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SRS WASTE REMOVAL AND D&D PROGRAM FOR UNDERGROUND WASTE TANKS (U)

by

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"SRS WASTE REMOVAL AND D&D PROGRAM FOR UNDERGROUND WASTE TANKS"

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ABSTRACT

Removal of radioactive waste from 51 large underground storage tanks at Savannah River Site (SRS) has been planned. Waste removal equipment and techniques were demonstrated in one tank (Tank #16) in 1980. Remote inspection techniques were used to monitor the demonstration. This demonstration provided the basis for planning waste removal from the remaining tanks. Waste removal will allow decontamination and decommissioning (D&D) of the tanks. Some alternatives for D&D have been evaluated. Facilities are being installed on other tanks with completion of waste removal from problem tanks scheduled for 2001.

INTRODUCTION

At the Savannah River Site, high-level radioactive liquid waste resulting from fuel processing in the Canyon Buildings is stored in large underground storage tanks. The process is illustrated in Figure 1. The waste consists of supernate, soluble salts and insoluble sludge. The waste is stored in these tanks, some for over 38 years, until it can be processed through in-tank operations (in-tank precipitation and sludge washing) that prepares the waste as feed for the Defense Waste Processing Facility (DWPF) which includes the Vitrification and Saltstone Facilities. The Vitrification Facility is designed to convert the high-level liquid waste into a stable form for disposal. The high-activity sludge and the precipitated radionuclides will be immobilized in borosilicate glass and encased in stainless-steel cannisters in the Vitrification Facility for interim storage at SRS until a future Federal repository is available. The decontaminated salt solution remaining after precipitation will be combined with a specially formulated cement to form saltstone which will be stored in vaults at SRS.

A key step in this operation is waste removal from the underground tanks, which will eventually permit D&D of the SRS waste tanks.

Waste Tank Description

At SRS the 51 large subsurface tanks that are used for handling aqueous high level radioactive waste consist of four different designs as shown in Figure 2. All of the waste tanks are below ground and are built of carbon steel and reinforced concrete. Three designs (designated Types I, II, and III) have double steel walls and forced water cooling systems. The Types I and II tanks only have only a five-foot high secondary wall height while the Type III secondary wall extends to the tank top. The fourth design (Type IV) has a single steel wall directly supported by the encasing reinforced concrete and has no cooling coils. The Type III design was developed after leaks occurred in the primary walls of the Type I and II tanks. It was concluded that the primary leak producing mechanism was stress corrosion cracking at sites near the seam welds, and that stress relieving after fabrication should eliminate the cracking. The Type III tanks were stress relieved and chemical controls implemented. No cracks have occurred in these tanks.

Waste Removal at SRS

A means of waste removal from these underground tanks is essential because:

- The Type I and II Tanks are susceptible to leaks due to wall cracks.
- The Type IV Tanks do not provide multiple barriers against leakage.
- Processing the removed waste through DWPF results in a stable waste form for permanent disposal.
- Removal of waste from the Type III Tanks allows reuse of the tanks and eliminates the need to construct additional tanks.

In the mid-seventies the Savannah River Laboratory developed a process to slurry waste using long-shafted centrifugal pumps to slurry waste sludge. Supernate and other radioactive liquid was used as the slurry medium to minimize waste volume. The same pumps were also used to provide mixing for salt dissolutions. This operation had been simulated by slurrying kaolin clay in water in a full-scale mockup. However, a demonstration in an actual waste tank was needed to ensure applicability and to evaluate actual waste removal performance. Waste Tank 16 at SRS was selected for this demonstration. The results of this successful demonstration (Reference 1) were used to plan the current SRS Waste Removal Program and should also provide useful information for other facilities requiring waste removal from underground tanks.

Tank 16 History

Tank 16 was constructed in 1955 but did not receive high activity waste until May 1959. In September 1959 waste spilled into the annulus through cracks in the primary tank wall. The annulus pan was overfilled and some waste (estimated to be a few tens-of-gallons) leaked into the soil and has been studied extensively (Reference 2). Most of the remaining high-activity waste was removed from the tank. The tank was removed from even low-activity waste service in 1972 but about 75,000 gallons (22-inch height) of sludge remained. Most of the salt that had leaked into the annulus was removed during a test demonstration in 1978. Figure 3 is a photograph of the tank interior prior to the demonstration of waste removal.

