RHO-RE-SR-37 P

# Closeout Report for the Decontamination and Decommissioning of the 203-S, 204-S, 205-S Facilities

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## ABSTRACT

The obsolete 203-S, 204-S, 205-S uranium nitrate hexahydrate purification and storage facility and the radioactive waste tank car unloading equipment in the 200 West Area of the U.S. Department of Energy Hanford Site were decontaminated and decommissioned. Aboveground facilities were dismantled and the area was backfilled with a minimum of 2 feet of clean fill over remaining underground concrete structures and piping. Fencing was removed and the site was released as a clean area with underground contamination. The 13-month project was completed by Rockwell Hanford Operations' new Decontamination and Decommissioning forces three months ahead of schedule and $275,000 under budget.

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## INTRODUCTION

The 203-S, 204-S, 205-S Decontamination and Decommissioning (D&D) project represents the first major D&D operation carried out by the recently established D&D Team in the U.S. Department of Energy Hanford Site's Chemical Processing Areas. The 203-S, 204-S, 205-S site was an easy and obvious D&D choice from several viewpoints - not only did this D&D operation offer an effective solution to a recognized environmental hazard, it offered a moderately sized facility with a variety of equipment types and structures, including an underground vault, a multistory building, and aboveground tank farms and provided the opportunity to develop D&D expertise in several areas. The lack of extreme radiation levels allowed new employees to acquire skills without a serious radiological hazard. Completion of the project below budget and well ahead of schedule has left Rockwell Hanford Operations (Rockwell) with an experienced and capable team for future D&D operations in the 200 Areas. Figure 1 shows the site before and after D&D.

## SUMMARY

The 203-S, 204-S, 205-S project was completed in 10 months from the start of engineering to final backfill of the site. With a very short engineering lead time, the project was broken into five phases to allow an early start of work. Rather than progress by facility, the work was organized by the complexity of the task and the degree of engineering, procedural, and safety documentation required. Phase I involved the isolation of utilities and removal of nonradioactive process piping and required a minimum of training and documentation. Subsequent phases were preceded by formal Safety Analysis Reports (SARs) and Readiness Reviews, and focused on dismantling the contaminated process piping, removing the medium-sized vessels and structures, partially backfilling, and, finally, removing the largest and most radioactive vessels and backfilling the site. Although the bulk of radioactive materials and equipment was removed and buried, no attempt was made to totally remove deeply buried concrete structures or piping. Structures were removed to a point at least 2 ft below the railroad grade level and backfilled with clean soil. The site is currently planted with wheatgrass and classified as "surface-stabilized with underground contamination." Total cost of the D&D project was $1.025 million, well below the $1.3 million projected for this work.

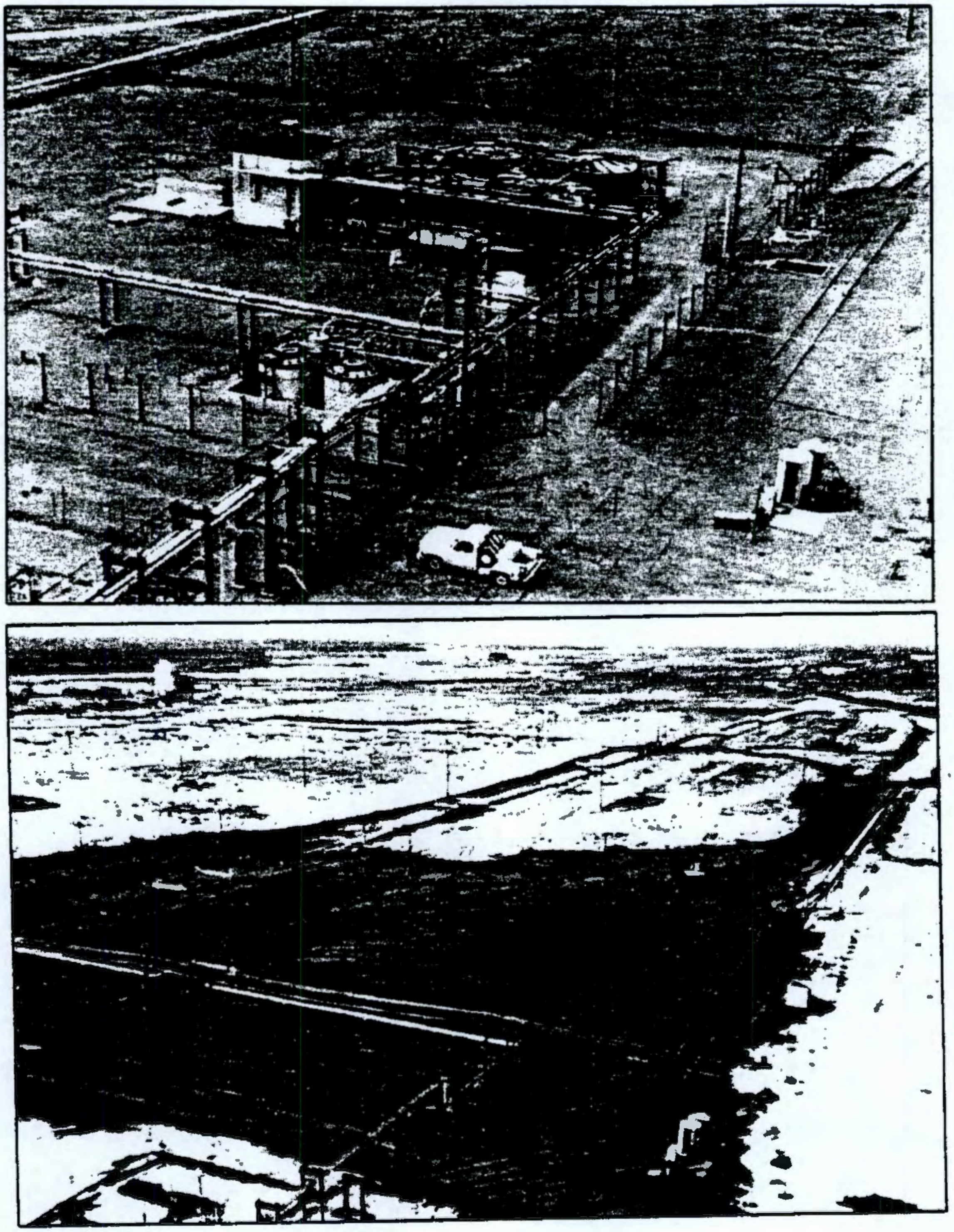


FIGURE 1. The 203-S, 204-S, 205-S Site Before and After Decontamination and Decommissioning.

# HISTORY

## CONSTRUCTION

The 203-S, 204-S, 205-S facilities were constructed in the early 1950's as a process unit for the decontamination of uranium nitrate hexahydrate (UNH) produced by the Redox (202-S) chemical separation plant (Fig. 2). The primary process unit consisted of a steel adsorption column filled with a silica gel bed that removed trace fission products from the UNH. The column (SG-1) was housed in an underground process vault (205-S) along with a waste neutralizer tank. Jumper connections made it possible to maintain fully remote operations. Most of the support facilities for the 205-S Process Cell were constructed above ground and included the following structures (Fig. 3):

- The two-story 205-S Chemical Makeup Building containing two chemical makeup tanks, a separate UNH sampling room, and an extensive piping system
- The 203-S aboveground UNH Storage Tank Farm consisting of two 5,000-gal stainless steel tanks housed in an open concrete basin
- The 204-S Tank Farm consisting of four 25-ft diameter 50,000-gal stainless steel tanks housed in two open concrete basins
- The 204-S Pumphouse constructed adjacent to the south wall of the 204-S Basin.
- The UNH cross-country pipeline running from the Redox Plant via the 203-S, 204-S, 205-S area to the uranium oxide facility ($UO_3$ Plant) one mile away.
- An extensive aboveground network of piping for chemicals, utilities, and radioactive solutions.

Additional facilities were constructed in later years and included a UNH tank truck unloading system, an extended railroad siding, and unloading facilities for liquid waste railroad tank cars. Design of these complex facilities in a largely aboveground configuration (except for the 205-S Silica Gel Column Vault) were to lead to inevitable operating and environmental problems, and to a top ranking among priority decontamination and decommissioning projects.

## URANIUM NITRATE HEXAHYDRATE PROCESSING

During the years of Redox operation, 1953-1965, the 203-S, 204-S, 205-S facilities purified and stored UNH. The uranium solution was pumped from the Redox Plant through the silica gel column, and the purified UNH was stored in the 203-S and 204-S tanks en route to the $UO_3$ Plant. Fission products collected by the silica gel column were stripped with nitric acid,

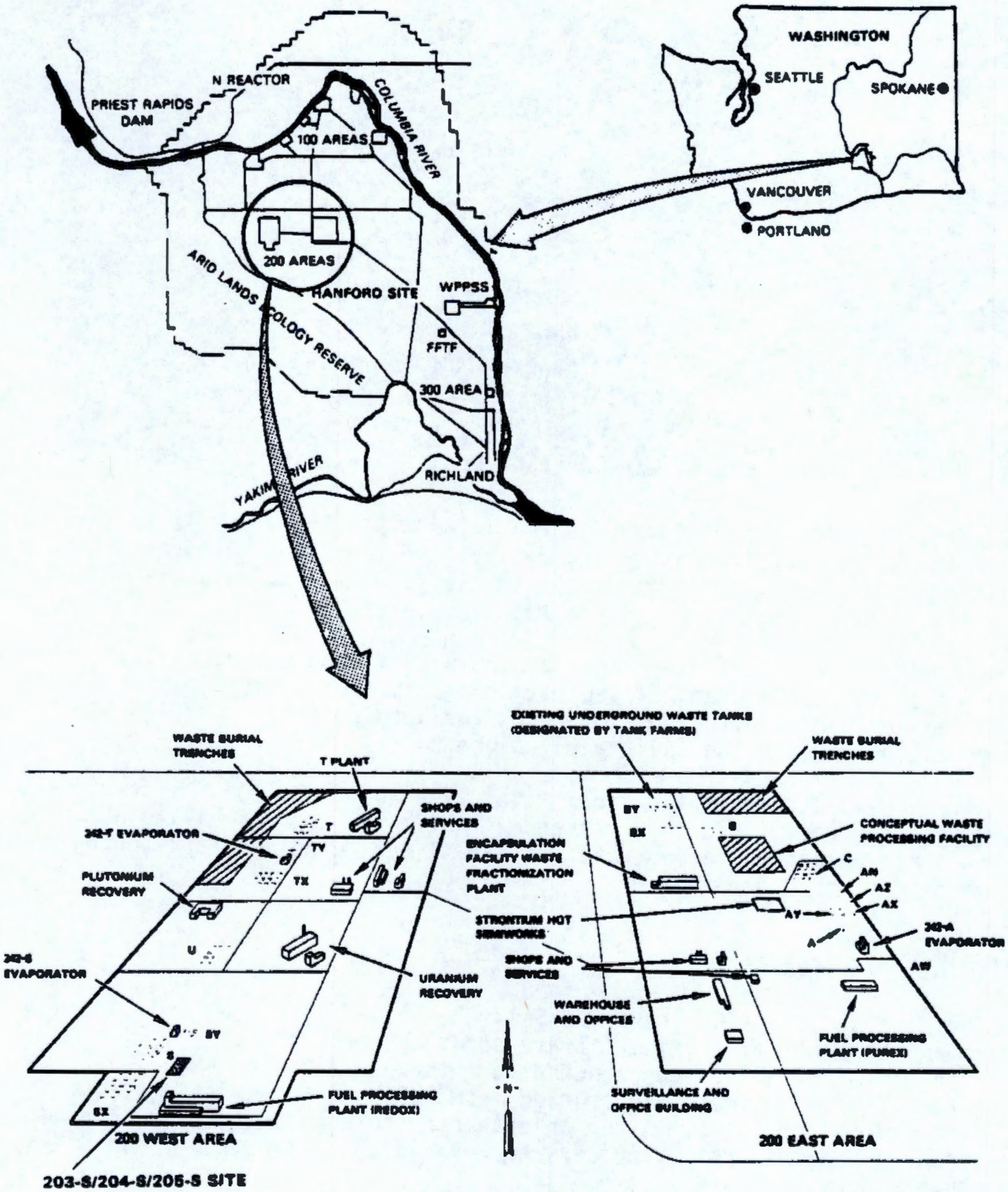



FIGURE 2. The 203-S, 204-S, 205-S Facility Location.

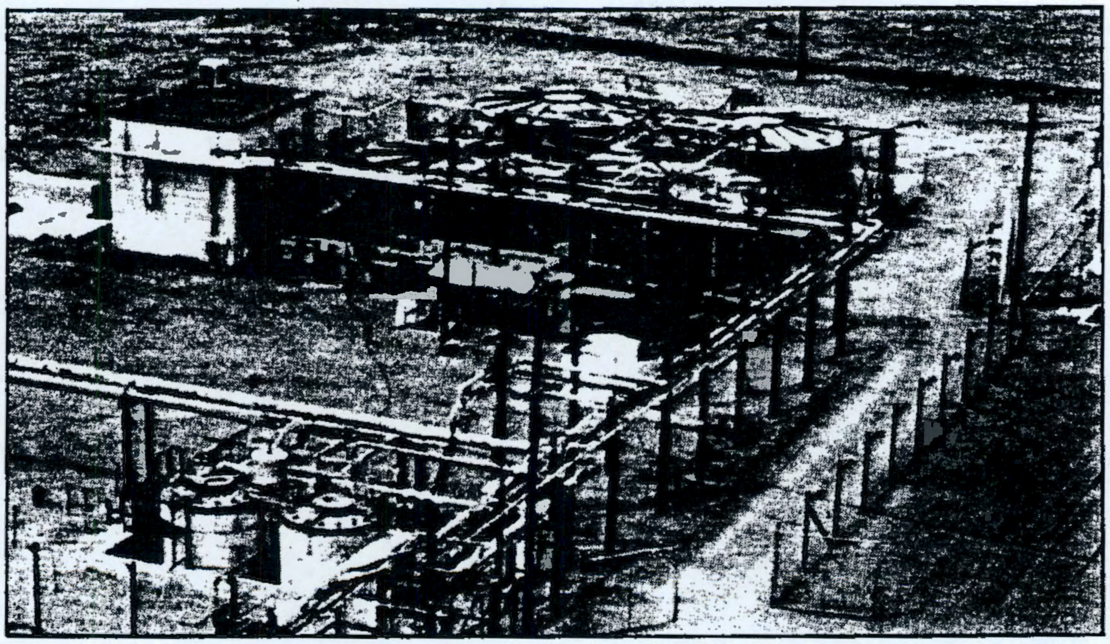


FIGURE 3. The 203-S, 204-S, 205-S Area. The 203-S Tank Farm is at lower left, the 204-S Tank Farm is at top center, and the 205-S Chemical Makeup Building and underground vault are at top left. The partially dismantled tank car unloading system is at top right.

neutralized in the neutralizer tank, and pumped to underground cribs. After the start of the PUREX chemical separation plant, truck unloading facilities were added and UNH was trucked from PUREX for loading into the 204-S tanks and processing through the silica gel column.

