WASTE CALCINATION

AT THE

IDAHO CHEMICAL PROCESSING PLANT

IDAHO NUCLEAR ENGINEERING LABORATORY

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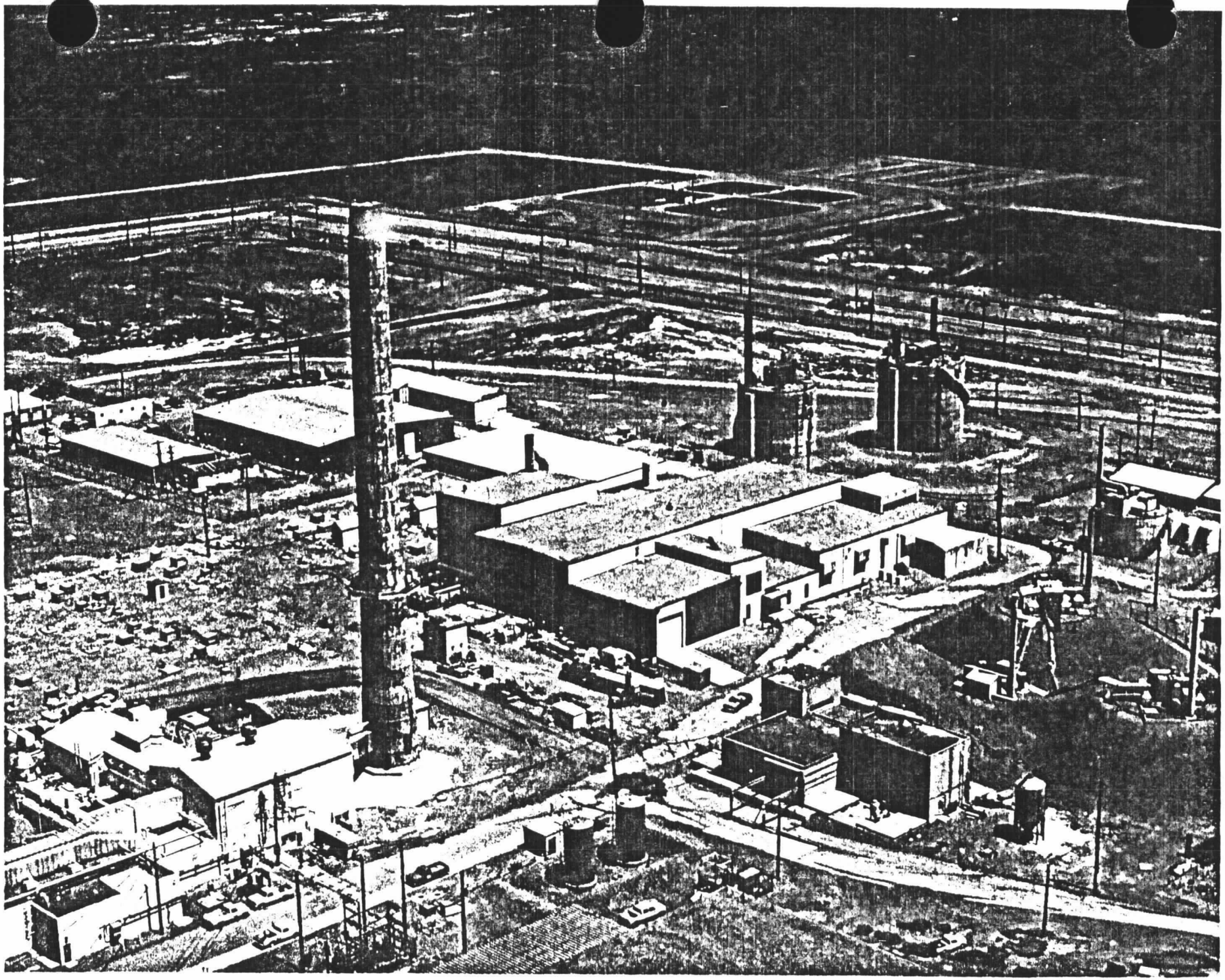
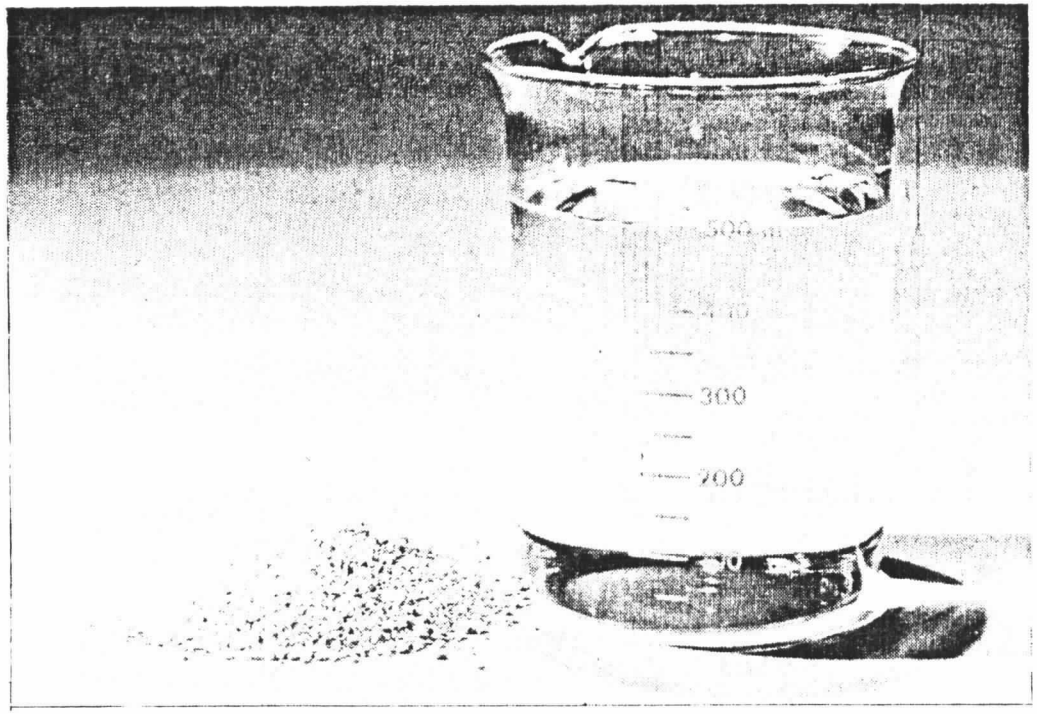


Calcining Process

- Conversion of liquid, high-level radioactive waste to solid by calcination (high temperature drying) process.
- Fluidized bed produces solidified granular high-level radioactive waste.
- Pneumatic transfer of solid waste to bin set storage.
- Sophisticated effluent cleanup system.



