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Decommissioning of a Grout- and Waste-Filled Storage Tank in the 200 East Area of the Hanford Site

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DECOMMISSIONING OF A GROUT- AND WASTE-FILLED STORAGE TANK IN THE 200 EAST AREA OF THE HANFORD SITE

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ABSTRACT

A self-concentrating waste tank located at the Strontium Semiworks Facility in the 200 East Area of the Hanford Site will be decommissioned following waste removal. During a previous decommissioning phase, the tank, thought to be empty, was filled with grout to prevent it from collapsing over time. Several years later, an agitator rod was pulled from within the tank and found to contain significant amounts of radiation, indicating there was still radioactive waste in the tank. Several alternative waste-removal options have been researched and evaluated. It is concluded that before the waste is to be disposed, the grout must be removed. This paper addresses that effort.

INTRODUCTION

Tank 241-CX-72 was installed at the Strontium Semiworks Facility in 1955 to be used as an experimental tank for determining characteristics of self-concentrating waste from pilot plant studies for the plutonium and uranium recovery by extraction solvent extraction process.

The tank is an upright cylindrical vessel 1.02 m (40 in.) in diameter and 10.9 m (35.67 ft) in length, as seen in Figure 1. The 0.9-cm (3/8-in.) -thick vessel wall is constructed of ASTM A-7-52T carbon steel and reinforced with five stiffener rings. A cylindrical electrical heater is mounted just above each ring. Three rows of vertical guides connect the stiffener rings.

The tank wall extends beyond the bottom plate of the tank, which is reinforced by additional stiffeners. A 7.6-cm (3-in.) -diameter drywell is mounted on the inside of the tank. Two 20.3-cm (8-in.) -diameter access pipes, a 20.3-cm (8-in.) -diameter instrument diptube, a 7.6-cm (3-in.) -diameter vapor header pipe, and a 5.1-cm (2-in.) -diameter fill pipe are mounted to the tank lid near the center of the tank. The instrument diptubes were used for liquid level monitoring and density measurements. The drywell and the diptubes still remain in the tank.

