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Date October 22, 1947

Subject Economic Study for Waste Storage and Disposal System in the 1200 Area

By F. L. Culler

To 1200-1300 Area Design File

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Subject: Economic Study for Waste Storage and Disposal System in the 1200 Area.

I Introduction

In a previous report on proposals for the 1200 Area waste disposal system, "Notes on September 5, 1947, "25" Process Waste Disposal Flow", estimated quantities of waste solution from the 1200 Area were outlined for two proposed waste systems, i.e., 1) neutralization of the acid wastes with subsequent storage in concrete tanks and 2) 50% volume reduction and storage in stainless steel tanks; an additional proposal of storage in concrete after a 50% volume reduction and subsequent neutralization has been added. The decision of what type of storage system was held pending a survey of the economics of two proposed systems. This memorandum is written to report the results of this survey and to recommend types of construction for storage and waste disposal tanks for the 1200 and 1300 Areas of the 1000 Project.

II Bases for Comparison

In order to establish a basis for the recommendations to follow, a brief discussion of the basic data applied is summarized in the following paragraphs.

Three types of tanks were considered:

1. Concrete tanks with a mild steel liner for storage of neutralized wastes.

2. Gunite (neat concrete sprayed on tank walls and bottoms under high pressure) lined tanks for storage of neutralized wastes.

3. Type 347 columbium stablized stainless steel, dished head, full penetration welded, tanks for storage of acid wastes after a 50% volume reduction of waste solutions.

Cost data on stainless steel tanks, with foundations, buried in the ground with a three foot earth cover (not adequate for proper shielding but satisfactory as a basis for comparison), was obtained from Kellex. The tanks are horizontal dished head, 347 stainless of ½" plate above 10,000 gal. capacity and 3/8" plate below 10,000 gal. capacity. A summary of cost estimates including 10% for contingencies and 25% for contractors fees and overhead is as follows:

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Economic Study for Waste Storage and Disposal in the 1200 Area

Capacity	Total Cost
1000 Gal	$ 5,700
10000 Gal	18,490
20000 Gal	36,860
30000 Gal	56,234

Cost data for concrete tank, both mild steel lined and gunite lined, was prepared by the Plant Engineering Group. These tanks are proposed as cylindrical, with dry wells and manhole, buried in the ground with a three foot earth cover. Contingencies of 10% and 25% contractors' fees and overhead have been included.

Capacity	Total Cost Concrete Lined W/Mild St.	Gunite
100,000	$84,200	$64,800
20,000	28,900	23,200
10,000	20,200	16,800
3,600	9,800	8,200
1,000	7,400	6,400

The excavating costs for the installation of both types of tanks was figured at $6.50 per cubic yard for rock without blasting (from Kellex). This figure is low, but it was used for the sake of comparison.

The cost of sodium hydroxide was figured at $3.00 per 100 lbs. of 50% caustic. It is tenatively planned to purchase 50% caustic in drums and to make up 50% caustic solution here on the area. The cost of steam was figured at $.40/1000 lb. and the cost of cooling water at $.10/1000 gal. The last two figures were obtained from Mr. M. A. Bugg of the Power Division.

The volumes of waste to be considered were taken from Dwgs. TD-359 and TD-360 for the 1200 Area, and TD-335 for the 1300 Area. Dwgs. TD-359 and TD-360 have been changed slightly since their first issue; these changes will be incorporated in a revised drawing.

III Table of Results and Discussion of Cost Comparison for 1200 Area Wastes.

The cost for storage of two types of waste material which contain great quantities of radioactivity is summarized in Table I. Estimates for three types of storage tanks are shown.

The costs listed in the "Total Cost of Extra Equipment" column were deduced as follows. The $1400 shown for items 1 and 2 would be the cost of a sodium hydroxide weigh tank, scales, and piping required to supply NaOH to the column raffinates in the hold tank in the process canyon. Air agitation was assumed. The $20,000 shown for item 3 was included to cover the cost of additional pipe lines and ventilation facilities for the two additional stainless tanks. The $40,000 for items 4 and 5 covers the cost of a neutralizer remote from the actual process area. The $1400 in items 6 and 7 was included for the sodium hydroxide addition system required. The $8000 in item 8, and the $24,000 in items 9 and 10 were included for the reasons listed above for item 3 and items 4 and 5 respectively.

From the cost figures shown in Table I, several things are apparent for the 10 year or permanent storage system:

1. Volume reduction and storage in stainless steel is definitely less expensive than neutralization and storage in mild steel lined concrete or gunite tanks.

2. Volume reduction with subsequent neutralization and storage in mild steel lined concrete tanks will cost approximately $75,000 less than storage in stainless steel over a period of ten years. Storage in gunite would save approximately $110,000 over storage in stainless steel.

