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HISTORY OF WASTE TANK 1
1954 THROUGH 1974

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INTRODUCTION

Alkaline radioactive wastes resulting from the chemical separation of fission products from plutonium and uranium at the 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 1 is a 750,000 gallon, Type I tank located in F Area and used for the storage of high heat waste (figure 1). It is 75 feet in diameter, 24½ feet high, and has 34 vertical cooling coils in the upper part. At the bottom, where the sludge and most of the fission products concentrate, there are two horizontal coils. The tank is constructed from type ASTM A-285-B steel with nonstress-relieved welds, and is inside a concrete vault with an annular space surrounding the tank. Lining the bottom of the vault is a 5-foot high steel annulus pan (secondary container) to collect leakage from the primary tank. There are 8 risers providing access to the tank interior and 4 risers to the annulus.

Events in the history of tank 1 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 the Works Technical Report for that month. The period this history covers is from November 1954 through December 1974.

SUMMARY

Tank 1 was placed in service as a receiver of HW in October 1954. The supernate was removed from the tank in October 1961 and the tank began receiving LW in January 1962. The LW supernate was decanted in October 1962 and prior to beginning a second HW filling in April 1963. The supernate from this HW filling was decanted twice in 1969. Sludge removal operations were conducted in May and August 1969 in order to use tank 1 for salt storage. The first evaporator concentrate receipt was in September 1969 and tank 1 has only been used as a salt storage tank since. Leakage from the tank into the annulus was discovered in February 1969. Deposits less than ¼ inch deep of leaked waste were found on the pan floor. However, no leaksites have been found.

Inspections of the tank interior and annulus were made by direct observation and by using a 40-ft optical periscope. Samples of sludge, supernate, tank vapors, and leaked material into the annulus were analyzed and tank temperature profiles were taken. Deflection measurements were made of the primary tank bottom knuckle plate while filling the tank with salt. Two vertical cooling coils have failed. Several equipment modifications and various equipment repairs were made.

DISCUSSION

OVERALL CHRONOLOGY

In October 1954, tank 1 was placed in service as a receiver of HW from the Purex process in Building 221-F. The tank was filled by July 1955 and remained so until October 1961 when the supernate was decanted from the sludge. In January 1962, the tank began receiving LW which was decanted in October 1962 and April 1963. A second HW filling was begun in April 1963. During this

filling with HW, the fission product heat peaked at about 6 million Btu/hr. and sludge temperatures measured as high as 344°C. These figures are maximums experienced for Savannah River Plant waste tanks. In February and May 1969, the supernate was decanted. In order to prepare tank 1 for salt storage, sludge removal operations were performed in May and August 1969. Sludge removal was conducted to ensure that the salt would be on a firm base thus avoiding tank roof overloading from salt buildup on the vertical cooling coils, which are suspended from the roof. The first sludge removal operation was not completely successful because the sludge had become compacted and hardened during the high temperatures experienced after the second HW filling. The second sludge removal operation was preceded by a soaking operation to soften the sludge. The tank was then placed in use as a salt storage tank with receipt of the first evaporator concentrate in September 1969.

In February 1969, inspections revealed small waste deposits on the pan floor under the east and west risers. While the tank was inspected through all annulus risers, the location of the leak(s) was not found. Several inspections have been made since the leakage was discovered and the waste deposits appear unchanged. Significant events, including all entries discussed below, are shown on the tank liquid level plot in figure 2. Figure 2 also shows the sludge, salt, and supernate temperatures.

Chronology of Events

Nov 1954	Tank 1 was placed in service receiving HW from the Purex process in Building 221-F.
May 1955	The specific gravity of the supernate was determined.
Jul 1955	The tank was filled to 274 inches.
Oct 1955	The cooling water flow was reduced. All but one coil was valved off.

Apr 1956	A supernate sample was taken and showed a pH greater than 11.
Jul 1956	Reduced cooling water flow to tank 1 was continued to make more cooling available for tank 3.
Sep 1956	Appreciable hydrogen was found in tank 1.
Apr 1957	A supernate sample was taken.
Nov 1957	A supernate sample showed 10.7 g NaOH/l.
Jul 1958	Sludge and supernate samples were taken for analysis by Savannah River Laboratory (SRL).
Oct 1961	Approximately 665,000 gallons of HW were transferred to tank 7.
Jan 1962	Approximately 9,600 gallons of LW were erroneously routed into the spare HW header in 221-F and thence to tank 1.
	The tank began receiving LW from Building 221-F.
Oct 1962	A supernate sample was taken.
	Approximately 128,000 gallons of supernate were transferred to tank 7.
Apr 1963	Approximately 63,000 gallons of supernate were transferred to tank 7, leaving a 29 inch heel in tank 1. Then a second filling with HW from 221-F was begun. The cooling water flow was increased to remove heat being generated by the fresh HW.
May 1963	A supernate sample was taken.
	The reel tape became contaminated and was replaced.
Jun 1963	Temperature profiles were taken.

Jul 1963	Thermocouples were installed to measure sludge temperatures.
	The Coppus blower that purges the tank was inadvertently turned off. During the outage contamination, about 1 rad/hr, was found on the blower discharge and hydrogen in the tank vapor space reached 5% of the lower explosive level (LEL).
Aug 1963	The tank temperature steadily increased since the addition of fresh HW in April. Cooling water flow was increased to reduce temperature.
Sep 1963	The necklace alarm sounded several times and was deactivated. It was found that no steam was being fed to the dehumidifier air heater. Introduction of steam to the heater dried the annulus and the necklace alarm was reactivated.
Oct 1963	An orifice with a 1.68-inch diameter was discovered in the 6-inch cooling water header to tank 1. It was removed to increase cooling water flow to the tank.
Feb 1964	Increased cooling water flow caused a drop of 3°C in the supernate temperature.
May 1964	Hydrogen concentration in the tank vapor space reached 8% of LEL.
	The sludge temperature reached 127°C.
Jun 1964	Hydrogen concentration in the tank vapor space remained high at about 5% of LEL.
	Temperature profiles were taken and the cooling water flow was increased in an effort to decrease temperature in the tank.
Aug 1964	Sludge temperature measured between 170° and 210°C.

The necklace alarm sounded twice during August but inspection of the area beneath the annulus risers revealed no visible liquid.

Preheating of the dehumidification air to prevent condensation formation and evaporate any previously condensed moisture silenced the alarm.

Oct 1964 To improve tank ventilation, permanent air purge facilities with an alarm were installed.

A jet was installed in the annulus to allow transfer of leaked waste into tank 2, should tank 1 fail.

Nov 1964 The pH of the supernate was determined to be greater than 10.

Temperature profiles revealed high and varying sludge temperatures. The maximum temperature observed was 344°C which represents the maximum waste temperature recorded at SRP.

Dec 1964 Two leak detection probes were installed in the annulus replacing the original necklace alarm.

Mar 1965 Sludge temperature profiles were taken.

Nov 1965 An inverted gas collection funnel was installed in the tank.

The apparent viscosity and mobility of the sludge were determined.

May 1966 Cooling water to both horizontal cooling coils was valved off to obtain data on their value in removing heat from the sludge.

Aug 1966 The supernate temperature increased about 5°C because the cooling water flow was decreased and the cooling water inlet temperature was 2°C higher.

Nov 1966	HW receipts from Building 221-F which had been stopped in 1964 were resumed to utilize more of the storage space in tank 1. Water flow to the cooling coils was fully restored.
Dec 1966	Almost 6,000 gallons of an aqueous-organic emulsion, containing an estimated 100 gallons of organic, were transferred to tank 1 from Building 221-F.
May 1968	A one liter sample of supernate was taken.
Sep 1968	The hydrogen concentration reached 10% of LEL with the tank ventilation off.
Jan 1969	A leak detection probe under the west annulus riser alarmed but no leakage was evident from direct visual observation through the riser.
Feb 1969	The leak detection probe installed in the west annulus riser was removed and found to be highly contaminated, 10 rad/hr. Subsequent periscopic inspections made through all four annulus risers revealed leaked waste on the annulus floor under the east and west risers. Approximately 318,000 gallons of supernate were transferred to tank 7.
May 1969	The remaining supernate was transferred to tank 7. Sludge removal was attempted to prepare tank 1 for solid salt storage.
Jun 1969	The tank interior was inspected following the May sludge removal operation and considerable sludge remained. A sharp-edged weighted probe lowered through the risers required several blows to break through a hard crust over the sludge. About 30,000

gallons of water and 20,000 gallons of tank 18 supernate were added to tank 1 with the objectives of protecting the lower portions of the vertical cooling coils from air-induced corrosion and softening the remaining sludge.

Aug 1969 A second sludge removal operation was performed using about 192,000 gallons of water. The tank interior was then periscopically inspected showing extensive areas were still covered with sludge. Although more sludge remained than is normally considered acceptable in a tank to receive evaporator concentrate, further cleaning was not deemed practical in view of the cost and the immediate need to put tank 1 in service.

Sep 1969 The tank was placed in service as a receiver of evaporator concentrate.

Test cooling coils were installed to evaluate roof loading by salt deposits on the cooling coils that are suspended from the tank roof.

Nov 1969 The concentrate supernate was transferred to tank 7.

A device was installed on the side wall of the tank to measure vertical deflection of the bottom knuckle during future filling of the tank.

Soundings at risers 3 and 7 indicated 11½ inches of sludge and 15 inches of salt.

Periscopic inspection of the tank interior through riser 5 showed considerable salt buildup on the cooling coils.

Full cooling water flow was used through 28 of the 34 vertical cooling coils during filling with concentrate.

Comparison was made of sludge removal from tank 1, 2, 3, 9, 10, 11, and 14.

Dec 1969	Salt depth measurements under risers 2, 3, 5, and 6 indicated sufficient salt (20, 21, 19, and 24 inches, respectively) had deposited on the tank bottom to provide support beneath vertical cooling coils.
Jan 1970	The volume of salt in the tank was estimated to be about 109,000 gallons.
	A periscopic inspection of the tank interior through riser 5 was made.
Apr 1970	A periscopic inspection of the tank interior through riser 5 was made.
May 1970	Tank 1 ventilation was changed to a negative pressure system.
	Knuckle deflection data analysis was reported.
Jun 1970	The transfer jet plugged during recycle of concentrated supernate.
Mar 1971	Four vertical cooling coils were valved off to minimize salt buildup around the suction of the transfer jet. The salt level was 134 inches.
Jul 1971	The concentrated supernate was transferred to tank 18.
Feb 1972	Cooling coils 1 and 2 failed.
Mar 1972	Periscopic inspections were made in the south, east, and west annulus risers. Salt deposited from leaked waste was found under the east and west riser. A sample of the deposit under the west riser was highly radioactive.
Feb 1973	A supernate sample was taken for analyses by SRL.
Apr 1973	Two leak detection probes in the annulus were replaced.

Jul 1973 A periscopic inspection of the annulus was made. Waste deposits appeared unchanged since the previous inspection.

Measurements determined the sludge level to be approximately 2.6 inches, the salt level to be approximately 160 inches, and the liquid level to be 198 inches.

Sep 1973 A periscopic inspection of the tank interior through riser 5 was made.

The reel tape cable was changed.

Nov 1973 Modifications were made to the leak detection probes.

May 1974 A Food Instrument Co. reel tape was installed.

Jul 1974 The steam jet installed in October 1964 was replaced.

Aug 1974 Three 200 ml samples were taken to be used by SRL in waste-solidification studies.

Sep 1974 Periscopic inspections in the south and west annulus risers showed no change in the waste deposits.

The cooling coils were valved off to allow the tank contents to increase to 38-55°C to avoid nil-ductility transition temperature (NDTT) in the tank steel. On August 26 the bypass valve around the coils at the tank was opened slightly allowing water to flow through the tank condenser.

The reel tape was removed from service due to recurring malfunction.

Oct 1974 Cooling water flow was resumed to one of the bottom coils since the tank temperature had increased to 54°C.

Nov 1974 The reel tape was returned to service after being inoperable for 10 weeks.

LEAKAGE INTO ANNULUS

Tank 1 was placed in service as a HW receiver in 1954. The tank had been filled twice by late 1964 and remained full until early 1969 when the supernate was transferred to other tanks to prepare tank 1 for a sludge removal operation. Evidence of tank 1 leakage was found on February 5, 1969, when a leak detection probe was removed from the west riser and was found to be contaminated. Further investigation showed small salt deposits under the east and west annulus risers. Although the location of the leak is unknown, periscopic annulus inspections and the location of the salt deposits suggest the leak site may be in the tank bottom. Subsequent inspections have shown the leaked waste deposits have remained unchanged since they were first discovered and no new leaks or leak sites have been seen. There has never been a substantial amount of liquid seen in the annulus; only low levels of moisture from rainwater inleakage and dehumidification air condensate.

INSPECTIONS OF TANK INTERIOR AND ANNULUS

The necklace alarm sounded several times in September 1963 and twice in August 1964 but annulus inspections revealed no visible liquid. Preheating the dehumidification air eliminated condensation on the tank wall and silenced the alarms. A tank leak was indicated in February 1969 when a leak detection probe was removed and found to be contaminated. Subsequent inspections showed leaked waste salt deposits on the primary tank grout pad under the east and west risers. No changes have been observed in these salt deposits since they were initially found. No leak sites have been observed. Periscopic visual and photographic inspections were made of the tank interior in June and August 1969 to evaluate the effectiveness of sludge removal operations.

