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ORNL/ER-121

ENVIRONMENTAL RESTORATION PROGRAM

Upgrade of Level Instruments in Inactive Liquid Low-Level Waste Tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee

E. L. Youngblood
T. D. Hylton
C. M. Kendrick

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Correction pages for *Upgrade of Level Instruments in Inactive Liquid Low-Level Waste Tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee*, ORNL/ER-121

Pages 2, 16, and 18 of *Upgrade of Level Instruments in Inactive Liquid Low-Level Waste Tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee*, ORNL/ER-121, contain errors that require correction. Enclosed are corrected pages for this report. The pages are printed on peel-and-stick paper that has been trimmed so that you may simply place the new pages over the old pages in the report.

Should you have questions about the corrections, please call Tom Hylton at 6-2225 or Kathy Swain at 6-6356.

Sincerely,

Cheryl Devaney / for
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Energy Systems Environmental Restoration Program
ORNL Environmental Restoration Program

Upgrade of Level Instruments in Inactive Liquid Low-Level Waste Tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee

E. L. Youngblood
T. D. Hylton
C. M. Kendrick

Date Issued—November 1992

Prepared by
Chemical Technology Division
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EXECUTIVE SUMMARY

Currently, 39 underground tanks that were previously used for storage of low-level liquid waste (LLLW) at Oak Ridge National Laboratory (ORNL) have been removed from service and are designated as inactive. Some of these tanks contain liquids and/or sludge, while others are empty. These tanks are either undergoing remediation or are scheduled for future remediation by the Environmental Restoration Program. However, the liquid level in the tanks is monitored by the Waste Management and Remedial Action Division for leak detection and for liquid inventory measurement prior to remediation of the tanks. The type and accuracy of the existing liquid level instruments in the inactive tanks vary widely. Some tanks contain modern level instruments that transmit signals to the Waste Operations Control Center, while other tanks have antiquated or no level instrumentation. There are no current Environmental Protection Agency or state level-measurement or leak-detection regulations applicable to these tanks. Vista Research, Inc., has proposed that the active tanks meet the regulations for underground storage tanks containing petroleum and hazardous liquids.

The objectives of this study were to (1) determine the requirements for inventory monitoring of inactive LLLW tanks at ORNL, (2) evaluate the existing inventory of monitoring instruments and determine whether the current requirements for monitoring and leak detection are being met, and (3) recommend improvements or upgrades of the level instruments where needed. The instrumentation was evaluated on the basis of its accuracy, previous experience with the instrumentation, and any other available evaluation data.

Instruments in the 39 inactive tanks were evaluated for their effectiveness in monitoring the liquid inventory. Level instrumentation for 12 of the tanks was considered satisfactory for monitoring liquid inventory and potential leakage. A list of options was provided for monitoring 12 tanks that are either currently empty or scheduled to be emptied during FY 1992 or 1993. Recommendations were also provided for the Group 5 tanks. Instrument upgrades were determined to be needed for the remaining eight tanks.

The study examined the capabilities and limitations of the level-monitoring instruments in use at ORNL and other sites for appropriateness for the tanks requiring upgrades. Technologies ranged from simple, classic devices to emerging state-of-the-art equipment. Because of their satisfactory performance in similar tanks at ORNL, the Foxboro® 823DP and the Robertshaw® Model 185 were recommended. For tanks with capacities of less than 3000 gal, the Foxboro® instrument, when used in conjunction with a resistance temperature device to correct the instrument bias due to ambient temperature changes, has been shown by Vista Research, Inc., to meet the stringent leak detection requirements for active ORNL LLLW tanks. When the Robertshaw® Model 185 is installed, the temperature of the tank contents should be monitored and the tank volume should be compensated accordingly.

1. INTRODUCTION

Currently, 39 underground tanks (see Table 1) that were previously used for storage of liquid low-level waste (LLLW) at the Oak Ridge National Laboratory (ORNL) have been removed from service and are designated as inactive tanks. Some of these tanks contain liquids and/or sludge while others are empty. These tanks are managed by the Environmental Restoration (ER) Program, and they are either undergoing remediation or are scheduled for future remediation.

The ER Program has divided these tanks into five groups for management purposes. The contents of the tanks in Groups 1 through 4 have been characterized, and characterization of the Group 5 tanks is underway. The tanks associated with each group are identified in Table 1, and the general definitions of the groups are as follows:

- Group 1—Tanks located in the South Tank Farm,
- Group 2—Tanks located at the Old Hydrofracture Facility,
- Group 3—Tanks located in the North Tank Farm,
- Group 4—Miscellaneous assortment of characterized tanks, and
- Group 5—Miscellaneous assortment of uncharacterized tanks.

The liquid levels in the tanks are monitored by the Waste Management and Remedial Action Division for leak detection and for liquid inventory measurement prior to remediation. The type and accuracy of the existing liquid-level instruments in the inactive tanks vary widely. Some tanks contain modern level instruments that transmit signals to the Waste Operations Control Center (WOCC), while other tanks have antiquated or no level instrumentation. The size and construction of the tanks also vary from small tanks (30 gal) constructed of stainless steel to large (170,000 gal) Gunite tanks. All the tanks have single shells; however, some tanks are located in concrete enclosures.

The objectives of this study were to (1) determine the requirements for level monitoring of inactive tanks at ORNL, (2) evaluate the existing level-monitoring instruments and determine whether the current requirements for monitoring and leak detection are being met, and (3) recommend improvements or upgrade of the level instruments where needed. The instrumentation was evaluated on the basis of its accuracy, previous experience with the instrumentation, and any available evaluation data.

There are no current U.S. Environmental Protection Agency (EPA) or state level-measurement or leak-detection regulations that are applicable to ORNL's LLLW tanks. A Federal Facility Agreement (FFA) has been negotiated for the management and remediation of ORNL's active and inactive LLLW tanks, but no specific requirements were outlined for level measurement or leak detection. Vista Research, Inc., (Vista) has been contracted by Martin Marietta Energy Systems, Inc., to develop and implement plans to conduct leak testing of the active LLLW tanks at ORNL to meet FFA requirements. This study used Vista's research and recommendations for active tanks instrumentation in developing recommendations for the inactive tanks since the tank systems are similar.

Table 1. Level detection status of liquid low-level waste tanks belonging to the Oak Ridge National Laboratory Environmental Restoration Program

ER Group	Tank	Location	Level detection
	W-5	South Tank Farm	New Robertshaw® Inven-Tel® 185
	W-6	South Tank Farm	New Robertshaw® Inven-Tel® 185
	W-7	South Tank Farm	New Robertshaw® Inven-Tel® 185
1	W-8	South Tank Farm	New Robertshaw® Inven-Tel® 185
	W-9	South Tank Farm	New Robertshaw® Inven-Tel® 185
	W-10	South Tank Farm	New Robertshaw® Inven-Tel® 185
	W-11	SE of South Tank Farm	Float and Staff Gauge
	T-1	Old Hydrofracture Facility	Foxboro® Model 13A
	T-2	Old Hydrofracture Facility	Foxboro® Model 13A
2	T-3	Old Hydrofracture Facility	Foxboro® Model 13A
	T-4	Old Hydrofracture Facility	Foxboro® Model 13A
	T-9	Old Hydrofracture Facility	Foxboro® Model 13A
	TH-1	South of Bldg. 3503	No instrumentation
	TH-2	South of Bldg. 3503	No instrumentation
	TH-3	South of Bldg. 3503	No instrumentation
	TH-4	South of Bldg. 3038	New Robertshaw® Inven-Tel® 185
	WC-1	East of Bldg. 3038	No instrumentation
	WC-15	South of Bldg. 3587	New Robertshaw® Inven-Tel® 185
	WC-17	South of Bldg. 3587	New Foxboro® 823
3	W-1	North Tank Farm	New Robertshaw® Inven-Tel® 185
	W-1A	North Tank Farm	New Foxboro® 823
	W-2	North Tank Farm	New Robertshaw® Inven-Tel® 185
	W-3	North Tank Farm	Float and staff gauge
	W-4	North Tank Farm	Float and staff gauge (broken)
	W-13	North Tank Farm	Float and staff gauge
	W-14	North Tank Farm	Float and staff gauge
	W-15	North Tank Farm	Float and staff gauge
	7560	East of Bldg. 7500	No instrumentation
	7562	Southeast of Bldg. 7500	No instrumentation
4	T-30	South of Bldg. 4507	No instrumentation
	W-19	South of South Tank Farm	No instrumentation
	W-20	South of South Tank Farm	No instrumentation
	3001-B	South of Bldg. 3001	No instrumentation
	3003-A	South of Bldg. 3003	No instrumentation
5	3004-B	East of Bldg. 3008	No instrumentation
	3013	Southwest of Bldg. 3008	No instrumentation
	H-209	Southwest of Bldg. 3517	No instrumentation
	7503-A	Inside Bldg. 7503	No instrumentation
	3001-S[a]	Unknown	No instrumentation

[a]Tank may not exist.

Although the FFA does not require that the active LLLW tanks meet the EPA regulations for underground storage tanks (USTs) containing petroleum and hazardous liquids, these regulations were proposed as the basis for the leak-testing program for the active waste tanks at ORNL.[1] The petroleum and hazardous liquids regulations (40 CFR 280 and 40 CFR 264, Sub-part J, respectively) require the system to detect a leak rate of 0.2 gal/h for monthly testing or 0.1 gal/h for annual testing with a detection probability of 95% and a false alarm probability of 5% or less. However, because of problems with inleakage, temperature variation, and accuracy of available level instruments, it is very difficult to measure the outleakage rate accurately with conventional level instruments alone, especially in larger tanks.

The requirements for level monitoring in inactive tanks that are empty are less well defined than for tanks containing liquids. The primary need for monitoring empty tanks is the detection of inleakage. The probability of inleakage is dependent on such factors as the material of which a tank is constructed (Gunite vs stainless steel) and whether all lines into the tank are blocked. Options for level measurement in tanks that have been emptied are discussed in Sect. 4.2.

Two types of level instruments have been used recently for upgrading or installation of new level instruments in waste tanks at the ORNL. These are the Foxboro® 823DP transmitter and the Robertshaw® Model 185 Inven-Tel® precision level gauge. The important difference between these two instruments is that the Foxboro® instrument is a mass-measuring instrument, and the Robertshaw® instrument is a level-measuring instrument. The Foxboro® instrument has an advantage since it is not affected by temperature variations of the contents. The Robertshaw® instrument would be affected by the temperature variations of the contents because the thermal expansions would cause the liquid level to change. However, the change in liquid level due to temperature variation can be easily determined, and the measured volume of the contents can be compensated to account for the change.

Previous use of differential pressure (DP) cells have shown that they are sensitive to ambient temperature conditions, and Foxboro® has responded by providing some temperature compensation in the Model 823DP. However, testing performed by Vista indicated that the ambient temperature of the transmitter should be carefully monitored, and the output data should be compensated accordingly. Alternatively, the transmitters could be mounted in a temperature-controlled enclosure so that the output data would not need to be compensated. There has been insufficient testing to determine whether the Robertshaw® Model 185 is affected by ambient temperature variations.

The Foxboro® 823DP was recently evaluated by Vista and determined to meet the petroleum and hazardous liquids requirement for leak detection in tanks having a volume of less than 3000 gal. However, when installing the Foxboro® 823DP, Vista recommended that a resistance temperature device (RTD) should be attached to the transmitter and wired out to the data concentrator. Vista recommends the RTD because it provides the opportunity to vastly improve the accuracy and precision of the DP cell when the influence coefficient compensation is used.[1] Because a leak rate of 0.2 gal/h is more difficult to detect in larger tanks, Vista is performing additional studies, and recommendations concerning the

Foxboro® 823DP have not been made for larger tanks. In addition to developing plans and methods for leak detection in active waste tanks, Vista is also testing and evaluating other level instruments that also may meet the requirements given above. The work by Vista does not include plans or methods for level- or leak-rate testing in inactive tanks, but its work with the active tanks should be applicable to the inactive tanks also.

Vista's evaluation involved both vertical and horizontal tanks using tap water to simulate the liquid waste product in the ORNL tanks. EPA's performance standard requires that a monthly monitoring method detect a leak of 0.2 gal/h with a detection probability of 95% or greater and a false alarm probability of 5% or less. Vista's results showed that the leak detection method (named ORNL/LT-823DP) will detect a 0.2 gal/h leak with a single-test probability of detection that is > 99.5% and a single-test probability of false alarm that is < 0.5%. The evaluation also indicated that correction for temperature change in the liquid in the tank is not required. Thus, the performance of the ORNL/LT-823DP method meets the federal standards.[1]

2. LEVEL INSTRUMENTS CURRENTLY RECOMMENDED FOR USE IN ACTIVE WASTE TANKS

Essentially all of the active waste tanks have either the Foxboro® 823DP or the Robertshaw® Model 185 level instruments installed or scheduled for future installation according to communications with Waste Management personnel. Foxboro® 823DP transmitters are currently used for inactive tanks W-1A and WC-17. These two transmitters are discussed below in more detail.

Foxboro® Model 823DP Transmitter—The Model 823DP is the most recent DP transmitter introduced by Foxboro®. Foxboro®'s performance specifications for accuracy are ±0.20% of calibrated span for the conventional transmitter (Model 823DP), ±0.10% of calibrated span for intelligent transmitters with mA output (Model 823DP-D), or ±0.07% of calibrated span for intelligent transmitters with digital output. The transmitter is compensated to correct for changes in temperature at the transmitter; however, Vista has recommended an additional temperature compensation that more accurately compensates the level output data for ambient temperature changes occurring on the body of the DP cell. The Foxboro® Model 823DP is the transmitter recommended for the leak-detection method that has been developed by Vista for the LLLW tanks with < 3,000-gal capacity at ORNL.[1] The Foxboro® 823DP has been previously purchased for approximately $1200, but it should be noted that this cost is only for the transmitter and does not include the cost of adding an auxiliary temperature device as recommended by Vista. The principle of operation for differential pressure transmitters is described in Sect. 3.1.

Older model Foxboro® DP transmitters (i.e., model 13A) are used for monitoring the liquid level in the tanks at the Old Hydrofracture Facility. The manufacturer reports an accuracy of 0.5% of calibrated span. This model is not temperature compensated, and experience has shown that it is sensitive to ambient temperature changes.

Robertshaw® Model 185 Inven-Tel® Precision Level Gauge—The Robertshaw® Model 185 Inven-Tel® precision level gauge uses the tape and sensor type system. It is a microprocessor-based, stepper-motor-driven unit with measuring ranges up to 120 ft. It provides measurement resolution of 0.001 ft with an accuracy and repeatability of 0.005 ft/100 ft. Various types of level sensors are available to allow the user to match the instrument to the application. The sensors include conductivity, float/conductivity, extended float, and proximity. The Model 185 operates by precisely measuring the movement of the tape that connects the sensor to the gauge. It requires a 2-in.-diam direct opening into the tank for installation. The tape is stored on a reel located in the reel housing. The motion of the reel is controlled by a stepper motor, and the tape movement is monitored with an optical shaft encoder. This device physically measures the level of liquid in the tank, so the accuracy is the same regardless of the measuring distance. This unit is not subject to the percent of span limitations of devices such as ultrasonic or radio-frequency capacitance.[2] The Robertshaw® Model 185 Inven-Tel® precision gauge is currently being evaluated by Vista. However, based on operating experience by ORNL Waste Management and the Instrumentation & Controls

Division, Robertshaw® Model 185 level gauges are used in some of the active and inactive waste tanks. The base cost of this unit starts at approximately $4500, but the units presently installed by Bechtel with the desired options cost approximately $8200.

The Robertshaw® Model 185 level gauge has the advantage of good accuracy without requiring an air supply. The Robertshaw® level instrument does not compensate for expansion of liquid in the tank due to temperature changes as the DP transmitter does. According to Waste Management personnel, an older version of the instrument, manufactured by Food Industries Corporation (FIC), provided good service in ORNL waste tanks for many years. FIC level instruments have also been used in approximately 178 waste tanks at Hanford. Hanford personnel have reported difficulties with the FIC gauge because of crystal growth on the sensor and maintenance problems due to motor failure. In tanks that have a solid crust, the sensor sometimes creates a hole in the crust and gives a false reading.

Based on the satisfactory use in both active and inactive tanks and the evaluation of the Foxboro® 823DP transmitter by Vista, both the Foxboro® 823DP transmitter and the Robertshaw® Model 185 Inven-Tel® precision gauge are recommended for use in inactive tanks when a level instrumentation upgrade is required. These two instruments are considered adequate to cover the needs for level instruments in the inactive tanks that need an upgrade or new level instruments. Both instruments have an output that is suitable for a local digital display or transmission to the WOCC.

3. CURRENT LEVEL MEASUREMENT TECHNOLOGIES

There are several types of liquid level measuring instruments currently in use at ORNL or other Department of Energy facilities. Each type differs in accuracy and precision as well as appropriate application. The available instrument types include, but are not limited to, DP transmitters, staff gauges, conductivity probes, tapes and sensors, microwaves, magnetostrictions, and ultrasonics. An ORNL Waste Management representative has reported unsatisfactory experience with ultrasonic level-measuring transmitters due to calibration problems, so these devices were not considered in our analysis for upgrading instruments. The other types of instruments are briefly described below.

3.1 DP TRANSMITTERS

DP transmitters have been used for many years. These instruments use bubble tubes for measuring hydrostatic pressure, as shown in the simple drawing in Fig. 1. Two tubes, which are connected to the DP transmitter and an air supply, are inserted into the tank. One tube is partly immersed in the liquid so that it is a fixed distance from the bottom of the tank. The other tube is inserted into the tank so that it never contacts the liquid. An equivalent amount of air is introduced through each tube. The pressure of the air supply overcomes the hydrostatic head on the submerged tube due to the depth of liquid in the tank. The excess pressure appears as small bubbles coming out of the bottom of the tube. The back pressure in the submerged tube is proportional to the pressure on the bottom of the tube due to the level of liquid in the tank. Any change in the back pressure is due to a change in the liquid level. The difference in pressure measured between these two probes is a measure of the liquid level in the tank.[3] It is necessary to know the density of the liquid to determine the actual volume when using the DP instrument. If desired, a second DP transmitter and a third bubble tube can be installed to measure the density and the liquid level simultaneously. However, one advantage of the DP transmitter is that it measures mass rather than level, and with vertical tanks (and usually horizontal tanks), little or no correction is required for temperature changes in the fluid. This advantage exists because the increase in height due to expansion is exactly offset by the decrease in density.

DP transmitters also have the advantages of having no moving parts and proven reliability in many applications. However, this type of instrument is not good for operation in sludge and solids, because the dip tube may plug by solids deposition (due to evaporation). This measurement system also requires an air supply and a tank vent.

3.2 STAFF GAUGE

The staff gauge is simply a rod connected to a float in the tank, as illustrated in Fig. 2. As the liquid level changes, the float and rod respond so that changes in the liquid level are determined from the distance the rod moves from the previous readings. The advantage of the staff gauge is that it is relatively inexpensive to install. The disadvantages include (1) the gauge can only provide a local reading, (2) the gauges in use in the inactive tanks at ORNL can only be read to $\pm$ 0.25 in. accuracy, (3) the design of the staff and float gauge does not

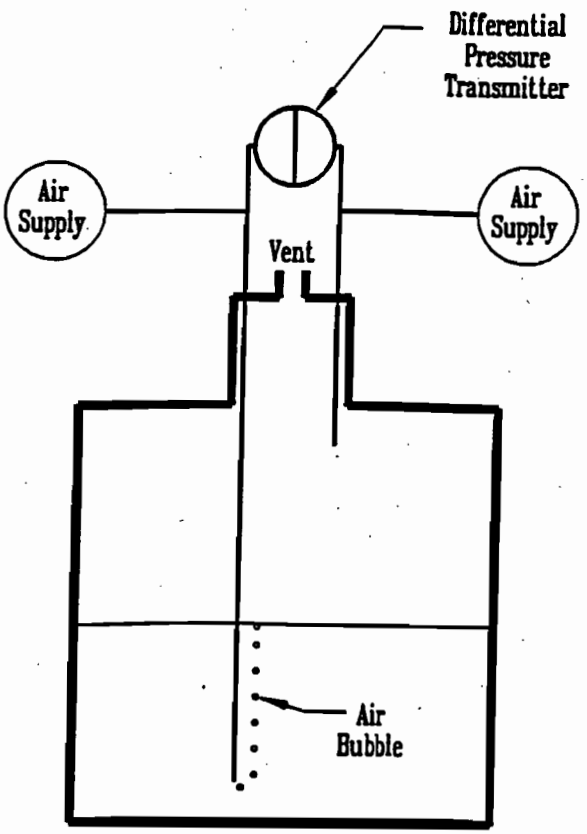


Fig. 1. Illustration of a differential pressure transmitter for liquid-level measurement.

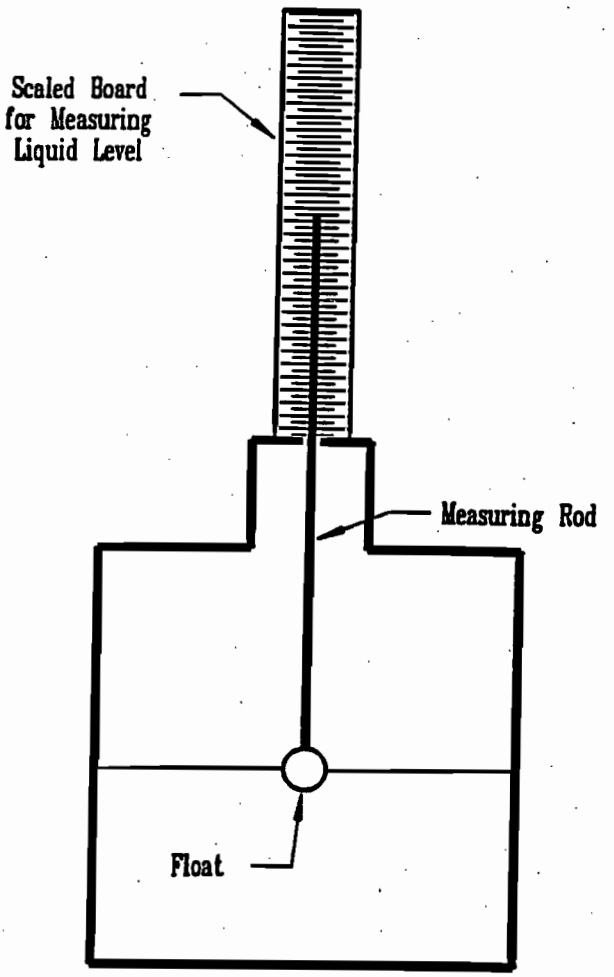


Fig. 2. Illustration of a staff gauge for liquid-level measurement.

permit a seal to the atmosphere to prevent some rain water from entering the tank, and (4) misinterpretation due to differences between level determinations by operators (parallax) is possible.

3.3 CONDUCTIVITY PROBE

The conductivity probe is a simple device that indicates whether liquid is contacting the probe. It does not provide any information about the quantity of liquid in the tank except at the detection point on the probe. The advantages of this probe are that it is inexpensive and relatively easy to install. This type of probe is often used to detect high levels in many of the active tanks at ORNL. For monitoring an empty tank, the probe would be installed near the bottom of the tank. When liquid contacted the probe, a signal would notify operators of potential leakage into the tank. However, this probe may not work with tanks that contain organic liquids.

3.4 MICROWAVE LEVEL INSTRUMENT

Hanford has recently been testing a microwave (radar) level detector. A simple drawing depicting how the unit operates appears as Fig. 3. One instrument has been installed in a waste tank at Hanford, and other tanks may be changed from the FIC instruments to the microwave-type unit. An Enraf-Nonius microwave unit was installed at Hanford. This unit was made in the Netherlands and cost $25,000. It operates in the 10 GHz range, sweeps between 9.5 and 10.5 GHz, and fits an 8-in.-diam port. One advantage for this instrument is that it does not have any moving parts. It gives the level over an average area if the surface is not flat. The instrument may have operational problems with a dry crust because of penetration of the microwaves below the surface. The instrument operates best with liquids, and it is used primarily in the gasoline industry. There were also some problems that resulted because of reflection and standing waves when the instrument was installed in a riser. Hanford personnel revised the software to take care of the riser configuration.

An American company recently started manufacturing a similar microwave level instrument that sells for about $8,000 and fits in a 4-in.-diam port. The instrument is a CannonBear manufactured by TN Technologies in Roundrock, Texas (near Austin). Hanford is interested in investigating the usefulness of this instrument because of the cost savings. The instrument is reported to have an accuracy of ± 0.5% of range, repeatability of 0.125 in., temperature range of -30 to 70°C, and an output signal of 4 to 20 mA. The CannonBear unit is preprogrammed to operate in a riser or standpipe above the tank.

3.5 MAGNETOSTRICTION LEVEL INSTRUMENT

A level instrument based on the principle of magnetostriction is currently being evaluated by Vista for level measurement in the active waste tanks at ORNL. These gauges have just one moving part—a float. A simple drawing that illustrates the operation of this instrument appears as Fig. 4. Some manufacturers (e.g., MTS® and Magnetek) claim these instruments provide a resolution of 0.001 in. with repeatability to 0.001% of scale. Gauges are available with 4–20 mA output.

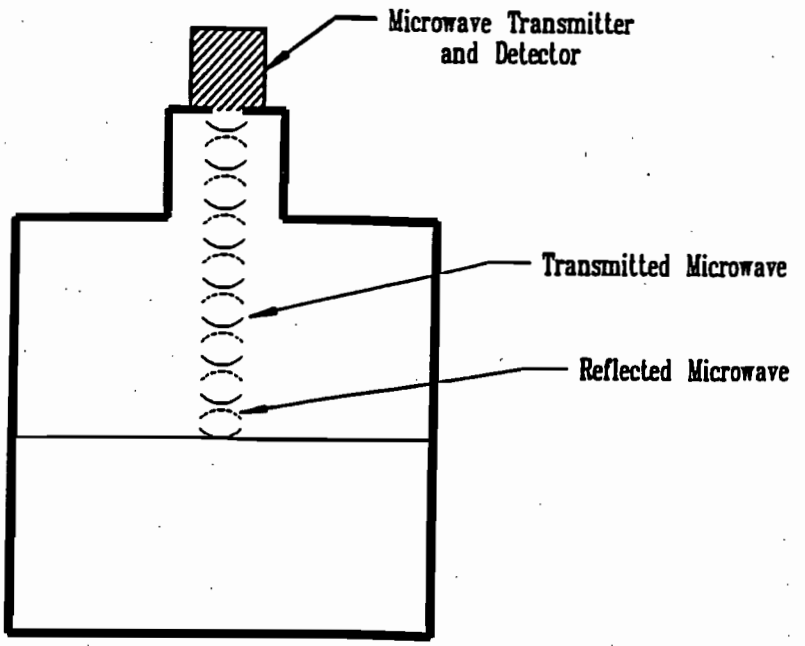


Fig. 3. Illustration of a microwave instrument for liquid-level measurement.