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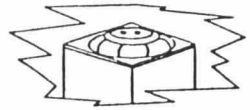
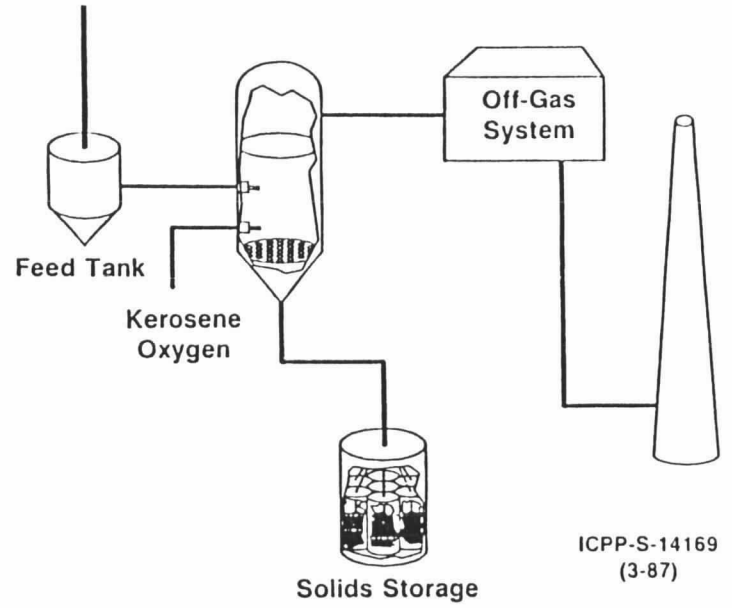


THE CALCINING PROCESS . . .



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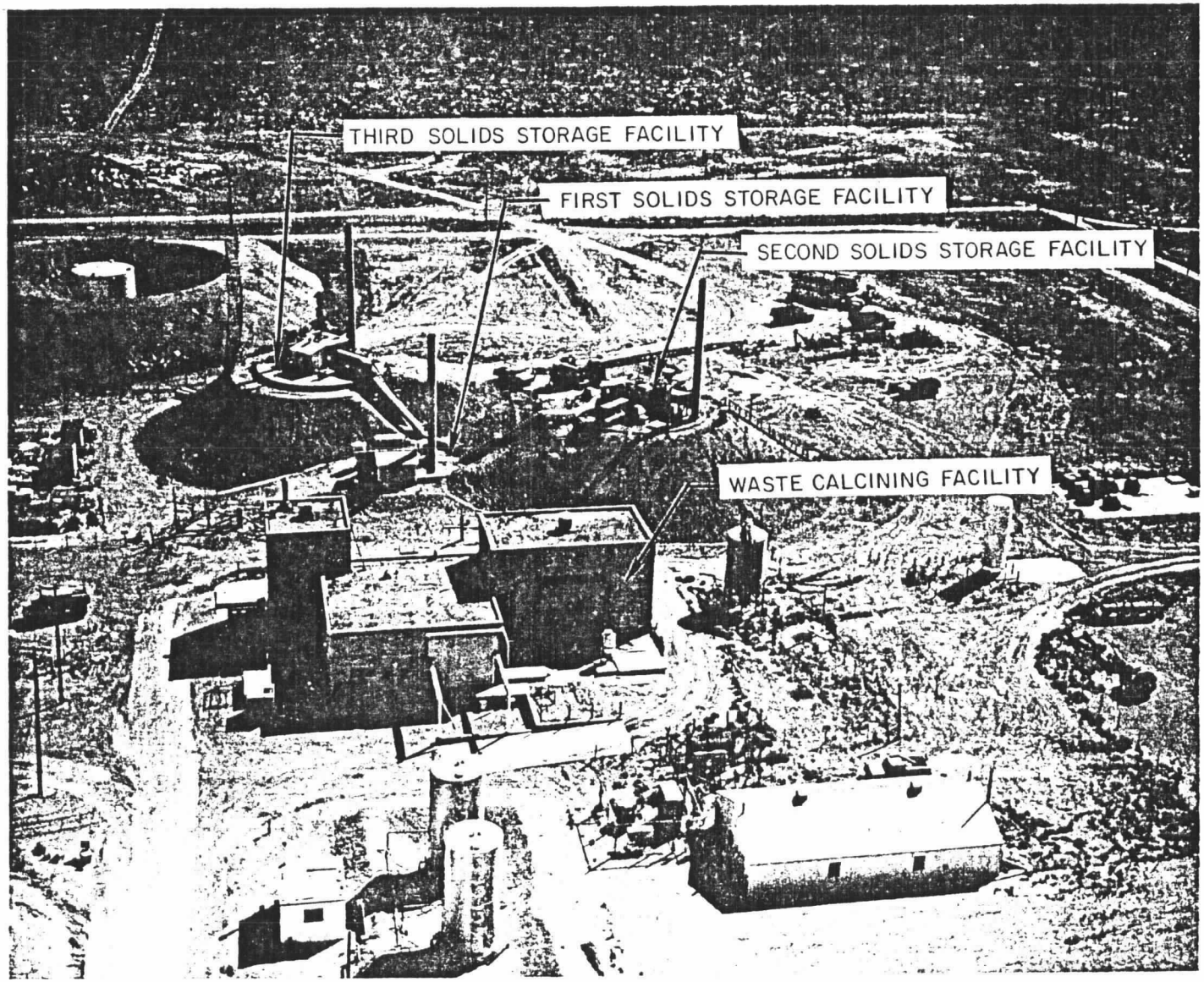
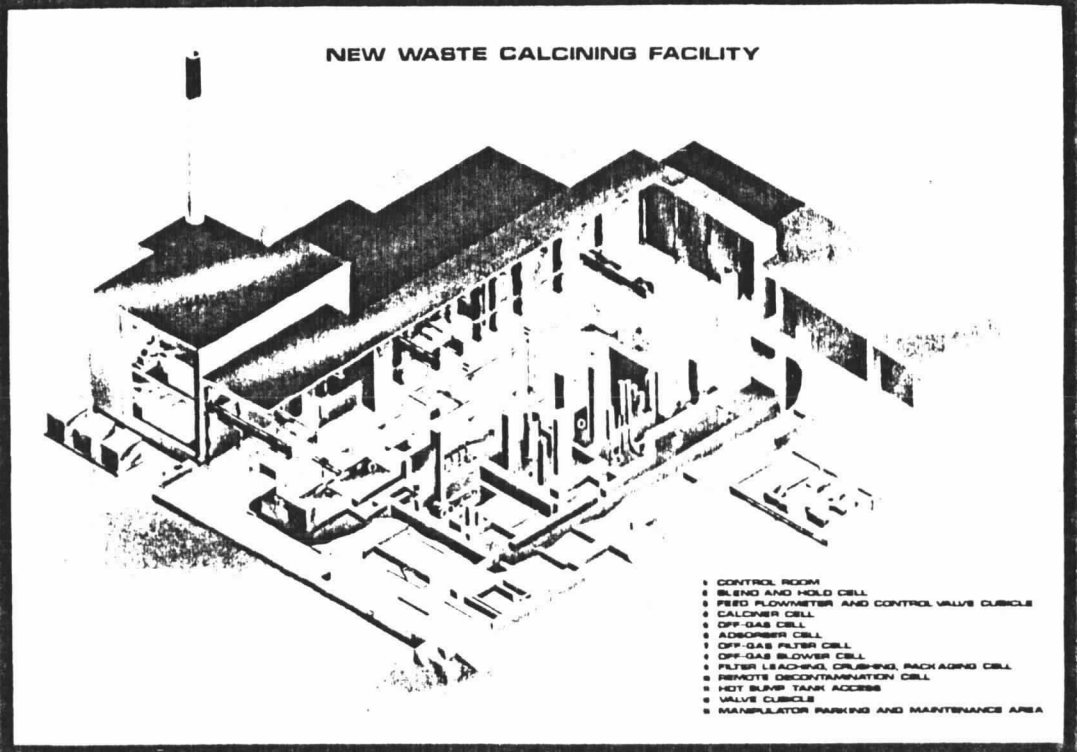


