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PUREX WASTE FACILITY
SCOPE DESIGN 241-AX

AUTHOR

H. W. Stivers

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PUREX WASTE FACILITY
SCOPE DESIGN 241-AX

Prepared by

H. W. Stivers

June 20, 1956

Process Engineering
Design Section
Engineering Department
General Electric Company
Hanford Atomic Products Operation

This document has been reviewed and approved by the appropriate members of the Process Engineering Sub-Section as the fundamental requirements and scope basis for the AX Tank Farm. It is transmitted to the Architectural, Civil, and Structural Design Unit for their use in preparing detailed designs.

Head, Utilities and Services Design and Development

Manager, Process Engineering

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PUREX WASTE FACILITY SCOPE DESIGN - 241-AX

INTRODUCTION

At present production rates and waste volumes, a new Purex tank farm will be required long before May 1958. However, by utilizing reserve storage in other tank farms, and by successful self-concentration of Purex wastes, a new tank farm may not be required before August 1958.

Purex waste volumes have greatly exceeded flowsheet quantities since plant start-up in January this year. The 241-A tank farm is presently one-third full (to the hydrostatic head limitation) of dilute process wastes. These large waste volumes are attributed to "new plant operating" and to storing of other waste streams with the neutralized waste stream producing a dilute waste incapable of self-concentration. It is planned to transfer this dilute waste to 241-C tank farm along with coating wastes, if space can be provided through successful in-farm scavenging.

It is planned for the Purex plant to be the base load plant and therefore it will not be effected by small changes in production schedules.¹ It is of utmost importance to have adequate waste storage capacities at Purex to handle all conceivable production demands and to permit flexibility in semi-permanent storage of self-boiling wastes without jeopardizing production schedules, and diminishing safety regulations, or reducing operability.

PURPOSE

The purpose of this report is to present the design scope and the fundamental requirements for a new Purex waste storage tank farm to be designated as 241-AX.

SUMMARY AND CONCLUSIONS

With the guidance of this report, a project proposal should be prepared immediately for a new 10 million gallon tank farm to store indefinitely, the self-boiling Purex process wastes. The new tank farm should be ready

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1. HW-42230, "200 Area Wastes Storage Study," H. E. Hanthorn, March 27, 1956.

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for use by August 1, 1958. It should be constructed in the reserved tank farm area north of 241-A tank farm, leaving space to the north for the future 241-AY tank farm, and providing gravity flow from the 241-A-152 diversion box.

Air-lift circulators, water addition facilities, and vapor handling facilities should be incorporated into the new tank farm to control self-concentration of wastes at maximum rates of heat generation. The maximum steam generating rate for the farm has been estimated at 200,000 lbs. per hr.

The "Fundamental Requirements" for the proposed tank farm are tabulated in Appendix A from which the design criteria can be developed for detailed design.

A new, economical tank concept has been incorporated in this scope to provide complete tank filling at maximum specific gravities of self-boiling wastes while still observing the present hydrostatic head limitation. The complete economical evaluation of this tank is presented in Appendix G. Only the failure to achieve self-boiling wastes could eliminate the economical justification of this new tank.

RECOMMENDATIONS

Recommendations for the tank farm are as follows:

- (a) Prepare a project proposal from this scope document for a new 10 million gallon Purex tank farm designated 241-AX. Detailed design and construction schedule will be guided by the "Fundamental Requirements" itemized in Appendix A.
- (b) Submit the project proposal to AEC not later than September 1, 1956. Construction should commence not later than February 1, 1957 to ensure a "ready-for-use" date of August 1, 1958.
- (c) Locate the proposed tank farm north of the existing 241-A tank farm. The area north of 241-AX is to be reserved for 241-AY tank farm. The elevation of 241-AX will be governed by the elevation of the effluent lines on the north wall of 241-A-152 diversion box to provide gravity flow to the new tank farm.
- (d) Equip each of the 241-AX tanks with air-lift circulators, water addition facility, and a vapor handling facility, designed for 90,000 lbs. per hr. maximum steam generating rate for the tank.

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- (e) Construct a new proportional sampler, radiological sciences leak detection wells, control house, instrumentation and other appurtenances outlined in the "Fundamental Requirements" in Appendix A, and as required in detail design. The 241-A-201 reservoir is considered adequate for both tank farms 241-A and 241-AX.
- (f) Provide fourteen 750,000 gallon horizontal tanks similar to those scoped in SK-2-2702 designed for the maximum hydrostatic head limitation.

DISCUSSION

Plot Plan

Attached drawing SK-2-2700 shows the general location of the proposed horizontal tank farm with its appurtenances. Three of the five 3-inch stainless steel fill lines which were provided at the north side of diversion box 241-A-152 will be extended to a new similar diversion box 241-AX-152. The other two fill lines shall remain stubbed for extension to 241-AY tank farm. Each horizontal tank is provided with one fill line from the new diversion box; one 3-in. water-addition line; one 6-in. overflow line to be used only in case of overfilling; one pump pit with a 4-in. transfer line to the diversion box; and two 24-in. vapor outlets, one located at approximately each outside quarter point.

The tank farm will be provided with an independent control house, proportional sampler, vapor handling facility, the exact locations of which will be determined in the detail design. It is preferred to route cribbable wastes to the 216-A-8 crib or its junction box. Also, test wells will be provided for sampling ground water as prescribed by Radiological Sciences.