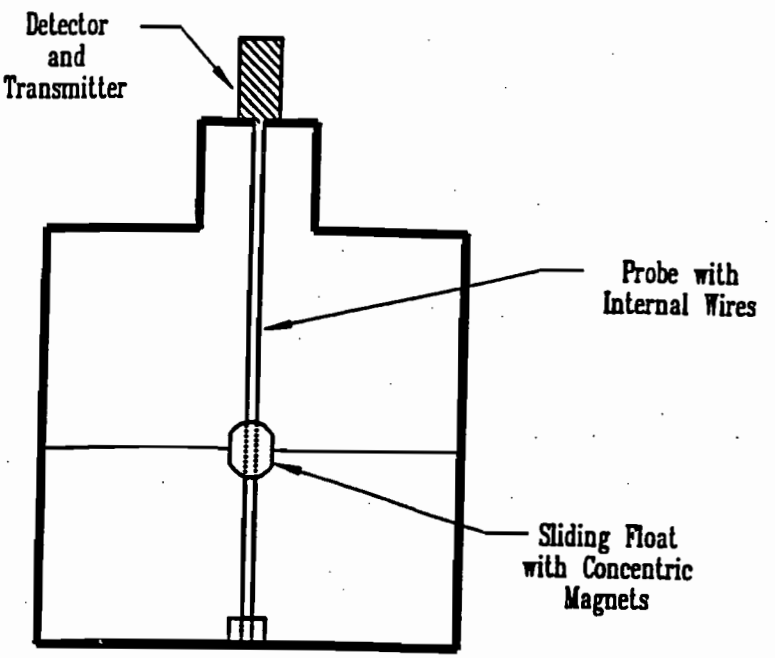


Fig. 4. Illustration of a magnetostriction instrument for liquid-level measurement.

The level-measuring instrument consists of a probe in which a special magnetostrictive wire is strung under tension from the upper housing to the bottom fitting and an insulated return wire completes the circuit to the upper housing. A voltage spike is applied to a piezoelectric crystal inside the upper housing that initiates a torsional pulse of vibration in the magnetostrictive wire. The vibration pulse travels down the wire at a constant rate of speed, unaffected by temperature variations. A float with concentric magnets mounted in the housing slides on the outside of the probe. The position of the float responds to the liquid level in the tank. The magnetic field from the float interacts with the vibration moving down the wire and causes a voltage to occur at that point in the wire. The electronics in the upper housing sense the voltage spike. The time difference between the initial pulse and the return pulse is proportional to the distance between the upper housing and the float and, thus, determines the liquid level in the tank. The physical properties of the float are the limiting factor and the major consideration of the overall system resolution and accuracy.

4. DESCRIPTION AND RECOMMENDATION FOR LEVEL INSTRUMENTS IN THE INACTIVE TANKS

A list of the inactive tanks, their general locations, and the status of the liquid level measuring systems appears as Table 1. Drawings of most of the inactive tanks are included in the appendix.

New level instruments have recently been installed or the existing instruments have been upgraded for 12 of the inactive tanks. The instrumentation on these tanks is now considered adequate. In addition, three tanks are known to be empty, and nine tanks are scheduled to be emptied within the next 2 y. Instrumentation or a method for detection of inleakage is needed for these empty tanks. The condition of seven tanks in ER Group 5 is not well known, but a characterization study, which is separate from this study, is underway.

Three inactive tanks containing liquid now have staff gauges, and five tanks use old model Foxboro® DP transmitters for level measurement. Upgrade of the level instruments in these eight tanks with either the Foxboro® Model 823DP transmitter or the Robertshaw® Model 185 Inven-Tel® precision level gauge is recommended. A detailed description of the tanks and recommendations for level instrumentation is outlined in Sects. 4.1–4.3.4.

4.1 INACTIVE TANKS WITH ADEQUATE LEVEL INSTRUMENTATION

The tanks have been grouped into three categories for discussion: (1) tanks with adequate level instrumentation installed, (2) tanks that are empty or scheduled for near-term emptying, and (3) tanks recommended for level instrumentation upgrades.

4.1.1 Tanks from Environmental Restoration Group 1

ER Group 1 Tanks W-5, W-6, W-7, W-8, W-9, and W-10 are 170,000 gal Gunite tanks that recently had their liquid level instrumentation upgraded with the Robertshaw® Inven-Tel®185 transmitter. Initially, some difficulty was experienced with grounding in the Gunite tanks; however, this problem has been solved and the instruments are performing satisfactorily. No further upgrade is recommended.

4.1.2 Tanks from Environmental Restoration Group 3

Foxboro® 823DP level instruments have recently been installed on the ER Group 3 tanks W-1A and WC-17. Signals from both tanks are transmitted to the WOCC. Bechtel recently installed Robertshaw® instruments on tanks W-1, W-2, WC-15, and TH-4 to meet an FFA milestone and because these were the only tanks in ER Group 3 that did not have level instrumentation. These transmitters do not send signals to the WOCC presently, but plans to connect these instruments to the WOCC are in place. These instruments should perform satisfactorily.

4.2 TANKS THAT ARE EMPTY OR SCHEDULED FOR NEAR-TERM EMPTYING

Twelve tanks are presently empty or scheduled to be emptied during fiscal years 1992 and 1993. These tanks are listed in Table 2 with other important information. The tanks that are scheduled for emptying during fiscal year 1992 are WC-1, W-13, W-14, and W-15. The tanks scheduled for emptying during fiscal year 1993 include T-30, TH-1, TH-2, TH-3, and 7562. Tanks that are already empty include W-19, W-20, and 7560.

According to the drawings in the appendix, the 8 of the 12 tanks that are empty or scheduled to be emptied in 1992 and 1993 are contained in a concrete encasement or vault. These tanks are W-19, W-20, W-13, W-14, W-15, TH-2, TH-3, and T-30. Tanks TH-1, WC-1, 7560, and 7562 are contained in an earth fill. All these tanks, except W-19 and W-20, have dry wells located near the tanks, according to the drawings. Some drawings indicate that the tanks were constructed with vents, but there is no evidence that the vents are currently connected.

The level-monitoring requirements for inactive waste tanks that are empty or scheduled for near-term emptying are different than the requirements for tanks that contain liquids. After the tanks are empty, the primary concern about the liquid level is whether there is any leakage into the tank. ER presently does not plan to install level instrumentation on the empty or soon-to-be-empty tanks. Instead, the plan is to inspect the empty tanks annually to determine whether any liquid has leaked into the tanks.

The possibility of inleakage (and the need for level monitoring) varies considerably from stainless-steel tanks that have all entry lines blocked off to tanks that have a higher probability of inleakage (such as Gunite tanks) and tanks that may not have all entry lines removed or blocked. In today's political environment, it may be wise to install level instrumentation on empty tanks, primarily to notify operators in the event of inleakage. Options for monitoring the liquid level in the empty or soon to be empty tanks include, but are not limited to:

(1) checking the level annually as planned by ER,

(2) installing a conductivity probe for quick detection of liquid inleakage,

(3) installing a staff gauge,

(4) installing a less expensive DP transmitter than the Foxboro® 823DP, or

(5) installing instrumentation such as the Foxboro®823DP or Robertshaw® Model 185.

Relatively speaking, the cost of options (1) through (3) are low, the cost of option (4) is moderate, and option (5) is the most expensive.

Option (1) provides little information about the volume of liquid in the tanks except on occasions when the level is physically checked. In some cases, it is difficult to check the tank level physically, and it may unnecessarily expose personnel to radiation. Option (2) will be useful after the tanks have been emptied, but its data output is limited, as previously discussed

Table 2. Information about empty or soon-to-be-emptied inactive tanks

Tank ID	Tank capacity (gal)	Status of tank	Type of containment	Type of vent	Current[a] level instrument	Recommended upgrade
W-19	2,250	Empty	Concrete encasement	None visible	1	Foxboro® 823DP
W-20	2,250	Empty	Concrete encasement	None visible	1	Foxboro® 823DP
7560	1,000	Empty	Earth & gravel	None visible	2	Foxboro® 823DP
W-13	2,000	To be emptied in FY 92	Concrete encasement	None visible	Staff gauge	Foxboro® 823DP
W-14	2,000	To be emptied in FY 92	Concrete encasement	None visible	Staff gauge	Foxboro® 823DP
W-15	2,000	To be emptied in FY 92	Concrete encasement	None visible	Staff gauge	Foxboro® 823DP
TH-1	2,500	To be emptied in FY 93	Earth	None visible	2	Foxboro® 823DP
TH-2	2,400	To be emptied in FY 93	Concrete encasement	None visible	2	Foxboro® 823DP
TH-3	3,300	To be emptied in FY 93	Concrete encasement	None visible	2	Foxboro® 823DP
WC-1	2,150	To be emptied in FY 92	Earth	HOG[b], but believed to be out of service	2	Foxboro® 823DP
7562	12,000	To be emptied in FY 93	Earth & gravel	Vented	3	Robertshaw® Model 185
T-30	825	To be emptied in FY 93	Concrete vault	VOG[b]	2	Foxboro® 823DP

[a]1 = Drawing shows lines that appear suitable for DP transmitter, 2 = Drawing shows level instrument lines for DP transmitter, and 3 = Ports appear accessible for installing level instruments.

[b]HOG = hot off-gas; VOG = vessel off-gas.

in Sect. 3.3. It should be noted that Tanks 7560 and 7562 previously contained oil, so a conductivity probe may not work well in these tanks. Option (3) will provide information about the volume of liquid in the tanks, but several gallons may leak into a tank before the gauge initially responds since the response is dependent on the weight of the rod and float. The parallax problem (see Sect. 3.2) could possibly be solved by placing a reflective backing on the scaled board so the operators could line up the pointer with its reflection and read the level at the proper angle. However, this option will still lower the accuracy of level monitoring. Option (4) will also indicate whether any liquid has entered the tank also. Since the main objective is to detect liquid inleakage, the transmitter does not need to be extremely accurate; however, it may be difficult to interpret variations caused by temperature changes, etc. Option (5) would provide the most accurate information about liquid in the tanks, but there is some question as to whether it is worth the cost to monitor an empty tank.

Although it is the most expensive choice, option (5) is recommended as the selection for these tanks. Using the more accurate transmitter would eliminate some variations caused by temperature, etc; however, it may not be necessary to use the auxiliary temperature device to monitor the ambient temperature of the Foxboro® transmitter. These instruments also could be used until the tanks are remediated; then the transmitters could be used for backup transmitters or for spare parts.

4.3 TANKS THAT ARE RECOMMENDED FOR INSTRUMENTATION UPGRADES

The Fifteen tanks listed in Table 3 are recommended for level instrumentation upgrades. It is also recommended that the signals from these tanks be transmitted to the WOCC. These tanks and their requirements are discussed in Sects. 4.3.1–4.3.4.

4.3.1 Tanks From Environmental Restoration Group 1

Tank W-11 is the only tank in the ER Group 1 tanks that is recommended for an instrumentation upgrade. This tank is a 1500-gal Gunite tank contained in an earth fill. Since the liquid level is presently monitored by a float and staff gauge, it is recommended that the liquid level instrumentation to be upgraded. Reworking the riser will be required regardless of transmitter selected. Both air and electricity are available in the area. Tank drawings (see appendix) indicate that the tank originally had a liquid-level dip tube and a high efficiency particulate air (HEPA) filter, but their present status is unknown. If the Foxboro® instrument is installed, a vent will be required for the air injected through the dip tubes. It is envisioned that a setup similar to the dip tubes and vent system on the nearby W-12 tank could be used for the W-11 tank. Since the tank capacity is less than 3000 gal, installation of the Foxboro®823DP transmitter is recommended for this tank.

4.3.2 Tanks From Environmental Restoration Group 2

The ER Group 2 tanks are underground tanks located west of the Old Hydrofracture Facility. The tanks are constructed of steel and are contained in an earth and gravel fill. The capacities of these tanks range between 13,000 and 25,000 gal. The risers through which the dip tubes enter the tank extend above ground and are readily accessible. The tanks are

Table 3. Inactive tanks recommended for instrumentation upgrade

Tank ID	ER group number	Tank capacity (gal)	Current instrumentation	Recommended instrumentation upgrade
W-11	1	1,500	Staff	Foxboro® Model 823DP
T-1	2	15,000	Foxboro® Model 13A	Foxboro® Model 823DP
T-2	2	15,000	Foxboro® Model 13A	Foxboro® Model 823DP
T-3	2	25,000	Foxboro® Model 13A	Foxboro® Model 823DP
T-4	2	25,000	Foxboro® Model 13A	Foxboro® Model 823DP
T-9	2	13,000	Foxboro® Model 13A	Foxboro® Model 823DP
W-3	3	42,500	Staff	Robertshaw® Model 185
W-4	3	42,500	Staff	Robertshaw® Model 185
3001-B	5	75	None	Either the Foxboro® 823DP or the Robertshaw® Model 185 are recommended for these tanks.
3003-A	5	16,000	None	
3004-B	5	30	None	
3013	5	400	None	
H-209	5	2,500	None	
7503-A	5	11,000	None	
3001-S	5	2,000	None	This tank may not exist.

vented through HEPA filters. Additional information for the tanks is given in Table 3, and drawings of the tanks are shown in the appendix.

These tanks presently have Foxboro®Model 13A DP transmitters to monitor the liquid level. A nearby air compressor provides air for operation of the DP transmitters. Considerable difficulty has been experienced in the past with level measurement in these tanks because of failure of the air compressor that provides air to the DP transmitter and because of the collection of water in the bubble tube lines. The air compressor has recently been replaced; however, the condition of the air lines and water-removal system is not known. The DP transmitters are located in a field-mounted, unheated instrument rack. The model 13A transmitters are not temperature compensated and therefore not as accurate as the newer instruments. The Model 823DP transmitters also would provide a more accurate digital readout than the Model 13A. The distance to a data concentrator from the Old Hydrofracture Site is only about 200 yds. The signal from either the Foxboro® 823 or Robertshaw® Model 185 could be relatively easily connected to the data concentrator and sent to the WOCC. Waste Management personnel have indicated that the WOCC could accept these data.

The easiest and possibly the least expensive option would be to replace the existing Model 13A DP transmitters with Model 823DP transmitters; however, replacement of the air tubing to the DP transmitters may be warranted because the condition of the compressed air piping to the DP transmitters and the air drier appears to be poor. The air-drying system also should be repaired (upgraded if required), routinely monitored, and routinely maintained. Installation of a backup air supply for the liquid-level transmitters should be considered. The condition of the dip tubes inside the tanks is not known, and an evaluation or inspection is recommended to determine if replacement is needed.

The Robertshaw® Model 185 also appears to be a suitable candidate for replacement of the Model 13A DP transmitters. This option would require removal of the existing dip tubes in the tanks. The risers are accessible, and Waste Management personnel have indicated that the removal should not be a difficult job. The use of the Robertshaw® 185 would eliminate the need for an air supply system for the liquid-level measurement system of the tanks at the site. However, the installation of the Robertshaw® 185 instrument requires the risers to be upgraded, as was done for existing installations of the Robertshaw® instrument.

Since the present liquid-level instrumentation is a bubbler system, it is recommended that the present transmitters be replaced with the Foxboro®823DPs.

4.3.3 Tanks From Environmental Restoration Group 3

Tanks W-3 and W-4 are Gunite tanks located in the North Tank Farm with earth and gravel fills. These tanks are presently monitored with staff gauges, but the gauge on W-4 has been broken for several months. These tanks are similar to, but much larger than, the W-1 and W-2 Gunite tanks that have had their instrumentation upgraded to the Robertshaw® Model 185 instruments.

The existing float and staff gauges must be removed and disposed of regardless of whether the Foxboro® or Robertshaw® instrument is installed. Air and electric utilities are available, so either the Foxboro® 823DP or the Robertshaw® Model 185 could be installed. As previously noted in Sect. 4.4.2, the risers must be upgraded for mounting the Robertshaw® instrument. Installation of the Foxboro® 823DP transmitter also would require installing a vent. Installation of the Robertshaw® Model 185 is recommended as the best option to maintain consistency with the other tanks in the North Tank Farm.

4.3.4 Tanks From Environmental Restoration Group 5

The ER Group 5 tanks are listed in Table 1. Little information has been found about these tanks, but some construction drawings that are not in good condition have been located for tanks 3003-A, 3004-B, 3013, 7503-A, and 3001-S. Construction or installation drawings for tanks 3001-B and H-209 have not been located. None of these tanks have liquid-level instrumentation, and the contents of these tanks are unknown. Remedial Actions has been tasked with inspecting these tanks to determine their liquid levels and sample their contents.

All of the tanks have been sampled now except 3001-B and 7503A. The results thus far indicate that all the tanks except 3003-A, which contains approximately 11,000 gal, contain

small volumes of liquid. The results also indicate that the radiation levels in these tanks are very low. Therefore, the significance of a leak from these tanks, except 3003-A, would appear to provide a minimal risk.

Tanks 3001-B and 3001-S are reported to be located just south of Building 3001 (the Graphite Reactor). The risers for 3001-B have been located, and it may be difficult to install any type of liquid level instrumentation since these risers are in the parking area for Building 3001. Tank access risers for Tank 3001-S have not been located, and it is believed that this tank may never have been installed. Photographs taken of the Graphite Reactor building before and after the alleged installation of 3001-S show no difference in the landscape. Tank 3004-B is located beside the visitors' walkway to the graphite reactor, and the risers are currently covered with landscape stones.

ER plans to have level instrumentation installed on all of the Group 5 tanks that are not empty; however, it is recommended that instrumentation be installed on the empty tanks as well. Options discussed in Sect. 4.2 are also applicable to the empty Group 5 tanks. However, it is also recommended that either the Foxboro® 823DP or Robertshaw® Model 185 be used when installing the new instrumentation. However, it may not be necessary to add the additional temperature device for monitoring the transmitter's ambient temperature.

5. CONCLUSIONS AND RECOMMENDATIONS

The liquid-level measuring devices for the 39 tanks currently designated inactive were evaluated for their effectiveness in monitoring the liquid inventory in these tanks. There are no current EPA or state level-measurement or leak-detection regulations applicable to these tanks. It has been proposed by Vista that the active tanks meet the regulations for underground storage tanks containing petroleum and hazardous liquids. The level instrumentation for 12 of these tanks is considered adequate for monitoring the liquid inventory and potential leakage. Twenty-six tanks (27 if Tank 3001-S exists) are recommended for instrumentation upgrades (see Tables 2 and 3). The tanks that are listed in Table 2 include 12 tanks that are empty or scheduled for emptying during fiscal years 1992 and 1993. The 14 tanks listed in Table 3 include 8 tanks that are known to contain waste from ER Groups 1, 2, and 3, in addition to 6 tanks from ER Group 5 (seven if Tank 3001-S exists) for which little characterization data is available. Two liquid-level measuring instruments are currently being used when installing or upgrading liquid level measurement instrumentation: Foxboro® 823DP and Robertshaw® Model 185. Vista has performed studies which have shown that the Foxboro® instrument, when used with an auxiliary RTD device, can meet the EPA requirements set for petroleum and hazardous liquids in USTs when it is used on tanks smaller than 3000 gal. Alternatively to the Vista recommendation for an auxiliary RTD device and compensating the output data accordingly, the transmitters could be installed in a temperature-controlled enclosure to eliminate variations due to ambient temperature changes. Vista is performing additional studies to determine whether the instrument can meet requirements when used on larger tanks. Vista is also currently testing the Robertshaw® instrument to determine whether it can meet the regulatory criteria. ORNL Waste Management has installed the Robertshaw® instrument on several of its tanks, and they are satisfied with its performance. In addition, the Robertshaw® instrument has been installed and is operating satisfactorily on 10 of the inactive Gunite tanks. When the Robertshaw® Model 185 is installed, the temperature of the tank contents should be monitored, and the tank volume should be compensated accordingly. The Robertshaw® Model 185 is also recommended for installation in tanks that have problems with differential pressure transmitter systems due to plugging probes.

6. REFERENCES

1. D. G. Douglas, R. F. Wise, J. W. Starr, and J. W. Maresca, Jr., *Leak Testing Plan for the Oak Ridge National Laboratory Liquid Low-Level Waste System (Active Tanks)*, ORNL/ER/SUB/92-SK263-1, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, June 1992.

2. *Instruction Manual: Inven-Tel® Model 185*, Number 909-GF-273, Robertshaw Controls Company, Knoxville, TN.

3. "Bubble Type Installations," Instruction MI 020-328 in Foxboro® *Instruction Book*, The Foxboro Company, Foxboro, MA, September 1988.

4. John W. Lindsey, "General Information on the 7030 and 7032 Magnetostrictive Transducers," Magnetek Controls, Clawson, MI, March 1991.

Appendix

DRAWINGS OF THE ORNL INACTIVE WASTE TANKS

Drawings originally printed in

U.S. DEPARTMENT OF ENERGY
OAK RIDGE NATIONAL LABORATORY
DRAFT WASTE STORAGE TANKS
REMEDIAL ACTION PLAN

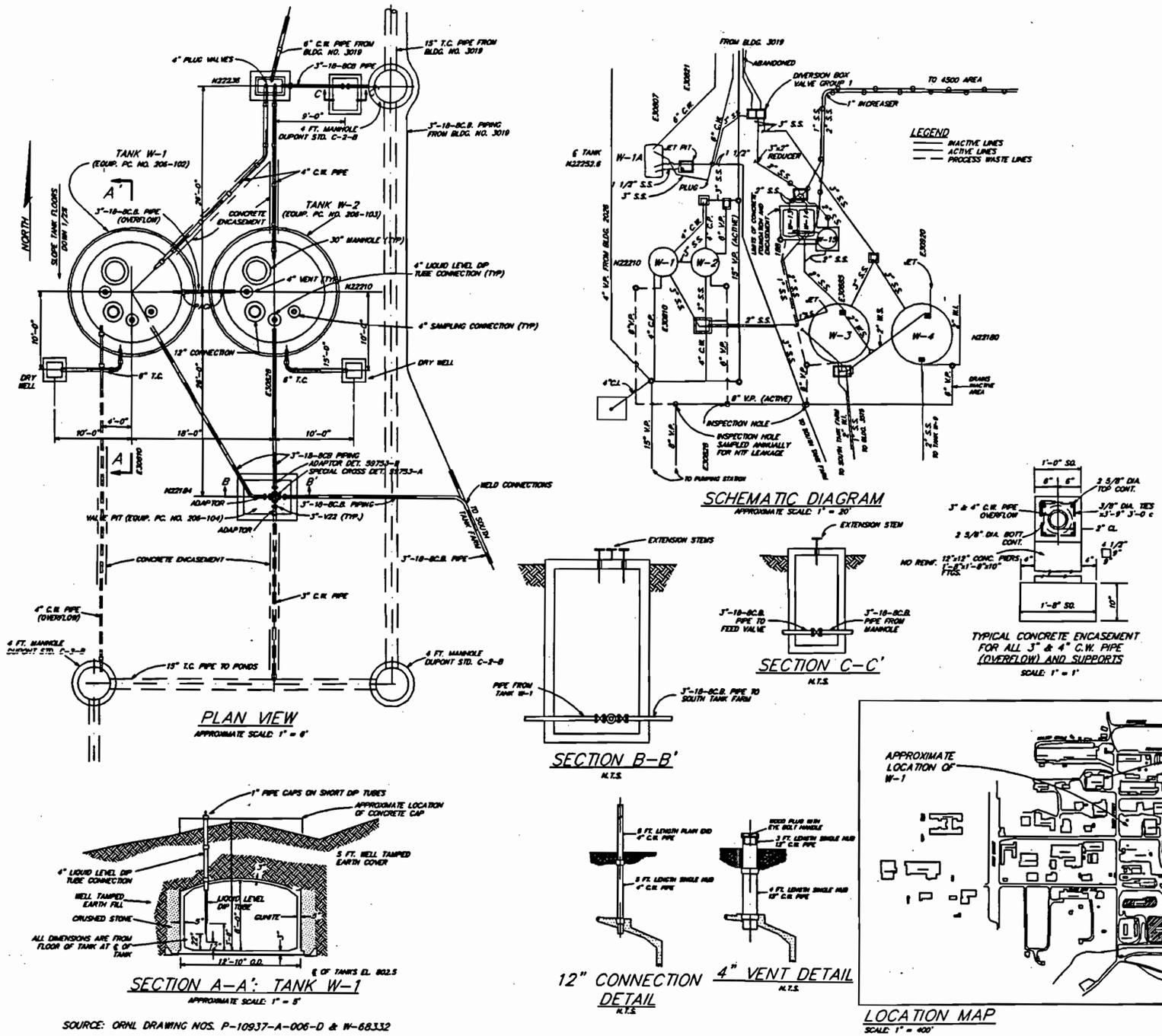
PREPARED FOR
MARTIN MARIETTA ENERGY SYSTEMS, INC.
OAK RIDGE, TENNESSEE

PREPARED BY

PEER CONSULTANTS, P.C.
575 OAK RIDGE TURNPIKE
OAK RIDGE, TENNESSEE 37930

MCI CONSULTING ENGINEERS, INC.
PELLISSIPPI CENTER
725 PELLISSIPPI PARKWAY
KNOXVILLE, TENNESSEE 37922

SEPTEMBER 1987



SOURCE: ORNL DRAWING NOS. P-10937-A-006-D & W-68332

TANK NUMBER W-1

LOCATION NORTH TANK FARM[1]

BUILDINGS SERVED 3019[2]

CONSTRUCTION MATERIAL GUNITE[2]

DIAMETER (a) 3.9 m (12.8 ft)

LENGTH (b) 2.4 m (8ft) (V)

CAPACITY 18,170 L (4800 gal)[1]

RESIDUAL VOLUME 3900 L (1030 gal)[2]

DEPTH FROM SURFACE TO TANK BOTTOM 4.0 m (13 ft)

TRANSFER METHOD JET[3]

VENTILATION(c) NONE VISIBLE[3]

INTEGRITY LEAKS[2]

SERVICE DATES 1943-1960S[2]

CONTAINMENT TYPE EARTH & GRAVEL FILL

LEAK DETECTION DRY WELL

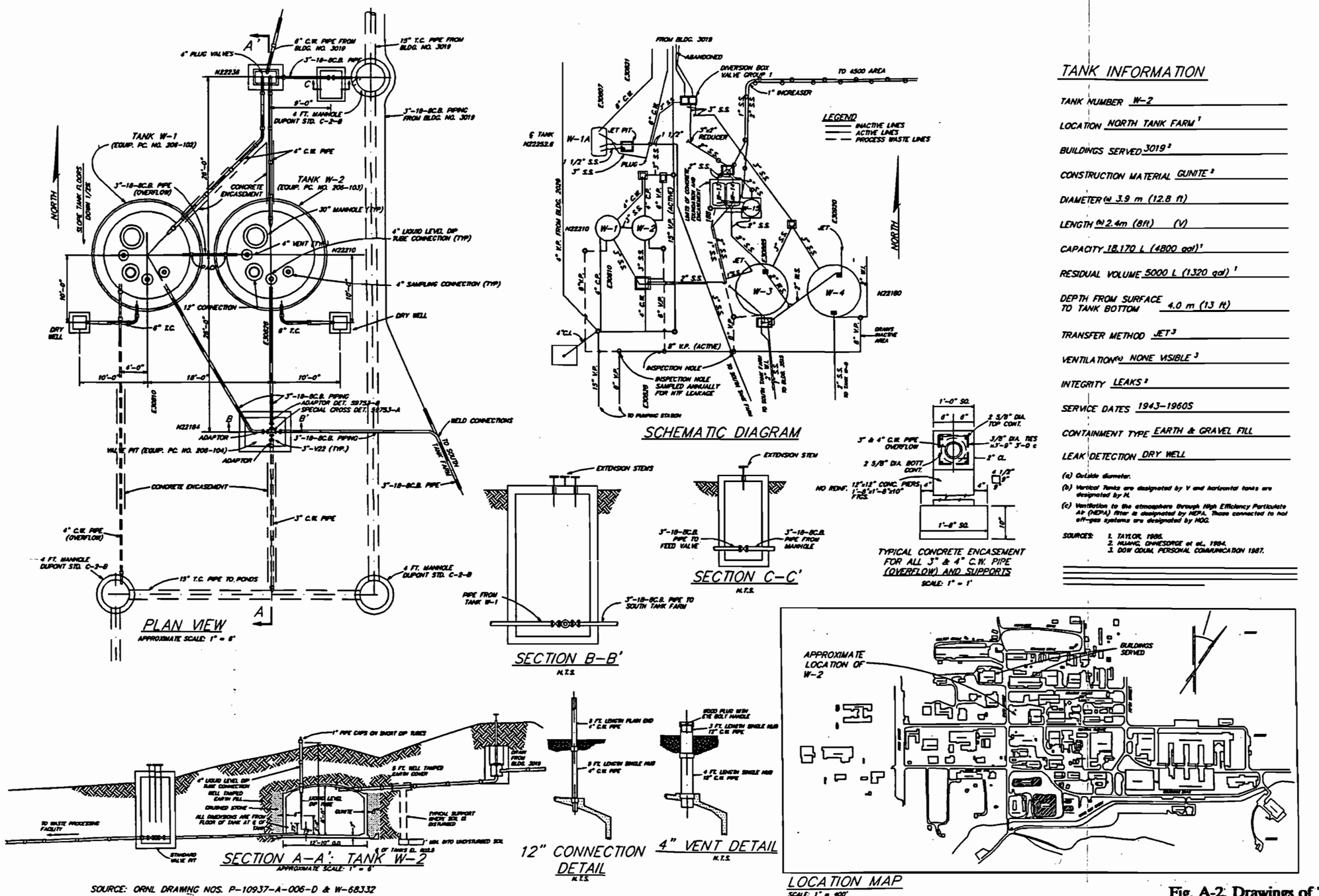
(a) Outside diameter.