The use of gunite lined tanks will be somewhat inadvisable in spite of their apparent economic advantage. Because of the high activity level of the wastes, a temperature use of 1°F per hour may be possible. It is doubtful that gunite will withstand any great amount of temperature gradient, so that concrete tanks lined with this material may be subject to cracking.

Storage in stainless steel tanks has many advantages:

1. The tank farm will be smaller since a smaller total volume of solution will be stored.

2. The resistance of stainless steel tanks to corrosion at elevated temperature is assured without worrying about neutralization and acid control.

3. Stainless steel will withstand temperature gradients without danger of cracking (maximum anticipated temperature 220°F).

4. Wastes sent to the tank farm unneutralized can be more easily reprocessed if it becomes necessary to recover any material such as Np.

5. Stainless tanks make the waste disposal system more versatile; no great care is required in the disposal of active wastes.

6. Structurally, stainless tanks are more sound, less susceptable to ground shock or to cracking due to settling of the ground.

It is felt that these advantages outweigh the savings incurred by using mild steel lined tanks to store volume reduced, neutralized solutions as shown by item 4 in Table I. Stainless steel tanks will be used for 10 year (or permanent) storage.

For essentially the reasons listed above, stainless steel tanks will be used for the five year storage system. The five year tanks will not contain material of activity great enough to cause a temperature rise, so that this point must be dropped from the list of advantages for stainless steel.

IV Other Storage and Waste Disposal Tanks for the 1200 Area

In addition to those tanks discussed in the preceding section, other storage facilities will be required.

Two 4000 gal. stainless steel tanks will be provided for the storage of MnO_2 cake solutions previous to processing for U recovery. These tanks will be buried in the ground near the 25 process canyon.

A bank of ten 10,000 gallon concrete, mild steel lined tanks will be buried in the ground adjacent to the 25 process canyon. Two of these tanks will see regular service alternately as collection and hole tanks (for U analysis) for steam condensate and cooling water. The other eight tanks will be installed to provide hold-up capacity for exterior decontamination wastes from the cells so that analysis for uranium can be made before disposal to the retention pond.

V 1300 Area Waste Storage and Disposal Tanks

A High activity waste storage tanks

1. The quantities of high activity waste from the 23 Process based on processing 16 kg thorium/day are shown on TD-335. Since the raffinates from the first cycle extraction are near saturation with thorium, no volume reduction can be performed. There raffinates must be stored in the acid condition for recovery of thorium, for which a process has not been developed. If we assume a volume increase of two in wastes during processing, a total final storage volume of 212,000 gallons must be provided for permanent storage. It is planned to install six 30,000 gallon, two 10,000 gallon, and four 500 gallon, type 347, stainless steel tanks for these wastes. Two of these tanks will collect raffinate from the first cycle preliminary to thorium recovery. When thorium recovery is undertaken, hot waste solution from this cycle can be stored in the other stainless tanks provided.

2. Second cycle raffinates will be collected and stored in one of the 5000 gallon stainless tanks provided.

3. Crude removal cake solution will be collected and stored preliminary to processing for U recovery in a 500 gal., type 347 stainless steel tank, buried in the ground outside the 23 process canyon. After processing this solution for U, assuming a four-fold increase in volume, these wastes will be stored in one of the 10000 gallon stainless steel tanks provided.

[redacted]

4. A 20 gal. stainless steel hold-up tank will be provided for the centrifugate after the diuranate precipitation step. This tank will be located in the 23 process canyon.

5. A bank of six 10,000 gal. concrete mild steel lined tanks will be buried in the ground adjacent to the 23 process canyon. Two of these tanks will see regular service alternately as collection and hold tanks (for U analysis) for steam condensate and cooling water. The other four tanks will be installed to provide hold-up capacity for exterior decontamination water so that uranium analysis can be made before disposal to the retention pond.

VI Storage and Disposal Facilities Common to Both 1200 and 1300 Areas

Some waste streams from the 1200 and 1300 areas will be combined to go to a common storage or disposal system. These streams may contain enough activity to warrant storing for a year to reduce the activity to a point where disposal to the retention pond is possible. These streams will contain no material that will require reprocessing for recovery. The following wastes fall into this class:

1. Treatment wastes from solvent recovery.
2. Interior decontamination water after uranium recovery.
3. Exterior decontamination water after uranium recovery.
4. Hot cooling water of steam condensate after uranium recovery.
5. Hot wastes from the salvage area.