The ICPP Waste Calcining Facility Area

New Waste Calcining Facility (NWCF)

- Began hot operations September 1982
- 3000 gallon per day design capacity
- Remote operations and maintenance
- Automated data collection
- 90% of facility devoted to effluent treatment



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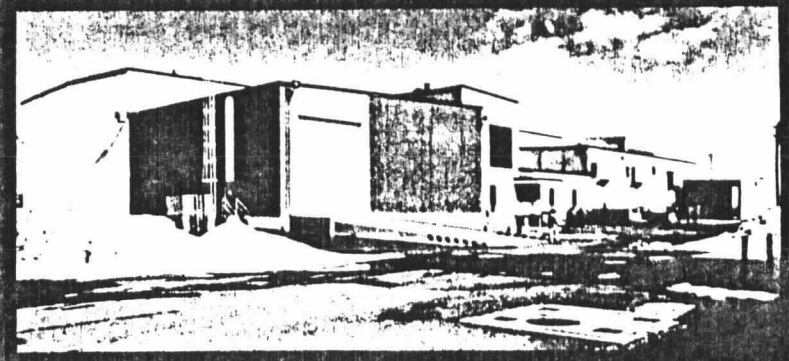

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NWCF OPERATIONAL HISTORY

- HOT RUN H-1 9/82 - 6/84, 1,500,000 GALLONS PROCESSED
- HOT RUN H-2 9/87 - 10/88, 800,000 GALLONS PROCESSED
- HOT RUN H-3 10/90 - PRESENT, 475,000 GALLONS PROCESSED

NWCF PROCESS

- WASTE BLEND PREPARED IN FEED TANKS
- ACIDIC LIQUID WASTE CONVERTED TO GRANULAR SOLIDS IN FLUIDIZED BED
- CALCINE PARTICLES 0.25 TO 0.6 MM DIAMETER
- FLUIDIZED BED OPERATED AT 500°C USING KEROSENE FUEL
- FUEL ATOMIZED WITH OXYGEN THROUGH 4 NOZZLES
- WASTE ATOMIZED WITH AIR THROUGH 4 NOZZLES

OFF-GAS TREATMENT

- PASSES THROUGH CYCLONE TO QUENCH TOWER, SCRUBBER, AND MIST ELIMINATOR TO REMOVE SOLIDS AND COOL GAS
- SCRUBBING SOLUTION IS RECYCLED TO FEED TANKS
- PASSES THROUGH Ru ABSORBERS, 3 HEPA FILTERS AND ATMOSPHERIC PROTECTION SYSTEM TO MAIN STACK
- MONITORED FOR RADIATION AND NOx EMISSIONS

