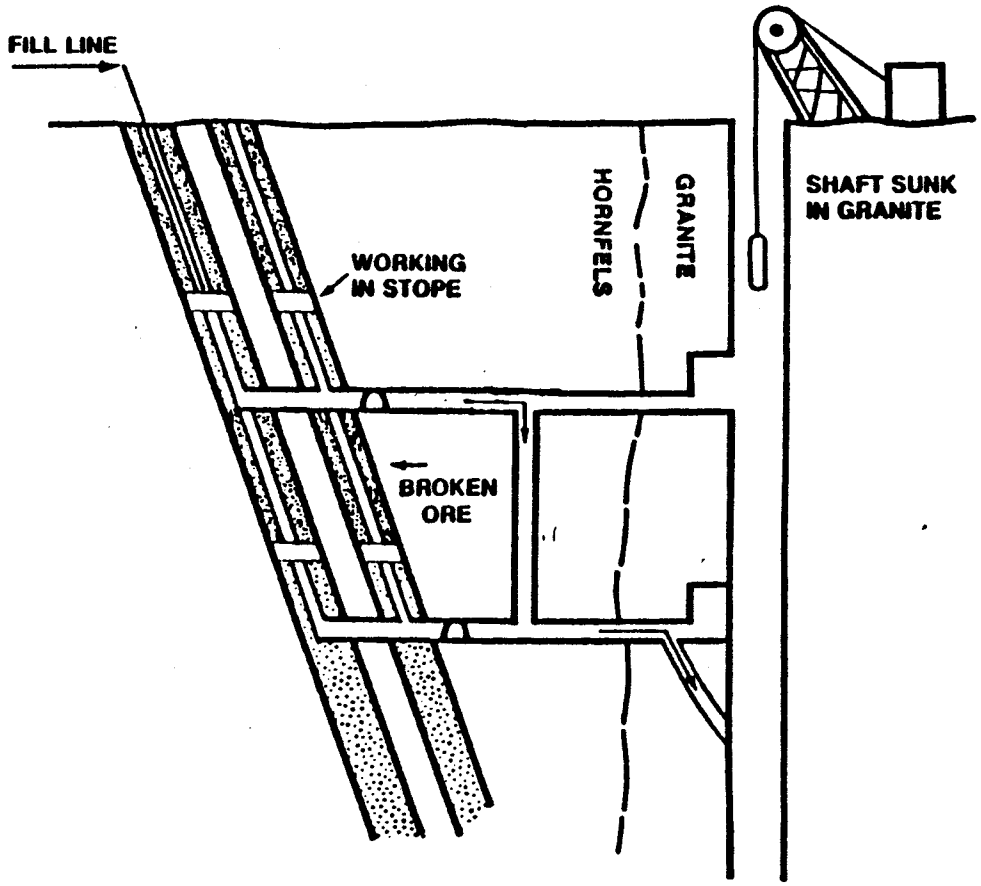
- SUTTON I, SUTTON II OPEN BELOW 1125 FT.
- OTHER BEDS
  - GEORGE
  - MILL
  - STANK
  - HUMBOLDT/SPRINGER
  - RIBBON

SPRINGER MINING COMPANY

ORE BODIES



MINE SCHEMATIC

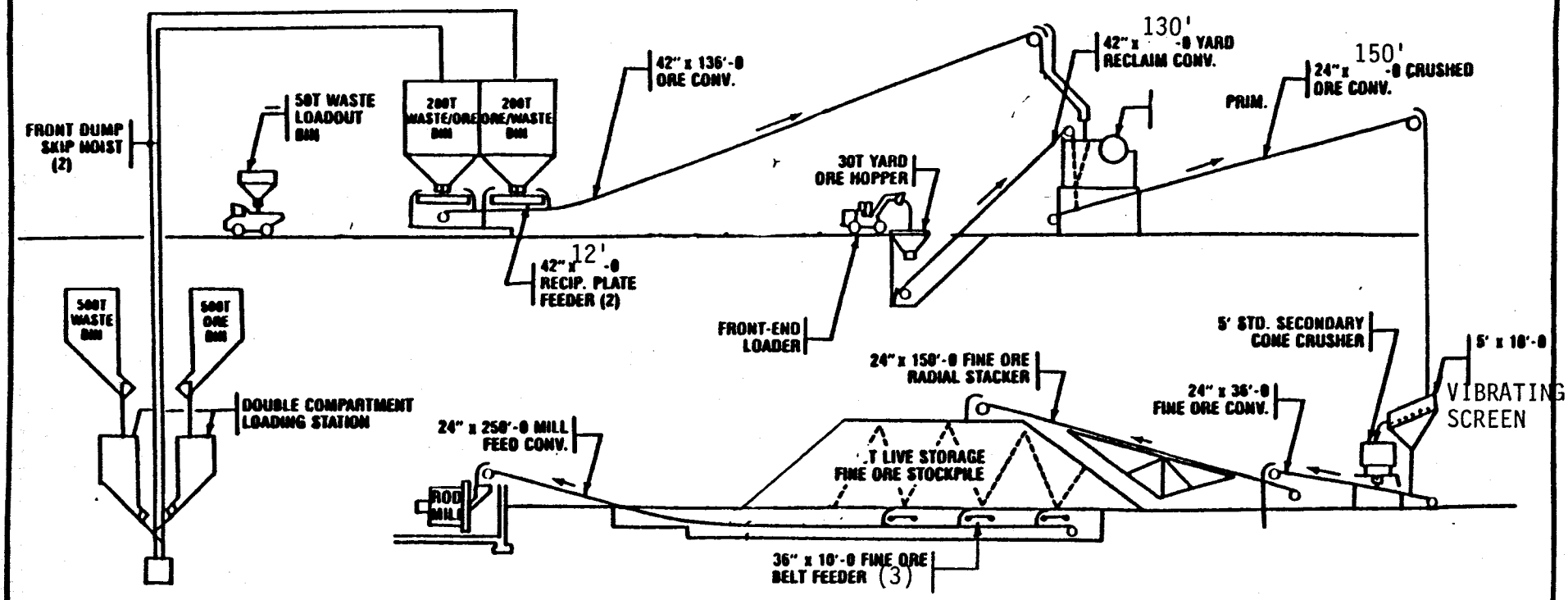


THE MINE

- ORE BODIES (SUTTON II AND SUTTON I)
  - STEEPLY (70° - 80°) DIPPING TACTITE BEDS
  - STRIKE LENGTHS UP TO 6000 FT
  - BED WIDTHS 3.5 FT TO 30 FT
  - RESERVES DOWN TO 1125 FT
  - OPEN AT DEPTH
- MINE METHODS
  - SHRINKAGE
  - CUT AND FILL
  - FUTURE - CRATER RETREAT
- ACCESS
  - 1360 FT VERTICAL SHAFT; 5 COMPARTMENTS
  - 5 TON PRODUCTION SKIPS
  - 200 TON ORE AND WASTE BINS
  - 650 HP DOUBLE DRUM PRODUCTION HOIST
  - 1250 HP SINGLE DRUM SERVICE HOIST
- HAULAGE
  - 24" RAIL
  - 10 FT X 10 FT DRIFTS
  - 375 FT, 625 FT AND 875 FT LEVELS