(b) Vertical tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

1. TAYLOR, 1986.
2. HUANG, ONNESORGE et al., 1986.
3. DOW COLIN, PERSONAL COMMUNICATION, 1987.

Fig. A-1. Drawings of Tank W-1.



SOURCE: ORNL DRAWING NOS. P-10937-A-006-D & W-68332

TANK INFORMATION

TANK NUMBER W-2

LOCATION NORTH TANK FARM [1]

BUILDINGS SERVED 3019 [2]

CONSTRUCTION MATERIAL GUNITE [2]

DIAMETER (a) 3.9 m (12.8 ft)

LENGTH (b) 2.4m (8ft) (V)

CAPACITY 18,170 L (4800 gal) [1]

RESIDUAL VOLUME 5000 L (1320 gal) [1]

DEPTH FROM SURFACE TO TANK BOTTOM 4.0 m (13 ft)

TRANSFER METHOD JET [3]

VENTILATION (c) NONE VISIBLE [3]

INTEGRITY LEAKS [2]

SERVICE DATES 1943–1960S

CONTAINMENT TYPE EARTH & GRAVEL FILL

LEAK DETECTION DRY WELL

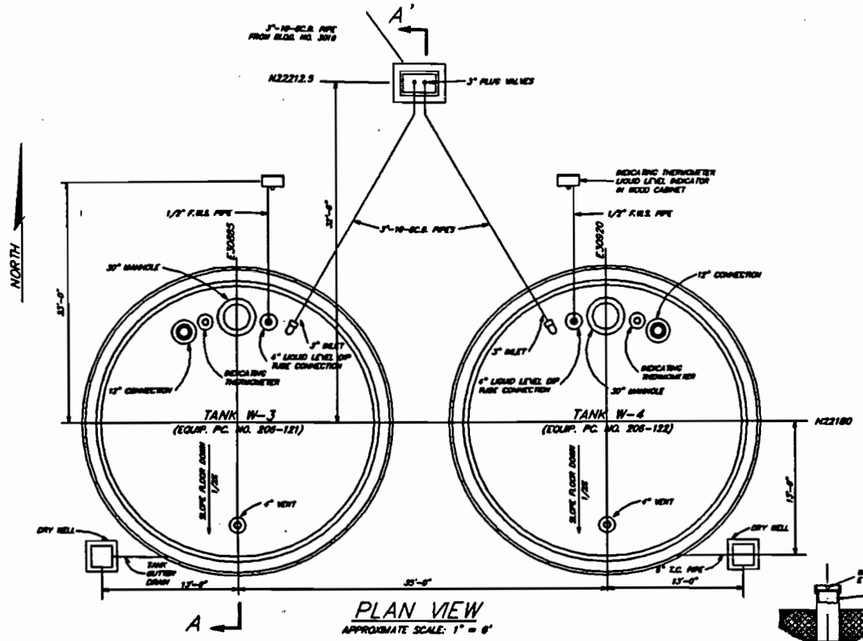
(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

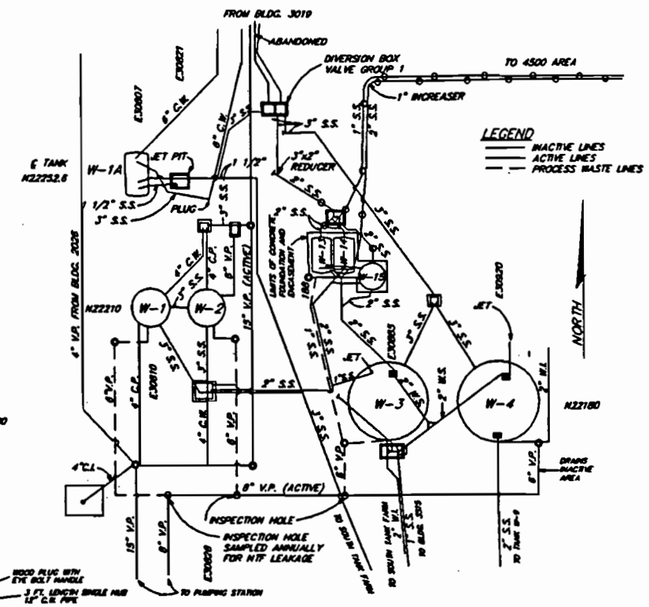
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. TAYLOR, 1986.
2. HUANG, CHNESORGE et al., 1984.
3. DOW COUM, PERSONAL COMMUNICATION 1987.

Fig. A-2. Drawings of Tank W-2.



PLAN VIEW
APPROXIMATE SCALE: 1" = 6'



SCHEMATIC DIAGRAM

TANK INFORMATION

TANK NUMBER W-3

LOCATION NORTH TANK FARM [1]

BUILDINGS SERVED 3019 [2]

CONSTRUCTION MATERIAL GUNITE [2]

DIAMETER [a] 7.9 m (26 ft)

LENGTH [b] 4.3 m (14.1 ft) (V)

CAPACITY 160,880 L (42,500 gal) [1]

RESIDUAL VOLUME 142,600 L (37,670 gal) [4]

DEPTH FROM SURFACE TO TANK BOTTOM 6.7 m (22 ft)

TRANSFER METHOD JET [3]

VENTILATION [c] NONE VISIBLE [3]

INTEGRITY GROUNDWATER INFILTRATION [2,5]

SERVICE DATES 1943–1960S [2]

CONTAINMENT TYPE EARTH & GRAVEL FILL

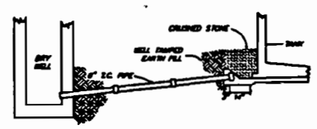
LEAK DETECTION DRY WELL

(a) Outside diameter.

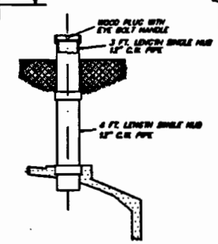
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

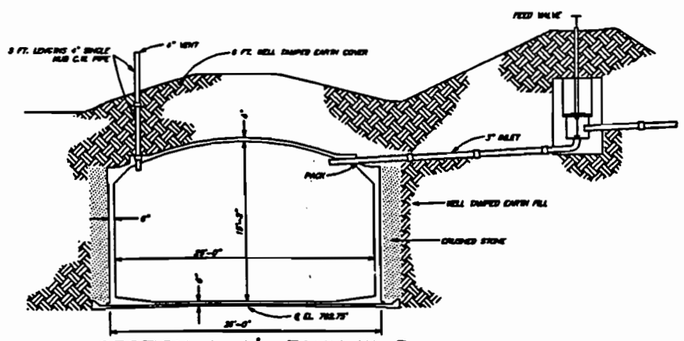
SOURCES: 1. TAYLOR, 1986.
2. HUANG, CHNESORCE, et al., 1984.
3. DOW COLM, PERSONAL COMMUNICATION 1987.
4. ORNL MEASUREMENTS, JUNE, 1987.
5. LINDA KAISER, PERSONAL COMMUNICATION, 1987.



TANK GUTTER DRAIN DETAIL
NOT TO SCALE

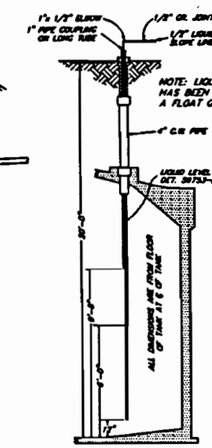


12" CONNECTION DETAIL
N.T.S.

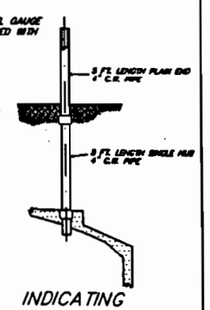


SECTION A–A': TANK W-3
APPROXIMATE SCALE: 1" = 6'

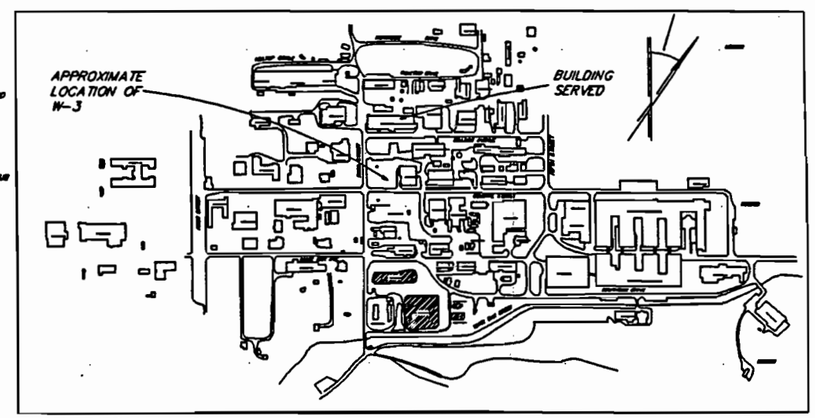
SOURCE: ORNL DRAWING NOS. P-10937-A-006-D & W-68333



4" LIQUID LEVEL DIP TUBE CONNECTION DETAIL
N.T.S.

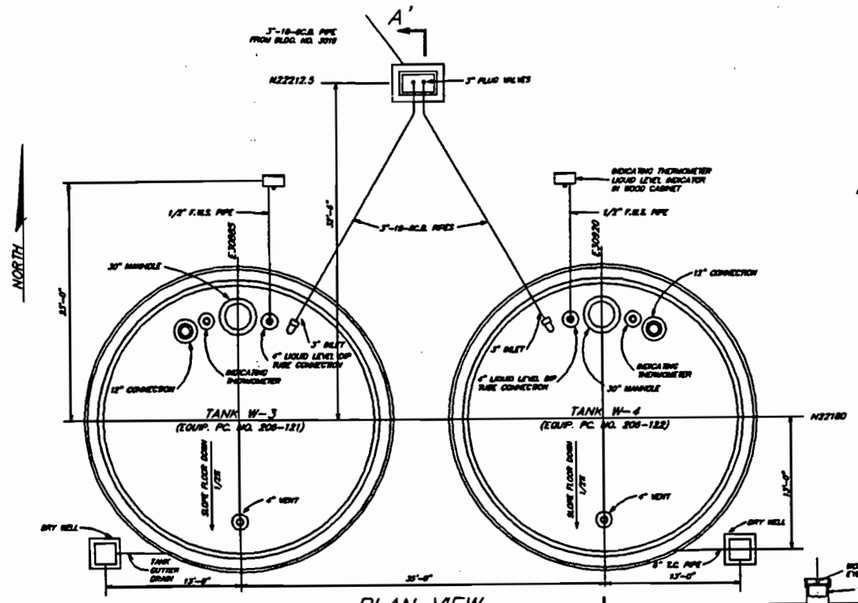


INDICATING THERMOMETER DETAIL
N.T.S.

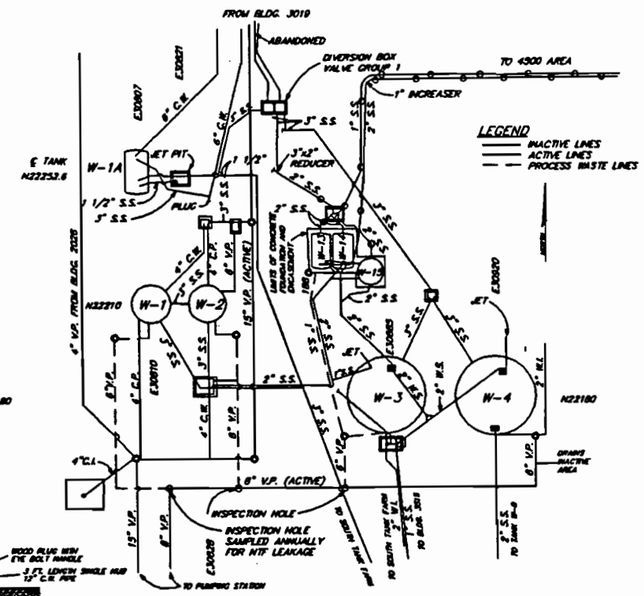


LOCATION MAP
SCALE: 1" = 400'

Fig. A-3. Drawings of Tank W-3.



PLAN VIEW
APPROXIMATE SCALE: 1" = 6'



SCHEMATIC DIAGRAM
APPROXIMATE SCALE: 1" = 20'

TANK INFORMATION

TANK NUMBER W-4

LOCATION NORTH TANK FARM [1]

BUILDINGS SERVED 3019 [2]

CONSTRUCTION MATERIAL GUNITE [1,2]

DIAMETER (a) 7.9 m (26 ft)

LENGTH (b) 4.3 m (14.1 ft) (V)

CAPACITY 160,880 L (42,500 gal) [1]

RESIDUAL VOLUME 90,360 L (23,870 gal) [4]

DEPTH FROM SURFACE TO TANK BOTTOM 6.7 m (22 ft)

TRANSFER METHOD JET [3]

VENTILATION (c) NONE VISIBLE [3]

INTEGRITY GROUNDWATER INFILTRATION [2,5]

SERVICE DATES 1943–1960S [2]

CONTAINMENT TYPE EARTH & GRAVEL FILL

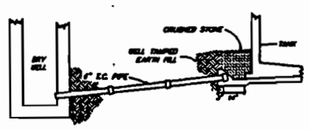
LEAK DETECTION DRY WELL

(a) Outside diameter.

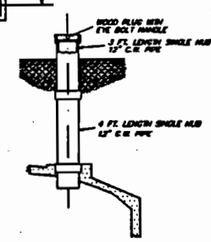
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

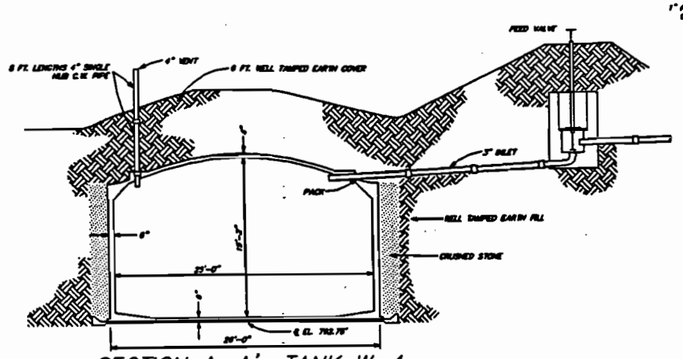
SOURCES:
1. TAYLOR, 1986.
2. HUANG, ONNESORGE et al., 1984.
3. DOW COLM, PERSONAL COMMUNICATION, 1987.
4. ORNL MEASUREMENTS, JUNE, 1987.
5. LINDA KAISER, PERSONAL COMMUNICATION, 1987.



TANK GUTTER DRAIN DETAIL
NOT TO SCALE

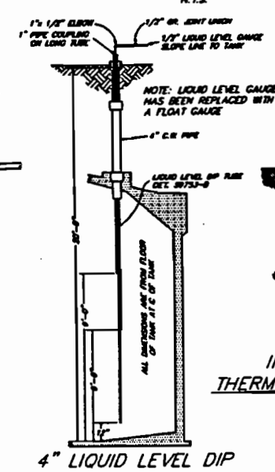


12" CONNECTION DETAIL
N.T.S.

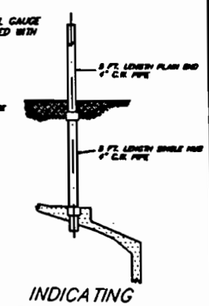


SECTION A–A': TANK W-4
APPROXIMATE SCALE: 1" = 6'

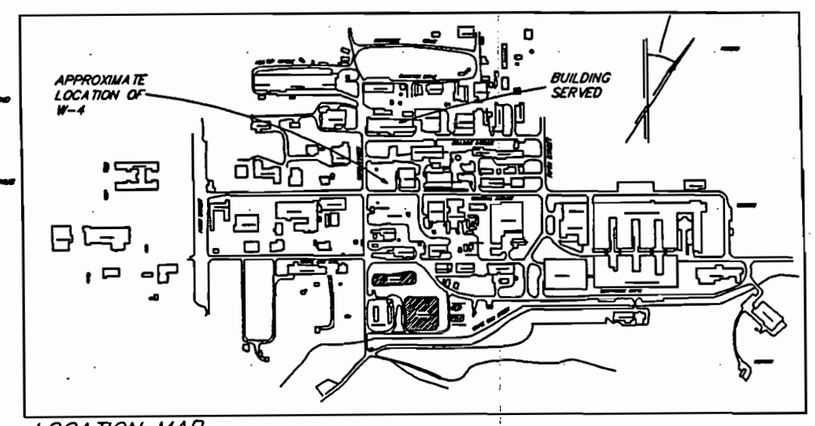
SOURCE: ORNL DRAWING NOS. P-1D937-A-006-D & W-68333



4" LIQUID LEVEL DIP TUBE CONNECTION DETAIL
N.T.S.

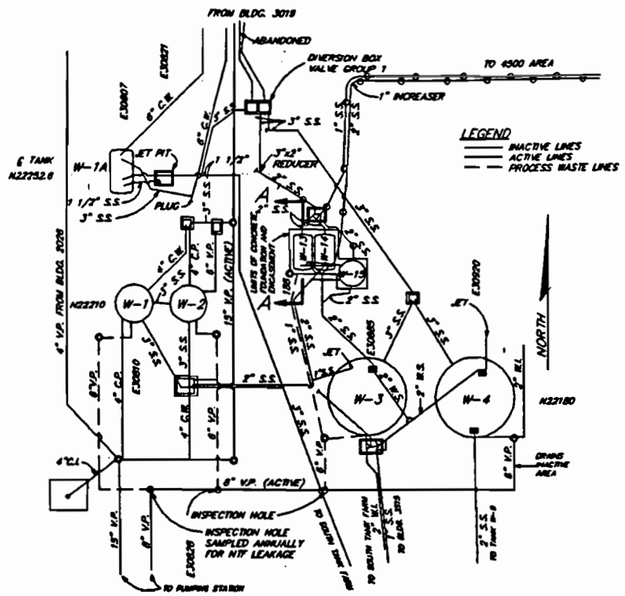


INDICATING THERMOMETER DETAIL
N.T.S.



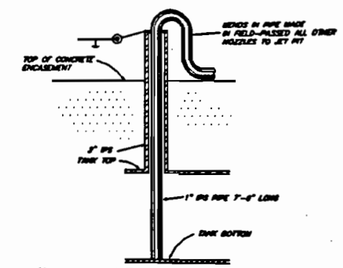
LOCATION MAP
SCALE: 1" = 400'

Fig. A-4. Drawings of Tank .W-4



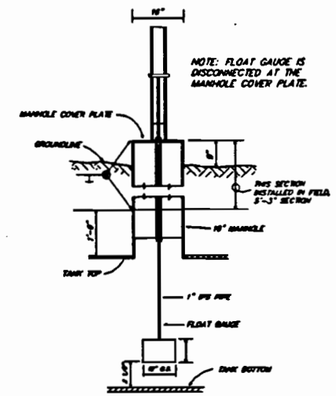
PLAN VIEW

APPROXIMATE SCALE: 1" = 20'



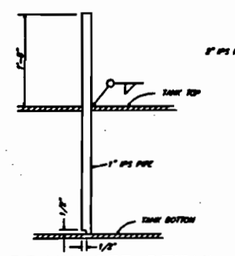
1" AIR SPARGER DETAIL

N.T.S.



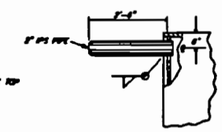
MANHOLE & FLOAT GAUGE DETAIL

N.T.S.



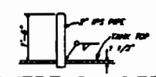
1" DRAW-OFF DETAIL

N.T.S.



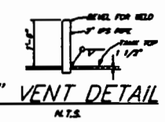
2" INLET DETAIL

N.T.S.



2" OVERFLOW DETAIL

N.T.S.



2" VENT DETAIL

N.T.S.

TANK INFORMATION

TANK NUMBER W-13

LOCATION NORTH TANK FARM [1]

BUILDINGS SERVED BUILDING 3019 [4]

CONSTRUCTION MATERIAL STAINLESS STEEL [2]

DIAMETER [a] 1.8 m (6 ft)

LENGTH [b] 3.4 m (11.1 ft) (H)

CAPACITY 7570 L (2000 gal) [4]

RESIDUAL VOLUME 1700 L (450 gal) [1,2,4]

DEPTH FROM SURFACE TO TANK BOTTOM 3.7 m (12 ft)

TRANSFER METHOD JET [3]

VENTILATION [c] NONE VISIBLE [3]

INTEGRITY NO LEAKS REPORTED [2]

SERVICE DATES 1940–1958 [1,2,4]

CONTAINMENT TYPE CONCRETE ENCASEMENT [1,4]

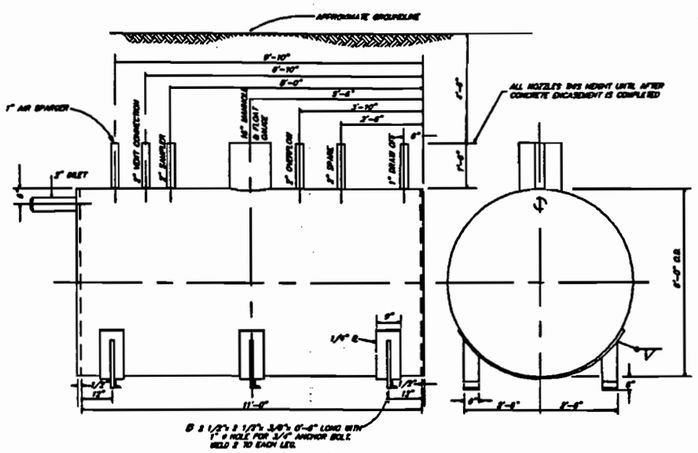
LEAK DETECTION DRY WELL

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

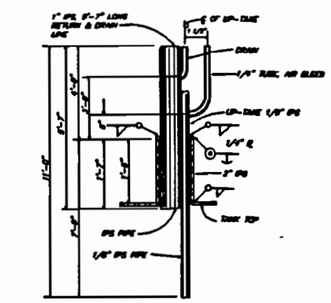
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. TAYLOR, 1986.
2. HUANG, ONKESORGE et al., 1984.
3. DOW COLM, PERSONAL COMMUNICATION 1987.
4. NORTON, 1984.



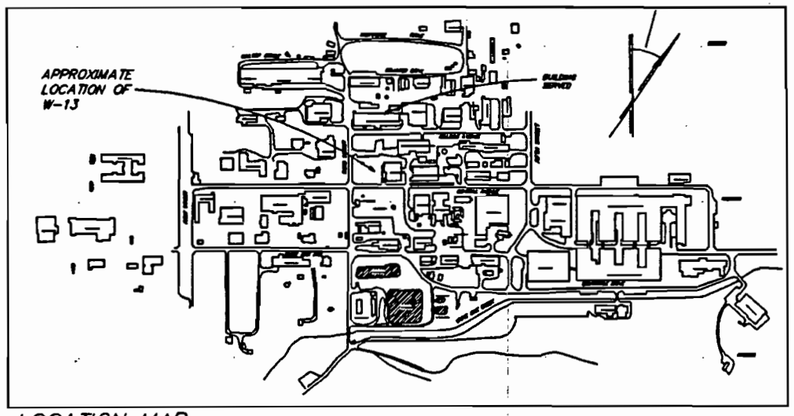
SECTION A–A': TANK W-13

APPROXIMATE SCALE: 1" = 3'



2" SAMPLER DETAIL

N.T.S.

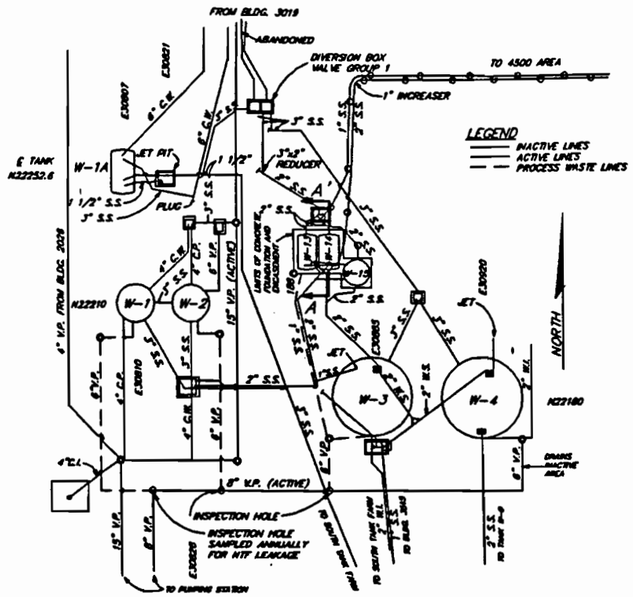


LOCATION MAP

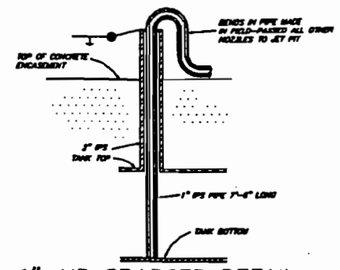
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. E-6917 & P-10937-A-006-D

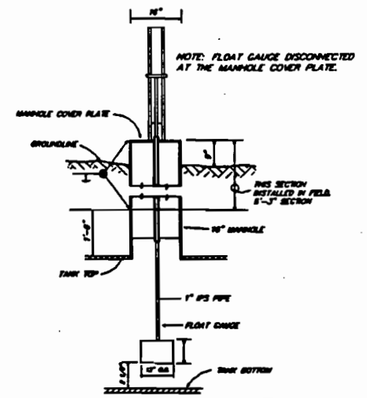
Fig. A-5. Drawings of Tank W-13.