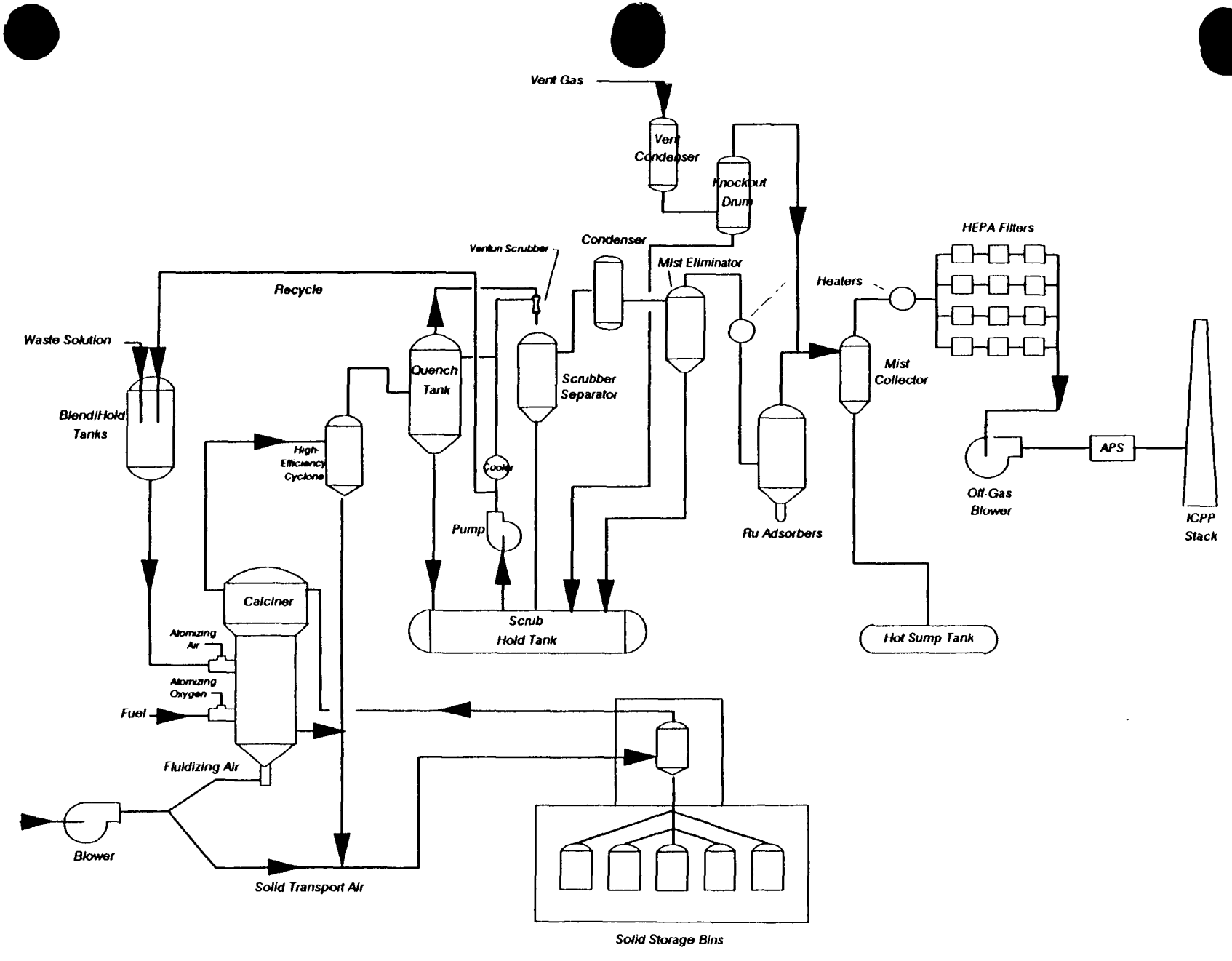


Figure 1 Schematic Flowsheet of NWCF and Off-Gas System

CHEMICAL COMPOSITIONS OF WASTE PLANNED FOR CALCINATION IN CAMPAIGN H-3

SPECIES	UNITS	WM-187	WM-188	WM-185	WM-182
ACID (H^+)	MOLAR	1.44	1.79	1.25	0.81
ALUMINUM (AL)	MOLAR	0.39	0.29	0.73	1.19
ZIRCONIUM (ZR)	MOLAR	0.26	0.23	0.011	0.007
BORON (B)	MOLAR	0.121	0.153	0.017	0.009
CADMIUM (CD)	MOLAR	0.048	0.102	0.001	0.002
SODIUM (NA)	MOLAR	0.017	0.021	1.253	0.016
POTASSIUM (K)	MOLAR	0.003	0.005	0.170	0.003
IRON (FE)	MOLAR	0.006	0.007	0.021	0.020
NITRATE (NO_3)	MOLAR	1.92	1.63	5.12	4.04
FLUORIDE (F^-)	MOLAR	1.83	2.09	0.16	0.08
CHLORIDE (CL)	MG/L	45	53	1061	36
SULFATE (SO_4)	MOLAR	0.028	0.045	0.043	0.028
URANIUM (U)	MG/L	7.9	4.6	66.4	32.0
UNDIS. SOLIDS	G/L	2.0	2.2	4.8	0.9
SP. GR.		1.157	1.138	1.250	1.214

CALCINATION CHEMISTRY

AT 500°C, THE FOLLOWING GENERAL REACTIONS OCCUR:

- EVAPORATION OF WATER
- DECOMPOSITION OF NITRIC ACID

  $2HNO_3 \Rightarrow 2NO_2 + 1/2O_2 + H_2O$

  SOME $NO_2 \Rightarrow NO + 1/2O_2$
- ALUMINUM NITRATES CONVERT TO ALUMINUM OXIDES

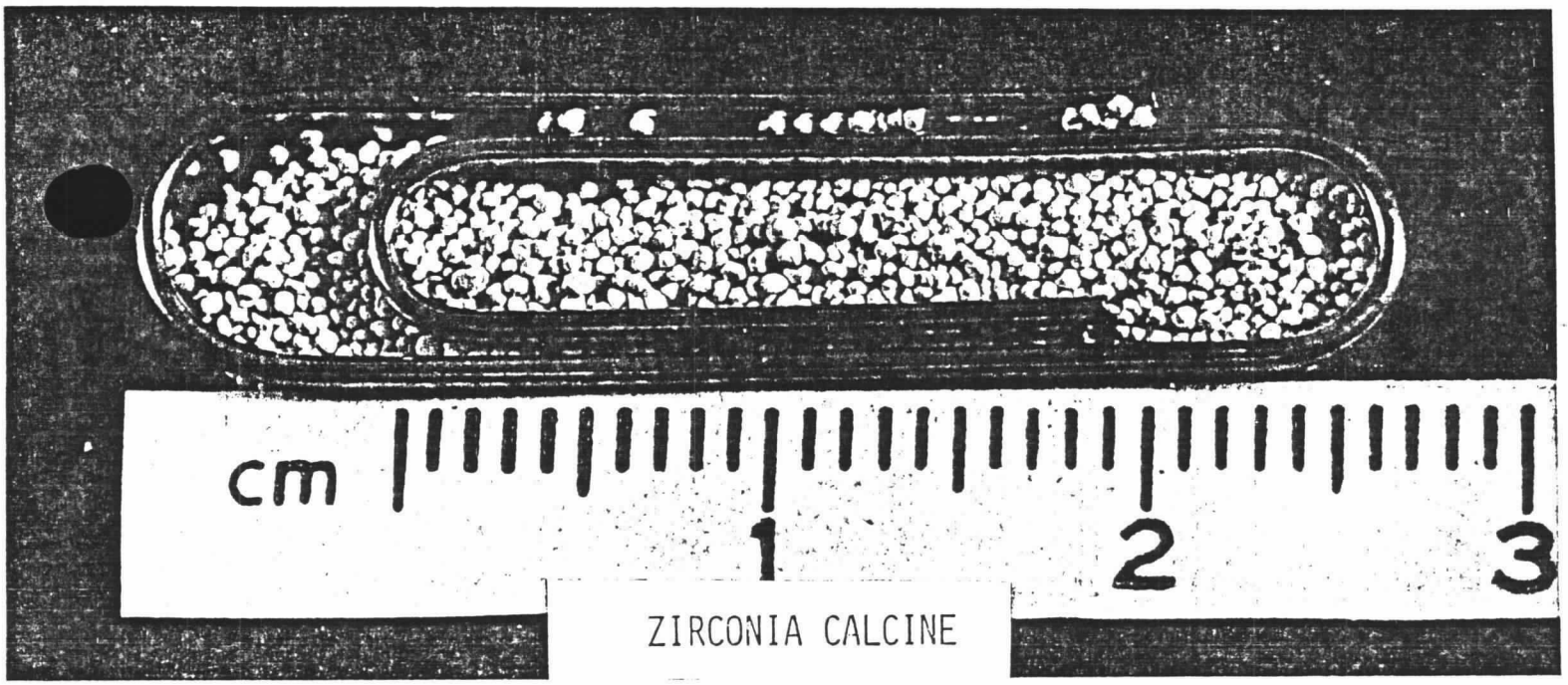
  $2AL(NO_3)_3 \Rightarrow AL_2O_3 + 6NO_2 + 3/2O_2$
- METAL NITRATES ==> METAL NITRATES, OXIDES
- ZIRCONIUM FLUORIDE ==> ZIRCONIUM OXIDE

  $ZRF_4 + 2H_2O \Rightarrow ZRO_2 + 4HF$

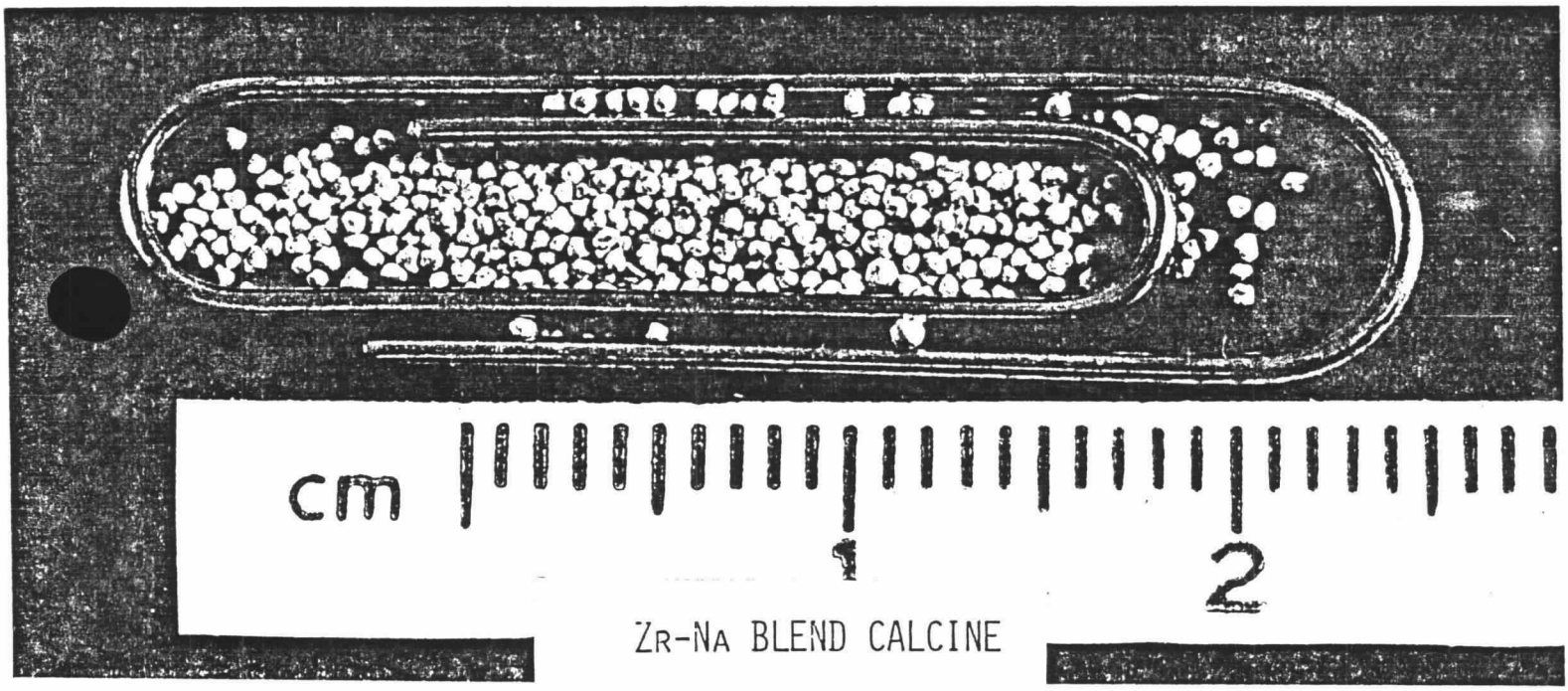
  $2HF + CA(NO_3)_2 \Rightarrow CAF_2 + 2HNO_3$
- FISSION PRODUCT NITRATES ==> F.P. OXIDES & NITRATES