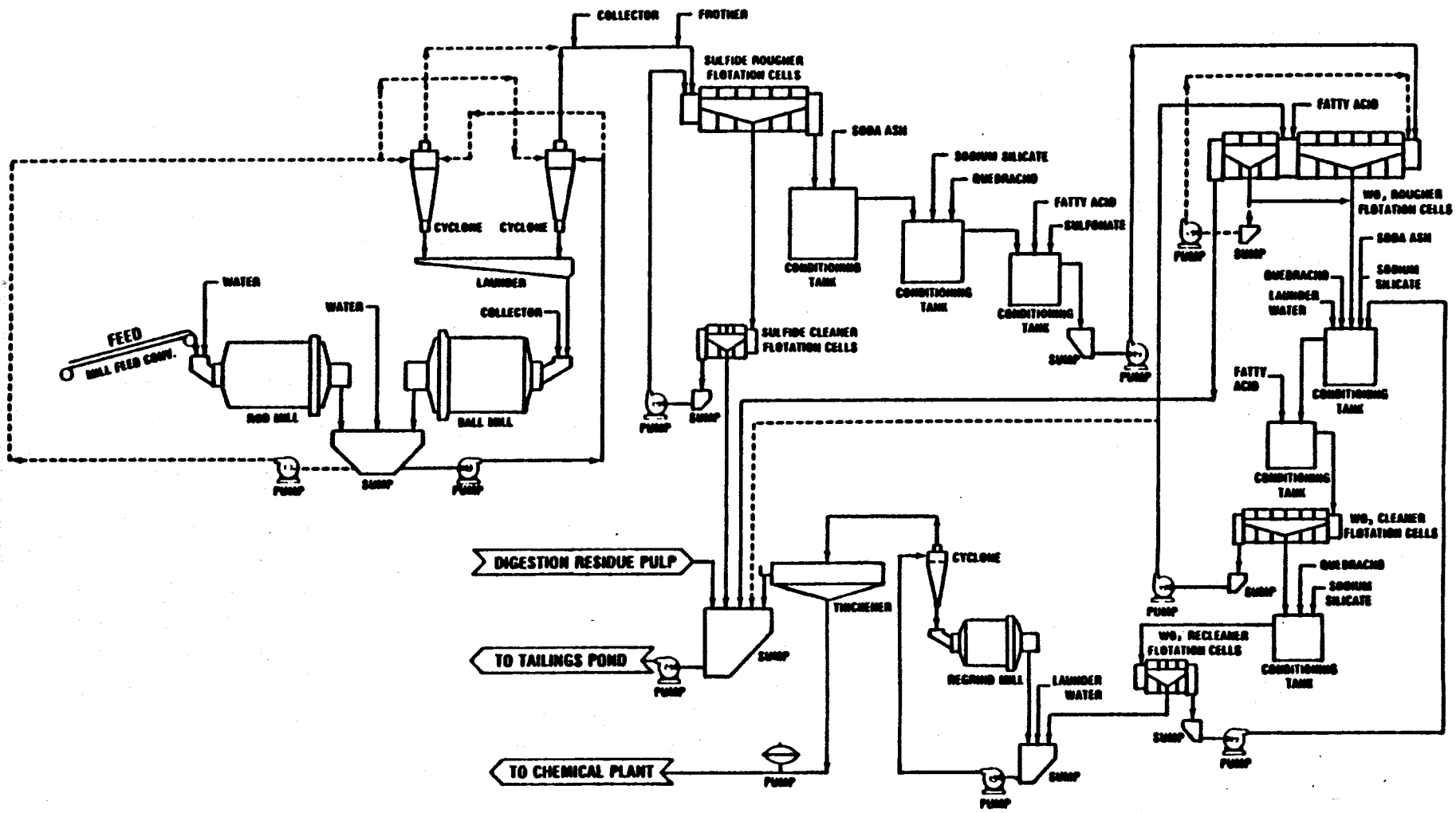
SPRINGER MINING COMPANY

FLOW SHEET - CRUSHING PLANT



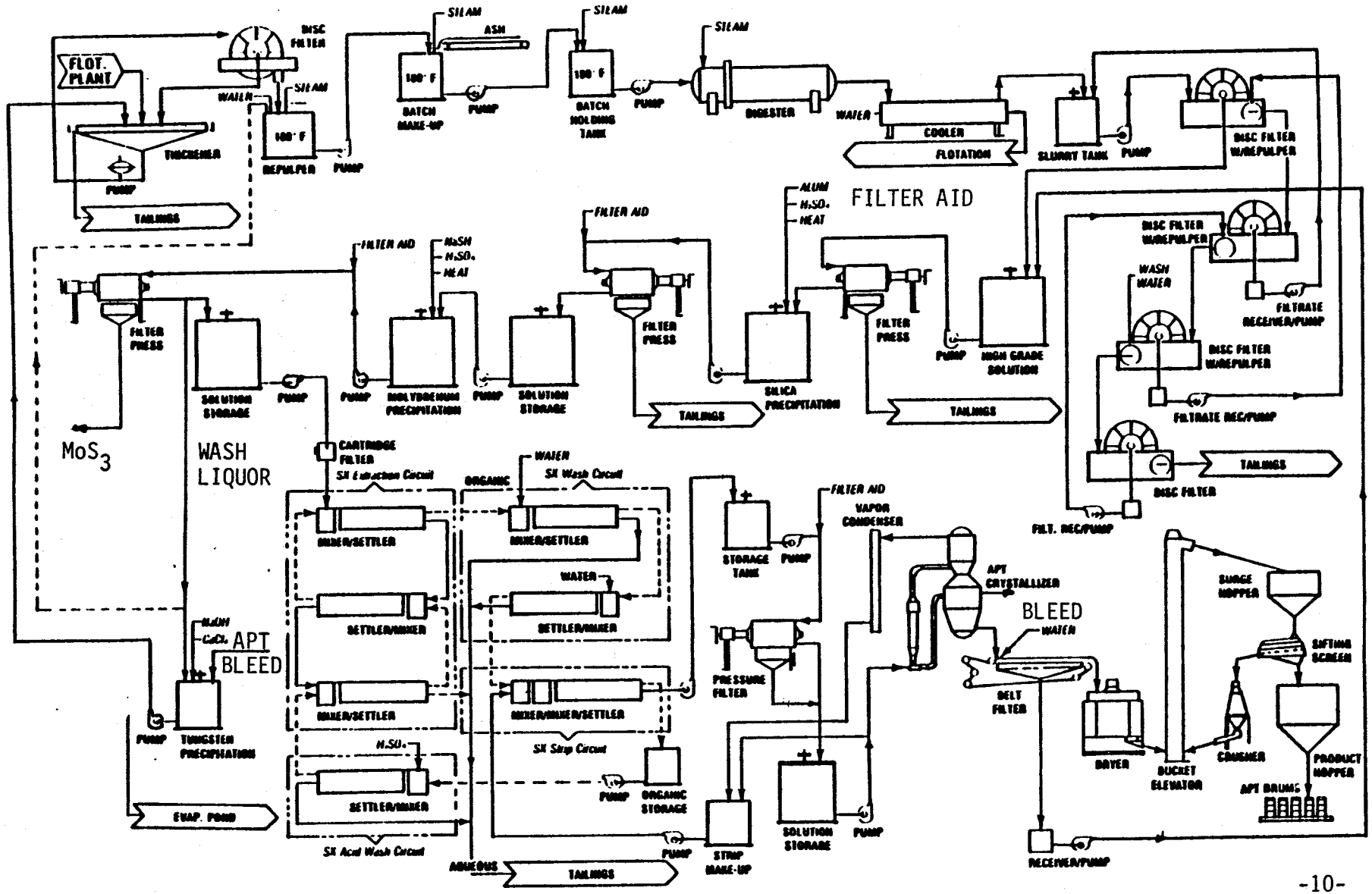
SPRINGER MINING COMPANY

FLOW SHEET: MILL



SPRINGER MINING COMPANY

FLOW SHEET: CHEMICAL PLANT



SPRINGER MINING COMPANY

CAPACITIES, RECOVERIES AND STAFFING

	OPERATION	TONS/YR.	STU/YR.	RECOVERY	NOTES
MINE	2-SHIFT, 5-DAY	300,000	135,000 @ .45% WO_3 MINED GRADE	-	CAN BE INCREASED BY DEVELOPING MORE STOPES
MILL	CONTINUOUS	330,000	126,000 @ .45% WO_3 HEADS GRADE	85%	CURRENT BOTTLENECK - SLURRY PUMPS
APT PLANT	CONTINUOUS	-	102,000	95%	FOR FEED GRADE $\geq$ 5% WO_3

THESE ARE "NAMEPLATE" CAPACITIES. INSUFFICIENT EXPERIENCE TO DETERMINE "PRACTIAL" CAPACITIES, ESPECIALLY IN APT PLANT.

	STAFFING		
	SALARIED	HOURLY	TOTAL
MINE	14	91	105
MILL/APT PLANT	16	26	42
MAINTENANCE	6	24	30
G & A	18	2	20
TOTAL	54	143	197

SPRINGER MINING COMPANY

APT SPECIFICATIONS

PURITY

ELEMENT	MAX PPM	ELEMENT	MAX PPM
Al	15	Sn	15
Ca	15	Na	80
Si	15	K	80
Fe	15	Cr	15
Nb	15	Sr	10
Co	10	Mn	15
Ni	10	Ti	10
Cu	10	Pb	10
Mo	50	Zr	10
Mg	15		

PARTICLE SIZE

MESH SIZE	% MIN.	% MAX.
+100	-	0.5
-100, +150	-	9
-150, +200	3	27
-200, +235	52	77
-325	9	32

IN 1982 OPERATIONS:
- o PURITIES WERE ACHIEVED
- o PARTICLE SIZES WERE NOT

SPRINGER MINING COMPANY

INVESTMENT / ASSETS

DOLLARS IN MILLIONS

MINE

PREMINE DEVELOPMENT		
SHAFT	3.6	
STATIONS AND POCKETS	3.7	
U.G. DEVELOPMENT	4.7	
VENTILATION	0.3	
MINE G&A	4.0	
START UP COSTS	4.9	
TOTAL PREMINE DEVELOPMENT		21.2
DEFERRED DEVELOPMENT		2.3
UNDERGROUND EQUIPMENT		2.3
MOBILE EQUIPMENT		0.4
TOTAL MINE		26.2

OTHER

LANDS AND LEASES	2.9
HOUSING	2.0
SEGERSTROM MILL & GE EQUIPMENT	1.4
MISCELLANEOUS EQUIPMENT	0.5
PRODUCT INVENTORY	0.9
SUPPLIES INVENTORY	1.7
TOTAL OTHER	9.4

SURFACE FACILITIES

HOIST AND SHAFT FURNISHINGS	3.6
ORE HANDLING AND CRUSHING	1.8
CONCENTRATOR	3.1
TAILINGS SYSTEM	2.0
CHEMICAL PLANT	7.4
BUILDINGS	2.8
YARD ELECTRICAL	1.6
YARD PIPING	1.6
ANCILLARIES & YARD SITE	2.9
ENGINEERING, PROCUREMENT & CONST.	7.2
TOTAL SURFACE FACILITIES	34.0

SUMMARY

AMORTIZABLE INVESTMENT		
PREMINE DEVELOPMENT	21.2	
SURFACE FACILITIES	34.0	
LANDS & LEASES	2.9	
SEGERSTROM MILL & GE PLANT	1.4	
TOTAL AMORTIZABLE INVESTMENT		59.5
DEPRECIABLE ASSETS		5.5
HOUSING		2.0
INVENTORIES		2.6
TOTAL		69.6

SPRINGER MINING COMPANY

ESTIMATED ANNUAL OPERATING COSTS

BASIS: TONS MINED	278,000
GRADE	0.457% WO_3 (SUTTON II)
MILL RECOVERY	85%
APT RECOVERY	95%
APT PRODUCED	102,300 STU

1983 DOLLARS

	M $ TOTAL	$/TON	$/STU OF APT
MINE			
DEVELOPMENT	1,360	4.89	13.29
STOPE PREPARATION	364	1.31	3.56
MINING	7,130	25.65	69.70
TOTAL VALUE	8,854*	31.85	86.55
MILL			
CRUSHING	580	2.09	5.67
FLOTATION	2,683	9.65	26.23
TOTAL MILL	3,263*	11.74	31.90
APT PLANT	4,001	---	39.11
GENERAL & ADMINISTRATIVE	1,783	---	17.43
TOTAL CASH COST	17,901*	---	174.99
NON-CASH COST	4,715	---	46.09
TOTAL	22,616	---	221.08

* INCLUDES SOME DEPRECIATION

SPRINGER MINING COMPANY

PROBLEMS/OPPORTUNITIES

MINE
o MINE PUMPING SYSTEM INCOMPLETE
o HIGH POWER CONSUMPTION ON SERVICE HOIST
o RELATIVELY INEXPERIENCED MINERS
o FINES PROBLEM IN SAND FILL
o DUST PROBLEM FROM ORE PASSES
o OLD WORKINGS HAMPERED OPERATIONS
o RELATIVELY HIGH DILUTION IN SOME STOPES
o OPPORTUNITY FOR LOWER COST MINING IN SUTTON I