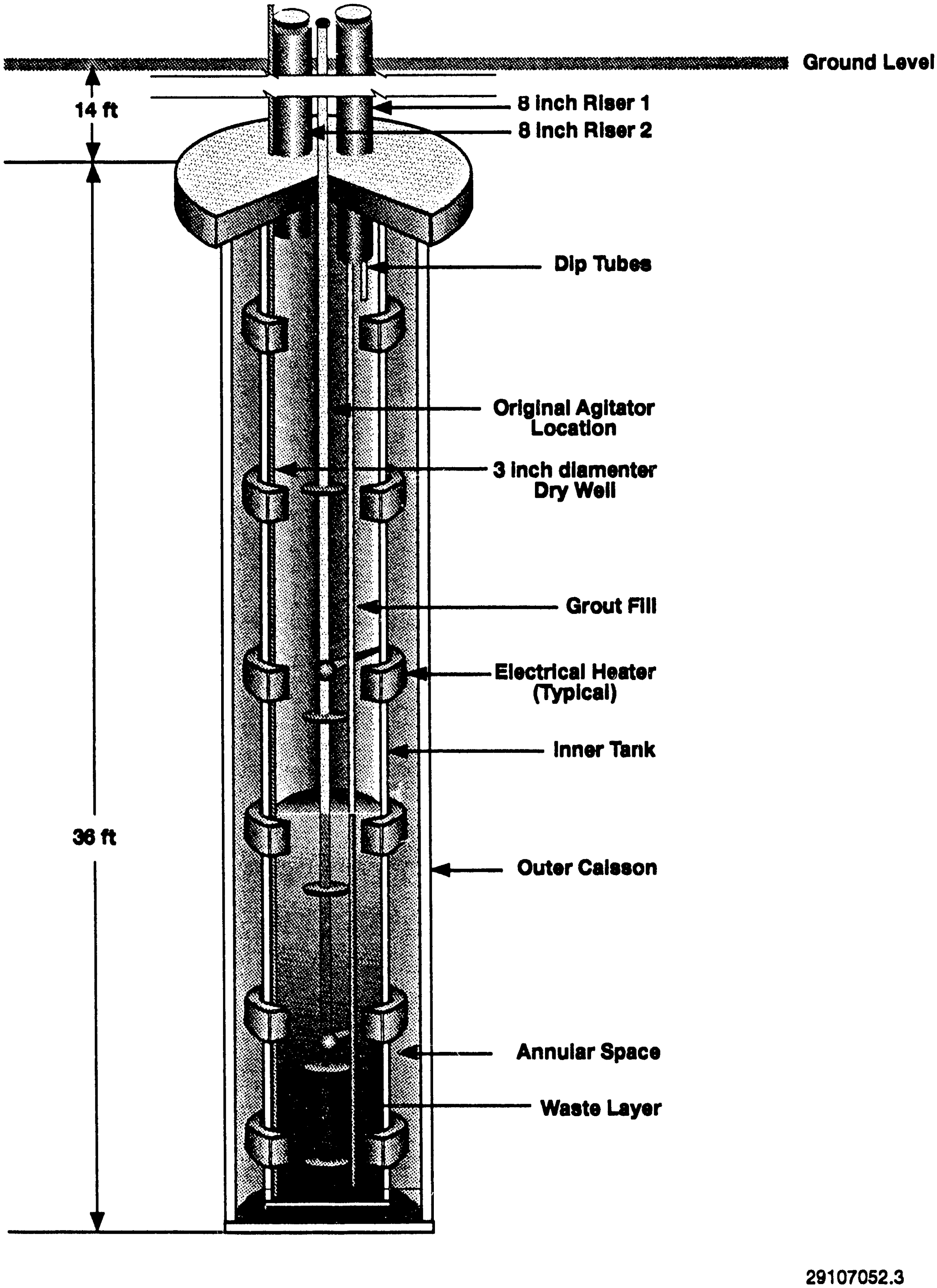
Paddles were mounted concentrically on the agitator rod to assess the height of the sludge level within the tank. The paddles were manually operated by the agitator assembly. A sparger system was also mounted near the bottom of the tank to enhance agitation of the tank contents. The agitator assembly and sparger-system pipes remain in the tank.

The tank is set inside a caisson, a cylinder fabricated from 1.3-cm (0.5-in.) carbon steel plate. The caisson is 1.8 m (6 ft) in diameter and 10.9 m (35.7 ft) deep. The bottom of the caisson is a 30.5-cm (12-in.) thick reinforced concrete pad supported by reinforcing bars welded to the inside. Support pads, which are welded to the bottom of the tank, rest on the caisson's concrete base. The top of the tank is welded to a plate that extends over and acts as a seal for the caisson. The tank was lifted by two lugs welded onto the plate.

Records indicate that this tank was in operation for less than 1 yr. In June 1974, material level measurements indicated that 1.9 m (73.5 in.) of sludge and 2.5 cm (1 in.) of liquid were present in the tank. A sample of the liquid showed it to be a clear, light brown solution with a pH of 9.5 and a trace of solids. The solution contained the following concentrations of radionuclides:

Pu	1.3×10^{-8} g/gal
U	2.43×10^{-3} g/gal
^{137}Cs	none detected
$^{89,90}Sr$	4.33 nCi/gal

Figure 1. Tank 241-CX-72.



In November of that year, a level of 1.9 m (75.75 in.) was measured. Sampling was then discontinued.

In November 1976, sludge measurements and a ground-level visual inspection indicated that no sludge was present in the tank. At this time, it was planned to obtain optical equipment that would allow a more detailed visual inspection from inside the tank; however, this equipment was apparently never obtained.

Records from June 1977 indicate a discrepancy between the tank volume and level:

Volume (gal)		Levels	
Liquid	Solid	Liquid	Solid
5	325	1.9 m (74.5 in.)	2.5 cm (1.0 in.)

In March 1978, the tank was recorded as empty. In 1986, a liquid level measurement indicated the tank was empty. Based on this information, the tank was decommissioned and filled with grout.