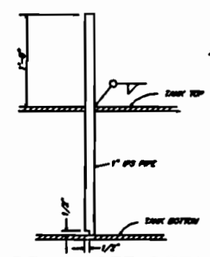
PLAN VIEW



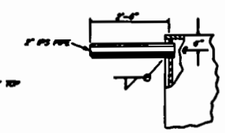
1" AIR SPARGER DETAIL
N.T.S.



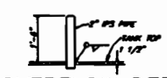
MANHOLE & FLOAT GAUGE DETAIL
N.T.S.



1" DRAW-OFF DETAIL
N.T.S.



2" INLET DETAIL
N.T.S.



2" OVERFLOW DETAIL
N.T.S.

2" VENT DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER W-14

LOCATION NORTH TANK FARM[1]

BUILDINGS SERVED BUILDING 3019[4]

CONSTRUCTION MATERIAL STAINLESS STEEL[2]

DIAMETER[a] 1.8 m (6 ft)

LENGTH[b] 3.4 m (11.1 ft) (H)

CAPACITY 7570 L (2000 gal)[4]

RESIDUAL VOLUME 470 L (125 gal)[2]

DEPTH FROM SURFACE TO TANK BOTTOM 3.7 m (12 ft)

TRANSFER METHOD JET[3]

VENTILATION[c] NONE VISIBLE[3]

INTEGRITY NO LEAKS REPORTED[2]

SERVICE DATES 1940–1958[2]

CONTAINMENT TYPE CONCRETE ENCASEMENT[4]

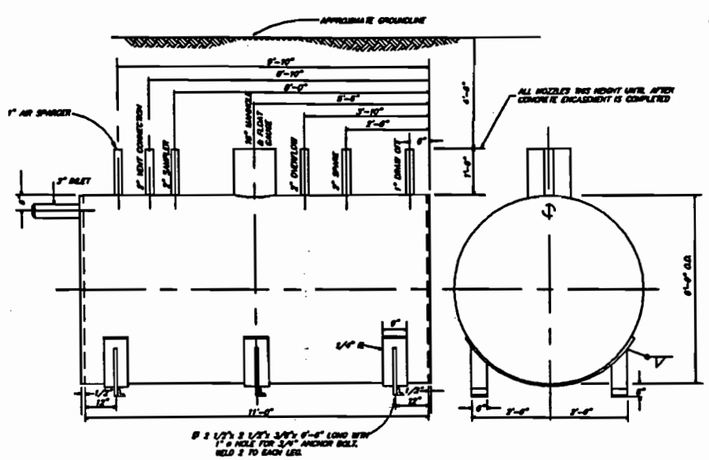
LEAK DETECTION DRY WELL

(a) Outside diameter.

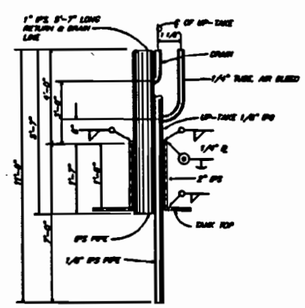
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

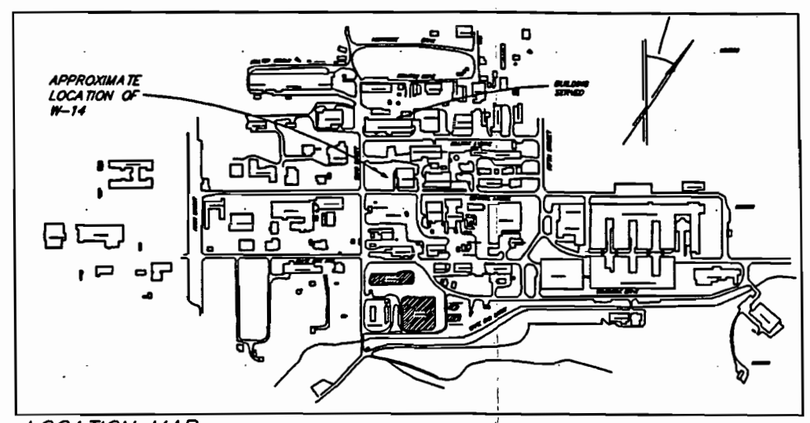
SOURCES:
1. TAYLOR, 1988.
2. MUANG, CHAESORGE et al., 1984.
3. DOW ODUM, PERSONAL COMMUNICATION 1987.
4. NORTON, 1984.



SECTION A–A': TANK W-14
APPROXIMATE SCALE: 1" = 3'



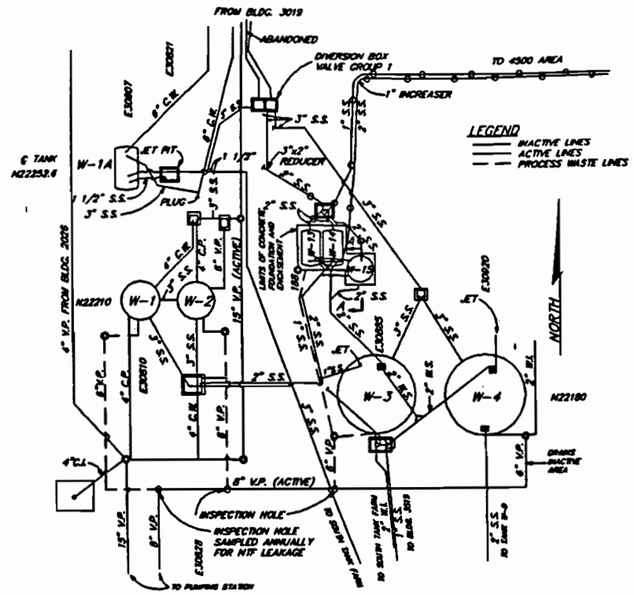
2" SAMPLER DETAIL
N.T.S.



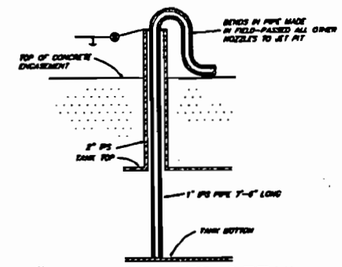
LOCATION MAP
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. E-6917 & P-10937-A-006-D

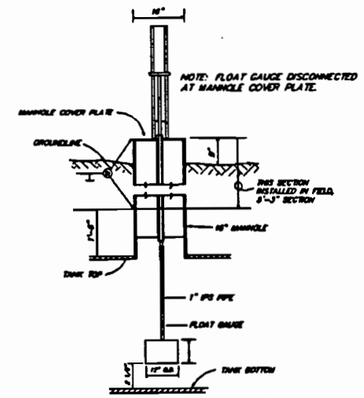
Fig. A-6. Drawings of Tank W-14.



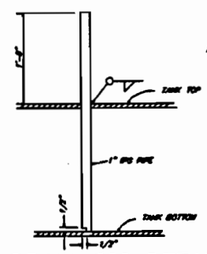
PLAN VIEW
APPROXIMATE SCALE: 1" = 20'



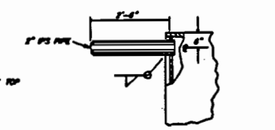
1" AIR SPARGER DETAIL
N.T.S.

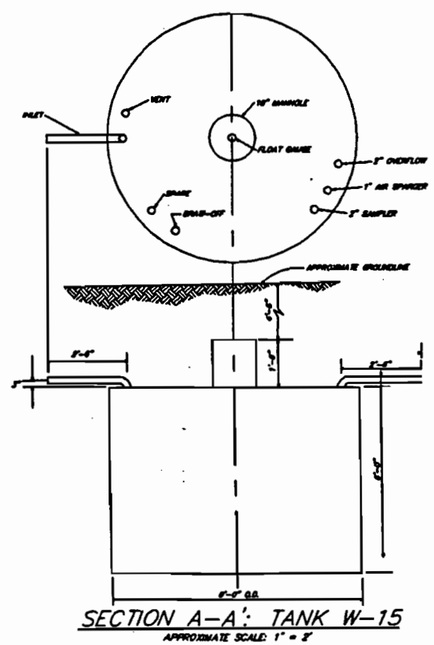


MANHOLE & FLOAT GAUGE DETAIL
N.T.S.

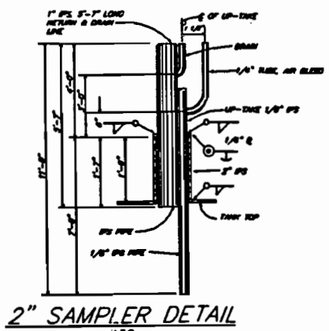


1" DRAW-OFF DETAIL
N.T.S.

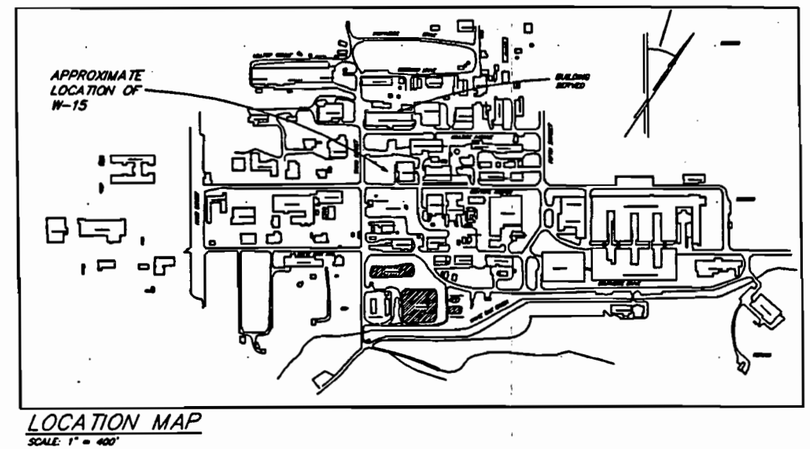




SECTION A-A': TANK W-15
APPROXIMATE SCALE: 1" = 3'



2" SAMPLER DETAIL
N.T.S.



LOCATION MAP
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. E-6917 & P-10937-A-006-D

TANK INFORMATION

TANK NUMBER W-15

LOCATION NORTH TANK FARM[1]

BUILDINGS SERVED BUILDING 3019[4]

CONSTRUCTION MATERIAL STAINLESS STEEL[2]

DIAMETER[(a)] 2.4 m (8 ft)

LENGTH[(b)] 1.8 m (6 ft) (V)

CAPACITY 7570 L (2000 gal)[4]

RESIDUAL VOLUME NOT SAMPLED

DEPTH FROM SURFACE TO TANK BOTTOM 3.7 m (12 ft)

TRANSFER METHOD JET[3]

VENTILATION[(c)] NONE VISIBLE[3]

INTEGRITY NO LEAKS REPORTED[2]

SERVICE DATES 1940–1958[3]

CONTAINMENT TYPE CONCRETE ENCASEMENT[1,4]

LEAK DETECTION DRY WELL

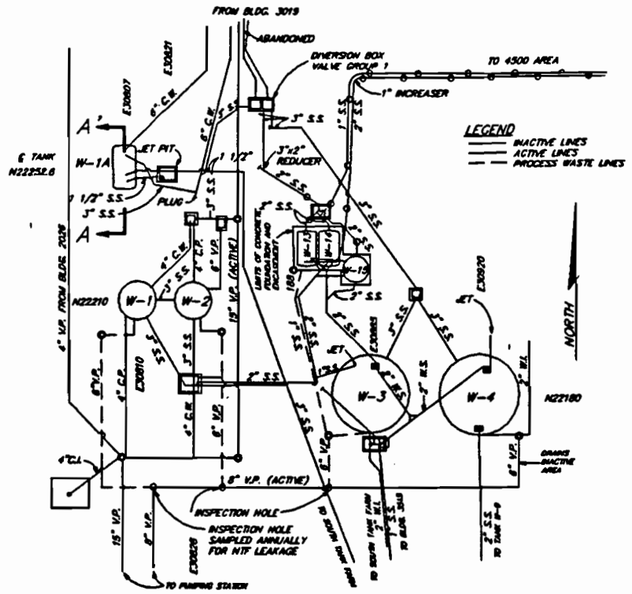
(a) Outside diameter.

(b) Vertical tanks are designated by V and horizontal tanks are designated by H.

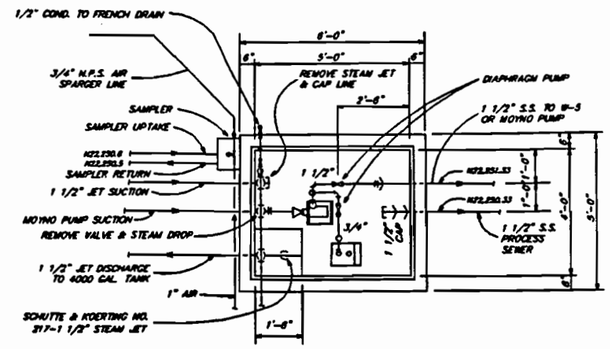
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. TAYLOR, 1988.
2. HUANG, CHNESORGE et al., 1984.
3. DOW ODUAL PERSONAL COMMUNICATION 1987.
4. HORTON, 1984.

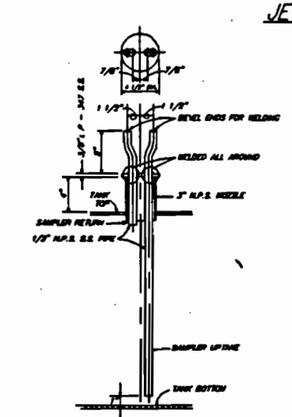
Fig. A-7. Drawings of Tank W-15.



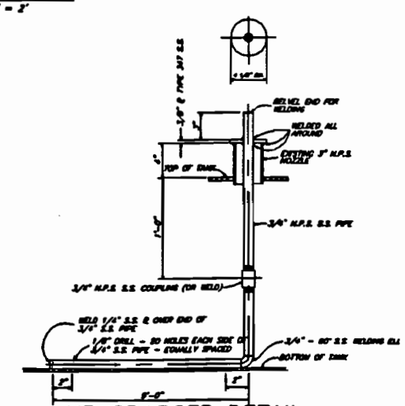
PLAN VIEW
APPROXIMATE SCALE: 1" = 20'



JET PIT DETAIL
SCALE: 1" = 2'



SAMPLER LINES DETAIL
N.T.S.



AIR SPARGER DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER W-1A

LOCATION NORTH TANK FARM [1]

BUILDINGS SERVED 2026 & 3019 [1]

CONSTRUCTION MATERIAL STAINLESS STEEL

DIAMETER [a] 2.3 m (7.5 ft)

LENGTH [a] 4.1 m (13.6 ft) (H)

CAPACITY 15,140 L (4000 gal) [1]

RESIDUAL VOLUME PERIODICALLY PUMPED DUE TO GROUND WATER INFILTRATION [3]

DEPTH FROM SURFACE TO TANK BOTTOM 3.8 m (12.5 ft)

TRANSFER METHOD JET [1]

VENTILATION [c] HEPA [1]

INTEGRITY GROUNDWATER INFILTRATION [2,4]

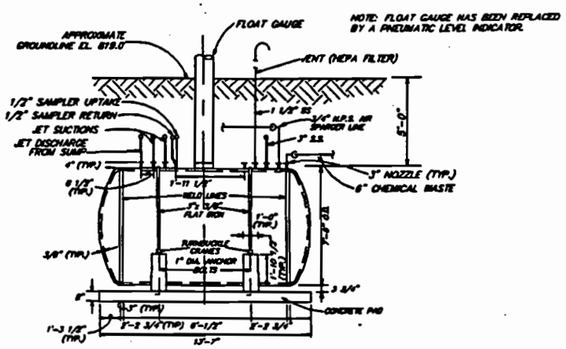
SERVICE DATES 1951–1986 [2]

CONTAINMENT TYPE EARTH

LEAK DETECTION NONE

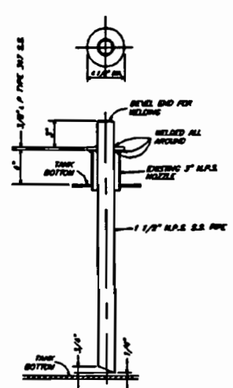
(a) Outside diameter.
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. BINFORD AND ORF L 1979.
2. ORNL/RAP-12/A.
3. LASHER, PERSONAL COMMUNICATION, 1987.
4. LINDA KAISER, PERSONAL COMMUNICATION, 1987.

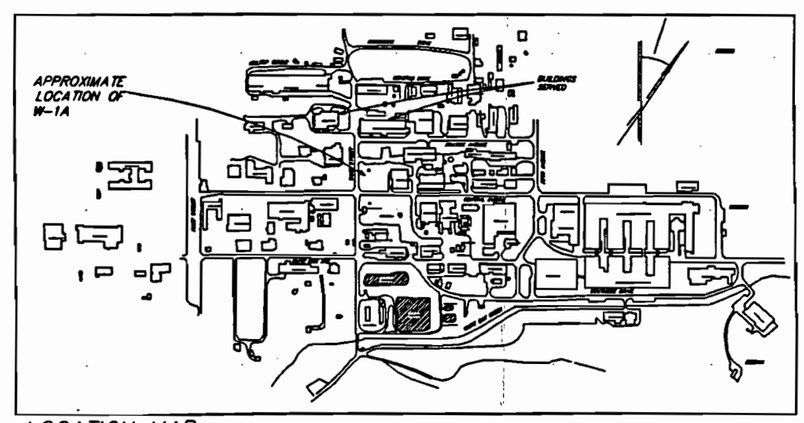


SECTION A–A': TANK W-1A
APPROXIMATE SCALE: 1" = 4'

SOURCES ORNL DRAWING NOS. P-10937-A-006-D, D-15603 & D-15646

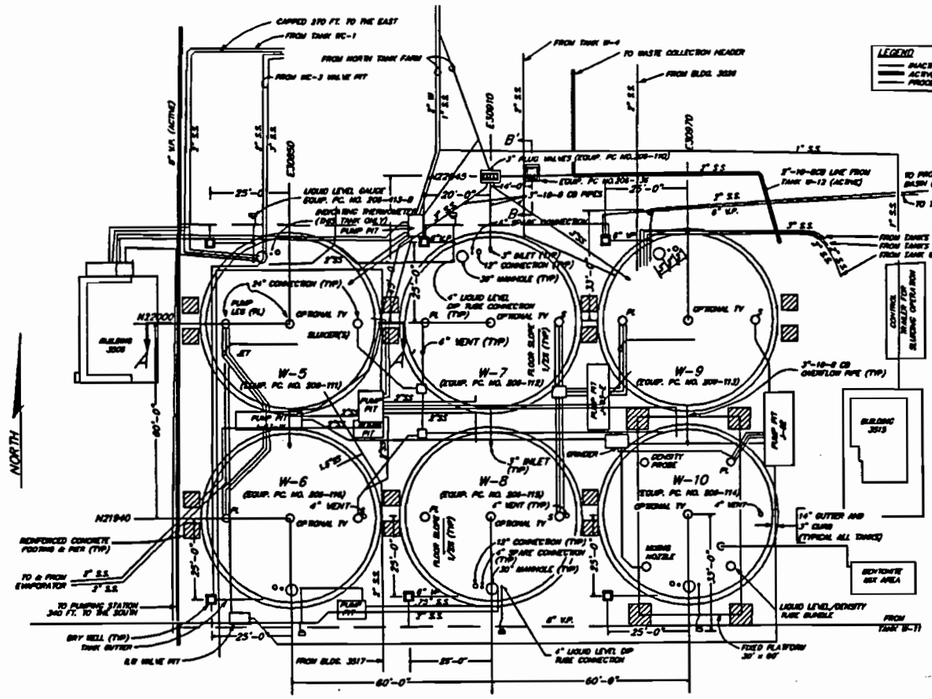


JET SUCTION DETAIL
N.T.S.

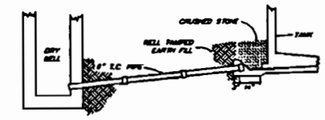


LOCATION MAP
SCALE: 1" = 400'

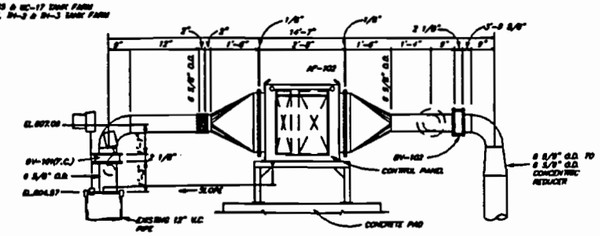
Fig. A-8. Drawings of Tank W-1A.



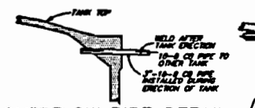
PLAN VIEW
APPROXIMATE SCALE: 1" = 20'



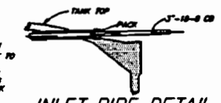
DRY WELL DETAIL
N.T.S.



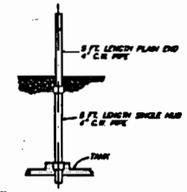
HEPA FILTER DETAILS
N.T.S.



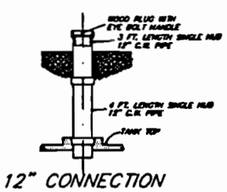
OVERFLOW PIPE DETAIL
N.T.S.



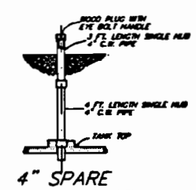
INLET PIPE DETAIL
N.T.S.



4" VENT DETAIL
N.T.S.



12" CONNECTION DETAIL
N.T.S.



4" SPARE CONNECTION DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER W-5

LOCATION SOUTH TANK FARM[1]

BUILDINGS SERVED VARIOUS BUILDINGS

CONSTRUCTION MATERIAL GUNITE[2]

DIAMETER[(a)] 15.5 m (51 ft)

LENGTH[(a)] 5.6 m (18.25 ft) (V)

CAPACITY 643,450 L (170,000 gal)[1]

RESIDUAL VOLUME 40,500 L (10,700 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 7.2 m (23.75 ft)

TRANSFER METHOD PUMP[4]

VENTILATION[(c)] HEPA[4]

INTEGRITY GROUNDWATER INFILTRATION[5] & WALL DETERIORATION[2]

SERVICE DATES 1943–1980[6]

CONTAINMENT TYPE EARTH & GRAVEL FILL

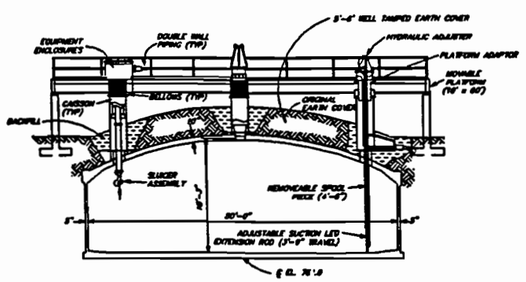
LEAK DETECTION DRY WELL

(a) Outside diameter.

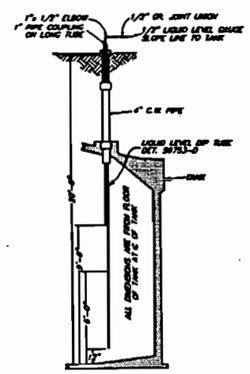
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

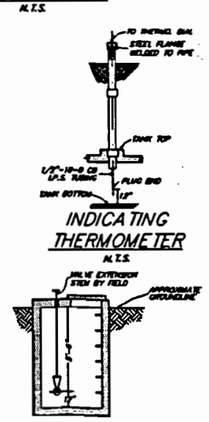
SOURCES:
1. TAYLOR, 1986.
2. HUANG, ALEXANDER ET AL., 1984.
3. ORNL MEASUREMENTS JUNE, 1987.
4. DOW DOUAI, PERSONAL COMMUNICATION, 1987.
5. LINDA KAISER, PERSONAL COMMUNICATION, 1987.
6. HARTMAN AND BATES, 1984.



SECTION A–A': TANK W-5
APPROXIMATE SCALE: 1" = 10'

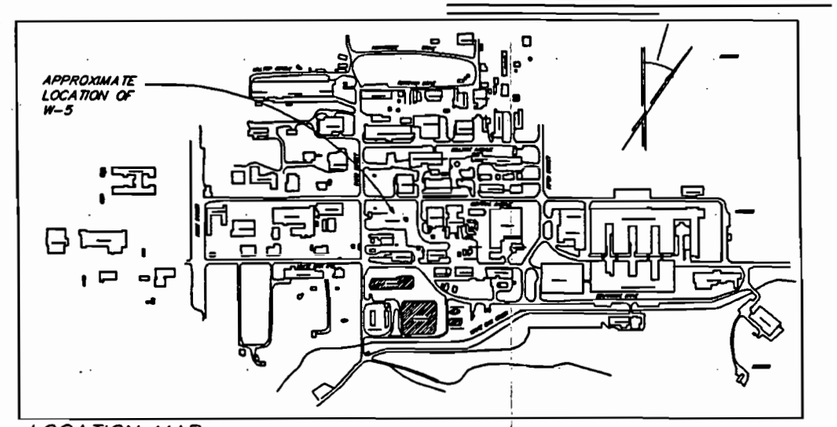


4" LIQUID LEVEL DIP TUBE CONNECTION
N.T.S.



INDICATING THERMOMETER
N.T.S.

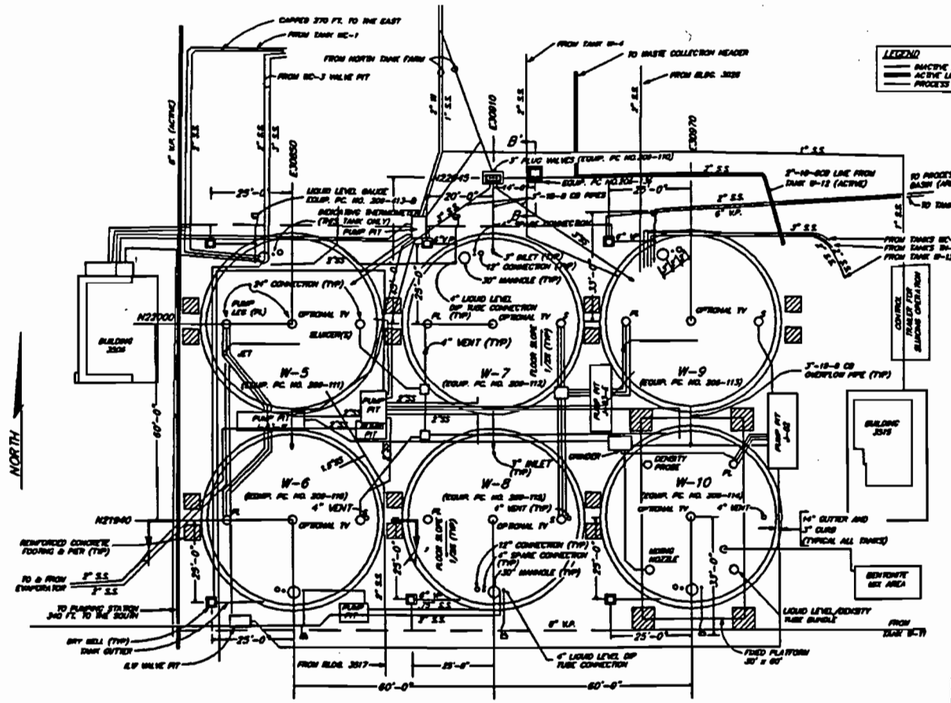
SECTION B–B'
N.T.S.