IN GENERAL, THE MINE IS VERY GOOD

- o SHAFT FACILITIES ARE EXCELLENT
- o ORE HANDLING IS EXCELLENT
- o WORKING CONDITIONS ARE VERY GOOD

SPRINGER MINING COMPANY

PROBLEMS/OPPORTUNITIES

MILL

- o SAMPLING/ASSAY RELIABILITY NEEDS IMPROVEMENT
- o ADDITIONAL MASS FLOW MEASUREMENTS NEEDED
- o SCREEN FOR WOOD, STEEL SCRAP NEEDED
- o HIGH WEAR IN ROD MILL CHUTE
- o BALL MILL NEEDS CONVERSION TO GRATE DISCHARGE
- o CLOSED CIRCUIT SYSTEM ON REGRIND MILL NEEDED
- o CYCLONE SYSTEM ON SAND PLANT NEEDS REVISION

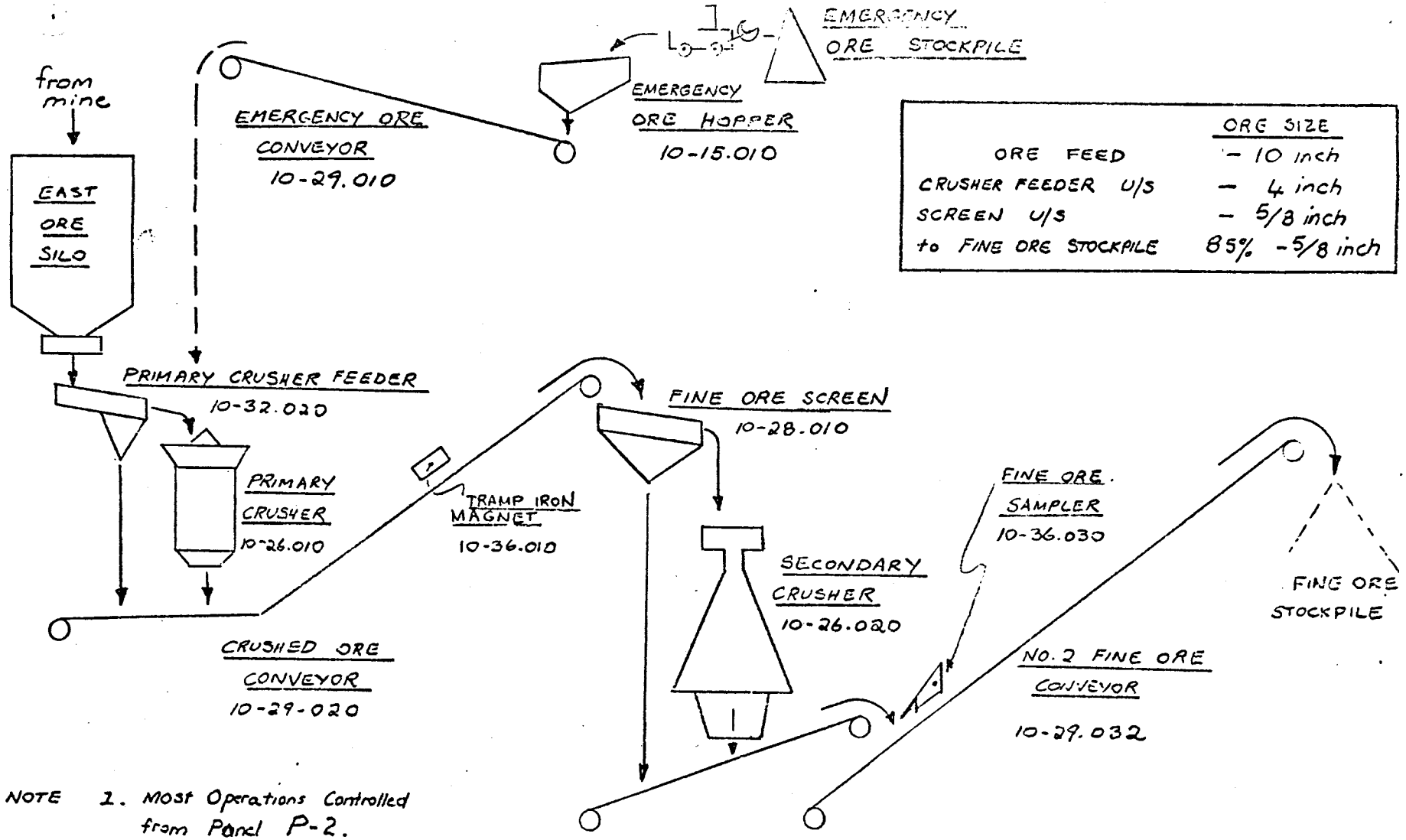
UTILITIES

- o DEIONIZED WATER SYSTEM UNDERSIZED
- o BOILER BLOW DOWN CONTROL NEEDS REDESIGN TO REDUCE HEAT LOSSES
- o CONDENSATE RETURN PUMP NEEDED FROM TANK FARM AND CRYSTALLIZER AREAS
- o INSTRUMENT AIR CAPACITY MARGINAL
- o SOME FIRE HYDRANTS NEED REPLACEMENT

APT PLANT

- o RECYCLE LOAD WAS EXCESSIVE
- o IMPROVED SODA ASH METERING NEEDED
- o HIGH FAILURE RATE IN DIGESTER COOLER BENDS
- o WASH FILTER PUMPS NOT RELIABLE DUE TO FOAMING
- o FLOW METER ON WASH FILTER NEEDED
- o WATER TREATMENT NEEDED FOR SILICA COOLER TO PREVENT SCALING
- o FOAMING IN H_2S SCRUBBER
- o ACID ADDITION SYSTEM TO MOLY PRECIPITATION TANKS NEEDS REPLACEMENT
- o H_2S ALARM MONITORS NEED RELOCATION
- o MOLY FILTERING SYSTEM COSTS TOO MUCH
- o RAFFINATE PUMP IN SX SYSTEM UNDERSIZED
- o CORROSION IN CRYSTALLIZER EXPANSION JOINTS

THE MILL AND APT PLANT INSTALLATION NEEDS MORE REVISION AND REWORK THAN THE MINE. AN ADDITIONAL $500M INVESTMENT IS ESTIMATED TO CORRECT FAULTS.



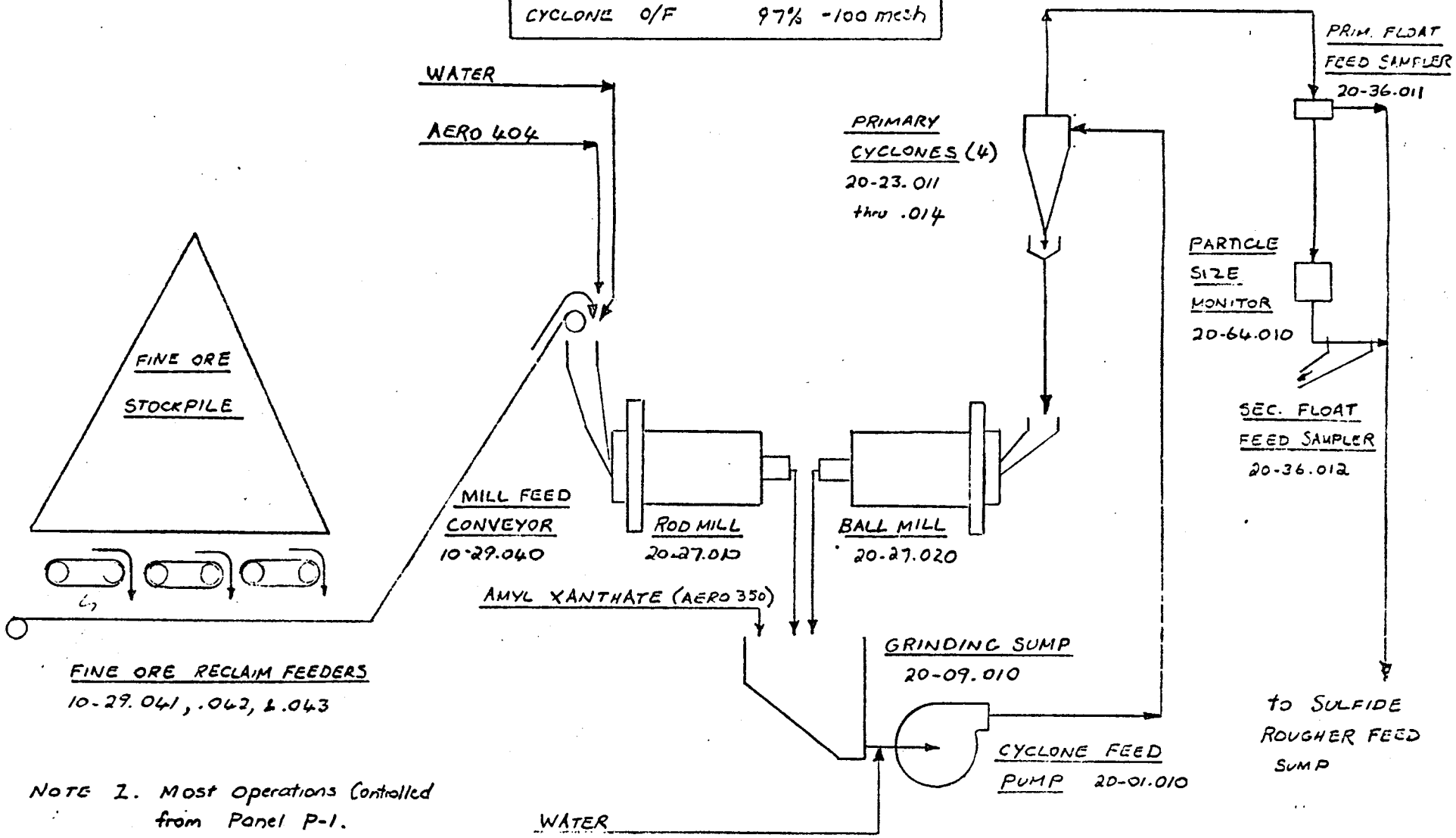
	ORE SIZE
ORE FEED	- 10 inch
CRUSHER FEEDER U/S	- 4 inch
SCREEN U/S	- 5/8 inch
to FINE ORE STOCKPILE	85% -5/8 inch

NOTE 1. Most Operations Controlled from Panel P-2.

CRUSHER CIRCUIT

OCT 81.

