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HISTORY OF WASTE TANK 20
1959 Through 1974

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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 HW, while other tanks, without cooling coils, are for LW.

Tank 20 is a 1,300,000 gal, uncooled, type IV tank located in F Area. It is 85 ft in diameter and 34 ft high and is designated for the storage of LW (figure 1). The tank is constructed of type ASTM A-285-54-T grade B steel, with nonstress-relieved welds, and it is inside a concrete vault with a domed concrete roof. Six risers provide access to the tank interior. A leak detection sump is provided for the tank bottom.

Events in the history of tank 20 are listed chronologically in figure 2 and are 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.

This history covers the period from August 1959 through December 1974.

SUMMARY

Tank 20 was placed in service in March 1960 receiving LW concentrate from the Building 242-F evaporator. Then in January 1961 the tank began receiving a blend of LW and HW. The tank was filled by January 1962 and decanted in August 1964. Tank 20 was then filled with HW concentrate twice, beginning in December 1964 and in January 1967, and decanted after each filling. Since January 1971, the tank has been filled several times with LW concentrate and decanted.

The tank interior has been inspected by direct observation and photography using an optical periscope inserted through access risers in the roof. Samples of supernate in the tank and liquid collected in the bottom leak detection sump were analyzed. Temperature profiles and salt sounding were taken and several equipment modifications and repairs were made.

DISCUSSION

OVERALL CHRONOLOGY

In March 1960, tank 20 was placed in service receiving LW from the Building 242-F evaporator. In November 1961, the tank began receiving concentrate that was a blend of LW and HW; by January 1962, the tank was full. The cooled concentrate supernate was decanted in August 1964. The tank was filled with HW concentrate from the evaporator between December 1964 and May 1965 and then decanted in September 1966. It was again filled with HW concentrate from the evaporator between January and June 1967 and then decanted in July 1967. Mixed LW and HW concentrate was received in tank 20 in July and August 1970 and the tank was decanted in January 1971. Since that time, the tank has been filled with LW concentrate from the evaporator and decanted several times.

Significant events including those in the following list 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.

Chronology of Events

Aug 1959 — The bottom leak detection sumps of uncooled tanks 17 through 20 showed water levels of 20 to 30 in. The source of the liquid was unknown.

Oct 1959 — Samples of the water in the bottom leak detection sumps of tanks 17 through 20 were taken. The samples were analyzed for radioactivity (tank 18 contained LW) and iron. The analyses indicated no radioactivity above background and no appreciable tank corrosion (less than 0.01 g of iron/liter).

Groundwater was considered the source of liquid in the bottom sumps of tanks 17 through 20. The water was removed from the sumps several times, but each time the water returned within 24 hours with no detectable loss of liquid from the tanks.

Mar 1960 — All risers on tank 20 were sealed with a mastic compound after smearable contamination was found at one riser on tank 18.

About 18 in. of LW was transferred via Building 242-F evaporator from tank 18 to tank 20 to provide uniform heat distribution over the bottom of tank 20 during the initial fill with concentrated waste.

On March 15 the evaporator was started and tank 20 began receiving LW concentrate.

Apr 1960 — About 146,000 gal of LW concentrate was received from the evaporator since startup.

Temperature profiles were taken (figure 3).

May 1960 — Boiling water was transferred from the evaporator through the steam lift piping to tank 20 to remove pluggage.

Nov 1961 — Tank 20 began receiving concentrate containing HW after the evaporator began processing a blend of aged HW and LW.

Jan 1962 — Tank 20 was filled to capacity. The tank had received evaporator concentrate since March 1960.

Measurements that determined that about 70% of the tank content was concentrated supernate were made. A supernate sample was taken to provide data to evaluate the benefits of reprocessing the supernate through the evaporator.

Jan 1963 The salt depth below five risers was measured on January 22. The sounding disk bumped solid formations above the final rest positions, indicating irregular, nonuniform salt formations. The results of these salt soundings were compared to soundings made on January 23, 1962 (table 1).

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

Sep 1963 From August 28 until October 1, the water level in tank 20 bottom leak detection sump was about 15 in. higher than the water level in the surrounding soil. The implication was that groundwater entered the sumps, not through cracks in the concrete base but through an imperfect seal between the steel tank and the base, at a time when the groundwater level was higher than the tank bottom. Piezometer well levels 1 to 2 ft higher than the tank bottom were recorded several times during the preceding 3 years.

Oct 1963 An explosimeter determination of the hydrogen content in the tank vapor space was less than 5% of the lower explosive level.

Nov 1963 A supernate sample was taken.

Feb 1964 During the inspection of tank 19 (which had been in concentrate service similar to tank 20), large flat-topped formations of salt were observed clinging to the thermocouple wells and large mounds of salt were observed around the bases of the thermocouple wells directly under the risers. Since thermocouple wells are located in the east, southwest, and west risers of tank 20, it was concluded that the salt depth measured under these risers in tank 20 on January 22, 1963, were not representative of the general salt depth.

Jun 1964 The transfer jet that was in tank 19 was installed in tank 20, after modification, to place the suction at 8 ft above the tank bottom, the approximate salt depth in the tank. The discharge of the jet was routed to tank 18 via the underground cascade line that originally extended from tank 18 to tank 20. The cascade line was cut at tank 20 and the resulting stubout and encasement pipe were both capped and welded.

Aug 1964 About 920,000 gal of concentrate supernate were transferred from tank 20 to tank 18.