Tank 16 Waste Removal Equipment

Figure 4 is a diagram of Tank 16. For the demonstration, structural steel platforms were constructed over the tank to support the slurry pumps and other equipment and prevent overloading the tank top. The slurry pumps were driven at 1800 rpm by 150-hp motors. The pump-motor-casing assembly rotated on a turntable at 0.2 rpm. Arrangements were provided for installation of up to five slurry pumps, but only three were ever installed. Special inspection equipment was inserted into the tank. The inspection techniques will be described in more detail.

Waste Tank Inspection

Special equipment has been developed at SRS to allow visual and photographic inspection of the tank interiors including the annular space. The techniques used are:

- Periscopic - visual and photographic
- Direct photography
- Direct wide-angle photography
- Closed circuit television

These techniques are normally used for tank inspections related to waste storage to help ensure tank integrity. However, tank interior inspections were invaluable in planning, monitoring and evaluating the results of the Tank 16 demonstration and subsequent waste removal operations performed in other SRS waste tanks. The tank interior photographs in this report were made by these techniques. Figure 5 shows a periscope being used for a tank interior inspection. Figure 6 shows the equipment used for direct photography in a tank. Figure 7 is a photograph of a salt deposit on the primary tank exterior wall due to leakage into the annulus. Again, Figure 3 was a photograph of the interior of Tank 16 prior to the waste removal demonstration. Other photographs will be shown later illustrating how tank inspection was used to monitor progress and evaluate the effectiveness of waste removal.

Tank 16 Demonstration

The Tank 16 waste removal demonstration consisted of sludge removal followed by tank cleaning. For sludge removal, supernate from other tanks was added to Tank 16. Using three pumps, 98% or 76,000 gallons of the sludge was slurried and transferred from the tank. Five rotary spray jets were installed in the tank through risers and the tank interior was sprayed with water containing corrosion inhibitors. This was followed by three washes with 4% oxalic acid. Afterwards, the tank interior was rinsed with water. Essentially all the waste was removed from the tank. Figure 8 shows the bottom of the tank after chemical cleaning. The residue on the tank bottom is from chemicals left after the liquid heel evaporated. Analysis indicated only 4100 Ci remained in the tank versus approximately 5 million Ci transferred from the tank. The dried solids remaining on the floor were estimated at 1.67 grams per square foot or 9.5 kg total.

Tank 16 D&D Plans

In 1989, United Engineers and Constructors in Philadelphia, PA was contracted by SRS to evaluate alternatives for D&D of Tank 16 (Reference 3). General criteria for the D&D were as follows:

- The tank (primary and annulus) will be entombed with suitable backfill (grout) to remain stable over 300 years.

- An Intrusion Barrier/Radiation Shield was to be placed on top of the tank with an effective life of 500 years.

- The tank was to be isolated from all other tanks and systems.

- Decommissioning was to be in accordance with Class C waste, as defined in 10 CFR 61.

The selection of Class C criteria is a conservative implementation of the regulations as the remaining waste curie levels in the tank qualified for Class B criteria. Evaluation of options for removal of the radioactive/hazardous material above the tank indicated significant cost variation in the total D&D costs. Cutting larger openings in the tank top for equipment disposal inside the tank resulted in the highest D&D Venture Guideance Appraisal (VGA) estimate of $20.4 million. However, entombment of equipment in-place on the tank top to an elevation of 6'-6" reduced the estimate to $10.5 million.

Because some liquid waste escaped from Tank 16 into the ground, the area was made a RCRA Facility Investigation/Remedial Investigation (RFI/RI) site. Assessment of data from monitoring wells in the Tank 16 vicinity is underway and is scheduled for completion in 1992 and a proposed plan will be submitted for regulatory review in 1994. Further planning for D&D of Tank 16 was put on hold until the RFI/RI results are known.

Waste Removal Other SRS Tanks

Since the Tank 16 waste removal demonstration, all high level waste has been removed from the eight SRS single-wall tanks using long-shaft slurry pumps. Figure 9 shows the interior of one of the Type IV tanks (single wall) after most of the waste was removed. Additional cleaning will be required to remove the residual waste, such as zeolite, from these tanks. Space was not available in Type III tanks to receive the contents of the waste remaining in all the older type tanks. Additional waste removal has been delayed until DWPF is operational, which is now predicted to be in 1993. During this time, projects were underway for the installation of equipment to remove waste from an additional 35 tanks. Figure 10 is a photograph of the typical equipment that must be installed on a tank top for waste removal. Additional projects will be required to provide facilities for other tanks. By the latest SRS project estimates, about $15 million is now required per tank for waste removal facilities. By current schedules (Reference 4), waste removal from all but the Type III tanks is to be completed by 2001.