	ORE SIZE
to ROD MILL	85% - 5/8 inch
ROD MILL DISCHARGE	97% - 28 mesh
CYCLONE O/F	97% -100 mesh

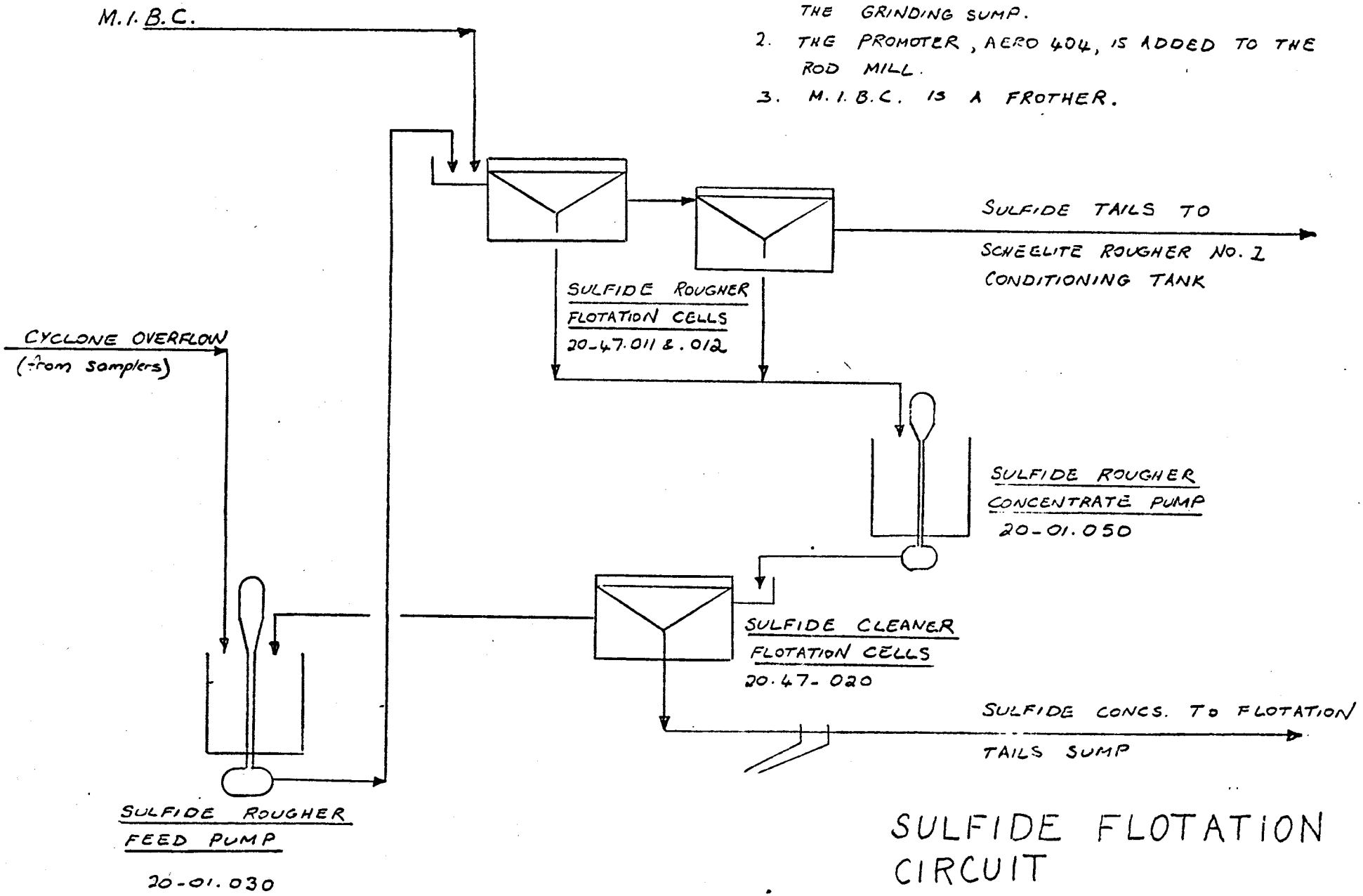


NOTE 1. Most Operations Controlled from Panel P-1.

GRINDING CIRCUIT

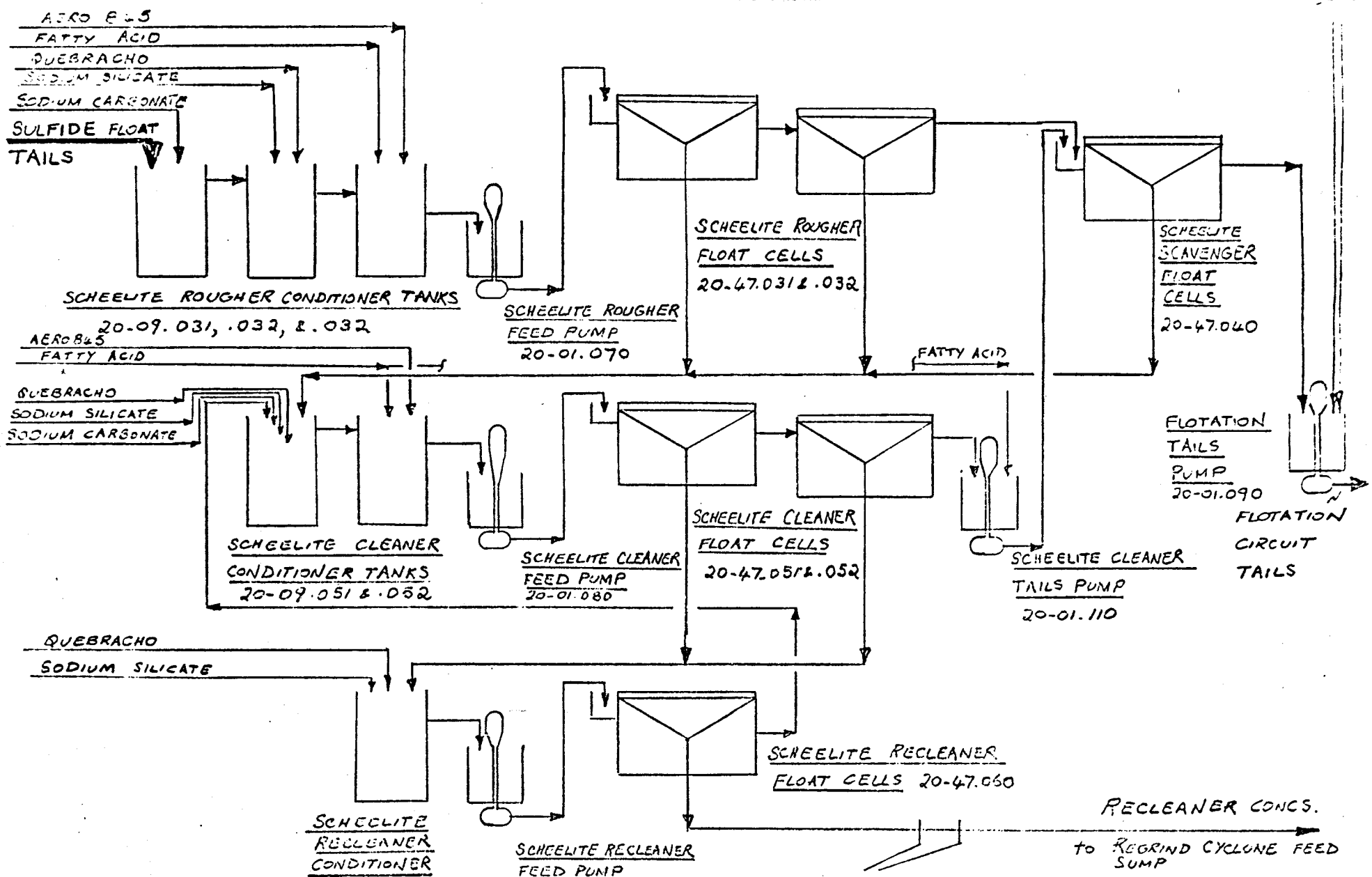
OCT 81

NOTES
1. THE COLLECTOR (AMYL XANTHATE) IS ADDED TO THE GRINDING SUMP.
2. THE PROMOTER, AERO 404, IS ADDED TO THE ROD MILL.
3. M.I.B.C. IS A FROTHER.



SULFIDE FLOTATION CIRCUIT

OCT 1981



SCHEELITE FLOTATION CIRCUIT

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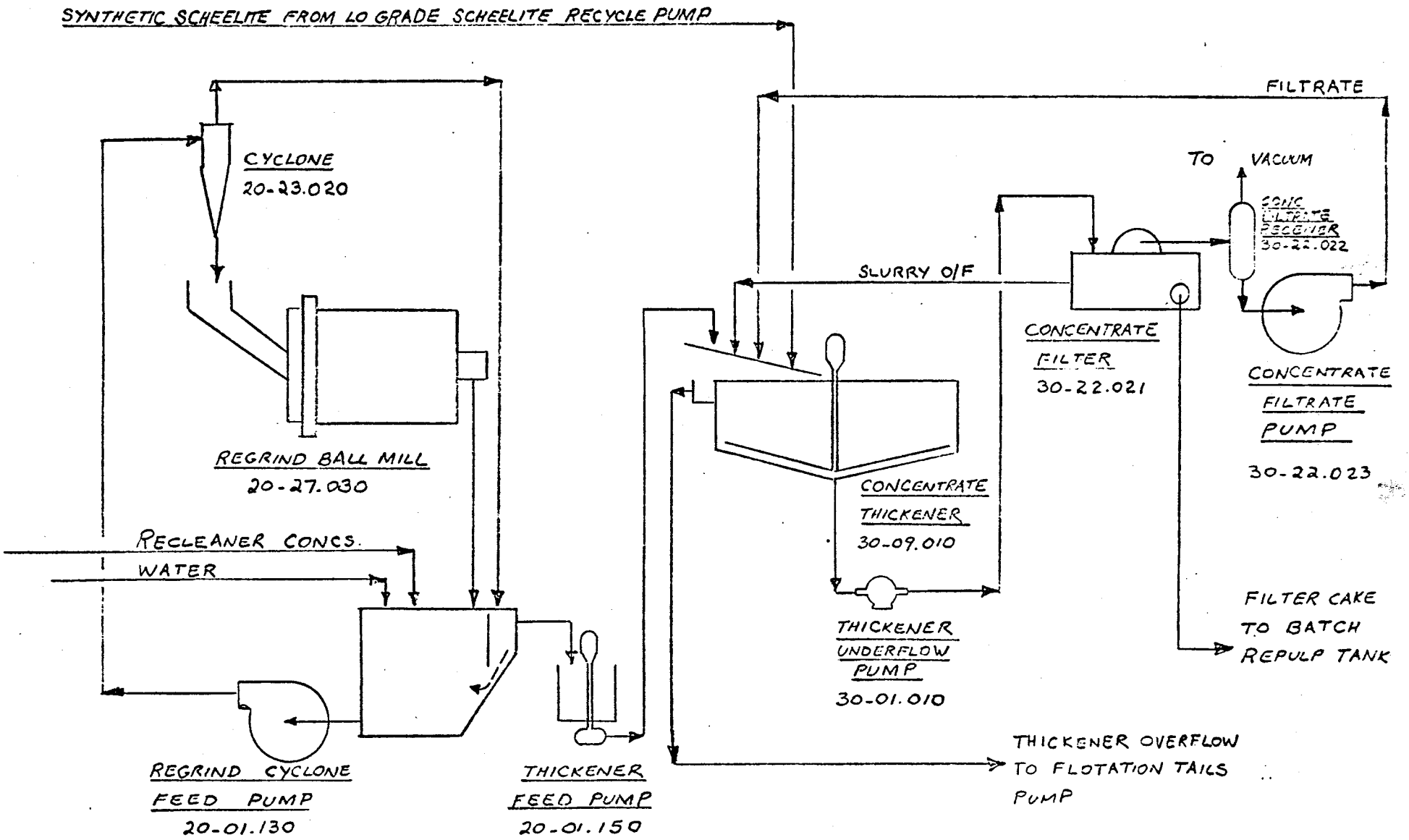