After the shutdown of the Redox Plant, the 203-S and 205-S systems were shut down and placed in long-term standby, while the 204-S facility was converted for unloading radioactive waste rail tank cars and for storing thorium nitrate solutions.

## THORIUM NITRATE STORAGE

The piping systems of Tanks 204-S-1, -2, and -3 were modified for storage and shipment of thorium nitrate solutions produced by the PUREX plant. A new pipeline was constructed to a tank car loading ramp 300 ft to the south. Thorium nitrate was trucked from PUREX to the existing truck unloading station at 204-S. After an extended storage period, the thorium nitrate was shipped in rail tank cars to Fernald, Ohio, and the three tanks were given a cursory flush.

## LIQUID WASTE RAILROAD TANK CAR UNLOADING

In 1966 tank car unloading facilities (Fig. 4) were installed at 204-S to transfer mixed fission product waste slurries from rail tank cars to the underground storage tanks in the Tank Farms complex.

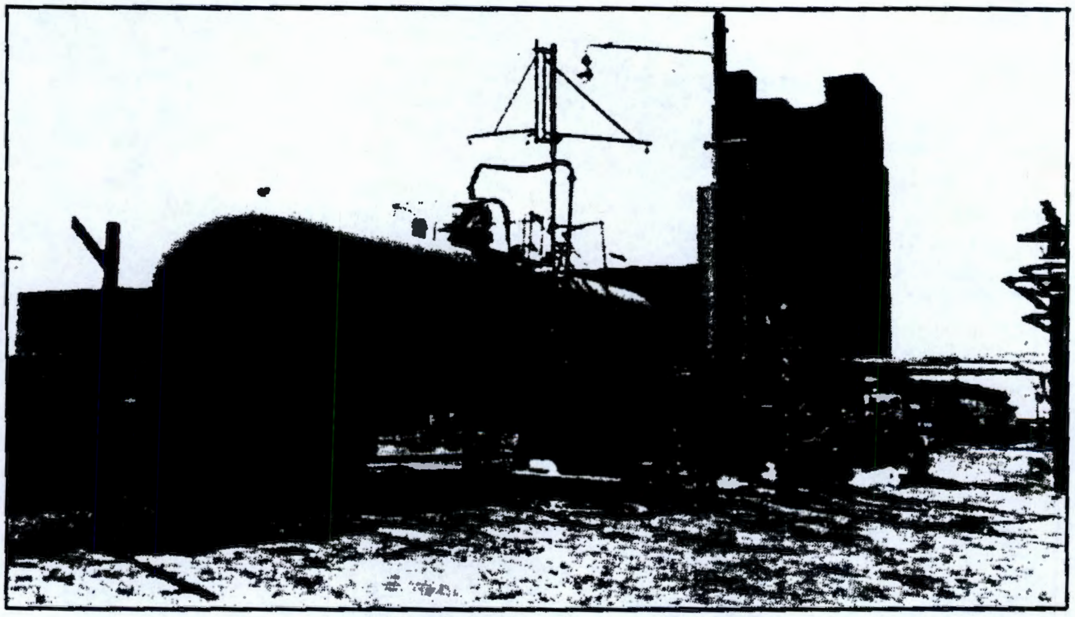


FIGURE 4. The 204-S Tank Car Unloading Station. Note the unloading derrick and access ramp. A small portable exhauster is positioned to the right of the access ramp.

Construction work included an extension of the existing railroad siding, installation of a tank car drain sump and addition of a syphon unloading system. The syphon priming tank and valving, as well as an access walkway, were installed next to the drain sump. Two centrifugal pumps were mounted in the 204-S North Basin, and a new piping system was routed to the 204-S-4 Tank and to the 240-S-151 Diversion Box leading into the tank farms systems.

The UNH and thorium nitrate operations had processed materials associated with very slight radiation doses; however, the mixed fission product tank car shipments brought substantial radiation doses to the area. Loaded tank cars frequently arrived with contact radiation doses of 3-5 rem/h with extreme doses encountered infrequently of up to 80 rem/h. Shipments consisted of neutralized decontamination wastes from N Reactor and chemical process wastes from the 300 Area laboratory and pilot plant facilities. The primary radionuclides were $^{60}Co$ in N Reactor waste, and $^{90}Sr$ and $^{137}Cs$ in 300 Area waste.

Initially, wastes were transferred from the tank cars into Tank 204-S-4 for sampling and lag storage before pumping to the tank farm system. Rapid sludge settling in the 204-S-4 Tank, however, made this operation impractical. Approximately 4-6 ft of sludge built up in the tank, resulting in contact dose levels of 3-5 rem/h. The system was then modified for direct pumping to the tank farm. Although the pumps were housed in protective covers, leakage from the mechanical shaft seals resulted in a continuous and slow flow of contaminated liquid into the north basin sump that had to be jetted to the 204-S-4 Tank. As the radiation dose level of tank car shipments increased over the years, the outdoor installation of the unloading system presented severe operating problems, particularly in winter, and developed into an increasing environmental liability. During its latter years of operation, the 204-S tank car unloading operations caused more than 50% of the occupational exposure absorbed by the entire tank farm staff. Design and construction of a new tank car unloading building was expedited, and the new facililty, 204-AR (Fig. 5 and 6), was placed in operation in the spring of 1981. A decline in tank car shipments from the 300 Area and deferral of reactor decontaminations at N Reactor reduced tank car unloading to a less-than-monthly frequency in its last year while plans were made for thorough decontamination and partial dismantling as part of the 204-S shutdown/standby work.

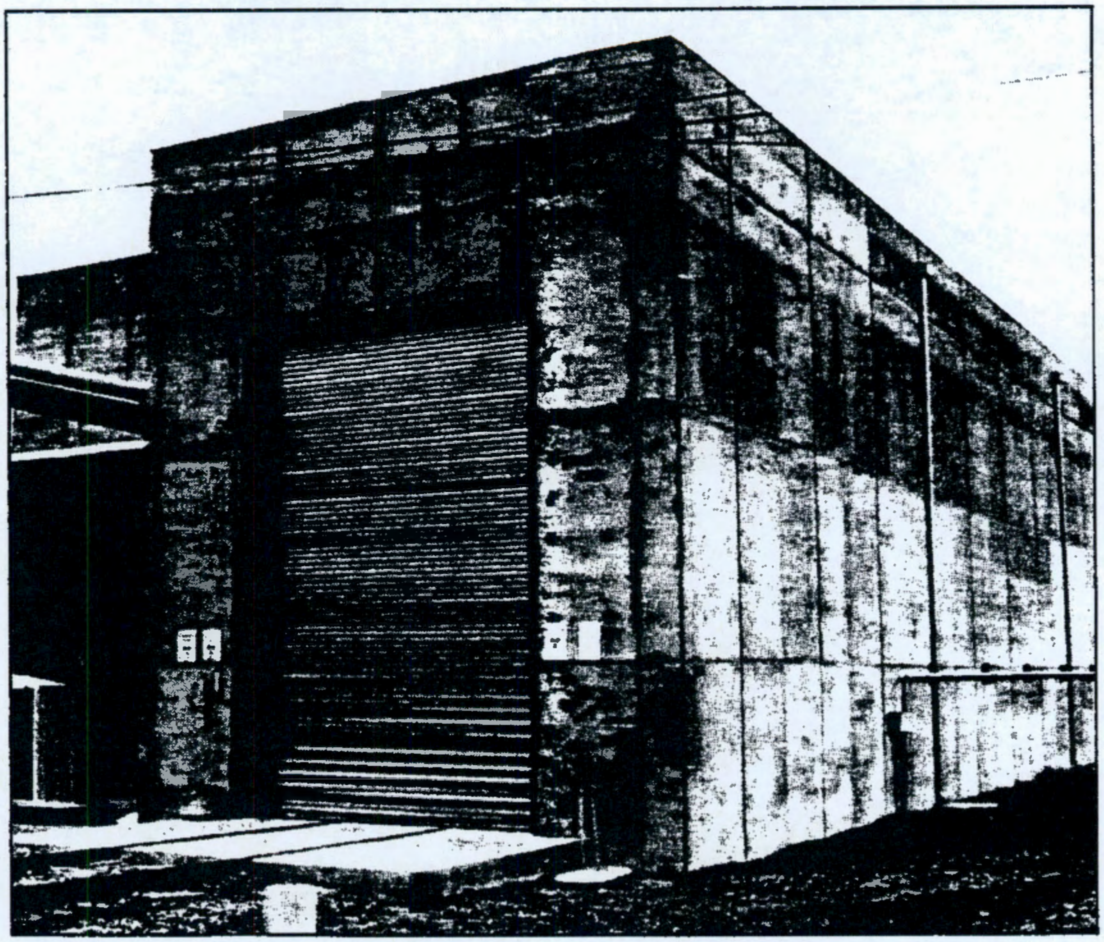


FIGURE 5. The New 204-AR Tank Car Unloading Building. This modern concrete structure replaces the outdoor facilities at 204-S.

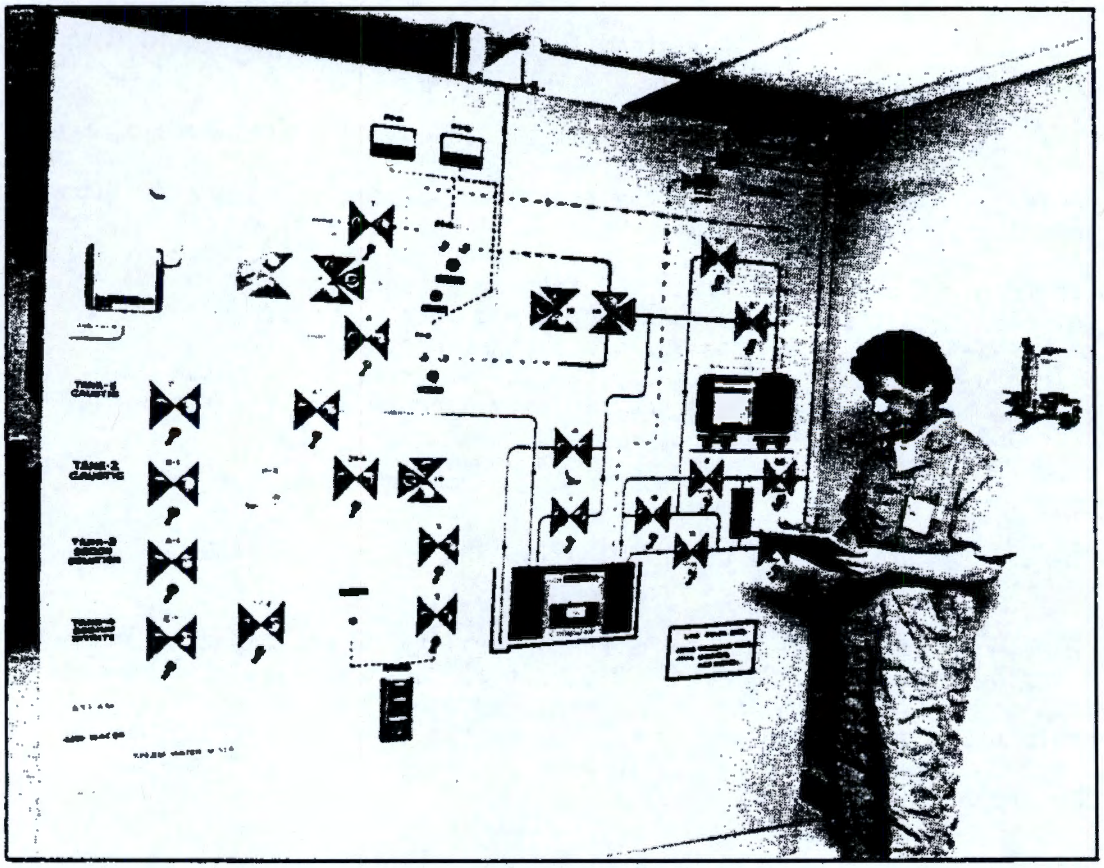


FIGURE 6. The 204-AR Graphic Control Panel in the Shielded Control Room. The design of the new building has dramatically reduced operator exposure.

## SHUTDOWN/STANDBY/PARTIAL DISMANTLING

The final tank car shipment was unloaded several months before startup of 204-AR, and dismantling of unloading equipment was started by Tank Farm operation and maintenance personnel as soon as the 204-AR facility was fully operational. Shutdown/standby work (pre-D&D) included the following operations:

- Removal of the unloading derrick, syphon tank, north basin sump jet, tank car unloading pump, and the UNH truck unloading station
- Sluicing of all four tanks to remove the thorium nitrate and silica gel residue from Tanks 204-S-1, -2, and -3, and the tank car sludge from Tank 204-S-4
- Decontamination of the north and south basins

- Shutdown of the 204-S steam system by replacing the basin sump jets with electric pumps and terminating all other steam services
- Sealing the tank car sump with a sprayed polyurethane foam cover.

A large net was placed over the entire 204-S complex to prevent bird and animal entry into the basins. While sluicing was very successful in the 204-S-1, -2, and -3 Tanks, and nearly three-fourths of the sludge was removed from 204-S-4, an estimated 10 tons of sludge remained in 204-S-4. The material resisted cold water sluicing and left 3-5 rem/h exposure fields in the 204-S-4 vicinity. Although shutdown/standby placed 203-S, 204-S, 205-S into a relatively safe standby condition, interest in total dismantling remained and placed the facility high on Rockwell's priority list for D&D.

## SELECTION FOR DECONTAMINATION AND DECOMMISSIONING

Funding became available for surplus facility decontamination and decommissioning in FY 1983. The 203-S, 204-S, 205-S facilities were chosen by virtue of their continuing high surveillance and maintenance costs, the favorable ratio of cost to environmental benefit, the manageable size of the facility, and the moderate radiation exposure levels to be encountered in the D&D effort.

