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DATE January 12 1959

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

THE SELF-CONCENTRATION OF HIGH LEVEL PUREX
WASTES IN THE HOT SEMIWORKS WASTE CONCENTRATION

JAN 20 1959

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by R. J. Sloat

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THE SELF-CONCENTRATION OF HIGH LEVEL PUREX WASTES

~~IN THE HOT SEMIWORKS WASTE CONCENTRATOR~~

By

R. D. DeWitt
and
R. J. Sloat

Chemical Development Operation
Chemical Research and Development Operation
HANFORD LABORATORIES OPERATION

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RICHLAND, WASHINGTON

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THE SELF-CONCENTRATION OF HIGH LEVEL PUREX WASTES
IN THE HOT SEMIWORKS WASTE CONCENTRATOR

1.0 INTRODUCTION

Prior to the startup of the Purex Plant it was considered desirable to study the "self-concentration" of wastes likely to be encountered in the Purex waste storage system. Consequently, a 39-inch diameter 35-foot high tank was built at the Hot Semiworks. This tank was designed to represent a core of the 75-foot diameter Purex waste tanks. During the period of Purex testing at the Hot Semiworks the tank was filled with "typical" Purex waste and self concentration phenomena were studied.

As pertinent data were developed from the studies it was informally transmitted to interested parties for use in establishing safe waste storage criterion for the Purex system. This document summarizes the Hot Semiworks waste self-concentrator basic data. No attempt has been made to cross-correlate this data with actual Purex experience although data are sufficiently detailed to permit calculation of such correlations.

2.0 SUMMARY AND CONCLUSIONS

The adiabatic Hot Semiworks 39-inch diameter 35-foot deep tank was built to simulate waste storage tank conditions likely to develop in the core of a 75-foot diameter Purex self-concentrating waste storage tank (approximately 1/530 scale). The tank when filled with waste (approximately 18-feet-of liquid depth) had a fission product heat generation rate of approximately 9000 Btu/hr. With continued boiling a layer of sludge developed on the bottom of the tank. As was indicated by temperature and radiation profiles taken of the tank, this sludge layer contained a large fraction of the fission products. This sludge layer was evidently either a thick or crystalline mass. It did not "fluidize" during "bumping" nor was it possible to disrupt the sludge when a force of approximately 500 lb per square inch of agitator contact area was applied.

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Soon after the tank was filled a phenomenon called "bumping" occurred. Periodically sensible heat was stored in the solution within the tank with successively higher solution temperatures measured at greater solution depths. When a temperature differential of approximately 20 to 25 F was obtained in the homogeneous solution above the sludge an unstable tank condition was reached and the tank "bumped", i.e., steam was rapidly evolved and the solution was essentially homogenized. With the rapid evolution of steam during a "bump", pressure was generated in the vapor space above the boiling liquid. With the tank vapor handling system, maximum pressures of 55 inches of water were attained. In the "Hot" Semiworks experiments no definite correlation could be observed between vapor-relief-system-piping-resistance to peak bump pressures. Pressures of approximately 50 inches of H_2O were achieved with either the 1/2-inch or the 1-1/2-inch valve system used. However, with the 1-1/2-inch valve opening the bump was generally dissipated quicker.

In the Hot Semiworks studies, bumping appeared to be a function of the liquid level in the tank. Bumping ceased when the liquid level in the tank got under 9 feet during the final tank boildown operations. Although no mathematical correlation was possible bumping was more pronounced at higher liquid levels.

Temperatures in the tank were highest in the sludge layer. These temperatures increased as: (1) additional waste was added to the tank and sludge scavenged fission products, (2) and as the fission product heat was concentrated in a smaller volume during boildown operations. Sludge temperatures increased from 220° early in the studies to 350 F when studies were completed and the adiabatic heaters were shut off.

With the deentrainment and condenser system available, very little waste carry-over was noted. Condensate decontamination factors of greater than 10^6 were obtained throughout the test period.

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3.0 EQUIPMENT

The Semiworks waste self-concentrator consists of: (1) a buried test waste tank designed to simulate the core of the large, 75-foot diameter, Purex waste tanks; (2) auxiliary equipment and instrument transmitters located in two vaults; and (3) controls and readout instruments located in a control building. See Figure VI.

3.1 Waste Tank

The test tank is a mild steel, vertical tank 39 inches inside diameter and 35 feet high. The top of the tank is 13 feet below grade level. The backfill over the tank serves as shielding.