1. In order to reduce the volume of waste that has to be stored, or in order to concentrate a solution containing uranium that must be recovered, it is proposed to install two evaporators, each of 100 gallons per hour capacity for the evaporation of the wastes described above. The concentrate from these evaporators can go to the appropriate salvage area or to the storage tanks provided. There will be three 100,000 gallon mild steel lined concrete tanks. In order to be sure that the wastes reaching these tanks contain no acid, it is proposed to install a limestone neutralizing bed after the evaporators. All wastes going to these tanks will pass through the limestone neutralizer. Five tanks will be installed.

2. A retention pond of 1,000,000 gallons capacity will be provided for wastes from both areas.

[redacted]

VI Discussion of Overdesign Factors

The size of the waste storage and disposal system for the 1200 Area has been determined entirely on the basis of processing 600 gms of 25 per day in the main process canyon every day over a period of ten years. We know that for three years at least, the separations plant will run at a capacity of less than 300 gms per day. Then too, the plant will not run 365 days per year, but may be shut down as much as 20% of the time. The waste disposal system as proposed is 1.3 to 3 times larger than may be required, since the need of processing material from other piles is uncertain.

The 1300 Area waste disposal system is based on processing 16 kg. of thorium per day, 365 days a year. Actually only 8 kg. max. are anticipated from the heterogeneous pile, and the plant will probably be shut down 20% of the time. Therefore the waste system is 1.2 to 2 times larger than may be required.

Because of the cost of the original installation required for waste disposal with a 600 gm "25" and 16 kg thorium per day basis, it seems reasonable to install just those waste disposal facilities required for processing material from the heterogeneous pile. In order to reduce the initial capital expenditure, it is recommended that only those waste tanks required for handling the one pile be installed initially with allowance for expansion when and if expansion is desired. In making the site plan, room for necessary expansion to full 600 gm and 16 kg capacity will be provided. Additional storage facilities will be installed when required.

In the near future two drawings will be prepared, one showing the waste storage and disposal requirements based on 600 gm. "25" per day and 16 kg. thorium per day, 365 day per year for ten years; the other showing the requirements based on 240 gm "25" per day and 8 kg. thorium per day, 365 days a year for ten years. In the following section a summary of the requirements for the above proposals is presented.

VII Summary of Requirements

See Table II.

VIII Conclusions

A. Wastes from the 1200 Area containing large amounts of radioactivity in acid solution will be reduced in volume and stored in type 347 stainless steel tanks. Designing for 600 gm. "25" per day, 365 days per year for ten years, would require the equivalent of fourteen 30,000 gal. tanks. Designing for 240 gm "25" per day, 365 days per year for ten years will require six 30,000 gal. tanks. It is recommended that the latter design be adopted for initial installation with space in the site plan for expansion of waste facilities at a latter date.

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B. For wastes from the 1200 Area containing enough activity to warrant five years storage, three 30,000 gal. type 347 stainless steel tanks will be required for 600 gm/day and one 30,000 gal. tank will be required for 240 gm/day. The latter design with provision for expansion at later date, is recommended for initial installation.

C. For wastes from the 1300 Area designing for 16 kg. thorium per day, 365 days per year for ten years, seven 30,000 gallon type 347 stainless steel tanks would be required. On the basis of 8 kg. per day, four will be necessary. It is recommended that the latter design be adopted for initial construction with provision made in the site plan for future expansion.

D. Two evaporators, one for "25" and one for "23", will be installed to volume reduce low activity wastes. A neutralization system tenatively a limestone bed, will be installed after the evaporators.

E. Low activity wastes from both the 1200 and 1300 Areas will be stored in concrete mild steel lined tanks after neutralization. It is recommended that three tanks be installed initially with provision for expansion at a later date.

F. A 1,000,000 gallon gunite lined retention pond will be installed.

F. L. Culler
Design Section

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TABLE I.

COST STUDY FOR 12[illegible]
WASTE STORAG[illegible]