Oct 1964 The tank interior was inspected through the center riser after most of the liquid had been removed. Salt formations were observed on all surfaces that had been submerged in the supernate. The surface of the salt appeared brownish. Figures 4 and 5 give views of the tank interior. A large salt column that had formed around the center thermowell had fallen and bent the well, possibly when the liquid was withdrawn from the tank or when the center riser plug was removed. There was another fallen column under the west riser (tank inlet riser) where the thermowell had been cut off a few months earlier when it would not allow the riser plug to seat after it had been raised a few feet.

Dec 1964 The reel tape was moved from the northeast to the southeast riser to avoid interference by the salt formations below the northeast riser.

HW concentrate from the evaporator was routed to tank 20.

Apr 1966 A pump was installed in the bottom leak detection sump. Water was removed from the sump and no radioactivity was detected in the water.

Jun 1966 Water was pumped from the bottom leak detection sump lowering the level from 52 in. to about 4 in.

Sep 1966 The reel tape became inoperable as the liquid level in the tank was lowered, presumably due to interference from salt formations in the tank.

About 600,000 gal of concentrated supernate were transferred from tank 20 to tank 18.

Feb 1967 Due to delays in startup of the concentrate transfer system (CTS), tank 20 began receiving HW concentrate from the evaporator about January 25, 1967.

Mar 1967 Radiation from the exhaust filter increased from nil to 130 mR/hr after HW concentrate was received in the tank and an exhaust blower was installed to purge H_2 from the vapor space.

Jul 1967 About 433,000 gal of concentrated supernate were transferred from tank 20 to tank 18.

Jan 1969 The liquid level in tank 20 increased steadily from 199.5 in. in July 1967 to 242 in. (about 150,000 gal) in January 1969, although no waste was intentionally added to the tank during this period. The source of the increase was considered to be vapor evolved in the operation of the CTS. Steam from lift operation, vapor from evaporation of concentrate in the CTS pump tank, and steam from the pump tank ventilation jet are all exhausted into tank 18 in the same riser in which tank 18 is vented to tank 20. An exhaust blower at tank 20 draws ventilation air through tank 18 and 20 in series.

Salt soundings were made (table 2).

Apr 1969 Two supernate samples were taken to determine ^{137}Ce and chemical salt contents.

The jet in the tank was modified to recirculate the liquid, thus enhancing salt dissolution, and to provide more representative sampling. These actions were taken in tank 20 in preparation for dissolving and removing the salt as planned under a program to minimize the radioactivity stored in waste tanks without secondary containment.

On March 28, a periscopic inspection was made to determine if the salt formations in the tank had been undercut by the 150,000 gal of condensate accumulated in tank 20 from ventilation of the CTS. All salt formerly present above the liquid level of 245 in. had disappeared except for a very small pile under the inlet riser and a band 2 ft wide extending about 230° around the tank wall at about the 350-in. level.

Jul 1970 — Mixed LW and HW concentrate from the evaporator was routed to tank 20 due to difficulties with the CTS pump.

Aug 1970 — Routing of evaporator concentrate from the evaporator to tank 20 was discontinued.

Jan 1971 — About 434,000 gal of HW concentrated supernate were transferred from tank 20 to tank 18.

May 1971 — On May 5, LW concentrate from the evaporator was routed to tank 20.

Jul 1971 — The bottom leak detection sump pump was repaired.

Routing of LW concentrate from the evaporator to tank 20 was discontinued.

Nov 1971 — Measurements taken at the ventilation exhaust on tank 20 showed the air flow was 266 cfm and the radiation from the filter was 1.1 R/hr at 2 in. Tanks 18 and 20 are ventilated in series with air drawn through tank 18 and exiting through tank 20.

Jan 1972 — About 481,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

LW concentrate from the evaporator was routed to tank 20.

Apr 1972 — Routing of LW concentrate from the evaporator to tank 20 was discontinued.

About 461,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

May 1972 — On May 7, LW concentrate from the evaporator was routed to tank 20.

Jun 1972 — On May 25, routing of LW concentrate from the evaporator to tank 20 was discontinued.

Oct 1972 — LW concentrate from the evaporator was routed to tank 20.

Nov 1972 — On November 13, routing of LW concentrate from the evaporator to tank 20 was discontinued.

Dec 1972 The salt depth was measured below the northwest riser (the jet riser) and found to be 220 in.

On December 4, a periscopic inspection was made through the east riser. No abnormalities were found.

About 304,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

On December 13, LW concentrate from the evaporator was routed to tank 20.

Jan 1973 On January 12, routing of LW concentrate from the evaporator to tank 20 was discontinued.

Jul 1973 Groundwater samples were taken around uncooled tanks 17 through 20. The samples contained no significant radioactivity.

About 140,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

Aug/
Sep 1973 About 564,000 gal of LW concentrate were transferred from tank 20 to tank 18.

On August 23, LW concentrate from the evaporator was routed to tank 20

Oct 1973 A new zero-correction factor was determined and applied to the reel tape.

On September 24, routing of LW concentrate from the evaporator to tank 20 was discontinued.

Nov 1973 About 307,300 gal of LW concentrated supernate were transferred from tank 20 to tank 18 in two parts because the transfer jet became plugged with salt. The transfer was interrupted and the jet was backflushed with water.

On November 9, LW concentrate from the evaporator was routed to tank 20.

Dec 1973 On December 7, routing of LW concentrate from the evaporator to tank 20 was discontinued.

About 88,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

Feb 1974 Liquid-level dip tubes were installed in the bottom leak detection sump that transmit the level to a recorder with an alarm set to activate at 24 in. of liquid.

Jul 1974 About 444,000 gal of LW concentrated supernate were transferred from tank 20 to tank 18.

On July 8, LW concentrate from the evaporator was routed to tank 20.

Aug 1974 A temperature profile was taken (figure 6).