Composite photos of the horizontal welds were made from the periscopic pictures taken in the 1972 annulus inspection. These are shown in figures 3, 4, and 5 and were obtained by fitting together black and white prints of color photographs. The top, middle, and bottom welds are shown as seen from the

annulus riser indicated. Extreme distortion results in an illusion that half of the tank periphery is visible whereas less than 10% is actually visible from each riser. The distortion is due to the great difference in distance between the periscope lens and the near wall (12 to 18 in.) and between the lens and the visual point of tangency with the tank wall (10 to 12 feet). As a result, the horizontal weld visible in most picture segments can be seen to occupy 5 to 30% of the height of the central portion of each composite, diminishing to a faint line at the visual point of tangency. The annulus duct is visible in the bottom strip of each figure. All inspections are shown in figure 2 while table 1 gives a list of all color photographs that are available.

Chronology of Events Related to Inspection

Aug 1964 — The necklace alarm sounded on two occasions during August, but inspection of the area beneath the four annulus risers revealed no visible liquid. The alarm was corrected the first time by preheating the high-humidity dehumidification air to prevent condensation formation and to evaporate any moisture previously condensed or seeping through the outer concrete wall. When the dehumidification air temperature was returned to "normal" after the annulus was dried out, the alarm sounded the second time. Air preheating was again employed.

Jan 1969 — A leak detection probe under the west annulus riser alarmed but no leakage was evident from direct visual observation through the riser.

Feb 1969 — Evidence of tank 1 leakage was found on February 5 when the leak detection probe installed in the west annulus riser was removed and found to be highly contaminated (10 rad/hr.). The probe installed in the east annulus riser was removed but was not contaminated. A direct visual inspection was made in the south annulus riser followed by periscopic visual and photographic inspections in the east, west, and south risers. Small

deposits of yellowish saltlike crystals were observed on the annulus floor under the east and west risers. A smear became highly contaminated when it contacted these deposits. Although the location of the leak is unknown, the absence of waste on the 25% of the exterior tank wall that has been inspected with the periscope and the appearance that the waste has collected on and at the toe of the sloped edge of the grout pad on which the tank rests (figure 6) indicates that the leak may be in the tank bottom.

Jun 1969 The tank interior was inspected following the May sludge removal operation. Figure 7 shows the sludge layout as determined from these inspections. Figure 8 shows one of the remaining sludge mounds. The abnormally hard nature of some of the remaining sludge was confirmed June 6 by lowering a sharp-edge weighted probe through available risers. Several blows of the probe were required to break through a crust over the 3-to-4-inch deep sludge layer under riser 2, after which the probe readily penetrated the remainder of the layer.

Aug 1969 A second sludge removal operation was performed and the tank interior was periscopically inspected following the operation. The inspection showed extensive areas were still covered with sludge (figure 9).

Nov 1969 A periscopic inspection of the tank interior through riser 5 showed considerable salt buildup on the vertical cooling coils.

Jan 1970 A periscopic inspection of the tank interior through riser 5 was made.

Apr 1970 A periscopic inspection of the tank interior through riser 5 was made.

Mar 1972 Periscopic visual and photographic inspections were made in the south, east, and west annulus risers. Salt was present in the annulus pan below the west riser and a small white deposit was present at the edge of a damp-appearing area on the pan floor adjacent to the east riser. No free standing liquid was observed in the annulus and no leak sites were found. A sample of the deposit under the west riser showed that the material is completely and readily water soluble and is highly radioactive (table 2).

Jul 1973 A periscopic inspection of the annulus was made. Waste deposits appeared unchanged since the previous inspection.

Sep 1973 A periscopic inspection of the tank interior through riser 5 was made.

Sep 1974 Periscopic inspections in the south and west annulus risers showed no change in the waste deposits.

SAMPLES OF TANK AND ANNULUS CONTENTS

Tank contents were sampled and analyzed to characterize the waste several times between April 1956 and August 1974. A sample was taken in May 1968 for an SRL study of palladium-rhodium recovery and in August 1974 for SRL study of waste solidification. The accumulation of hydrogen in the tank vapor space prompted several vapor analyses between September 1956 and September 1968. A sample of the dried waste under the west riser was taken in March 1972. All samplings are shown in figure 2 and all available analytical results are summarized in table 2.

Chronology of Events Related To Sampling

Apr 1956	A supernate sample was taken and showed a pH greater than 11.
Sep 1956	Appreciable hydrogen was found in tank 1.
Apr 1957	A supernate sample was taken.
Nov 1957	A supernate sample showed 10.7 g NaOH/1.
Jul 1958	A sludge and a supernate sample were taken for SRL study.
Oct 1962	A supernate sample was taken of the LW concentrate to determine if it was suitable for processing through the evaporator and storage in uncooled tanks.
May 1963	A supernate sample was taken April 1963.
May 1964	Hydrogen concentration in the vapor space rose to 5% LEL in mid-April and to 8% LEL on April 30.
Jun 1964	Hydrogen concentration continued to run about 5% LEL.
Nov 1964	The pH of the supernate was determined to be greater than 10.
Nov 1965	An inverted gas collection funnel was installed below the supernate surface to collect gas for analysis.
May 1968	A one liter sample of supernate was taken for SRL studies.
Sep 1968	A maximum hydrogen concentration of 10% LEL was observed with the tank ventilation off.
Mar 1972	A sample of the dried salt under the west riser was taken. It was highly radioactive and water soluble.

Feb 1973 A supernate sample was taken for analyses by SRL.

Aug 1974 Three 200 ml samples were taken to be used by SRL in waste solidification studies.

PHYSICAL MEASUREMENTS

Numerous temperature profiles, especially of the sludge, have been made in tank 1. Temperature measurements were of particular interest due to the excessively high temperatures occurring in the sludge when fresh HW sludge was mixed with tank 1's relatively large volume of aged HW and LW sludges. A special thermocouple probe was built and used to make temperature measurements in November 1964 when the sludge temperature peaked at 344°C. Measurements with the probe indicated that the sludge had compacted and hardened due to the high temperatures. The apparent viscosity and mobility of the sludge was measured in November 1965. The measurements indicated the presence of a hard layer at about 11 inches from the tank bottom, over which about 3 inches of mobile sludge had accumulated. Other physical measurements made include specific gravity of the supernate, knuckle plate deflection and salt depth measurements. These events are included in figure 2.

Chronology of Events Relating to Physical Measurements

May 1955 The specific gravity of the supernate was determined.

Jun 1963 Temperature profiles were taken under risers 2 and 7 (figure 10).

Jun 1964 Temperature profiles were taken under risers 1, 5, and 7 (figure 11).

Aug 1964 Maximum measured temperatures of the sludge cycled between 170° and 210°C.

Nov 1964 Temperature profiles revealed high and cyclically varying sludge temperatures (figure 12). The maximum temperature observed was 344°C under riser 2 on November 10. A special thermocouple probe was used to make temperature measurements at known elevations above the tank bottom (figure 13). The height and temperature of a hard surface within the sludge was explored with the probe (figure 14).

Mar 1965 Sludge temperature profiles were made with the thermocouple probe (figure 15).

Nov 1965 The apparent viscosity and mobility of the sludge beneath riser 5 were determined (figure 16).

Nov 1969 A device was installed for measuring the vertical deflection of the bottom knuckle during tank filling with waste salt.

Jan 1970 The volume of salt in the tank was estimated from salt depth measurements and tank transfer data to be about 109,000 gallons on January 19.

May 1970 Analysis of knuckle deflection data indicated an average deflection constant, K_d, of 0.47 mil/inch of water (figure 17). This is greater than the calculated K_d of 0.28 and the 0.27 found in tank 11. This difference implies that some abnormal condition exists in tank 1, such as a somewhat flexible support under the tank bottom near the deflection gage, but there is no evidence as to its nature.

Jul 1973 Measurements were made to determine the sludge, salt, and liquid levels.

COOLING COIL FAILURES

Two cooling coils were found to be leaking in February 1972 during the annual pressure test of relief valves on coils (figure 18). These are the only known cooling coil leaks in tank 1. Figure 2 includes these cooling coil failures.

TESTS CONDUCTED

In May 1966, cooling water to the horizontal cooling coils was valved off to obtain data on their value in removing heat from the sludge. In May 1969 sludge removal was attempted so solid salt could be stored in the tank. Poor removal efficiency was experienced. In June 1969, about 30,000 gallons of water and 20,000 gallons of waste were added to soften the sludge. A second sludge removal operation was performed in August 1969. In September 1969, test cooling coils were installed to evaluate the load transmitted to the roof by salt buildup on the roof-supported vertical cooling coils. However, the data resulting from the test were inconclusive (DPSPU 70-11-2). In November 1969, following the removal of supernate from the tank, a device was installed on the tank to measure vertical deflection of the bottom knuckle during filling of the tank with salt. Significant events relating to these subjects are discussed below and included in figure 2.

Chronology of Events Relating to Tests Conducted

May 1966 — Cooling water to both horizontal cooling coils of tank 1 was valved off on May 17 to obtain data on their value in removing heat from the sludge.

May 1969 — Sludge removal was attempted in order to use tank 1 for solid salt storage. Sludge removal was required to ensure that stored salt would rest on a firm base. On May 19 and 20, 331,000 gallons of water were added to the tank and the sludge

was slurried with high pressure water jets. Following slurry transfer from the tank, a considerable amount of the original 41,000 gallons of sludge remained.

Jun 1969 About 30,000 gallons of water and 20,000 gallons of tank 18 supernate were added to tank 1 on June 6, with the objectives of protecting the lower portions of the vertical coils from air-induced corrosion and softening the remaining sludge.

Aug 1969 A second effort to remove the sludge from tank 1 was made on August 6 and 7. Much of the sludge remaining was removed. Inspection photographs taken from four risers showed 53% of the tank area free of visible sludge above the 5 inch liquid heel, 12% of the area covered with sludge greater than 5 inches deep, and 35% of the area indeterminate because of inadequate visibility.

Sep 1969 Test cooling coils were installed to evaluate the load transmitted to the roof by salt deposited on the coils that are suspended from the tank roof.

Nov 1969 A summary comparing sludge removal from seven tanks (1, 2, 3, 9, 10, 11, and 14) to date revealed that tanks 1 and 11 differ from the other five tanks in that they were filled more than once with sludge-bearing waste, had received Purex LW, and experienced the highest sludge temperatures for the longest time.

Full cooling water flow was used through 28 of the 34 vertical cooling coils during filling with concentrate, whereas water flow through coils in tanks 2 and 3, also in concentrate service, was limited by 1/8-inch orifices.

EQUIPMENT MODIFICATIONS AND REPAIRS

Several reel tape replacements and repairs were made between May 1963 and November 1974. Permanent air purge facilities were installed for hydrogen removal in October 1964, then changed to a negative pressure ventilation system in May 1970. In October 1964, a steam jet was installed in the annulus to provide for transfer of leaked waste into tank 2, should tank 1 fail. This jet with a bore carbon steel discharge line was replaced in May 1974 with a jet having a stainless steel discharge line jacketed with a carbon steel line. In December 1964, the necklace alarm was replaced by two leak detection probes that were installed in the east and west risers. These probes were replaced in April 1973 and again in November 1973. These and other equipment modifications and repairs are noted below and in figure 2.

Chronology of Events Relating to Equipment Modifications and Repairs

May 1963	The reel tape, which had only a rubber wiper seal, became contaminated and was replaced with a mercury-sealed assembly.
Jul 1963	Four thermocouples were installed under riser 2 to measure sludge temperatures.
Oct 1963	An orifice with a 1.68-inch diameter was removed from the 6-inch cooling water header to tank 1.
Oct 1964	Permanent air purge facilities with an alarm were installed.
	A steam jet was installed in the annulus and connected into the diversion box. A jumper was provided to allow transfer of leaked waste into tank 2, should failure of tank 1 occur.
Dec 1964	Two leak detection probes were installed in the east and west risers, replacing the original necklace alarm.
May 1970	Tank 1 ventilation was changed to a negative pressure system by installing a new blower on the exhaust.

Apr 1973	Two leak detection probes in the annulus were replaced.
Sep 1973	The reel tape cable was changed to obtain agreement with hand-held steel tape measurements.
Nov 1973	Modifications to the leak detection probes included replacement of two probes in the tank, movement of the alarm relay inside the valve house, and installation of relay test switches.
May 1974	A Food Instrument Co. reel tape was installed and tank liquid levels are now recorded in the 242-F control room.
Jul 1974	The steam jet installed in October 1964 was replaced and its bare carbon steel discharge line was replaced with a stainless steel line jacketed with a carbon steel line.
Sep 1974	The reel tape was removed from service due to recurring malfunction.
Nov 1974	The reel tape was returned to service after being inoperable for 10 weeks.