Flow Sheet

Attached drawing SK-2-2703 is the Engineer's Flow Diagram for the proposed tank farm. There is a very low and concentrated waste volume predicted for future Purex process wastes, the full realization of which could render a 10-MG tank farm capable of twenty years operating life; while the present operating waste quantities could render a 10-MG farm filled within two and a half years. The predicted waste streams will self-generate heat sufficient for concentration to complete solidification providing no prohibiting chemical reaction prevails. The rate of crystallization of the sodium nitrate will be controlled by water addition or by addition of other dilute process wastes. Compositions and characteristics of waste

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streams from Purex Chemical Flow Sheets HW #3 and HW #4 are tabulated on the drawing SK-2-2703. The sp.gr. of the waste streams vary from 1.1 to 1.2 at an initial temperature of 100° F. As the waste temperature rises, the sp.gr. increases, and eventually the salts begin to crystallize. At the saturation of sodium salts (220° F) the sp.gr. of the waste is approximately 1.5. Maximum sludge temperatures and sp.gr. cannot be accurately determined until extended operating experience is obtained from 241-A Farm. Laboratory tests on "cold runs" indicate sludge temperatures at ~4T300° F and Sp.gr. of 2.0.² Design will therefore be based on liquid Sp.gr. of 2.0 and a tank bottom temperature of 500° F

Operating Life

The 10.5-MG farm capacity is justified by the present inability to accurately predict waste volume forecasts of Purex wastes which require permanent storage. There are several studies being conducted to minimize waste volumes for permanent storage; any one of which could effect the net waste volume two or three fold. The present goal for 1961 is about 1,250 gallons per day to permanent storage while the goal for 1956 is about 4,070 gallons per day.³ The actual rate for 1956 to date is about 13,000 gallons per day. Budget studies have been based on rates from 8,000 to 11,650 gallons per day.^{4,5} If the 1961 goal is attained for the operation of this farm, a 10-MG capacity would have a fill time of 8,000 days while the present actual rates would only yield a fill time of 770 days. It may be expected that a 10-MG farm will last 1,000 days (Refer to Appendix B).

It is planned for the Purex plant to be the base load plant and therefore it will not be effected by small changes in production schedules. It is of utmost importance to have adequate waste storage capacities at Purex to handle all conceivable production demands and to permit flexibility in storage of self-heating wastes without jeopardizing production schedules and safety regulations and with a minimum of operation complexity.

- - - - -
2. BNL-343

3. Op. Cit, Hanthorn

4. HW-40698, "FY-1958 Budget Study-Separations Waste Disposal Facilities Requirements Through December 1958, D. E. Peterson, 12/29/55.

5. HW-42114, FY-1958 Budget Study - Separations Waste Disposal Facilities, V. W. Wood, 2/15/56.

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The cost of appurtenances for tank farms can be better absorbed in large tank farms. It is also conceivable that the tanks of large tank farms can be constructed for less unit cost because of flexibility of construction and use of mass-production methods, and re-use of costly formwork. Diversion boxes, vapor handling facilities, piping systems, and initial cribs, are practically a fixed cost when connecting a group of large storage tanks.

Heat Evolution

The radioactive wastes will liberate heat of varying rates and quantities depending on the degree of concentration, conditions of metal exposure, "cooling-time," processing rates, and tank farm fill time. To establish order-of-magnitude predictions for a suitable design basis, it was necessary to calculate a specific case for which the basic assumptions were as high as could be foreseen for the operating life span of the proposed tank farm. By assuming a set of highly conservative conditions, the following steam rates were calculated for the design basis of vapor handling facilities.

Maximum (Normal) Farm-Rate = 50,000 lbs. steam per hr.
Maximum (Normal) Tank-Rate = 22,500 lbs. steam per hr.

Eruption rates were approximated by a factor of four; therefore, the maximum design vapor rates are:

Maximum (Burp) Farm Rate = 200,000 lbs. steam per hour⁶
Maximum (Burp) Tank Rate = 90,000 lbs. steam per hour⁶

The maximum design rates have been increased from the reference document to facilitate the 10.5-MG tank farm capacity and the 750,000 gal. tank capacity. Independent calculations made by the author of the original rough draft of this document resulted in identical quantities for the maximum (normal) farm rate.

When the vapor handling system is designed to handle maximum burp rates for 1000-day-fill-time, the system will be sufficient to handle heat evolution rates for any conceivable increase in fill time which could be achieved through ultimate low waste volumes and maximum self-concentration benefits (Refer to Appendix C). After the tank farm has exceeded the 1000-day fill time, the total heat production of the farm increases only a very small percentage of the 1000-day-fill-time heat generation rate.

6. HW-42565, "A Design Basis for Tank Farm Vapor Systems," G. L. O'Neill, April 17, 1956.

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The design factor of safety in the burp rate and the neglected heat loss to ground more than off-set any increase in heat evolution beyond the 1000-day-fill-time.

Corrosion

A laboratory study was conducted on mild steel in simulated Purex process wastes and vapors in August 1954⁷ in which it was determined that the initial pitting corrosion rates decreased rapidly with time during the first three months of exposure. There was no significant difference between a polished steel surface, and a fine sand-blasted surface in their resistance to pitting type attack in the vapor phase. The general corrosion rates for steel exposed to vapor are less than 0.0001 inches penetration per month (ipm). The general corrosion rates for SAE-1010 mild steel exposed in the liquid/sludge phase are less than 0.0001 ipm.

A metals study was initiated in January 1955 to determine the life expectancy of the present steel liners and to evaluate the economics of low-alloy high-strength steels for future tank liner designs. Sample specimens have been installed in Redox and Purex waste storage tanks.⁸ Until results of these tests can be analyzed the assumed pitting corrosion rate for the mild steel tank liner will be 0.0006 inches penetration per month. The assumed general corrosion rate will be 0.0001 inches per month.