Sep 1974 A portable filter was installed in series downstream of the existing ventilation exhaust filter when air samples were taken at the existing filter after it was observed emitting fog showed it was passing 3.1×10^{-8} μCi/cc beta-gamma and 5.8×10^{-12} μCi/cc alpha. A dioctyl phthalate test of the failed filter showed an efficiency of 95.8% vs. 99.9 + % measured about 1 month earlier.

About 526,000 gal of concentrated supernate were transferred from tank 20 to tank 18.

On September 18, routing of LW concentrate to tank 20 was discontinued.

Oct 1974 On October 2, the failed ventilation exhaust filter was replaced.

Nov 1974 A Food Instrument Company reel tape was installed and connected to alarm at the Building 242-F annunciator panel.

A problem was experienced with the sensing unit on the reel tape.

Dec 1974 Periscopic inspection and photography made of the tank interior revealed no abanormalities.

INSPECTION OF TANK INTERIOR

The interior of tank 20 was inspected by direct observation and photography using an optical periscope through access risers in the roof. Periscopic inspections were made in 1964, 1969, 1972, and 1974 and showed conditions to be normal except that large salt deposits formed on thermowells had bent the wells. All inspections are shown in figure 2.

Color transparencies are isted in table 3.

Chronology of Events Related to Inspection

Oct 1964 Periscopic inspection and photography of the tank interior were performed. Figures 4 and 5 are views of the tank interior where large salt columns had formed on thermowells and bent them.

Apr 1969 Periscopic inspection and photography of the tank interior revealed no abnormalities.

Dec 1972 Periscopic inspection and photography of the tank interior revealed no abnormalities.

Dec 1974 Periscopic inspection and photography of the tank interior revealed no abnormalities.

SAMPLES

Tank contents were sampled in 1962, 1963, and 1969. Samples of water from the bottom leak detection sump showed no radioactivity above background. All samplings are indicated on figure 2 and analytical results of tank contents samples are summarized in table 4.

Chronology of Events Related to Sampling

Oct 1959 Samples of the water in the bottom leak detection sumps of tanks 17 through 20 were taken. The samples were analyzed for radioactivity (tank 18 contained LW) and iron. The analyses indicated no radioactivity above background and no appreciable tank corrosion (less than 0.01 g of iron/liter).

Jan 1962 A supernate sample was taken.

Oct 1963 Hydrogen concentration in the tank vapor space was less than 5% of the lower explosive level.

Nov 1963 A supernate sample was taken.

Apr 1969 Two supenate samples were taken.

Jul 1973 Groundwater samples taken around tanks 17 through 20 contained no significant radioactivity.

Chronology of Events Related to Test Conducted

May 1963 The results of a heat dissipation study for uncooled waste tanks, including tank 20, were reported.

PHYSICAL MEASUREMENTS

Vertical temperature profiles were obtained by lowering a thermocouple into existing thermowells. 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

Apr 1960 Temperature profiles were taken (figure 3).

Jan 1963 Salt soundings were taken below five risers (table 1).

Jan 1969 Salt soundings were taken (table 2).

Dec 1972 Salt sounding beneath the northwest riser revealed 220 in. of salt.

Oct 1973 A new zero-correction factor was determined and applied to the reel tape.

Aug 1974 A temperature profile was taken (figure 6).

EQUIPMENT MODIFICATIONS AND REPAIRS

In 1964, a transfer jet was installed in tank 20 to provide for decanting concentrate supernate from the tank. Also in 1964, the reel tape was relocated in the tank to minimize the effect of salt formations on the performance of the reel tape. In 1966 a pump and liquid level dip tubes were installed in the bottom leak detection sump. A portable filter was installed in series with the existing ventilation exhaust filter when it started passing radioactivity. The portable filter was removed after the ventilation exhaust filter was replaced. These and other equipment modifications and repairs are noted on figure 2.

Chronology of Events Related to Equipment Modifications and Repairs

Jun 1964 The transfer jet from tank 19 was modified and installed in tank 20. The discharge of the jet was routed to tank 18 via the underground cascade line that originally extended from tank 18 to tank 20. The cascade line was cut at tank 20 and the resulting stubout and encasement pipe were both capped and welded.

Dec 1964 The reel tape was moved from the northeast to the southeast riser.

Apr 1966 A pump was installed in the bottom leak detection sump.

Apr 1969 The recirculation jet in the tank was modified to enhance salt dissolution.

Feb 1974 Liquid level dip tubes that transmit to a recorder and an alarm in Building 242-F were installed in the bottom leak detection sump.

Sep 1974 A portable filter was installed downstream of the existing ventilation exhaust filter.

Oct 1974 The ventilation exhaust filter was replaced and the portable filter removed from service.

Nov 1974 A Food Instrument Company reel tape was installed and connected to alarm at the Building 242-F annunciator panel.