In summary, techniques have been successfully demonstrated for waste removal and cleaning of the large underground tanks used to store radioactive waste at SRS. Facilities for waste removal and processing of this waste have been constructed. Planning is in progress for D&D of the empty tanks.

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3. STUDY REPORT, "Detailed Project Status and History Report For Tank 16 Decommissioning Demonstration Project, Volume 1, 7244.056-S-M-0001, United Engineers and Contractors (February 1990).

4. SAVANNAH RIVER SITE RADIOACTIVE LIQUID WASTE FORECAST - 1990, WSRC-RP-90-589, Westinghouse Savannah River Co., (June 1990).

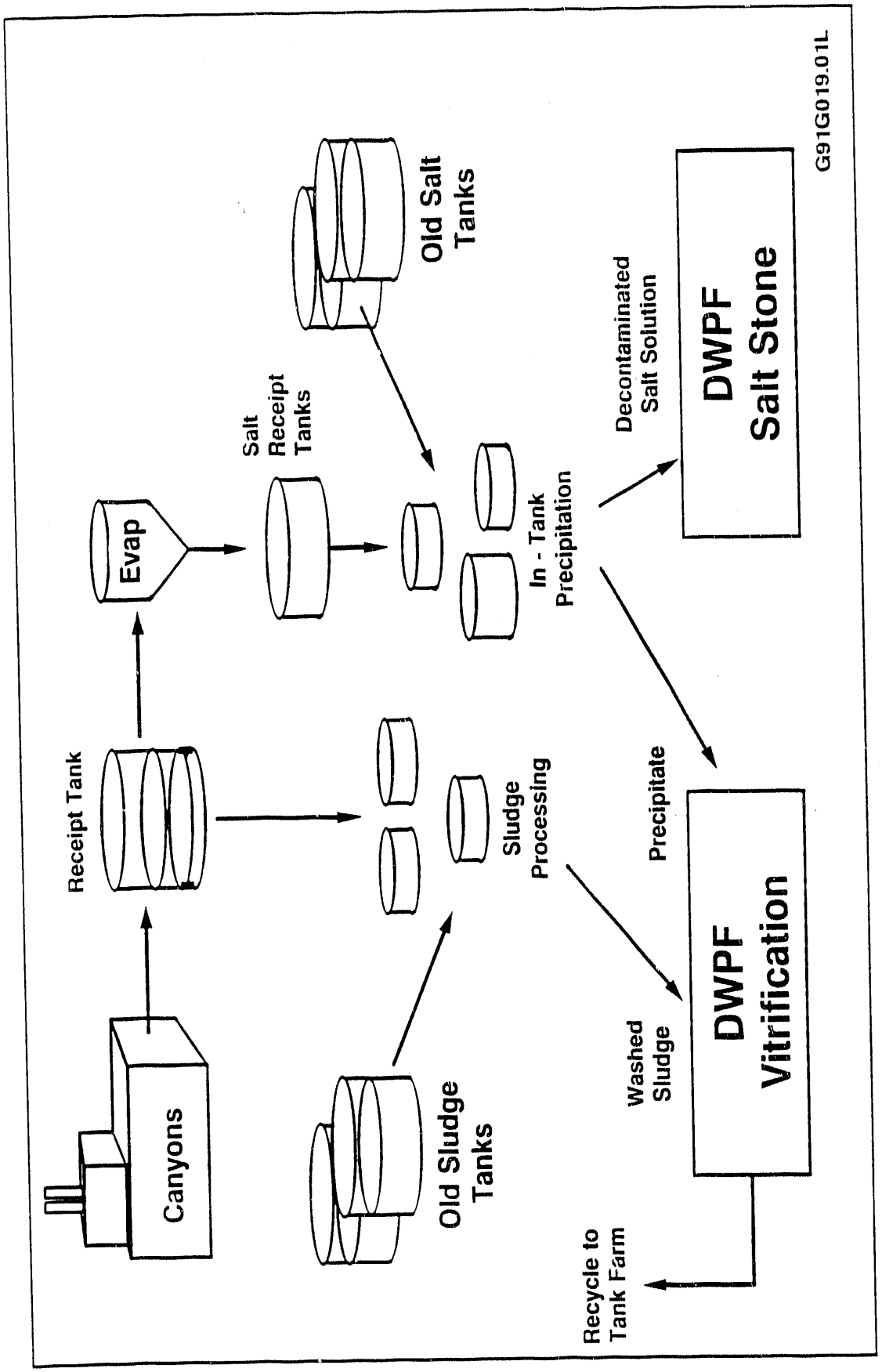

Figure 1. SRS High-Level Waste Management System

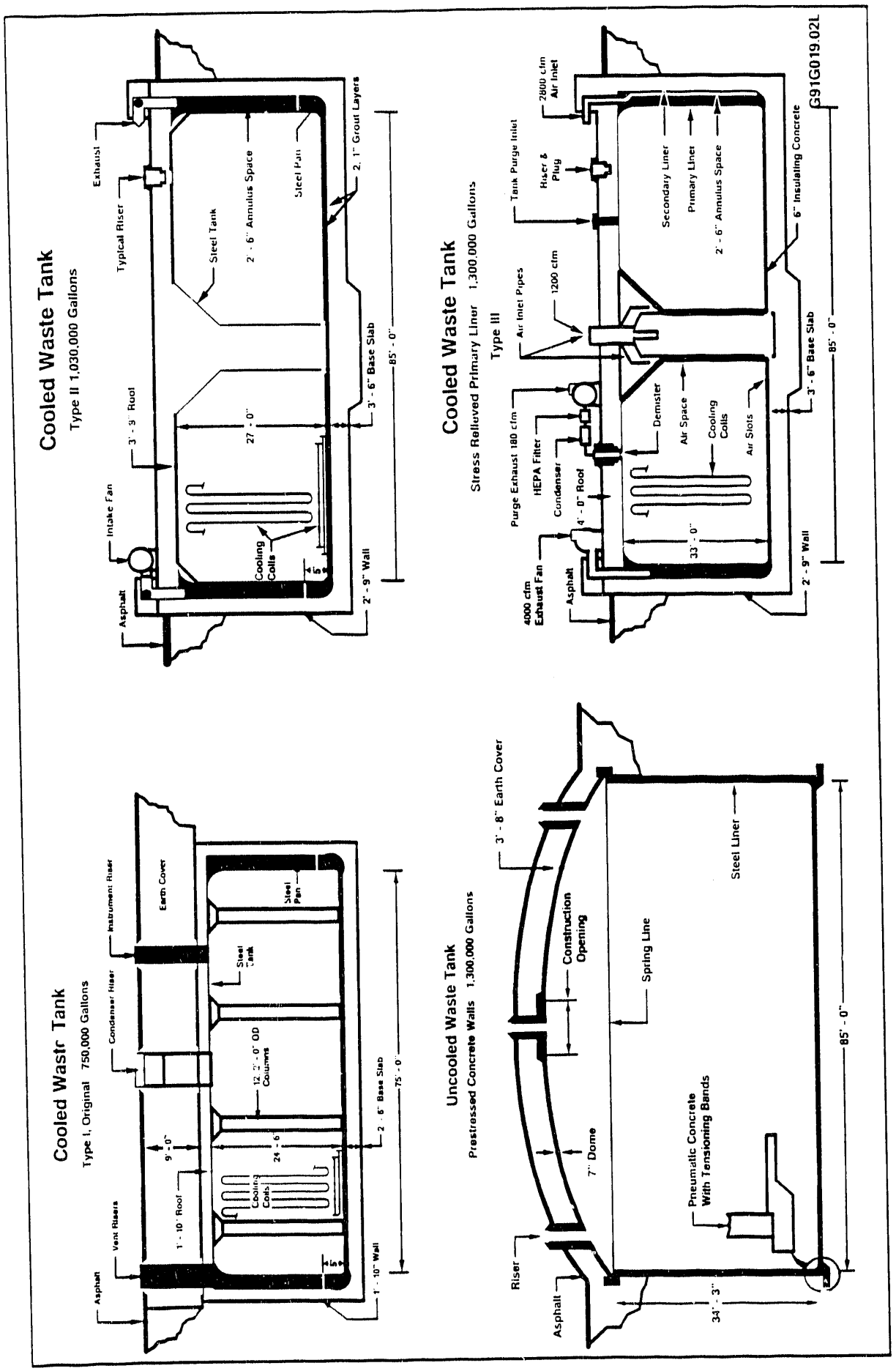

Figure 2. SRS Waste Tank Designs

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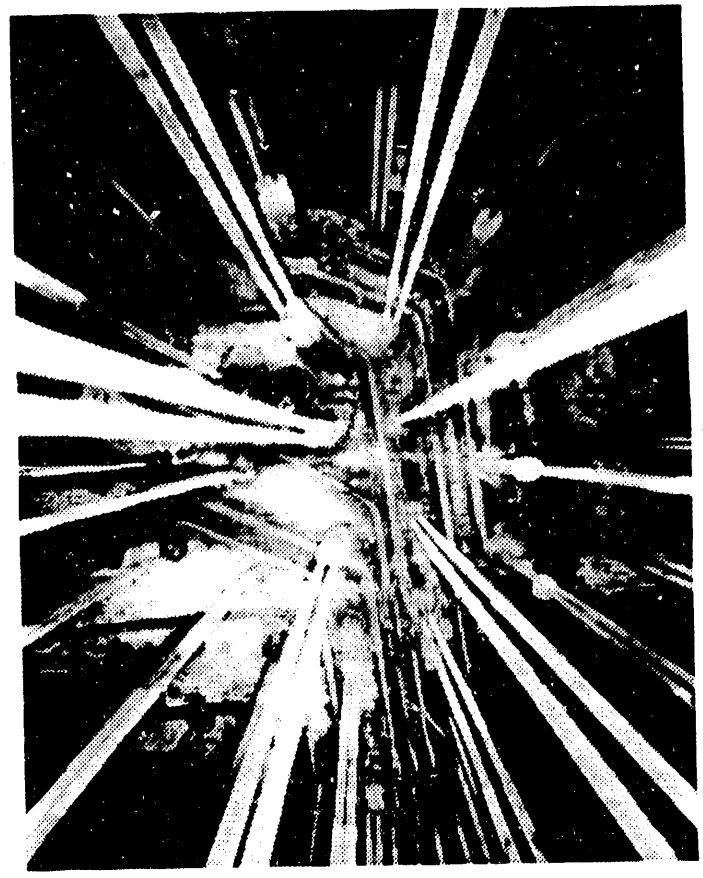