TABLE 1

TANK 1 COLOR PHOTOGRAPHS

Date	Access Port	Object of Photo	PRD Number	Separations Technology File Location Box	Slots
2/7/69	W	Annulus	13193-1 thru 3	11	127-129
2/11/69	W	Annulus	13197-1 thru 24	11 12	130-150 1-3
2/25/69	S	Annulus	13243-1 thru 15	12	4-18
1/19/69	E	Annulus	13216-1 thru 6	12	19-24
2/17/69	W	Annulus	13215-1 thru 10	12	37-46
2/19/69	E	Annulus	13216-7 thru 14	12	47-54
2/14/69	W	Annulus	13214-1 thru 11	12	55-65
3/5/69	E	Annulus	13252-1 thru 2, 4 thru 13	12	25-36
5/22/69	6	Interior	13452-1 thru 12	12	115-126
6/6/69	CTR	Interior	13451-1 thru 12	12	127-138
8/11/69	2	Interior	13574-1 thru 6, 8 thru 13	13	1-12
8/12/69	6	Interior	13577-1 thru 12	13	13-24
8/22/69	1	Interior	13575-1 thru 12	13	25-36
8/25/69	8	Interior	13578-1 thru 12	13	37-48
11/6/69	5	Interior	13769-1 thru 10, 12 & 13	13	121-132
1/19/70	5	Interior	13935-1 thru 12	14	1-12
4/10/70	5	Interior	14097-1 thru 13	14	13-25
3/2/72	W	Annulus, Welds Leakage	15675-1 thru 30	19 19B	1-25 26-30
3/3/72	S	Annulus, Welds	15679-1 thru 4, 6 thru 26	19C	1-25
3/3/72	E	Annulus, Welds	15669-1 thru 23	19D	1-23
6/28/73	W	Annulus, Welds	17145-1 thru 24	41	88-111
9/21/73	5	Interior	17335-1 thru 14	44	108-121
9/12/74	W	Annulus, Welds	18320-1-23	53	10-32
9/13/74	S	Annulus, Welds	18334-1-23	52 53	136-150 1-8

TABLE 2

TANK 1 SAMPLE ANALYSES

	4/56	9/56	9/56	4/57	11/57	7/58	10/62	4/63	3/72	2/73
Type Sample	Supernate	Vapor	Vapor	Supernate	Supernate	Supernate	Supernate	Supernate	Annulus Salt	Supernate
Wt. % Solids	34.1			32.6		38	5.5	35.0		
Wt. % Soluble in H_2O									99	
Organic, %	<0.1									
Specific Gravity	1.220			1.21		1.22	1.298	1.284		
Density, g/l										1.41
pH	>11					>11	10	11		
NaOH, g/l				13	10.7	9				
Na_2CO_3, g/l				33	0.30	39				
$NaHCO_3$					ND	ND				
Reducing Normality	0.712						0.08	<0.01		0.005
Al^{+3} moles/l							0.002			
AlO_2^-, Wt. %								<0.012		
$Al(OH)_4^-$										0.8 moles/l
Cl^-						<0.02 g/l				0.06 moles/l
CO_3^{-2}							0.77 moles /l	0.67 wt.%		<0.1 moles/l
CrO_4^{-2}										0.008 moles/l
F^-										0.002 moles/l
Na^+										10.1 moles/l
NO_3^-							4.35 moles /l	24.6 wt.%		1.6 moles/l
NO_2^-										2.4 moles/l
NH_4^+										7 μg/ml

TABLE 2 (Cont'd)

	4/56	9/56	9/56	4/57	11/57	7/58	10/62	4/63	3/72	2/73
OH^-							0.67 mole /1	2.71 wt.%		6.3 moles/1
PO_4^{-3}										0.08 moles/1
SO_4^{-2}							0.45 moles /1	7.15 wt.%		0.02 moles/1
H_2, %		0.9	0.6							
O_2, %		25.5	17.8							
N_2, %		12.8	81.1							
CO_2, %		0.8	0.5							
Ag, μg/ml										3
Fe, moles/1										$5x10^{-4}$
Hg, μg/ml										30
Pb, μg/ml										<0.2
U, g/1	$8.8x10^{-2}$			$1x10^{-4}$		$4x10^{-2}$				$5x10^{-6}$
Gross Alpha, d/m/ml	$1.52x10^4$			$2.9x10^3$						$<5x10^3$
Gross Beta, c/m/ml	$4.68x10^7$			$1.8x10^7$		$1.88x10^7$	$7.48x10^6$	$1.26x10^6$		$6.0x10^7$
Gross Gamma, c/m/ml	$9.37x10^6$			$9.8x10^6$		$8.7x10^6$	$1.54x10^6$	$3.97x10^5$		$2.0x10^8$
Pu Alpha, d/m/ml	$8.48x10^3$			$2.1x10^3$			$6.3x10^3$	$3.2x10^2$		$4x10^2$
$^{141,144}Ce$, c/m/ml	$4.74x10^5$					$3.8x10^4$				ND
$^{103,106}Ru$, c/m/ml	$1.13x10^6$			$1.1x10^6$		$4.12x10^5$	$1.07x10^4$	$1.4x10^7$*		
^{103}Ru										ND
^{106}Ru, d/m/ml										$1.40x10^8$
$^{89,90}Sr$, c/m/ml	$3.62x10^6$			$1.5x10^4$		$1.77x10^4$*				
^{89}Sr, d/m/ml										$<5x10^3$
^{90}Sr, d/m/ml										$5x10^5$
Zn-Nb, c/m/ml	$3.69x10^6$			$1.2x10^6$		$<5x10^4$	ND			ND
^{134}Cs, d/m/ml									$9x10^7$†	$3x10^8$
^{137}Cs, c/m/ml				$4.7x10^4$		$7.5x10^6$	$1.46x10^6$	$1x10^7$*	$9x10^7$†	$1.4x10^{10}$†
$^{137}Cs/^{134}Cs$ Ratio									87	
^{154}Eu										ND
^{243}Am, d/m/ml										$<5x10^4$