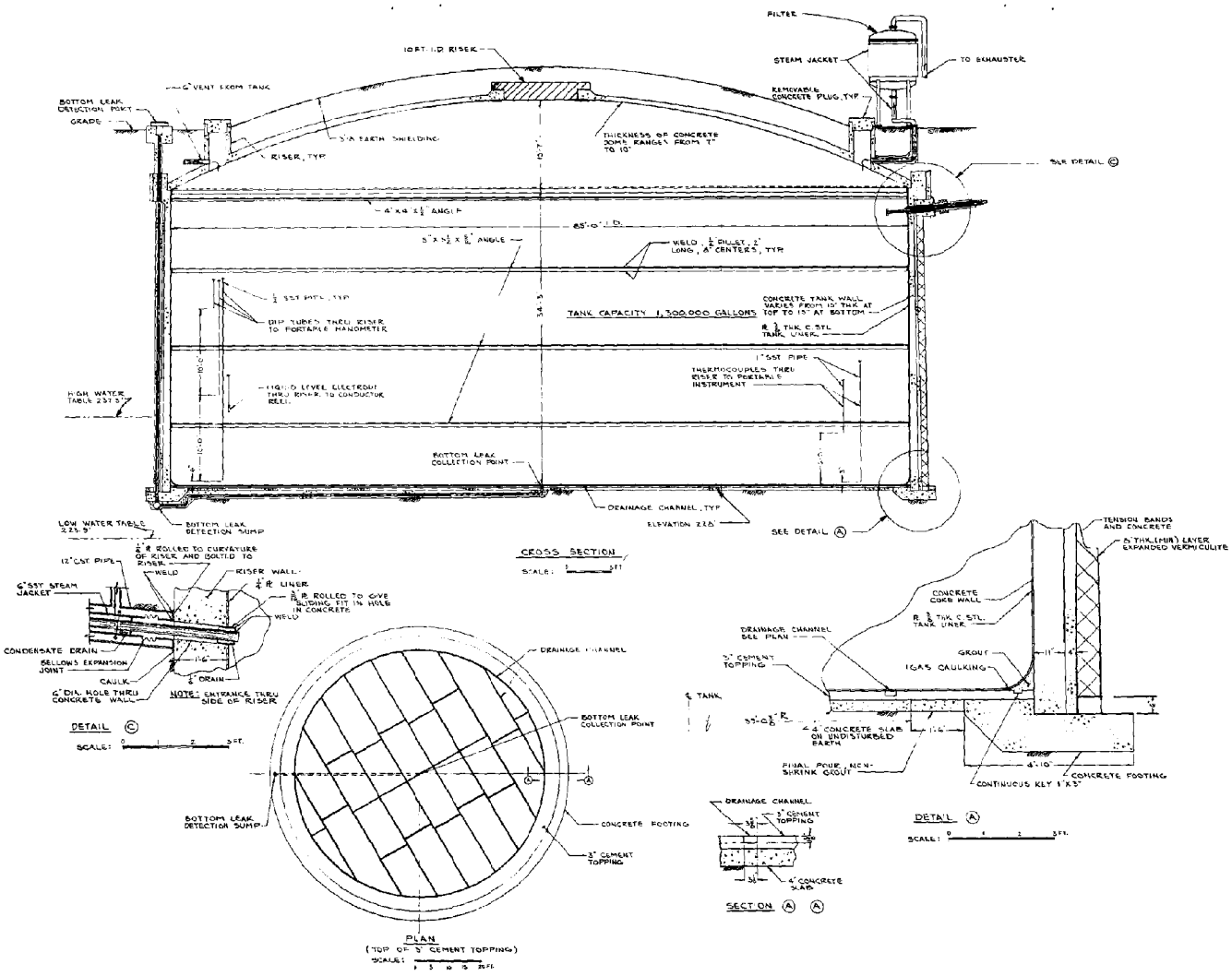

FIGURE 1. WASTE STORAGE TANK 20

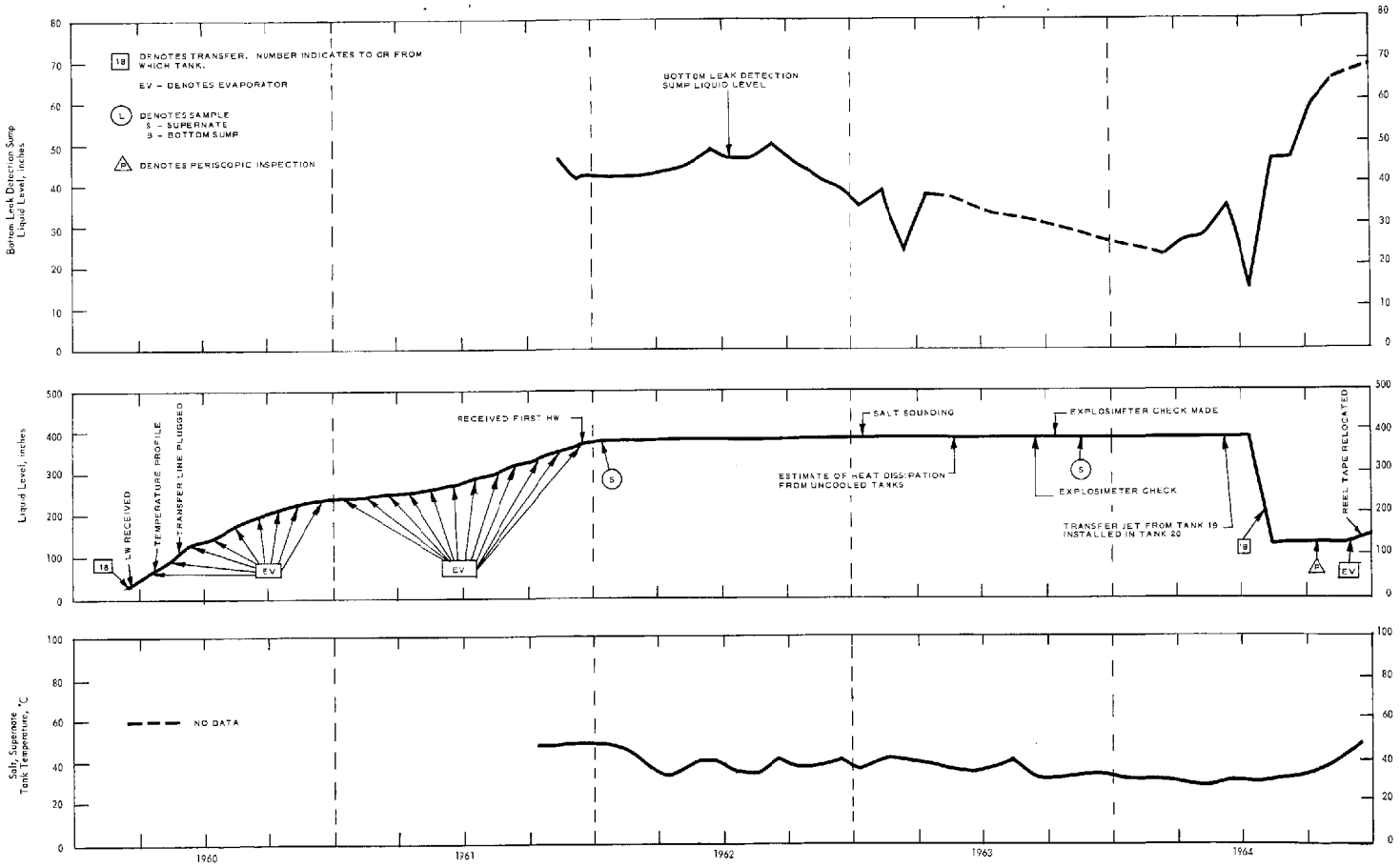

