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HISTORY OF WASTE TANK 24
1962 THROUGH 1974

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DU PONT

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INTRODUCTION

Alkaline radioactive wastes resulting from the chemical separation of fission products from plutonium and uranium at Savannah River Plant are stored underground in carbon steel tanks having capacities that range from 0.75 to 1.3 million gallons. The waste falls into two general categories: high heat waste (HW), which contains the majority of the fission products, and low heat waste (LW), which results from purification processes and from dissolving aluminum cladding from reactor fuels. Some tanks equipped with cooling coils are for storage of high heat waste while other tanks without cooling coils are for low heat waste.

Tank 24 is a 1,300,000 gallon, uncooled, type IV tank located in H Area and is designated for the storage of low heat waste (figure 1). It is 85 feet in diameter and 34 feet high. It is constructed of ASTM A-285-54-T Grade B steel with non-stress-relieved welds, and is inside a concrete vault with a domed concrete roof. There are six risers providing access to the tank interior. A leak detection sump is provided for the tank bottom and two leak detection sumps 180° apart provide leak detection for the side wall.

Events in the history of tank 24 are listed chronologically in figure 2 and discussed briefly in this report. Listing of a date by month and year at any place in this report serves as a reference to Works Technical Report for that month. The period this history covers is from June 1962 through December 1974.

SUMMARY

Tank 24 was placed in service in April 1963 receiving HW concentrate from the Building 242-H evaporator. The tank was filled by October 1965. In October 1966 the cooled concentrate supernate was decanted. The tank was again filled with concentrate by March 1967, then decanted in June 1967 and refilled by July 1967. Since that time the tank has remained in service storing LW and HW salt and receiving spent zeolite from the cesium removal column (CRC).

In April 1973 an influx of slightly contaminated water in the bottom leak detection sump was observed. The tank was inspected with an optical periscope and numerous tests and investigations were conducted but the source of the contaminated water was not determined. However, subsequent to this report period a D_2O tracer test in tank 21 which also experienced an influx of contaminated water into its bottom sump provided conclusive evidence of communication between the tank vapor space and the bottom leak detection sump. The D_2O tracer test was documented in DPSPU 76-11-19.

Inspections of the tank interior were performed by direct observation and photography using an optical periscope inserted through access risers in the roof. Samples of the vapor condensate and supernate in the tank, and liquid collected in the bottom leak detection sump were analyzed. Numerous temperature profiles were taken and several equipment modifications and repairs were made.

DISCUSSION

Overall Chronology

In April 1963, tank 24 was placed in service receiving HW concentrate from the Building 242-H evaporator. By October 1965, the tank was filled, and in October 1966 the cooled concentrate supernate was decanted. The tank was filled again with concentrate by March 1967, decanted in June 1967 and refilled by July 1967. Since that time the tank has been inactive, serving to store a mixture of LW and HW salt, except for receipt of spent zeolite from the CRC.

In April 1973, an influx of low level radioactively contaminated water (7700 d/m/ml ^{137}Cesium) into the bottom leak detection sump was observed. Inleakage was initially as high as 25 gallons per day but decreased to 0.2 to 3 gallons per day while the concentration of the radioactivity remained fairly constant. Extensive investigations, including ground water analyses and correlation with environmental and process data, failed to identify the source of the contaminated water. However, subsequent to this report period (early in 1976), D_2O tracer tests were conducted in tank 21 (also a type IV tank in similar service) by continuously vaporizing D_2O into the vapor space and concurrently analyzing condensate from the vapor space and the liquid from the sump. These tests provided conclusive evidence that there was communication between the tank vapor space and the bottom sump and that this was the source of low level contamination in the sump. The tank 24 bottom sump has been pumped out and monitored periodically since April 1973.

Significant events including those listed below are shown on the tank liquid level plot (figure 2). Salt and supernate temperatures are also shown in figure 2, along with liquid level in the bottom leak-detection sump.

Jun 1962 The concentrate line from the evaporator was cut and blanked to prevent strain on tank 24 since the evaporator building settled 6 to 8 inches.

Ground water accumulated in the vermiculite filled space (see figure 1) and surrounding soil. A jet pump was used to remove the water via a side wall leak-detection well.

Jul 1962 Elevation measurements indicated that the tank had settled about 1 inch.

Aug 1962 After pumping the accumulated ground water from the side wall sump, the ground water level remained almost a foot above the tank bottom.

Jan 1963 The concentrate line from the evaporator was re-installed with modification to facilitate backflushing.

After the concentrate line was re-installed, its elevation and slope were measured to establish maximum fill level for the tank.

Ground water was pumped from the side wall sump in preparation for emptying ballast water from the tank. Figure 3 shows the ground water height and the rainfall at the H Area uncooled tanks (21-24) for January 7 through February 5.

Settlment gages were installed on the tank.

Feb 1963 Pumpout of ground water from the side wall sumps was continued. Figure 4 shows the ground water level and the rainfall at the uncooled tanks (21-24) for February.

Mar 1963 Pumpout of ballast water from the tank was started.

Pumpout of ground water from the side wall sump continued on an intermittent basis. Figure 5 shows the ground water level and rainfall at the uncooled tanks (21-24) for March.

To minimize uneven loading around the tanks, the voids left primarily around the upper part of the tank by settling of the vermiculite cushion layer (see figure 1) were filled by injecting a sand-clay-water grout into a series of injection wells around the tank.

Settlement gage measurements were taken indicating about 0.1 inch of settlement per week.

Apr 1963 Settlement gage measurements were taken again. The gages recovered most of the drop measured during March, indicating that the apparent weekly change of about $\pm$ 0.1 inch resulted from measurement errors.

Tank 24 was accepted from Construction Division on March 25.

The ballast water was pumped down to a 10-inch heel during the period March 2 through April 4.

The tank was placed in service April 5, receiving concentrate from the Building 242-H evaporator.

The liquid level and temperature rises experienced in tank 24 during the first few weeks of receiving concentrate from the evaporator are shown in figure 6.

May 1963 The side wall sump was pumped out continuously at a rate too low to measure on existing flow meters.

The liquid level and temperature rises experienced in the tank during receipt of evaporator concentrate through May 27 are shown in figure 7.

The results of a heat dissipation study for uncooled waste tanks, including tank 24, were reported.

Jun 1963 The rate of waste and heat addition to the tank decreased (figure 8) due to intermittent operation of the Building 242-H evaporator.

The ground water levels in the sumps of the uncooled tanks (21-24) during April, May, and June were reported (figure 9).

Jul 1963 Two sets of mild steel coupons had been placed in tank 24 to study corrosion rates. One set was removed.

A thermocouple was installed at the bottom of the center settlement gage.

Nov 1963 Consideration was given to a possible leak path from the H-Area uncooled tanks (21-24) to the Savannah River.

Dec 1963 Salt soundings made through four risers averaged 7 ft 4 in.

Feb 1964 The pumps used to remove ground water from the sumps around tanks 21-24 were operated two or three times a week and were run each time until they lost prime.

Apr 1964 The sump pumps around tanks 21, 23, and 24 were kept in operation after mid-April to hold the ground water level around tank 23 at least a foot below the tank liquid level.

Thirteen piezometer wells were installed around tanks 21-24 by the Health Physics Section to determine flow patterns of ground water around the bases of these tanks.

Oct 1964 Pumpout of water from the side wall sumps of tanks 21 through 24 continued, but at too low a rate to substantially affect the level of perched water surrounding the tanks.

Nov 1964 Water pumped from the side wall sump was monitored daily and no radioactivity was detected.

The limited ability to lower the perched water around tank 24 was attributed to slow percolation into tanks 21, 22, 23, and 24 sumps, probably due in part to the clay grout that was injected into the ground around these tanks.

Feb 1965 A summary of the quantity of ground water pumped from the side wall sumps was reported.

May 1965 Data on the ground water levels around tanks 21-24 were reviewed. Water levels in the tank leak detection sumps are shown in figure 10. Piezometer well data are shown in table 1 and the well locations are shown in figure 11.

Jun 1965 A permanent ventilation blower was installed on tank 24. The blower purges by drawing air from tank 23 through tank 24. This changed the ventilation system from positive to negative with respect to atmosphere. CWS filters were installed at the inlet of tank 23 and the outlet of tank 24.

Jul 1965 The permanent ventilation blower, installed in June, was placed in service.

Feb 1966 The reel tape was repaired.

Temperature profiles were taken in the tank and the side wall sump (figure 12). The temperature profiles in the tank indicated that the salt depth was about 75 inches at the tank center and about 85 inches at about 6 ft from the tank wall.

Apr 1966 The ventilation air flow was reduced through tanks 23 and 24 (series flow) from 200 to 35 cfm. The reduction was to eliminate or reduce the contaminated condensate which was dripping from the blower.

Jun 1966 A 2-ounce supernate sample was taken.

Aug 1966 The thermocouple installed in the center settlement gage near the tank bottom was raised to a point about 100 inches above the bottom to facilitate measurement of the maximum temperature in the tank.

Tank 24 was filled 10 months ago and should have reached thermal equilibrium with its surroundings (except for seasonal variations). During the first five months after filling, tank 24 exhibited a cooling trend. However, during the subsequent five months, an increase of 3^{o}C in the maximum tank 24 temperature was observed.

The proximity of tank 22, which was experiencing an increasing heat load and higher temperature, appeared to affect the tank 24 temperature. Figure 13 shows the temperature profiles of tanks 22 and 24 taken at the tank centers.

Sep 1966 After being full and idle for 11 months, tank 24 appeared to be virtually at thermal equilibrium with its surroundings. The temperature of the liquid phase of the tank center was 55°C. A salt sounding was made on September 12 and showed 133 inches.

Oct 1966 An adjustable-length transfer jet was installed in the north riser and a transfer line was installed connecting the jet to diversion box 3.

About 805,000 gallons of supernate was transferred from tank 24 to tank 21 using the new jet and transfer line.

Nov 1966 Temperatures were measured in the tank under the center riser during the initial filling in October with first-pass evaporator concentrate and after second-pass concentrate was started into the tank on October 27. The temperature profiles (figure 14) shown for October 12 were generally representative after thermal equilibrium was achieved with first-pass concentrate. The tank was dissipating 89,000 Btu/hr of fission product heat. On October 12, supernate was moved to tank 21. The later temperatures reflect the removal of supernate (October 26) and addition of second-pass concentrate (November 8 and 22). The temperatures shown for November 8 and 22 result from sensible heat in the hot (up to about 155°C) evaporator concentrate as well as from fission product heat.

Jan 1967 The maximum temperature recorded this month, while the tank was receiving evaporator concentrate, was 90°C. The heat evolution rate from fission products in the tank was 88,000 Btu/hr.

During evaporator operation on concentrated feed, a huge stalagmite of salt built up under the outlet of the concentrate line in tank 24. The stalagmite height reached the outlet and caused a plug, which was removed by flushing with water.

Feb 1967 The maximum temperature in the tank increased to 92°C on February 14.

Mar 1967 Tank 24 was filled to 370 inches and stopped receiving evaporator condensate.

May 1967 A temperature profile was taken (figure 15). The maximum temperature was 96°C.

Jun 1967 Temperature and specific gravity profiles were taken. The temperature profile taken last month (5/29/67) showed a 33°C gradient across the upper 130 inches of liquid waste. This implied that differences in salt concentration existed simultaneously in different layers of liquid waste solution within the tank. The tank had received transfers of dissimilar waste solutions. The implied difference in layers and lack of convection in the upper 130 inches of liquid waste was confirmed by a specific gravity profile taken June 8 and a temperature profile taken June 19 (figure 16).

Jul 1967 The tank was filled to 371.8 inches with evaporator concentrate.

May 1968 An undetermined amount of CRC feed leaked into tank 24.

Jul 1968 About 156,000 gallons of supernate were transferred from tank 24 to tank 21 to provide space in tank 24 for CRC zeolite and flushes.

May 1969 A smoke test indicated little or no ventilation air flow through the inlet filter of tank 23 (in series with tank 24) despite reasonable air exhausting from tank 24.

Jun 1969 "Freon" tracer was used to verify that the uncooled tanks (21-24) were being adequately ventilated.

Dec 1969 Work was started on diversion box 5 which included new transfer piping and jet for tank 24.

Salt soundings were made under the northwest riser (168 inches), the south riser (158 inches), and the northeast riser (160 inches).

Mar 1971 A sample from the bottom leak-detection sump showed 5 d/m/ml ^{137}Cs and the pH was 9.99.

Nov 1972 The reel tape was repaired.

Dec 1972 Periscopic inspection and photography of the tank interior below the northwest riser showed no abnormal conditions.

Feb 1973 A supernate sample was taken.