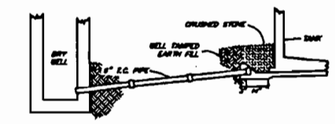
LOCATION MAP
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. W-68336, P-10937-A-007-D, P3E-20539-C027, H3E20539G006D HARTMAN AND BATES (1984).

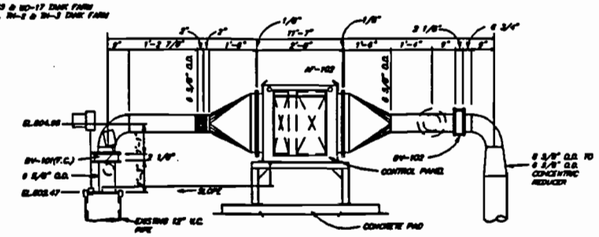
Fig. A-9. Drawings of Tank W-5.



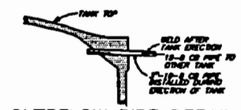
PLAN VIEW
APPROXIMATE SCALE: 1" = 20'



DRY WELL DETAIL
N.T.S.

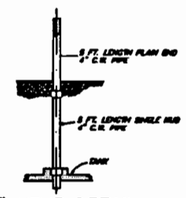


HEPA FILTER DETAILS
N.T.S.

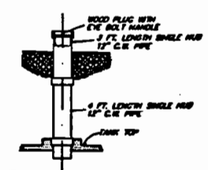


OVERFLOW PIPE DETAIL
N.T.S.

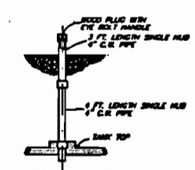
INLET PIPE DETAIL
N.T.S.



4" VENT DETAIL
N.T.S.



12" CONNECTION DETAIL
N.T.S.



4" SPARE CONNECTION DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER W-6

LOCATION SOUTH TANK FARM[1]

BUILDINGS SERVED VARIOUS BUILDINGS

CONSTRUCTION MATERIAL GUNITE[2]

DIAMETER(a) 15.5 m (51 ft)

LENGTH(b) 5.6 m (18.25 ft) (V)

CAPACITY 643,450 L (170,000 gal)[1]

RESIDUAL VOLUME 300,940 L (79,500 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 7.2 m (23.75 ft)

TRANSFER METHOD PUMP[4]

VENTILATION(c) HEPA[4]

INTEGRITY GROUNDWATER INFILTRATION[5] & WALL DETERIORATION[2]

SERVICE DATES 1943–1980[6]

CONTAINMENT TYPE EARTH & GRAVEL FILL

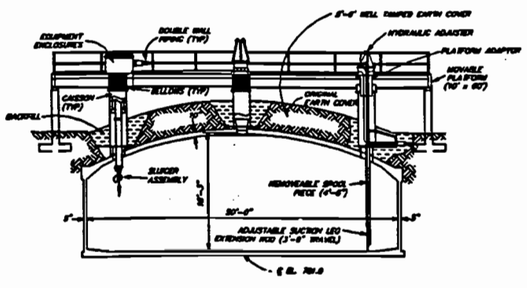
LEAK DETECTION DRY WELL

(a) Outside diameter.

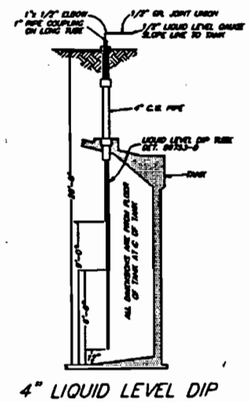
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

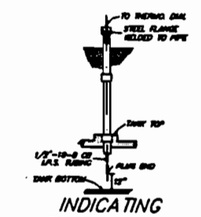
SOURCES:
1. TAYLOR, 1986.
2. HUANG, ALEXANDER ET AL., 1984.
3. ORNL MEASUREMENTS JUNE, 1987.
4. DOW COUK, PERSONAL COMMUNICATION, 1987.
5. LINDA KAISER, PERSONAL COMMUNICATION, 1987.
6. HARTMAN AND BATES, 1984.



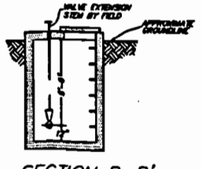
SECTION A–A': TANK W-6
APPROXIMATE SCALE: 1" = 10'



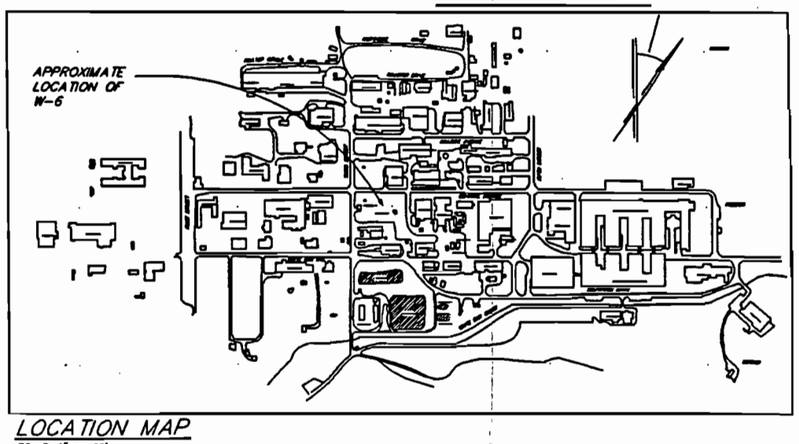
4" LIQUID LEVEL DIP TUBE CONNECTION
N.T.S.



INDICATING THERMOMETER
N.T.S.



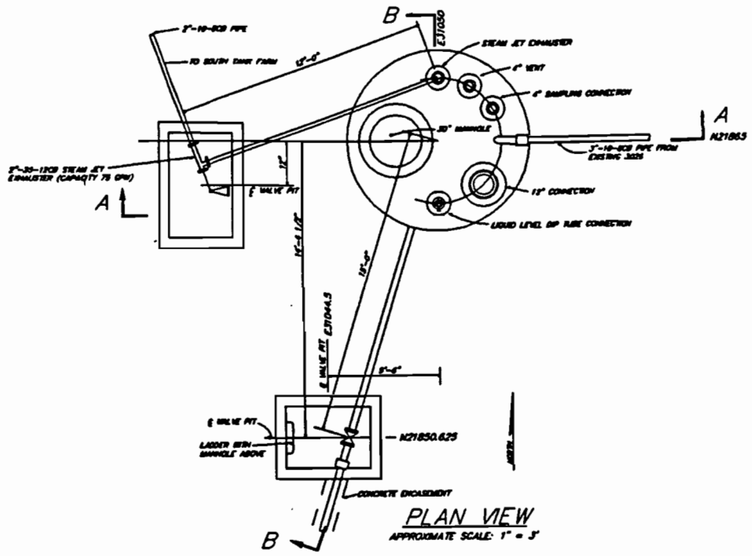
SECTION B–B'
N.T.S.



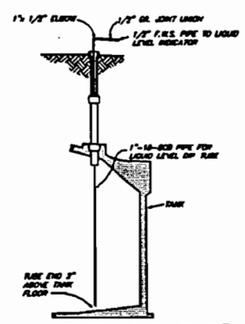
LOCATION MAP
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. W-68336, P-10937-A-007-D, P3E-20539-C027, H3E20539G006D HARTMAN AND BATES (1984).

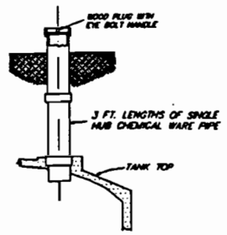
Fig. A-10. Drawings of Tank W-6.



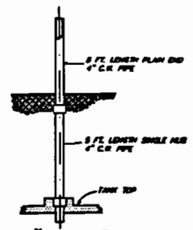
PLAN VIEW
APPROXIMATE SCALE: 1" = 3'



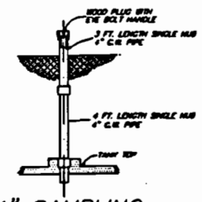
LIQUID LEVEL DIP TUBE CONNECTION DETAIL
N.T.S.



12" CONNECTION DETAIL
N.T.S.



4" VENT CONNECTION DETAIL
N.T.S.



4" SAMPLING CONNECTION DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER W-11

LOCATION EAST OF BUILDING 3505 [1]

BUILDINGS SERVED 3550 [2]

CONSTRUCTION MATERIAL GUNITE [2]

DIAMETER (a) 2.7m (8.7 ft)

LENGTH (b) 1.7 m (5.5 ft) (V)

CAPACITY 5,680 L (1500 gal) [1]

RESIDUAL VOLUME 1170 L (310 gal) [2]

DEPTH FROM SURFACE TO TANK BOTTOM 3.4 m (11 ft)

TRANSFER METHOD JET [4]

VENTILATION (c) HEPA [4]

INTEGRITY LEAKS [2]

SERVICE DATES 1943–1948 [2]

CONTAINMENT TYPE EARTH

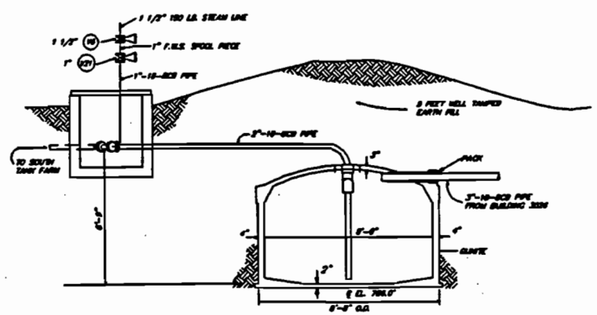
LEAK DETECTION

(a) Outside diameter.

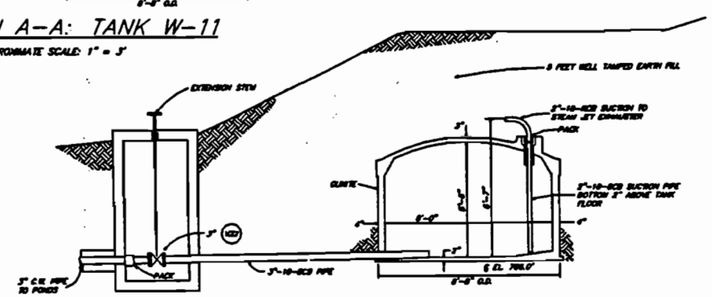
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. TAYLOR, 1986.
2. HUANG, CHNESORGE et al., 1984.
3. DOW GOUAL, PERSONAL COMMUNICATION 1987.

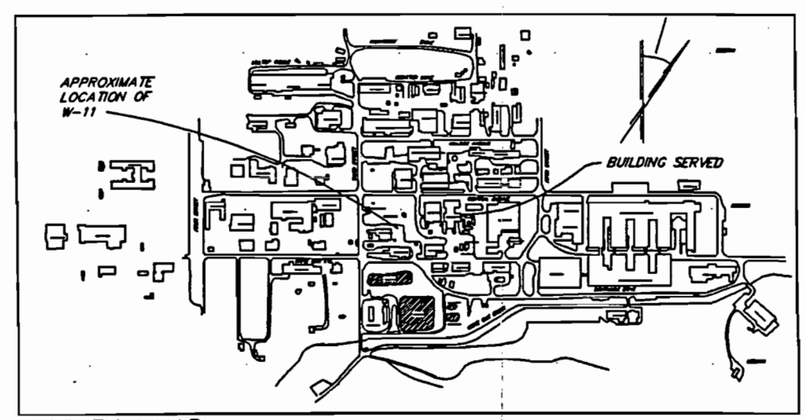


SECTION A–A: TANK W-11
APPROXIMATE SCALE: 1" = 3'



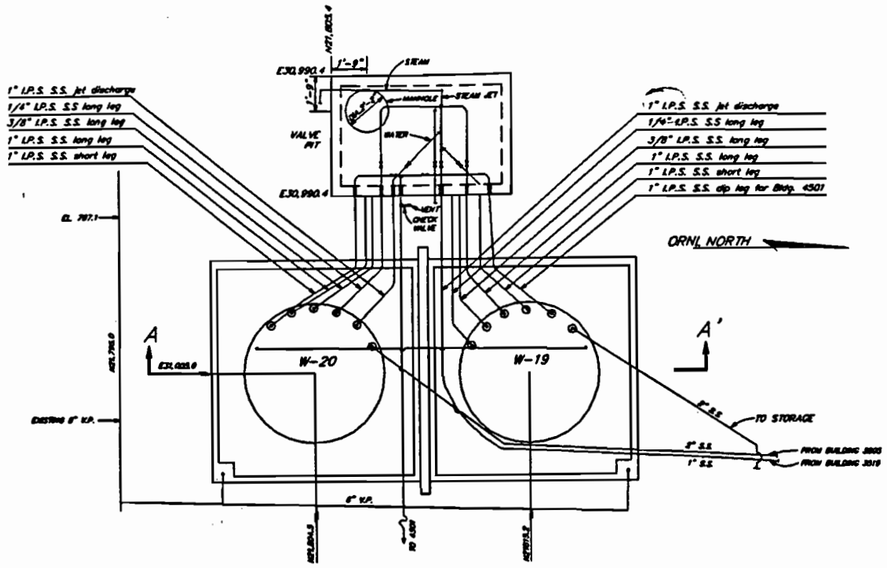
SECTION B–B: TANK W-11
APPROXIMATE SCALE: 1" = 3'

SOURCE: ORNL DRAWING NO. W-69065

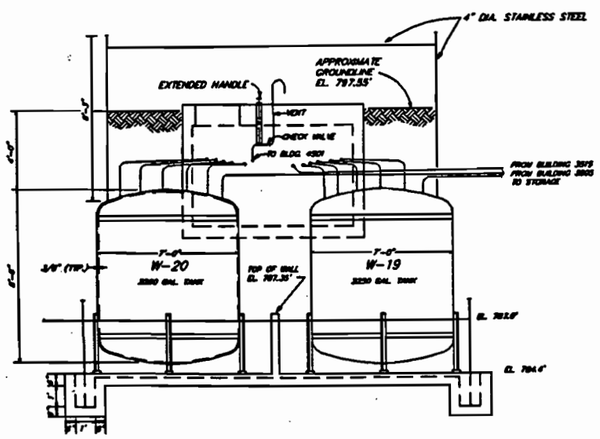


LOCATION MAP
SCALE: 1" = 400'

Fig. A-11. Drawings of Tank W-11.



PLAN VIEW
APPROXIMATE SCALE: 1" = 3'



SECTION A-A': TANK W-19
APPROXIMATE SCALE: 1" = 3'

SOURCE: ORNL DRAWING NOS. D-20830 & D-8931

TANK INFORMATION

TANK NUMBER W-19

LOCATION NORTH OF BUILDING 3517[1]

BUILDINGS SERVED 3517[2] & 3505[3]

CONSTRUCTION MATERIAL STAINLESS STEEL

DIAMETER[(a)] 2.1 m (7 ft)

LENGTH[(b)] 2.6 m (8.5 ft) (V)

CAPACITY 8520 L (2250 gal)

RESIDUAL VOLUME REPORTED TO BE EMPTY[4]

DEPTH FROM SURFACE TO TANK BOTTOM 3.8 m (12.5 ft)

TRANSFER METHOD JET[1]

VENTILATION[(c)] NONE VISIBLE[1]

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1955–1960S[3]

CONTAINMENT TYPE CONCRETE ENCASEMENT

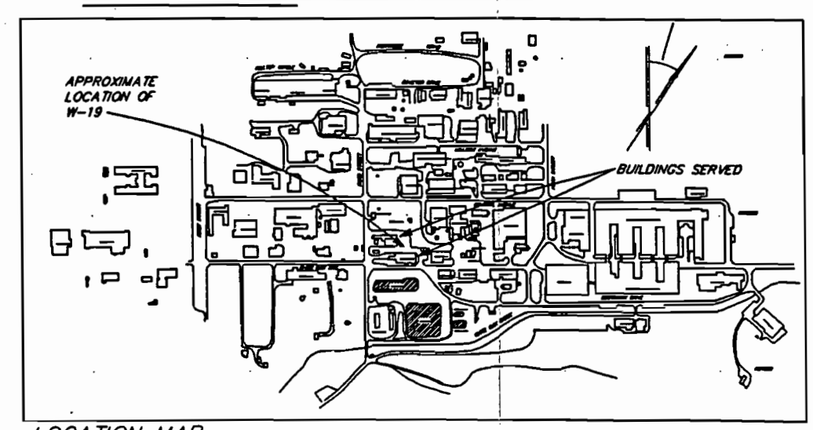
LEAK DETECTION

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

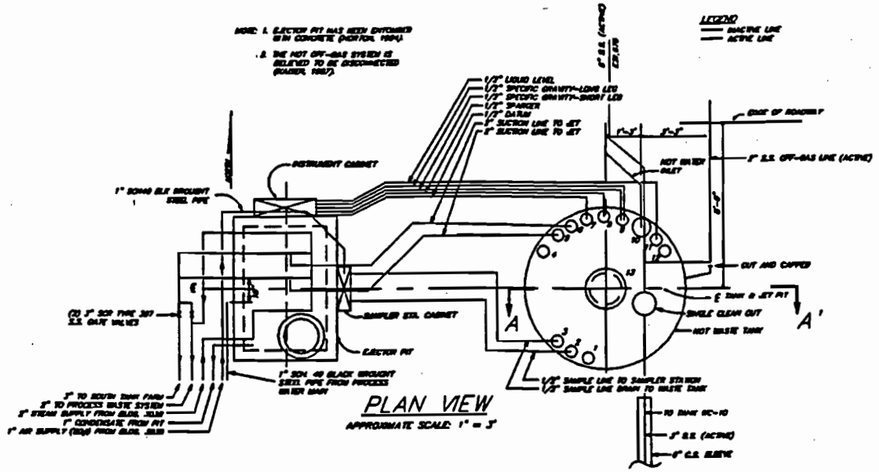
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. DOW DRUM, PERSONAL COMMUNICATION, 1987.
2. BINFORD AND ORT (, 1972.
3. UCC-ND, 1984.
4. LARRY LASHER, PERSONAL COMMUNICATION, 1987.

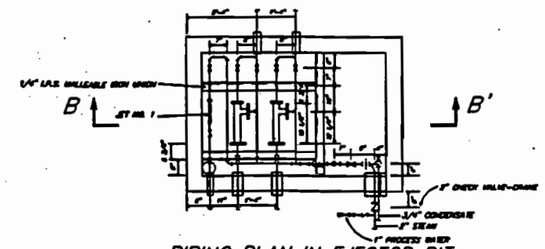


LOCATION MAP
SCALE: 1" = 400'

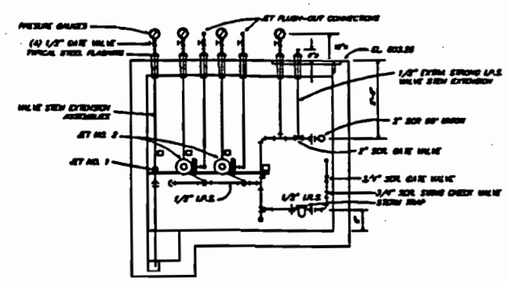
Fig. A-12. Drawings of Tank W-19.



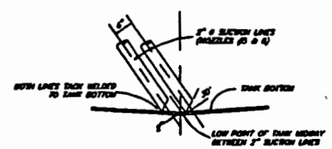
PLAN VIEW
APPROXIMATE SCALE: 1" = 3'



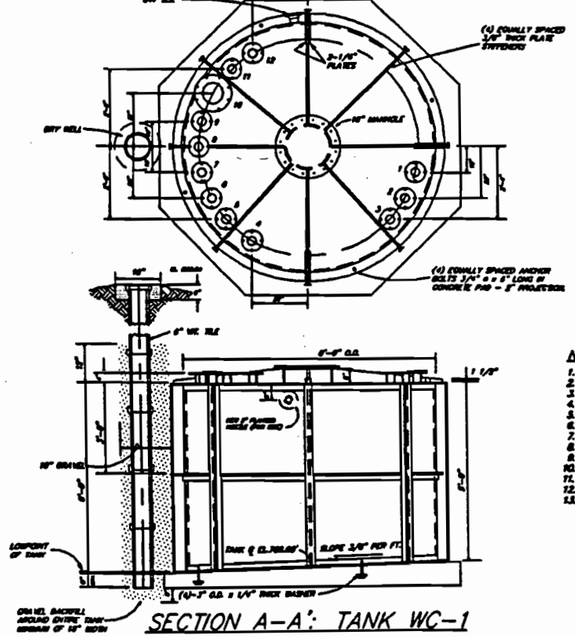
PIPING PLAN IN EJECTOR PIT
N.T.S.



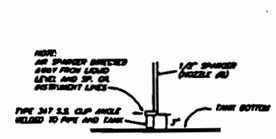
SECTION B–B: EJECTOR PIT PIPING
N.T.S.



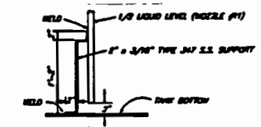
2" SUCTION LINE DETAIL
N.T.S.



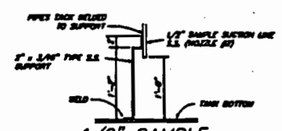
SECTION A–A': TANK WC–1
APPROXIMATE SCALE: 1" = 3'



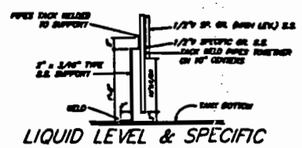
1/2" SPARGER LINE DETAIL
N.T.S.



1/2" LIQUID LEVEL LINE DETAIL
N.T.S.



1/2" SAMPLE SUCTION LINE DETAIL
N.T.S.



LIQUID LEVEL & SPECIFIC GRAVITY LINE DETAIL
N.T.S.

NOZZLE SCHEDULE

1. BLANK
2. 1/2" SAMPLE SUCTION LINE
3. 1/2" SAMPLE RETURN LINE
4. BLANK
5. 2" SUCTION LINE
6. 2" SUCTION LINE
7. 1/2" DATUM
8. 1/2" SPARGER
9. 1/2" SPECIFIC GRAVITY LINE
10. 6" HOT WASTE INLET
11. 1/2" LIQUID LEVEL
12. BLANK
13. MANHOLE

SOURCE: ORNL DRAWING NOS. D-6700, D-6701, 3702 & P-11158-EA-002-D.

TANK INFORMATION

TANK NUMBER WC-1

LOCATION EAST OF BUILDING 3038 [1]

BUILDINGS SERVED 3110, 3039, 3092, 3038, 3028, 3029, 3030, 3031, 3032, 3033, 3047 [1]

CONSTRUCTION MATERIAL STAINLESS STEEL [2]

DIAMETER (a) 2.6 m (8.67 ft)

LENGTH (a) 1.8 m (6 ft) (V)

CAPACITY 8140 L (2150 gal) [4]

RESIDUAL VOLUME REPORTED TO BE EMPTY [4]

DEPTH FROM SURFACE TO TANK BOTTOM 5.0 m (16.5 ft)

TRANSFER METHOD JET [3]

VENTILATION (b) HOG [3]

INTEGRITY LEAKING DISCHARGE LINES [2] & GROUNDWATER INFILTRATION

SERVICE DATES 1950–1968 [2]

CONTAINMENT TYPE EARTH

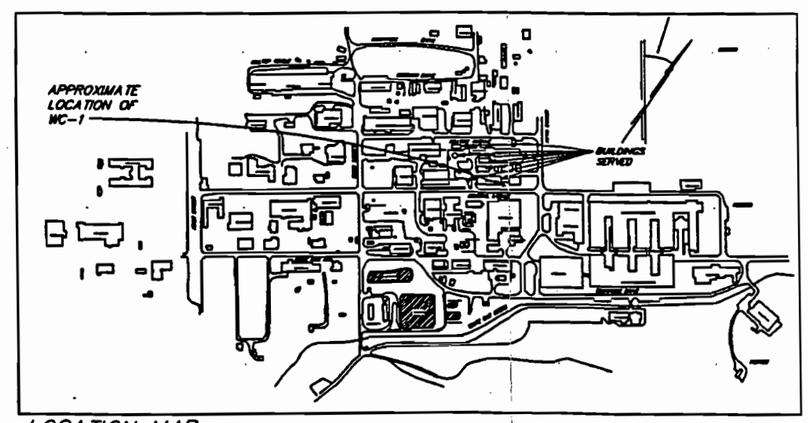
LEAK DETECTION DRY WELL

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

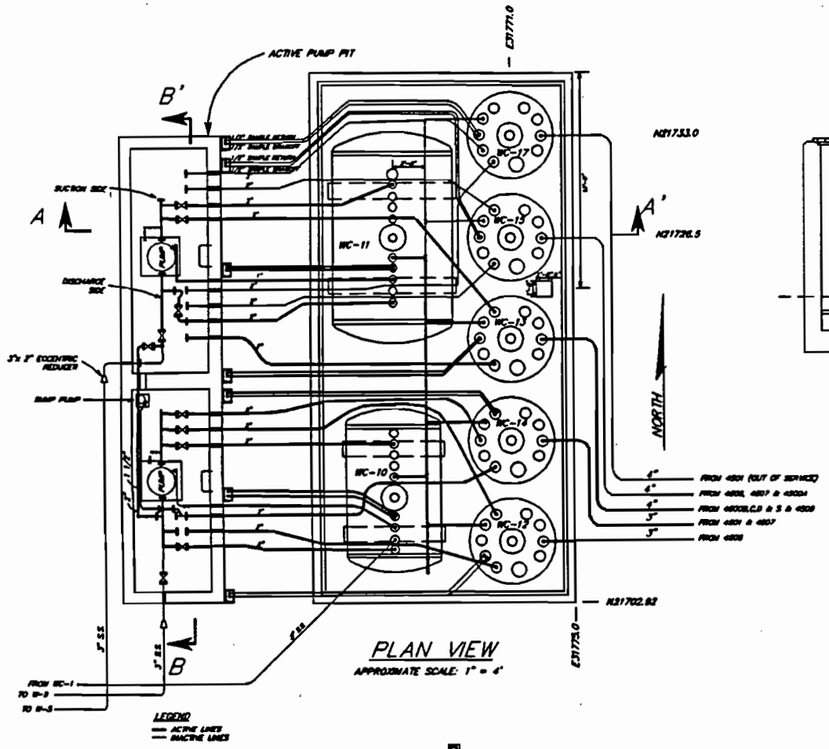
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. TAYLOR, 1986.
2. HUANG et al., 1986.
3. DONI COLIN, PERSONAL COMMUNICATION 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION, 1987.