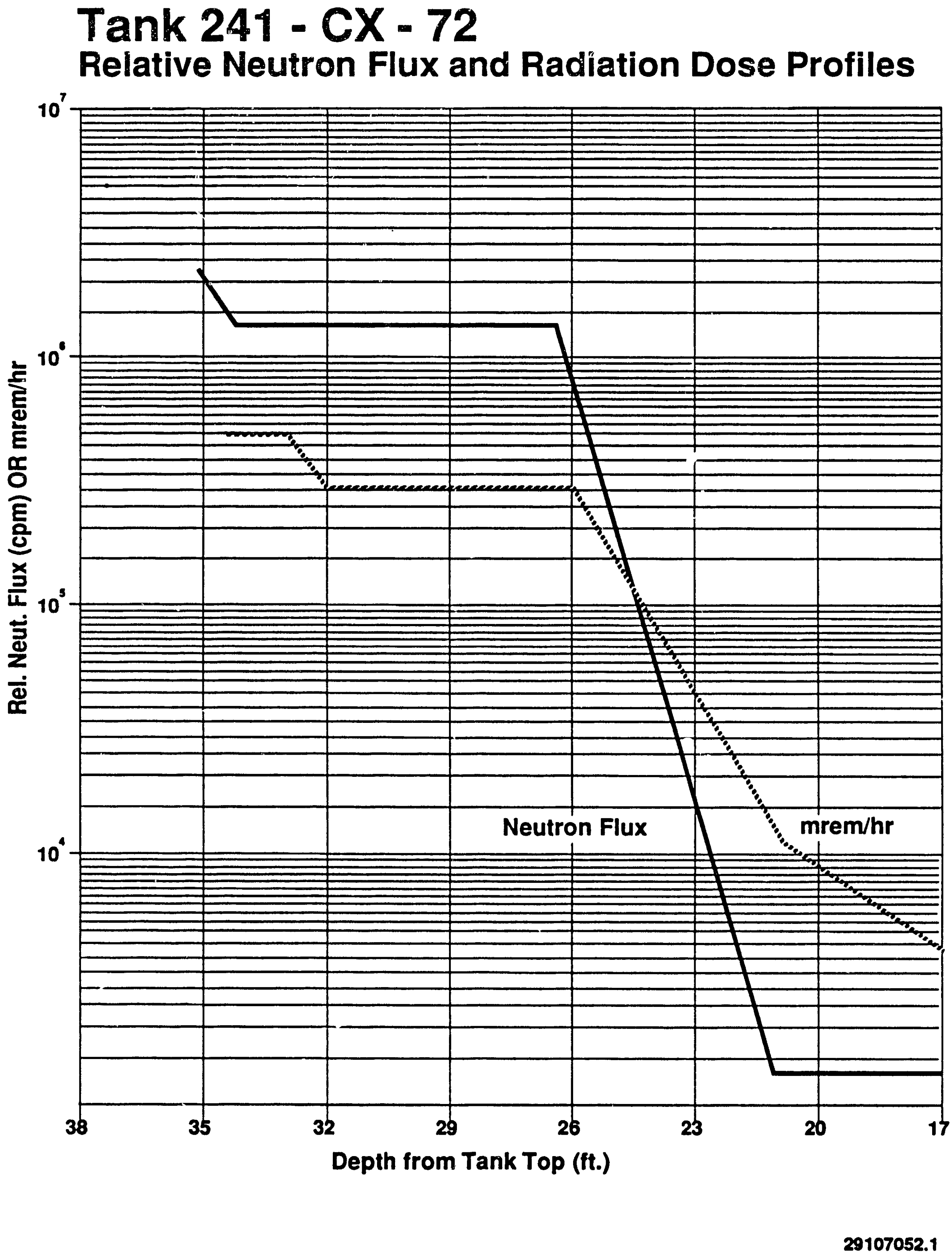
Two years later, 4.6 m (15 ft) of the actuator rod were accidentally pulled from the tank and found to be radioactively contaminated. Subsequent analyses of the tank contents using nondestructive testing methods indicated the tank may contain transuranic (TRU) wastes. Radiation measurements taken through the drywell indicate that three distinct regions exist in the tank. The bottom 3 m (10 ft) of the tank probably contain a dry waste that contains most of the TRU material and 0.6 m (2 ft) of contaminated grout, which may be TRU waste. The intermediate layer probably consists of grout, which may contain small amounts of cesium between the grout fill and vessel walls. Little or no radioactivity was detected in the upper 1.5 m (5 ft) of the tank. This analysis has been plotted and is shown in Figure 2.