Apr 1973 Samples from the bottom leak-detection sump showed 7700 d/m/ml ^{137}Cs and 85 d/m/ml ^{134}Cs in the sump water. No other fission products were detected. In previous samples, the radioactivity in the sump water had been very low, <100 d/m/ml.

On April 6, a pump was installed in the tank bottom sump to determine the influx rate. After a few days at an initial rate of 25 gal/day, the influx decreased to 1.5-3 gal/day (table 2). A review of the sump liquid level prior to April 6 showed that until November 1972, the sump contained 10-12 inches of water, Beginning in December 1972, the level rose to 24 inches, and then increased slowly to 32 inches by mid-March 1973. Investigation for potential sources of the sump water was begun. Samples were taken and analyzed from the regional water table, the perched water table above the tank bottom (tank 21-24 side wall sump samples), the bottom sump, evaporator overheads, and CRC effluent (tables 3 and 4). No conclusions as to the source of the contaminated water were reached.

May 1973 A transfer jet was installed in the north riser.

Twelve inches of supernate was transferred from tank 24 to tank 21.

A temperature profile was taken. The profile was practically a duplicate of the profile taken in May 1970, indicating a very gradual cooling trend (figure 17).

Drilling was begun for 12 additional piezometer wells around the uncooled tanks (21-24) for hydrology studies.

The influx of contaminated water to the bottom leak-detection sump declined to 1.5-2 gal/day while the radioactivity level remained essentially unchanged (table 5).

Samples of condensate were taken from the tank vapor space. The samples were analyzed for fission products (table 6) and compared with the bottom-sump water. While the fission product content was greater in the vapor condensate, there was good correspondence between the ^{137}Cs to ^{134}Cs ratios; however, the tritium content was four times greater in the vapor condensate. Spectrochemical analyses of samples taken in April of the sump water, the evaporator overheads, the CRC effluent, and the perched and regional water tables were also reviewed (tables 7 and 8). Generally, there was no difference in the samples, most elements were less than the minimum detectable quantity. No conclusion as to the source of the contaminated water in the sump was reached.

Jun 1973 Pumpout of the bottom leak-detection sump continued on a semiweekly basis. The influx was about 3 gal/week.

The twelve new wells around the uncooled tanks (21-24) were completed.

Jul 1973 Semiweekly pumpout of the bottom leak-detection sump continued. The influx was 0.5-1 gal/week.

Aug 1973 Pumpout of the bottom leak-detection sump continued. The influx was 0.5-1 gal/week.

Sep 1973 The water influx to the bottom leak-detection sump continued at a rate of less than a gallon per week. Based on sample data, condensate from the tank roof was believed to be the source of the contaminated water.

Periscopic inspection and photography of the tank interior was made below the south riser.

The concrete roof dome and the stainless steel flashing were inspected using the 5X lens for greater detail. Two locations in the southeast quadrant of the tank showed evidence of inleakage of rain water at the junction of the flashing and the roof.

Oct 1973 The reel tape was repaired.

A new correction factor was determined for the reel tape.

Nov 1973 The water influx to the bottom leak-detection sump continued at 0.2 to 1 gal/week. The ^{137}Cs was 1820 d/m/ml, the ^{134}Cs was 24 d/m/ml, and the pH was 10.6 to 11.1.

Dec 1973 The water influx to the bottom leak-detection sump continued at <1 gal/week. The concentration of radioactivity and the pH remain unchanged.

Jun 1974 A Food Instrument Co. reel tape was installed with local and remote readout in Building 242-H.

Aug 1974 Two 200 ml supernate samples were taken for SRL to use in waste solidification studies.

Contaminated Water in the Bottom Sump

The water level in the bottom sump began rising in December 1972 and had slowly increased to 32 inches by mid-March 1973. The radioactivity was first detected in April 1973. Samples from the sump showed about 7700 d/m/ml ^{137}Cesium and 85 d/m/ml ^{134}Cesium in the sump water. On April 6, 1973, a pump was installed to determine the influx rate of water. Initially the rate was 25 gallons per day decreasing after a few days to 1.5-3 gallons per day. The rate continued to decrease and by late 1973 was about 0.2-1 gallons per day while the ^{137}Cesium concentration remained essentially the same.

Extensive investigations conducted during this report period failed to identify the source of the radioactively contaminated water. However, D_2O tracer tests performed in 1976 in tank 21 (which also experienced an influx of contaminated water into its bottom sump) established that condensate from the tank vapor space was the source of the low level contamination in the bottom leak-detection sump.

Chronology of Events Related to Contaminated Water in the Bottom Sump

Mar 1971 A sample from the bottom leak-detection sump showed 5 d/m/ml ^{137}Cs and the pH was 9.99.

Apr 1973 Samples from the bottom leak-detection sump showed 7700 d/m/ml ^{137}Cs and 85 d/m/ml ^{134}Cs in the sump water. No other fission products were detected. In previous samples, the radioactivity in the sump water had been very low, <100 d/m/ml.

On April 6, a pump was installed for the tank bottom sump to determine the liquid influx rate. After a few days at an initial rate of 25 gal/day, the influx decreased to 1.5-3 gal/day (table 2). A review of the sump liquid level prior to April 6 showed that until November

1972, the sump contained 10-12 inches of water. Beginning in December 1972, the level rose to 24 inches, and then increased slowly to 32 inches by mid-March 1973. Investigation for potential sources of the sump water was begun. Samples were taken and analyzed from the regional water table, the perched water table above the tank bottom (tank 21-24 side wall sump samples), the bottom sump, evaporator overheads, and CRC effluent (tables 3 and 4). No conclusion as to the source of the contaminated water was reached.

May 1973 The influx of contaminated water to the bottom leak-detection sump decreased to 1.5-2 gal/day while the radioactivity level remained essentially unchanged (table 5).

Samples of condensate were taken from the tank vapor space. The samples were analyzed for fission products (table 6) and compared with the bottom sump water. While the fission product content was greater in the vapor condensate, there was good correspondence between the ^{137}Cs to ^{134}Cs ratios; however, the tritium content was four times greater in the vapor condensate. Spectrochemical analyses of samples taken in April of the sump water, the evaporator overheads, the CRC effluent, and the perched and regional water tables were also reviewed (tables 7 and 8). Generally, there was no difference in the samples. Most elements were less than the minimum detectable quantity. No conclusion as to the source of the contaminated water in the sump was reached.

Jun 1973 Pumpout of the bottom leak-detection sump continued on a semiweekly basis. The influx was about 3 gal/week.

Jul 1973 Semiweekly pumpout of the bottom leak-detection sump continued. The influx was 0.5-1 gal/week.

Aug 1973 Pumpout of the bottom leak-detection sump continued. The influx was 0.5-1 gal/week.

Sep 1973 The water influx to the bottom leak-detection sump continued at a rate of less than a gallon per week. Based on sample data, condensate from the tank roof was believed to be the source of the contaminated water.

Nov 1973 The water influx to the bottom leak-detection sump continued at 0.2 to 1 gal/week. The ^{137}Cs was 1820 d/m/ml, the ^{134}Cs was 24 d/m/ml, and the pH was 10.6 to 11.1.

Dec 1973 The water influx to the bottom leak-detection sump continued at <1 gal/week. The concentration of radioactivity and the pH remain unchanged.

Inspection of Tank Interior

The interior of tank 24 was inspected by direct observation and photography using an optical periscope through access risers in the roof. Periscopic inspections were made in 1972 and 1973 and showed conditions to be normal except for evidence of inleakage of ground water at two locations at the junction of the flashing and the roof. All inspections are shown in figure 2. Color transparencies are listed in table 9.

Chronology of Events Related to Inspection

Dec 1972 Periscopic inspection and photography of the tank interior below the northwest riser showed no abnormal conditions.

Sep 1973 Periscopic inspection and photography of the tank interior was made below the south riser. The concrete roof dome and the stainless steel flashing were inspected using 5X magnification for greater detail. Two locations in the southeast quadrant of the tank showed evidence of inleakage of rain water at the junction of the flashing and the roof.

Samples

Tank contents were sampled several times between June 1966 and August 1974. After radioactively contaminated water began accumulating in the bottom leak detection sump in April 1973, samples were taken and analyzed from the bottom leak detection sump, side wall sump, tank vapor space, other process points, and regional ground water in an effort to identify the source of water collecting in the bottom sump. All samplings are indicated on figure 2 and analytical results of tank contents samples are summarized in table 10.

Chronology of Events Related to Sampling

Jun 1966 A 2-ounce supernate sample was taken.

Mar 1971 A sample from the bottom leak detection sump showed 5 d/m/ml ^{137}Cs and the pH was 9.99.

Feb 1973 A supernate sample was taken.

Apr 1973 Samples from the bottom leak detection sump showed 7700 d/m/ml ^{137}Cs and 85 d/m/ml ^{134}Cs in the sump water. No other fission products were detected.

May 1973 Samples of condensate were taken from the tank vapor spaces for comparisons with the water accumulated in the bottom sump (table 6).

Aug 1974 Two 200 ml supernate samples were taken for SRL to use in waste-solidification studies.

Physical Measurements

Numerous vertical temperature profiles were obtained by lowering a thermocouple incrementally into existing thermowells. Elevation measurements detected that the tank settled about one inch in 1962. Several elevation measurements made during 1963 revealed that settlement of the tank had essentially stopped. Salt soundings were made for surveillance of the salt formation from evaporator concentrate. These and other entries are shown in figure 2.

Chronology of Events Related to Physical Measurements

Jul 1962 Elevation measurements indicated that the tank had settled about one inch.

Jan 1963 The elevation and slope of the concentrate line were measured to establish maximum fill level for the tank.

Mar 1963 Settlement gage measurements were taken indicating about 0.1 inch tank settling per week.

Apr 1963 Settlement gage measurements were taken again. The gages recovered most of the drop measured during March, indicating that the apparent weekly change of about ± 0.1 inch resulted from measurement errors.

The liquid level and temperature rises experienced in tank 24 during the first few weeks of receiving concentrate from the evaporator are shown in Figure 6.

May 1963 The liquid level and temperature rises experienced in the tank during receipt of evaporator concentrate through May 27 are shown in figure 7.

Jun 1963 The rate of waste and heat addition to the tank decreased (figure 8).

Dec 1963 Salt soundings made through four risers averaged 7 ft 4 in.

Feb 1966 Temperature profiles were taken in the tank and the side wall sump (figure 12).

Aug 1966 Temperature profiles were taken (figure 13).

Sep 1966 A salt sounding was made on September 12 and showed 133 inches.

Nov 1966 Temperature profiles were taken (figure 14).

May 1967 A temperature profile was taken (figure 15).

Jun 1967 Temperature and specific gravity profiles were taken (figure 16).

Dec 1969 Salt soundings were made under the northwest riser (168 inches), the south riser (158 inches), and the northeast riser (160 inches).

May 1973 A temperature profile was taken (figure 17).

Tests Conducted

Studies were made of heat dissipation, corrosion rate, and ventilation air flow. These items are shown below and in figure 2.

Chronology of Events Related to Tests Conducted

May 1963 The results of a heat dissipation study for uncooled waste tanks, including tank 24, were reported.

Jul 1963 Two sets of mild steel coupons had been placed in tank 24 to study corrosion rates. One set was removed.

May 1969 A smoke test indicated little or no ventilation air flow through the inlet filter of tank 23 (in series with tank 24) despite reasonable air exhausting from tank 24.

Jun 1969 "Freon" tracer was used to verify that the uncooled tanks (21-24) were being adequately ventilated.

Equipment Modification and Repairs

The concentrate line from the evaporator was cut and blanked in June 1962 to prevent strain on tank 24 when it was discovered that the evaporator building, 242-H, had settled. The line was reinstalled in January 1963 with a modification to facilitate backflushing. In March 1963, grout was injected into voids created around the upper part of the tank by settling of the vermiculite cushion layer. The voids were filled to prevent uneven loading around the tank. In June 1965 a permanent ventilation blower and filters were installed. These modifications changed the ventilation operation of tanks 23 and 24 from positive to negative pressure with respect to atmosphere. In October 1966, an adjustable length jet with a transfer line to diversion box 3 was installed. The transfer jet was replaced in May 1973. A pump was installed for the bottom leak-detection sump in April 1973. The reel tape was repaired several times and replaced in June 1974. These and other equipment modifications and repairs are noted on figure 2.

Chronology of Events Related to Equipment Modification and Repairs

Jun 1962 The concentrate line from the evaporator was cut and blanked to prevent strain on tank 24 since the evaporator building settled 6 to 8 inches.

Jan 1963 The concentrate line from the evaporator was re-installed with modification to facilitate backflushing.

Settlement gages were installed on the tank.

Mar 1963 To minimize uneven loading around the tank, the voids left primarily around the upper part of the tank by settling of the vermiculite cushion layer (see figure 1) were filled by injecting a sand-clay-water grout into a series of injection wells around the tank.