In an effort to obtain conditions approaching those at the core of the large plant tanks, an attempt was made to make the test tank adiabatic with respect to radial heat transfer. There is a 2-1/2-inch layer of fiber glass lagging around the tank. Surrounding the insulation are six pairs of calrod heating elements. The heating elements can be controlled to maintain a given positive, negative, or zero temperature differential across the insulation layer. The top and bottom of the tank are not insulated nor heated. The tank, insulation and heaters are encased as a unit in a steel caisson six feet in diameter.

Openings to the tank include a 2-inch fill pipe, a 3-inch vapor outlet, a 4-inch dip tube nozzle, a 3-inch sealed test well, and two 8-inch access nozzles. The test well and access nozzles, with plugs, extend to above level.

The tank is fitted with five concentric-shaft manually-operated, paddle agitators. Each agitator may be operated independently of the others.

3.2 Auxiliary Equipment

A three-inch, heated and insulated vapor line runs from the tank to the equipment vault. At that point, there are two parallel air-operated valves in the vapor header. One valve has a 1/2-inch plug and seat and the other valve has a 1-1/2-inch plug and seat. Scaling down from plant waste systems, the valves roughly correspond to 12-inch and 36-inch vapor headers, respectively.

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After the valves the vapor passes through two parallel condensers. The condensers are of the double pipe, water cooled type. The condensate then drops by gravity to a 55-gallon drum "distillate tank". The distillate tank can be drained either to a crib or back to the waste tank. ~~Originally, the piping layout permitted the alternate valving of the condensate to the waste tank directly from the condenser by-passing the distillate tank. However, the by-pass system was removed during the last modification to the system.~~

The condenser and the distillate tank vent to a common off-gas system. The off-gas system includes a water-cooled cooler and a fiberglass filter. The system is finally vented to atmosphere.

A sampler system is provided so that distillate samples can be taken without entering the equipment vault.

3.3 Instrumentation

The waste tank is instrumented to permit measurement of temperatures, pressure, and liquid weight factor. There are 24 pairs of thermocouples which determine the temperature across the waste tank insulation. Six of these pairs serve as the input to the differential temperature recorder-controller which controls the calrod heaters. There are six thermocouples located to measure the temperature at the caisson wall. Seven air purged dip tubes located at different levels in the tank are used for weight factor and specific gravity measurements. The air used to purge the dip tubes was heated and saturated with water to minimize plugging of the tubes. An eighth tube located at the top of the tank was used for sensing pressure. Both the weight factor and pressure were recorded on a circular chart. In addition, vapor space pressures greater than two inches of water were recorded on a high speed strip chart.

Distillate flows over 100 ml/min were measured by a transmitting rotameter and recorded. Distillate flows less than 100 ml/min were determined over a period of

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time from the change in liquid level in the distillate tank. An air purged dip tube monitored the distillate tank liquid level.

Auxiliary instrumentation provided for temperature measurements of the vapor header, the vapor, the distillate, and the off-gas, as well as the condenser influent and effluent cooling water temperatures. The condenser cooling water flow rate was metered by an indicating rotameter.

Since the waste self-concentrator control building is separate from the main Hot Semiworks control room, an alarm system was installed in the main control room. This system was actuated by a waste self-concentrator instrument air failure, high waste tank pressures, or high temperature differential across the waste tank insulation.

Besides the alarm system there was a safety system actuated by the off-gas temperature. The system was set to turn off all the waste tank calrod heaters and the vapor header heater if the off-gas temperature reached 175 F. If the temperature were to have risen to 195 F, a 55 gallon drum of deluge water would have drained to the waste tank.

4.0 OPERATION

The first radioactive waste was put into the tank in May 1955. The tank heaters were set to just balance the heat losses to the ground. Additional waste was added to the tank periodically. Thirty-five days after the initial addition the tank contents reached boiling and distillate began to condense and collect. The first sudden pressurization of the waste tank, commonly referred to as a "bump", occurred 39 days later. The last addition of radioactive solution was made in March 1956. The last bump occurred in March of 1957. In July 1957, the tank heaters were turned off and the tank contents were allowed to cool through heat lost to the ground.

A chronological summary of the waste concentrator operation is presented in Table 1.