- - - - -

7. HW-32734, "A Laboratory Study of the Extent of Pitting and General Corrosion of SAE-1010 Steel in Simulated Neutralized Purex Process Waste Solution," N. Endow, K. L. Sanborn, August 6, 1954.
8. HW-37642, "Field Corrosion Tests in Redox and Purex Waste Storage Tanks," by N. D. Groves, W. L. Walker, M. C. Fraser, August, 1955.

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APPENDIX A FUNDAMENTAL REQUIREMENTS FOR 241-AX TANK FARM

Instrumentation has been provided in the 241-A Tank Farm to obtain design data for future tank farms.⁹ As these design data are acquired through actual operation of the Purex "A" Farm, the scope requirements used in this report can be adjusted and applied to this tank farm in the detailed design.

The fundamental requirements of the proposed tank farm shall be in accordance with the following criteria:

1. The general plot plan shall be as shown on attached drawing SK-2-2700.
2. The new tank farm shall be designated as 241-AX.
3. A total storage capacity of 10,500,000 gallons shall be provided in fourteen 750,000 gallon horizontal tanks spaced 35 ft. on centers. Each tank shall have inside dimensions of 25 ft. diameter, 211 ft. cylinder length with hemispherical heads. The overall dimensions shall be 29 ft. 8-in. diameter and 240 ft. long.
4. The tanks shall be cascaded on approximately a one per cent grade sloping away from the diversion box. Seven feet minimum earth coverage shall be provided over the tanks and fill lines. Four feet minimum coverage shall be provided over the vapor manifold.
5. The tank farm "ready-for-use" date is August 1, 1958. Eighteen months should be provided for construction.
6. The inner steel tank shall be designed for a vapor pressure equal to the hydrostatic head developed by a filled tank with a waste specific gravity of 2.0 and a bottom pressure of twice this amount. The outer concrete tank shall be designed for the liquid pressure or the earth pressure, whichever is greater.
7. The inner steel tank must be designed independent of the outer concrete tank to minimize temperature stresses in the steel plate.
8. The design temperatures shall be assumed as follows: Sludge Temperature 500° F, Supernatant Temperature 250° F, Vapor Temperature 220° F.
- - - - -
9. HW-25274, "Preliminary Specifications for Storage Facilities of Purex Salt Wastes," R. E. Tomlinson, F. W. Woodfield, 8/24/52.

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APPENDIX A (Cont'd)

9. The allowable design stresses shall be governed where applicable, by the following standards:
 - (a) Hanford Works Standards (HWS).
 - (b) American Petroleum Institute - American Society of Mechanical Engineers Standards for unfired pressure vessel (API-ASME).
 - (c) American Concrete Institute, Building Code Requirements for Reinforced Concrete (ACI).
10. All tank connections such as fill lines, vapor manifolds, overflow lines, and water fill lines must permit expansion of the steel liner.
11. Four 24-inch diameter, 1/4-inch wall, mild steel circulators shall be provided in each tank. Only minimum motive gas is required for initial starting of circulators. The structural integrity of the tank is not dependent on successful operation of these circulators.
12. Tank farm instrumentation shall include provisions for reading tank liquid level, sludge level near the pump pit, and vapor pressure. Provide instrumentation for sludge, supernatant, and vapor temperature near the longitudinal quarter points of the tank.
13. Two 4-inch, water-tight, steel-plate expansion joints shall be constructed in the concrete shell; one 4-inch expansion at each outer quarter-point. The steel liner shall be keyed to the bottom of the concrete shell at the transverse centerline.
14. A pitting corrosion rate of 0.0006 ipm and a general corrosion rate of 0.0001 ipm shall be assumed for SAE-1010 steel exposed to vapor or liquid phases of boiling Purex process wastes.¹⁰
15. The following steam vapor rates will be used for sizing vapor handling facilities for the proposed 10.5 million gallon tank farm with 750,000 gallon tanks:

Maximum (Normal) Farm rate = 50,000 lbs. steam per hr.

Maximum (Normal) Tank rate = 22,500 lbs. steam per hr.

-
10. HW-32734, "A Laboratory Study of the Extent of Pitting and General Corrosion of SAE-1010 Steel in Simulated Neutralized Purex Process Waste Solution, "N.E. Endow, K. L. Sanborn, August 6, 1954.

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APPENDIX A (Cont'd)

Eruption rates can be approximated by a factor of four; therefore, the maximum design vapor rates are:

Maximum (Burp) Farm Rate = 200,000 lbs. steam per hr.¹¹
Maximum (Burp) Tank Rate = 90,000 lbs. steam per hr.¹¹

16. Flow sheet compositions for the proposed tank farm will be similar to Purex Chemical Flowsheet HW #4, as described on the attached Engineering Flow Diagram, SK-2-27C3.
17. Raw water will be supplied to the vapor condenser for condenser cooling water. An auxiliary cooling water supply will be the 241-A-201 ground reservoir.
18. Three tie-lines shall be provided from Diversion Box 241-A-152 to a new similar diversion box 241-AX-152. The new diversion box shall be provided with three stub outlets for future tank farm; sixteen 3-inch tank fill lines, two stubbed for spares and one 3-inch stainless steel fill line to each of the fourteen 750,000 gallon tanks.
19. The 241-AX-152 diversion box shall have spray-down nozzles, and a catch tank with a jet to send waste water to crib.
20. The installation and cathodic protection of all waste lines shall be in accordance with the latest Hanford Standards.¹²
21. Each tank shall be provided with a 3-inch stainless steel fill line, 6-inch overflow line, 4-inch transfer line from the pump pit to the diversion box and two 24-inch vapor headers.
22. Integrated into the vapor header system to control entrainment and vapor flow shall be a cyclone de-entrainment vessel, contact condensers, packed de-entrainment vessel, a local stack, and a by-pass seal pot designed for the maximum burp rate of the tank farm similar to the present 241-A installation.
23. Raw water and/or dilute process wastes shall be supplied to each tank to control the rate of crystallization of sodium nitrate.