Jul 1963 A thermocouple was installed at the bottom of the center settlement gage.

Jun 1965 A permanent ventilation blower was installed on tank 24. The blower purges by drawing air from tank 23 through tank 24. This changed the ventilation system from positive to negative with respect to the atmosphere. CWS filters were installed at the inlet of tank 23 and the outlet of tank 24.

Feb 1966 The reel tape was repaired.

Aug 1966 The thermocouple installed in the center settlement gage near the tank bottom was raised to a point about 100 inches above the tank bottom to facilitate measurement of the maximum temperature in the tank.

Oct 1966 An adjustable-length jet was installed in the north riser and a transfer line was installed connecting the jet to diversion box 3.

Dec 1969 Work was started on diversion box 5 which included new transfer piping and transfer jet for tank 24.

Nov 1972 The reel tape was repaired.

Apr 1973 A pump was installed for the bottom leak-detection sump.

May 1973 A transfer jet was installed in the north riser.

Oct 1973 The reel tape was repaired.

Jun 1974 A Food Instrument Co. reel tape was installed with local and remote readout in Building 242-H.

TABLE 1
GROUND WATER ELEVATIONS AROUND H-AREA UNCOOLED TANKS

Elevation of tank bottoms, feet	282	-	-	-	-	-	-	-	-
Elevation tip of piezometer, feet	296.54	281.07	281.52	281.33	281.10	280.75	295.25	301.14	280.54
Casing head el, feet	322.04	322.46	322.71	322.83	322.69	322.60	324.43	311.69	322.30
Well No.	HPM32	HPM33	HPM34	HPM35	HPM36	HPM37	HPM38	HPM39	HPM40
Date Sampled									
3/11/64	-	-	-	-	-	-	-	-	-
4/3/64	302.8	282.1	Dry	283.0	Dry	Dry	Dry	Dry	Dry
4/6/64	303.1	281.8	282.4	285.2	Dry	Dry	Dry	Dry	Dry
4/8/64	303.3	281.9	282.9	286.1	282.0	Dry	Dry	Dry	Dry
4/10/64	304.1	281.9	283.3	286.6	282.1	Dry	Dry	301.7	281
4/12/64	304.2	281.8	284.3	287.2	282.5	Dry	Trace	Dry	Dry
4/24/64	303.9	281.9	285.3	287.3	282.9	Dry	Dry	Dry	280.8
4/29/64	304.1	282.0	285.5	287.5	283.1	Dry	Dry	Dry	281.1
5/6/64	304.5	282.2	285.6	287.4	283.2	Dry	Dry	301.7	281.2
5/12/64	304.3	282.3	285.8	287.5	283.2	281.0	Dry	Dry	281.1
5/27/64	303.3	282.4	285.5	287.4	283.2	281.1	Trace	Dry	281.2
6/2/64	302.9	282.5	285.4	287.3	283.2	281.1	Dry	Dry	281.2
6/9/64	302.7	282.5	285.1	287.2	283.2	Dry	Dry	Dry	281.2
7/2/64	301.4	282.6	284.6	286.8	283.1	Dry	Dry	Dry	281.3
2/1/64	303.2	283.9	283.5	286.3	283.7	283.5	Dry	Dry	283.1
5/3/65	-	-	-	-	-	-	-	-	-

Elevation of tank bottoms, feet	-	-	-	-	-	-	-	-	-
Elevation tip of piezometer, feet	281.15	281.24	280.94	296.17					
Casing head el, feet	322.63	322.76	322.44	311.74	324.00	324.03	322.89	322.90	324.3
Well No.	HPM41	HPM42	HPM43	HPM44	PN	PE	PW	PS	PC
Date Sampled									
3/11/64	-	-	-	-	278	278.9	278.7	279.6	278.3
4/3/64	Dry	283.7	281.9	302.4	-	-	-	-	-
4/6/64	282.0	284.7	282.0	302.3	-	-	-	-	-
4/8/64	281.9	285.4	282.4	302.7	-	-	-	-	-
4/10/64	282.1	285.8	282.5	303.9	-	-	-	-	-
4/12/64	282.6	285.8	282.5	303.9	-	-	-	-	-
4/24/64	283.9	286.5	282.9	301.7	278.9	279.3	279.6	279.0	279.4
4/29/64	283.1	286.5	283.0	302.6	278.9	279.2	279.5	279.8	279.5
5/6/64	283.2	286.2	282.6	303.3	279.0	279.4	279.7	280.3	279.6
5/12/64	283.4	286.3	282.7	302.2	279.4	279.9	280.2	280.6	279.9
5/27/64	283.5	285.7	282.7	300.1	279.0	279.2	279.4	279.6	279.7
6/2/64	283.7	283.9	282.6	299.7	278.7	278.8	279.0	279.2	279.2
6/9/64	283.8	285.5	282.6	299.4	278.2	278.3	278.5	278.7	278.7
7/2/64	283.9	284.6	282.4	297.0	277.3	277.4	277.5	277.7	277.8
2/1/64	284.0	283.6	282.7	302.3	278.6	278.9	279.1	279.3	279.1
5/3/65	-	-	-	-	280.4	280.5	280.8	280.9	-

TABLE 2
CONTAMINATED WATER PUMPED FROM TANK 24 BOTTOM LEAK-DETECTION SUMP

April 1973	Sump Liquid Level, in. Initial	Final	Gallons Pumped Out	Radioactivity, c/m/mℓ[a] ^{137}Cs[b]	Beta[c]	Gamma[c]
6	25	7.0	25	–	1500	245
7	25	2.6	25	140	588	277
8	30	2.7	19	140	587	270
9	23	2.0	16	170	580	298
10	15	2.5	13	230	616	306
11	9	2.5	6.0	130	594	255
12	12	3.0	6.5	170	628	304
13			4.8	140	–	–
14			3.0	190	–	–
15			2.0	110	586	272
16			3.4	190	523	235
17			2.8	240	621	291
18			2.6	175	593	270
19			2.0	225	643	295
20			3.4	225	614	301
21			1.7	225	286	139
22			2.6	240	382	255
24			1.7	210	558	260

a. 1 c/m/mℓ = 50 d/m/mℓ.
b. Analyzed by PHA in 242-H.
c. Analyzed in 772-F laboratory.

TABLE 3
FISSION PRODUCT ANALYZERS FOR WATER TABLES

Regional Water, April 5-6, 1973

241-H Well	Water Table Elevation, feet	Alpha, 10^{-3} d/m/mℓ	Beta, 10^{-2} d/m/mℓ
North	277.5	1.1	<1.0
East	279.4	5.1	1.8
South	279.5	<0.5	<1.0
West	279.0	<0.5	<1.0
Center	278.5	0.7	16.0

[NOTE] In all samples, no gamma was detected, and ^3H was $<5 \times 10^{-5}$ μCi/mℓ.

Sidewall-Sump Water, April 13, 1973

Tank	pH	d/m/m ^{137}Cs	^{134}Cs	^3H, μCi/mℓ
22	7.1	<5	<5	0.001
23	7.3	<5	<5	0.001
24	6.9	<5	<5	0.001

TABLE 4
BUILDINGS 241, 242-H PROCESS AND SUMP SAMPLES

Sample	Date (1973)	pH	^{3}H, µCi/mℓ	d/m/mℓ ^{137}Cs	^{134}Cs	^{95}Zr	^{95}Nb	^{144}Ce	^{103}Ru	^{106}Ru	^{131}I	^{51}Cr	$^{137}Cs/^{134}Cs$ Ratio
Bottom leak detection sump	4/2	-	-	$7.7x10^3$	85	ND	ND	ND	ND	ND	ND	ND	90
	4	11	-	$9.3x10^3$	110	ND	ND	ND	ND	ND	ND	ND	84
	6	-	-	$9.5x10^3$	126	ND	ND	ND	ND	ND	ND	ND	75
	9	-	-	$1.13x10^4$	142	ND	ND	ND	ND	ND	ND	ND	79
	13	12.1	0.03	$9.3x10^3$	132	ND	ND	ND	ND	ND	ND	ND	71
Process streams													
Evaporator overheads	13	-	0.98	$5.3x10^4$	$7.6x10^3$	$1.1x10^3$	$2.6x10^3$	ND	ND	ND	ND	ND	7.0
	18	-	2.19	$9.7x10^4$	$1.6x10^4$	ND	$3.2x10^3$	ND	ND	$4.8x10^3$	ND	ND	6.1
CRC effluent	13	11.8	0.30	$3.8x10^4$	$6.8x10^3$	$2.0x10^3$	$3.6x10^3$	$5.8x10^3$	ND	ND	ND	ND	5.6
	18	-	1.21	ND	ND	ND	ND	ND	290	$1.7x10^3$	104	$1.2x10^3$	-
Tank 24 waste	2/7	-	-	$3.0x10^9$	$3.6x10^7$	-	-	-	-	-	-	-	83

ND = Not detected.
- = Not analyzed.

TABLE 5
CONTAMINATED WATER PUMPED FROM TANK 24 BOTTOM LEAK-DETECTION SUMP

Date (1973)	Gallons Pumped Out	^{137}Cs,[a] c/m/ml[b]	772-F Laboratory Analyses β, c/m/ml	γ, c/m/ml	^{137}Cs, d/m/ml	^{134}Cs, d/m/ml	^{3}H, µCi/ml	NH_3, ppm
4/25	2.5	200	30	231				
26	1.7	200	482	229				
27	1.5		475	237				
28	0							
29	1.7		288	141				
30	1.0	140	304	141				
5/1	<1.0	170	359	165	5,000	56		13
2	1.7	185	170	94				
3	No pumping							
4	3		178	103				
5-9	No pumping							
10	3.5	90	157	147				
11-14	No pumping							
15	6.0	220			8,510	112	0.02	
16	2.0	210	456	258				

[a]Analyzed by PHA in Building 242-H.
[b]1 c/m/ml ≅ 50 d/m/ml.

TABLE 6
ACTIVITY IN TANK 24 VAPOR SPACE CONDENSATE

	24	24
Date	5/9/73	5/9/73
Riser	S	S
Ventilation	Off 6 hr	Off 12 hr
^{3}H, µCi/ml	0.09	0.07
^{137}Cs, d/m/ml	168,000	10,300
^{134}Cs, d/m/ml	1,990	125
Ratio $^{137}Cs/^{134}Cs$	84	82

TABLE 7
SPECTROCHEMICAL ANALYSES OF TANK 24 SUMP WATER, 242-H PROCESS SOLUTIONS, AND GROUND WATER

(April 13, 1973)

Source	Element, ppm Ag	Al	B	Ba	Be	Bi	Ca	Co	Cr	Cu	Fe	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Sb	Si	Sn	Ti	Zn
Bottom sump	<2	<20	<2	<50	<0.5	<10	80	<20	<20	<5	<20	5	<2	<5	<20	300	<20	<20	<100	<5	<20	5	<5	<10	<50
Sidewall sump	L1-	L10	L10-	L50-	L1-	L10-	115	L200-	L20	L2	L10		10	L5	L10-		L10-	L20-		L20-	L20-	20	L50-	L5	L20-
Regional wells																									
North	L1-	L10	L10-	L50-	L1-	L10-	L50-	L200-	L20	L2	L10		L1	L5	L10-		L10-	L20-		L20-	L20-	L1	L50-	L5	L20-
South	L1-	L10	L10-	L50-	L1-	L10-	L50-	L200-	L20	L2	L10		L1-	L5	L10-		L10-	L20-		L20-	L20-	L1	L50-	L5	L20-
East	L1-	L10	L10-	L50-	L1-	L10-	L50-	L200-	L20	L2	L10		L1	L5	L10-		L10-	L20-		L20-	L20-	L1	L50-	L5	L20-
West	L1-	L10	L10-	L50-	L1-	L10-	L50-	L200-	L20	L2	L10		L1	L5	L10-		L10-	L20-		L20-	L20-	L1	L50-	L5	L20-
Center	L1-	L10	L10-	L50-	L1-	L10-	L50-	L200-	L20	L2	L10		2	L5	L10-		L10-	L20-		L20-	L20-	L1	L50-	L5	L20-
Process streams																									
Evap overheads	<2	<20	<2	<50	<0.5	<10	<5	<20	<20	<5	<20	<5	<2	<5	<10	<20	<20	<20	<100	<5	<20	<5	<50	<10	<50
CRC effluent	<20	20	<2	<50	<0.5	<10	<5	<20	30	<5	<20	<5	<2	<5	<20	400	<20	<20	<100	<5	<20	30	<5	<10	<50

Blank Element not investigated.
L___- Element not detected, limit shown.
L___ Element detected, but less than limit shown.
<___ Element, if present, less than limit shown.