ND = Not detected

* = d/m/ml

† = d/m/g

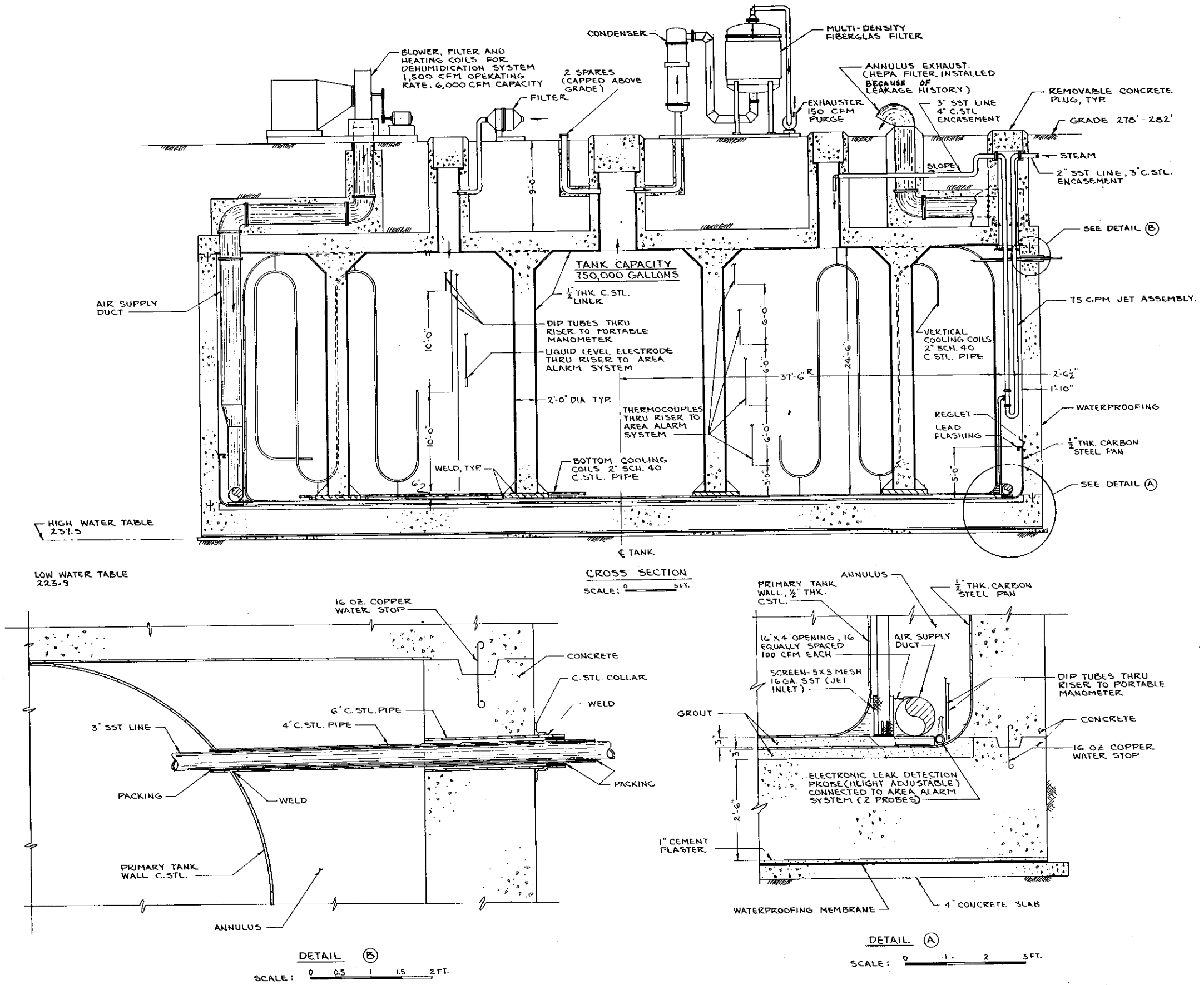

FIGURE 1. WASTE STORAGE TANK 1

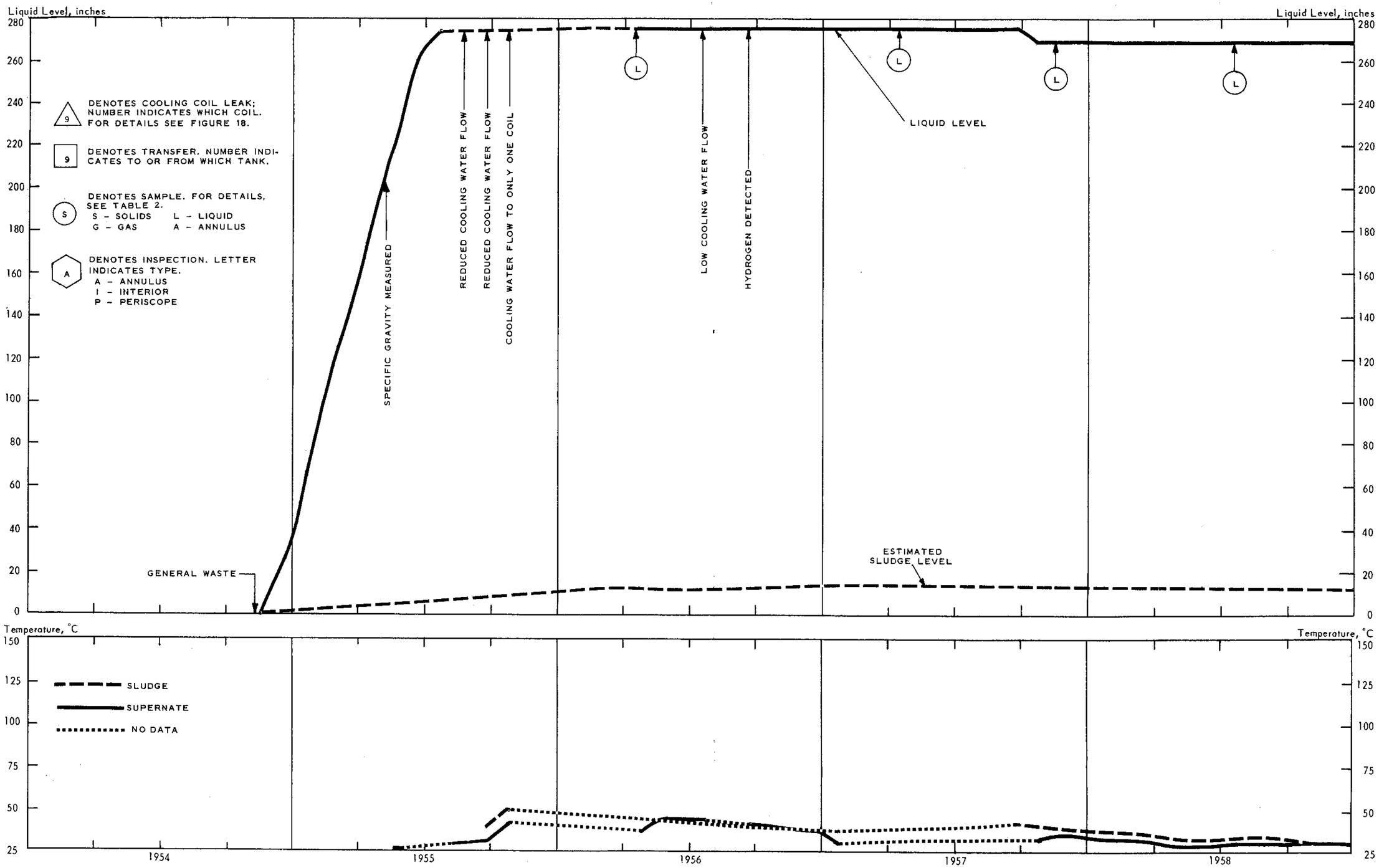

FIGURE 2. TANK 1 LIQUID LEVELS AND TEMPERATURES

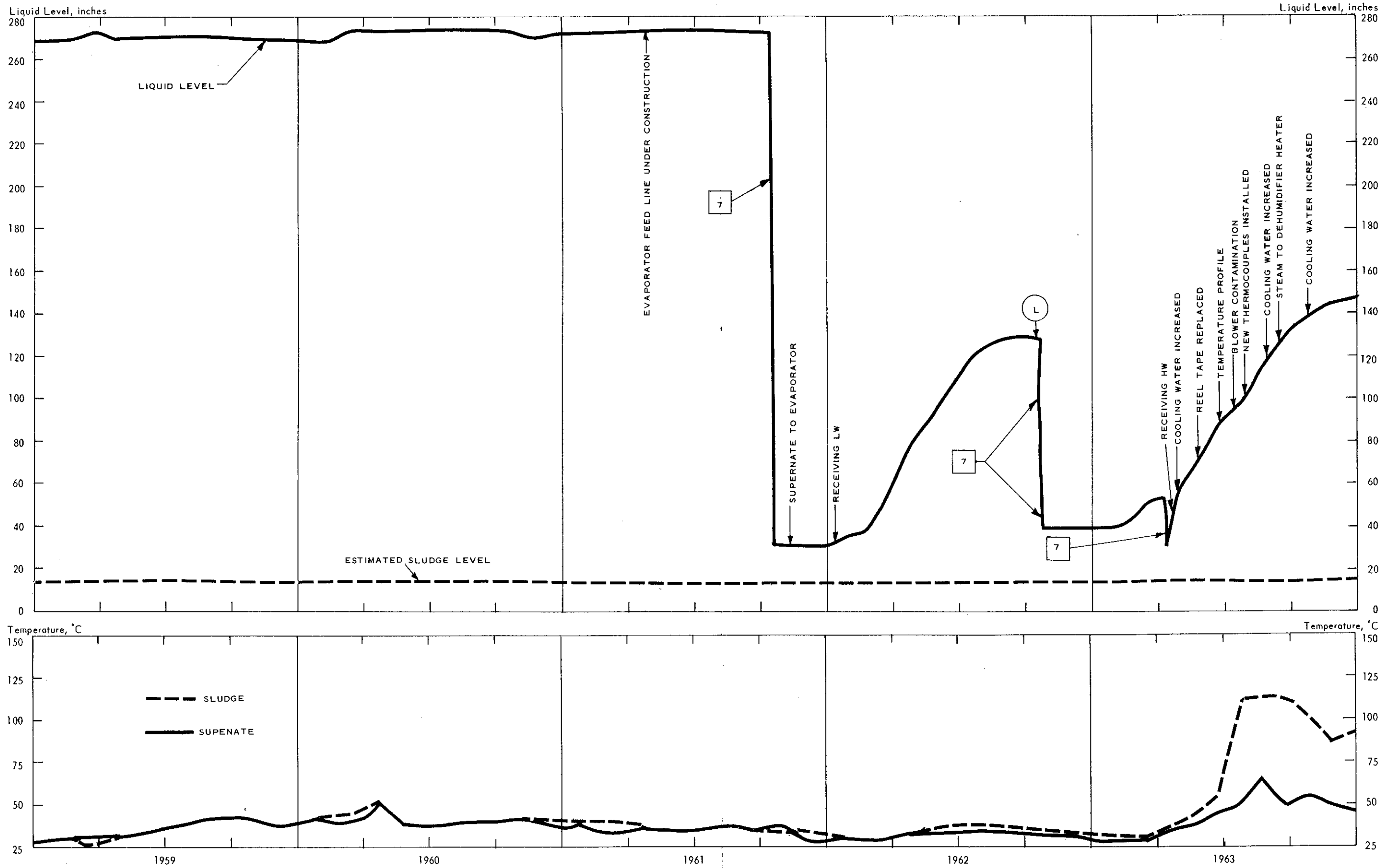

FIGURE 2 (contd)

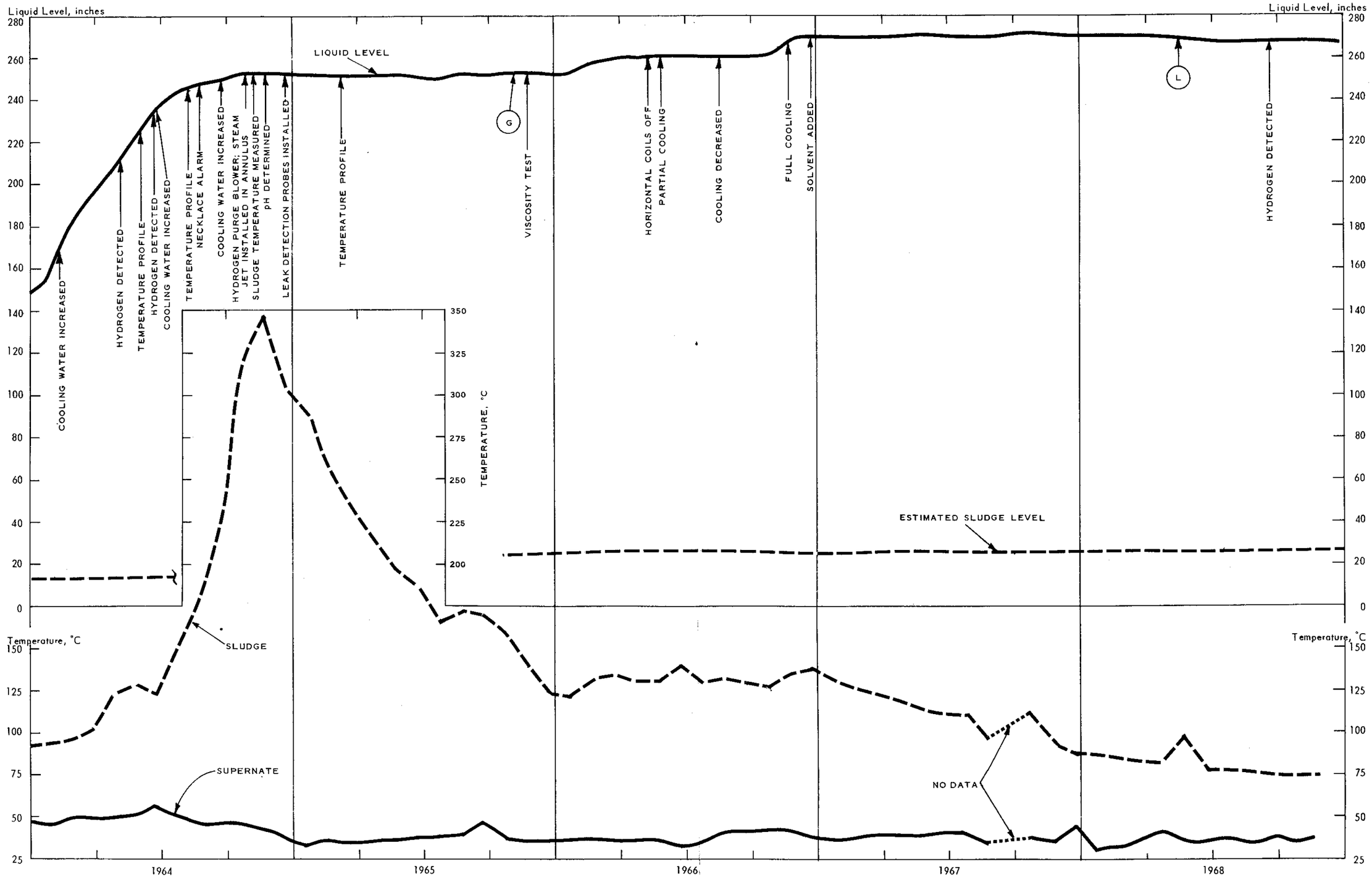

FIGURE 2 (contd)

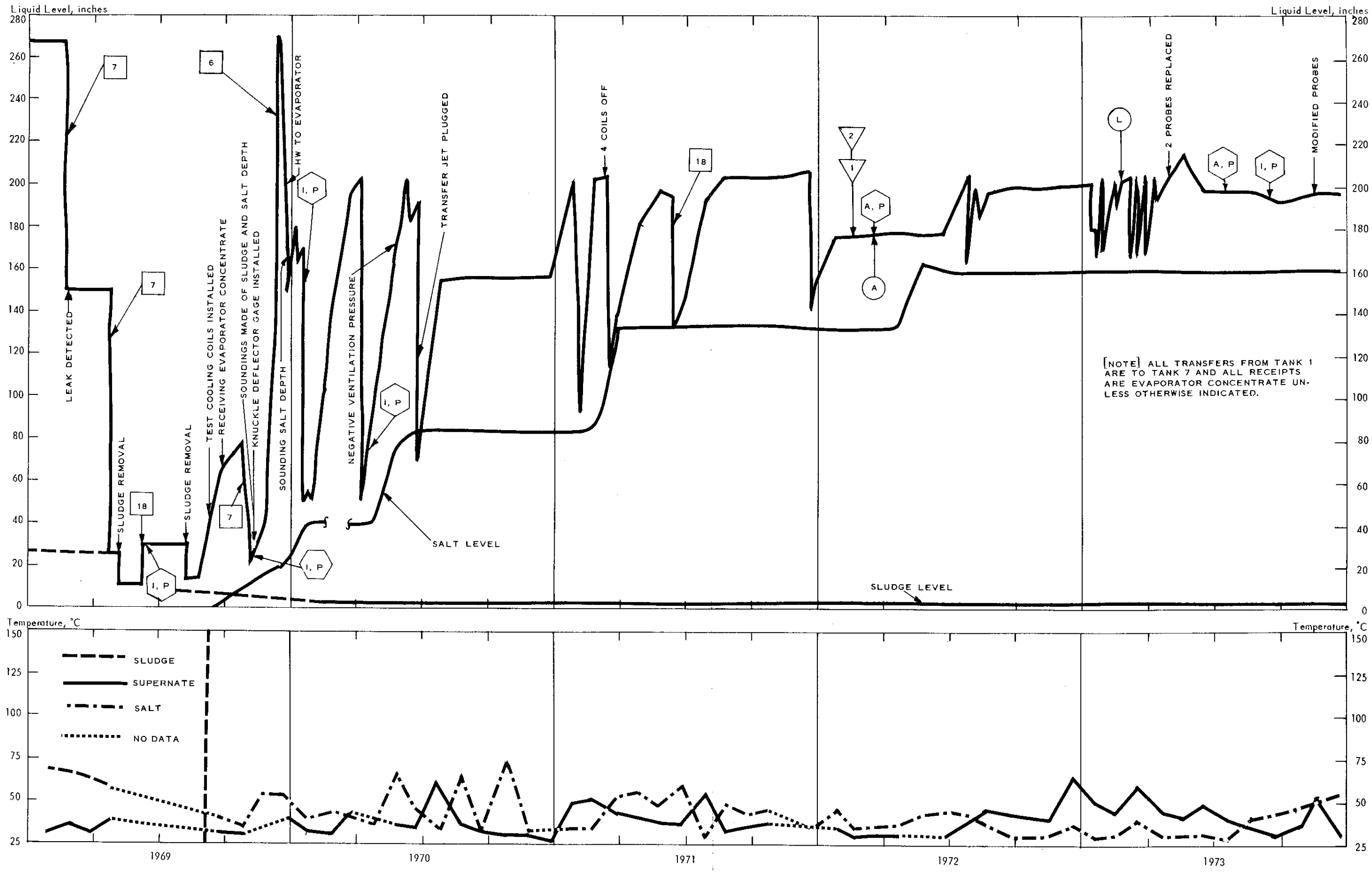

FIGURE 2 (contd)