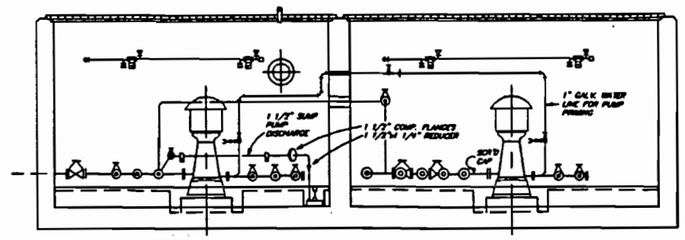
LOCATION MAP
SCALE: 1" = 400'

Fig. A-13. Drawings of Tank WC-1.



PLAN VIEW

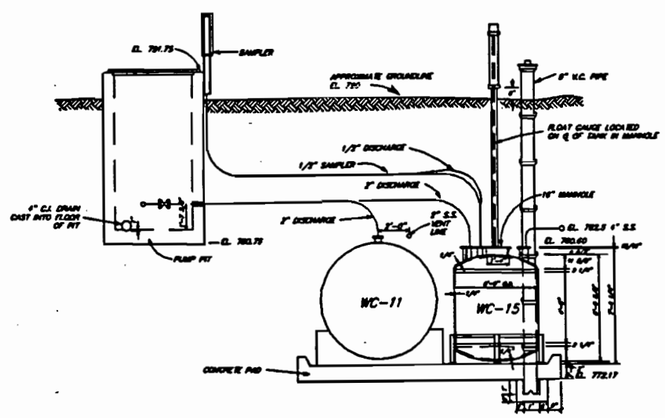
APPROXIMATE SCALE: 1" = 4'



SECTION B–B': PUMP PIT

APPROXIMATE SCALE: 1" = 3'

NOTE: PUMPS ARE LABOUR TYPE "C" MODEL "B" NO. 10 PUMP



SECTION A–A': TANK WC-15

APPROXIMATE SCALE: 1" = 4'

SOURCE: ORNL DRAWING NOS. D-7152, D-8672, P-20599-EC-001-D & X-20013-EE-101-D.

TANK INFORMATION

TANK NUMBER WC-15

LOCATION SOUTH OF BUILDING 3587 [1]

BUILDINGS SERVED 4500 [2]

CONSTRUCTION MATERIAL STAINLESS STEEL [2]

DIAMETER (a) 1.5 m (5 ft)

LENGTH (b) 2.0 m (6.75 ft) (V)

CAPACITY 3790 L (1000 gal) [4]

RESIDUAL VOLUME NOT SAMPLED [3]

DEPTH FROM SURFACE TO TANK BOTTOM 5.1 m (16.7 ft)

TRANSFER METHOD PUMP [3]

VENTILATION (c) HOG [3]

INTEGRITY LEAKS [3]

SERVICE DATES 1951–1960S [2]

CONTAINMENT TYPE EARTH & GRAVEL FILL

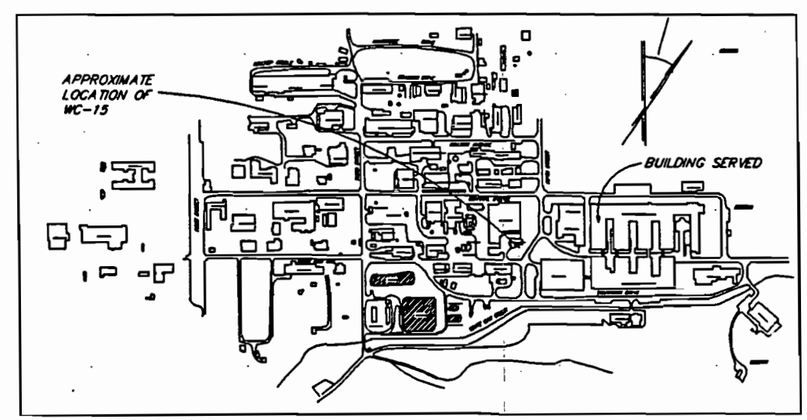
LEAK DETECTION DRY WELL [3]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

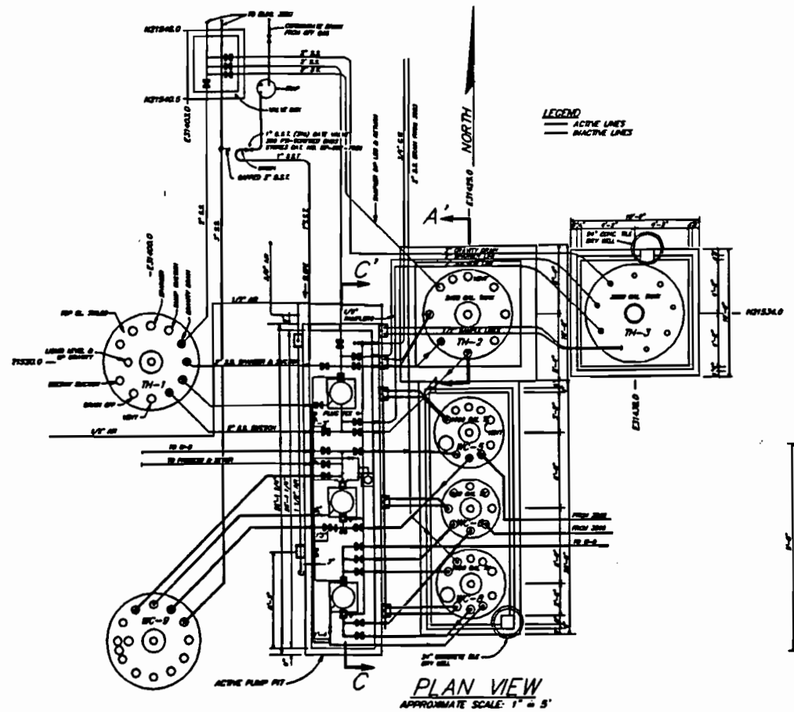
SOURCES:
1. TAYLOR, 1985.
2. HUANG, OHNESORGE et al., 1984.
3. DOW COLAL PERSONAL COMMUNICATION 1987.
4. HORTON, 1984.



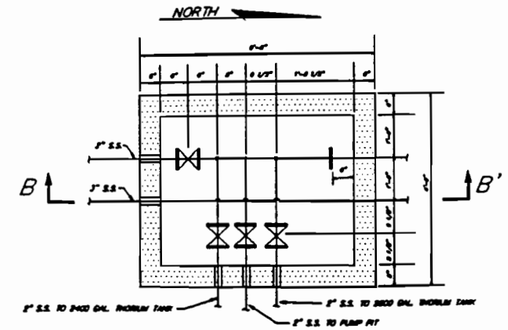
LOCATION MAP

SCALE: 1" = 400'

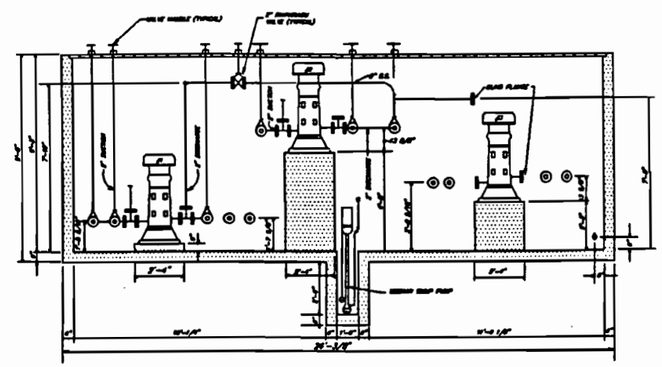
Fig. A-14. Drawings of Tank WC-15.



PLAN VIEW
APPROXIMATE SCALE: 1" = 5'



PLAN VIEW OF VALVE BOX
N.T.S.



SECTION C–C'
APPROXIMATE SCALE: 1" = 3'
NOTE: ALL PUMPS ARE LABOUR NO. 10.

TANK INFORMATION

TANK NUMBER TH-2

LOCATION SOUTH OF BUILDING 3503 [1]

BUILDINGS SERVED 3503 [2]

CONSTRUCTION MATERIAL STAINLESS STEEL [3]

DIAMETER [a] 2.1 m (7 ft) (V)

LENGTH [a] 3.0 L (10 ft) (V)

CAPACITY 9080 L (2400 gal) [1]

RESIDUAL VOLUME NOT SAMPLED

DEPTH FROM SURFACE TO TANK BOTTOM 4.6 m (15 ft)

TRANSFER METHOD PUMP [3]

VENTILATION [c] NONE VISIBLE [3]

INTEGRITY NO LEAKS REPORTED [1]

SERVICE DATES 1952–1970 [2]

CONTAINMENT TYPE CONCRETE ENCASEMENT

LEAK DETECTION

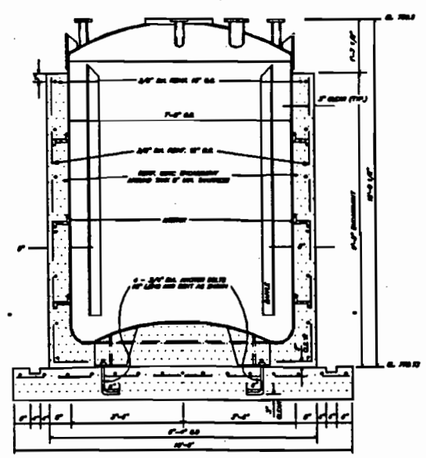
(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

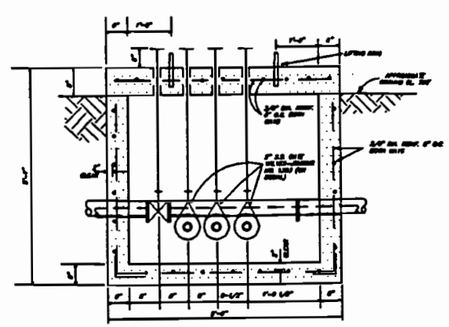
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. TAYLOR, 1985.
2. HUANG, ONKESORGE et al., 1984.
3. DOW DOUAK, PERSONAL COMMUNICATION 1987.

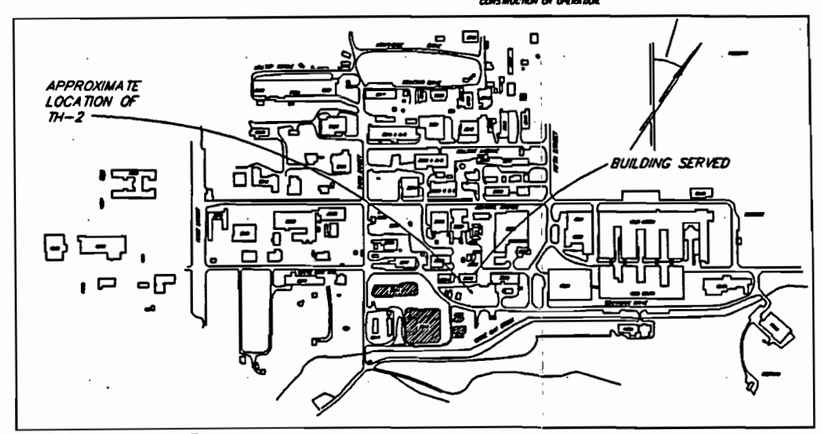
NOTES:
2. TANK TH-1 WAS SALVAGED FROM BURIAL GROUND (NORTON, 1984)
1. THIS DRAWING IS A COMPILATION OF THE AVAILABLE INFORMATION ON THE PHYSICAL CONFIGURATION OF THIS TANK AND IS TO BE USED FOR INFORMATION PURPOSES ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION OR OPERATION.



SECTION A–A': TANK TH-2
SCALE: 1" = 3'
SOURCE: ORNL DRAWING NOS. D-16294, D-12051 & D-12052

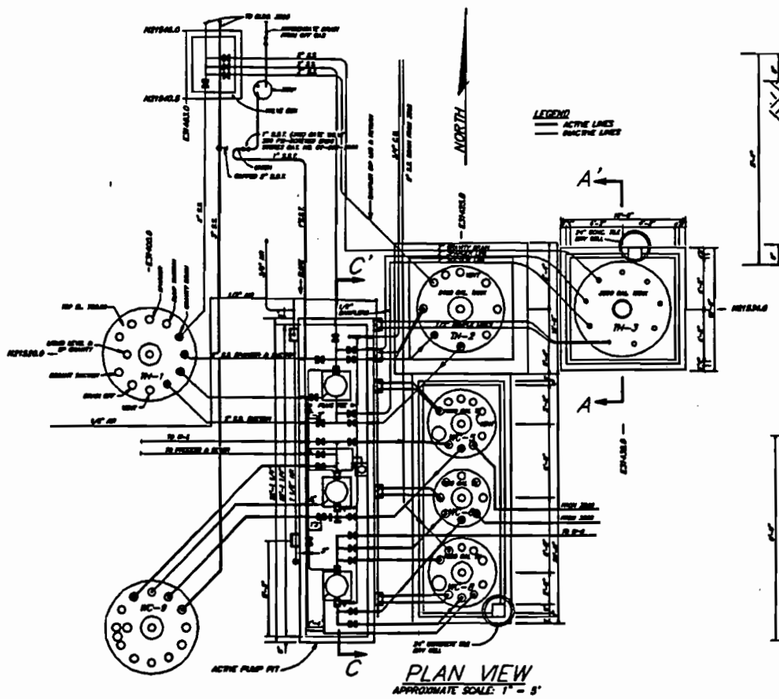


SECTION B–B'
N.T.S.

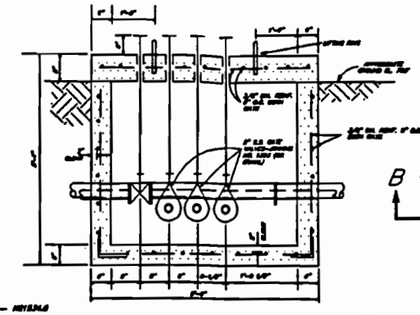


LOCATION MAP
SCALE: 1" = 400'

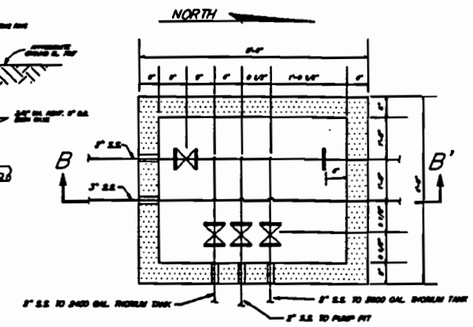
Fig. A-15. Drawings of Tank TH-2.



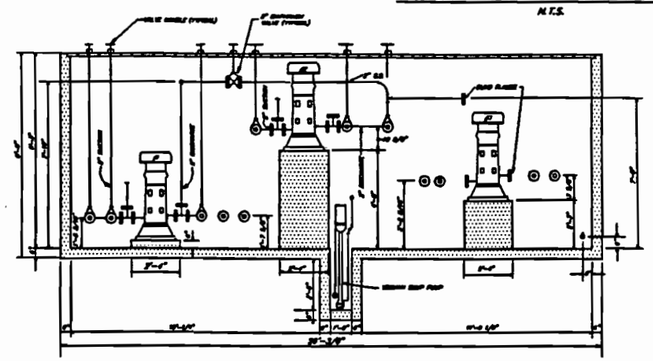
PLAN VIEW
APPROXIMATE SCALE: 1" = 5'



SECTION B–B'
N.T.S.



PLAN VIEW OF VALVE BOX
N.T.S.



SECTION C–C'
APPROXIMATE SCALE: 1" = 3'
NOTE: ALL PUMPS ARE LABOUR NO. 10.

TANK INFORMATION

TANK NUMBER TH-3

LOCATION SOUTH OF BUILDING 3503[1]

BUILDINGS SERVED 3503[2]

CONSTRUCTION MATERIAL STAINLESS STEEL[2]

DIAMETER[(a)] 2.3 m (7.7 ft)

LENGTH[(b)] 3.0 L (10 ft) (V)

CAPACITY 12,490 L (3300 gal)[2]

RESIDUAL VOLUME 2600 L (690 gal)[2]

DEPTH FROM SURFACE TO TANK BOTTOM 4.9 m (16 ft)[1]

TRANSFER METHOD PUMP[3]

VENTILATION[(c)] NONE VISIBLE[3]

INTEGRITY NO LEAKS REPORTED[1]

SERVICE DATES 1952–1970[2]

CONTAINMENT TYPE CONCRETE ENCASEMENT

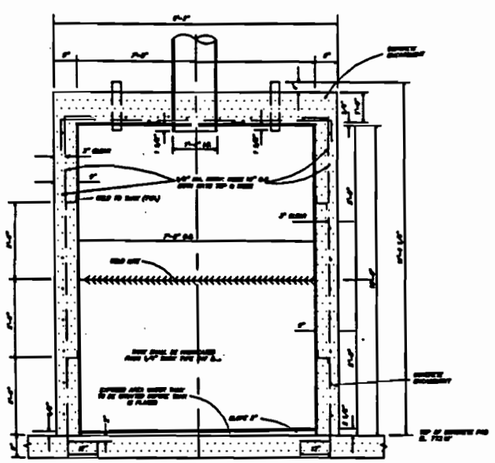
LEAK DETECTION

(a) Outside diameter.

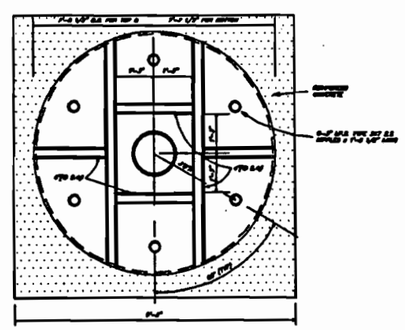
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. TAYLOR, 1986.
2. HUANG, ONNESORGE et al., 1984.
3. DOW ODUM, PERSONAL COMMUNICATION 1987.

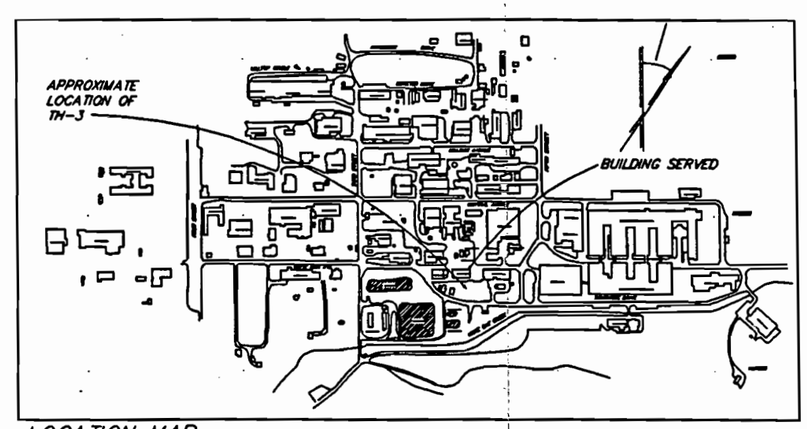


SECTION A–A': TANK TH-3
APPROXIMATE SCALE: 1" = 3'



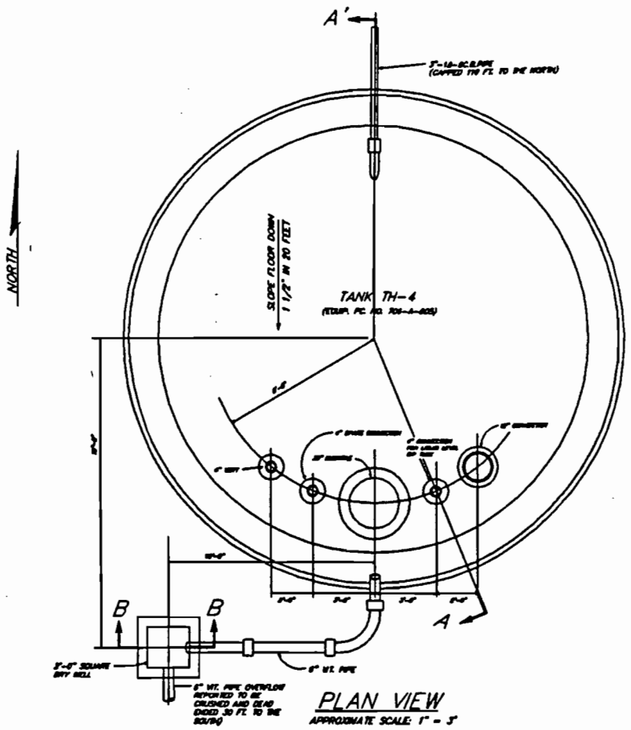
TANK TOP VIEW
APPROXIMATE SCALE: 1" = 3'

SOURCE: ORNL DRAWINGS NOS. D–12051, D–12310 D–12052 & D–10294

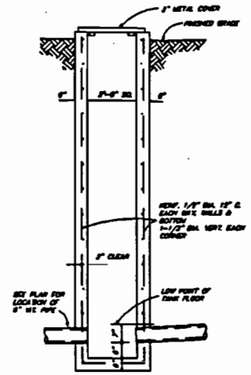


LOCATION MAP
SCALE: 1" = 400'

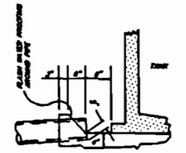
Fig. A-16. Drawings of Tank TH-3.



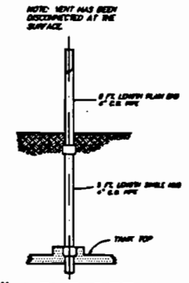
PLAN VIEW
APPROXIMATE SCALE: 1" = 3'



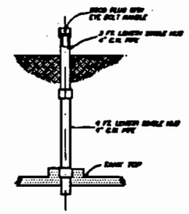
SECTION B–B'
N.T.S.



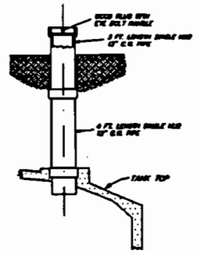
GUTTER DETAIL
N.T.S.



4" VENT DETAIL
N.T.S.



4" SPARE CONNECTION DETAIL
N.T.S.



12" CONNECTION DETAIL
N.T.S.

TANK INFORMATION

TANK NUMBER TH-4

LOCATION SOUTHWEST OF BUILDING 3500

BUILDINGS SERVED 3550[5]

CONSTRUCTION MATERIAL GUNITE[2]

DIAMETER[(a)] 6.4 m (21 ft)

LENGTH[(b)] 2.9 m (9.5 ft) (V)

CAPACITY 52,990 L (14,000 gal)[1]

RESIDUAL VOLUME 52,190 L (14,000 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 4.7 m (15.5 ft)

TRANSFER METHOD PUMP[3]

VENTILATION[(c)] NONE VISIBLE[3]

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1943–1970[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

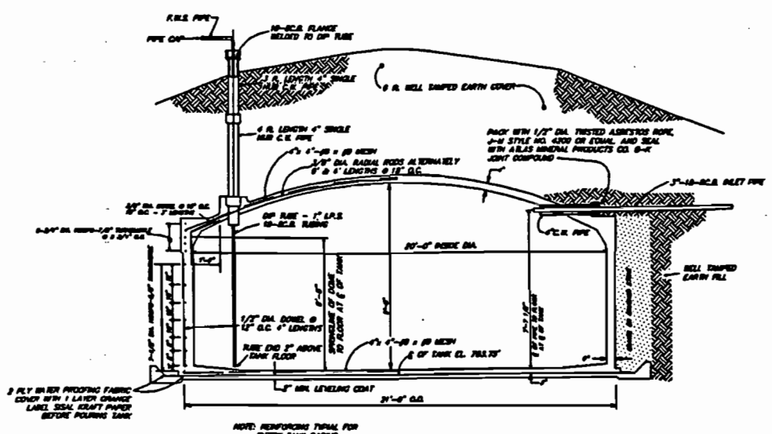
LEAK DETECTION DRY WELL

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

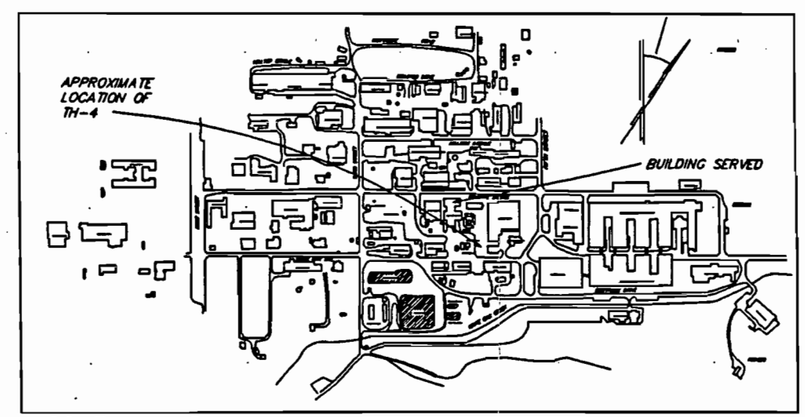
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES: 1. TAYLOR, 1988.
2. HUANG, OHMESORGE et al., 1984.
3. DOW COLIN, PERSONAL COMMUNICATION 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION ON 8/25/87.
5. ORNL, 1987; ORNL/RAP-12/M.



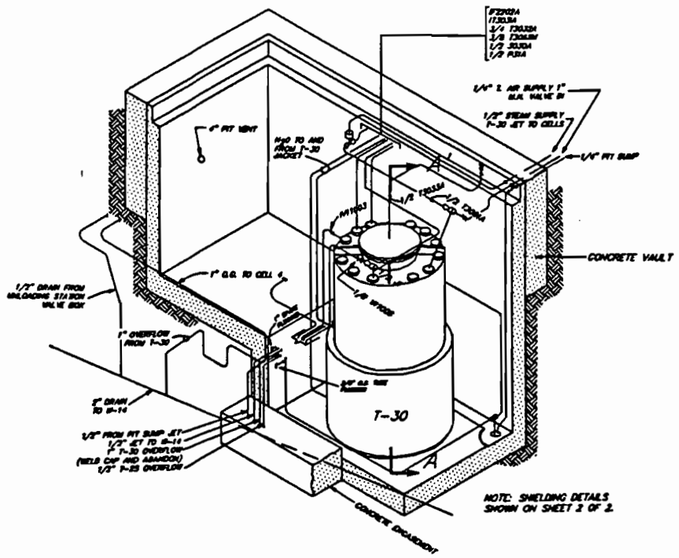
SECTION A–A': TANK TH-4
APPROXIMATE SCALE: 1" = 3'

SOURCE: ORNL DRAWING NOS. W-69334 & A-56869.

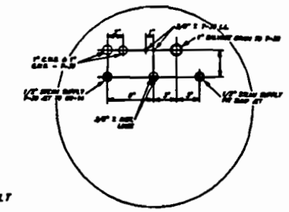


LOCATION MAP
SCALE: 1" = 400'

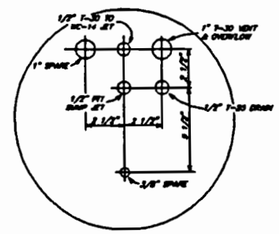
Fig. A-17. Drawings of Tank TH-4.