TABLE 8
SPECTROCHEMICAL ANALYSES OF SOLIDS SUSPENDED IN TANK 24 SUMP WATER, 242-H PROCESS SOLUTIONS, AND GROUND WATER

(April 13, 1973)

Source	Element, ppm or Abundance Ag	Al	B	Ba	Be	Bi	Ca	Co	Cr	Cu	Fe	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Sb	Si	Sn	Ti	Zn
Bottom sump	-	Min	-	-	-	-	Min	-	Min	T	Maj	-	T	T	-	-	-	T	-	Min	-	Maj	-	T	Maj
Sidewall sump	L10-	5000	L100	500	L10-	L100-	5000	L2000	L200	2000	30,000		1000	500	L100-		L100-	200		5500	L200-	11,000	<500-	200	11,500
Regional wells																									
North	L125-	37,500	L1250	L6250-	L125-	L1250-	L6250	L25,000-	L2500	1250	50,000		1000	L625	L1250-		L1250-	L2500-		2500	L2500	62,500	L6250-	2500	L2500
South	L125-	12,500	L1250	L6250-	L125-	L1250-	L6250-	L25,000-	L2500	2500	25,000		1250	L625-	L1250-		L1250-	L2500-		L2500	L2500-	50,000	L6250-	1250	L2500
East	L125-	12,500	L1250	L6250-	L125-	L1250-	L6250-	L25,000	L2500	1250	37,500		1000	1250	L1250-		L1250-	L2500-		L2500-	L2500-	57,500	L6250-	1250	L2500
West	L10-	50,000	100	L500	L10-	L100-	2000	2000	L200	500	50,000		1500	1000	L100-		L100-	500		500	L200-	40,000	L500-	1000	1000
Center	L125-	12,500	L1250	L6250-	L125-	L1250-	18,750	L25,000-	L2500	1250	62,500		1250	2500	L1250-		L1250-	L2500-		L2500	L2500-	25,000	L6250-	12,500	12,500
Process streams																									
Evap overheads	-	-	Maj	-	-	-	Maj	-	Maj	Min	Maj	-	Min	Maj	-	-	-	Maj	-	Maj	-	Maj	-	-	-
CRC effluent	-	-	Min	-	-	-	Maj	-	-	-	Maj	-	Min	-	-	-	-	Maj	-	-	-	Maj	-	-	-

Blank Element not investigated.
\- Element not detected.
L___- Element not detected, limit shown.
L___ Element detected, but less than limit shown.
<___ Element, if present, less than limit shown.
Maj Major, 10-100% of sample.
Min Minor, 1-10% of sample.
T Trace, 0.01-1% of sample.

TABLE 9
TANK 24 COLOR PHOTOGRAPHS

Date	Access Port	Object of Photo	PRD Number	Separations Technology File Location Box	Slots
11/27/72	NW	Interior	16582-(1-13)	34	47-59
9/4/73	S	Interior	17289-(1-31)	44	1-31

TABLE 10
TANK 24 SAMPLE ANALYSES

Phase	Supernate	Vapor[a]	Vapor[b]
Date	2/7/73	5/9/73	5/9/73
^{137}Cs, d/m/ml	$3.0x10^9$	$1.68x10^5$	$1.03x10^4$
^{134}Cs, d/m/ml	$3.6x10^7$	$1.99x10^3$	125
$^{137}Cs/^{134}Cs$ Ratio	83	84	82

[a]Ventilation blower off for 6 hours.

[b]Ventilation blower off for 12 hours.