CHEMICAL COMPOSITION OF CALCINE
(WEIGHT %)

	FLUORINEL/SODIUM	ALUMINUM
CaF_2	42	
ZrO_2	18	
CaO	12	
Al_2O_3	10	95
CdO	6	
Na_2O	5	2
B_2O_3	3	
HgO		3
OTHER	4	



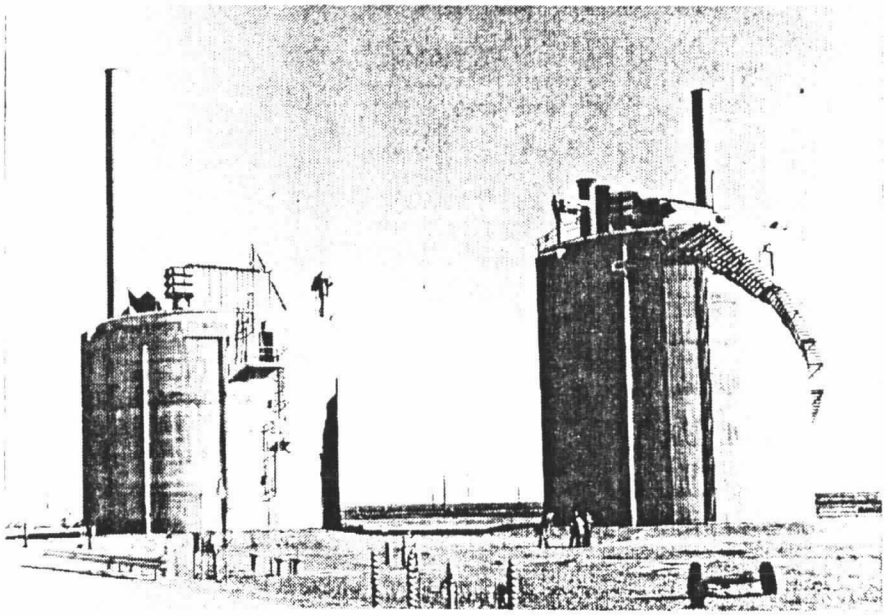
ZIRCONIA CALCINE



ZR-NA BLEND CALCINE

Calcined Waste Management

- Safer waste form
- Volume reduction
- 500 year retrievable storage
- Construction emphasis on safety
- Continuous monitoring



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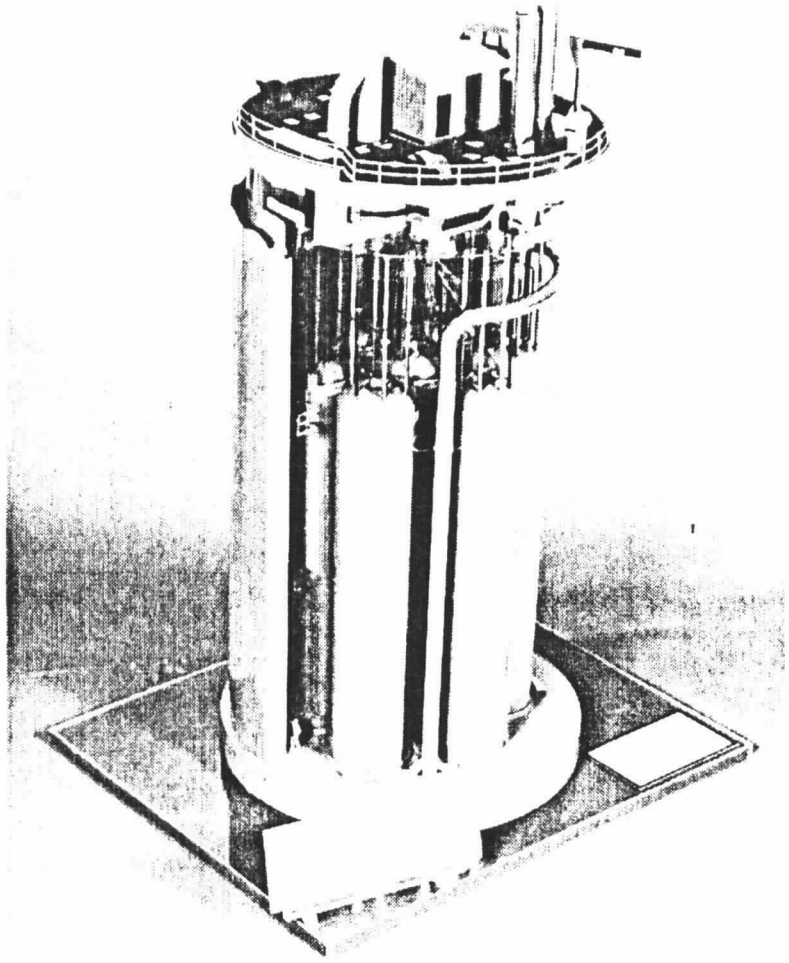