Figure 3. Tank 16 Interior Before Sludge Removal

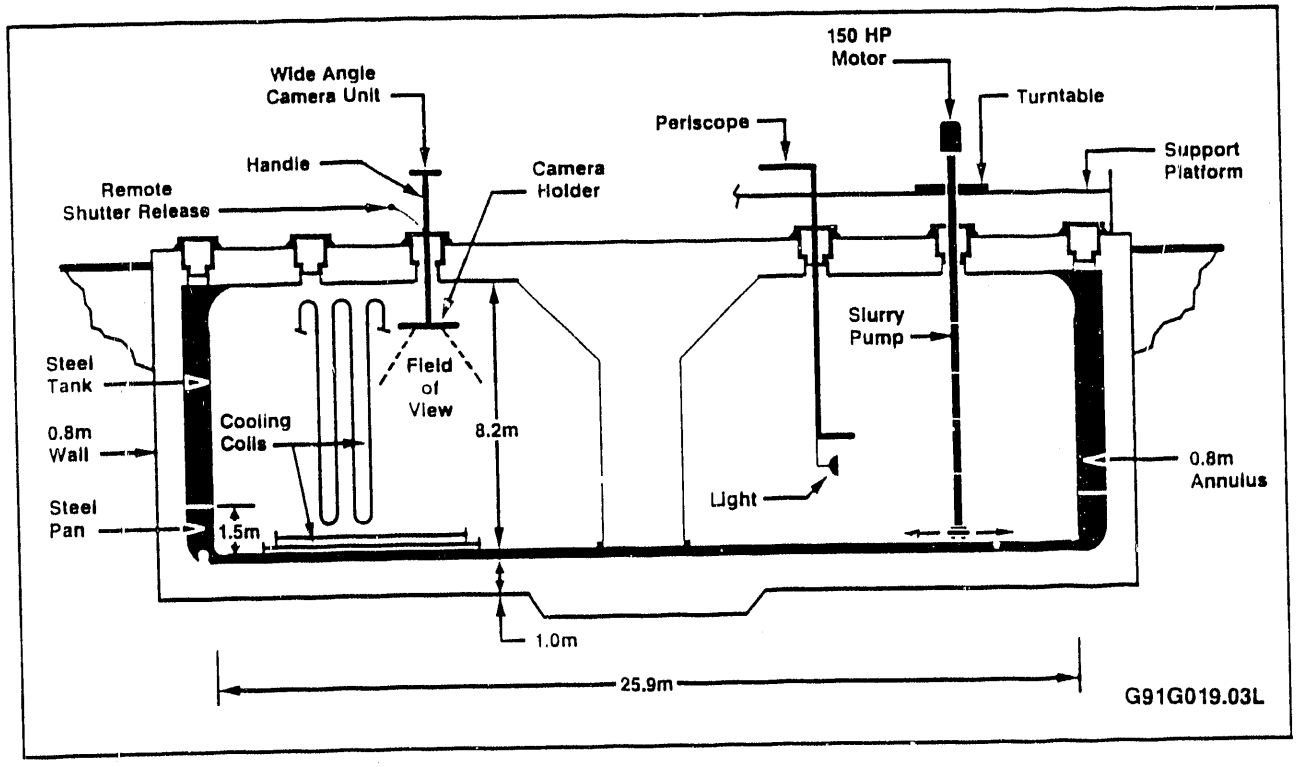

Figure 4. Tank 16 Dimensions and Equipment Arrangements

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