FIGURE 2. TANK 20 LIQUID LEVELS AND TEMPERATURES

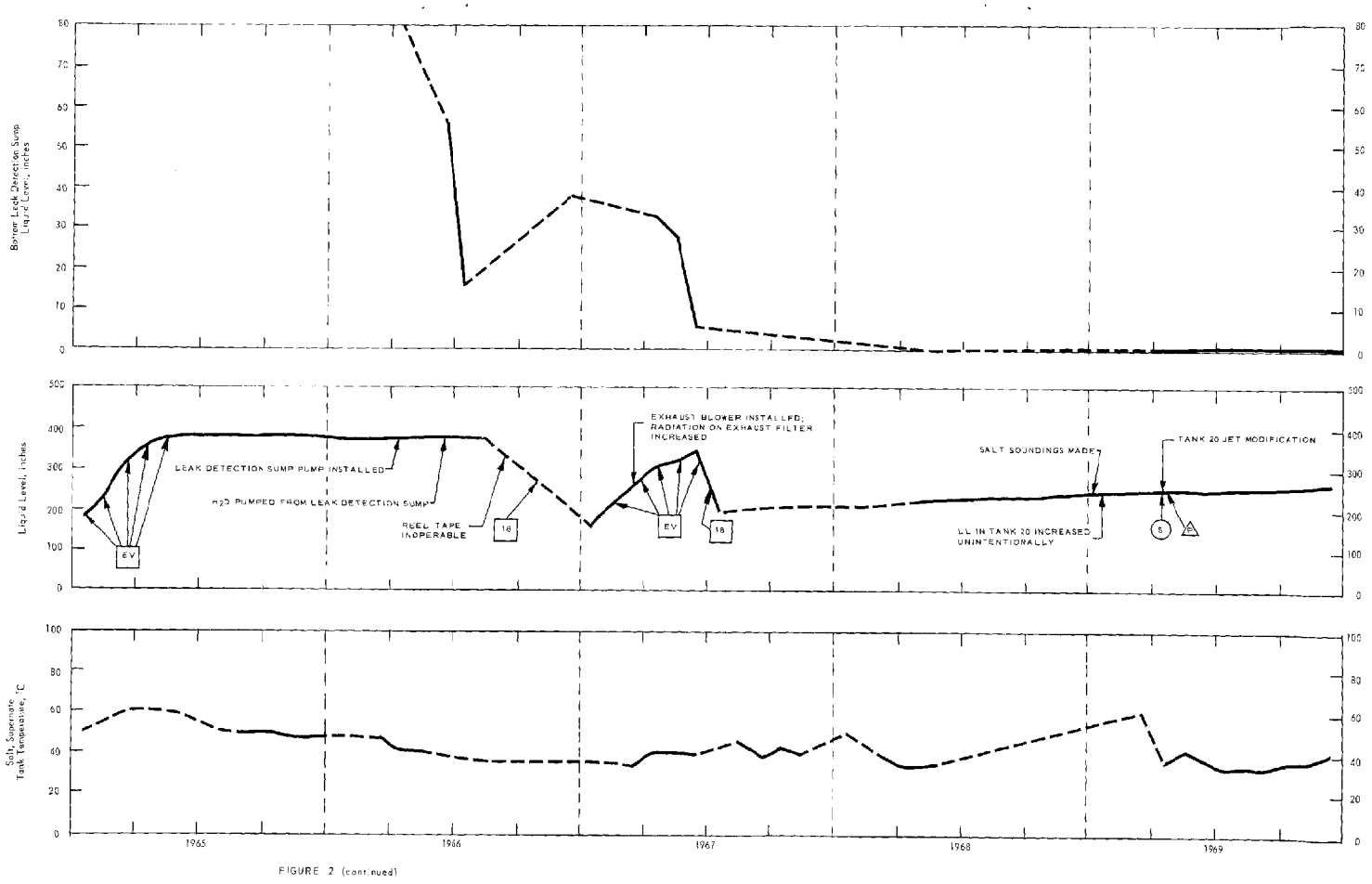

FIGURE 2 (continued)