11. Op. Cit., O'Neill

12. HW-35009, "An Evaluation of Buried Waste Line Design Practice, Interim Report No. 2", R. T. Jaske, April 1, 1955.

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APPENDIX A (Cont'd)

24. Utilities to be supplied or relocated shall include raw water, steam, electric power, perimeter fence, patrol road and test wells for detecting the escape of radioactivity.
25. Flood lighting to a level or intensity of 0.5 to 1.5 candles at ground surface shall be provided.

Instrumentation

Instrumentation shall be provided on each tank for reading liquid, sludge and vapor temperatures, liquid level, and vapor pressure in the tank. The temperature is to be measured at the approximate quarter points along the longitudinal centerline of each tank. Also, an eight-inch diameter dry well will be provided in which an instrument can be lowered to detect the sludge level.

Utilities

Raw water will be required at the AX Tank Farm for the following purposes:

1. A three-inch pipe line to supply spray-down water in the diversion box.
2. A three-inch pipe line to supply make-up water in each tank on a batch basis.
3. A four-inch pipe line to supply condenser cooling water.
4. A six-inch pipe line to be used during construction work on the farm.
5. A three-inch steam line will be required for steam cleaning walls in the diversion box.

Electrical power must be supplied for the following purposes:

1. Operation of impact wrenches at 241-AX-152 diversion box, and pump pits.
2. Flood lighting of the farm.
3. Instrumentation.
4. Service for transfer pumps.
5. Cathodic protection.

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APPENDIX A (Cont'd)

6. Heat for the control building.

The woven wire fence of 241-A Tank Farm will be partially relocated and fully extended to include the new 241-AX Tank Farm in one enclosure.

Flood lighting at a level or intensity of 0.5 to 1.5 foot-candles at ground surface is to be provided in the 241-AX Tank Farm area for possible night operation. Test wells for use in detecting sub-surface activity will be required at the site of the 241-AX Tank Farm. About eight test wells are assumed adequate for the group of fourteen tanks. The exact number, and the location and depth of each is to be determined during detailed design.

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APPENDIX B
PUREX WASTE STORAGE RATES

Table 1. Bases for Purex Waste Storage Rates

Item	Conversation with Separations Technical 5/3/56 (1)	HW-42565 4/20/56 Heat Evolution Rate (2)	HW-42230 3/27/56 (3)		HW-40798 12/29/55 Budget Study (4)	Actual Rate 1/18/56-5/1/56 241-A Tk Farm (5)
			Goal Rate 1955	Goal Rate 1961		
Processing Rate (tons/day)	12	25	9	25	5,653,000 gallons of storage will be re- quired to take care of Purex wastes thru Sept. 1958 to December 1959	'A' Farm Tanks 101 & 102 filled to hydrostatic head limitation with non- boiling high-activity wastes.
Self-Conc. factor	4	4	3.5	5		
High Activity waste (gal/ton)	600	500	700	410		
Coating Wastes (gal/ton)	250 to 'C' Farm	None	250	0		
Permanently Stored Waste (gal/day)	4800	3120	4070	1250		
					11,650	13,200

The above bases were used to plot the curves in Fig. 1.

The high storage rates during the first quarter of 1956 were attributed to unsuccessful self-concentration and to instability of new plant operation. These rates have been greatly reduced since May 15, 1956, and are itemized in Column (1). With successful self-concentration, cribbing of coating wastes, and in-plant flowsheet improvements, it will be possible to attain the 1961 goal rate of 1250 gallons per day. The realization of this goal rate entails many uncertainties and complex problems; some of which may never be solved satisfactorily. The reduction of the tank farm storage capacity on these unproven bases would seriously jeopardize production schedules and operating safety.

Fig. 1, compares the fill-rate of a 10-million-gallon farm with those of Table 1. Assuming a 1000-day-fill-time, the fill-rate would be 10,000 gallons per day. This rate is just a little less than the rate for the first quarter of 1956 and requires some achievements in reduction of waste volumes. The rate is conservative for determining the size of a new farm. Assuming a 4000-day-fill-time, the fill-rate would be 2500 gallons per day which is less than the rate used for heat evolution calculations, but greater than the goal rate for 1961. A 10-million-gallon farm filled at the rate used for heat evolution calculations would have a fill time of 3200 days.

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APPENDIX C

PUREX HEAT EVOLUTION RATES

Bases for the heat evolution rates of Purex wastes in Fig. 2, for the proposed 241-AX tank farm were obtained from document HW-42565. The bases are considered highly conservative and vapor handling facilities designed for these steam generating rates are considered adequate. The rates given below have been increased from those of document HW-42565 to provide for a 10.5-million-gallon tank farm consisting of fourteen 750,000-gallon tanks.

Maximum (Normal) Tank Rate = 22,500 lbs. steam per hr.

Maximum (Normal) Farm Rate = 50,000 lbs. steam per hr.

Eruption rates are approximated by a factor of four; therefore the design vapor rate will be:

Maximum (Burp) Tank Rate = 90,000 lbs. steam per hr.

Maximum (Burp) Farm Rate = 200,000 lbs. steam per hr.

(Maximum Vapor Header Rates)

If it could definitely be shown that lower MWD/T material were to be processed at a lower production rate during the entire life of the farm, these design rates could be proportionally reduced.