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4.1 Waste Tank Contents

All additions to the waste tank are listed in Table II. A total of 2,130 gallons of neutralized Purex LWV solutions were added to the tank. Ninety-one gallons of flush solutions were also added. In addition, 583 gallons of distillate were returned to the waste tank.

The neutralized LWV added to the tank contained 6,365 pounds of sodium nitrate plus 1,440 pounds of excess sodium hydroxide. The solution also contained 61 pounds of uranium and 46 grams of plutonium.

The fission products contained in the LWV came from 13,321 pounds of irradiated uranium. Of that uranium, 5,442 pounds had been exposed to 866 MWD/T and the other 7,879 pounds to about 250 MWD/T. The pile power level in both cases was approximately 4 MW/T. The age of the fission products from date of pile discharge to addition to the waste tank ranged from 123 days to 182 days.

4.2 Operating Variables

Very few operating variables were changed during the two years that the tank was boiling. The liquid weight factor dip tube in service was changed as required to monitor the liquid level in the waste tank. Repeated blowing of the dip tubes was required to remove concentrate plugs. The humidifier, installed to heat and saturate the purge air with water, helped but did not eliminate the plugging problem. In fact the frequency of plugging increased as the waste concentrated. Finally, in March 1957 during final boildown operations, the immersed dip tubes plugged permanently. The air purge rate to the dip tubes when unplugged, was adjusted to a value from 0.2 to 1.0 SCFH per dip tube in an attempt to determine if the air rate was a factor in bumping.

The effect of vapor header size on bumping was studied by opening the large and/or small vapor header valves.

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In the fall of 1955 it was determined that just maintaining a zero temperature differential across the waste tank insulation was not adequately compensating for the ground losses. Therefore, the temperature controller was adjusted to maintain the outside of the insulation approximately 8 F warmer than the inside. On one occasion, the tank heaters were out of service for eleven days due to water in the conduit. The situation was corrected by air purging the conduit.

On two occasions, the vapor header heaters burned out. While the heaters were out to service, all the distillate condensed in the header and refluxed to the tank except during bumps. Generally, the distillate collected was discarded to a crib. However, between June and November 1956, all distillate collected was transferred back to the waste tank in 100 to 150 liter batches. Thus, a fairly constant hydrostatic head was maintained in the waste tank during that five month period.

Periodically, a radiation profile of the waste tank was obtained by inserting a probe down the 3" sealed test well.

In March 1957, the manual agitators were operated for the first time. The top four agitators which were in air or supernatant liquid turned without too much difficulty. However, the bottom one, believed imbedded in sludge, would not turn. Finally, the shaft sheared under the applied stresses. The waste tank instrumentation did not show any effects from turning the agitators.

5.0 RESULTS

The results of the two-year study on the self-concentration of Purex wastes are presented in Figures I through V and Table III.

Figure I includes plots of the waste tank hydrostatic head, liquid level, sludge depth, and sodium ion concentration. The plot of hydrostatic head vs time was obtained from a weight balance on the waste tank. (Weight of solution added minus weight of distillate removed divided by the tank factor, pounds of water per foot, equaled the hydrostatic head in feet of water.) Because of the dip tube plugging problem the

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hydrostatic head as indicated by the weight factor recorder was inconsistent and has not been presented. The liquid level curve was plotted from values based on calculated specific gravities. No correction was made for volume changes as a result of concentration, therefore the liquid levels calculated were only approximate. The sodium ion concentration curve is fictitious in that the values were based upon the assumption that the waste remained homogeneous. However, the sodium ion curve does serve to indicate the degree of concentration at any time during the study. The sludge depth plotted in Figure I was obtained from the radiation profiles that were taken periodically.

Also included in Figure I are the graphic representations of the following operating variables: operating weight factor dip tube location, dip tube purge air rate, periods during which the heaters were off, and which vapor header valve was open.

The fission product theoretical heat generation curve, gamma intensity at the bottom of the tank, and the distillate collection each month are presented in Figure II. The "Fission Product Heat Generation Tables"⁽¹⁾ were used to calculate the heat generation curve. Basis for the curve was the irradiation history of the fuel elements which produced the fission products put into the waste tank. The curve showing the gamma intensity at the bottom of the tank was obtained directly from the various tank radiation profiles. The amount of condensate collected each month is represented on the bar graph in Figure II. Of the total of 9864 liters of distillate collected, 2203 liters were returned to the waste tank. The remainder was discarded.