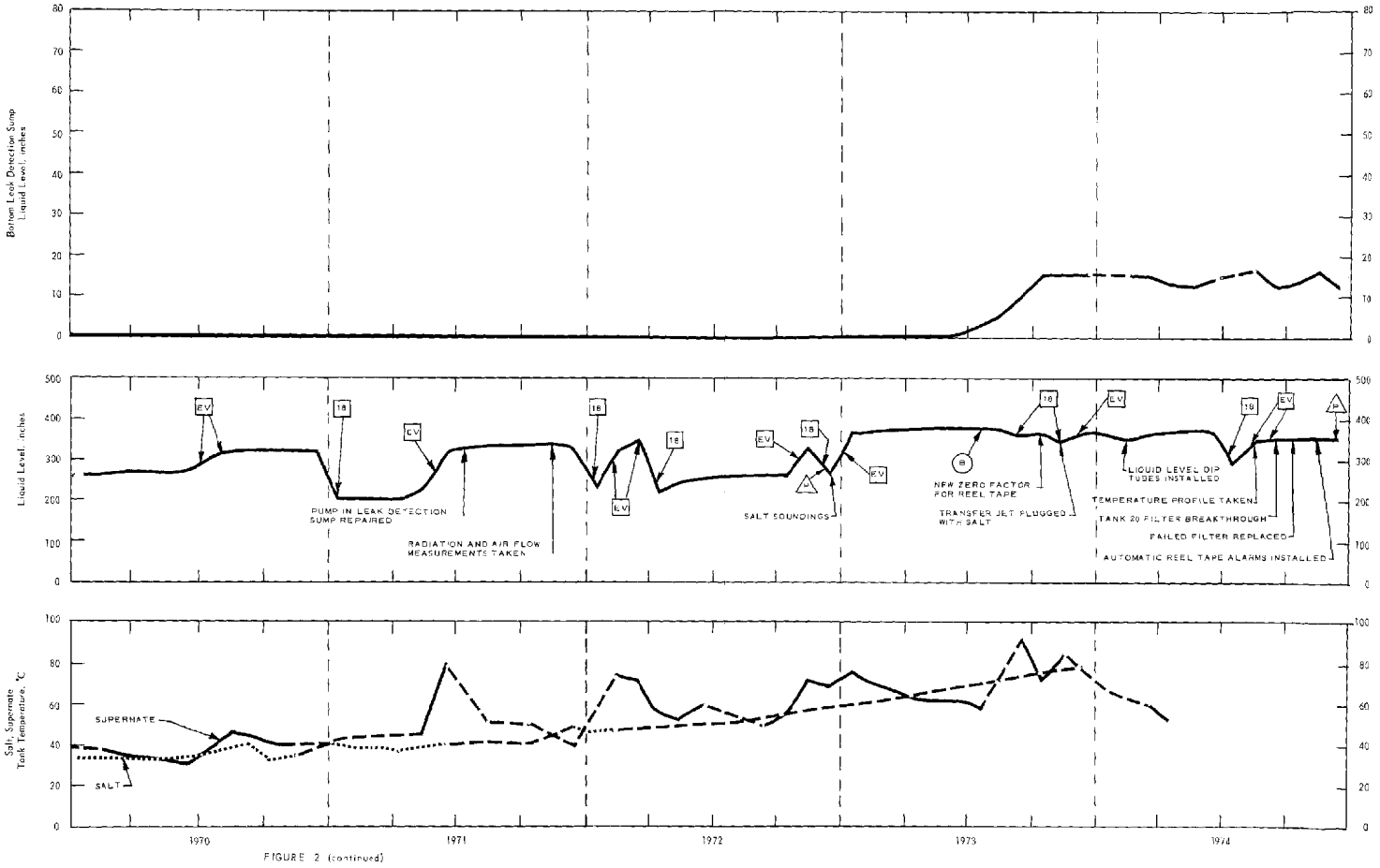

FIGURE 2 (continued)