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Bases
 8AW/T
 800 LWD/T
 90 Day Cooling Time
 3.0 Capacity Factor
 100% Efficiency
 500 gal/tor U Waste Volume
 4:1 Self Concentration
 14 - 750,000 gal Tanks
 10.5-MG Tank Farm

FIG. 2
 GROSS HEAT EVOLUTION
 PUREX PROCESS

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02)
 8 30 9 10 11 12

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APPENDIX D

SK-2-2700	- Purex Waste Facility, Plot Plant	Page 21
SK-2-2702, Sh. 1 and 2	- Purex Waste Facility, Waste Storage Tank	
SK-2-2703	- Purex Waste Facility, Engineering Flow Diagram	24

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QTY. DESCRIPTION HW 43561 R/S
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- LEGEND**
- C — 3.0 KV ELECTRICAL
 - CM — COOLING WATER
 - CW — RAW WATER
 - CWM — CONDENSABLE WASTE LINE
 - WLM — WASTE COOLING WATER
 - PML — PROCESS WASTE LINE
 - SC — STEAM CONDENSATE
 - CS — CHEMICAL SPOUR
 - — POWER POLE
 - NS — WASTE CONDENSATE

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U. S. ATOMIC ENERGY COMMISSION HANFORD ATOMIC PRODUCTS OPERATION GENERAL ELECTRIC			
PUREX WASTE FACILITY PLOT PLAN			
SK-2-2700		SK-2-2700	

PUREX PLANT
SCOPE

SK-2-2700	AWA. ALUM. BUREAU
SK-2-2700	WASTE TREATMENT SEC. 7 DISTRICT
DATE 12, 470	DESIGNED BY
DATE 12, 470	DATE 12, 470
REFERENCE DRAWINGS	

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HW 43561 RD
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NOTES

1. TANK DESIGN:
MINIMUM EARTH COVER - 7'-0"
INTERNAL VAPOR PRESSURE - HYDROSTATIC HEAD OF WASTE.
3000" CONC. & INTERMEDIATE GRADE W-11L BARS.
STEEL TANK: ASTM A7 STD. CARBON STEEL.
2. WASTE CHARACTERISTICS:
IN GR. 20
MAX. TEMP. - 600°F.
VAPOR TEMP. - 270°F.
3. TANK TANK CHARACTERISTICS
TANK TANK CAPACITY - 10.5 MG.
TANK L.S. - 50'-0", LENGTH - 115'-0"
14 - 140,000 GAL. TANKS
4. GROUT BETWEEN STL. PLATE LINER AND CONCRETE SHELL WITH
LIGHT-WE AGGREGATE MORTAR. (TYPICAL STRENGTH - 1500 PSI - 70 MPa)

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NOT FOR CONSTRUCTION

SCOPE

REVISIONS		DATE		BY	
=SK-2-2702		1		2	
NONE		K. H. H. H.		S. H. H. H.	
SCALE: 1/4" = 1'-0"		1/4" = 1'-0"		1/4" = 1'-0"	
17600		17600		17600	
U. S. ATOMIC ENERGY COMMISSION HANFORD ATOMIC PRODUCTS OPERATION GENERAL ELECTRIC					
PUREX WASTE FACILITY WASTE STORAGE TANK SECTIONS & DETAILS					
=2411A		=SK-2-2702		1	

STEEL LINER

INSIDE TANK FACE

GRANITE

END PIECE OF TANK (5)

TO 241AX-
152 BLDG.

ANCHOR 6

LONGITUDINAL SECTION OF TANK FARM 8
1" = 20'-0"

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SK-2-2702	PLOT PLAN
DATE	DRAWING TITLE
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PUREX WASTE FACILITY WASTE STORAGE TANK SECTIONS & DETAILS			
SK-2-2702		2	2

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REVISIONS

ENGINEERING FLOW DIAGRAM

PUREX WASTE FACILITY

GENERAL ELECTRIC

U. S. ATOMIC ENERGY COMMISSION

MANFORD ATOMIC PRODUCTS OPERATION

SCALE: 1/8" = 1'-0"

DATE: 1/25/54

BY: [Signature]

CHKD: [Signature]

APPROVED: [Signature]

FIG. 2-9

SCOPE

THIS DOCUMENT CONTAINS DESIGN DATA
FOR THE CONSTRUCTION OF THE FACILITY
AND THE EQUIPMENT TO BE INSTALLED THEREIN.
IT IS THE RESPONSIBILITY OF THE DESIGNER
TO SEE THAT THE DATA ARE CORRECT
AND THAT THE FACILITY IS CONSTRUCTED
IN ACCORDANCE WITH THE DATA.

ITEM	DESCRIPTION	UNIT	QTY	PRICE	TOTAL
1	STEEL JOIST	LB	100	0.15	15.00
2	STEEL JOIST	LB	100	0.15	15.00
3	STEEL JOIST	LB	100	0.15	15.00
4	STEEL JOIST	LB	100	0.15	15.00
5	STEEL JOIST	LB	100	0.15	15.00
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99	STEEL JOIST	LB	100	0.15	15.00
100	STEEL JOIST	LB	100	0.15	15.00

BASIS: ONE TON METAL INTO PROCESS PLANT

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DESCRIPTION

QTY.

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APPENDIX E

PROJECT COST ESTIMATE

The Estimating Unit of Project Section, has estimated the complete new 241-AX tank farm at \$5,000,000. This total project cost includes all Design and Administrative, and contingency additives. The cost of the tank farm appurtenances such as the diversion box, sampler building, control building, ventilation building, all utilities, cribs, and all pipe lines, was extrapolated from 241-A tank farm costs and then escalated for future labor and material costs. The tank structure cost was estimated from SK-2-2702, Sheets 1 and 2.