Figure III is a plot of the radiation profile of the waste tank taken December 27, 1955. The plot is typical of all the radiation profiles taken of the tank. The profiles were taken by the Irradiation Testing Operation, IPD. Except for the December 1955 profile, all the radiation profiles were reported separately⁽²⁾⁻⁽⁷⁾. From these radiation profiles, sludge accumulation and liquid levels can be approximated.

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A summary of the bumping history of the waste is given in Table III. The values listed under column 1 were peak pressures. Generally, the peak pressure lasted for only a fraction of the time listed in column 3. The times listed in column 3 were for ~~the total time that the pressures remained above 1" of H₂O. A typical pressure curve~~ for a bump is shown in Figure IV. Repeated sticking of the rotameter in the distillate line made it necessary to rely upon changes in the liquid level in the distillate catch tank in determining the distillate rates listed in column 2. The maximum quantity of distillate collected during a single bump was 60 liters.

The temperature of the waste varied with depth. However, the temperature profile changed radically during each bump as shown in Figure V.

The temperature of the boiling waste not only varied with depth but also with concentration. The initial boiling temperature at the 0.6 foot point was 220 F. It rose to 240 F by October 1955, and to 277 F by July 1956, as more waste was added and additional sludge settled out with its scavenged fission products. It remained fairly level during the five month reflux period. Then from December 1956 to May 1957, as the tank was boiled toward dryness and fission product heat was generated in a smaller volume, the sludge temperature rose to 300 F. The temperature at the 0.6 foot point was 350 F when the tank adiabatic heaters were turned off.

~~Laboratory analysis of samples of the distillate showed a beta-gamma decontamination factor of 1×10^6 or better throughout the two-year period. The maximum gamma concentration for the distillate samples was 250 microcuries per gallon.~~

6.0 DISCUSSION

The term "bump", when applied to boiling waste, implies a sudden release of energy as evidenced by an accelerated boil-off rate and a rapid pressurization of the waste tank. Coppinger and Tomlinson⁽⁸⁾ have discussed the phenomenon of bumping with respect to the causes, mechanics, and hazards. It was the purpose of the study to obtain data to characterize bumping in terms of measurable variables.

The Hot Semiworks waste self-concentrator established a general pattern of bumping over the two-year operating period. The severity of bumping, in terms of both frequency and maximum pressure developed, proved to be proportional to the rate of heat generation and heat storage as sensible heat in the waste solution. In other words, the faster the "normal" boil-off rate, the more severe was the bumping. This was illustrated by the very close interrelationship shown by the bumping history (Table III); the amount of distillate collected (Fig. II); the theoretical heat generation curve (Fig. II), and the periods of cooling due to additions or heater failure (Fig. I).

During the last seven months of operation the tank was boiled down and the liquid level was reduced from approximately 12 feet to 6 feet. During this period the tendency of the tank to bump decreased. However, when bumps did occur they were almost (more than half) as energetic as those which occurred during the period of maximum heat evolution and bumping. Finally, when the tank liquid level passed below approximately 9 feet, bumping discontinued completely and a steady boil was encountered for the remainder of the boil down operation. It is true that fission product heat generation during the final boil down period was only half that encountered during the maximum bumping period. However, it is believed that sufficient heat was still being generated to permit bumping, but that the tank contents were sufficiently agitated by boiling action at this low level to prevent accumulation of the static liquid zone and tank stratification associated with bumping.

The temperature profiles of the waste, as illustrated in Figure V, showed, that for the entire operating period, the point of initiation of bumping was roughly 8 to 9 feet up from the bottom of the tank. The bump then worked down as well as up through the liquid. The maximum activity, according to temperature fluctuation, tended to occur at about 5 feet off the bottom of the tank. As is indicated temperatures five feet from the tank bottom varied as much as 20 F during a bump cycle.

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Progressing on down, the effects of the bump decreased until the sludge layer was essentially unaffected.

The maximum pressure developed during a natural bump was 51 inches of water.

~~The size of vapor header valve did not affect the maximum pressure developed except~~
as follows: The maximum pressure recorded, 55 inches of water, was induced by opening the large vapor header valve while the residual pressure from a previous bump was dissipating through the small vapor header valve. That type of induced bump was produced on several occasions. The pressure dropped to zero and then immediately rose to the new high level. Thus, it appeared that a bump pressure relief mechanism could merely serve to accelerate vapor generation and perhaps even magnify the bump.