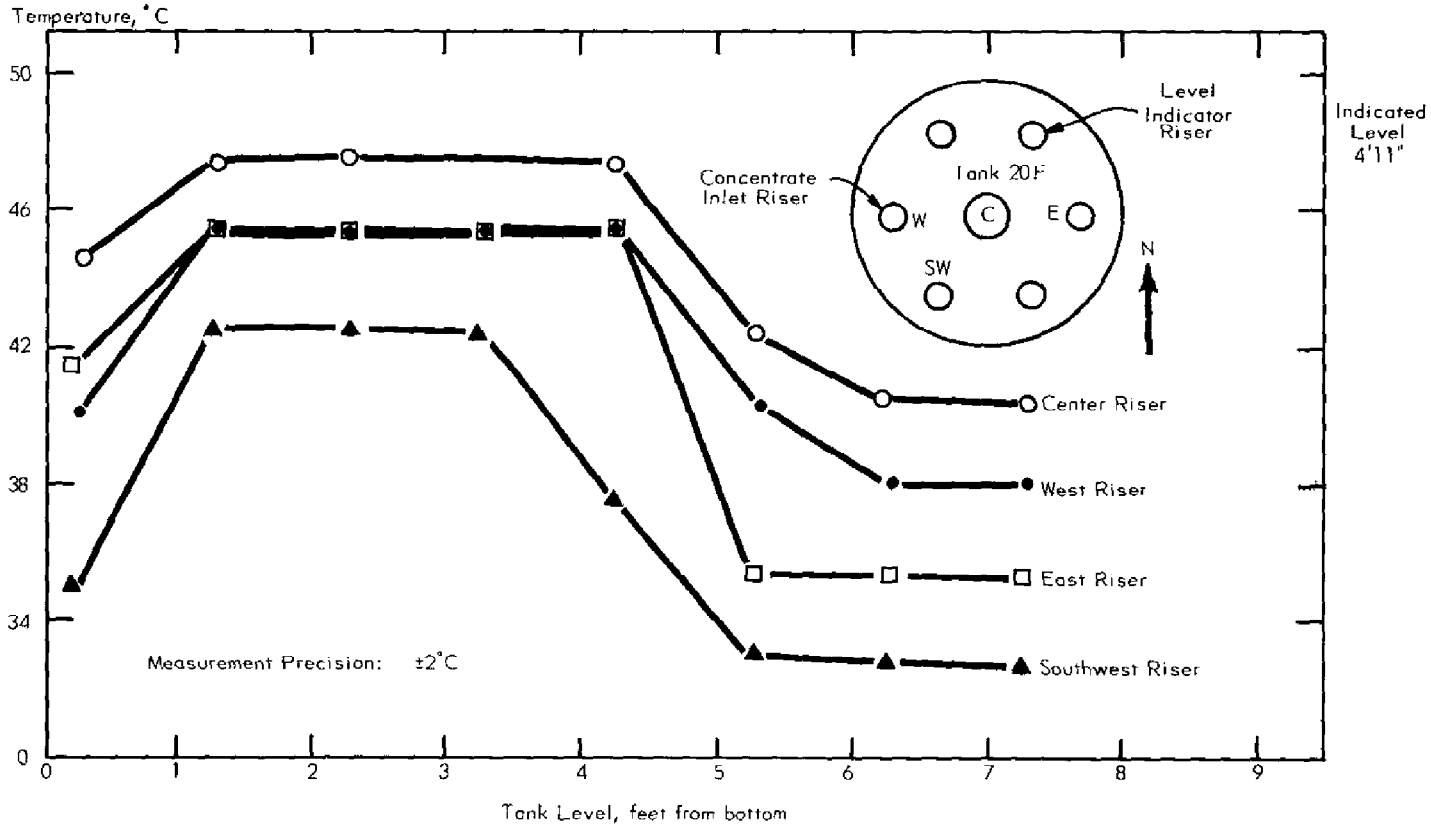

FIGURE 3. TANK 20 TEMPERATURE PROFILES, MARCH 1960

FIGURE 4. SALT FORMATION ON THERMOWELL PIPES (0.84" OD). DPSPF 9987-1.

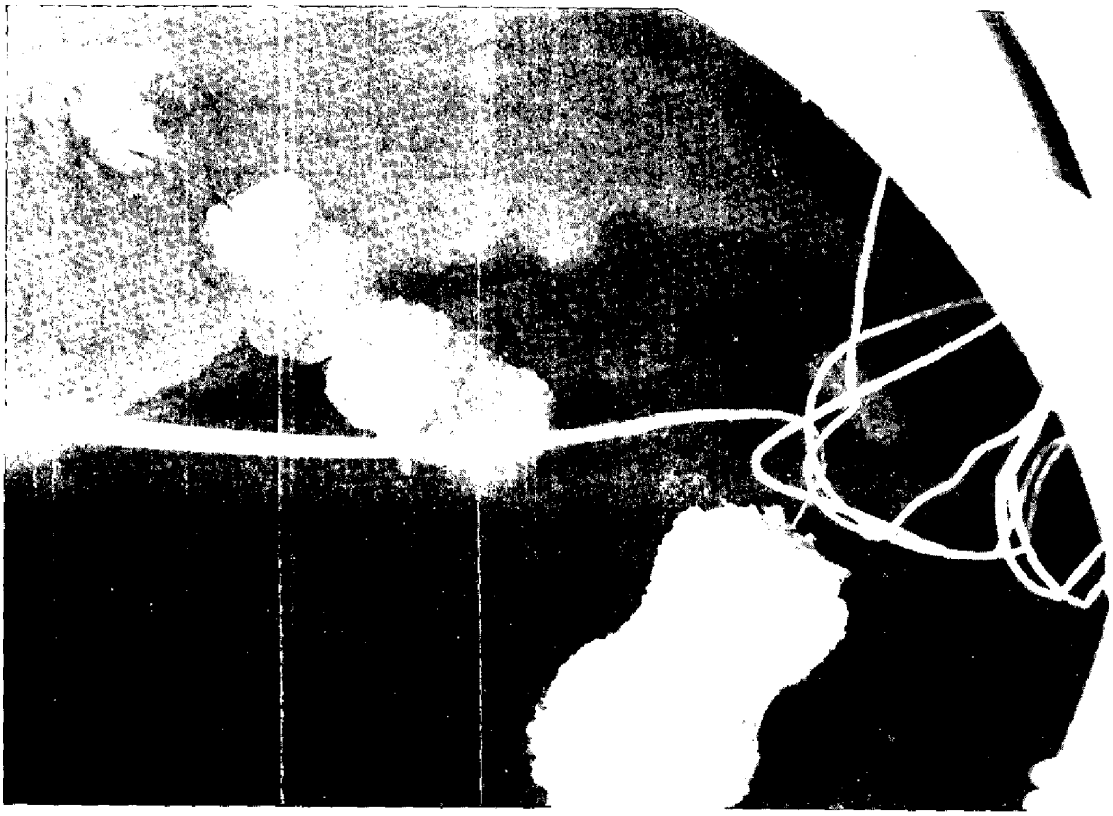

FIGURE 5. SALT FORMATIONS AROUND THERMOWELL PIPES (1.315" OD). Cluster in lower right was in the center riser plug; the one in the upper left was in the west riser plug. DPSPF 9987-4.