This "high-spot" estimate is believed to be high to provide adequate funds for the construction of 241-AX tank farm. If this farm is constructed next year in accordance with this document, then a competitive bid based on detailed design should be less than \$5,000,000.

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APPENDIX F
DESIGN LOADS

Hydrostatic Head

The "hydrostatic head limitation" defines a severe internal loading condition that develops when deep tanks are filled with high Sp.gr. wastes. This loading has been defined in HW-37207,---"Analysis has shown, however, that regardless of the amount of stored heat in the tank, any liquid layer at the base of the tank, if suddenly transported to the top, cannot produce a vapor pressure on flashing into steam that will exceed the hydrostatic head to which it was subjected prior to turnover."

To economically design for the "hydrostatic head limitation" it is necessary to do two things: (1) The liquid depth must be kept to a minimum because the area of the internal pressure diagram varies as the square of the liquid depth. (2) The roof span must be kept to a minimum because the moment stress varies as the square of the span. Fig. 3 illustrates the effect when the liquid depth has been decreased to one half and the span has been decreased to one third, which is similar to comparing 241-SY liquid depth and roof span to those of the horizontal tank. In this example the moment stress in the dome of 241-SY is 18 (K_1/K_2) times the moment stress in the horizontal tank of shorter span and lesser liquid depth. K_1 and K_2 are constants derived from the geometry of the roof slab.

The net upward pressure for a 20-ft. storage depth of 2.0 Sp.gr. waste is 1500 lb. per sq. ft. which is about three times the floor design loading for industrial warehouses and about 50 times the design loading for conventional roofs. The internal loadings require the lower walls of a tank for Purex waste storage to be designed for four times the pressure of conventional water reservoirs having the same liquid depth. These loadings are greater than those common to the vertical tank type of structural geometry. It is also conceivable that the maximum practical dimensions for any type of container storing wastes at these pressures are ~50 ft. diameter, and ~20 ft. liquid depth. The capacity of a vertical container of these dimensions is only 300,000 gallons. This small tank capacity is not desirable because of the complex connecting piping systems that would be required on a 10-MG tank farm. More important, the small container would have a short fill time which would inhibit self-concentration.

The concrete shell is designed for the internal liquid pressure or the earth pressure, whichever is the greater. During the operable life time of the tank farm the concrete shell must support only the earth pressures. The inner steel tank is designed for all internal pressures. After years of service the liner could possibly have a corrosion failure, at which time the concrete shell must be capable of taking only the liquid pressure assuming the waste has completed its self-concentration and all potential burping has ceased.

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Fig. 3 Effect of Liquid Depth and Roof Span on Design Loadings

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APPENDIX F (Cont'd)

Temperatures

During the life span of 241-AX, Purex wastes could commence boiling within 30 days of initial tank usage. As the waste self-concentrates, sludge and vapor temperatures could approach 500° F and 220° F respectively. The massive concrete shell will heat gradually while the inner steel tank will heat almost instantaneously to the temperature of the stored waste. Temperature gradients will be formed through the structural material and the surrounding soil with the most critical gradient being vertical through the roof slab and the moistened earth-fill to the atmosphere. It is important to design for the temperature stresses in the steel tank. This can best be accomplished by providing independent deformation between the concrete tank and steel tank.

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APPENDIX G
TANK COMPARISON STUDY AND COSTS

Comparable Costs

Two approaches were made for the economical evaluation of tanks analysed in this report with existing 241-A tanks, from which it will be possible to determine the approximate cost of the "hydrostatic head limitation." The first approach was to compare the unit cost of tanks on the basis of "tank structure cost per gallon of waste stored" when observing the hydrostatic head limitation (Fig. 4). The second approach was to compare the unit cost of tanks on the basis of "tank structure cost per gallon of waste stored" when neglecting the hydrostatic head limitation (Table 2).

The cost of the "hydrostatic head limitation" is less than the four cents per gallon shown in Table 2. The inner steel tank of 241-A, for future boiling wastes, must be designed to support the internal loads as well as providing for corrosion-thickness and water-tightness which would increase appreciably the 17¢ per gal. The unit cost of the horizontal tank was 21¢ per gal. when designing for the hydrostatic head limitation and temperature stresses. If the hydrostatic head limitation could be reduced, so could this unit cost. Therefore, estimated cost of the "hydrostatic head limitation" is less than two cents per gallon when using the horizontal tank (approximately five per cent of the total tank farm project cost).

The present true cost evaluation for storage of self-boiling, high-activity wastes is illustrated in Fig. 4, which observes the "hydrostatic head limitation" as it is presently applied in Purex operations. As the waste self-concentrates, the specific gravity increases which directly limits the liquid depth to which 241-A can be filled because of the 10 lbs. per sq. in. allowable dome pressure. The scoped tanks are designed for the maximum internal pressures at specific gravity of 2.0 which is achieved at self-concentrations greater than 5:1 in Purex wastes. In Fig. 4, the horizontal tank provides the most economical storage facility.

The bases for determining the unit cost of each tank is tabulated in Table 2. The unit costs are based on the material quantities and the cost of fabrication to provide the storage tank. Other tank farm costs such as pipe lines, diversion box, cribs, vapor handling system, test walls, etc., have been excluded from the tank structure cost.