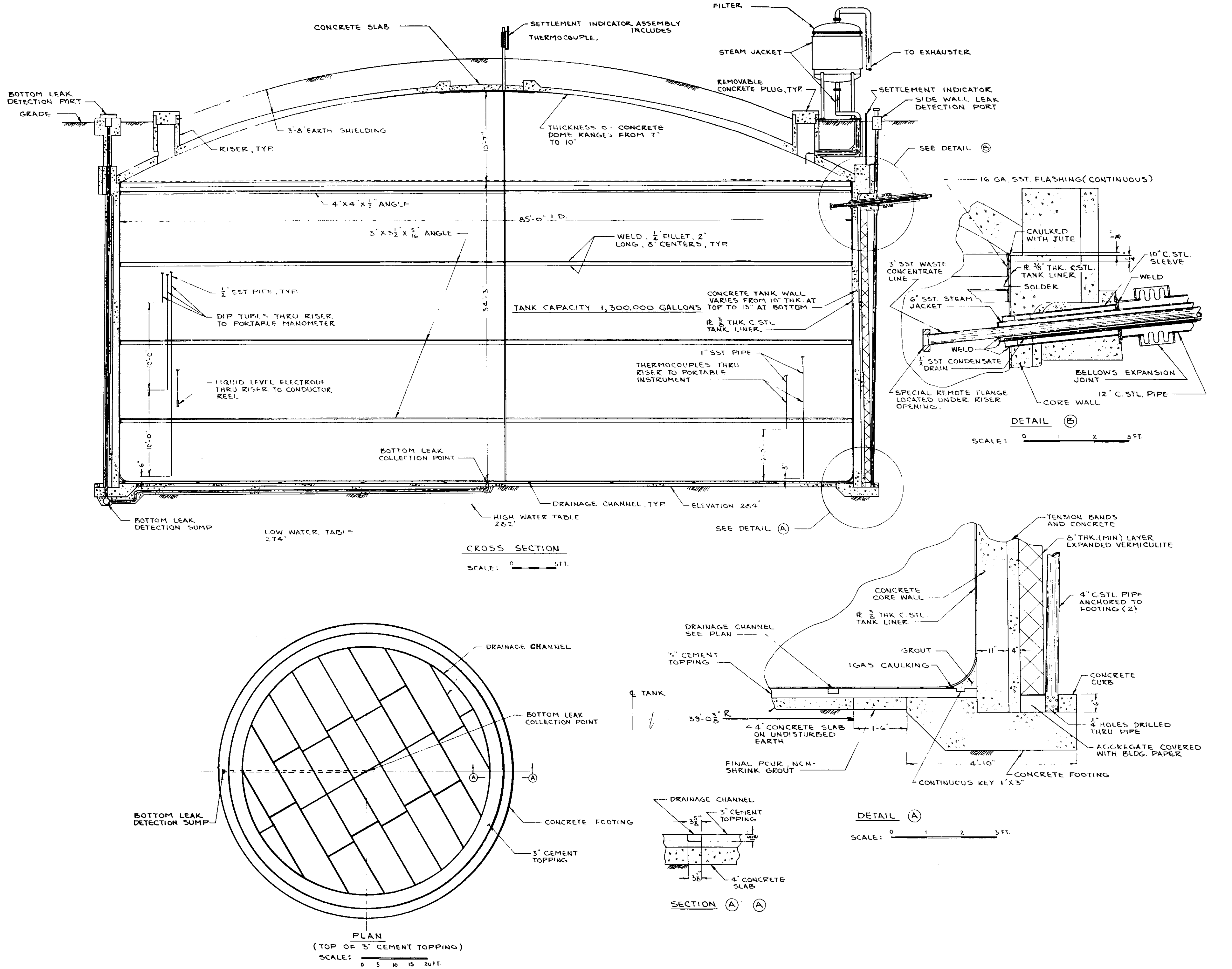


FIGURE 1. WASTE STORAGE TANK 24

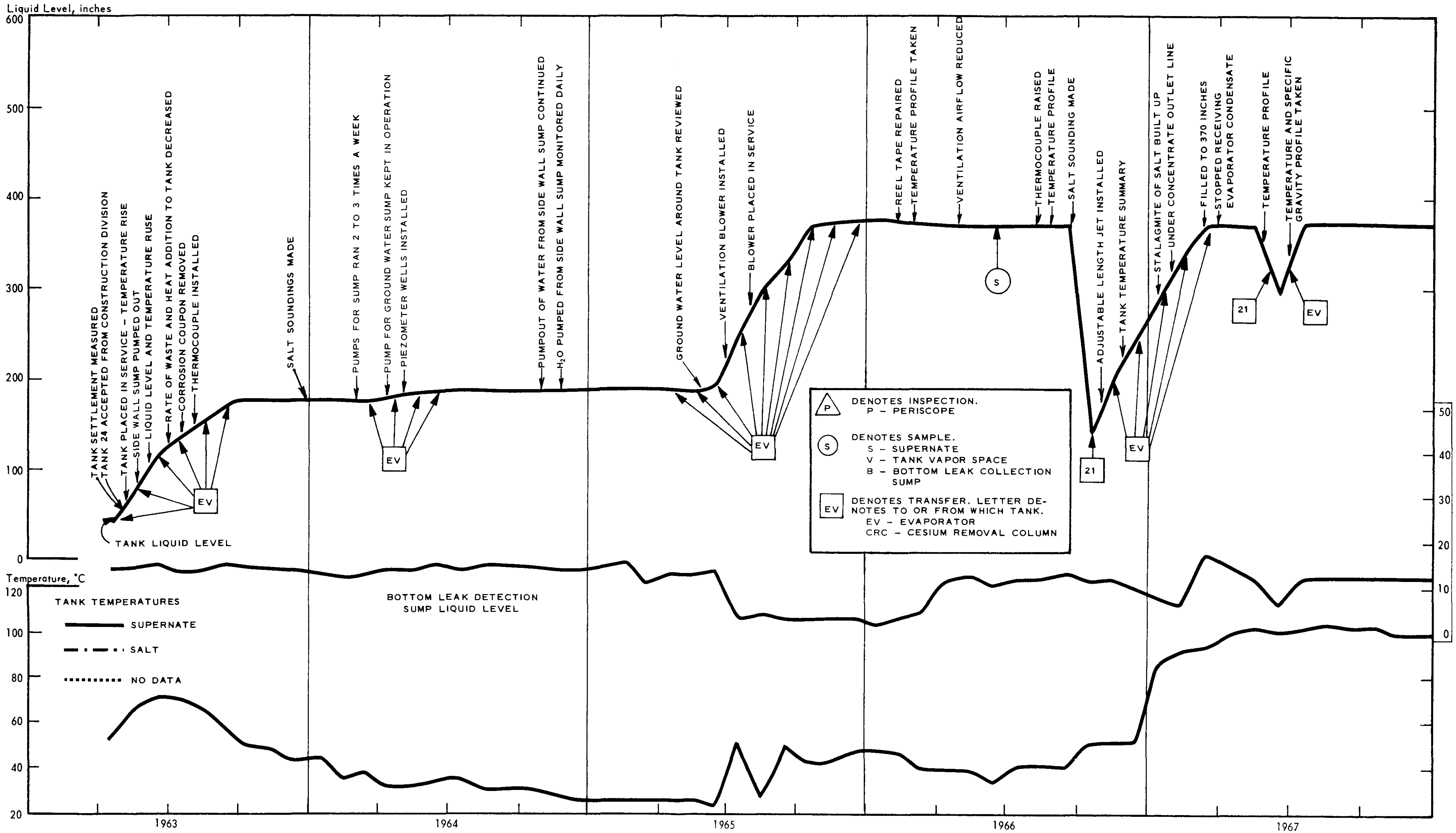


FIGURE 2. TANK 24 LIQUID LEVELS AND TEMPERATURES

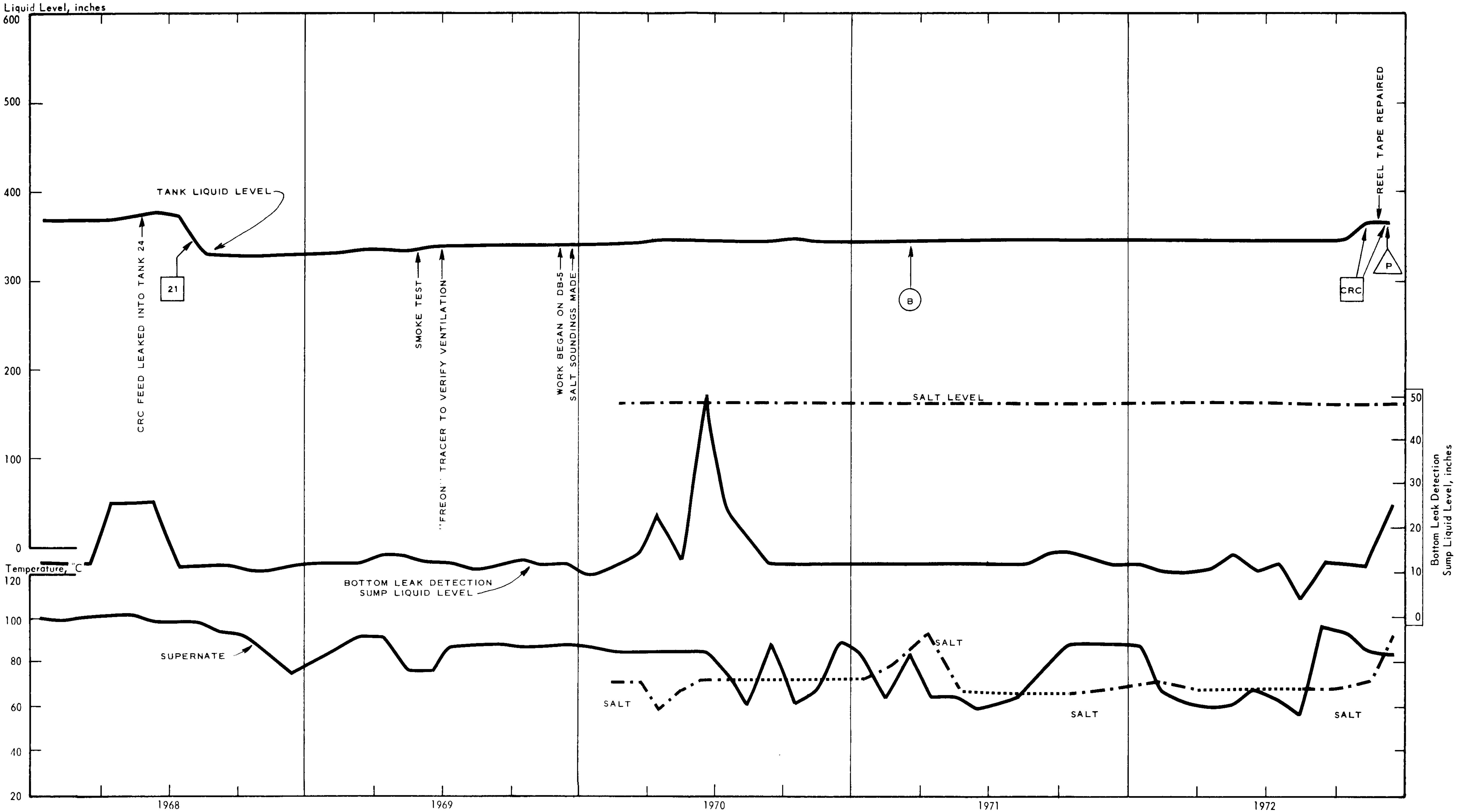


FIGURE 2 (contd)

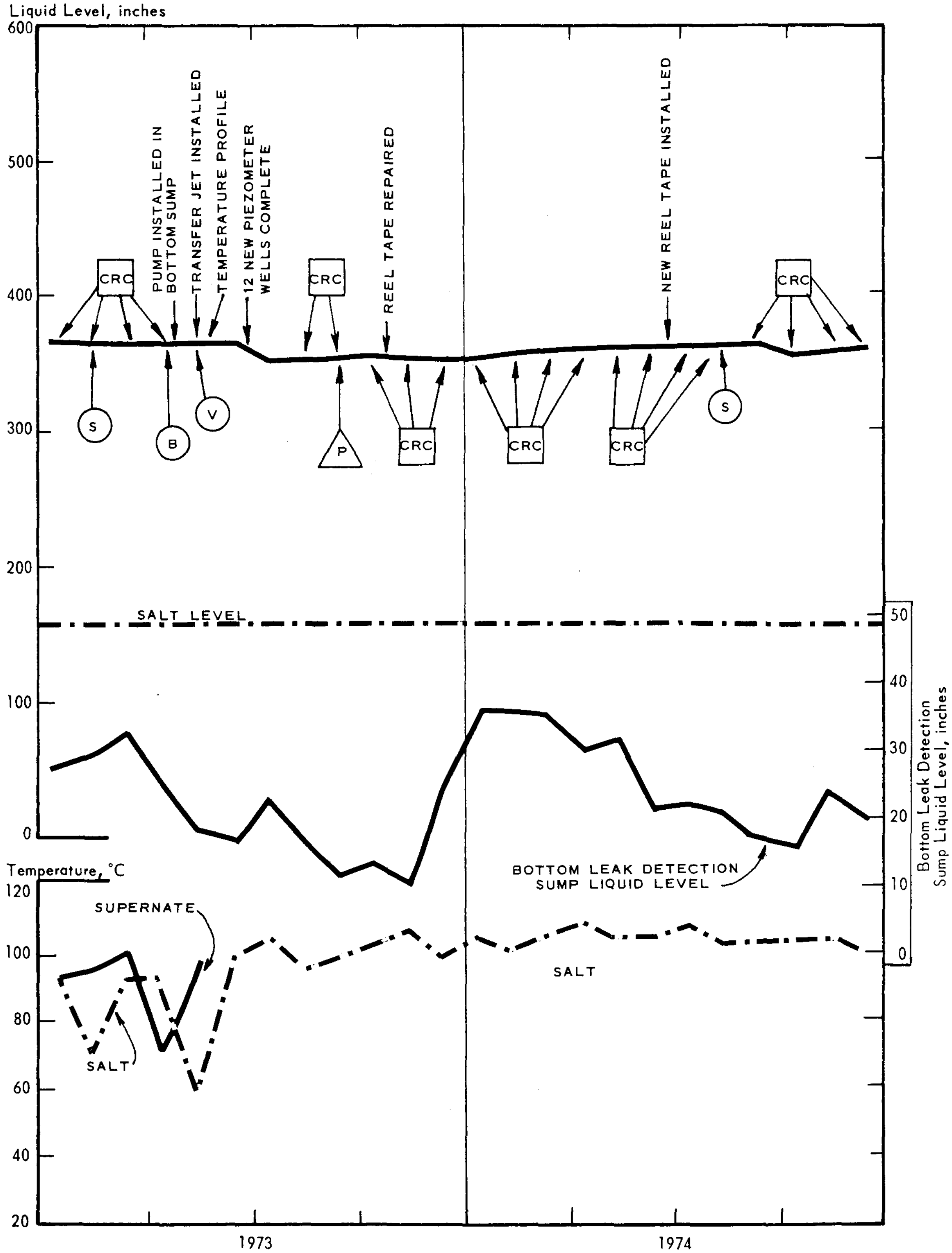
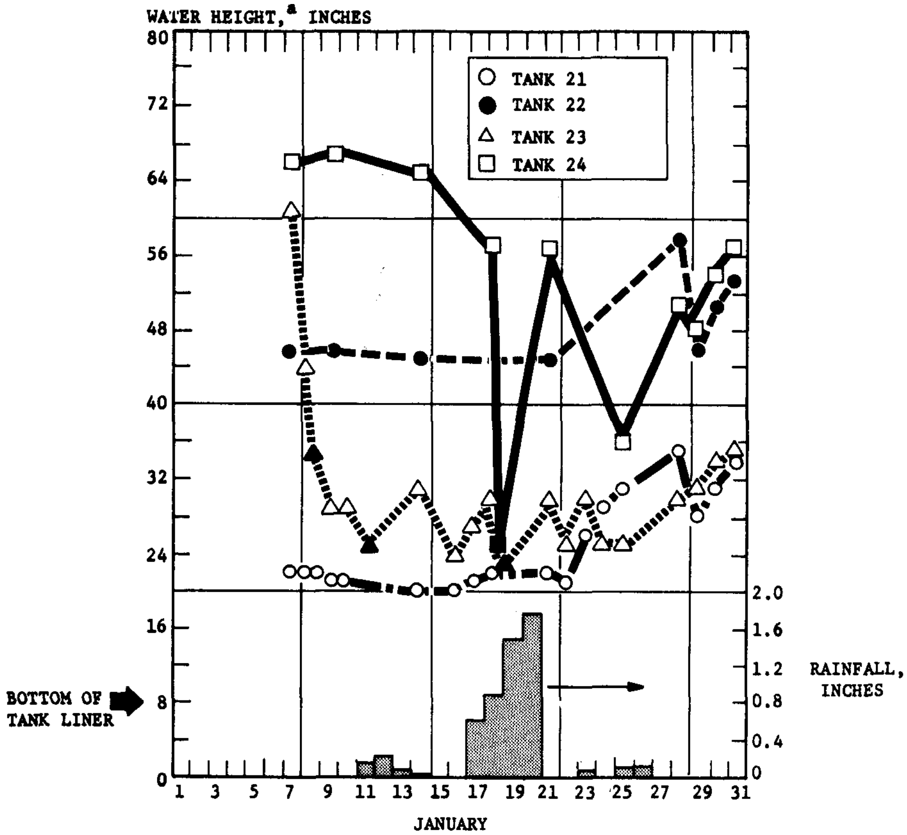


FIGURE 2 (contd)



[a] MEASURED FROM BOTTOM OF SIDE-WALL SUMPS.

FIGURE 3. GROUND WATER LEVEL AROUND H-AREA UNCOOLED TANKS – JANUARY 1963

[NOTE]
- OPEN POINTS ARE MORINING READINGS (BEFORE DAY'S PUMPING).
- SOLID POINTS ARE AFTERNOON READINGS (AFTER DAY'S PUMPING).
- PUMPING TANK 23 STARTED JANUARY 7, 1963.
- PUMPING TANK 24 STARTED JANUARY 18.
- PUMPING TANK 23 STOPPED JANUARY 25.
- PUMPING TANKS 21 AND 22 WAS DONE FOR ONE DAY, JANUARY 28.