## ENGINEERING AND DECONTAMINATION AND DECOMMISSIONING PLANNING

The timing of facility selection, funding approval, and scheduled start of dismantling placed the engineering and document preparation phase on an extremely tight schedule. The main time constraint was the preparation of safety analysis and readiness review documentation. The work was divided into one nonradioactive/maintenance-type phase not requiring formal safety analysis (SAR) documentation, and four radioactive equipment dismantling phases, each with separate safety analysis and readiness review documentation. The following overall dismantling plan was established.

Phase I: Remove all utilities - steam, water, compressed air, electric power - from the area and dismantle most of the essentially clean piping and structures.

Phase II: Remove contaminated piping and associated support poles.

Phase III: Remove medium-sized vessels and structures.

Phase IV: Partially backfill 203-S and 205-S vaults and pits.

Phase V: Remove 204-S tanks and facilities and complete backfilling of the 203-S, 204-S, 205-S area to final configuration.

Phases I-IV were scheduled for completion in March - September 1983, and Phase V was scheduled for October 1983 - March 1984.

Engineering started in February 1983. Maintenance forces isolated utilities and set up temporary power in March, while D&D management hired and trained D&D workers. Actual dismantling started in April and was completed in December 1983.

## SEVERANCE OF UTILITIES AND REMOVAL OF CLEAN EQUIPMENT

The initial work phase consisted of the severance of utilities inside the D&D work area by maintenance forces, and the dismantling of isolated nonradioactive utility systems by D&D workers.

Maintenance forces cut overhead and underground electric power outside the 203-S, 204-S, 205-S fence line to assure the absence of electrocution hazards from the extensive wiring systems in the area. New temporary electrical outlets were installed in the old 203-S Pump Control Center just inside the fence gate. The control center was served by an underground circuit from the Redox Plant. Power was also obtained from a portable generator where the use of long power cords would have been impractical or hazardous. The electric sump pumps in the 204-S Basin were connected to a power outlet only during an actual transfer operation.

Raw and sanitary water was cut outside the fence line on the south side of the area. The existing 8-in. water valve was left in place and a hose bib was installed above grade to provide water for dismantling work and portable safety showers. Portable self-contained eye and body wash stations were purchased for use at the work area.

Steam was severed at the two branches leaving the main line. The main line was shut down temporarily to allow blanks to be installed downstream of the shutoff valves. The main steam line itself was left in operation as it remains essential for continuing Redox and 222-S Laboratory operations. The live main line did not represent a hazard, as it was not connected with further D&D efforts except for partial sleeving during the project closeout. The line was shut down briefly when the 203-S tanks were lifted out of their basins and over the steam line to truck trailers.

All other utilities including air and chemical pipelines were cut and sealed outside the fence line. The railroad switch was spiked into the main track position to prevent train entry into the area.

Upon completion of utility isolation by maintenance forces, a sizable fraction of the nonradioactive utility system was removed by D&D workers. This work was carried out on a prejob safety plan basis while the formal SAR and Readiness Review documentation for radioactive equipment dismantling was in preparation. The removal of steam, water, and chemical piping, and of various electrical panels and conduit systems provided a valuable training opportunity for the new D&D work force.

## REMOVAL OF CONTAMINATED PIPING AND SUPPORT POLES

The second work phase initiated radioactive process equipment dismantling and cleared the area of most piping, poles, and miscellaneous small equipment.

### ASBESTOS LAGGING REMOVAL

All piping was drained or verified to be empty before cuts were made. Where necessary, small holes were drilled to assure the absence of liquids. A great deal of effort was focused on the safe cutting and handling of asbestos materials, as the bulk of piping in the area was asbestos lagged. Standard procedure was to remove a short section of lagging in the area where a cut was to be made. A plastic bag was taped around the piping to catch asbestos fines (Fig. 7) and a constant water mist was sprayed on the cutting area to minimize airborne fines. After cutting out an asbestos section, the cut faces were securely sealed with tape and plastic for the actual pipe-cutting operation.

### PIPE CUTTING

All piping was verified to be empty by opening drain valves in the low points of pipe systems. Where further verification was necessary, holes were drilled through the pipe. Holes were also used to assess the radiological conditions inside pipes (Fig. 8).

Piping was cut with a variety of cutting equipment. For pipes 2 in. or smaller in diameter, a hydraulic crimper (Fig. 9) was the favored cutting method because the crimper sealed the pipes except for a small hole in each corner of the flattened ends.

Piping larger than 2 in. in diameter was cut with a saw (Fig. 9). In rare instances, where required by radiological conditions inside the pipe, the line was filled with foam-producing chemicals to fix and immobilize radioactive contamination.

Cut piping sections were wrapped in plastic and securely sealed with tape for transport to the burial ground.

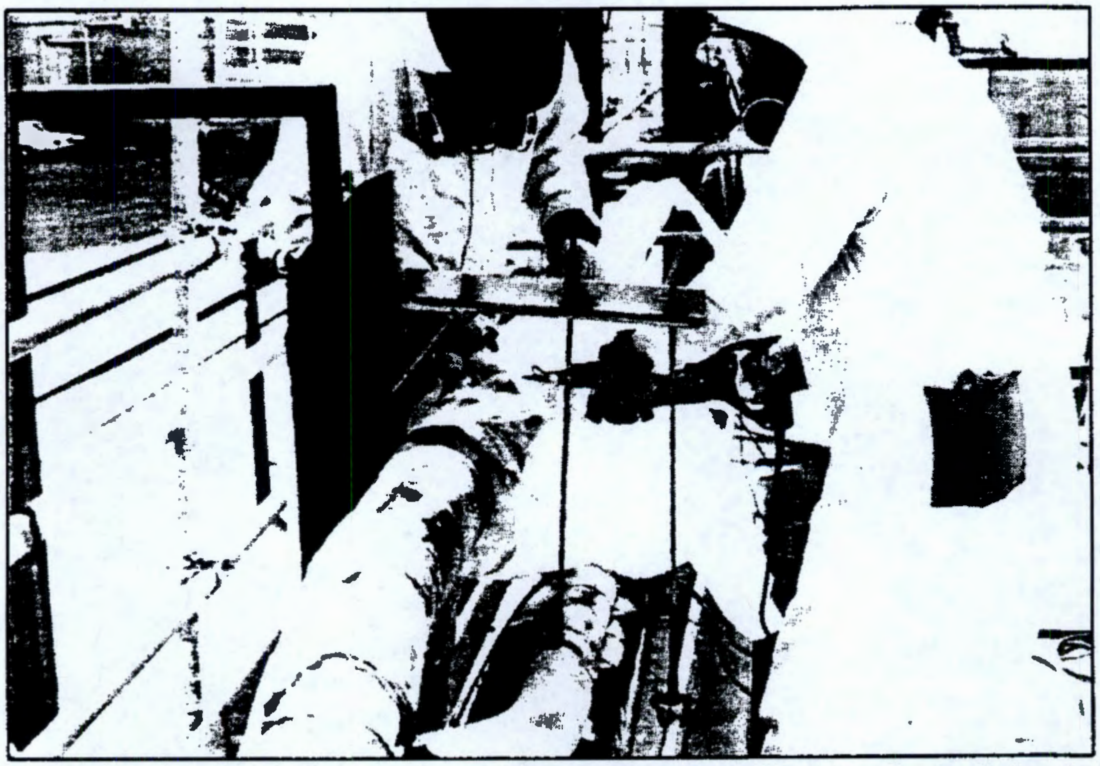


FIGURE 7. Removing Asbestos Lagging with a Reciprocating Saw. Note the plastic bag used to catch fine particles. The D&D worker at left is applying a fine water mist to prevent airborne suspension of particles. Workers were trained for asbestos work and were required to wear protective clothing and respiratory protection at all times.

FIGURE 8. Pipe Draining and Inspection. Holes were drilled through piping to assure the absence of liquids or to allow swabbing of the pipe interior for detecting contamination in the line.

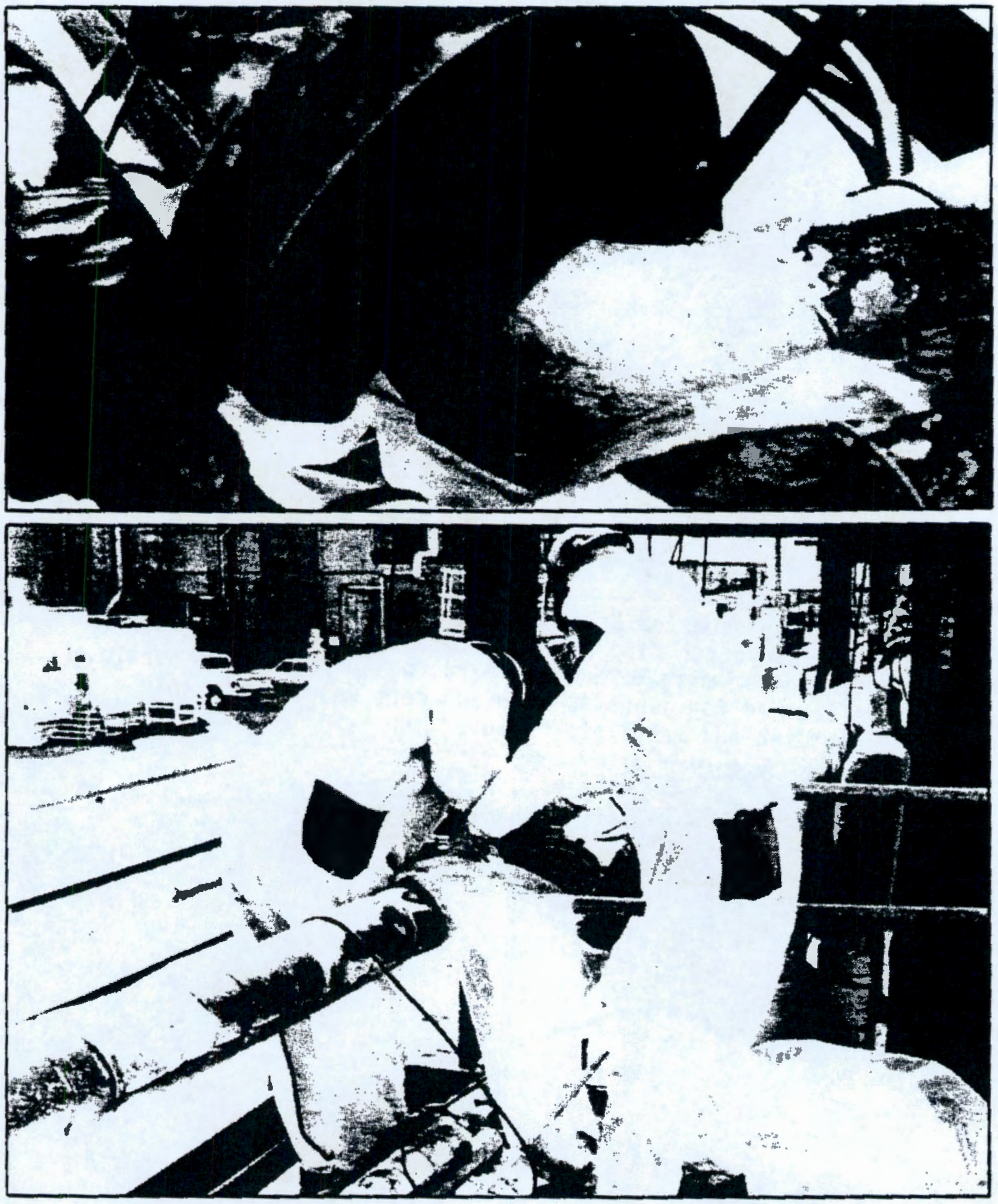


FIGURE 9. Pipe Cutting Operation. A hydraulic crimper (top) was the preferred cutting tool for piping 2 in. or smaller in diameter because the crimper sealed the pipe ends except for two small pinholes. A portable bandsaw (bottom) was used for large-diameter piping where the crimper could not be utilized.

## POLE REMOVAL

The extensive system of steel and wooden pipe support poles was removed by holding the poles with a crane and cutting the bases with a saw as appropriate.

## DISMANTLING THE URANIUM NITRATE HEXAHYDRATE PIPELINE

The UNH pipeline, leading from the 203-S, 204-S, 205-S area south to the Redox plant and north to the $UO_3$ Plant, was totally dismantled. The line consisted of nearly a mile of overground-lagged and electrically heat-traced 2-in. stainless steel pipe. The entire pipe was wrapped in plastic by D&D workers. Lagging was only removed at cut points to allow use of the hydraulic crimper. Additional piping related to the UNH system was removed at both Redox and the $UO_3$ Plant. While much of the pipeline ran cross-country about 2 ft above the ground and allowed dismantling from ground level, cranes and a scissor lift had to be used for the elevated portion of the line in the plant areas. All piping was disposed of by burial. Progression of the UNH line dismantling is shown in Figures 10 through 12.

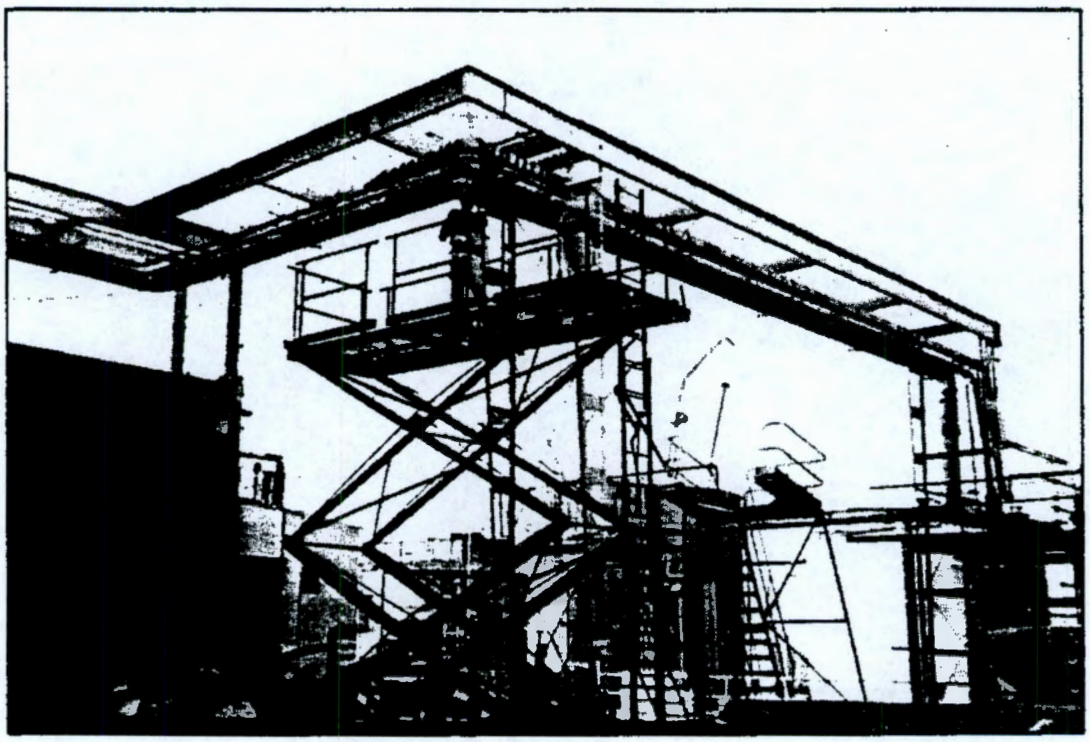


FIGURE 10. Plastic Wrapping of Uranium Nitrate Hexahydrate Piping at the Redox Plant. The scissor lift received extensive use during pipe removal.