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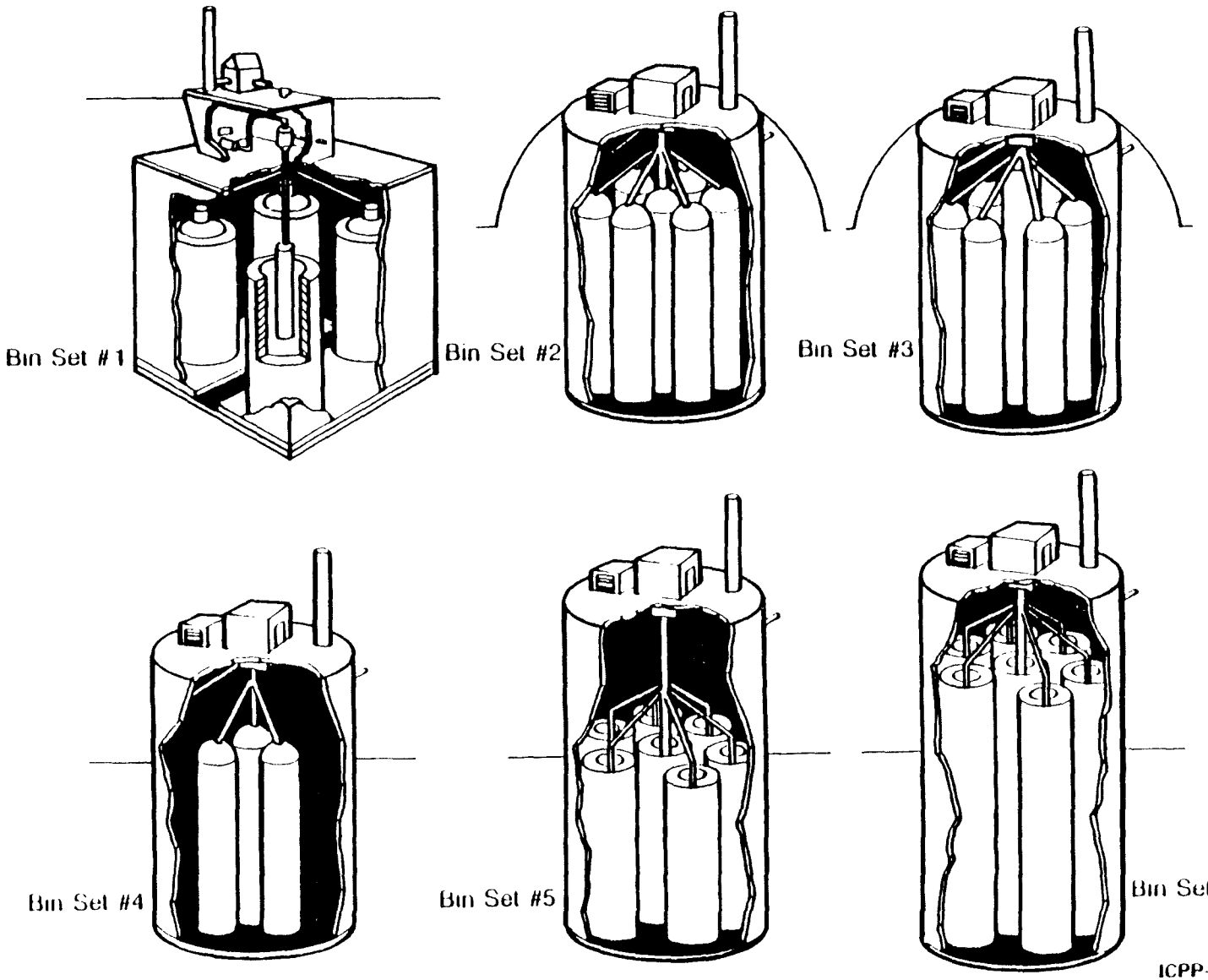
CALCINED SOLIDS INVENTORY

BIN SET	CAPACITY FT^3	INVENTORY FT^3	CALCINE TYPES	REMARKS
1	7,800	7,800	Al	
2	30,000	30,000	Al, Zr	
3	38,000	38,000	Zr	
4	17,000	17,000	Zr	FILLED IN RUN H-1
5	35,000	35,000	Zr, Zr-Na, Zr-Na-Al	FILLED IN RUN H-2 AND H-3
6	55,000	EMPTY	---	COMPLETED, PENDING SAFETY DOCUMENT APPROVAL
7	63,000	EMPTY	---	COMPLETED, PENDING SAFETY DOCUMENT APPROVAL

CALCINE STORAGE FACILITIES AT THE ICPP



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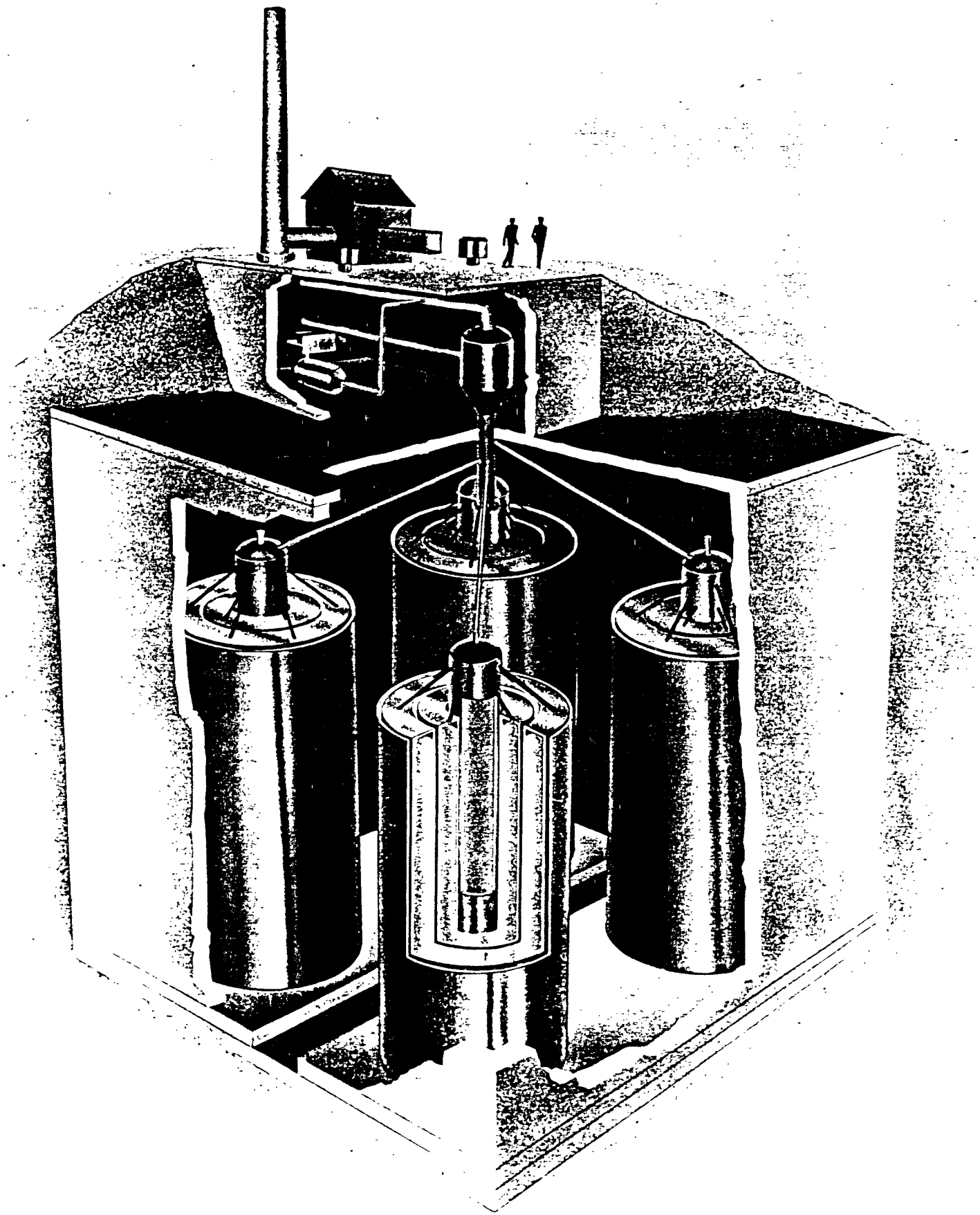