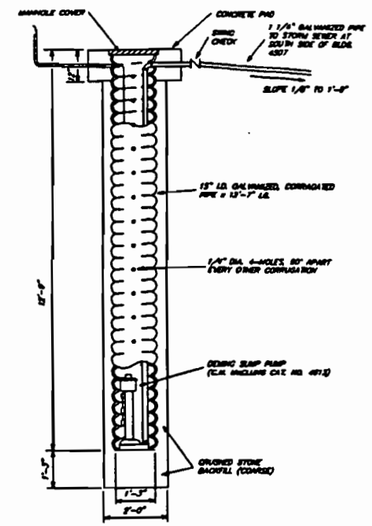
ISOMETRIC VIEW
APPROXIMATE SCALE: 1" = 2'



NORTH WALL
N.T.S.



SOUTH WALL
N.T.S.



DRY WELL SUMP
N.T.S.

TANK INFORMATION -SHEET 1 OF 2

TANK NUMBER T-30

LOCATION SOUTH OF BUILDING 4507

BUILDINGS SERVED 4507

CONSTRUCTION MATERIAL STAINLESS STEEL [3]

DIAMETER [a] 1.4 m (4.5 ft.)

LENGTH [a] 2.5 m (8.2 ft.) (V)

CAPACITY 3120 L (825 gal) [1,3]

RESIDUAL VOLUME REPORTED TO BE EMPTY [2]

DEPTH FROM SURFACE TO TANK BOTTOM 3.1 m (10.3 ft.)

TRANSFER METHOD JET

VENTILATION [c] VESSEL OFF-GAS

INTEGRITY SOUTH WALL OF CONCRETE VAULT LEAKS [3]

SERVICE DATES 1945– ?

CONTAINMENT TYPE CONCRETE VAULT

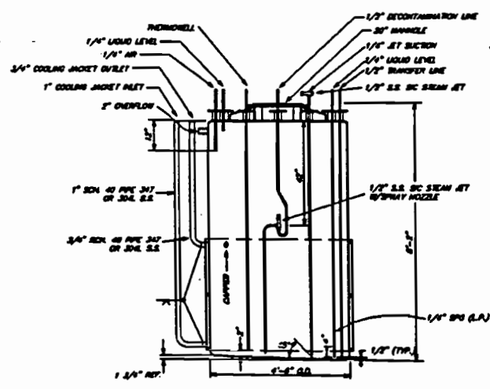
LEAK DETECTION DRY WELL SUMP

(a) Outside diameter.

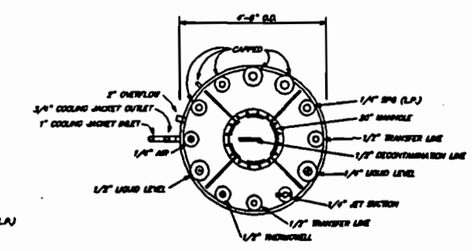
(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

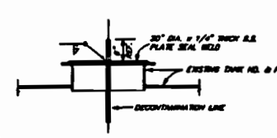
SOURCES: 1. CODDE, 1975.
2. LINDA KAISER, PERSONAL COMMUNICATION ON 8/21/87.
3. KERTESZ, 1963.



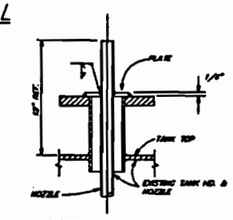
SECTION A–A': TANK T-30
APPROXIMATE SCALE: 1" = 2'



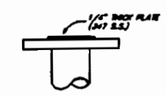
TANK TOP VIEW
SCALE: 1" = 2'



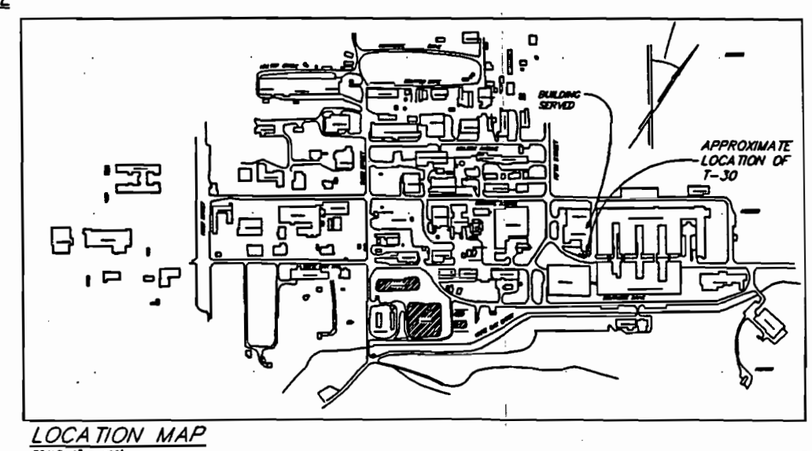
MANHOLE DETAIL
N.T.S.



NOZZLE DETAIL
N.T.S.



CAPPED NOZZLE DETAIL
N.T.S.

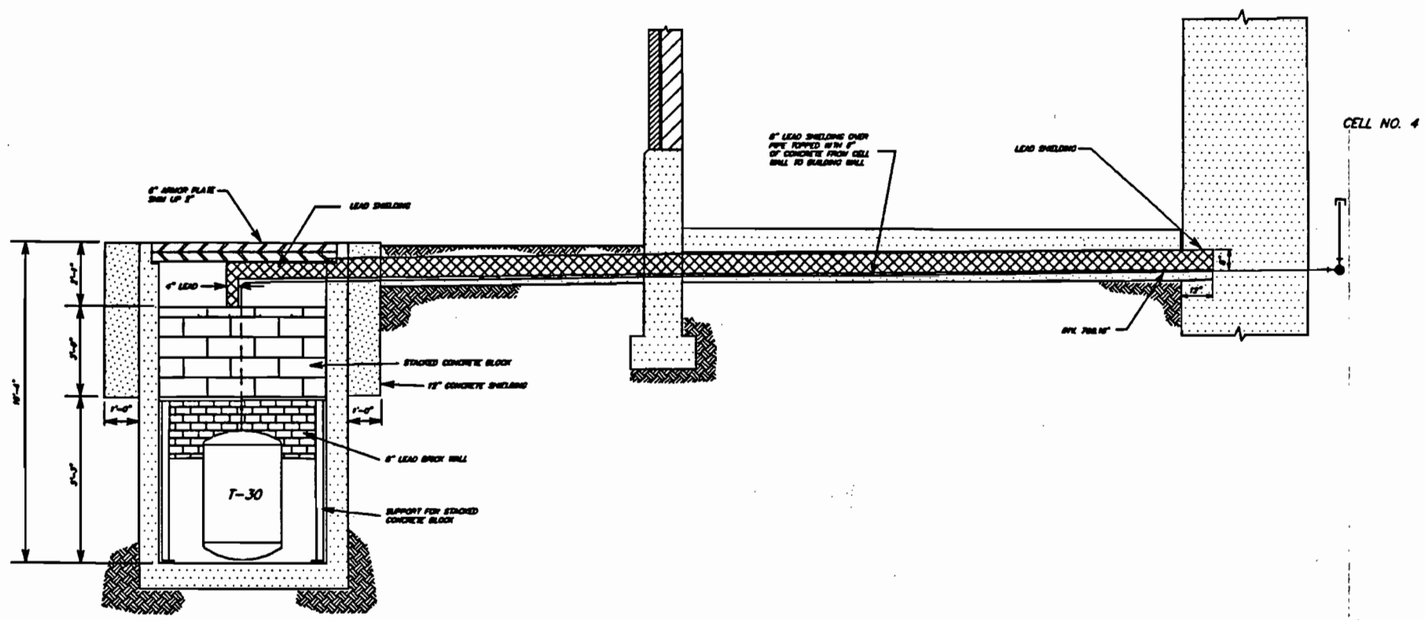


LOCATION MAP
SCALE: 1" = 400'

SOURCE: ORNL DRAWING NOS. D-57542, D-45657, D-45660 & D-45696

Fig. A-18(a). Drawings of Tank T-30.

TANK T-30-SHEET 2 OF 2

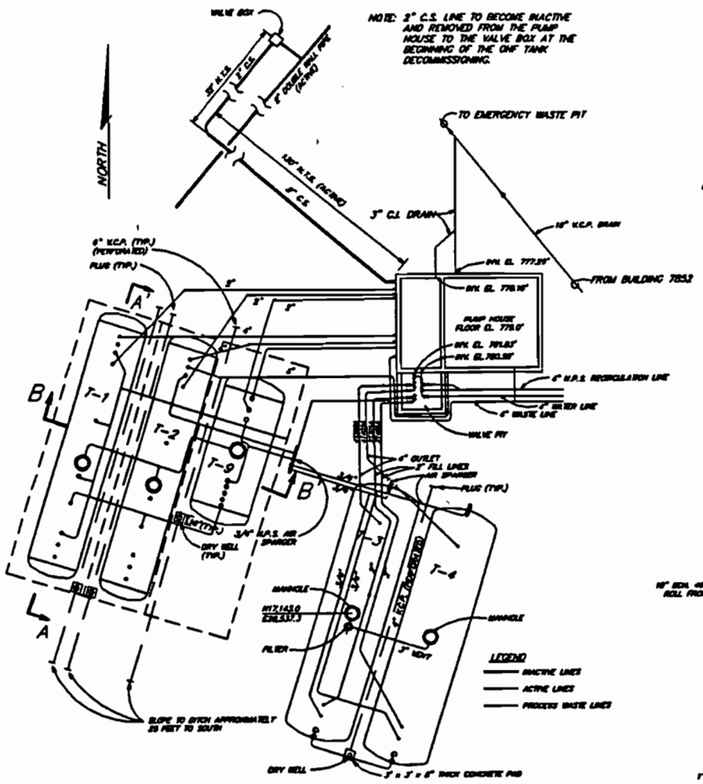


SHIELDING DETAIL: TANK T-30

APPROXIMATE SCALE: 1" = 3'

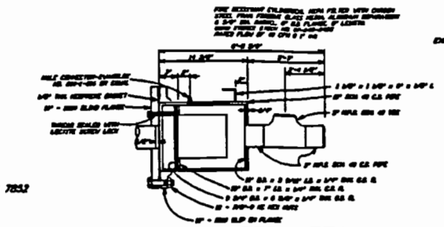
SOURCE: ORNL DRAWING NO. E-34272.

Fig. A-18(b). Drawings of Tank T-30 (continued).



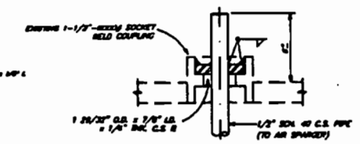
PLAN VIEW

APPROXIMATE SCALE: 1" = 10'



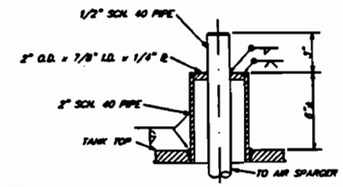
HEPA FILTER DETAIL

N.T.S.



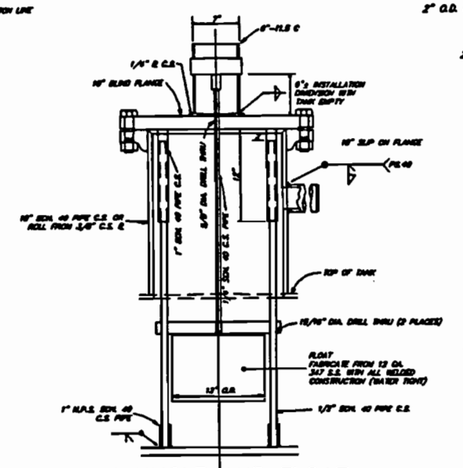
1-1/2" NOZZLE DETAIL

N.T.S.



2" NOZZLE DETAIL

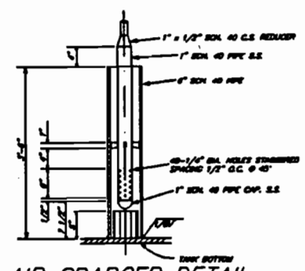
N.T.S.



MANHOLE AND FLOAT INDICATOR DETAIL

N.T.S.

NOTE: FLOAT INDICATOR HAS BEEN REMOVED AND REPLACED BY A PNEUMATIC INDICATOR.



AIR SPARGER DETAIL

N.T.S.

TANK INFORMATION

TANK NUMBER T-1

LOCATION OLD HYDROFRACTURE FACILITY[1]

BUILDINGS SERVED 7852[2]

CONSTRUCTION MATERIAL MILD STEEL[1]

DIAMETER[(a)] 2.4 m (8 ft)

LENGTH[(b)] 13.4 m (44.1 ft) (H)

CAPACITY 56,780 L (15,000 gal)[1]

RESIDUAL VOLUME 39,910 L (9,750 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 3.7 m (12 ft)

TRANSFER METHOD PUMP[2]

VENTILATION[(c)] HEPA[2]

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1963–1980[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

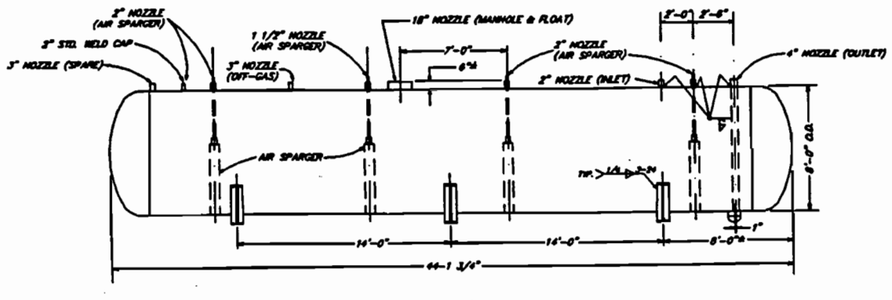
LEAK DETECTION DRY WELL[2]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

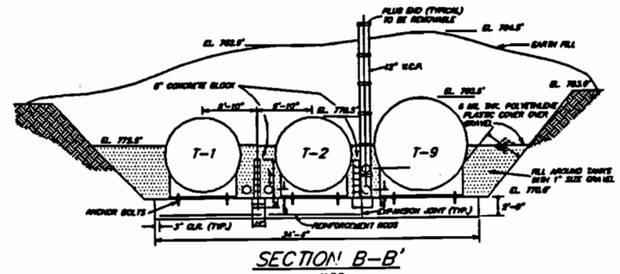
SOURCES:
1. TAYLOR, 1986.
2. DOW COULL PERSONAL COMMUNICATION 1987.
3. ORNL MEASUREMENTS PERFORMED JUNE, 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION ON 8/25/87.
5. ORNL 1987; ORNL/RAP-12/14.



SECTION A-A': TANK T-1

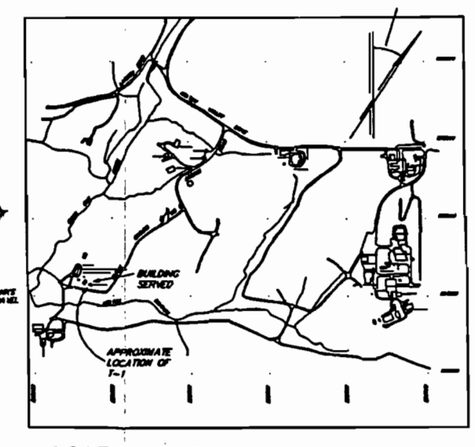
APPROXIMATE SCALE: 1" = 4'

SOURCE: ORNL DRAWING NOS. S-10002-EE-003-D, M-10002-E-004-D, M-10002-EE-012-D, M-10002-E-004-D & H-10002-EE-007-D.



SECTION B-B'

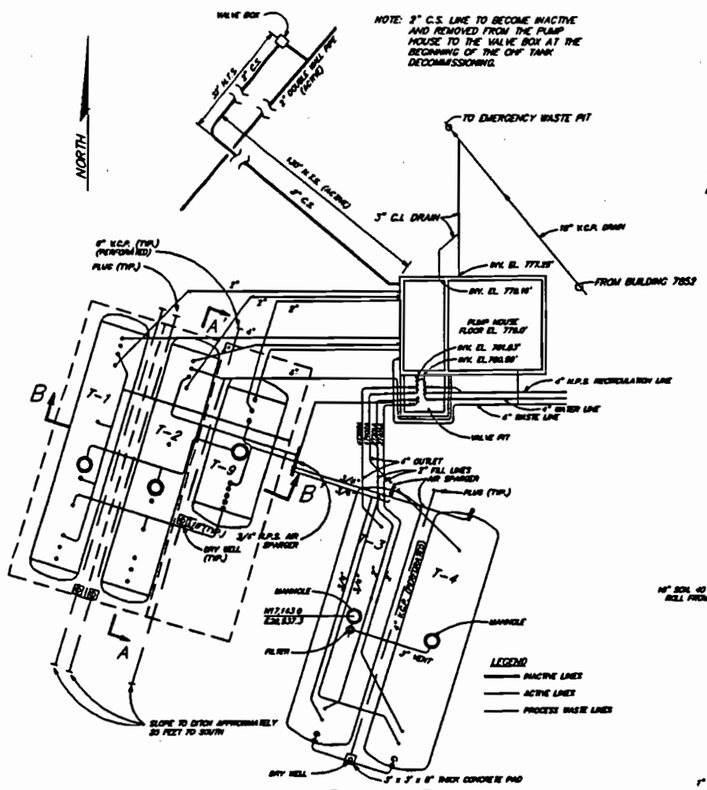
N.T.S.



LOCATION MAP

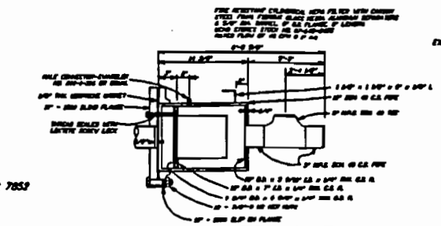
SCALE: 1" = 800'

Fig. A-19. Drawings of Tank T-1.



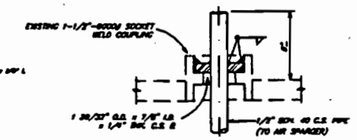
PLAN VIEW

APPROXIMATE SCALE: 1" = 10'



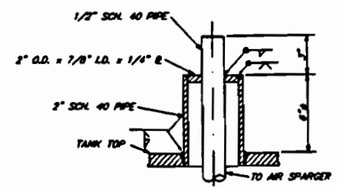
HEPA FILTER DETAIL

N.T.S.



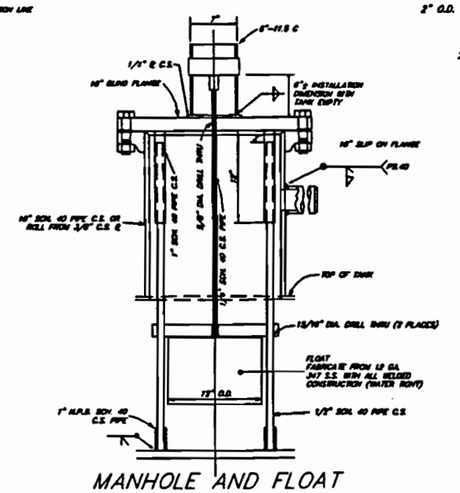
1-1/2" NOZZLE DETAIL

N.T.S.



2" NOZZLE DETAIL

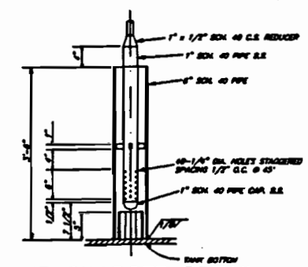
N.T.S.



MANHOLE AND FLOAT INDICATOR DETAIL

N.T.S.

NOTE: FLOAT INDICATOR HAS BEEN REMOVED AND REPLACED BY A PNEUMATIC INDICATOR.



AIR SPARGER DETAIL

N.T.S.

TANK INFORMATION

TANK NUMBER T-2

LOCATION OLD HYDROFRACTURE FACILITY[1]

BUILDINGS SERVED 7852[2]

CONSTRUCTION MATERIAL MILD STEEL[1]

DIAMETER[(a)] 2.4 m (8 ft)

LENGTH[(a)] 13.4 m (44.1 ft) (H)

CAPACITY 56,780 L (15,000 gal)[1]

RESIDUAL VOLUME 37,480 L (9,900 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 3.7 m (12 ft)

TRANSFER METHOD PUMP[2]

VENTILATION[(c)] HEPA[3]

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1963–1980[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

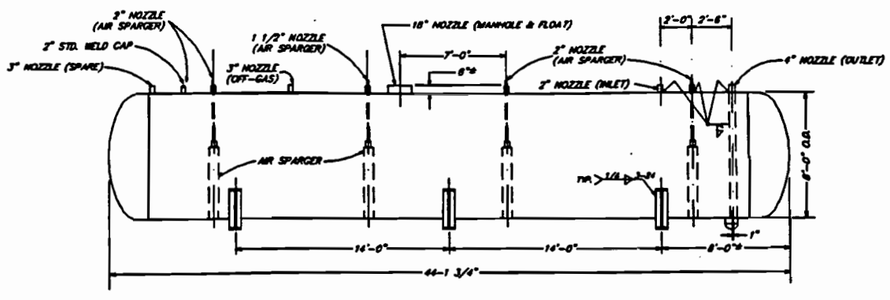
LEAK DETECTION DRY WELL[2]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

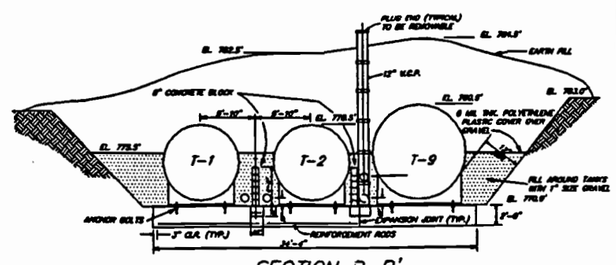
SOURCES:
1. TAYLOR, 1986.
2. KOW COLM, PERSONAL COMMUNICATION 1987.
3. ORNL MEASUREMENTS PERFORMED JUNE, 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION ON 8/25/87.
5. ORNL, 1987; ORNL/RAP-12/VI.



SECTION A-A': TANK T-2

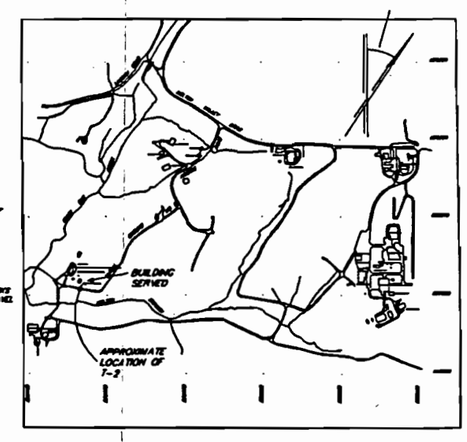
APPROXIMATE SCALE: 1" = 4'

SOURCE: ORNL DRAWING NOS. S-10002-EE-003-D, M-10002-E-004-D, M-10002-EE-012-D, M-10002-E-004-D & H-10002-EE-007-D.



SECTION B-B'

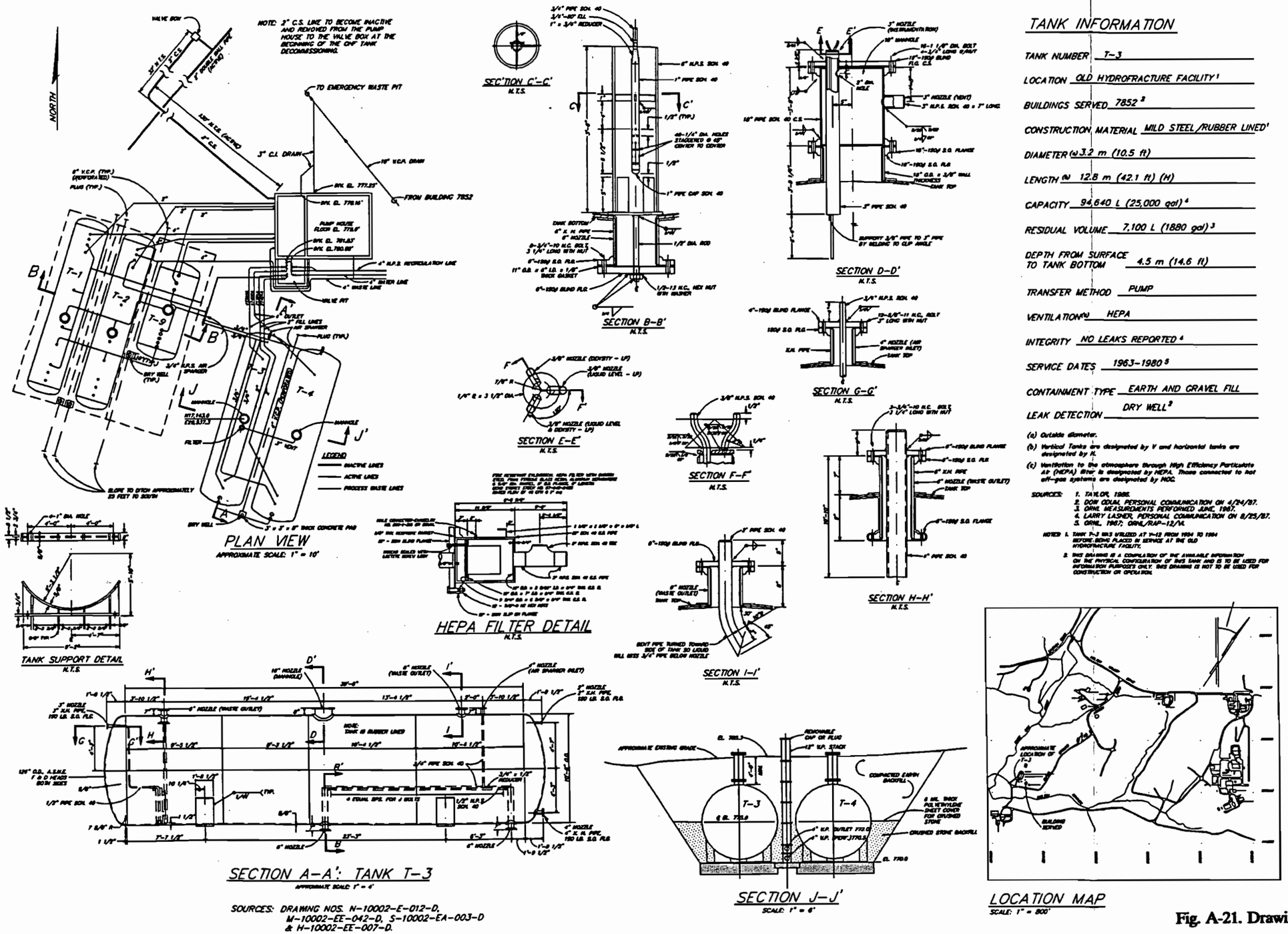
N.T.S.



LOCATION MAP

SCALE: 1" = 800'

Fig. A-20. Drawings of Tank T-2.



SOURCES: DRAWING NOS. N-10002-E-012-D, M-10002-EE-042-D, S-10002-EA-003-D & H-10002-EE-007-D.