TYPE OF STORAGE	GALLONS WASTE UNTREATED	GAL. 50% NaOH FOR NEUT.	TOTAL GALLONS TO STORAGE	TOTAL $ COST OF NaOH FOR NEUTRALIZATION	COST OF NaOH $/GAL. STORED	NO. OF TANKS TANK[illegible]
.0 YR. PERMANENT [illegible]ORAGE IN MILD STEEL [illegible]ED CONCRETE, NEUTRALIZED.	968 100	183 600	1,151 700	69 600	.06	12[illegible] 100,00[illegible]
10 YR. NEUTRALIZED IN GUNITE	"	"	"	"	"	"
[illegible]0 YR. STORAGE IN 347 [illegible]SS. AFTER 50% VOLUME REDUCTION	442 000	—	442 000	—	—	14 3000[illegible]
[illegible]YR STORAGE, 50% VOL. RED. NEUTRALIZED IN MILD STEEL [illegible]NED CONCRETE	442 000	194 000	636000	72 500	.11	7 100,000
ABOVE IN GUNITE	"	"	"	"	"	"
[illegible]YR. STORAGE IN [illegible]LD STEEL LINED CONCRETE	142 320	56 920	199 240	21 540	.11	2 100,000
ABOVE IN GUNITE	"	"	"	"	"	"
[illegible]YR. STORAGE IN 347 [illegible]S. WITH 50% VOL. RED.	71 160	—	71,160 .4 28464.0	—	—	3 30000[illegible]
[illegible]YR. STORAGE, 50% VOL. RED. NEUTRALIZED IN MILD STEEL [illegible]NED CONCRETE	71 160	31 700	102 860	11 800	.11	1-1000[illegible] 1-[illegible]000[illegible]
ABOVE IN GUNITE	"	"	"	"	"	"

AREA

Drawing # 4746

...IZE	TOTAL COST OF TANKS $.	TANK COST $/GAL	TOTAL $ COST OF STEAM	STEAM COST $/GAL	TOTAL $ H2O COST	WATER COST $/GAL.	TOTAL COST OF EXTRA EQUIPMENT	EX. EQ COST $/GAL	TOTAL COST $/GAL	TOTAL COST
...AL	1,010,000	.88	—	—	—	—	1400	—	.94	1,081,000
	780000	.68	—	—	—	—	"		.74	851,000
...AL	782,000	1.85	2400	.005	338	—	20000	.05	1.91	804,800
...AL	589400	.90	2400	.004	338	—	40 000	.06	1.08	729,400
	453,600	.71	"	"	"	"	"	"	.89	694,400
...L	168,400	.85	—	—	—	—	1400	.007	.97	191,400
	129,600	.65	—	—	—	—	"	"	.77	152,600
...L.	169,000	1.87	770	.01	60	—	8000	.11	1.99	177,800
...OAD ...AL	113,100	1.10	770	.01	60	—	24000	.23	1.42	161,560
	88000	.86	"	"	"	—	"	"	1.21	136,600

[redacted]

[redacted]

TABLE II

1200 & 1300 AREA
REQUIREMENTS
COST …

…TORAGE FACILITY	TYPE OF TANK	CAPACITY GAL.	600 gm. "25"; 16 KG. TH. — No. REQ'D	UNIT COST $	TOTAL COST $	240… — No. REQ
…0 AREA						
…nO$_2$ CAKE SOLUTION	STAINLESS	4000	2	8 000	16 000	2
STEAM & COOLING H_2O HOLD-UP	CONCRETE, MS	10000	2	20 200	40 400	2
DECONTAMINATION H_2O HOLD-UP	" "	10 000	8	20 200	161 600	8
"25" EVAPORATOR	STAINLESS	100 GAL/HR	1	10 000	10 000	1
10 YR. PERMANENT STORAGE	"	30 000	12	56 230	674 000	5
		10 000	4	18 500	74 000	2
		5000	4	10 000	40 000	2
5 YR. STORAGE	STAINLESS	30000	3	56 230	168 690	1
…0 AREA						
…nO$_2$ CAKE SOLUTION	STAINLESS	5000	1	10000	10000	1
…EAM & COOLING H_2O …D-UP	CONCRETE, MS	10 000	2	20200	40400	2
…EC. H_2O HOLD-UP	" "	10 000	4	20 200	80800	4
23" EVAPORATOR	STAINLESS	100 GAL/HR.	1	6000	6000	
…0 YR. PERMANENT STORAGE	"	30000	6	56230	337380	3
		10000	2	18500	37000	1
		5000	4	10 000	40000	2
…MMON FACILITIES						
1 YR. STORAGE	CONCRETE, MS	100 000	5	84 200	421 000	3
RETENTION POND	CONCRETE, GUNITE	1,000,000	1	150 000	150 000	1
					2307,270	

Drawing # 1767

/ASTE DISPOSAL
WITH ESTIMATED

GM. 25,	8 KG. TH	
PACITY GAL.	UNIT COST $	TOTAL COST $
000	8,000	16000
000	20,200	40400
0000	20,200	161,600
0 GAL/HR	10000	10000
0000	56230	281150
0000	18,500	157000
5000	10000	20000
0000	56230	56230
5000	10000	10000
0 000	20200	40400
/0 000	20 200	40400
00 GAL/HR	6000	6000
30000	56230	168690
10000	18500	18500
5000	10000	20000
00000	84 200	252600
00,000	150000	150000
		1,448,970

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