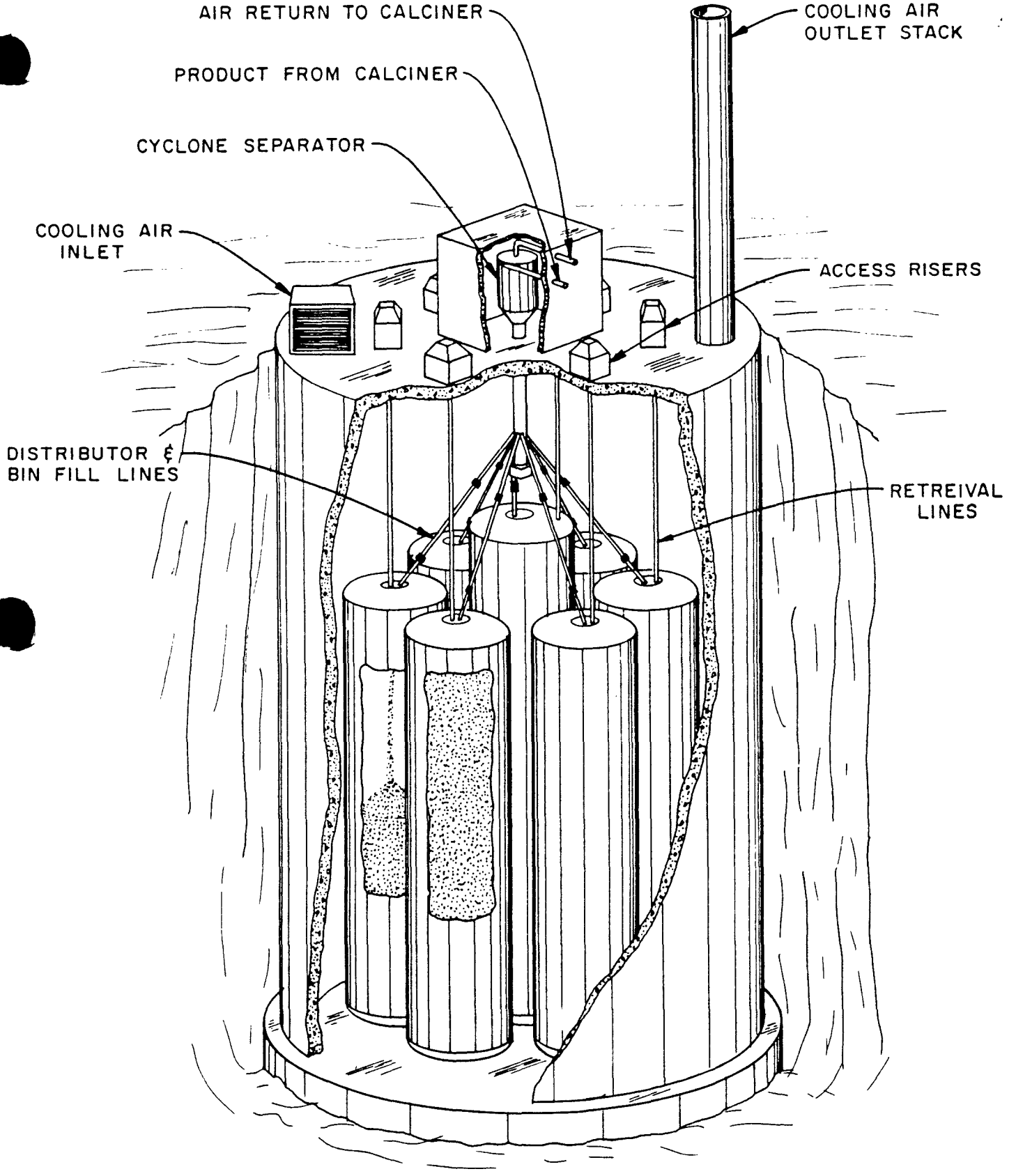
AIR RETURN TO CALCINER
PRODUCT FROM CALCINER
CYCLONE SEPARATOR
COOLING AIR INLET
DISTRIBUTOR & BIN FILL LINES
COOLING AIR OUTLET STACK
ACCESS RISERS
RETREIVAL LINES

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