TANK INFORMATION

TANK NUMBER T-3

LOCATION OLD HYDROFRACTURE FACILITY[1]

BUILDINGS SERVED 7852[2]

CONSTRUCTION MATERIAL MILD STEEL/RUBBER LINED[1]

DIAMETER[(a)] 3.2 m (10.5 ft)

LENGTH[(a)] 12.8 m (42.1 ft) (H)

CAPACITY 94,640 L (25,000 gal)[4]

RESIDUAL VOLUME 7,100 L (1880 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 4.5 m (14.6 ft)

TRANSFER METHOD PUMP

VENTILATION[(c)] HEPA

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1963–1980[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

LEAK DETECTION DRY WELL[3]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

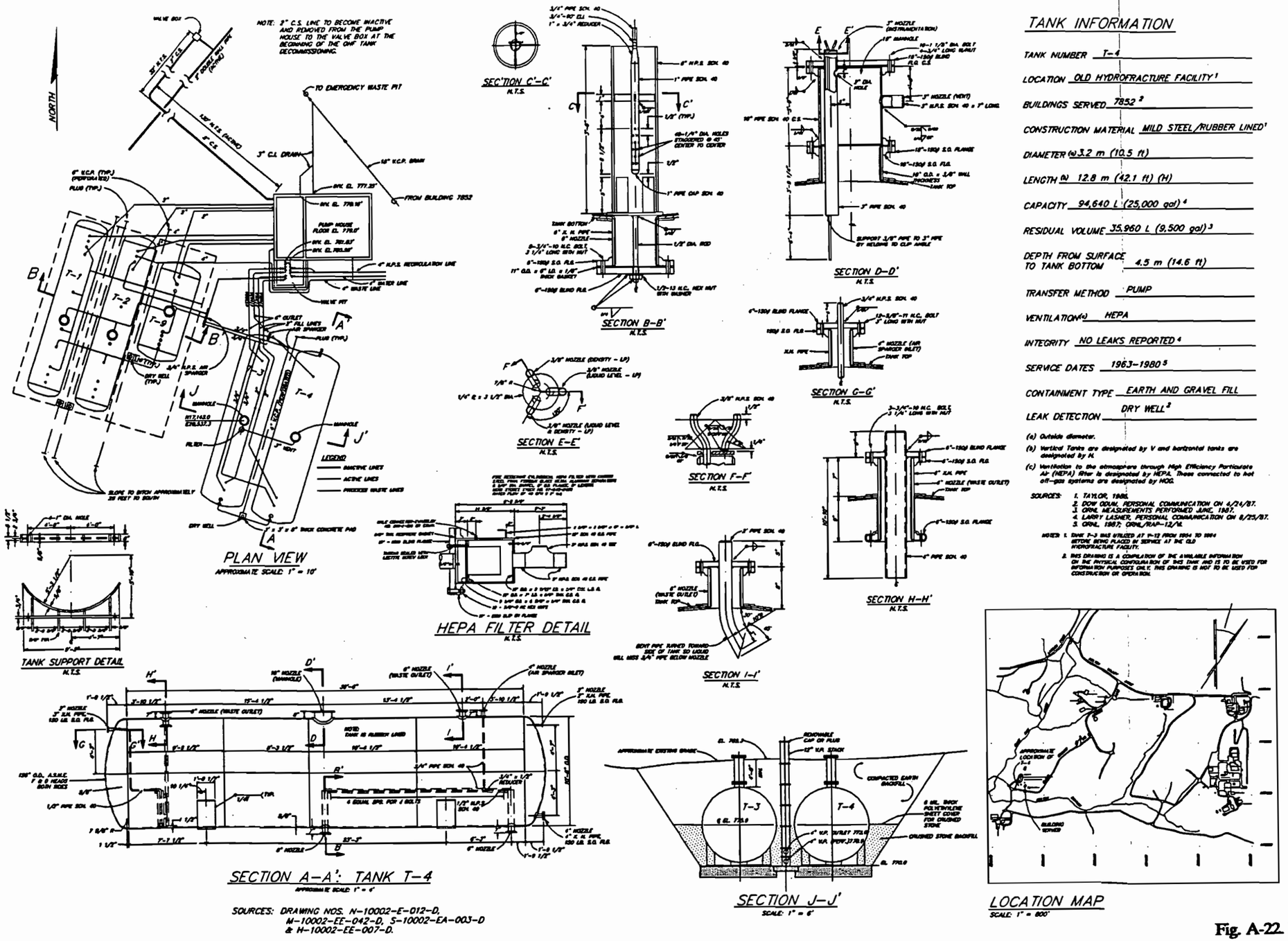
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. TAYLOR, 1988.
2. DOW COLAL PERSONAL COMMUNICATION ON 4/24/87.
3. ORNL MEASUREMENTS PERFORMED JUNE, 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION ON 8/25/87.
5. ORNL, 1987; ORNL/RAP-12/V4.

NOTES: 1. TANK T-3 WAS UTILIZED AT Y-12 FROM 1964 TO 1984 BEFORE BEING PLACED IN SERVICE AT THE OLD HYDROFRACTURE FACILITY.

2. THIS DRAWING IS A COMPILATION OF THE AVAILABLE INFORMATION ON THE PHYSICAL CONFIGURATION OF THIS TANK AND IS TO BE USED FOR INFORMATION PURPOSES ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION OR OPERATION.

Fig. A-21. Drawings of Tank T-3.



SOURCES: DRAWING NOS. N-10002-E-012-D, N-10002-EE-042-D, S-10002-EA-003-D & H-10002-EE-007-D.

TANK INFORMATION

TANK NUMBER T-4

LOCATION OLD HYDROFRACTURE FACILITY[1]

BUILDINGS SERVED 7852[2]

CONSTRUCTION MATERIAL MILD STEEL/RUBBER LINED[1]

DIAMETER (a) 3.2 m (10.5 ft)

LENGTH (b) 12.8 m (42.1 ft) (H)

CAPACITY 94,640 L (25,000 gal)[4]

RESIDUAL VOLUME 35,960 L (9,500 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 4.5 m (14.6 ft)

TRANSFER METHOD PUMP

VENTILATION(c) HEPA

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1963–1980[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

LEAK DETECTION DRY WELL[2]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

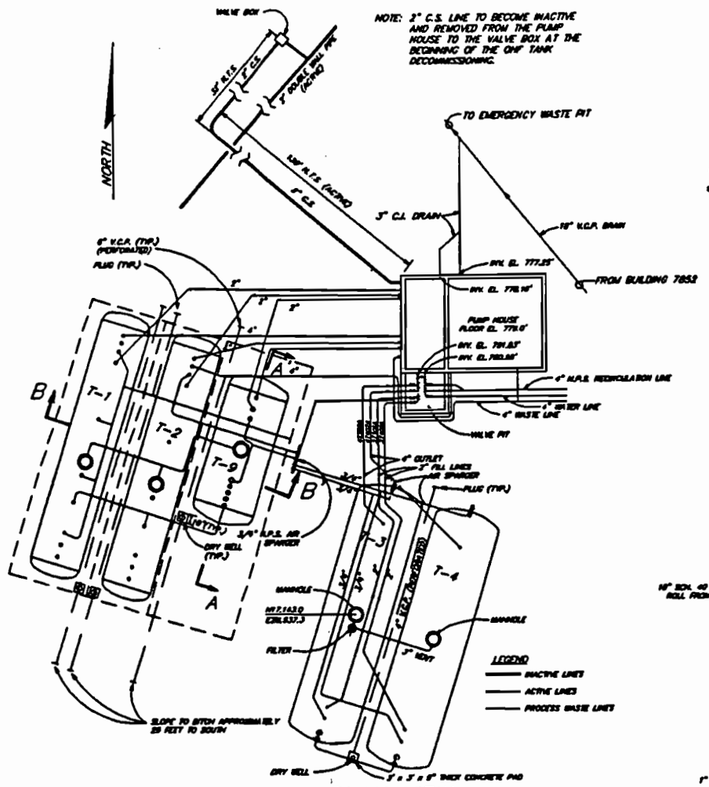
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCES:
1. TAYLOR, 1986.
2. DOW COUM, PERSONAL COMMUNICATION ON 6/24/87.
3. ORNL MEASUREMENTS PERFORMED JUNE, 1987.
4. LARRY LASNER, PERSONAL COMMUNICATION ON 8/25/87.
5. ORNL, 1987; ORNL/RAP-12/R1.

NOTES: 1. Unit T-3 was utilized at T-13 from 1984 to 1994 before being placed in service at the OLD HYDROFRACTURE FACILITY.

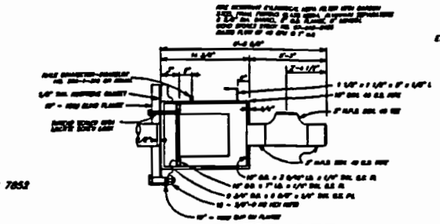
2. This drawing is a compilation of the available information on the physical configuration of this tank and is to be used for information purposes only. This drawing is not to be used for construction or operation.

Fig. A-22. Drawings of Tank T-4.



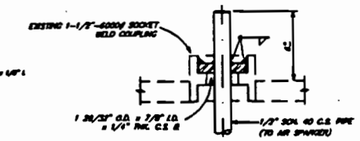
PLAN VIEW

APPROXIMATE SCALE: 1" = 10'



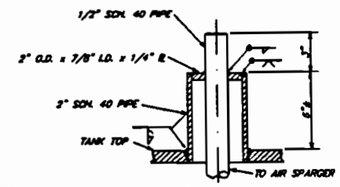
HEPA FILTER DETAIL

N.T.S.



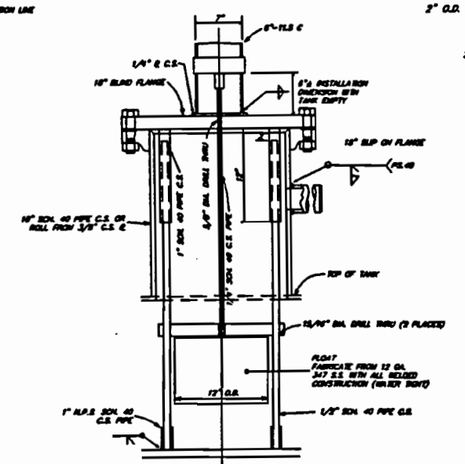
1-1/2" NOZZLE DETAIL

N.T.S.



2" NOZZLE DETAIL

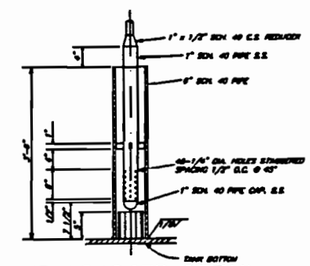
N.T.S.



MANHOLE AND FLOAT INDICATOR DETAIL

N.T.S.

NOTE: FLOAT INDICATOR HAS BEEN REMOVED AND REPLACED BY A PNEUMATIC INDICATOR.



AIR SPARGER DETAIL

N.T.S.

TANK INFORMATION

TANK NUMBER T-9

LOCATION OLD HYDROFRACTURE FACILITY[1]

BUILDINGS SERVED 7852[2]

CONSTRUCTION MATERIAL MILD STEEL[1]

DIAMETER[(a)] 3.0 m (10 ft)

LENGTH[(b)] 7.3 m (23.8 ft) (H)

CAPACITY 49,210 L (13,000 gal)[4]

RESIDUAL VOLUME 7870 L (2080 gal)[3]

DEPTH FROM SURFACE TO TANK BOTTOM 4.3 m (14 ft)

TRANSFER METHOD PUMP[2]

VENTILATION[(c)] HEPA[2]

INTEGRITY NO LEAKS REPORTED[4]

SERVICE DATES 1963–1980[5]

CONTAINMENT TYPE EARTH AND GRAVEL FILL

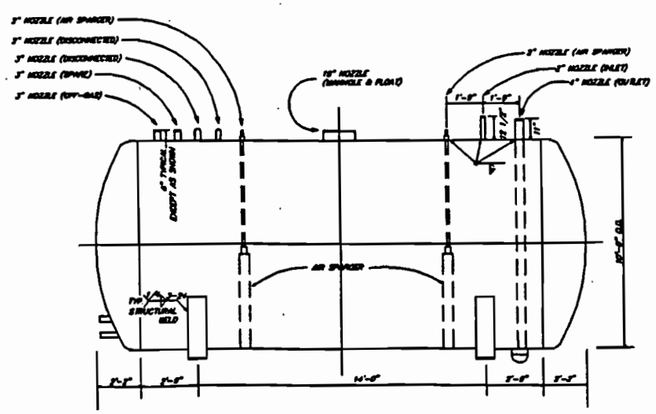
LEAK DETECTION DRY WELL[2]

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

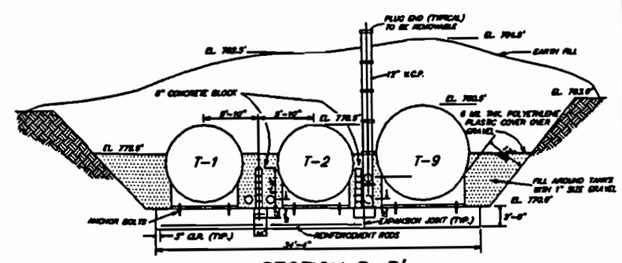
SOURCES:
1. TAYLOR, 1986.
2. DOW CODAL PERSONAL COMMUNICATION 1987.
3. ORNL MEASUREMENTS PERFORMED JUNE, 1987.
4. LARRY LASHER, PERSONAL COMMUNICATION ON 6/25/87.
5. ORNL, 1987; ORNL/RAP-12/V4.



SECTION A–A': TANK T-9

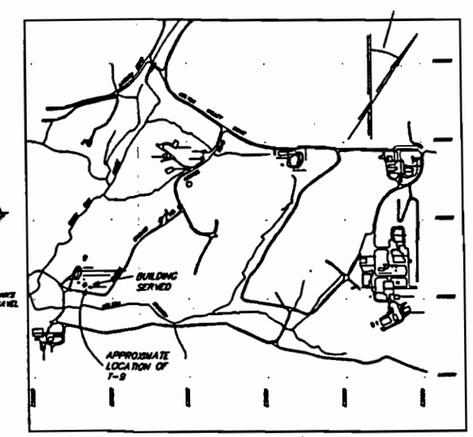
APPROXIMATE SCALE: 1" = 3'

SOURCE: ORNL DRAWING NOS. S-10002-EE-003-D, M-10002-E-004-D, M-10002-EE-012-D, M-10002-E-004-D & H-10002-EE-007-D.



SECTION B–B'

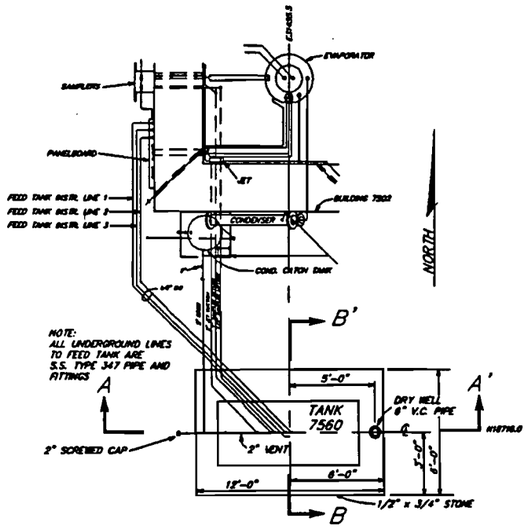
N.T.S.



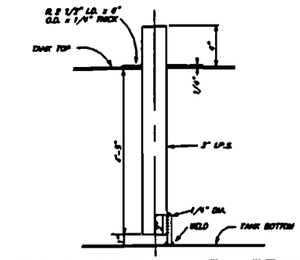
LOCATION MAP

SCALE: 1" = 800'

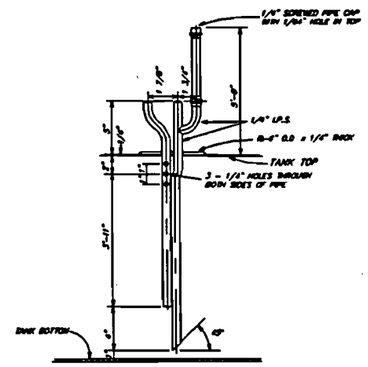
Fig. A-23. Drawings of Tank T-9.



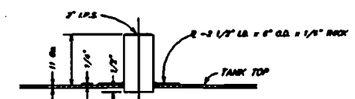
PLAN VIEW
APPROXIMATE SCALE: 1" = 4'



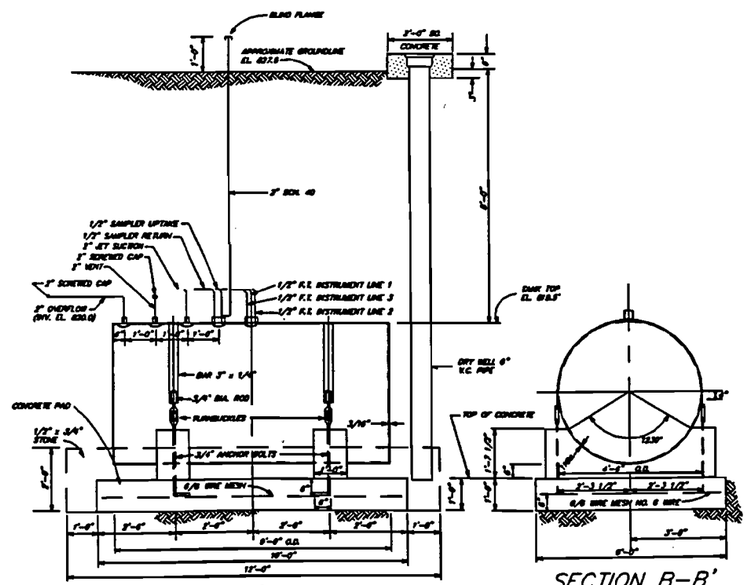
JET SUCTION LINE DETAIL
N.T.S.



SAMPLER LINE DETAILS
N.T.S.

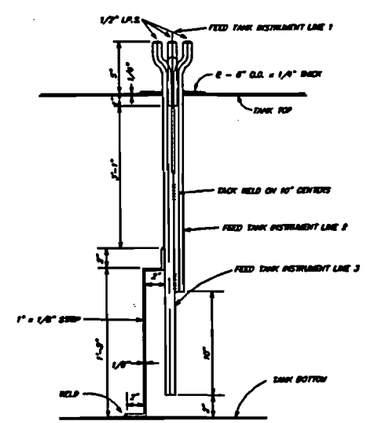


2" VENT & 2" OVERFLOW DETAIL
N.T.S.



SECTION A–A': TANK 7560
APPROXIMATE SCALE: 1" = 2'

SECTION B–B'



INSTRUMENT LINES 1, 2 & 3 DETAILS
LIQUID LEVEL & SPECIFIC GRAVITY LINES
N.T.S.

TANK INFORMATION

TANK NUMBER 7560

LOCATION EAST OF BUILDING 7500[1]

BUILDINGS SERVED 7502[1]

CONSTRUCTION MATERIAL STAINLESS STEEL[3]

DIAMETER[(a)] 1.4 m (4.5 ft)

LENGTH[(b)] 2.7 m (9 ft) (H)

CAPACITY 3790 L (1000 gal)[1,2]

RESIDUAL VOLUME NOT SAMPLED[1]

DEPTH FROM SURFACE TO TANK BOTTOM 3.8 m (12.5 ft)

TRANSFER METHOD JET

VENTILATION[(c)]

INTEGRITY NO LEAKS REPORTED

SERVICE DATES 1957–1961[1,2]

CONTAINMENT TYPE EARTH & GRAVEL FILL

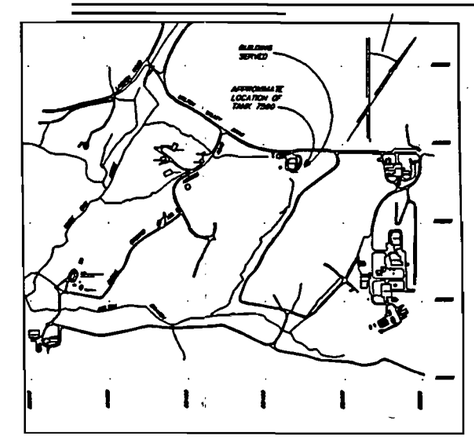
LEAK DETECTION DRY WELL

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

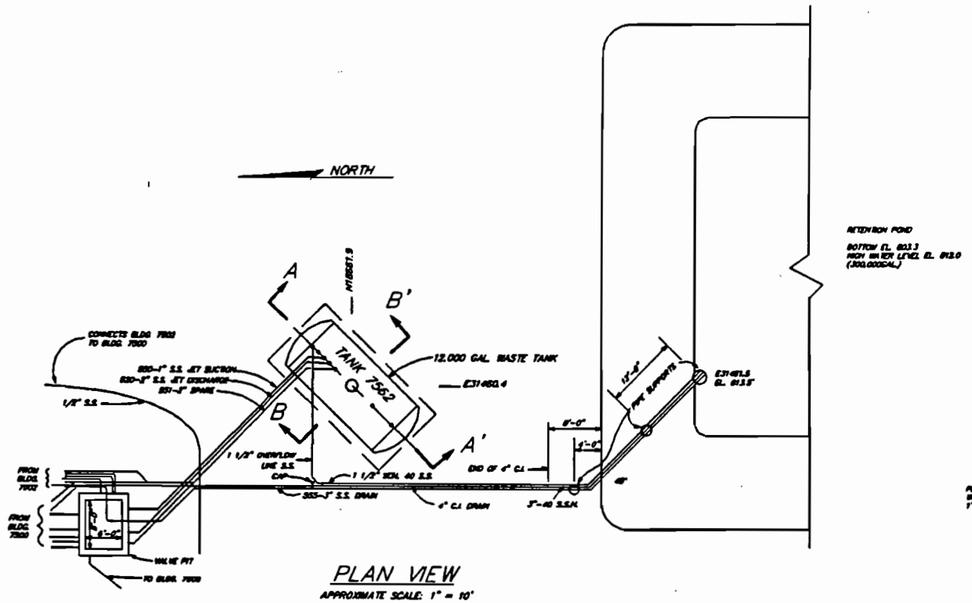
SOURCES: 1. HUANG, SIMPSON et al., 1984.
2. ORNL, 1987; ORNL/RAP–12/A.
3. CAGLE AND PUGH, 1978.



LOCATION MAP
SCALE: 1" = 800'

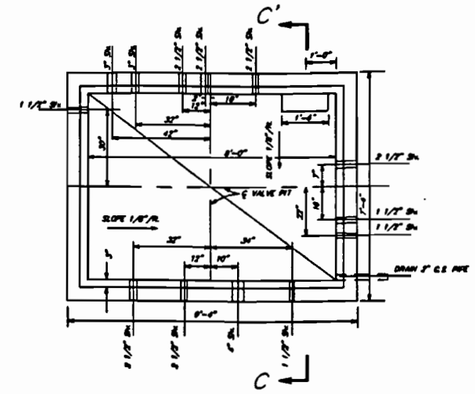
SOURCE: ORNL DRAWING NOS. D–7579, D–7580, D–7587 & 7588.

Fig. A-24. Drawings of Tank 7560.



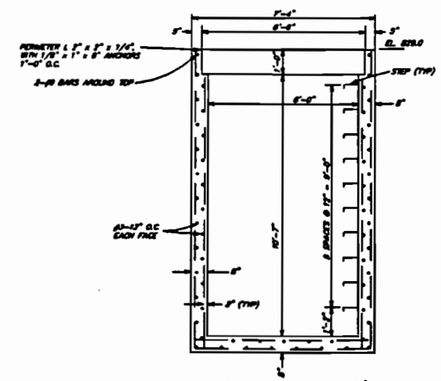
PLAN VIEW

APPROXIMATE SCALE: 1" = 10'



PLAN VIEW OF VALVE PIT

N.T.S.



SECTION C–C'

N.T.S.

TANK INFORMATION

TANK NUMBER 7562

LOCATION SOUTHEAST OF BUILDING 7500[1]

BUILDINGS SERVED 7500[1]

CONSTRUCTION MATERIAL STAINLESS STEEL[3]

DIAMETER[(a)] 3.0 m (10 ft)

LENGTH[(b)] 6.8 m (22.3 ft) (H)

CAPACITY 45,420 L (12,000 gal)[1,2]

RESIDUAL VOLUME NOT SAMPLED[1]

DEPTH FROM SURFACE TO TANK BOTTOM 3.0 m (10 ft)

TRANSFER METHOD JET

VENTILATION[(c)]

INTEGRITY NO LEAKS REPORTED

SERVICE DATES 1957–PRESENT

CONTAINMENT TYPE EARTH & GRAVEL FILL

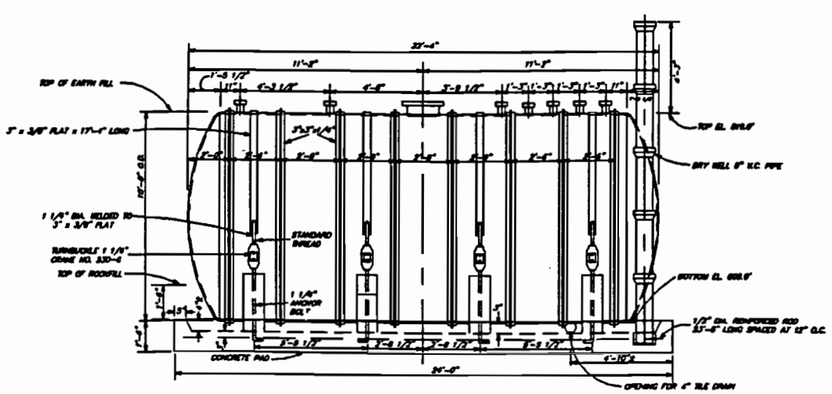
LEAK DETECTION DRY WELL

(a) Outside diameter.

(b) Vertical Tanks are designated by V and horizontal tanks are designated by H.

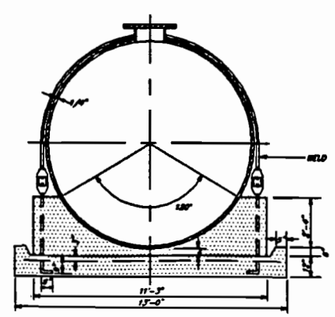
(c) Ventilation to the atmosphere through High Efficiency Particulate Air (HEPA) filter is designated by HEPA. Those connected to hot off-gas systems are designated by HOG.

SOURCE: 1. HUANG, SIMPSON et al., 1984.
2. ORNL, 1987; ORNL/RAP–12/N.
3. CAGLE AND PUGH, 1978.
4. LINDA KAISER, PERSONAL COMMUNICATION, 1987.



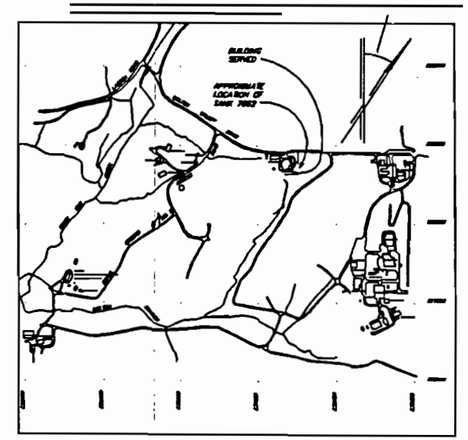
SECTION A–A': TANK 7562

APPROXIMATE SCALE: 1" = 3'



SECTION B–B'

APPROXIMATE SCALE: 1" = 3'



LOCATION MAP

SCALE: 1" = 800'

SOURCE: ORNL DRAWING D–20769, E–24800, & D–24805

Fig. A-25. Drawings of Tank 7562.

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