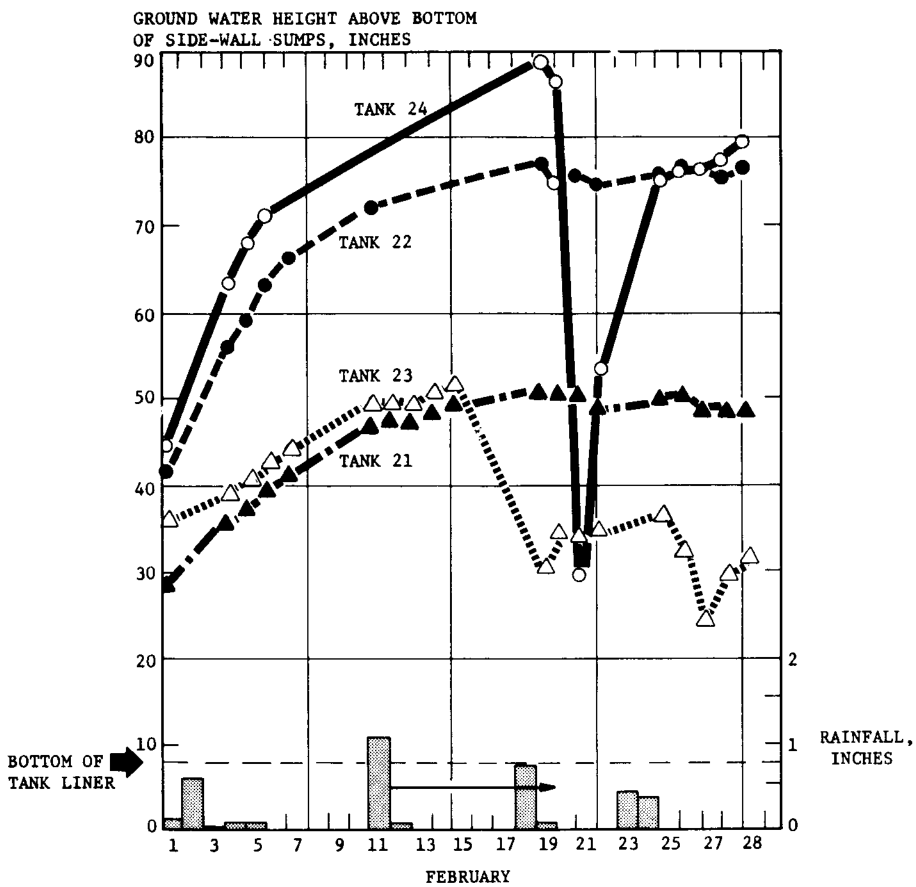


FIGURE 4. GROUND WATER LEVEL AROUND H-AREA UNCOOLED TANKS - FEBRUARY 1963

[NOTE] GALLONS OF WATER PUMPED BETWEEN 1/29 AND 2/26:
FROM TANK 23 1712
FROM TANK 24 1426

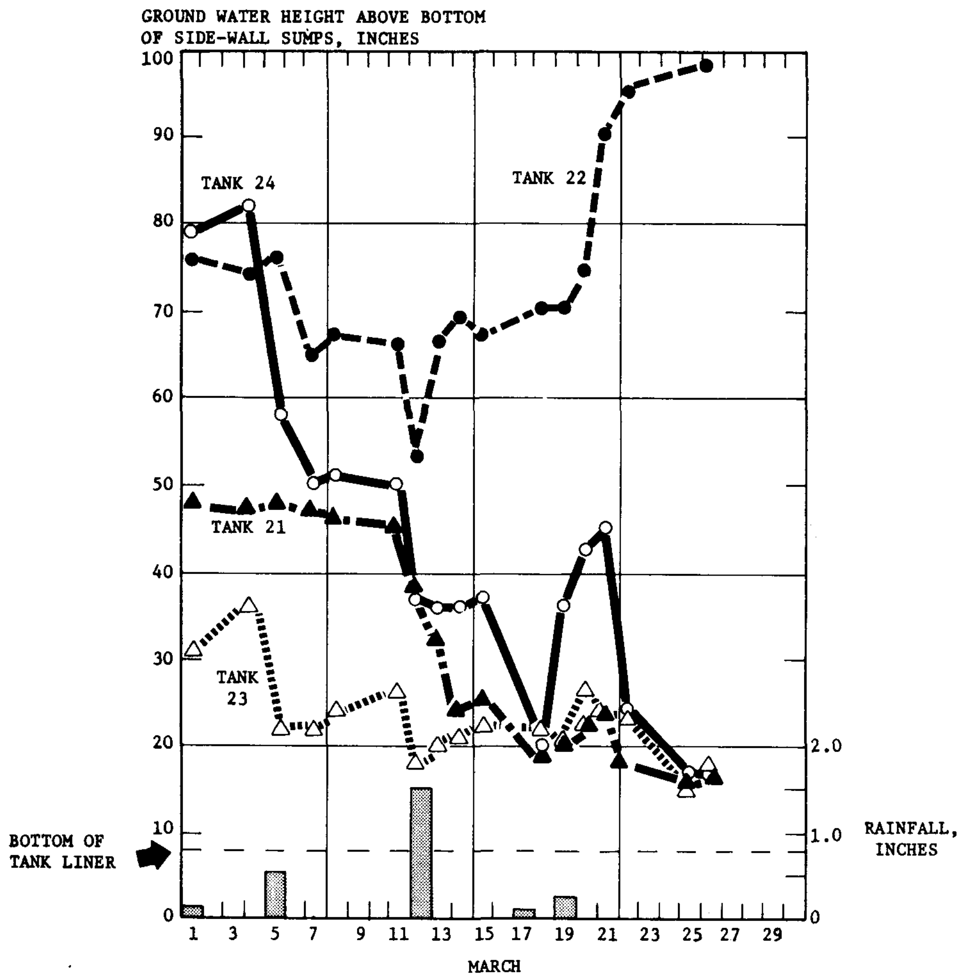


FIGURE 5. GROUND WATER LEVEL AROUND H-AREA UNCOOLED TANKS - MARCH 1963

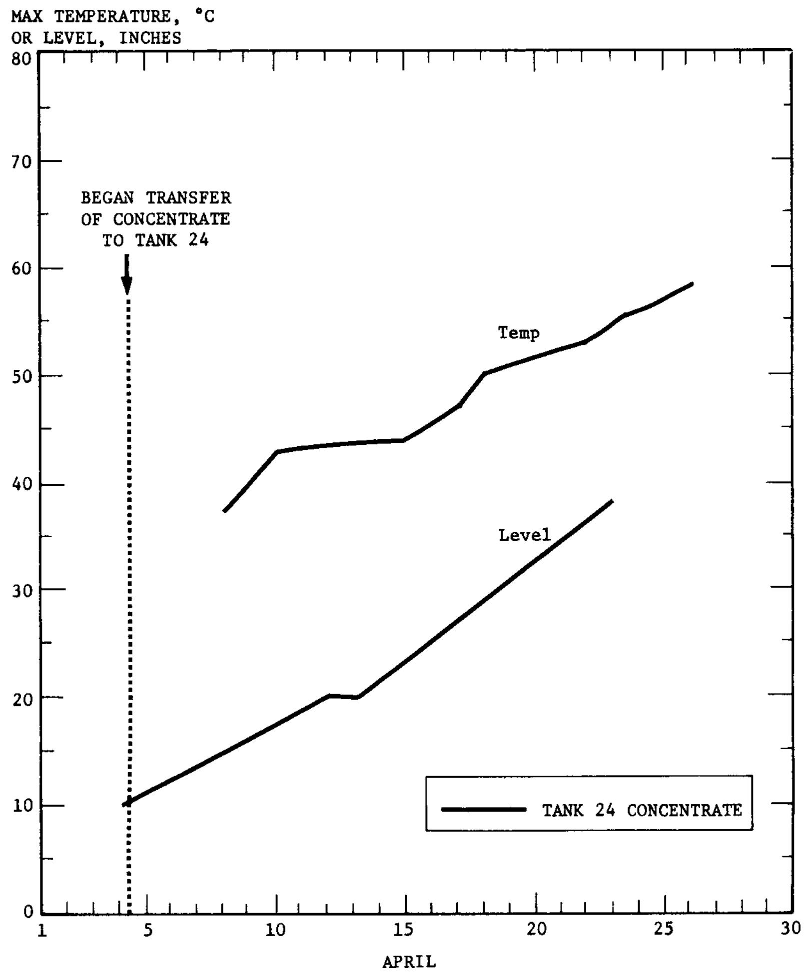


FIGURE 6. TANK 24 LIQUID LEVEL AND TEMPERATURE RISE - APRIL 1963

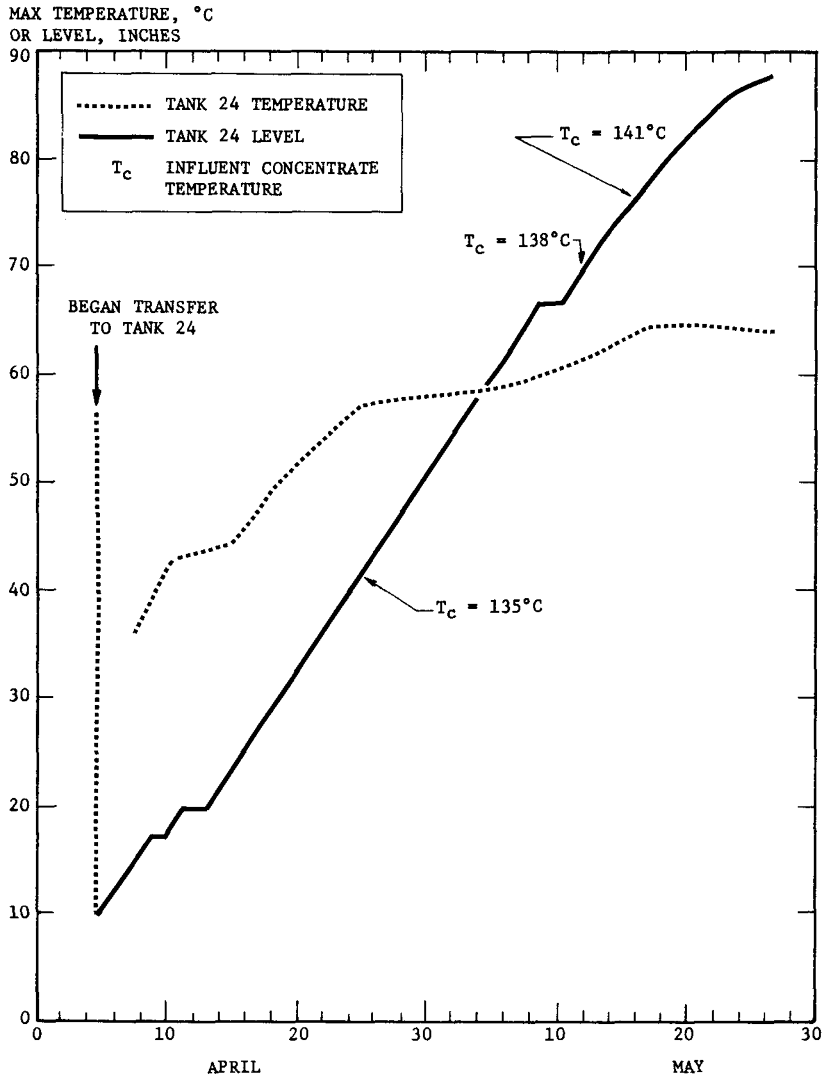


FIGURE 7. TANK 24 LIQUID LEVEL AND TEMPERATURE RISE - APRIL AND MAY 1963