REGRIND, THICKENING, AND FILTERING

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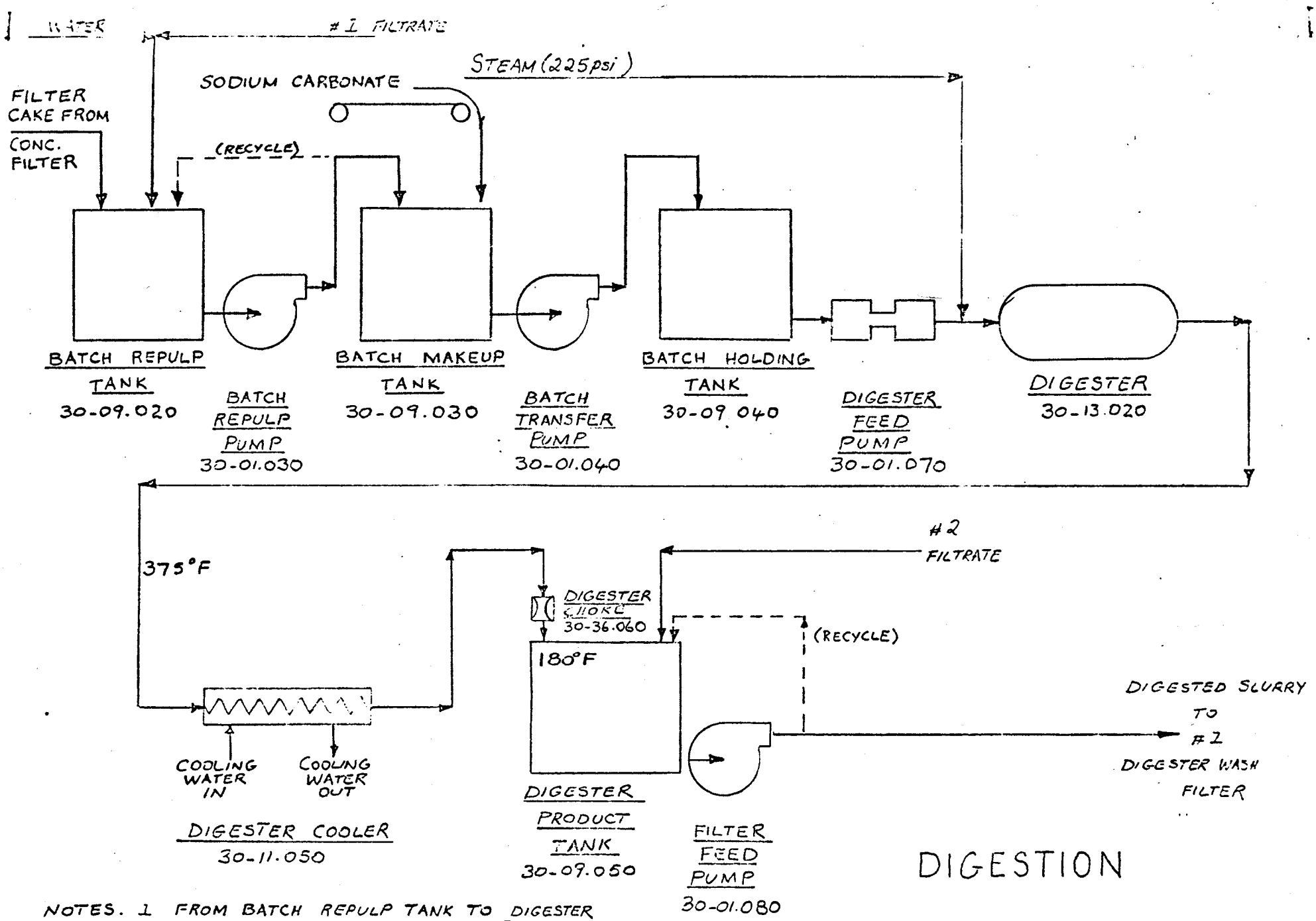

DIGESTION

NOTES. 1 FROM BATCH REPULP TANK TO DIGESTER PRODUCT TANK, THE PROCESS IS BATCH OPERATED.

2. ALL TANKS ABOVE ARE AGITATED, INSULATED, AND STEAM HEATED.

3 MOST OPERATIONS CONTROLLED FROM P-3

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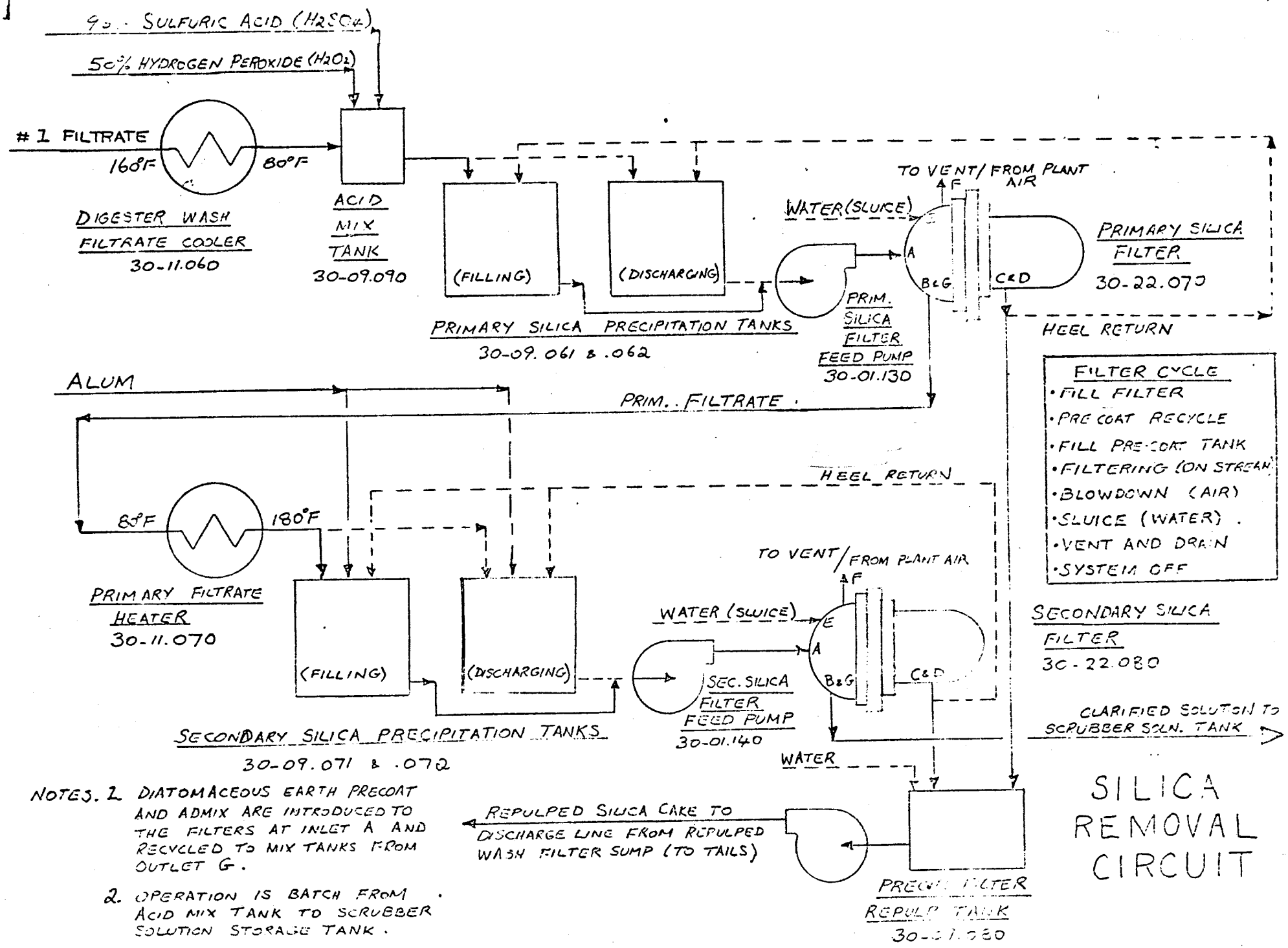
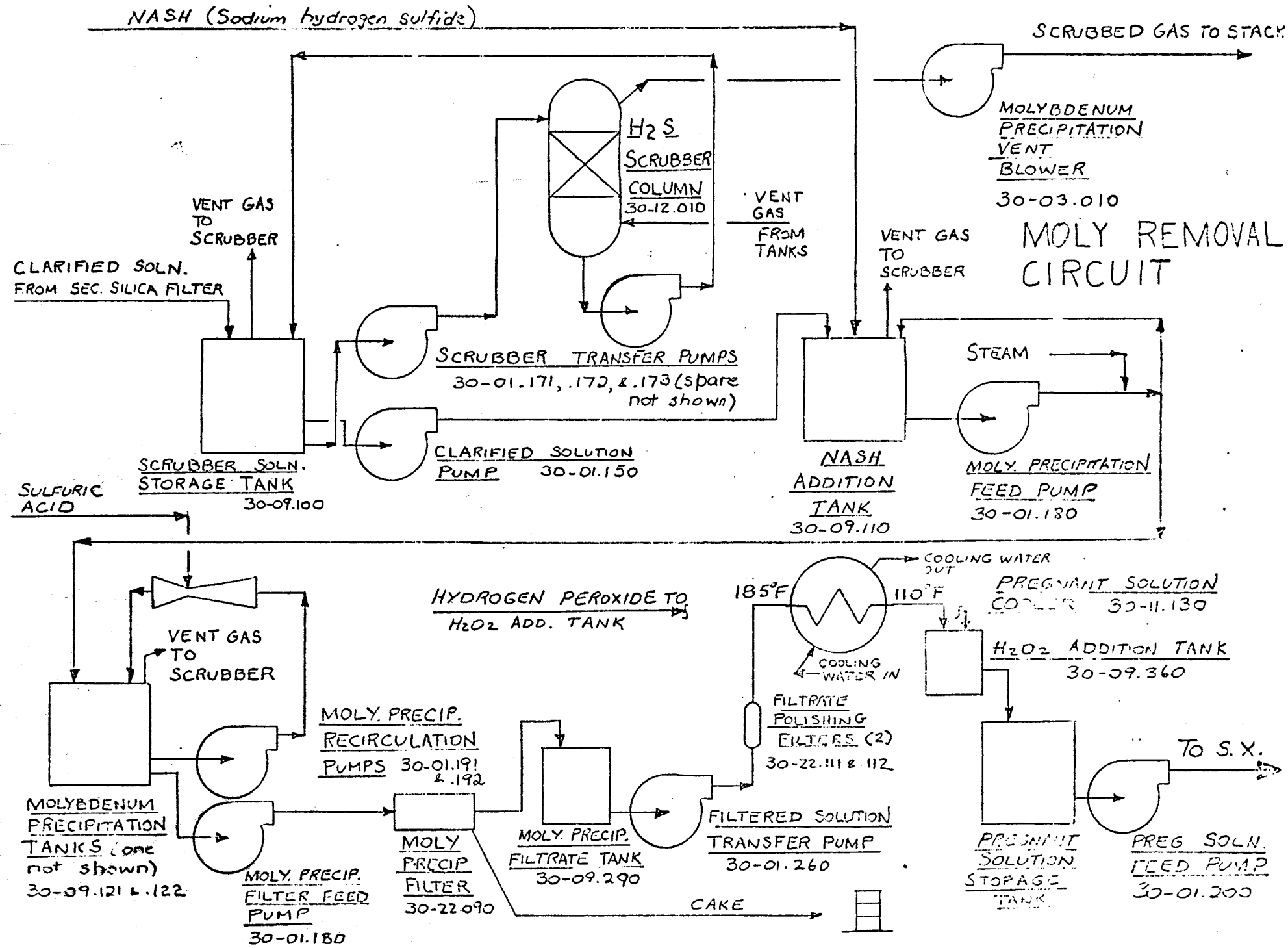