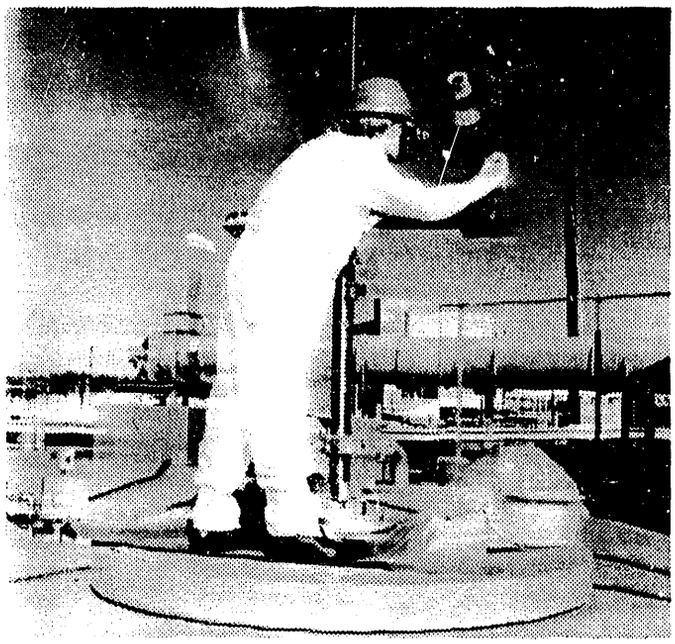

Figure 5. Periscope Being Used to Inspect Tank Interior

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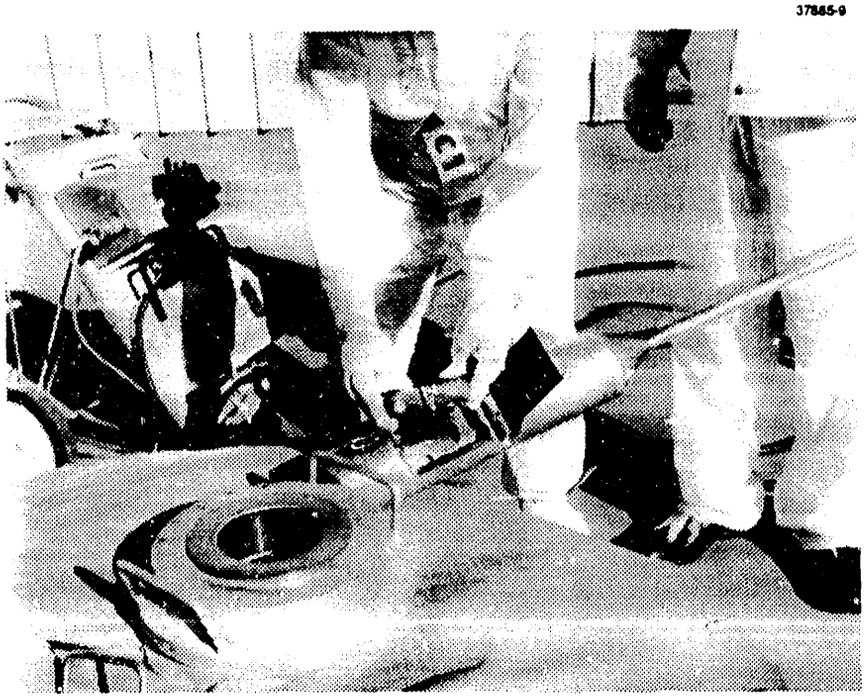