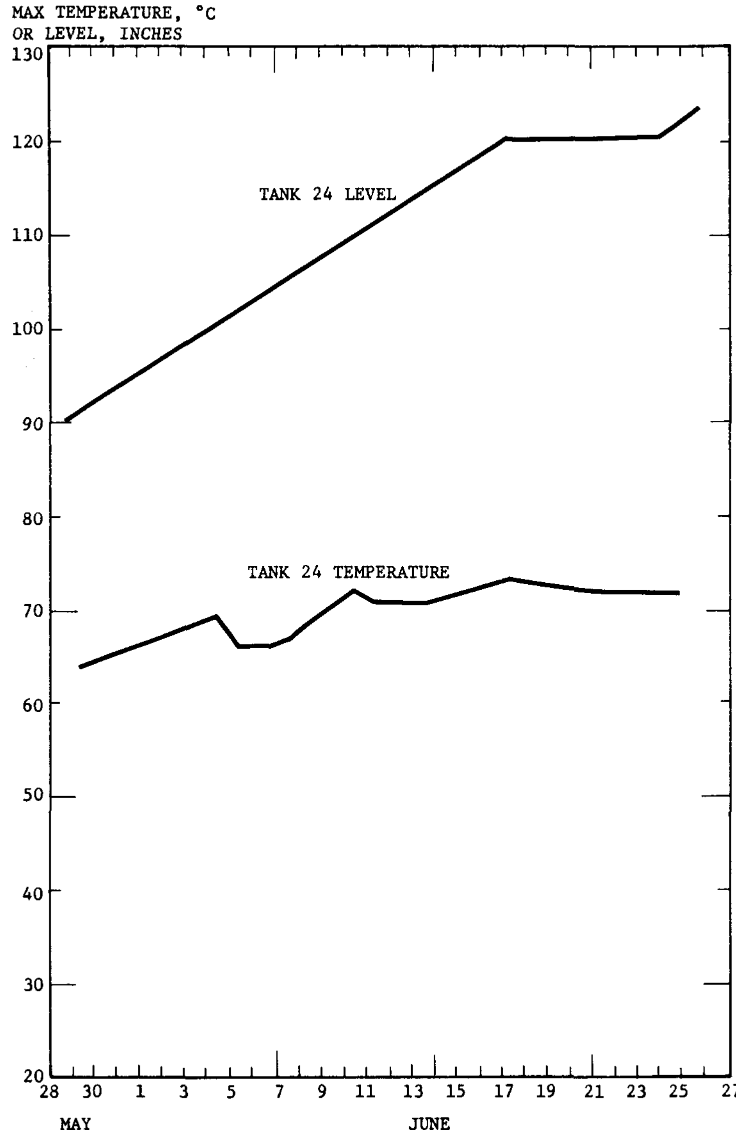


FIGURE 8. TANK 24 LIQUID LEVEL AND TEMPERATURE RISE - JUNE 1963

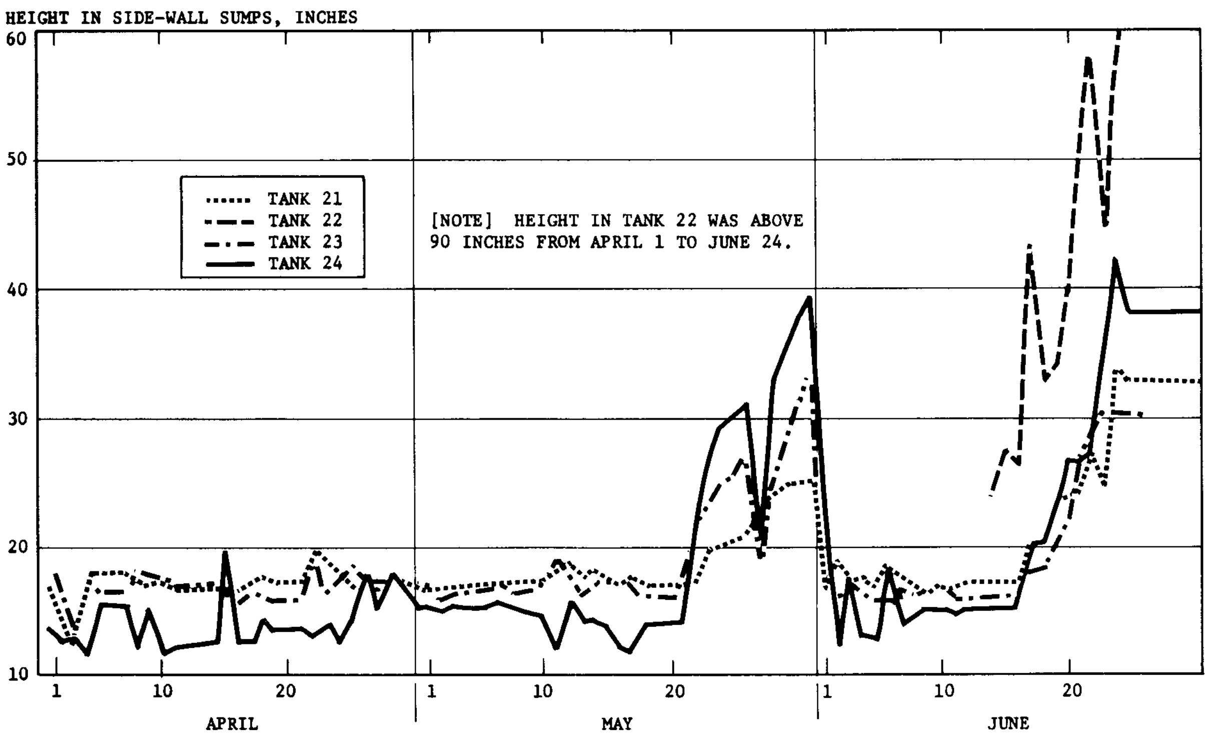


FIGURE 9. GROUND WATER LEVEL AROUND H-AREA UNCOOLED TANKS – APRIL, MAY, AND JUNE 1963

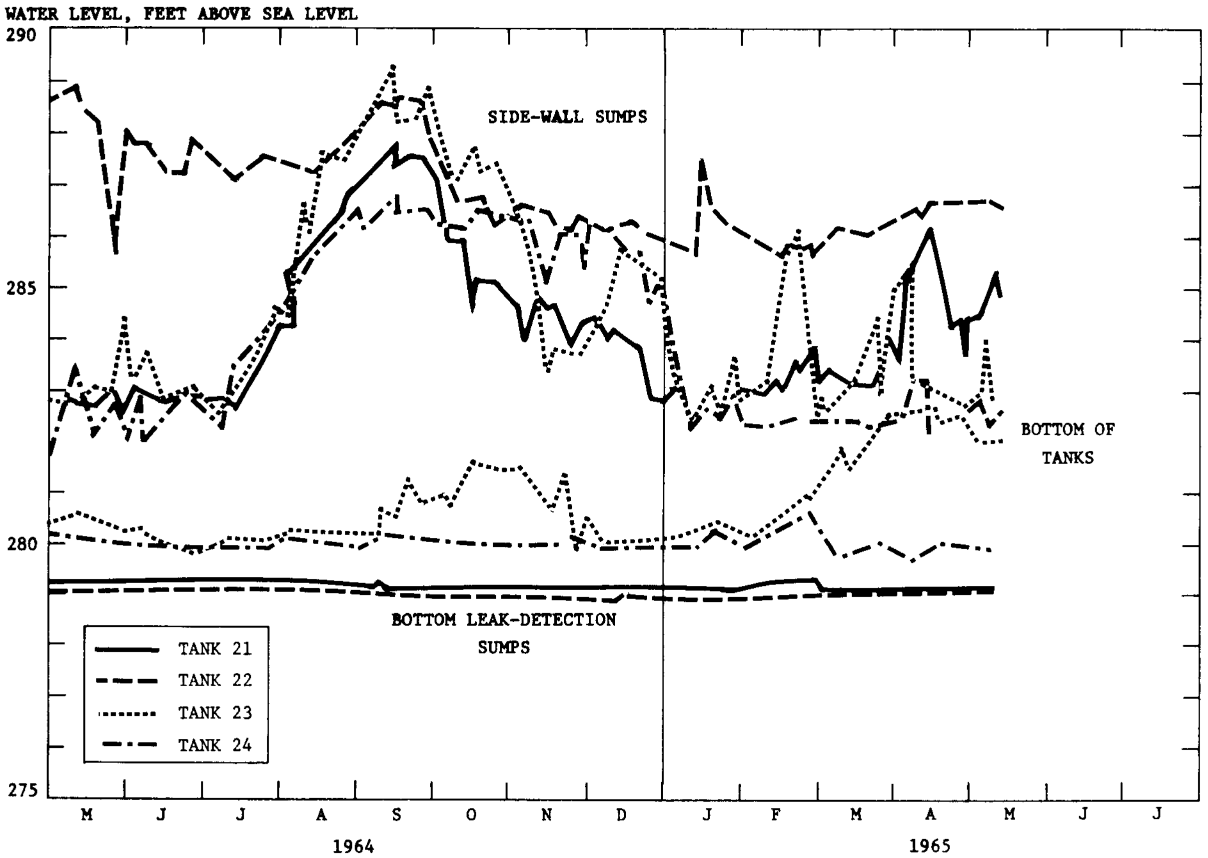


FIGURE 10. GROUND WATER LEVEL AROUND H-AREA UNCOOLED TANKS

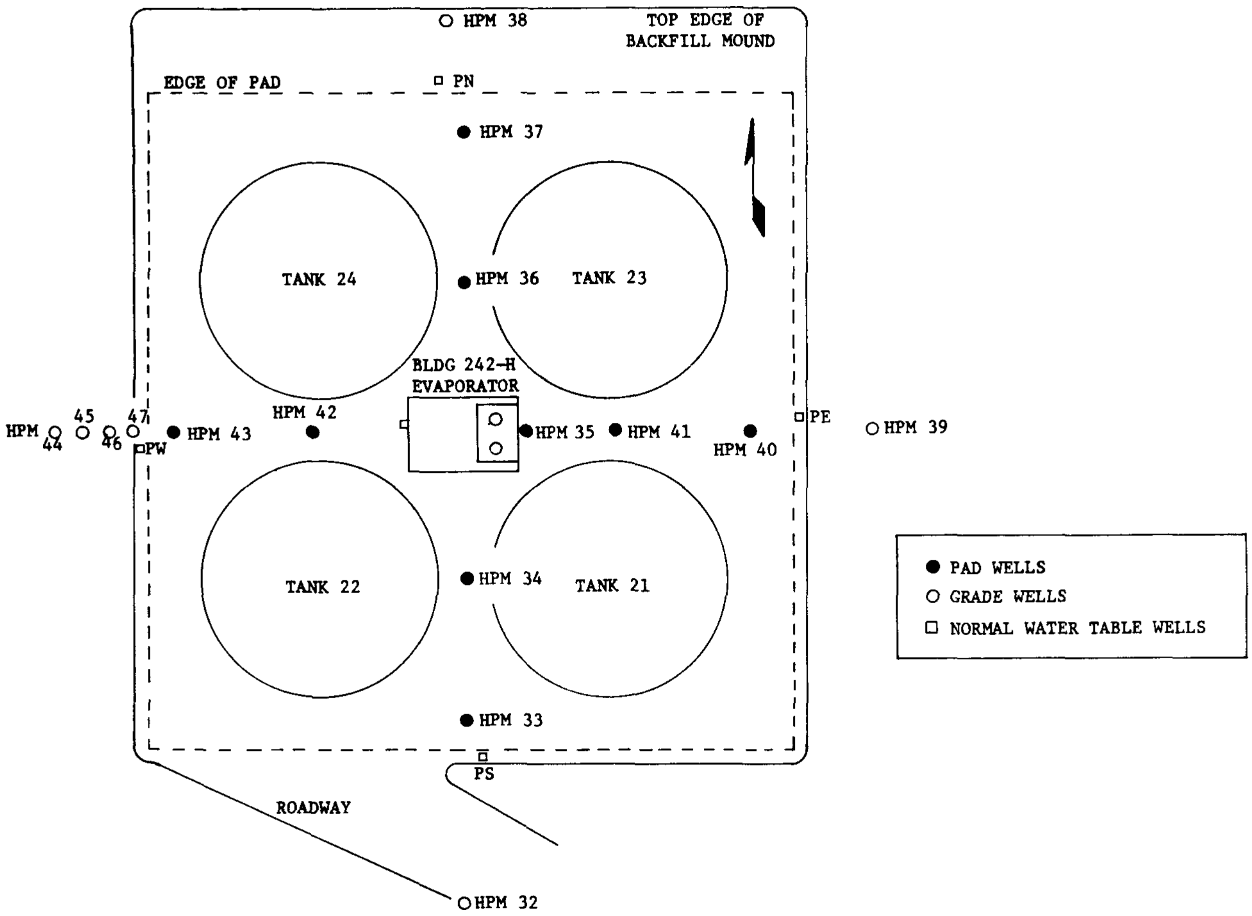


FIGURE 11. LOCATION OF OBSERVATION WELLS AT H-AREA UNCOOLED TANKS

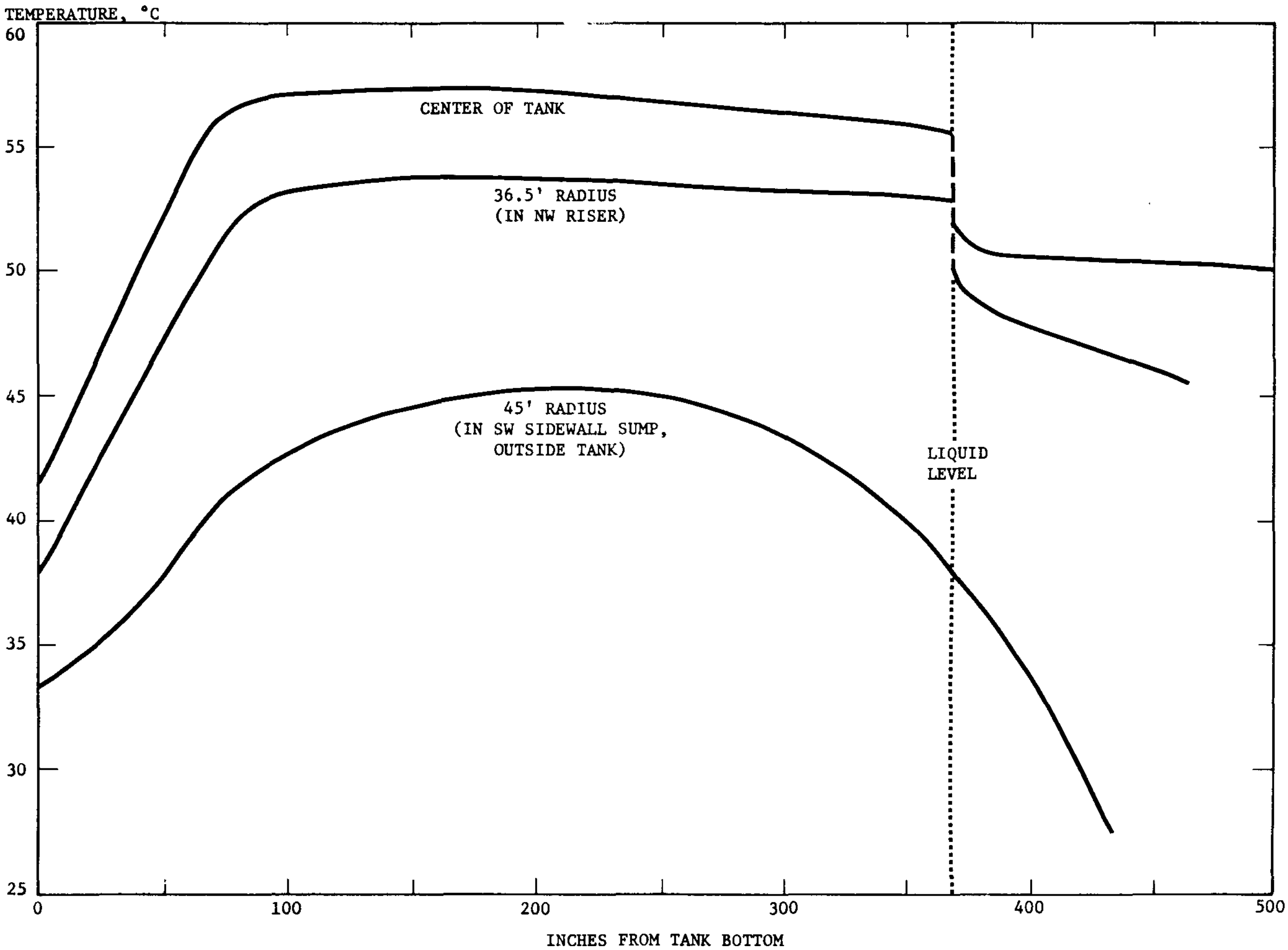


FIGURE 12. TANK 24 TEMPERATURE PROFILES - FEBRUARY 1966