The tank is believed to contain a waste layer approximately 3.1 m (10 ft) deep. The 1986 inspection failed to indicate the presence of sludge either because the inspection was made in the drywell or the dryness of the waste made it appear that the tank was empty.

PRELIMINARY ALTERNATIVES

Three basic alternatives are available for decommissioning Tank 241-CX-72: (1) further stabilize the waste and leave it where it is, (2) remove the tank and treat/dispose of the waste, or (3) remove the waste from the tank in place. Each of these alternatives and some of the subalternatives are briefly discussed below.

Figure 2. Intermediate Layer Analysis.



In Place Disposal

In place disposal is considered an alternative based on the *Final Environmental Impact Statement* (EIS): *Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes*, DOE/EIS-0113[1]. This EIS includes the in place disposal of several kilograms of plutonium in liquid waste sites (cribs) based on a risk-benefit analysis. In place disposal of Tank 241-CX-72 would require a valid characterization of the waste and a similar risk-benefit analysis.

Tank Removal and In-Vitro Waste Removal

This alternative consists of three basic suboptions: (1) storage of the waste for eventual disposal in a deep geological repository, (2) dissolution of the waste and pumping it to Tank Farms, or (3) direct transfer of the waste to Tank Farms. Each of these suboptions would require the tank to be lifted out of its caisson and sectioned to separate the high-level waste portion from the concrete-filled portion. Sectioning can be done using a diamond-wire rope-cutting technique. Sectioning would be accomplished by lifting the tank partially out of its caisson with a crane and cutting approximately 3.1-m (10-ft) -long pieces off until only 3.1 m (10 ft) remained. This would require a remotely operated grapple for the crane and a grapple or alternative for the bottom portion of the tank.

In Place Waste Removal

In place waste removal would require the removal of the grout covering the waste. Once the grout was removed, the waste could be sampled and characterized. After waste characterization, the appropriate waste removal operation would be developed, based on the contents and the consistency of the material. Several options for waste removal may be sluicing the waste to a double-shell tank (DST), removing the waste as a solid and then sluicing to a DST, or removing the waste as a solid for burial as a solid TRU waste.

The in place disposal of the tank is not considered practical because of perceived difficulty. It would require an extensive characterization effort and a complete revision of the project environmental assessment. Because no valid characterization of the waste exists, this alternative is not considered.

The preparatory steps for each of the three suboptions of tank removal and in-vitro waste removal are considered viable, but involve a relatively high level of risk in moving and sectioning the tank. In addition, the radiation exposures are all considered higher for these suboptions.

The in place waste removal is considered viable and is recommended based on relative ease of operation, relatively low radiation exposure, and perceived cost in comparison with the other possible alternatives.

Because of the relative ease of operation and the low radiation exposure expected for the in place waste removal, this directive is being pursued.

CURRENT CONFIGURATION

An engineering study was performed to find the most effective way of sampling and disposing of the waste. The study concluded that the decommissioning of Tank 241-CX-72 would occur in three phases as follows:

I. Grout removal
II. Waste layer sampling and analysis
III. Waste removal and disposal as determined by analysis

The most effective technique found for Phase 1 was to dry mine the grout down to a level at which the waste could be sampled and analyzed (dry mining is using a drilling bit without using a liquid for cooling and material removal). Because of potential airborne particles migrating from the tank as the grout is removed, an elaborate air curtain and containment building have been designed to ensure that no radioactive particles are released to the atmosphere. The air curtain is a hollow steel barrier located at the top of the tank, which is 4.3 m (14 ft) below grade. It will draw approximately 57 m^3/min (1900 ft^3/min) of air from the building down the hole to the tank, at which point the air will be routed to a filtering vacuum and then through an exhauster. This will ensure that no particles migrate into the building, causing a contamination problem. The overall component setup is diagrammed in Figure 3.