Figure 6. Equipment Used for Direct Photographs of Tank Interior

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Figure 7. Tank 16 Primary Wall by Periscope

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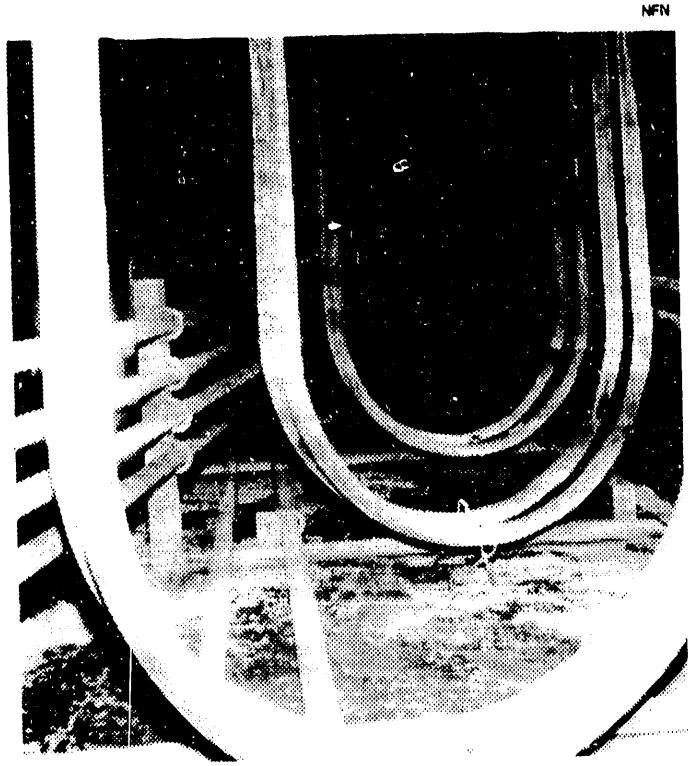

Figure 8. Floor of Tank 16 After Chemical Cleaning

Figure 9. Interior of Single-Wall Tank After Waste Removal

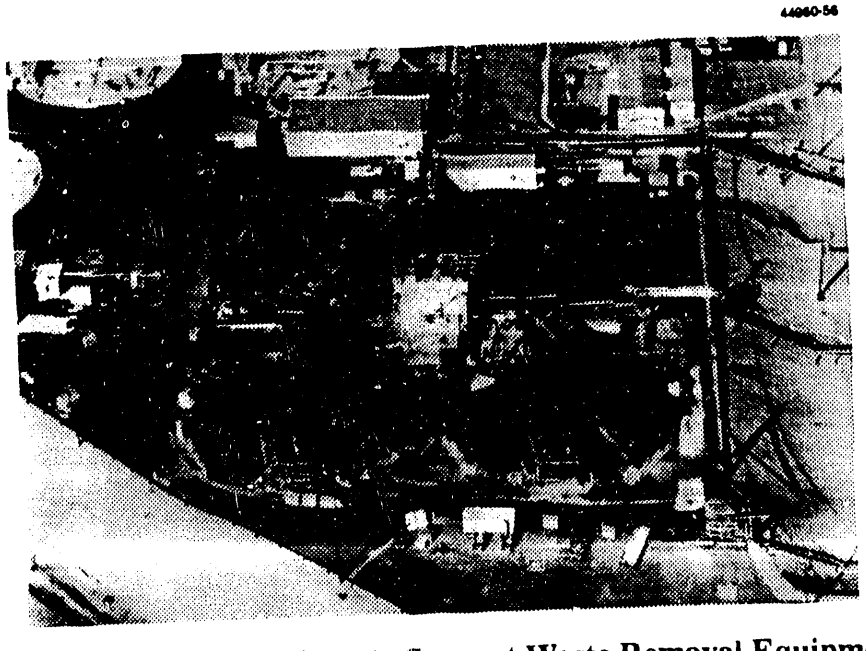

Figure 10. Structural Steel to Support Waste Removal Equipment from Single-Wall Tanks

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