FIGURE 11. Dismantling the Cross-Country Section of the Uranium Nitrate Hexahydrate Line. Note cut-and-wrapped pipe sections (top), and dismantling a pipeline heat trace station (bottom).

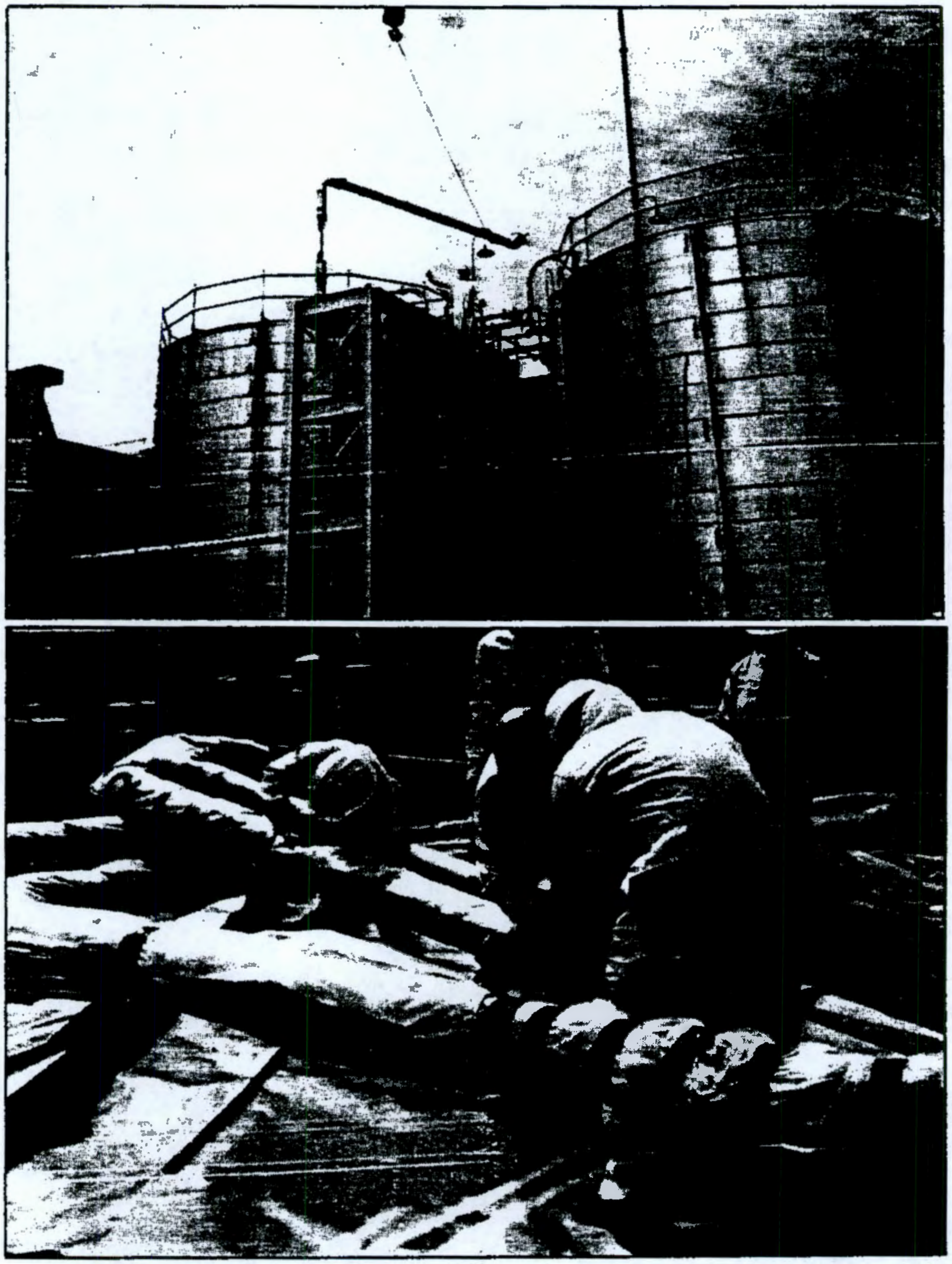


FIGURE 12. Dismantling and Wrapping Uranium Nitrate Hexahydrate Piping at the $UO_3$ Plant. Piping was double-wrapped and fully sealed for transport and burial.

## DISMANTLING AND SALVAGE OF 203-S

The D&D of the 203-S UNH storage facility involved extensive piping and utility removal, salvage of the two storage tanks, and gravel/soil fill of the concrete basin (Fig. 13).

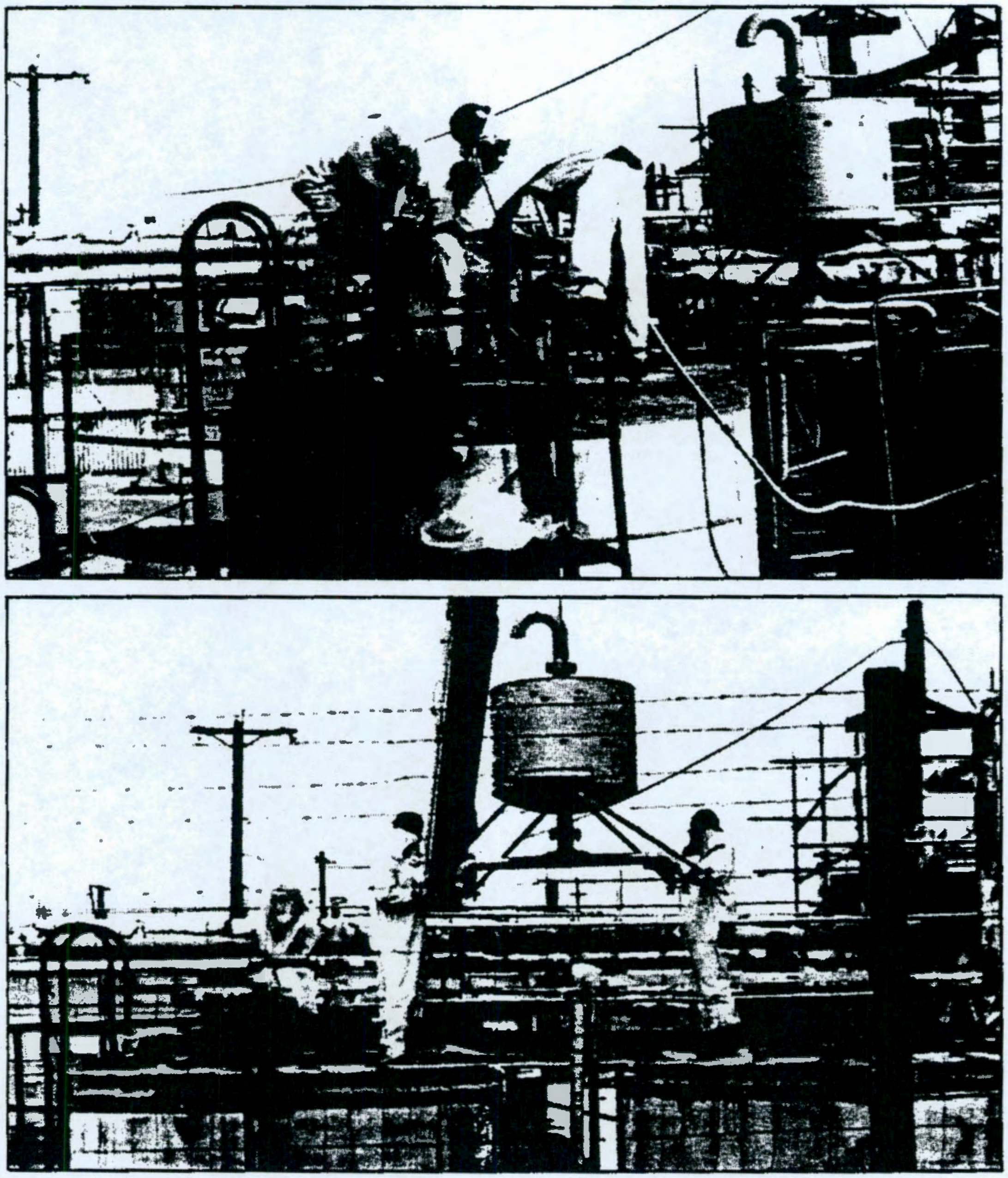


FIGURE 13. Cutting Piping (top) and Removing the Vent Filter (bottom) at 203-S.

## PIPING AND UTILITY REMOVAL

The D&D workers removed a large volume of piping and miscellaneous small equipment such as pumps, agitators, platforms, filters, and electrical systems as the first stage of the 203-S effort. All of this auxiliary equipment was wrapped in plastic and buried (Fig. 13 and 14).

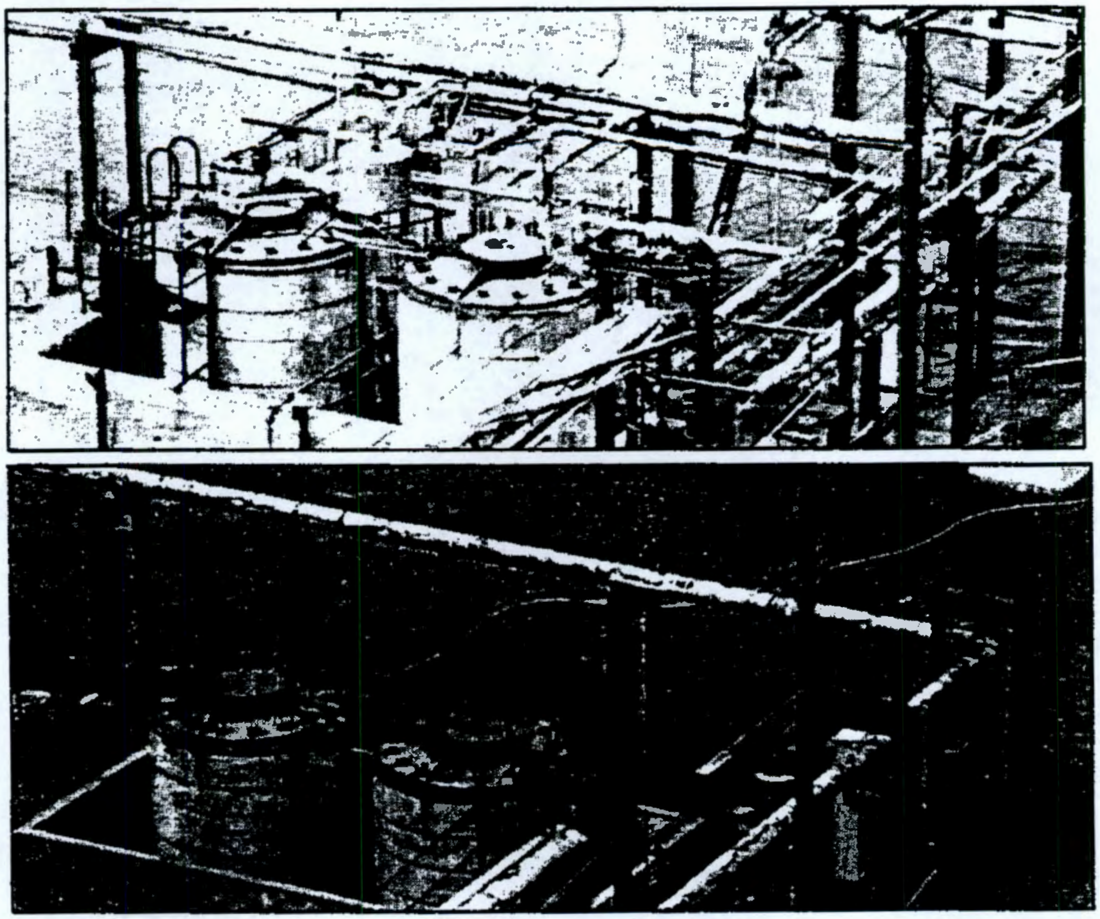


FIGURE 14. The 203-S Area Before and After Piping Removal.