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APPENDIX G

Table 2. Bases for Tank Structure Unit Cost

Tank	Type A	Type B	Type C	Type D	Type E
Tank Structure Cost (cents per gal) (1)	21	45	39	30	28
Farm Area (acres) (2)	4.5	11.3	5.8	6.5	10.4
Depth of Excavation (feet) (2)	37	54.5	57	41.5	44.6
Excavation (cu.yd.) (2)	208,000	762,000	400,000	315,000	584,000
Backfill (cu.yd.) (2)	136,000	549,000	163,000	237,000	390,000
Carbon Steel Plate (tons) (2)	(3)		(3)	(3)	(3)
(a) Gtr than $\frac{1}{2}$ " thk	(a) None	(a) None	(a) 3500	(a) 3200	(a) 1030
(b) Less than $\frac{1}{2}$ " thk	(b) 1650	(b) 2820	(b) None	(b) 465	(b) 840
Structural Concrete (cu.yd.) (2)	25,600	35,000	30,000	14,500	27,800
Reinf. Steel (tons) (2)	4,000	4,950	2,730	2,200	3,940
Tank Structure Cost (4) (cents per gal)	21	17	39	30	28

Assume

- (1) Tank Structure cost per gallon of waste stored when observing the hydrostatic head limitation.
- (2) Estimated material quantities for a 10-million-gallon tank farm when observing the hydrostatic head limitation.
- (3) Steel quantities are for structural requirements only; corrosion requirements must be added in final design.
- (4) Tank structure cost per gallon of waste stored when neglecting the hydrostatic head limitation.

Type A Horizontal Tank, 25 ft. Diameter

Type B 241-A Tank, 75 ft. Diameter

Type C Steel Spheroids in a Concrete Vault, 48 ft. Diameter

Type D Vertical Concrete Tank with inner steel tank, 75 ft. Dia.

Type E Vertical Concrete Tank with inner steel saucer, 100 ft. Dia.

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APPENDIX G

Note for Fig. 5 (Opposite Page)

Fig. 5 is a sketch of the horizontal tank scoped on drawing SK-2-2702 and is the most desirable tank for the new tank farm, 241-AX. All of the structures discussed in these following sketches have been scope-designed for the cost comparisons in Table 2, and Fig. 4. Detail design will be performed by Design Section. All structures except Type B, the 241-A Tank, were designed for the hydrostatic head limitation and independent deformation in the steel tank.

There were three basic types of horizontal tanks analysed as follows: (1) The double tank of steel plate and reinforced concrete illustrated in Type A. (2) An all-steel tank buried directly in the earth. (3) An all-steel tank encased in a reinforced concrete vault similar to Type C. Various sizes of these types were reviewed and it was found that the larger diameters were more economical providing special construction methods were not required. The study resolved that a tank of the dimensions shown in Fig. 5 were about maximum for conventional construction methods and therefore is the most economical to construct.

The steel plate thickness required to support the heavy external load rendered the all-steel tank more costly than the selected tank in Fig. 5. If the internal pressures were to be increased, then the all-steel tank would be more competitive.

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TYPICAL LONGITUDINAL SECTION

1 DUMP PIT 2 EXP. JOINT 3 VAPOR HEADER

TYPE "A"
HORIZONTAL TANK

FIG. 5

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Notes for Fig. 6 (Opposite Page)

Fig. 6 is the existing 241-A tank. An evaluation of this tank is presented in document HW-37519. Reference drawings H-2-55911, H-2-55912, H-2-55913 were approved for construction in October and November 1953. The hydrostatic head limitation and temperature requirements have been incorporated since that date. Inclusion of the tank in this Appendix is to provide a comparison of the requirements of self-boiling high-activity wastes from the Purex process. The material quantities in Table 2, Type B, are for 26 tanks to provide 10 million gallons of storage for self-boiling wastes under the hydrostatic head limitation.

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5 0 5 10
SCALE - FT.

TYPE "B"
EXISTING 241-A TANK

FIG. 6

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Notes for Fig. 7 (Opposite Page)

Fig. 7 is a sketch of steel spheroids enclosed in a reinforced concrete vault. An evaluation of this tank was presented in D.O. 101316. By supporting the heavy earth loads with the concrete vault it was possible to use thin-wall steel pressure tanks to contain the internal pressures. However, the volume of the massive reinforced concrete vault is four times the storage capacity of the tank farm. This inefficient storage space plus the massive concrete and difficult shoring to form the roof system render it too expensive. A horizontal tank in this type of construction utilizes about 40 per cent of the vault space; but still it is more costly than Type A.

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P L A N

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D. O. 1 0 1 3 1 6

F I G. 7

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APPENDIX G

Notes for Fig. 8 (Opposite Page)

Fig. 8 is a modified 241-A tank. The inner steel tank is independent of the outer reinforced concrete tank to provide for temperature deformations. The liquid depth has been decreased to reduce the vapor pressure and a steel dome has been added to allow filling above the major axis of the dome. The steel tank is designed for the internal pressures while the concrete shell is designed for the earth pressure or liquid pressure, which ever is greater.

There is less reinforced concrete used in this tank than in the horizontal tank. However, the thick steel plate required for the vertical walls and the dome, and the cost of steel fabrication in the dome render this vertical tank more costly than the horizontal tank.

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TYPE "D"
VERTICAL TANK
FIG. 8

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APPENDIX G

Notes for Fig. 9, (Opposite Page)

Fig. 9 is a modified 241-A tank. The diameter has been increased from 75 ft. to 100 ft. and the liquid depth reduced to a depth not to exceed the hydrostatic head limitation. The steel saucer supports the internal load while the dome supports the earth load or the *vapor* pressure, whichever is the greater. In this way it is possible to eliminate the expensive steel plate dome construction; however, the formwork and massive concrete for the concrete dome render it more expensive than the horizontal tank. The larger vapor space provides better gas flow and would be desirable if the tank were not so expensive.