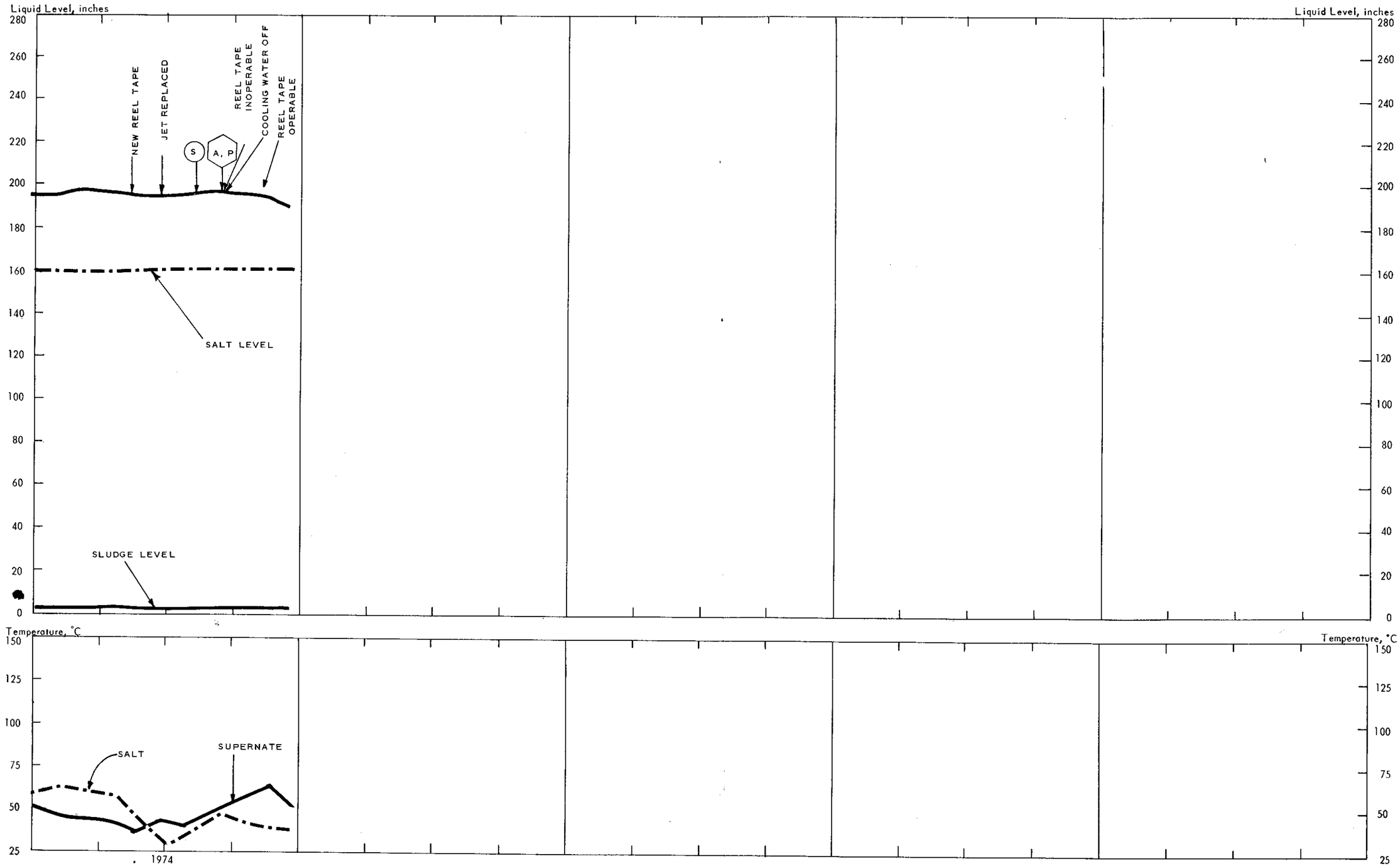

FIGURE 2 (contd)

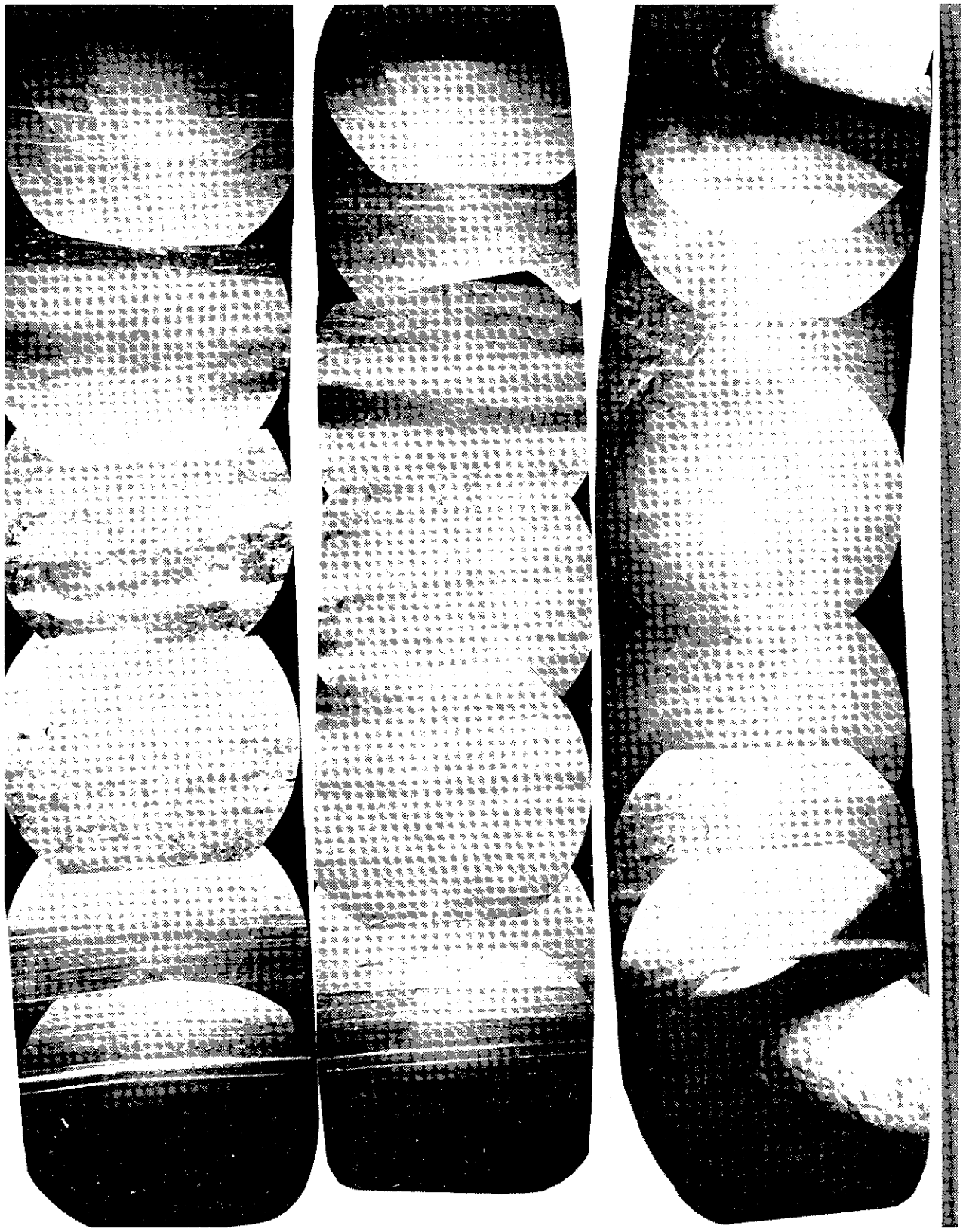

FIGURE 3. TANK WALL FROM EAST INSPECTION PORT

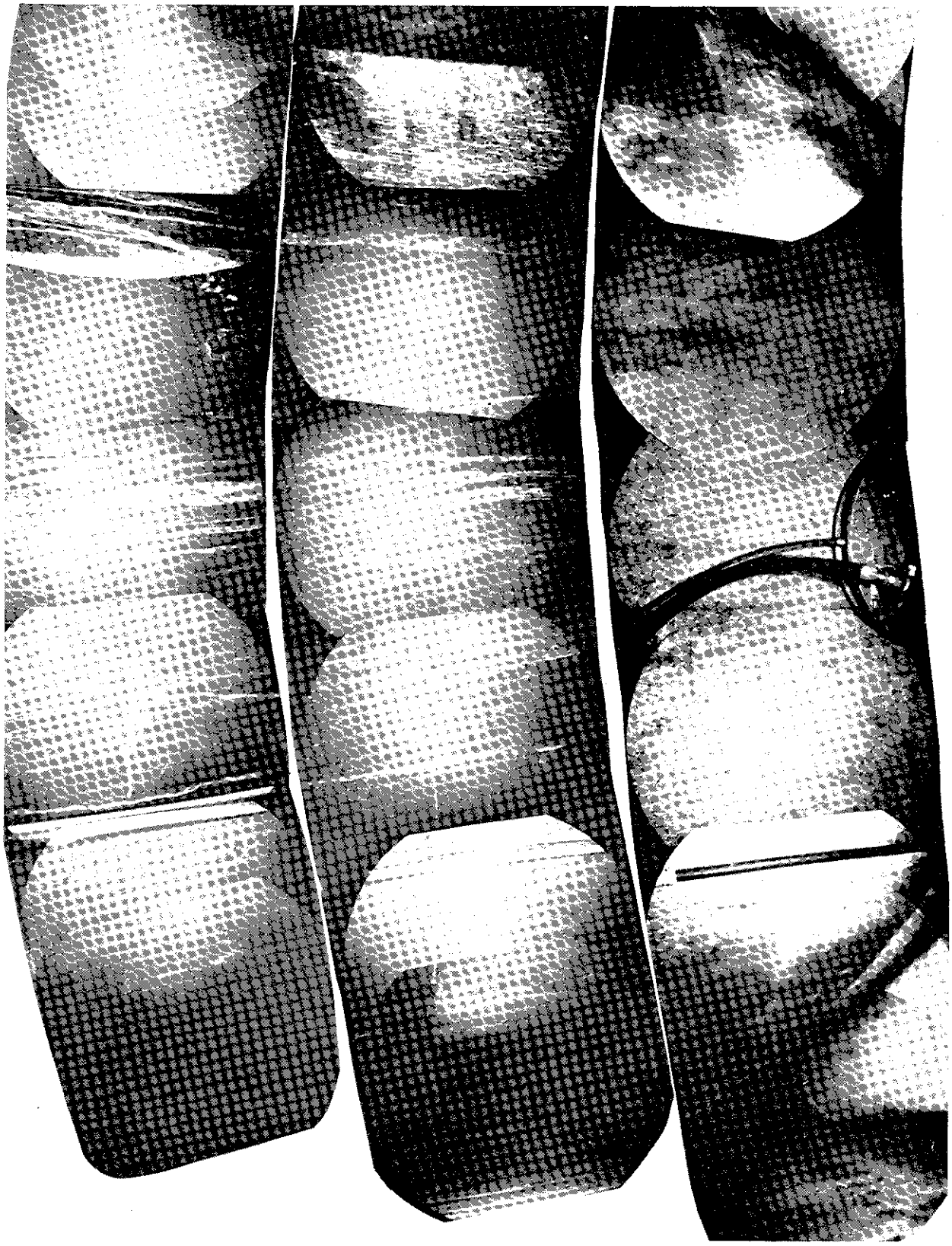

FIGURE 4. TANK WALL FROM SOUTH INSPECTION PORT

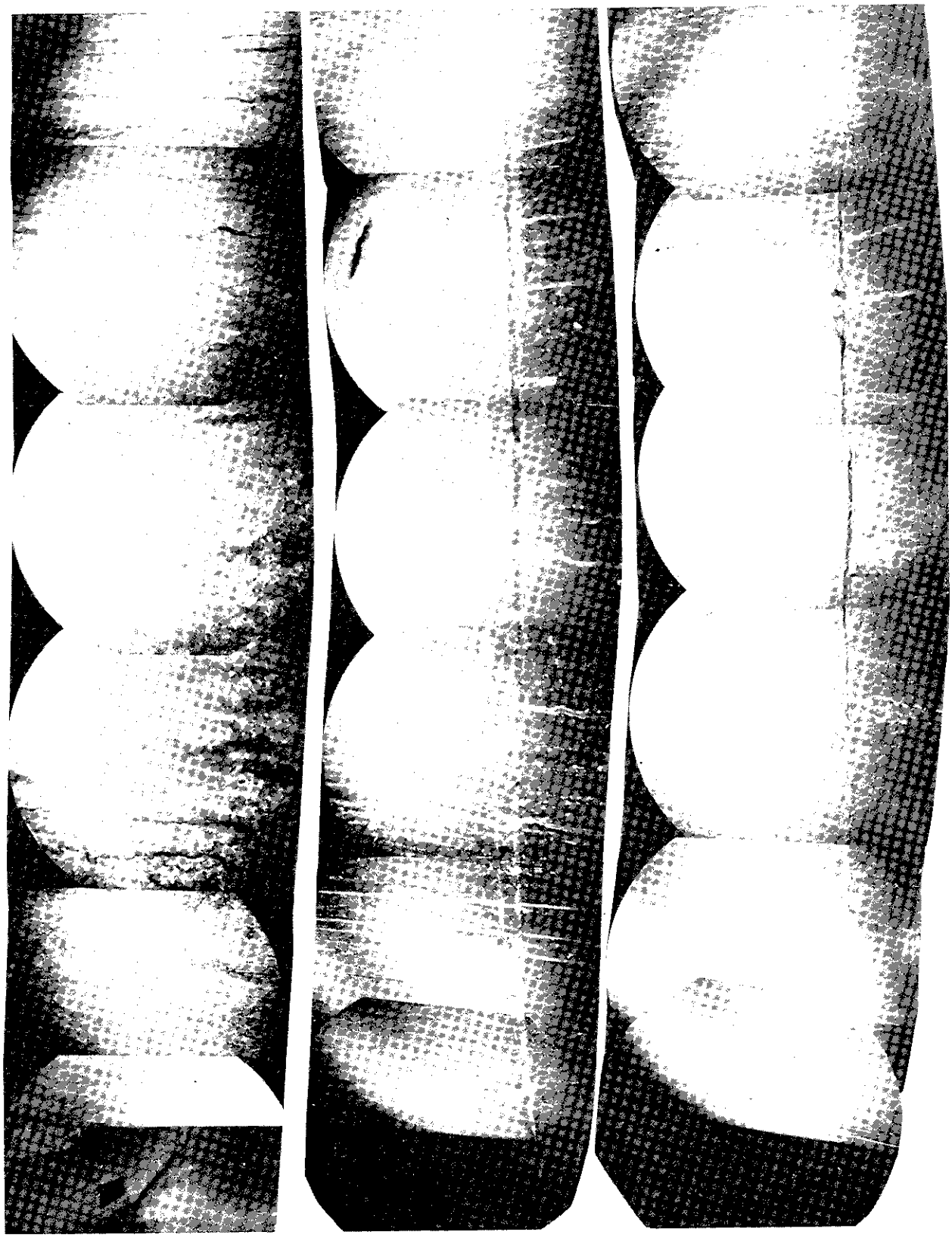

FIGURE 5. TANK WALL FROM WEST INSPECTION PORT

FIGURE 6. DRIED WASTE IN TANK 1 ANNULUS. DPSPF 13255-1.