## TANK SALVAGE

The excellent condition and low level of contamination (uranium) of the two 5,000-gal stainless steel tanks made regulated salvage a practical option. Following the removal of all piping and accessories, a "greenhouse" was installed over the basin for removing the uranium-soaked lagging. Both tanks had been grouted into their base pads during construction, and D&D workers used jackhammers to free the tanks within the confines of the greenhouse enclosure (Fig. 15). A hole was punched into the sump floor

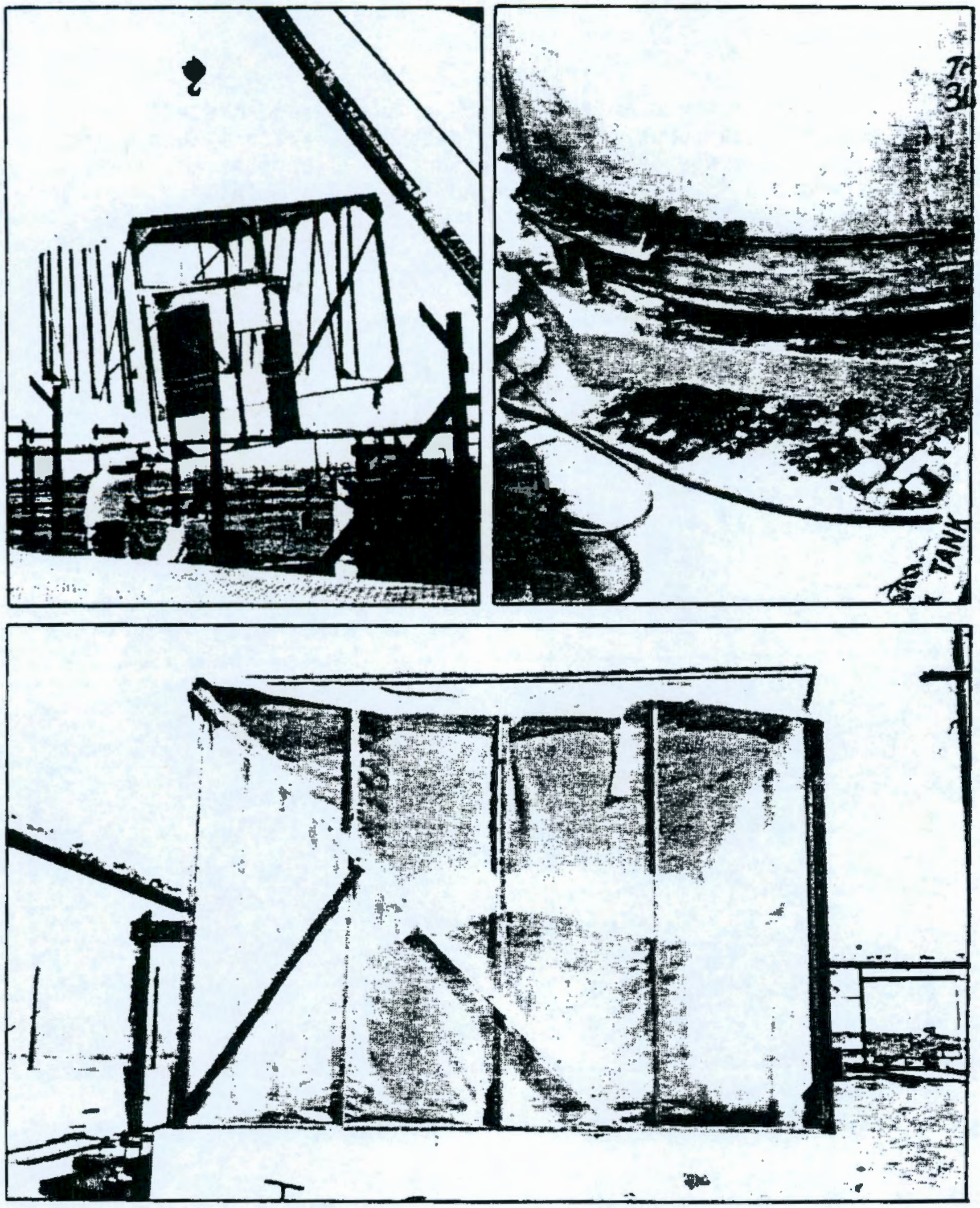



FIGURE 15. Lagging and Concrete Removal at 203-S. Hoisting the prefabricated greenhouse into position (top left); the completed greenhouse in place for controlled stripping of uranium-soaked lagging and concrete (bottom); the tank bottom after using the jackhammer on the grout seal from the lower 12 in. of the tank side (top right).

preventing any chance of future liquid accumulation. Following thorough external decontamination and sealing of the tank openings, the greenhouse was removed and a crane and rigging crew hoisted the tanks out of the pit to a tractor trailer (Fig. 16). The vessels are currently stored in the regulated spare equipment yard in the 200 West Area and are awaiting potential users.

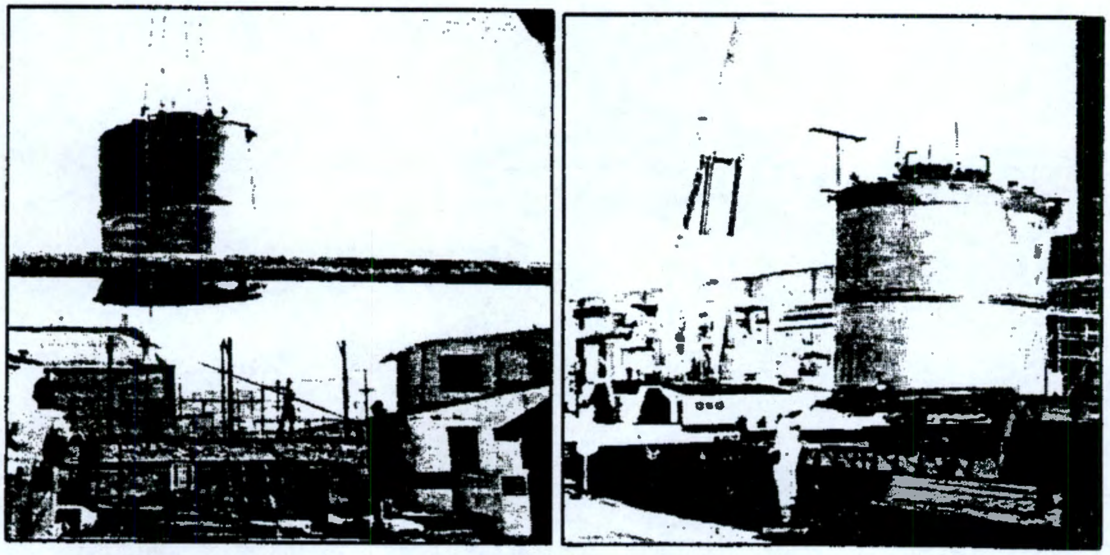


FIGURE 16. Hoisting a Decontaminated Vessel out of the 203-S Basin.

BACKFILL

The 203-S Basin was backfilled to the top of the concrete walls with gravel and soil (Fig. 17). Final backfill was left for the 203-S, 204-S, 205-S site fill-and-grading operation at the close of the project.

FIGURE 17. The 203-S Basin After Filling with Compacted Soil.

## DISMANTLING AND SALVAGE OF 205-S

The 205-S facility consisted of an underground concrete process vault and an aboveground chemical makeup and control building (Fig. 18). The 205-S Building was razed down to its concrete base pad, and the vault was stripped of equipment and filled with gravel and concrete. Both structures received a final concrete cap.

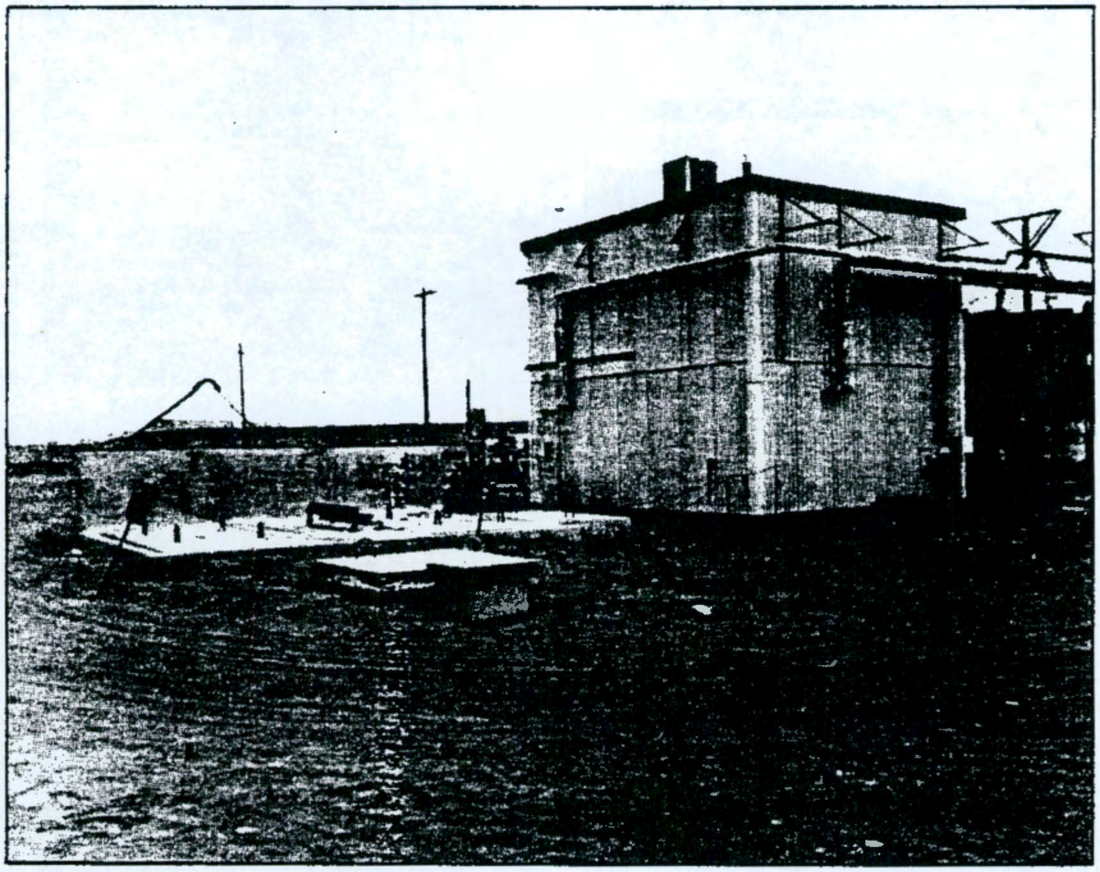


FIGURE 18. The 205-S Vault and Chemical Makeup Building. The underground vault is at left. Concrete cover blocks seal the top of the vault. The concrete shielding wall behind the vault was designed to protect workers during remote cell work. The chemical makeup building, at right, housed two chemical tanks, the control facilities for the 205-S system, and a separately ventilated and filtered Uranium Nitrate Hexahydrate line from Redox, which can be seen entering the sample room just above the door.

## PRELIMINARY LIQUID REMOVAL

Inspection of the 205-S Building and Vault revealed that the two chemical makeup tanks in the building were empty, but the process vault contained a substantial amount of accumulated liquid, most likely rainwater that drained though the cracks in the cell cover blocks. A submersible electric pump was installed in the vault, and the low-level contaminated liquid was pumped into a tank truck designed for hauling this type of waste (Fig. 19). The liquid in the ion exchange column and the neutralizer tank was transferred into the truck in a later operation. All liquid wastes were transported to the double-shell underground waste Tank 241-SY-102 for evaporation and solidification in the tank farm system.

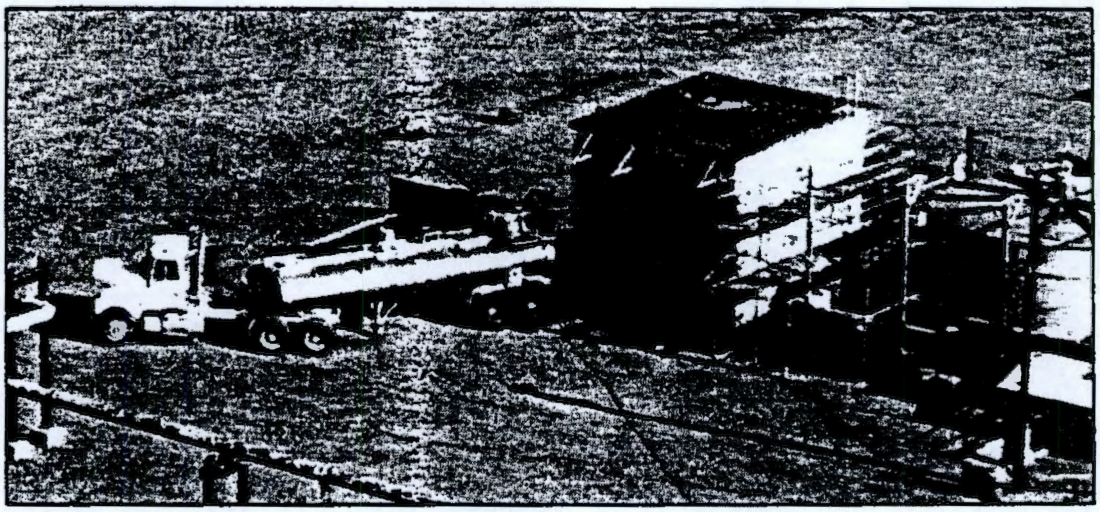


FIGURE 19. Pumping Water out of the 205-S Vault into a Regulated Tank Truck.

## DISMANTLING OF THE 205-S BUILDING

The 205-S Building consisted of a structural steel framework with asbestos-cement siding. A 2,750-gal chemical makeup tank occupied the center of the structure, with a steel mezzanine surrounding the top of the tank. A small caustic makeup tank was mounted on the floor. A separate UNH sample room occupied the northwest corner of the structure and contained equipment for drawing samples from the UNH pipelines and the process vault. Initial dismantling operations removed the extensive piping system in the building and disposed of all small structures, including the overhead hoist, sample room, and mezzanine. The caustic tank was salvaged and transferred to Z Plant for reuse. All underground pipelines leaving the building were sealed with pipe caps, flanges, or wooden plugs and were later covered with cement during the grouting operation. The structure was taken down in large sections for burial, and the chemical makeup tank was salvaged (Fig. 20 and 21).