The initial pressure surge during a bump was generally quite rapid, as illustrated in Figure IV. The time from zero to maximum pressure usually did not exceed 5 seconds. Frequently, there were pressure increases during the decline of bump. These probably indicated localized boiling caused by sludge turbulence during bump activity.

The duration of the pressurization varied from minutes to hours for the same maximum pressure developed and with the same vapor header valve open. The size of the vapor header valve did have some effect on the duration of the bump. In general, bumps having equal maximum pressure dissipated faster and had higher distillate rates when the large valve was open. However, the total distillate collected was independent of valve size. The maximum of 60 liters of distillate collected during a single bump is equivalent to about 8500 gallons for a 75 foot diameter tank.

The time between successive bumps varied greatly. During the periods of high bumping frequency, the time between bumps varied from minutes to hours. The time lapse increased to as long as two months on several occasions. Only during the period when the tank was on total reflux (7-56 to 1-57) could one reasonably predict bump occurrences.

Normal fluctuations in purge air rate to the weight factor dip tube had no noticeable effect on bumping. These air discharge rates were quite low (0.2 to 1 scfh)

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and even at maximum flow created only minor tank agitation. However, whenever plugged dip tubes were unplugged, the abnormally high air discharge rates produced a sufficient tank shock to initiate premature bumping.

Most of the fission products settled out in a sludge layer soon after their introduction into the tank (Fig. 3). The relatively constant thickness of the sludge layer (Fig. 1) plus the fact that the sludge was undisturbed by bumps indicate a relatively high solids content. This is supported by the fact the shaft to the bottom agitator sheared because of the resistance of the sludge. Force of 500 pounds per square inch was exerted on the agitator paddles.

Of particular significance is the fact that, even during the period of severest bumping, the distillate remained quite low in radioactivity.

One point that has to be considered in evaluating the waste self-concentrator operation is the fact that the tank walls were heated. Although only enough heat was supplied to compensate for the ground losses and an attempt was made to distribute the heat evenly by insulation techniques, convection eddy currents may have been produced in the waste which would have affected the bumping history.

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BIBLIOGRAPHY

1. G. L. O'Neil & W. H. Swift, "Fission Product Heat Generation Tables," HW-42488, April 10, 1956, (Unclassified).
2. W. E. Fry, "Purex Waste Tank Traverse," HW-43107, May 17, 1956.
3. W. E. Fry, "Waste Self-Concentrator Radiation Profile," HW-44278, July 11, 1956.
4. W. E. Fry, "Waste Self-Concentrator Radiation Profile," HW-44754, August 1, 1956.
5. G. J. Busselman, "Waste Self-Concentrator Radiation Profile," HW-46155, October 22, 1956.
6. W. E. Fry, "Waste Self-Concentrator Radiation Profile," HW-47741, January 7, 1957.
7. W. E. Fry, "Waste Self-Concentrator Radiation Profile," HW-50251, May 17, 1957.
8. E. A. Coppinger & R. E. Tomlinson, "Heat Problems in the Disposal of High Level Radioactive Wastes," HW-40900, December 12, 1955, (Unclassified).
9. J. S. Kane & R. E. Burns, "Heat Generation in Stored Redox Wastes," HW-23477, September 2, 1952.
10. R. E. Tomlinson, "Storage of High Activity Wastes," HW-37207, July 8, 1955.
11. J. Chernick, "The Sludge Problem in Waste Storage Tanks," BNL-2642, March 3, 1954.
12. O. F. Hill, "Steam Eruptions in a Redox Waste Storage Tank," HW-33683, November 4, 1954.
13. C. A. Rohrman & M. W. Cook, "Vapor Handling Facilities for Project CG-539 and Some Comments on Waste Tank Eruptions," HW-35962, March 29, 1955.
14. H. W. Stivers, "Purex Waste Facility-Scope Study," HW-41258 RD, February 16, 1956.
15. F. Hittman, "Laboratory Study Program for Determining Feasibility of Concentrating in Savannah River Waste Tanks," BNL-C-3261, August 13, 1954.
16. B. Manowitz, et al., "Feasibility of Concentrating Savannah River Plant Wastes in Existing High Level Storage Tanks," BNL-343, May 1955.
17. B. Manowitz, et al., "Studies on Characteristics of Savannah River Wastes," BNL-392, April 1956.