The concrete dome is 18 inches thick at the crown, and increases to a maximum thickness at the haunch to provide adequate concrete coverage and bond for the reinforcing steel. Formulas used for stress calculations in the dome have been obtained from the Portland Cement Association pamphlet PCA-ST-55, 11-53. The PCA formulas are derived from the theory of thin plates and shells in which the shells are so thin that they cannot develop bending moment, yet so thick that there is no danger of buckling. It is also assumed that the shells support light loads over long spans. Therefore, the stresses calculated from these formulas for this dome carrying these heavy loads may not be representative of the actual stresses in the dome and material selections for final design on these bases is cautioned.

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APPENDIX H

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Horizontal Tank Characteristics

The evaluation of the "hydrostatic head limitation" resulted in the development of an unusual concept of a pressure vessel which in this report is designated a "horizontal tank." It is similar to a pressure vessel with comparatively low pressure and large volume. It is designed as a large diameter aqueduct about 240 ft. long with hemispherical steel bulkheads inside of a concrete shell with an outside diameter slightly less than 30 ft. Fourteen 750,000-gal. horizontal tanks buried in two parallel rows of seven tanks each lying side by side on 35 ft. centers with a minimum earth coverage of seven feet are connected with stainless steel fill lines from the conventional diversion box to provide a 10.5-million-gallon tank farm.

Observing the "hydrostatic head limitation," the maximum internal pressure in the horizontal tank is equivalent to a hydrostatic pressure of 80 ft. of water. This pressure is considered the upper economical limit for large diameter, unlined, reinforced-concrete aqueducts.¹³ If the structure has a watertight lining it is economical to triple this hydrostatic pressure.

The Soap Lake Siphon constructed by the Bureau of Reclamation during 1950, consisted of a low pressure section of 25 ft. inside diameter, unlined reinforced concrete pipe and a high pressure section of 22 ft.-4 in. inside diameter, steel lined, reinforced concrete pipe.¹⁴ The design loads and dimensions of the horizontal tank are well within the limits of those for conventional aqueduct designs.

The tank consists of a reinforced concrete shell which encloses the carbon steel plate liner and an insulating material which can be applied before or after the installation of the liner. The liner is keyed at the bottom into the concrete shell at the transverse centerline. Also, the liner must be temporarily braced during construction. As the tank heats up, the liner is allowed to expand eight inches longitudinally. Two 4-inch expansion joints are provided in the concrete shell, one at each outside quarter point which tend to close as the concrete shell expands longitudinally. Transverse deformation of the steel plate is cushioned, but not prohibited by the insulating material and prevents direct contact between the steel plate and the concrete shell.

Larger capacities can be obtained in horizontal tanks more economically than vertical tanks when designing for the hydrostatic head limitation by increasing its length, which is independent of the governing pressures

13. "Soap Lake Siphon of the Col. River Project, Wash., USA." Engineer, 1/12/51.

14. Ibid.

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APPENDIX H (Cont'd)

illustrated in Fig. 3. The length of the horizontal tank is governed by total temperature deformation in the steel tank and the concrete shell. A 750,000-gal. storage capacity is about the maximum size for economical construction methods and for provision of thermal expansion.

Other merits of the horizontal tank are as follows: (1) The horizontal tank, with no abrupt radii, is inherently better adapted for circulation of wastes to prohibit "hot-spots" in uncirculated sludge. (2) The horizontal tank is inherently more resistant to earthquake and bomb-blast. (3) The horizontal tank provides a steel plate corrosion barrier for all phases of the stored waste (vapor, supernatant and sludge). (4) The horizontal tank permits corrosion on only one side of the steel plate while it is conceivable to obtain moisture on both sides of the liner in Types B, C, and E. (5) The horizontal tank provides an insulating media between the steel plate and the concrete shell, *which reduces considerably the thermal stresses in the concrete.*

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BIBLIOGRAPHY

1. Davis, C. V., Handbook of Applied Hydraulics, Second Edition, M McGraw - Hill Book Co., 1952.
2. Preist, H. M., J. A. Gilligan, Design Manual for High Strength Steels, United States Steel Corporation, 1954.
3. Smith, E. F., Undocumented letter entitles "241-SY Waste Storage Facility," Design Section, December 28, 1955. (D.O. 101316).
4. BNL-343, "Feasibility of Concentrating Savannah River Plant Wastes in Existing High level Storage Tanks," Summary Report #1, May, 1955.
5. HW-25274, "Preliminary Specifications for Storage Facilities of Purex Salt Wastes," R. E. Tomlinson, F. W. Woodfield, 8/24/52.
6. HW-28217, "Heat Generation in Radioactive Wastes," A. M. Platt, July 28, 1953.
7. HW-31000, "Purex Technical Manual," HAF0, March 25, 1955.
8. HW-31373, "Purex Chemical Flowsheet HW #3," R. E. Smith, April 6, 1954.
9. HW-35225, "Purex Chemical Flowsheet HW #4 - Increased Purex Plant Capacity," R. E. Smith, March 4, 1955.
10. HW-36791, "Instantaneous Capacities - Separations Plants 1955-1960," May 20, 1955.
11. HW-36920, "Future Power Levels of Hanford Piles," May 13, 1955.
12. HW-37207, "Storage of High Activity Wastes," R. E. Tomlinson, July 8, 1955.
13. HW-37319, "Future Separations Capacity," July 1, 1955.
14. HW-37519, "Structural Evaluation Underground Waste Storage Tanks," E. F. Smith, June 23, 1955.
15. HW-40698, "FY-1958 Budget Study - Separations Waste Disposal Facilities Requirements through December 1959," D. E. Peterson, December 29, 1955.

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