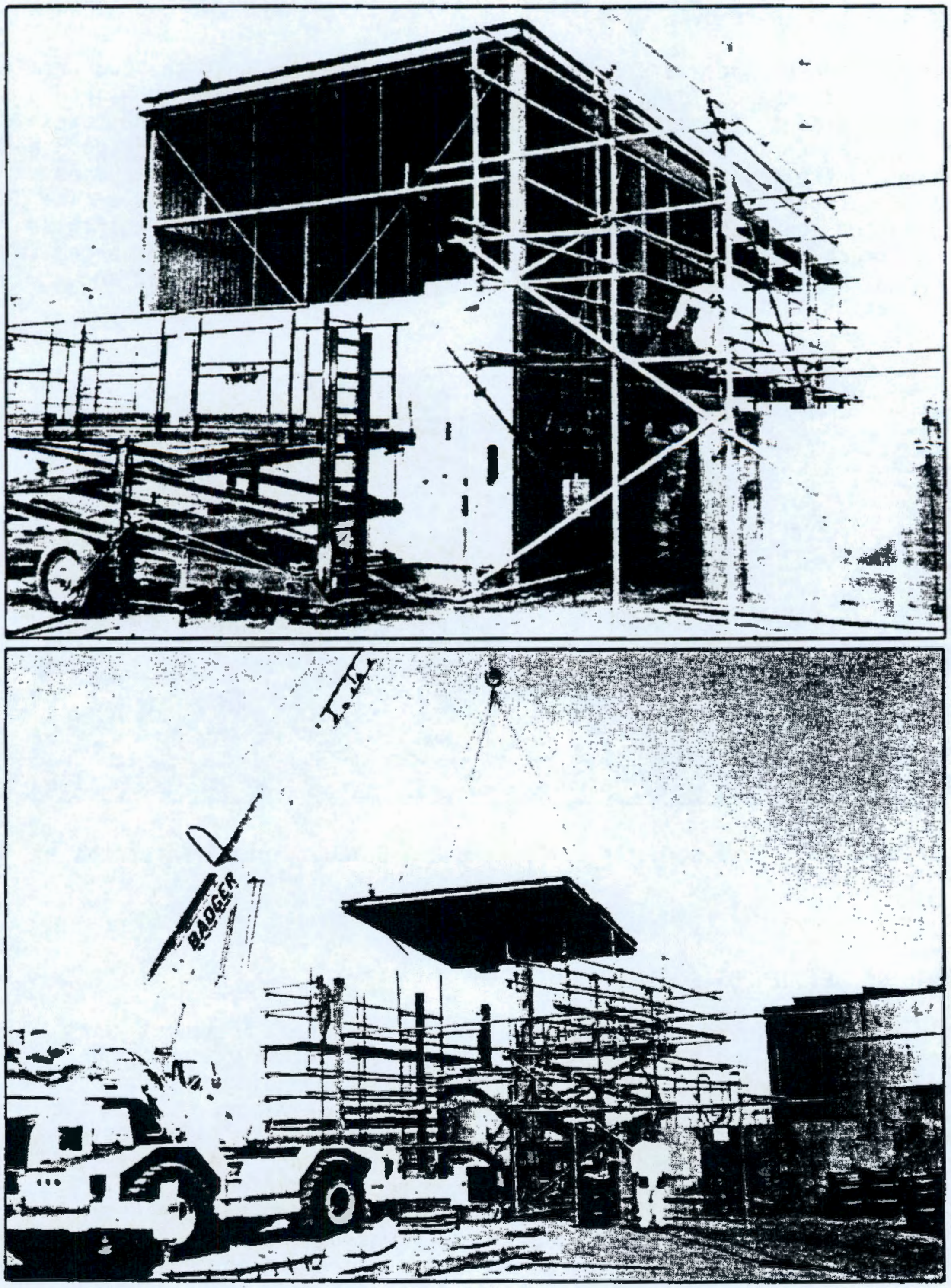



FIGURE 20. Removing Asebestos-Cement Siding Panels and Roof from the 205-S Building.

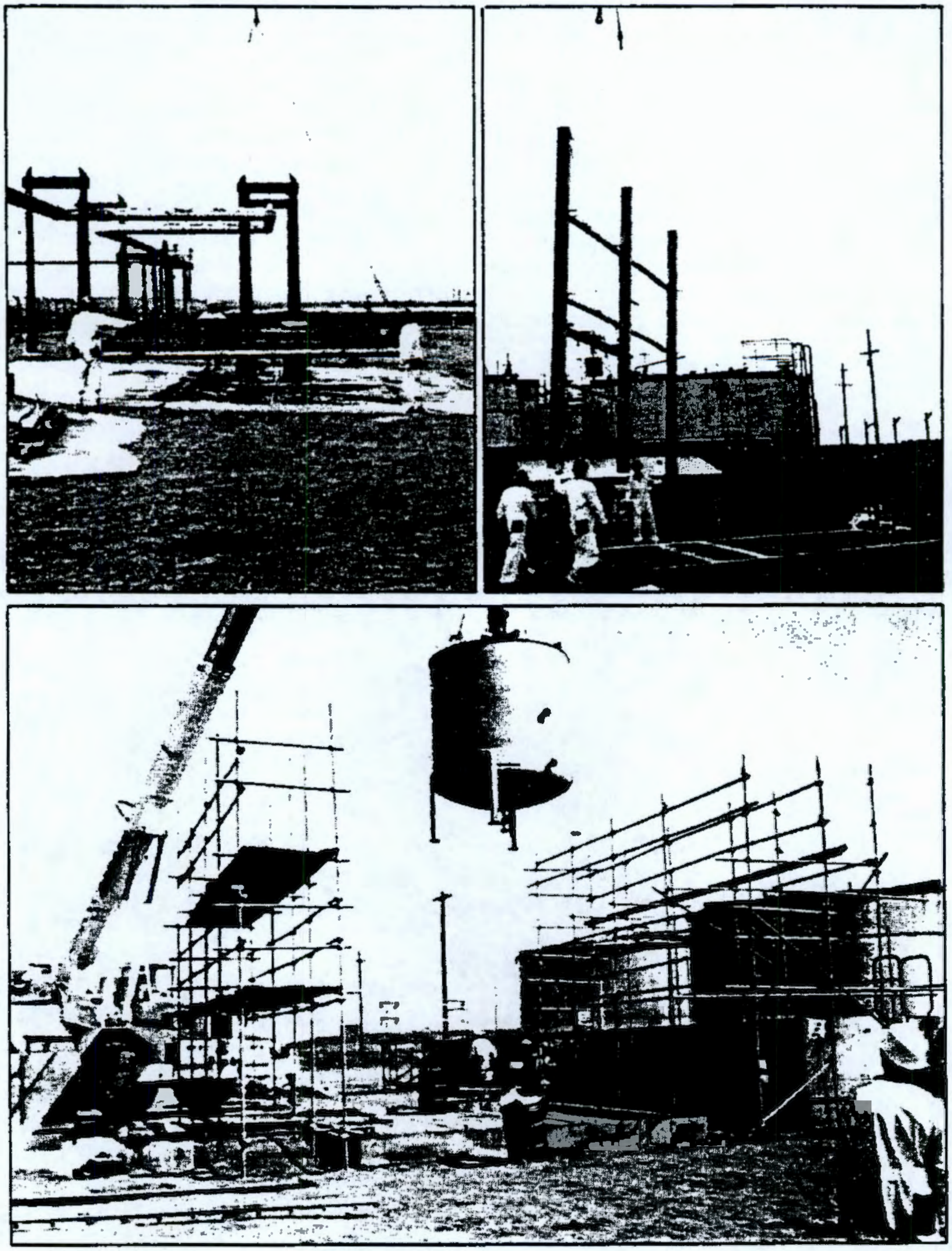


FIGURE 21. Final Dismantling Operations at 205-S. (Clockwise from left) lowering the roof onto a plastic sheet; hoisting sidewall frame sections; and lifting the chemical tank from the building pad.

DISMANTLING OF THE 205-S VAULT FACILITIES

The 205-S Process Vault consisted of the process vault proper, a concrete valve pit, and a ventilation/filter pit. The valves and piping were removed from the valve pit, and the ventilation/filter pit was filled with soil. Equipment in the process vault was completely stripped. The jumpers connecting piping and utilities to the process equipment were removed with a crane and remote impact wrench (Fig. 22). The agitator was removed from the neutralizer tank and the tank contents were pumped into the liquid waste tank truck using the submersible pump. The neutralizer tank and the ion exchange column were then thoroughly washed down to remove built-up external dirt and contamination (Fig. 23).

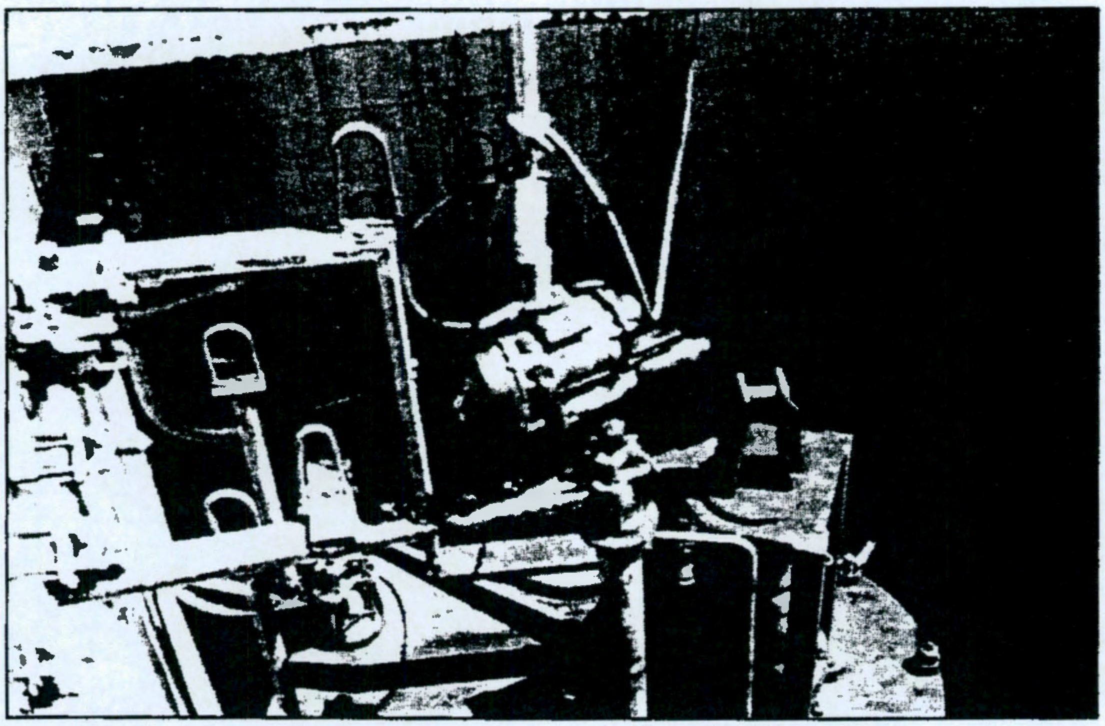


FIGURE 22. Jumper Removal from the 205-S Vault. The remotely operated impact wrench (top) was used to disconnect jumpers.

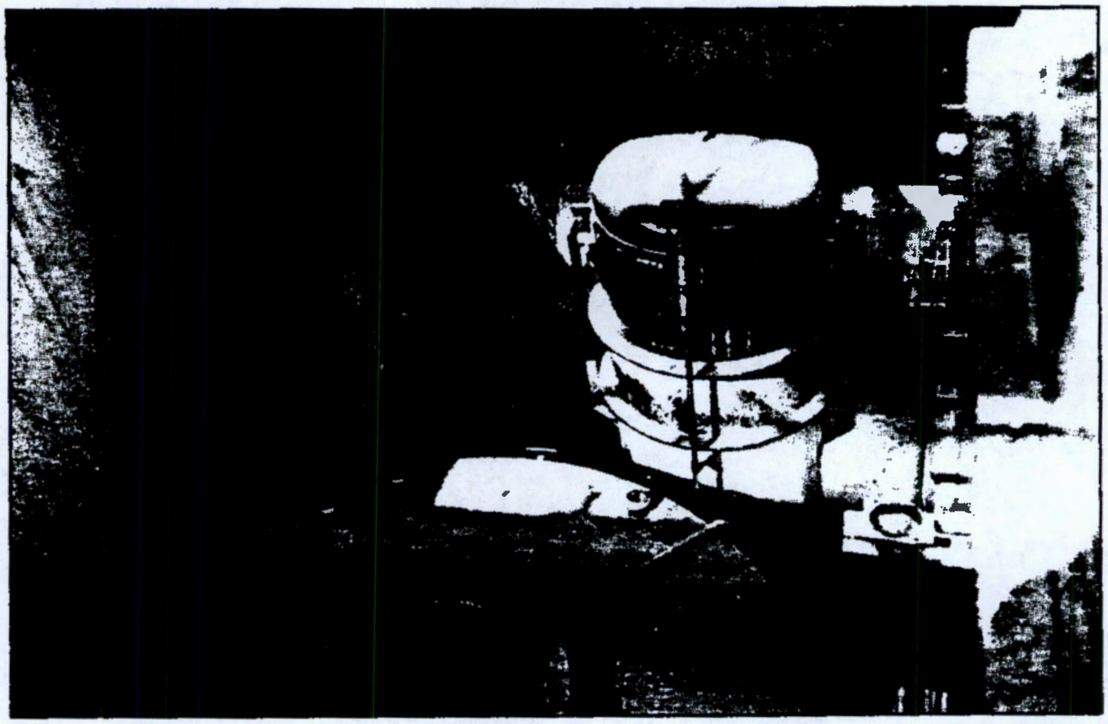
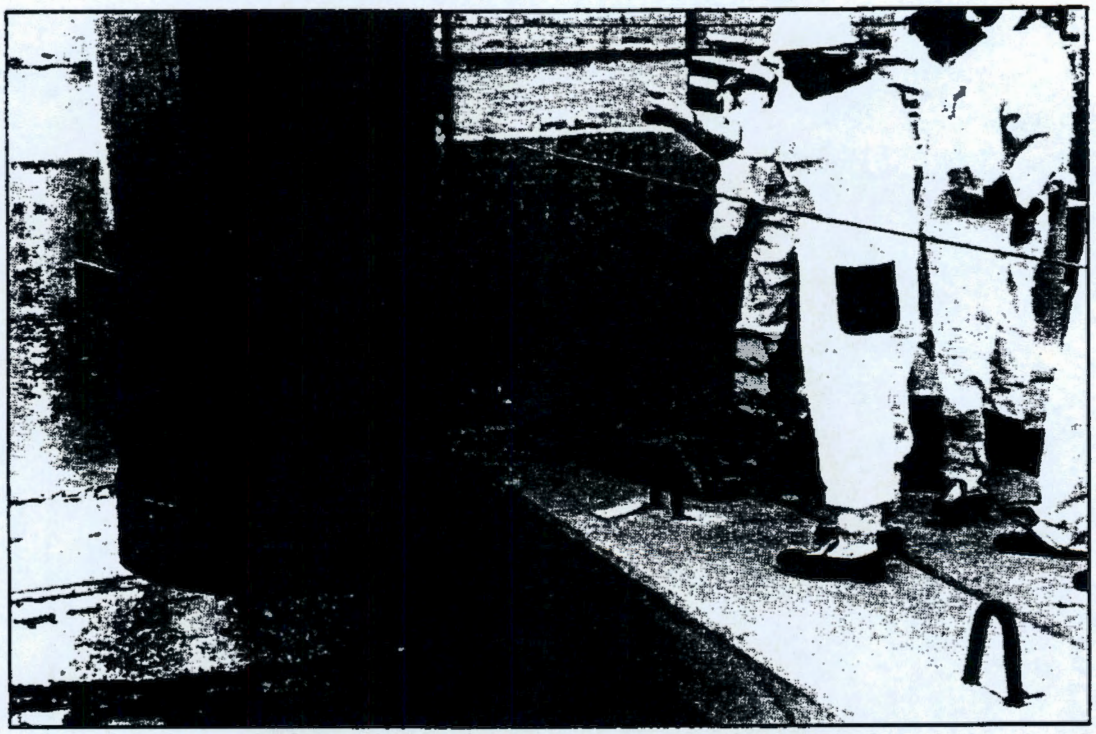


FIGURE 23. The 205-S Vault After Jumper and Other Equipment Removal and Washdown of Exposed Surfaces. The silica gel column is at top and the open neutralizer tank is in the lower part of the photograph.