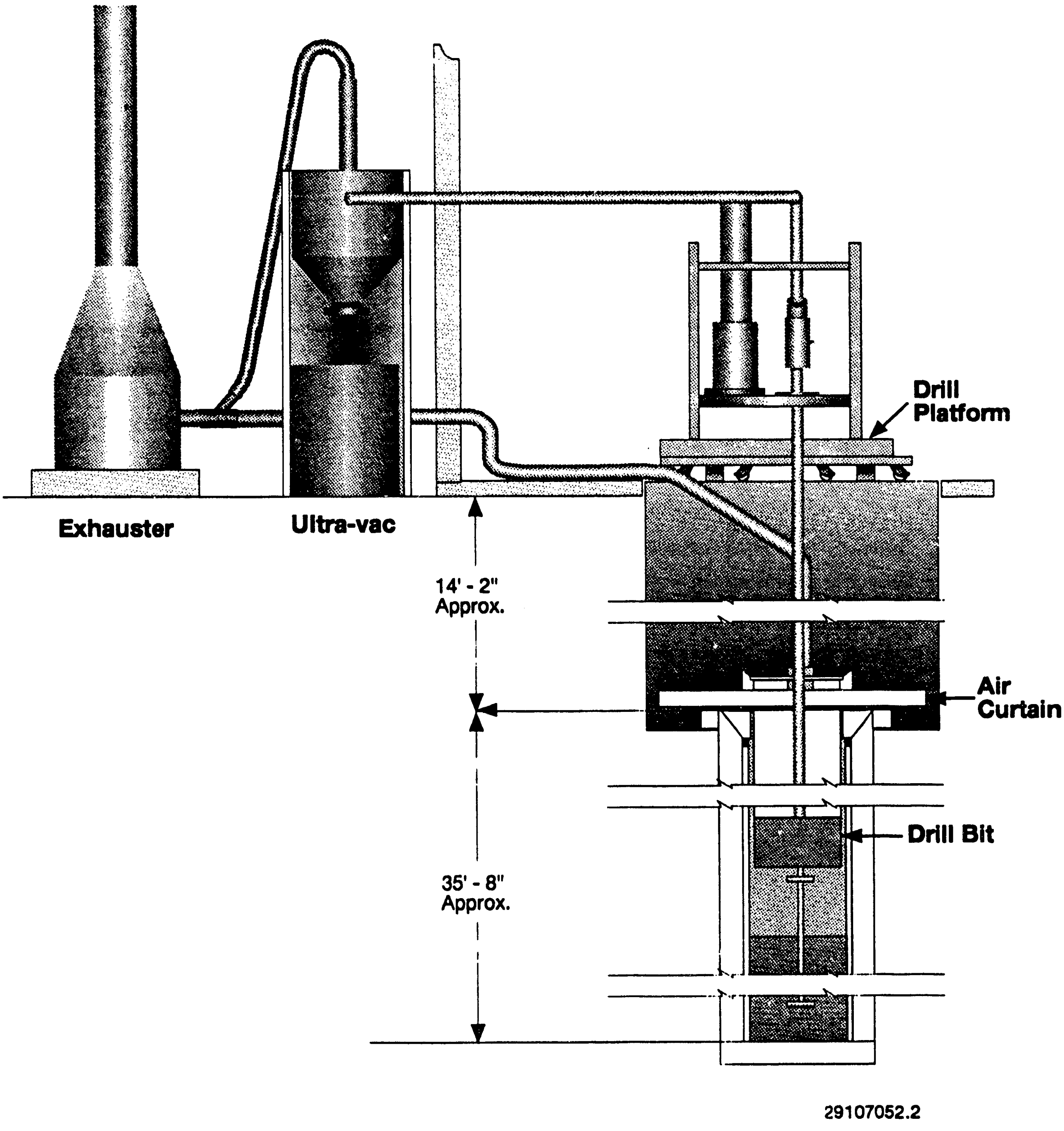
The drill bit designed for the grout removal is 0.9 m (36 in.) in diameter and weighs approximately 1,085 kg (2,400 lb). The bit will remove all the grout except for a 5.0-cm (2-in.) ring along the tank sidewall. The drill face has 10 steps toward the middle, each step housing several diamond-imbedded inserts, for a total of 96 inserts. The bit center is a 10.2-cm (4 in.) -diameter by 15.2-cm (6-in.) -long nose used as the pilot for the bit. This pilot will direct the motion down the center of the tank with minimal movement toward the tank sidewalls. The overall length of the bit is 2.2 m (7 ft 3 in.), which helps ensure that if the bit does encounter the tank sidewall, it will not breach the wall and cause a potential contamination.