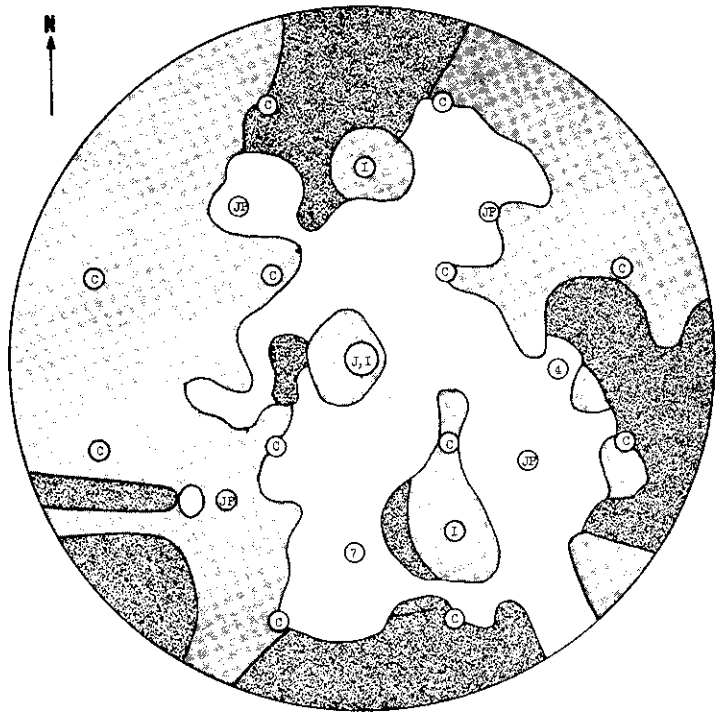

FIGURE 7. RESIDUAL SLUDGE DISTRIBUTION AFTER INITIAL CLEANING

JP	Slurring Jet & Pump Locations		Clean Sludge: <4" Deep
J	Slurrying Jet Only		Sludge: >4" Deep
I	Inspection Periscope Locations		Indeterminate Regions
4	Other Risers		
C	Roof Support Columns		

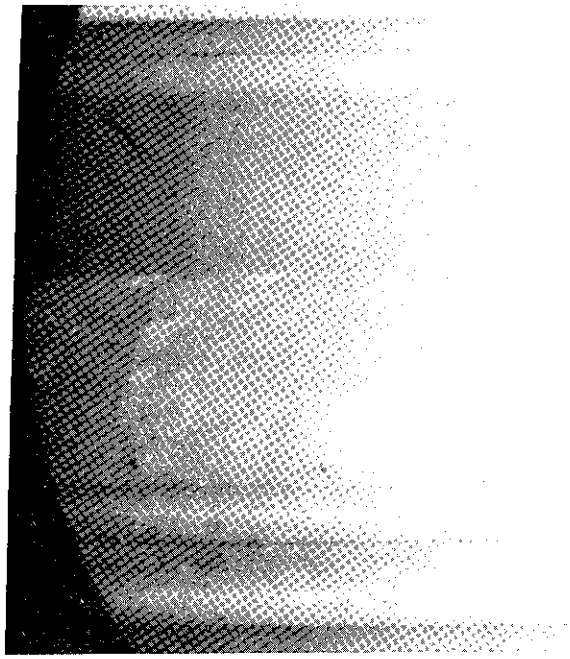

FIGURE 8. RESIDUAL SLUDGE BEHIND SSE COLUMN OF TANK 1 AFTER INITIAL SLUDGE REMOVAL. DPSPF 13426-6

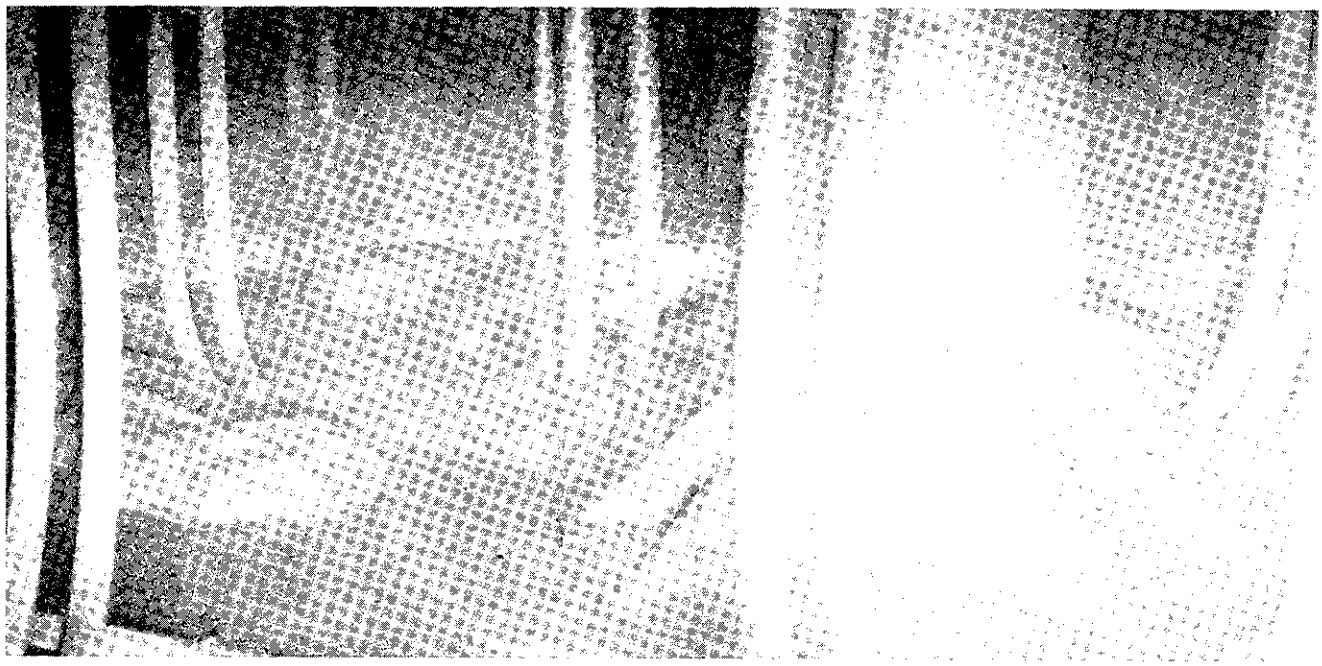

FIGURE 8. RESIDUAL SLUDGE BEHIND SSE COLUMN OF TANK 1 AFTER INITIAL SLUDGE REMOVAL. DPSPF 13426-6

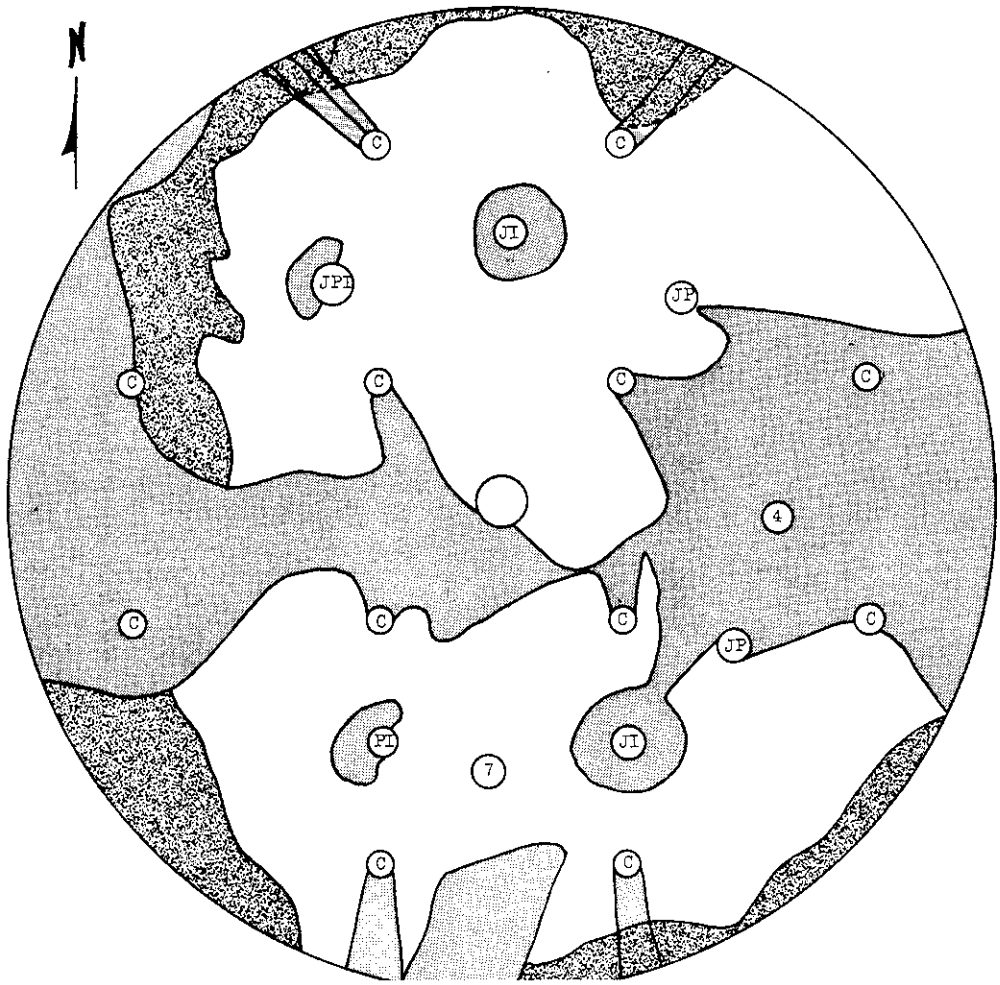

FIGURE 9. RESIDUAL SLUDGE DISTRIBUTION AFTER SECOND CLEANING

- JP — Slurring Jet & Pump Locations
- J — Slurrying Jet Only
- I — Inspection Periscope Locations
- 4 — Other Risers
- C — Roof Support Columns
- Clean Sludge: <4" Deep
- Sludge: >4" Deep
- Indeterminate Regions

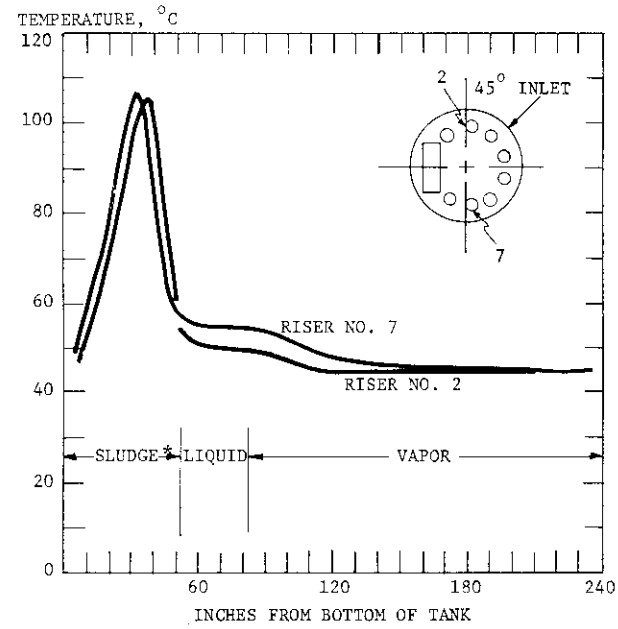

FIGURE 10. TEMPERATURE PROFILE - JUNE 1963

* SLUDGE-TO-LIQUID INTERFACE MEASURED 52" APRIL 1, 1963 (SEE REPORT DPSP 63-60-4).