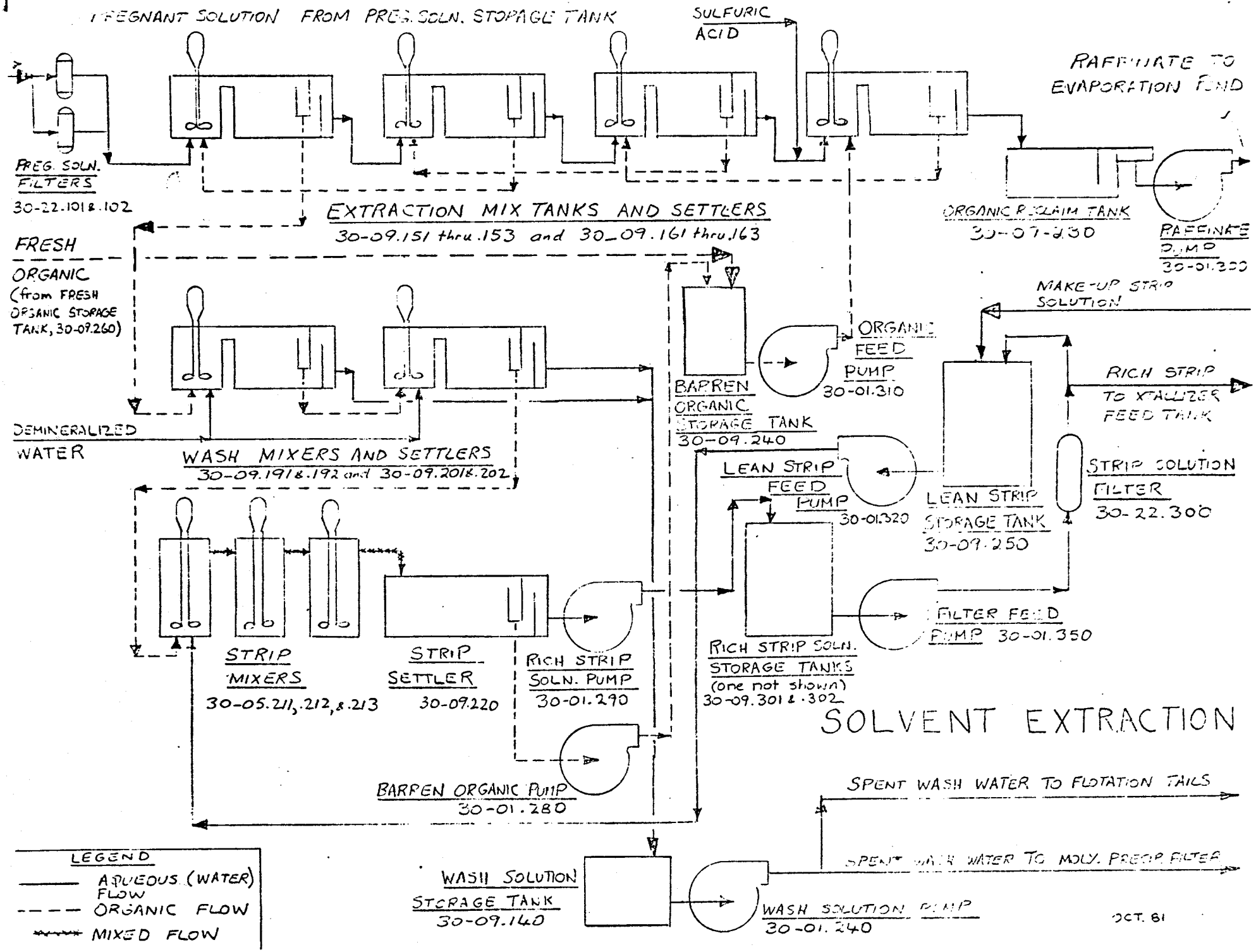
NOTES. 1. DIATOMACEOUS EARTH PRECOAT AND ADMIX ARE INTRODUCED TO THE FILTERS AT INLET A AND RECYCLED TO MIX TANKS FROM OUTLET G.

2. OPERATION IS BATCH FROM ACID MIX TANK TO SCRUBBER SOLUTION STORAGE TANK.

3. ALL TANKS ARE AGITATED

SILICA REMOVAL CIRCUIT


NASH (Sodium hydrogen sulfide)
SCRUBBED GAS TO STACK
MOLYBDENUM PRECIPITATION VENT BLOWER
30-03.010
MOLY REMOVAL CIRCUIT
H2S SCRUBBER COLUMN
30-12.010
VENT GAS TO SCRUBBER
VENT GAS FROM TANKS
VENT GAS TO SCRUBBER
CLARIFIED SOLN. FROM SEC. SILICA FILTER
SCRUBBER TRANSFER PUMPS
30-01.171, .172, & .173 (spare not shown)
STEAM
SCRUBBER SOLN. STORAGE TANK
30-09.100
CLARIFIED SOLUTION PUMP 30-01.150
NASH ADDITION TANK
30-09.110
MOLY. PRECIPITATION FEED PUMP
30-01.180
SULFURIC ACID
COOLING WATER OUT
185°F
110°F
PREGNANT SOLUTION COOLER 30-11.130
HYDROGEN PEROXIDE TO H2O2 ADD. TANK
COOLING WATER IN
H2O2 ADDITION TANK
30-09.360
VENT GAS TO SCRUBBER
FILTRATE POLISHING FILTERS (2)
30-22.111 & 112
MOLY. PRECIP. RECIRCULATION PUMPS 30-01.191 & .192
TO S.X.
MOLYBDENUM PRECIPITATION TANKS (one not shown)
30-09.121 & .122
MOLY. PRECIP. FILTER FEED PUMP
30-01.180
MOLY PRECIP FILTER
30-22.090
MOLY. PRECIP. FILTRATE TANK
30-09.290
FILTERED SOLUTION TRANSFER PUMP
30-01.260
PREGNANT SOLUTION STORAGE TANK
PREG SOLN. FEED PUMP
30-01.200
CAKE