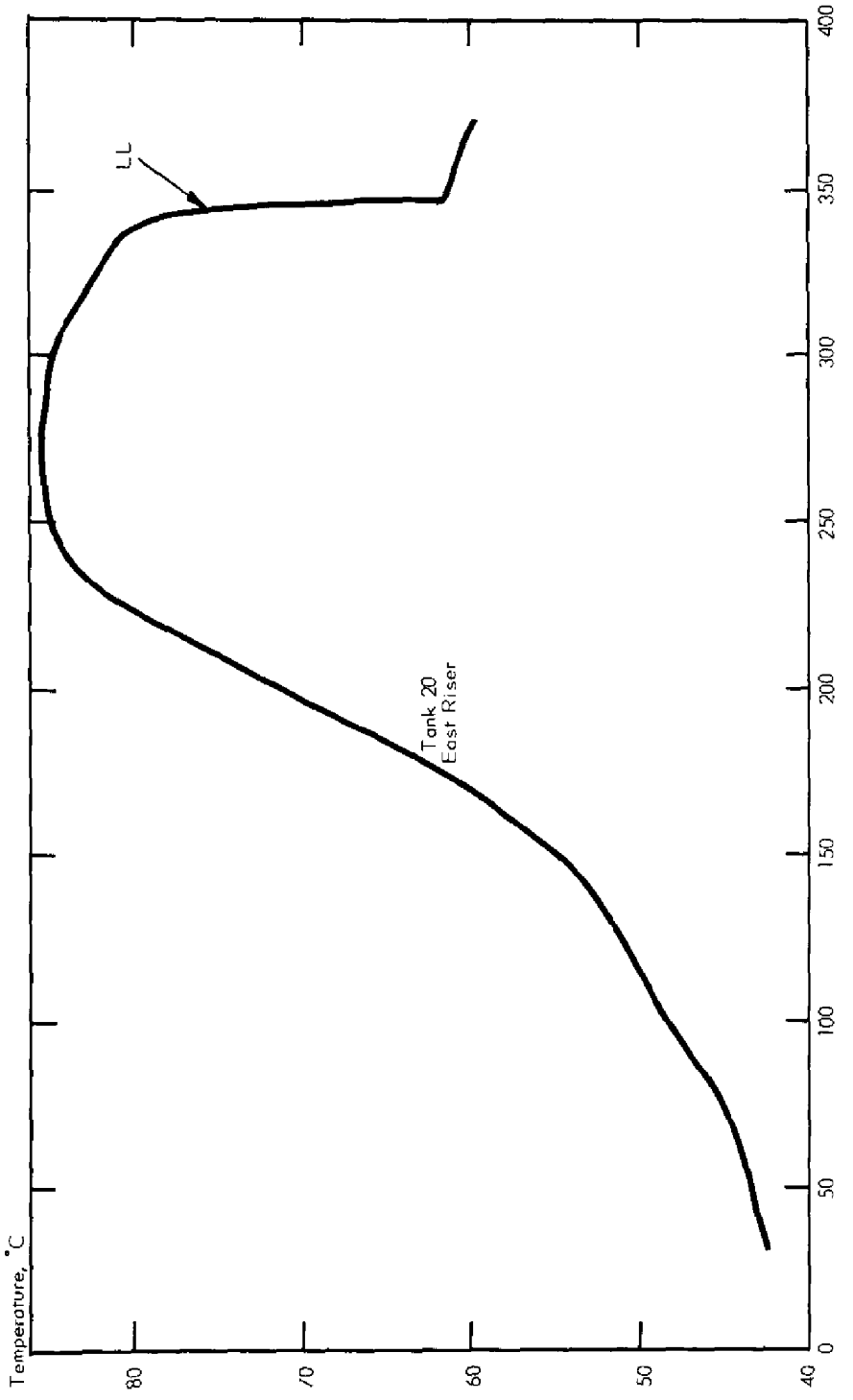

FIGURE 6. TANK 20 TEMPERATURE PROFILE, JULY 1974

TABLE 1
TANK 20 SALT DEPTHS, 1962 AND 1963

Date	1/23/62	1/22/63
Tank temperature, °C	48	36.5
Liquid level, in.	382	380.5
Salt depth, in.		
Riser:		
E	88	377.5
SE	-	64.5
SW	-	102.5
W	178	279.5
NW	-	94.5

TABLE 2
TANK 20 SALT DEPTHS, JANUARY 1969

Riser	Depth, in.
W (inlet)	290.5
NW (jet)	192.5
NE	196.5
E	204.0
SW	182.5

TABLE 3
TANK 20 COLOR PHOTOGRAPHS

Date	Access Port	Object of Photography	PRD Number	WMT File Location Box	Slot
3/28/69	NE	Interior	13328 (1-5)	12	139-143
12/4/72	E	Interior	16587 (1-24)	34	137-150
				35	1-11
12/11/74	E	Interior	18646 (1-12)	57	2

TABLE 4
TANK 20 SAMPLE ANALYSES

Phase	Supernate	Supernate	Supernate
Date	1/23/62	3/20/69	3/20/69
Location (height above tank bottom)	-	175 in.	225 in.
Gross alpha, d/m/ml	2.99×10^3		
Gross beta, c/m/ml	7.62×10^6		
Gross gamma, c/m/ml	3.72×10^6		
Specific gravity	1.437	1.41	1.29
Total solids, wt %	44.6		
^{95}Zr-^{95}Nb gamma, c/m/ml	1.08×10^5		
^{106}Ru gamma, c/m/ml	1.57×10^5		
^{137}Cs, c/m/ml	3.42×10^6		
^{137}Cs, g/l		3.4	0.9
$^{89,90}Sr$, c/m/ml	3.5×10^3		
$NaNO_3$, wt %	18.9		
NaOH, wt %	2.62		
$NaAlO_2$, wt %	6.55		
$NaCO_3$, wt %	4.94		
$NaSO_4$, wt %	1.08		

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