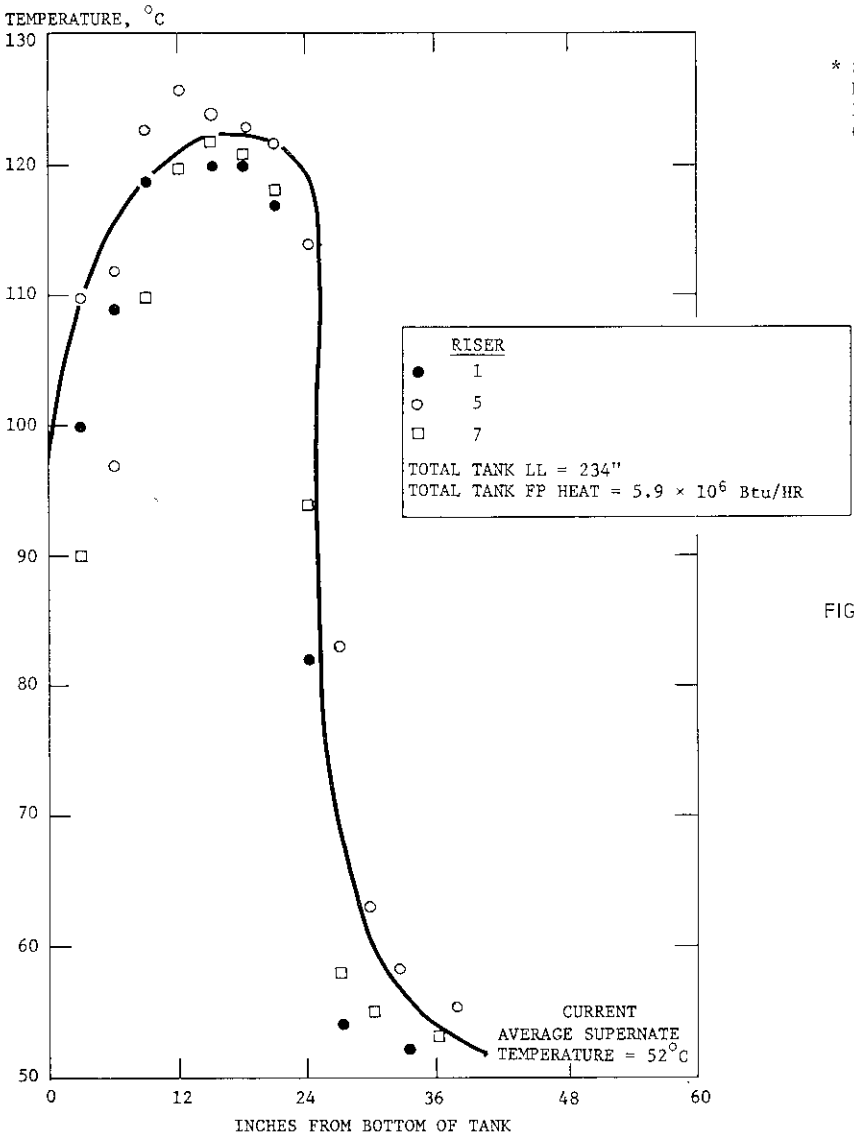

FIGURE 11. TEMPERATURE PROFILE - JUNE 1964

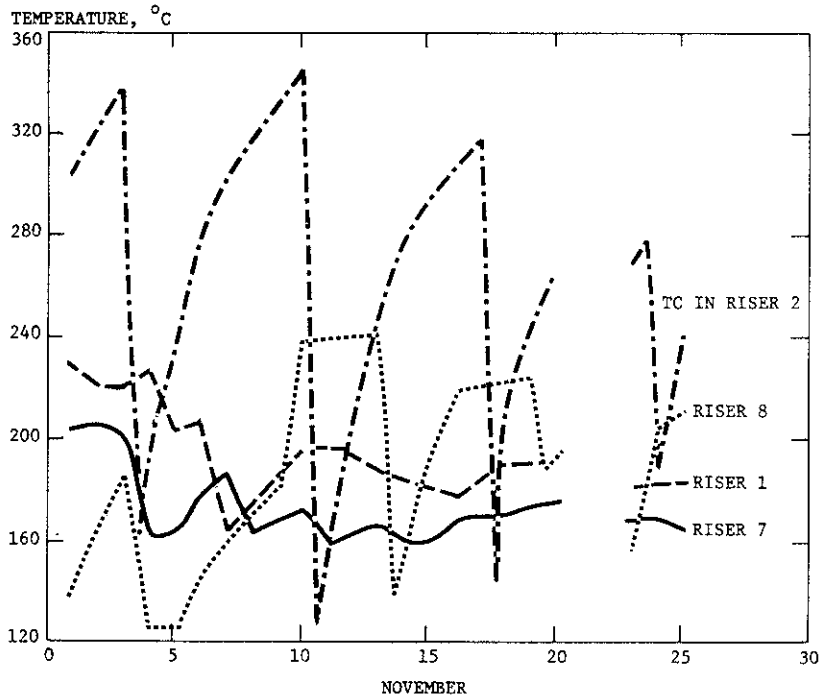

FIGURE 12. TANK SLUDGE TEMPERATURES – NOVEMBER 1964

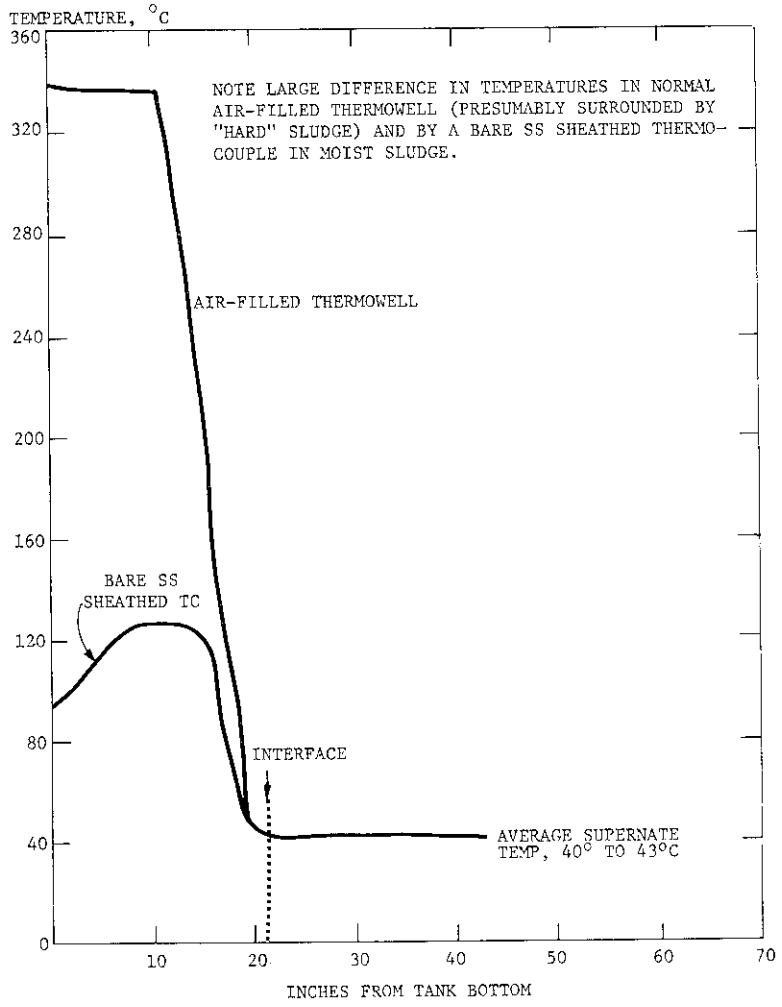

FIGURE 13. TEMPERATURE PROFILES – RISER 2, NOVEMBER 1964

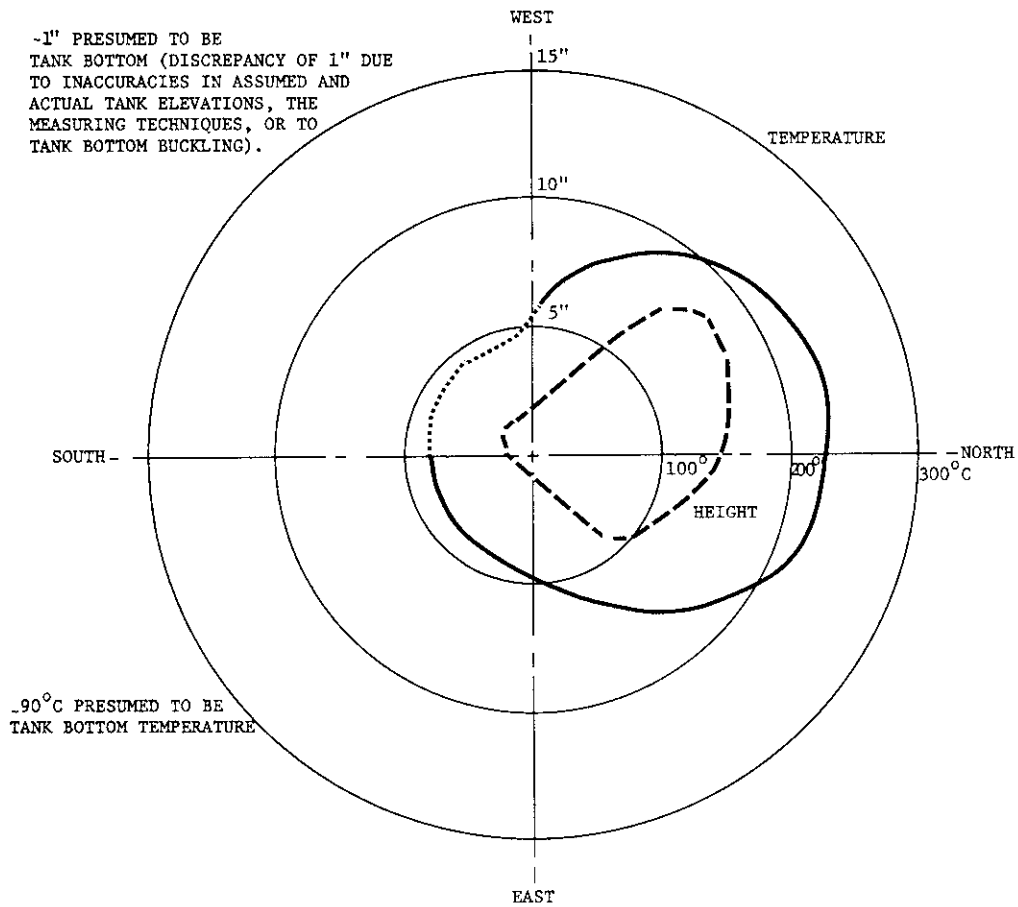

FIGURE 14. HEIGHT AND TEMPERATURE OF "HARD" SLUDGE - RISER 2, NOVEMBER 1964

NOTE PRESENCE OF HARD, HOT MOUND AS INDICATED BY TEMPERATURE AND HIGHT MEASURED WHILE ROTATING A TC GUIDE PIPE WHICH WAS UN-INTENTIONALLY CURVED ON UNKNOWN AMOUNT, AND BY PRESSING THE TC AGAINST THE HARD SURFACE.

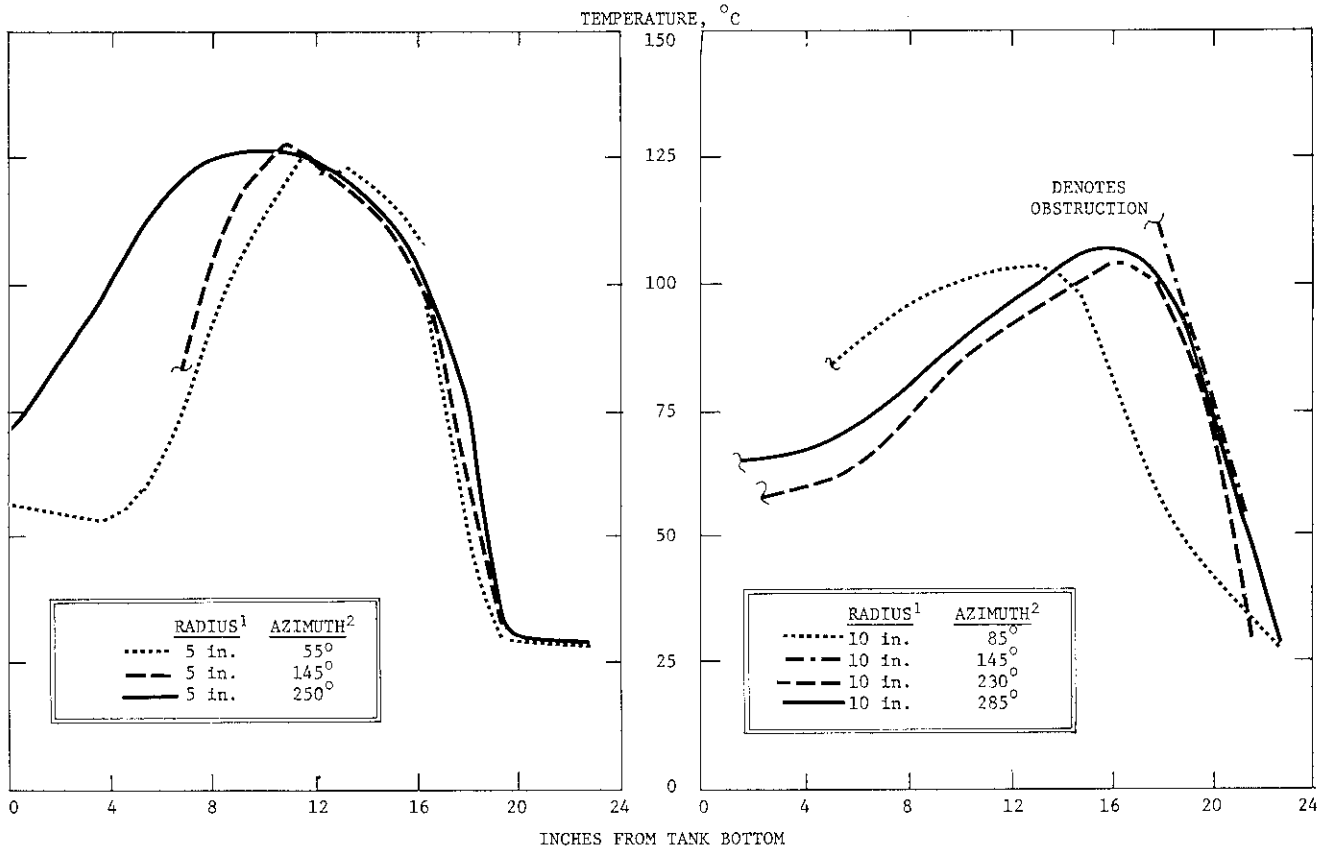

FIGURE 15. SLUDGE TEMPERATURES – RISER 1, MARCH 1965

[NOTE]
1. RADIAL DISTANCE FROM ASSEMBLY CENTER LINE TO THERMOCOUPLE PROBE TIP.
2. REFERENCE ANGLE BETWEEN DIRECTION JOINTED ARM IS POINTING AND PLANT NORTH (APPROX).