The drill string is made of two concentric pipes for compressed and vacuumed air flow. The compressed air flows down the volume between the two pipes and supplies air for cooling. It also forces the grout and steel grindings toward the center of the drill bit. Once the particles are within the area near the center of the drill bit, the vacuum will draw the debris up the interior pipe to the filtering system.

The drill bit and string are operated by a large Shimpo drive motor, which is mounted to a platform with the necessary gearing and vertical motion for operating the drill. The vertical motion is controlled by a Compumotor

Figure 3. Dry Mining Component Setup.

Tank 241 - CX - 72 General Overview



servo controller and motor, which drive the drill platform either up or down by four ball-screw jacks. Once the drill platform reaches the lower limit of its ball-screw jacks, the drill string is disconnected, the platform is raised, and a new drill string section is connected for further drilling.

Preliminary off-site testing shows that the drill bit grinds the grout, the steel pipes, and the center rod into a very fine dust, which is easily removed by the vacuum system. Although the rate is slow, the process is very effective.

PRESENT STATUS

The soil has been excavated to the top of the tank, and the hole has been shored for safety. A 7.3-m (24-ft) by 14.63-m (48-ft) concrete pad has been poured around the excavated hole to provide the foundation for a greenhouse. The greenhouse has been constructed over the tank area for secondary containment of the system. Vacuum and exhausting systems have been purchased and tested, as well as the compressor, which is used for providing the compressed air down the tank. These components are all at the tank site and ready for use.

For safety reasons, the drilling platform will be tested in a radioactively clean area over a test pit. This test will serve a dual purpose, providing input into how the operation will take place once over the actual tank and giving the operators a chance to become familiar with the system. By testing over a test pit, minor changes can take place without the need for contamination control. This gives personnel involved in the final operation of the drilling platform a better understanding and a reassurance toward the final operation of the platform.

Also, by performing the test, several final supporting documents can be written toward the final operation of the platform, such as the decommissioning work plan, the operability test procedure, and the radiation work permit.

Once the testing is complete and the necessary changes have been made, the drilling platform will be moved and fixed above the tank.

FUTURE WORK

The drilling operation will proceed at the rate of 0.6 cm (0.25 in.) per hour, or at the optimum speed developed through testing. This will continue until the drill bit is 0.6 m (2 ft) above the waste layer or the radiation monitoring indicates that the waste layer is nearing. The drill will then be removed from the tank and placed on the air curtain for storage. The drill platform will be wheeled away from the pit and placed in the west end of the greenhouse. This will be the end of Phase I and the start of Phase II.
A core sampling truck will be brought in from the east side of the greenhouse

and will sample through the 0.6-m (2-ft) grout cap into the waste layer. The grout cap will help provide shielding while the air curtain continues working to prevent any airborne particles.

The samples will be analyzed and, from this analysis, Phase III will be developed: the removal and disposal of the waste. Several options are available at this time for various types of waste, but until the waste is analyzed, none of these options can be incorporated into the final design. One of the options is to continue using the drill bit, but this is only possible if the waste layer is of a dry consistency.

When the waste has been removed and disposed of properly, the tank will be decommissioned and the Strontium Semiworks Facility decommissioning can be finalized.

REFERENCES

1. *Final Environmental Impact Statement: Disposal of Hanford Defense High-Level, Transuranic, and Tank Waste*, DOE/EIS-0113, Vol. 3, U.S. Department of Energy, Washington, D.C. (December, 1987).

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