TABLE I

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Operating Summary

5-13-55	Initial addition to waste tank. Small vapor header valve open. Temperature controller set to maintain a zero temperature differential across the waste tank insulation.
6-27-55	First distillate collected
8-6-55	First Bump
9-27-55	First distillate discarded to crib
10-27-55	Both vapor header valves open
10-26-55 to 11-7-55	Tank heaters out of service
11-7-55	Temperature controller set to maintain outside of insulation 8 F warmer than inside
11-15-55 to 11-28-55	Vapor header heater out of service
11-29-55	Closed large vapor header valve
12-27-55	Obtained Radiation Profile
1-6-56	Installed humidifier for air supply to dip tubes
2-17-56	Reduced dip tube purge air rate from 1 CFH to 0.5 CFH
3-17-56 to 4-30-56	Period of maximum bumping activity
3-20-56	Maximum hydrostatic head in tank
3-21-56	Both vapor header valves open
3-28-56	Last addition of hot waste
4-10-56	Closed small vapor header valves
4-16-56	Closed large vapor header valve, opened small valve.
4-19-56	Highest pressure developed during a natural bump

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Table I (Continued)

4-23-56	Highest pressure developed in tank. Resulted from opening large vapor header valve during a natural bump. Closed small vapor header valve
5-14-56	Obtained radiation profile
5-17-56	Pulled corrosion coupons
6-20-56 to 11-20-56	All distillate collected was returned to waste tank in 100-150 liter batches, main- taining the hydrostatic head at approxi- mately 21 ft of H ₂ O
6-21-56	Obtained radiation profile
7-27-56	Obtained radiation profile
7-30-56	Closed large vapor header valve, opened small valve
8-1-56	Vapor header heaters out of service
8-30-56	Adjusted dip tube air purge rate to 0.1 to 0.2 CFH
10-19-56	Obtained Radiation Profile
11-5-56	Adjusted dip tube air purge rate to 0.5 CFH
11-26-56	Vapor header heaters back in operation
12-13-56	Obtained Radiation Profile
12-26-56	Closed small vapor header valve, opened large valve
1-10-57	Increased control point for the tank heaters around the vapor space in the tank to prevent internal refluxing
1-17-57	Closed large vapor header valve, opened small valve
1-18-57 to 1-24-57	Air purge to dip tubes off
2-5-57 to 2-19-57	Both the tank and vapor header heaters off to permit modification of vault piping

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Table I (Continued)

3-21-57	Last Bump
3-25-57	Weight factor dip tube plugged Unable to unplug
4-15-57	Closed small vapor header valve, opened large valve
4-23-57	Attempted to turn manual agitators
5-16-57	Obtained Radiation Profile
7-1-57	Turned all heaters off
7-15-57	Tank contents cooled to well below boiling. Shut off instrumentation

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Addition to Waste Tank

	<u>Date</u>	<u>Volume Liters</u>	<u>Solution</u>
1955	5-13	944	Neutralized LWW
	5-15	758	Neutralized LWW
	5-18	284	Neutralized LWW
	5-24	820	Neutralized LWW
	5-25	545	Neutralized LWW
	6-27	984	Neutralized LWW
	7-15	16	Condensate Reflux
	8-3	194	Condensate Reflux
	8-11	370	Neutralized LWW
	8-18	176	Condensate Reflux
	9-5	197	Condensate Reflux
	9-18	296	Neutralized LWW
	9-29	765	Neutralized LWW
	10-27	95	Line Flush Solutions
	11-21	100	Line Flush Solutions
1956	1-6	323	Neutralized LWW
	1-11	370	Neutralized LWW
	1-14	321	Neutralized LWW
	2-22	156	Condensate Reflux
	3-6	388	Neutralized LWW
	3-12	239	Neutralized LWW
	3-15	387	Neutralized LWW
	3-28	275	Neutralized LWW
	4-20	150	Line Flush Solutions
	6-26 to 10-19	1464	Condensate Reflux
Totals:			Neutralized LWW; 8069 liters
			Line Flush Solutions; 345 liters
			Condensate Reflux; 2203 liters