PREGNANT SOLUTION FROM PREG. SOLN. STORAGE TANK
SULFURIC ACID
RAFFINATE TO EVAPORATION POND
PREG. SOLN. FILTERS
30-22.101 & .102
EXTRACTION MIX TANKS AND SETTLERS
30-09.151 thru .153 and 30-09.161 thru .163
ORGANIC RECLAIM TANK
30-07-230
RAFFINATE PUMP
30-01.300
FRESH ORGANIC (from FRESH ORGANIC STORAGE TANK, 30-09.260)
MAKE-UP STRIP SOLUTION
ORGANIC FEED PUMP
30-01.310
BARREN ORGANIC STORAGE TANK
30-09.240
RICH STRIP TO XTALLIZER FEED TANK
DEMINERALIZED WATER
WASH MIXERS AND SETTLERS
30-09.191 & .192 and 30-09.201 & .202
LEAN STRIP FEED PUMP
30-01.320
LEAN STRIP STORAGE TANK
30-09.250
STRIP SOLUTION FILTER
30-22.300
STRIP MIXERS
30-05.211, .212, & .213
STRIP SETTLER
30-09.220
RICH STRIP SOLN. PUMP
30-01.290
RICH STRIP SOLN. STORAGE TANKS (one not shown)
30-09.301 & .302
FILTER FEED PUMP 30-01.350
SOLVENT EXTRACTION
BARREN ORGANIC PUMP
30-01.280
SPENT WASH WATER TO FLOTATION TAILS
SPENT WASH WATER TO MOLY. PRECIP. FILTER
LEGEND
AQUEOUS (WATER) FLOW
ORGANIC FLOW
MIXED FLOW
WASH SOLUTION STORAGE TANK
30-09.140
WASH SOLUTION PUMP
30-01.240
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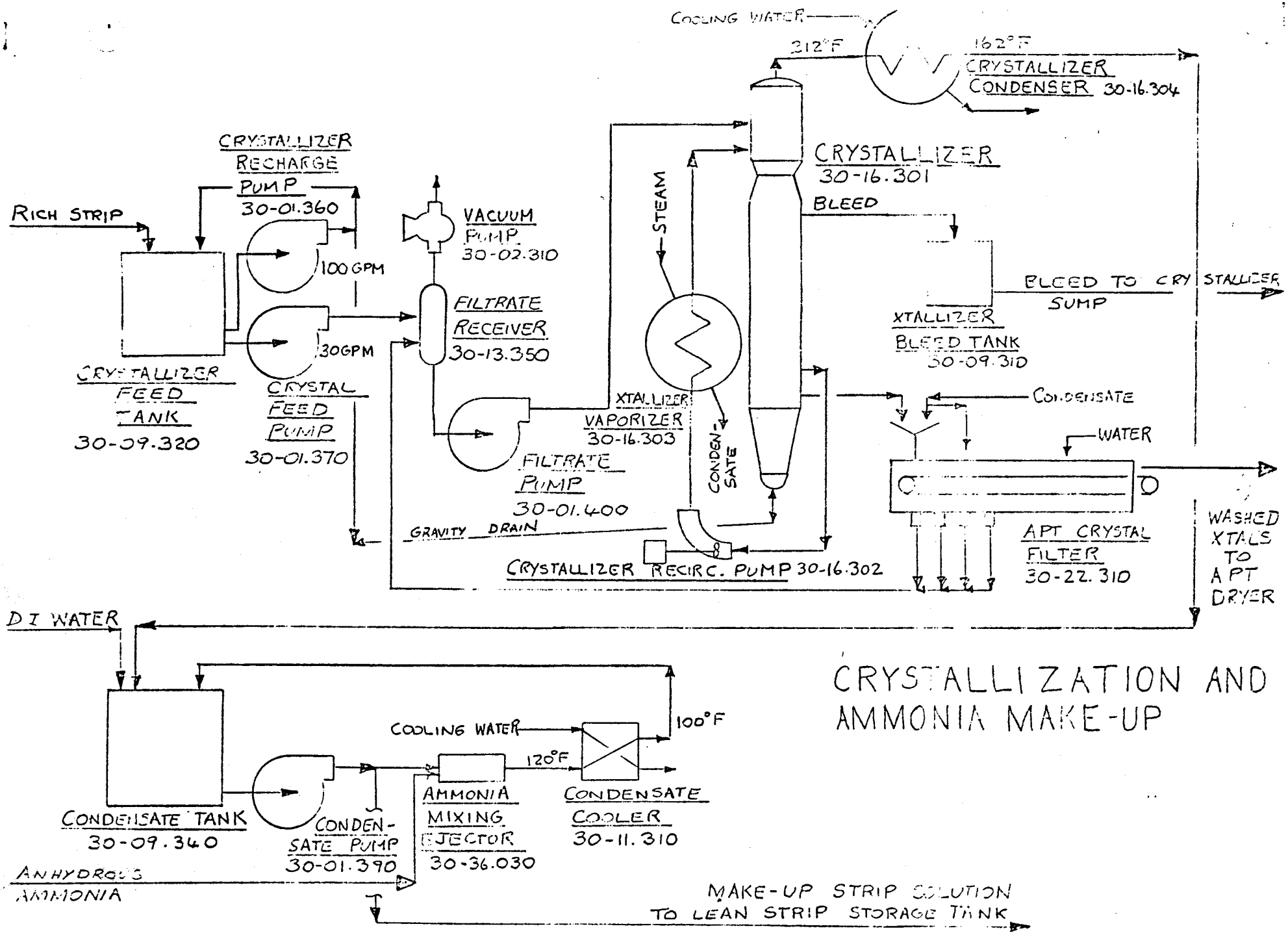
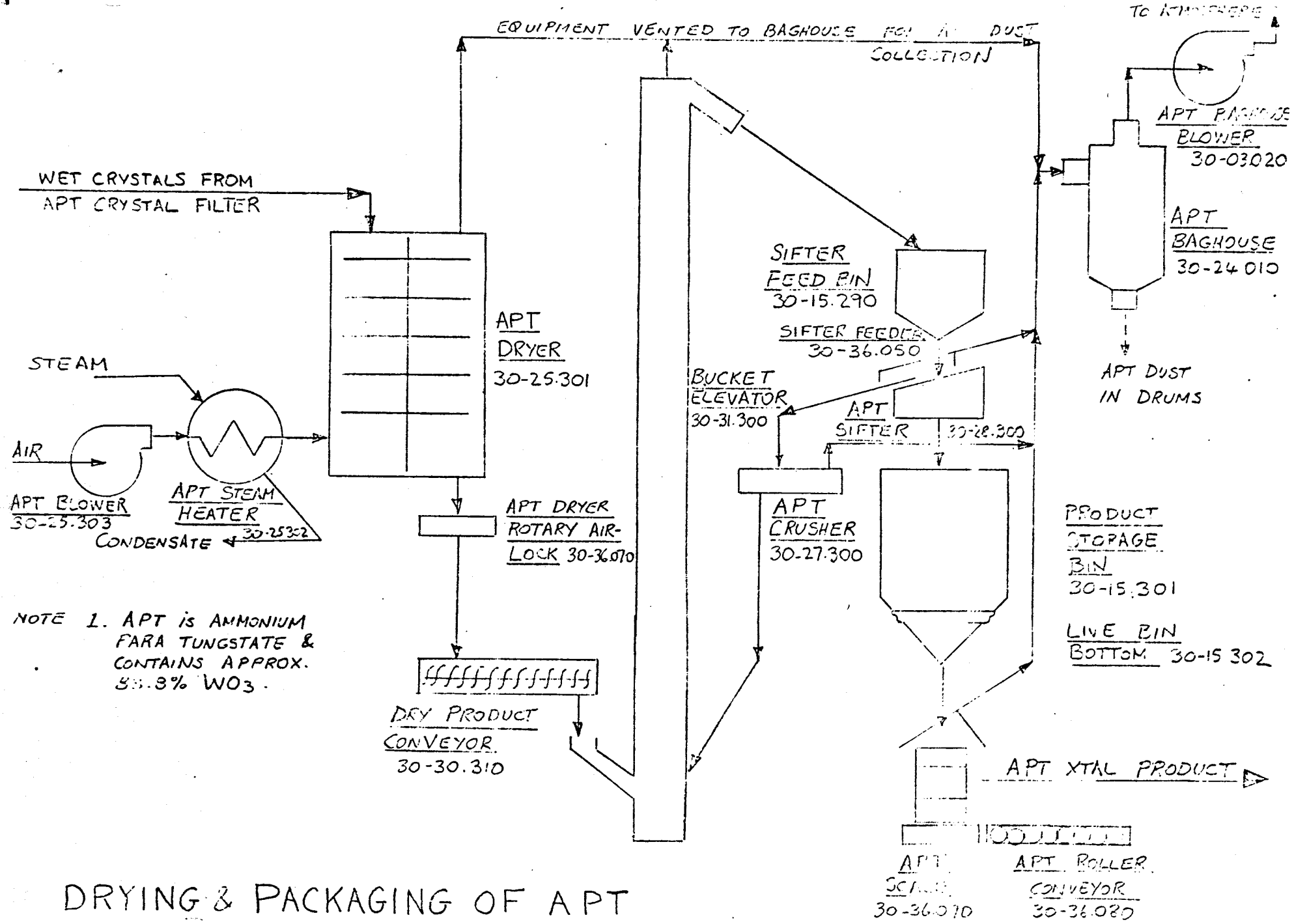


CRYSTALLIZATION AND AMMONIA MAKE-UP



NOTE 1. APT is AMMONIUM PARA TUNGSTATE & CONTAINS APPROX. 8[illegible].8% WO_3.