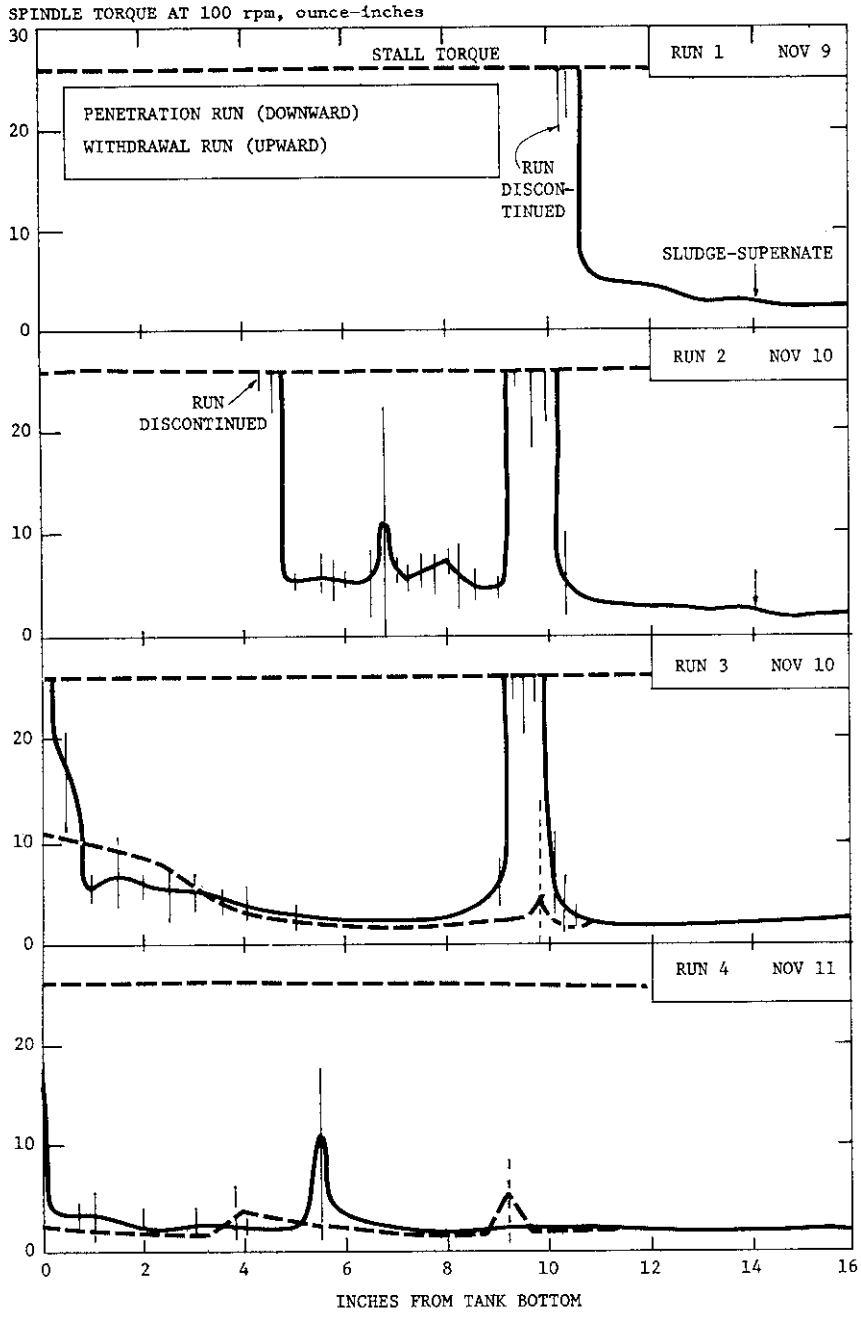

FIGURE 16. SLUDGE VISCOSITY PROFILES - RISER 5

CONDITIONS: SPINDLE, 3-1/2" DIAMETER × 1" HIGH, TWO BLADE PADDLE: 100 rpm SPINDLE DRIVE; 0.5 TO 1.5 IN/MIN VERTICAL MOVEMENT.

[NOTE] VERTICAL LINES SHOW SWING LIMITS OF INDICATED TORQUE WHERE HARDENED SLUDGE WAS ENCOUNTERED.

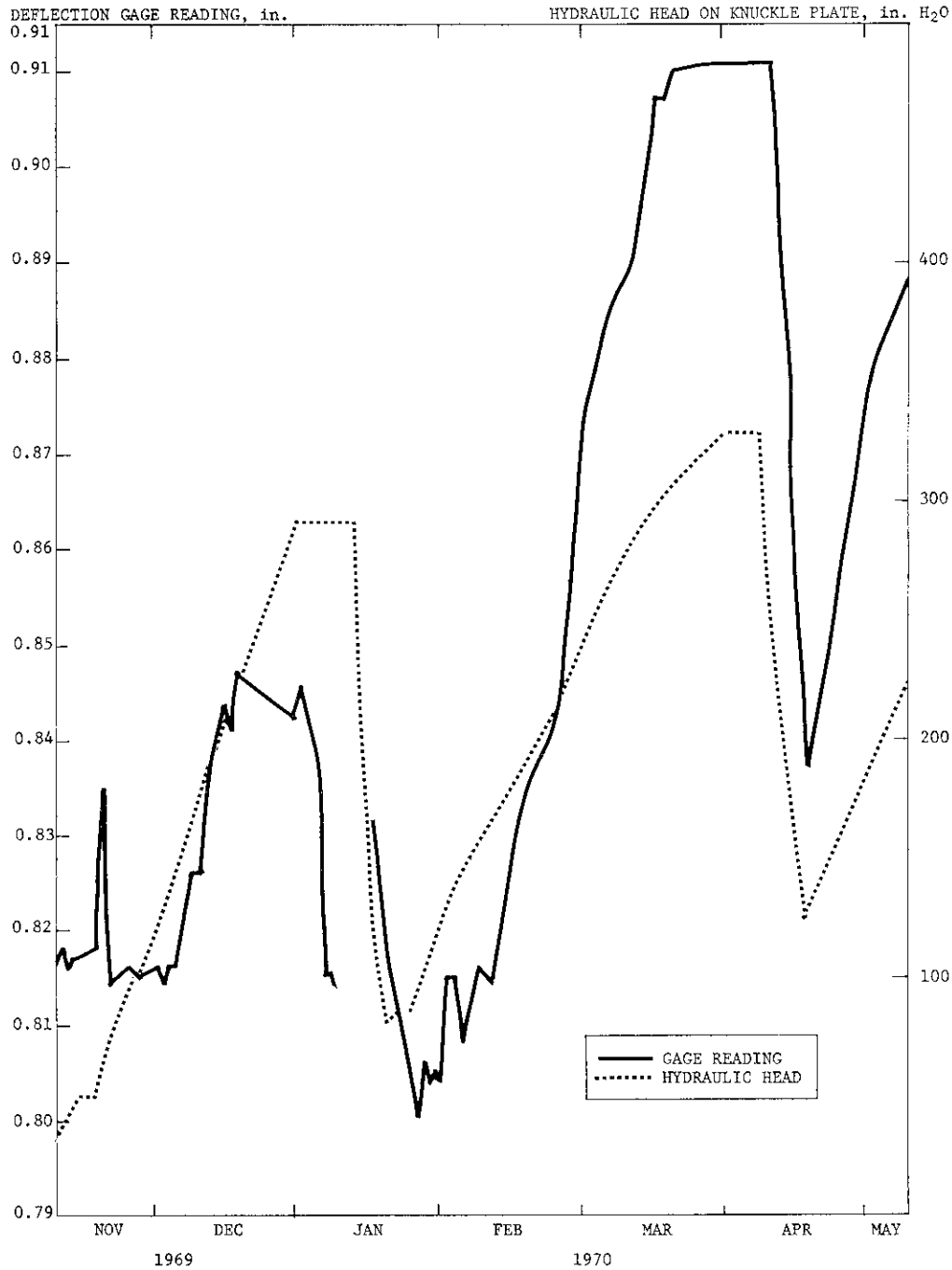

FIGURE 17. TANK 1 KNUCKLE DEFLECTION

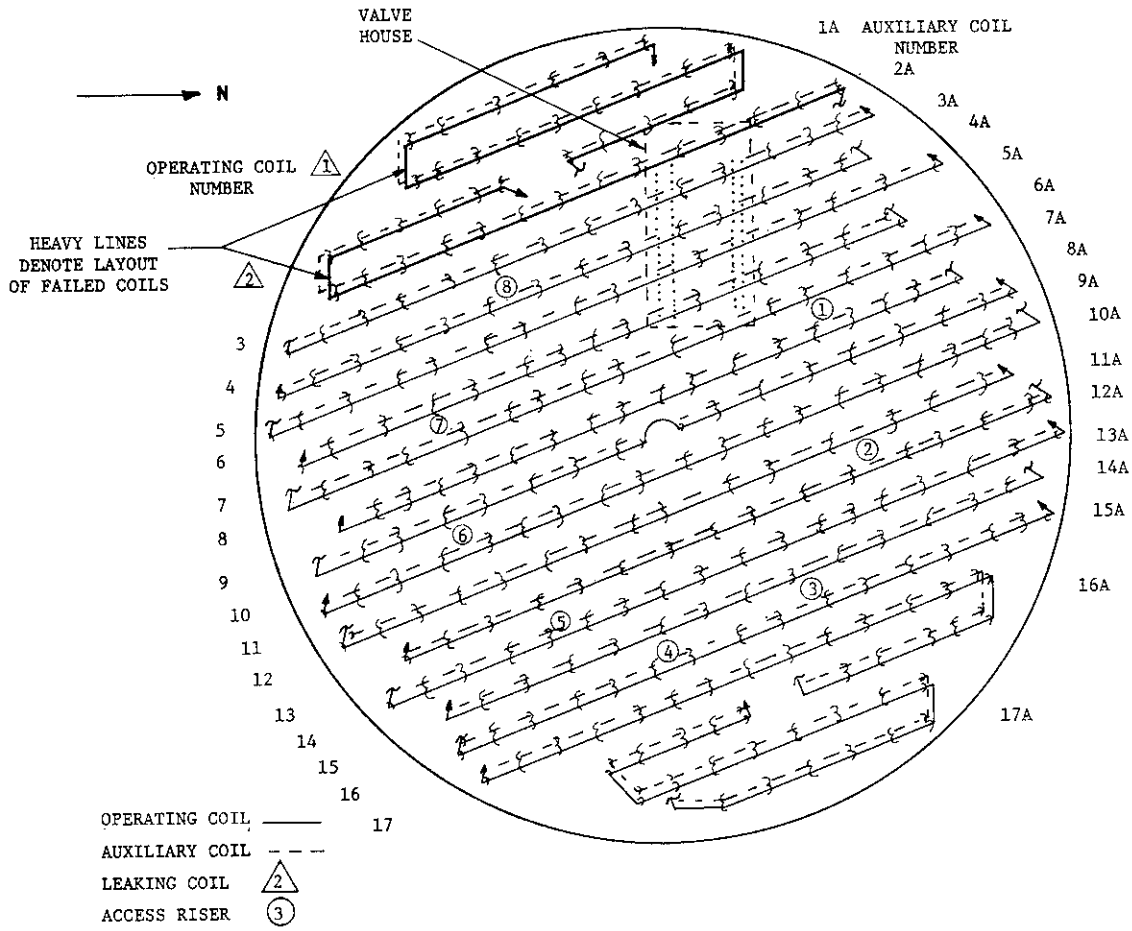

FIGURE 18. TANK 1 VERTICAL COILING COIL LAYOUT

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