The SG-1 Silica Gel Column was drained by lifting the column to grade level, installing a valved tee on a side-entering pipe with an explosive-activated self-fastening fitting, and dropping the contents to the cell floor (Fig. 24). The drained column was then removed and wrapped in plastic for burial. The neutralizer tank was sprayed with a fixative and loaded on a truck for storage in the regulated spare equipment yard and potential reuse in another Hanford facility. As a final operation, the cover blocks were placed into the bottom of the vault, the shield wall was demolished with a wrecking ball, and backfill was dumped into the vault to just below the level of the wall pipe nozzles (Fig. 25-27). A 1-ft-thick concrete pad was poured to thoroughly seal all nozzles. More backfill completed the fill to grade level. A final concrete pad was poured over both the vault and the 205-S Building floor to further preclude any future water or animal entry into this area (Fig. 28).



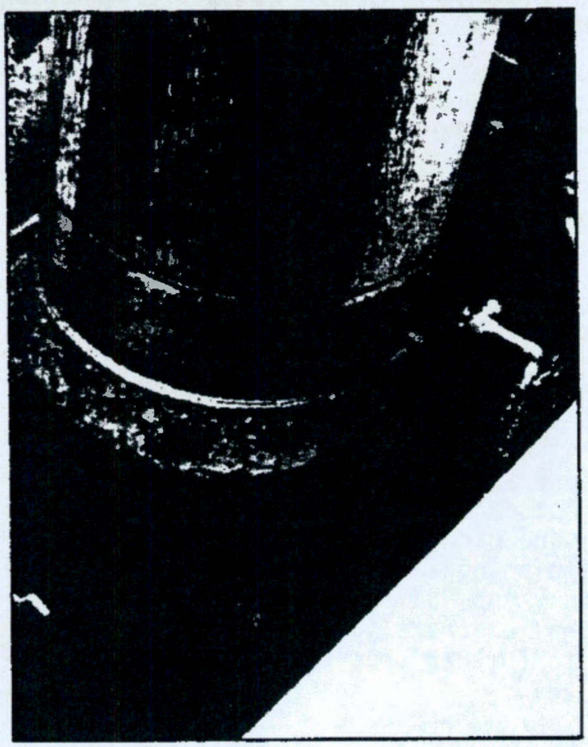


FIGURE 24. Draining the Silica Gel Column. The column was raised with a crane to grade level and an explosive-activated tee was clamped to the pipe (above). The column was then lowered part way back into the vault, and the tee was breached into the pipe by activating the tiny explosive charge in the fitting.

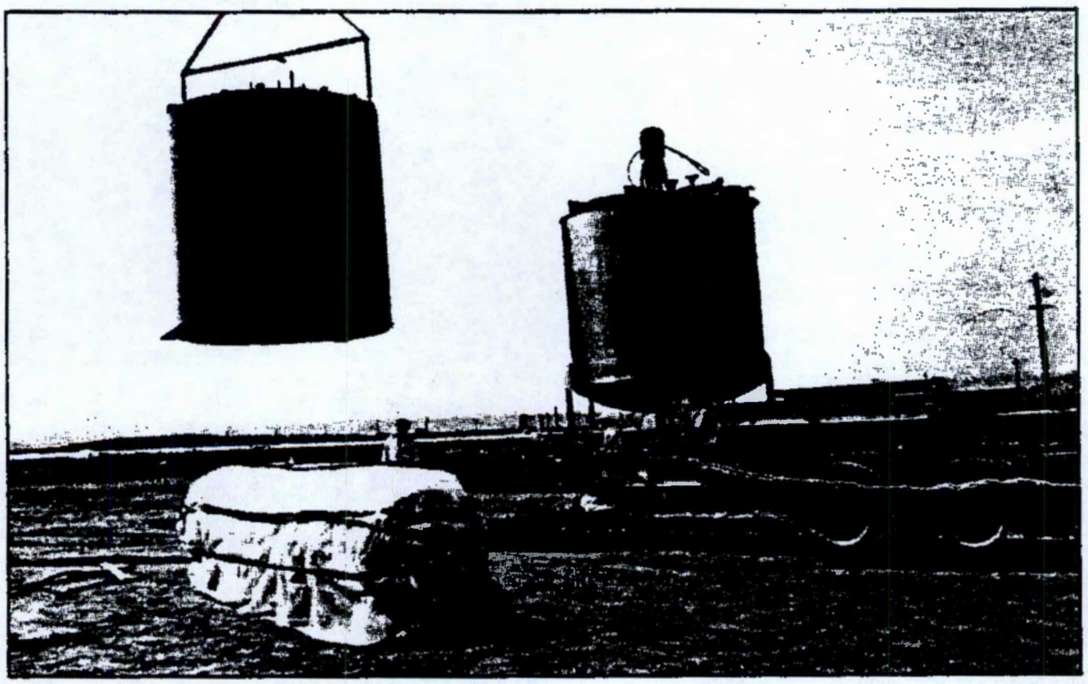


FIGURE 25. Placing the Neutralizer Tank on the Trailer for Hanford Salvage. The 2,750-gal chemical makeup tank was already on the trailer, while the silica gel column was wrapped for burial and separate transport.

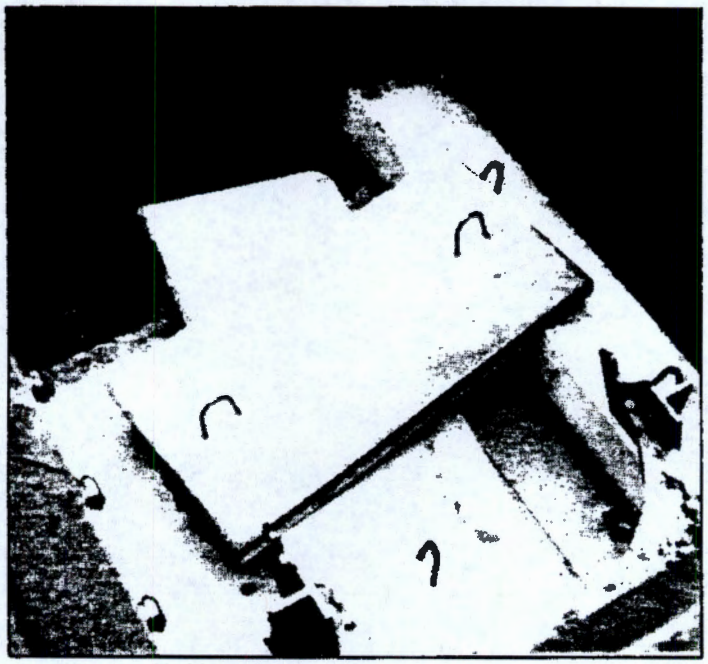


FIGURE 26. Cell Cover Blocks in Bottom of Vault. The cover blocks were placed into the cell as the first stage in the total fill of the cell with soil and concrete.

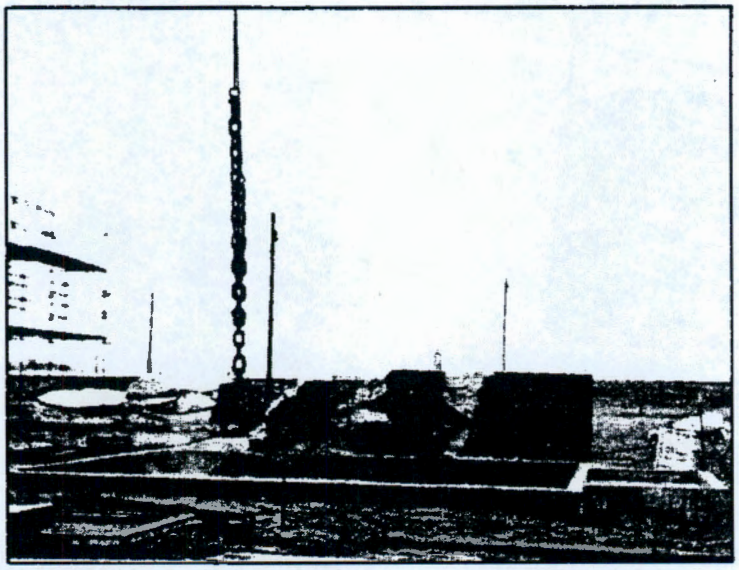


FIGURE 27. Demolishing the Shielding Wall with a Wrecking Ball. Debris was knocked into the vault.

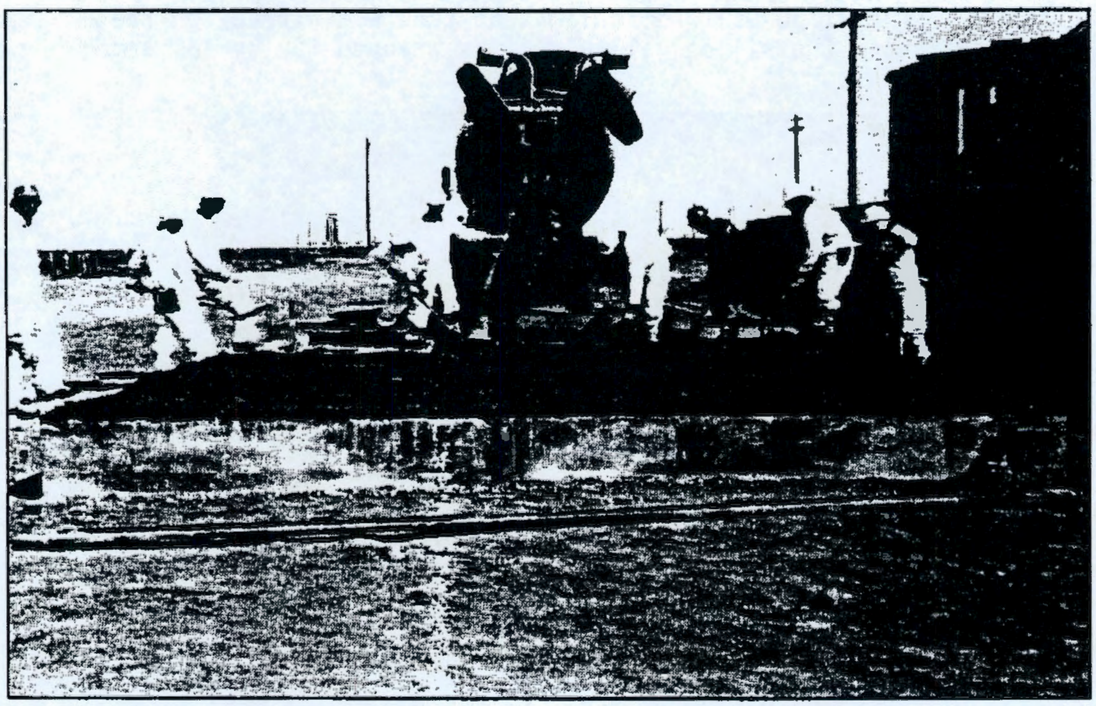


FIGURE 28. Pouring Concrete Over the 205-S Building Base Pad. Both the pad and the vault received a cover of concrete to assure a permanent seal over all piping in the system.

## DISMANTLING AND BURIAL OF 204-S

The 204-S decontamination, dismantling, and burial operations presented the most difficult tasks of the D&D project. The 204-S facility (Fig. 29) contained by far the largest vessels to be disposed of, and also held more than 99% of the radioactive fission products stored in the 203-S, 204-S, 205-S complex. The bulk of these fission products were contained in one tank: 204-S-4. Although various in situ dismantling and burial options were considered, the decision was made to sluice the bulk of the radioactive sludge to the tank farms, and to haul the tanks to the burial ground.

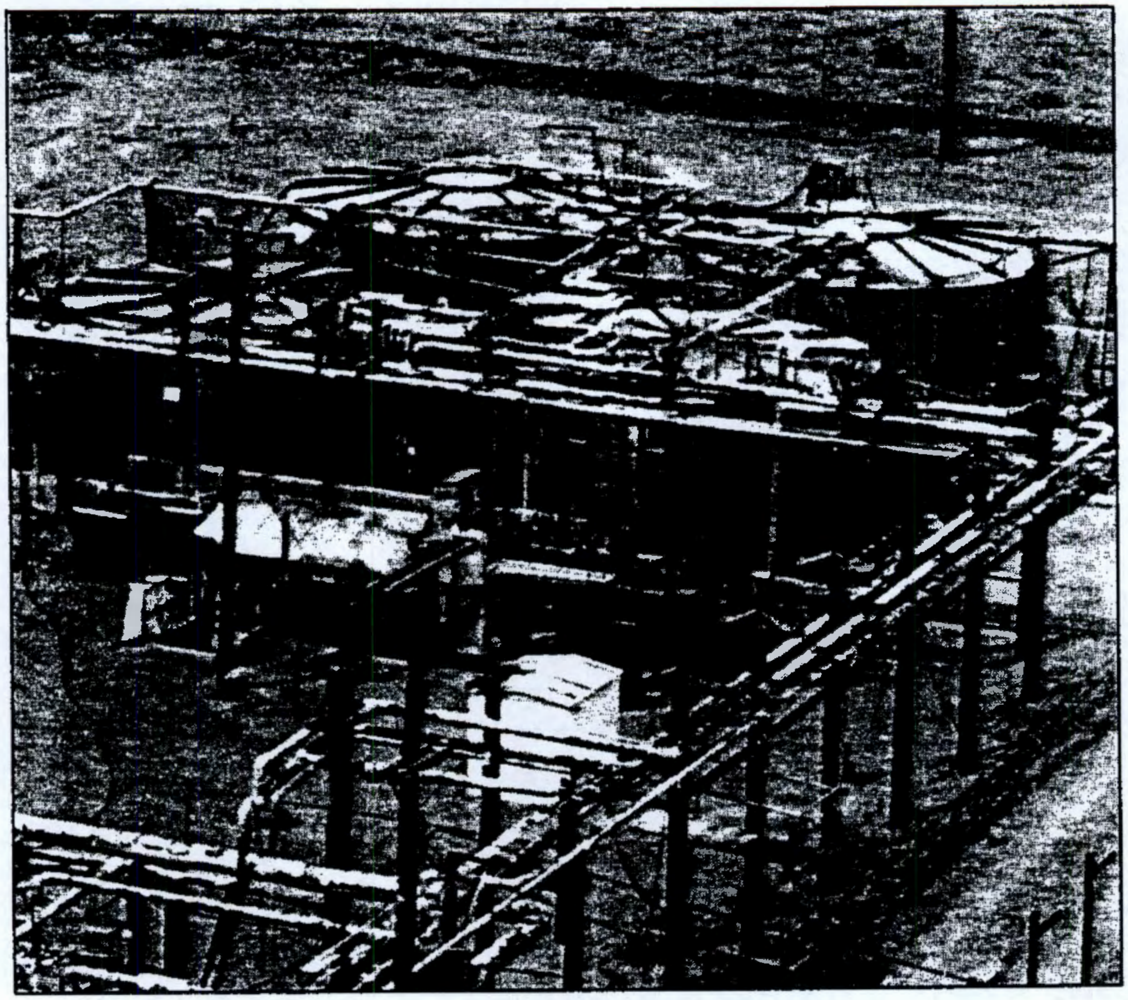


FIGURE 29. 204-S Tank Farm. The tanks were set in two concrete basins. The pumphouse for the facility is in the lower center of the photograph.