DRYING & PACKAGING OF APT

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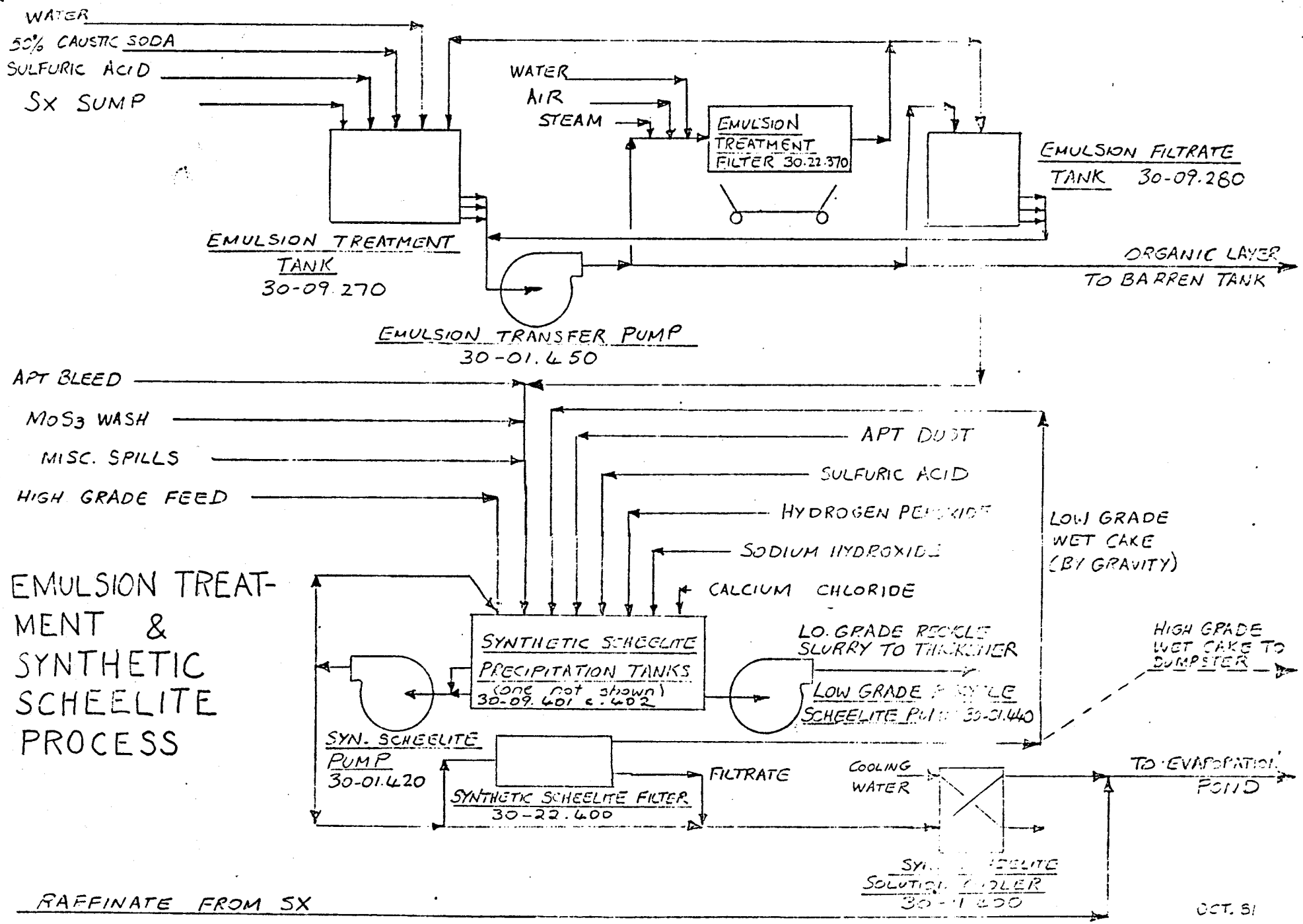
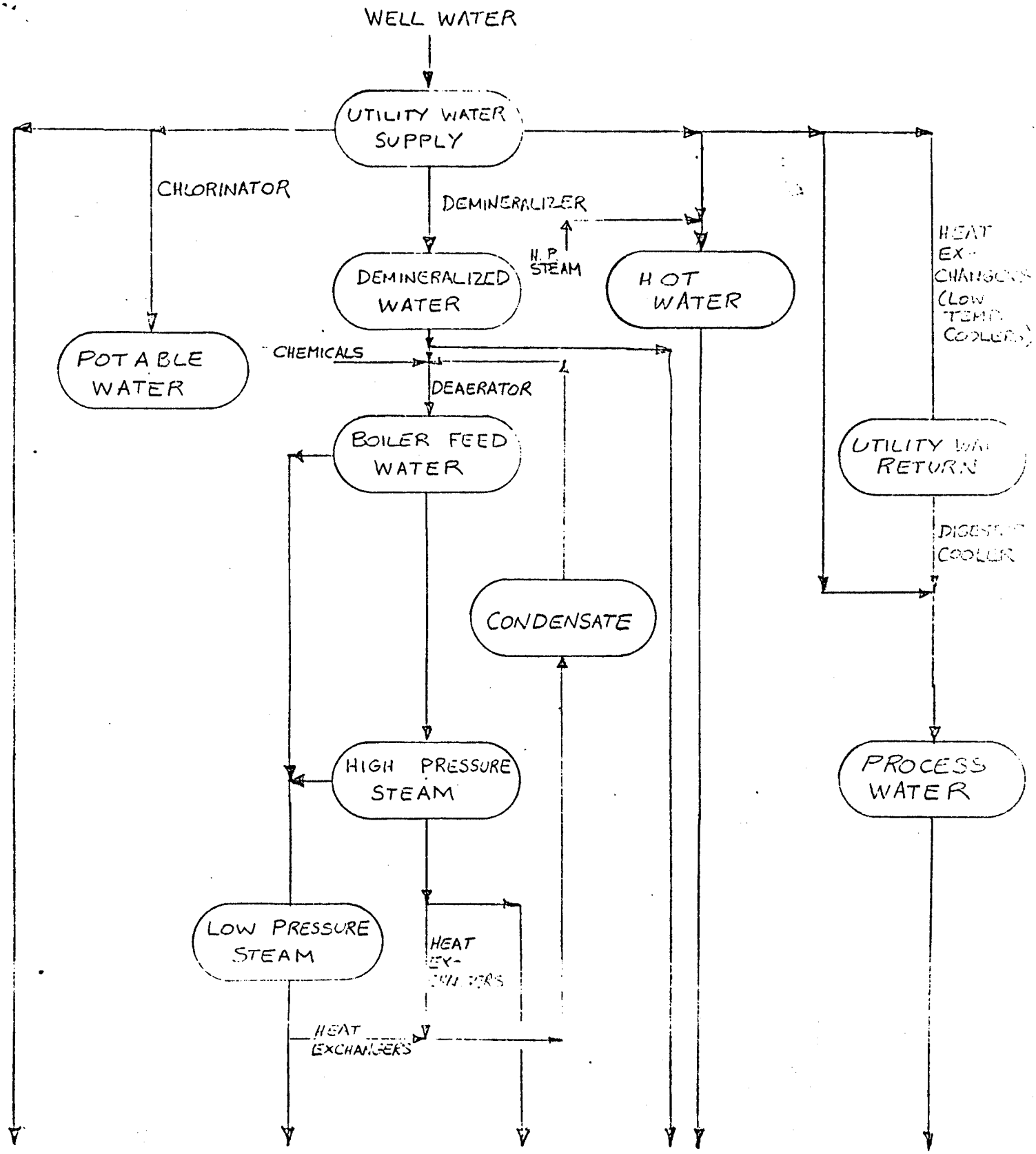
EMULSION TREATMENT & SYNTHETIC SCHEELITE PROCESS





WATER AND STEAM CONSUMED DIRECTLY IN PROCESS, OR OTHERWISE FINALLY CONSUMED, AT MANY DIFFERENT POINTS.

GENERAL WATER PATHS IN MILL
(not a flow diagram)

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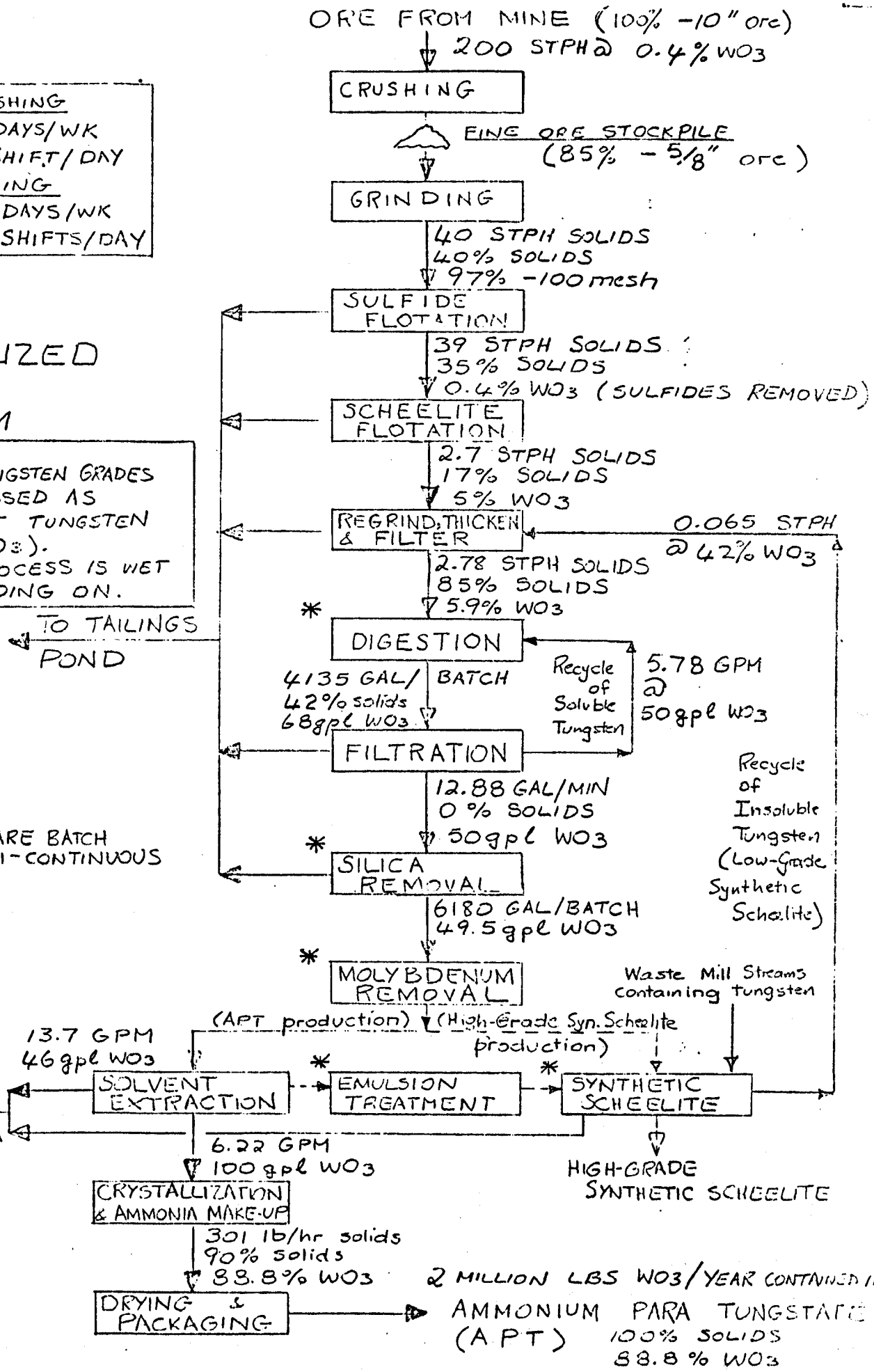
GENERALIZED FLOW DIAGRAM

CRUSHING
5 DAYS/WK
1 SHIFT/DAY
MILLING
7 DAYS/WK
3 SHIFTS/DAY

NOTES. 1 TUNGSTEN GRADES ARE EXPRESSED AS EQUIVALENT TUNGSTEN OXIDE (WO_3).
2. PROCESS IS WET FROM GRINDING ON.



* THESE ARE BATCH OR SEMI-CONTINUOUS STEPS.