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TABLE III

Bumping History

<u>Date</u>	<u>Pressure Developed, Inches H₂O</u>	<u>Condensed Distillate Rate, ml/min</u>	<u>Average Duration of Pressure</u>	<u>Vapor Header Valve Open</u>	<u>Remarks</u>
6-27-55	--	--	--	--	First distillate collected
8-6-55	18	100	3 hrs	1/2"	First Bump
10-3-55	2 14	14 --	10 hrs 10 min	1/2" 1-1/2"	Opened 1-1/2" Valve momentarily
10-4-55 to 10-9-55	15* 3***	-- 14 --	13 min 2-24 hrs	1/2"	Bumping essentially continuously
10-10-55 to 10-20-55	14* 12** 10***	-- --	-- --	1/2"	Average 4 Bumps per day
10-20-55 to 10-27-55	16* 14** 12***	14	15 min	1/2"	Average 4 Bumps per day
10-27-55 to 11-13-55	Not boiling - heaters not operating				
12-7-55	8	100	10 min	1/2"	
12-15-55	12.5	128	10 min	1/2"	
2-16-56	--	190	--	1/2"	No pressure record
3-8-56	--	166	--	1/2"	No pressure record
3-12-56	--	168	--	1/2"	No pressure record
3-17-56	28	196	2 hrs	1/2"	No pressure record
3-17-56 to 3-21-56	31* 23** 3***	300	2 hrs	1/2"	Average 3 Bumps per day
3-21-56 to 4-10-56	31* 25** 4***	1700* 500** 200***	30 min	1/2 + 1-1/2"	Average 4 Bumps per day
4-10-56 to 4-15-56	32* 20** 5***	650* 400** 100***	5 min	1-1/2"	Average 5 Bumps per day

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TABLE III (Cont.)

<u>Date</u>	<u>Pressure Developed, Inches H₂O</u>	<u>Condensed Distillate Rate, ml/min</u>	<u>Average Duration of Pressure</u>	<u>Vapor Header Valve Open</u>	<u>Remarks</u>
4-16-56 to 4-18-56	35* 20** 3***	100	1 hr	1/2"	
4-19-56	51	200	3 hr	1/2"	Biggest Bump
4-21-56	48* 20** 5***	150 100**	40 min	1/2"	16 Bumps
4-22-56	21* 15***	80	15 min to 7 hrs	1/2"	6 Bumps
4-23-56	55	150	5 hrs	1/2"	Maximum pressure induced by opening 1-1/2" valve
4-25-56 to 4-27-56	29* 20** 12***	1000* 200**	1 hr* 2 min**	1-1/2"	Frequency of Bumps steadily increased
4-28-56 to 4-30-56	29* 15** 5***	160* 100**	1 hr* 5 min*	1-1/2"	
5-1-56 to 5-31-56	8 to 30	--	1 min to 90 min	1-1/2"	23 Bumps during May
6-1-56 to 6-30-56	5 to 20	200	10 min to 40 min	1-1/2"	22 Bumps during June
7-1-56 to 7-31-56	2 to 17	200	20 min	1-1/2"	15 Bumps during July
8-1-56 to 8-31-56	1 to 18	100	4 hrs	1/2"	17 Bumps during August
9-1-56 to 9-30-56	1 to 13	100	2 hrs to 8 hrs	1/2"	10 Bumps during Sept.
10-1-56 to 10-31-56	8 to 19	--	3 hrs	1/2"	4 Bumps during November

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TABLE III (Cont.)

<u>Date</u>	<u>Pressure Developed Inches H₂O</u>	<u>Condensed Distillate Rate, ml/min</u>	<u>Average Duration of Pressure</u>	<u>Vapor Header Valve Open</u>	<u>Remarks</u>
11-5-56	4	88	1-1/2 hr	1/2"	
1-2-57	12	400	21 min	1/2"	
2-7-57	31	200	30 min	1/2"	
2-28-57	38	200	95 min	1/2"	
3-2-57	38	300	105 min	1/2"	
3-8-57	35	200	100 min	1/2"	
3-21-57	20	150	95 min	1/2"	Last Bump

Notes: *Maximum
 **Average
 ***Minimum
 --No data recorded

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FIGURE 1
WASTE SELF CONCENTRATOR OPERATING VARIABLES

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FIGURE II
WASTE SELF CONCENTRATOR ENERGY RELATIONSHIPS

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FIGURE III
WASTE SELF CONCENTRATOR GAMMA TRAVERSE
2 P.M. Dec. 27, 1955

FIGURE IV
WASTE SELF CONCENTRATOR "BUMP" PRESSURE CURVE

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FIGURE 10
PARAMETRIC SCHEMATIC WASTE SELF-CONCENTRATOR

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