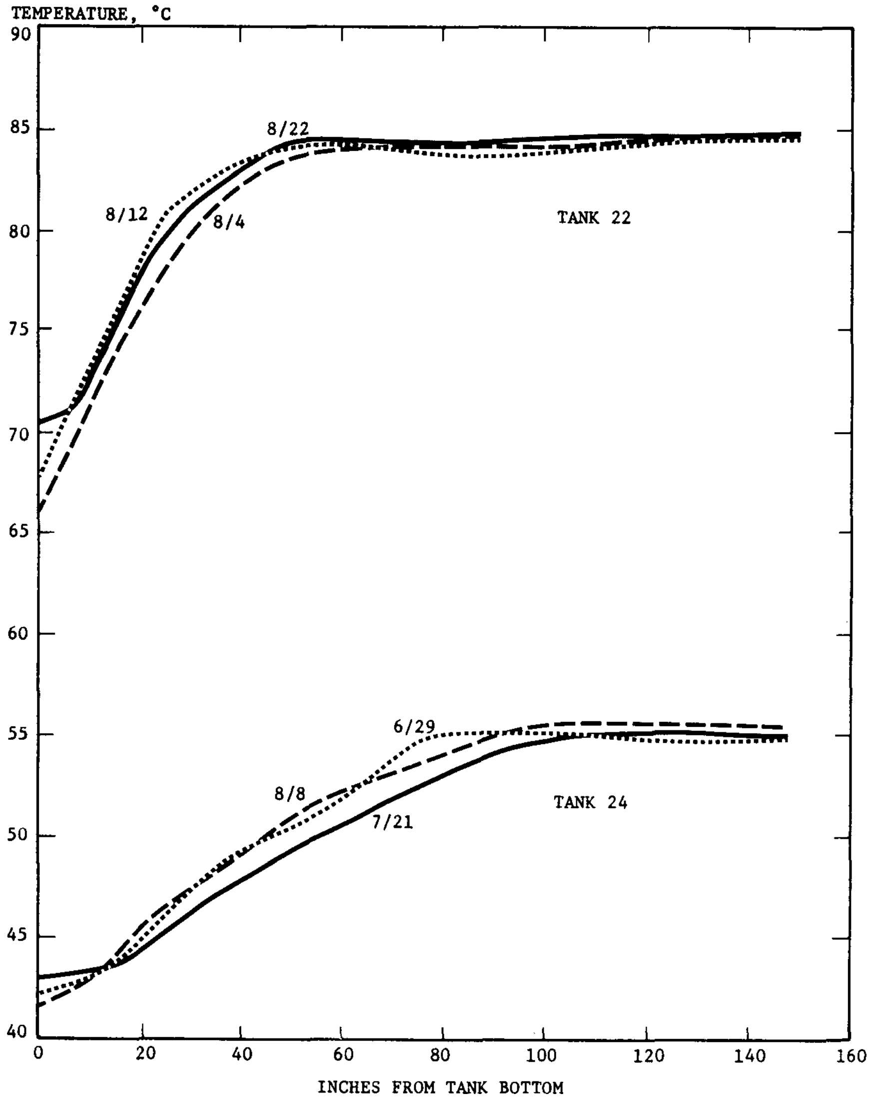


FIGURE 13. TEMPERATURE PROFILES OF TANKS 22 AND 24

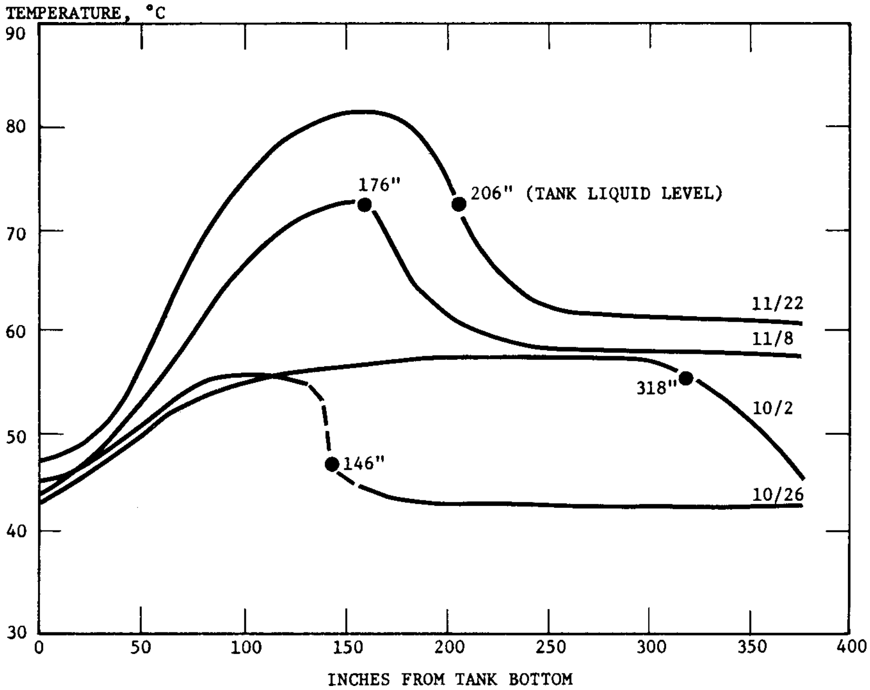


FIGURE 14. TANK 24 TEMPERATURES - OCTOBER AND NOVEMBER 1966

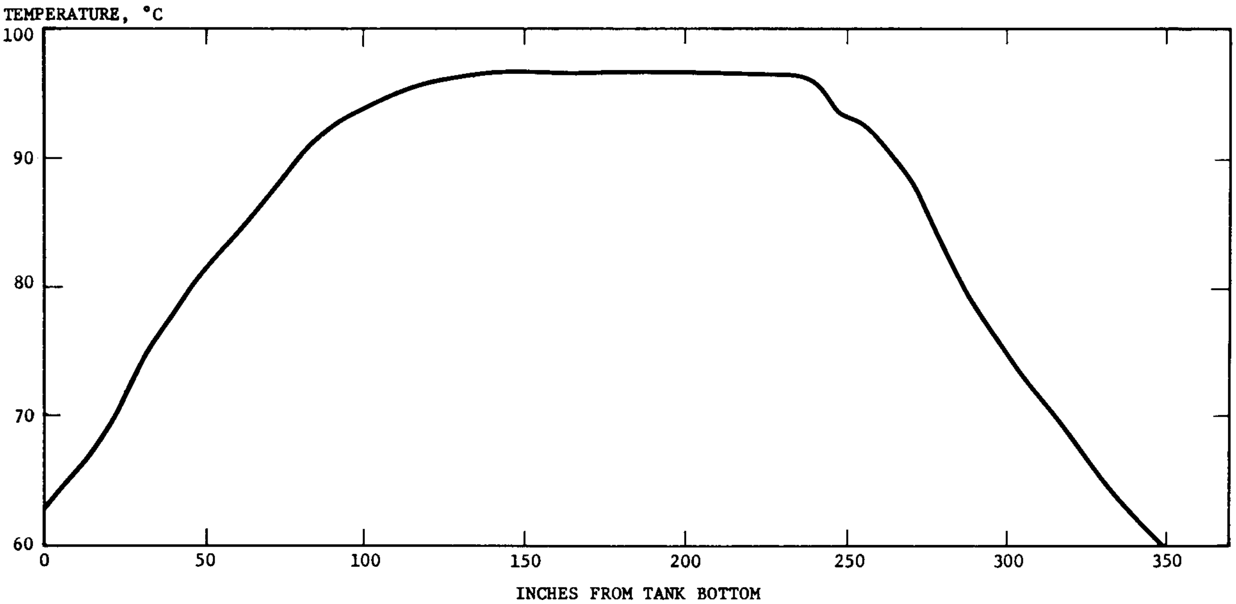


FIGURE 15. TANK 24 TEMPERATURE PROFILE - MAY 29, 1967

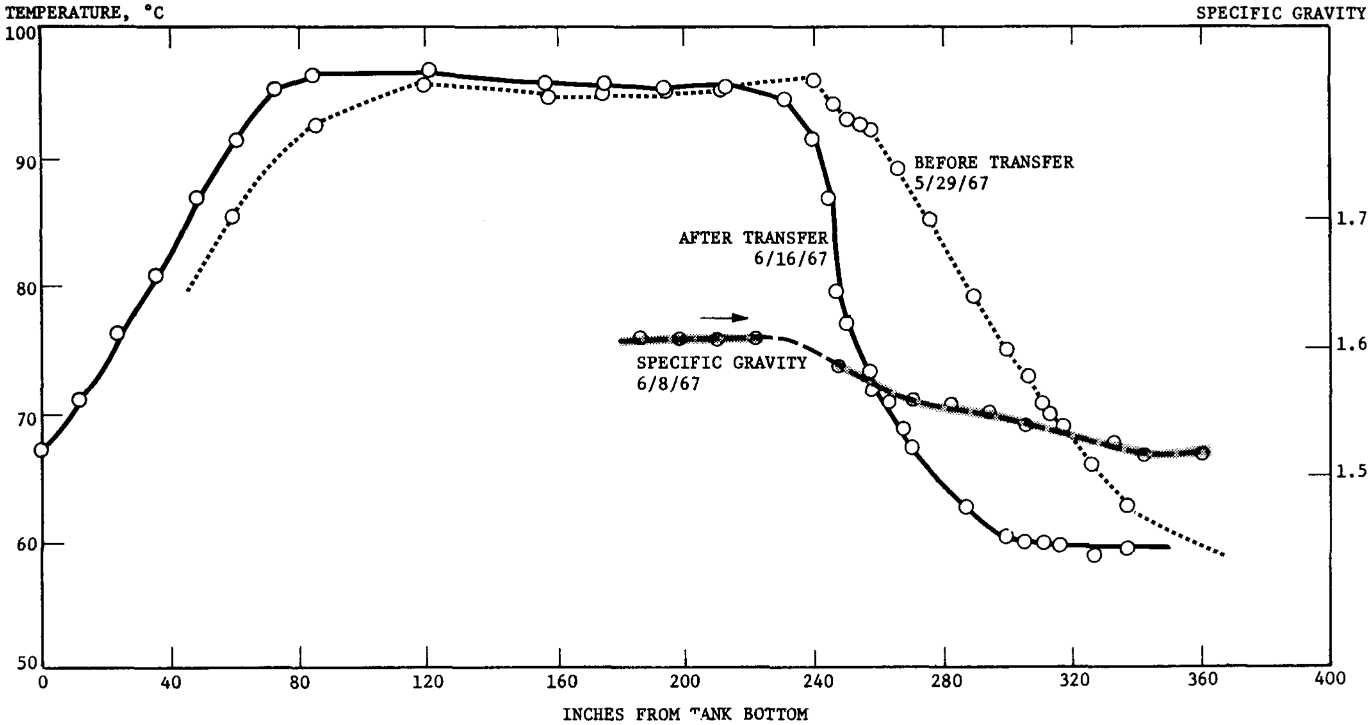


FIGURE 16. TANK 24 TEMPERATURE AND SPECIFIC GRAVITY PROFILES

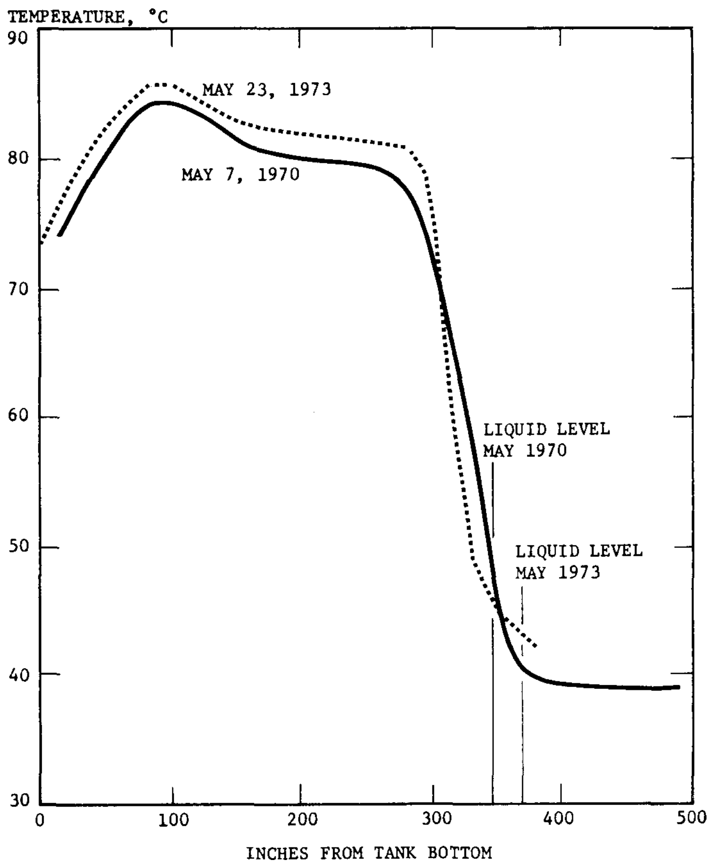


FIGURE 17. TANK 24 TEMPERATURE PROFILES – MAY 1970 VERSUS MAY 1973