## SLUICING TANK 204-S-4

The sluicing operations carried out during the pre-D&D shutdown/standby phase removed the bulk of the sludge in the four 204-S tanks and left all but Tank 204-S-4 in a transportable condition with a solids heel of 1 ton or less. In spite of an extensive sluicing effort directed toward Tank 204-S-4, the tank still contained 10-12 tons of heavy sludge when sluicing operations were terminated due to lack of progress. The sludge buildup in the tank consisted of old sludge waste frcm N Reactor decontamination work and from 300 Area laboratory and process wastes. Radiation levels along the bottom foot of the tank ranged from 3-5 rem/h at contact. Removal of this sludge material was essential for transport of the tank, as engineering calculations indicated that an internal tank load of more than 2 tons could lead to unacceptable stresses in the welds joining the tank bottom to the side. The laboratory tested samples of the sludge material and found that although no practical means of chemical sludge dispersion or dissolution was available, a significant amount of sludge softening could be obtained with hot water. Consequently, Process Engineering, Tank Farm Operations, and Production Support (maintenance) worked out a hot water sluicing system, consisting of a high pressure hot water pump and the commercial tank cleaning machine (Fig. 30 and 31) used in earlier operations.

With utilities shut down in the 204-S area, a considerable quantity of support equipment was required (Fig. 32), including the following:

- A diesel-driven generator for the hot water pump
- A fuel trailer for the diesel generator
- A 7,000 $ft^3$/min HEPA-filtered portable exhauster for venting the tank
- Two gasoline-driven portable generators for lighting and operating the exhauster
- An air-driven diaphragm pump for transferring the slurry to the tank farm
- A gasoline-driven air compressor for operating the slurry pump.

Hot water (180-200°F) was loaded into tank trucks at the 200 West Steam Plant and hauled to the site. A 1,000-gal and a 10,000-gal truck operated in relays to maintain operating continuity. The very heavy nature of the sludge made it necessary to cut two new openings in the tank top to allow moving the sluicer to new positions as sluicing progressed. A typical sluicing pattern is shown in Figure 33.

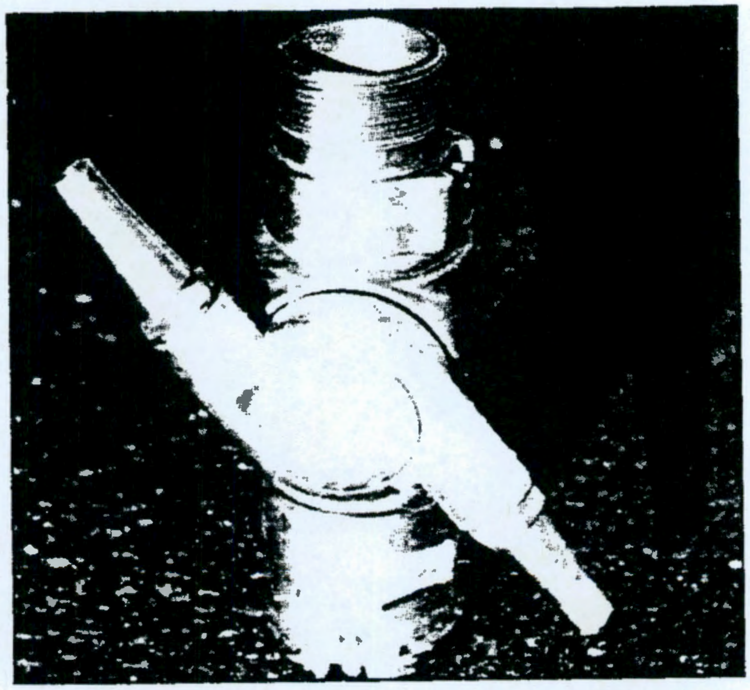


FIGURE 30. Tank Cleaning Machine. A commercial tank cleaning machine was used for sluicing the 204-S Tanks. The machine contains a water-driven turbine and gear box that rotate the nozzles as well as the body of the machine in a 360-degree pattern.

FIGURE 31. Sluicing Support Equipment Outside the Tank. A large array of equipment was required for hot water sluicing, including the high-pressure pump, portable motor starter, diesel generator, and fuel trailer in the foreground. The 7,000-$ft^3$/min Portable Exhauster (left center) was used to draw vapors from the tank and to maintain a vacuum in the vessel.

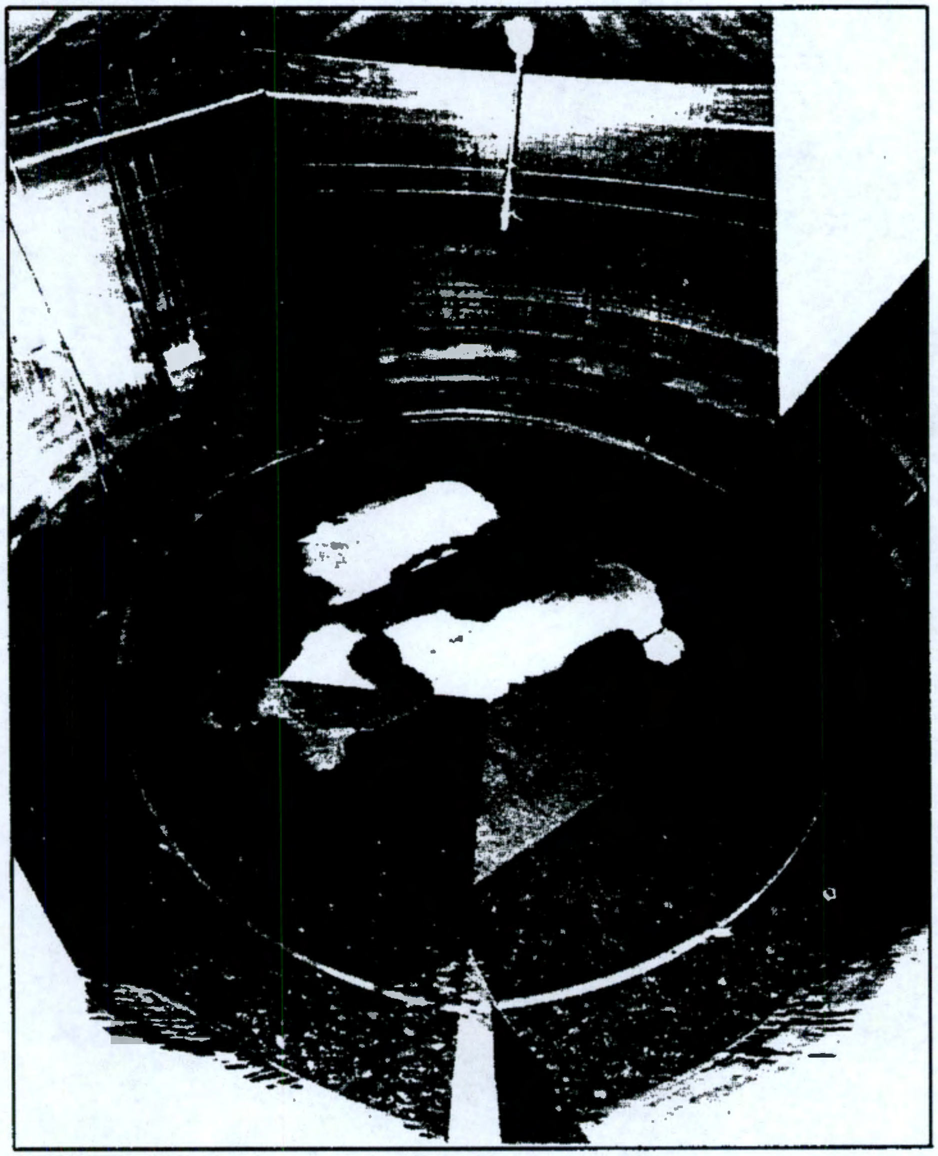


FIGURE 32. The 204-S-4 Tank Near the End of Sluicing Operations. Note the tank cleaning machine (sluicer) extended through a roof penetration. In this photograph, the tank has been pumped out for sludge level evaluation and areas of clear tank bottom are visible.

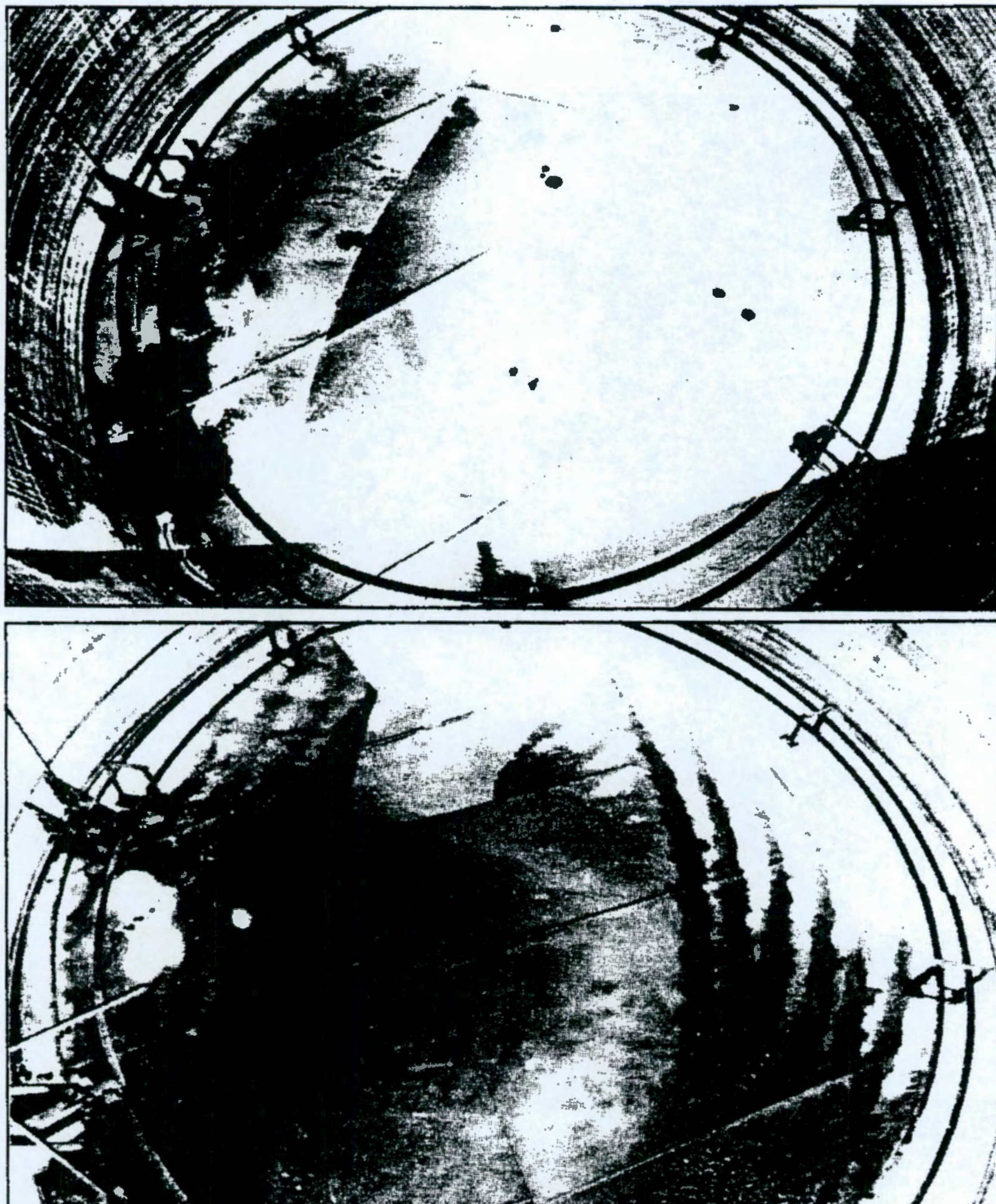


FIGURE 33. Sludge Removal from Tank 204-S-1 (before and after). Note the sludge removal pattern from a single location with an automatic sluicer and the development of a cross-hatch sluice pattern with increasing distance from the sluicer in the 25-ft diameter vessel. Three sluicer positions were required to remove the bulk of the heavy sludge.

The hot water sluicing operation successfully removed more than 90% of the sludge heel. Sluicing was terminated when liquid level, sludge level, and photographic data indicated that the 1-ton level had been reached and that the sludge was relatively evenly distributed in the tank. Approximately 113,000 gal of hot water were used in the operation. The large volume of water was required by the intermittent nature of the sluicing operation (i.e., overnight cooling due to one- to two-shift per day staffing) and by the heavy consistency of the sludge.

## THE 204-S TANK LIFTING PREPARATIONS

The four 50,000-gal 204-S tanks were by far the largest and heaviest equipment items transported to the burial ground in this D&D operation. The tanks were welded stainless steel vessels 25 ft. in diameter, 17 ft. in height, and made up from 1/4-in. and 1/2-in. plates. The weight of each vessel, when empty, was 12.5 tons. A special six-point spreader bar and six lifting clamps were designed for safe lifting of the tanks. The lifting clamps gripped the underside of the slightly overhanging tank roof and were also bolted to the tank wall by means of six pairs of tabs welded to the side of each vessel. However, before the tanks could be lifted they had to be chipped free from their base pads in the basins.

## CONCRETE CHIPPING

Two of the tanks, 204-S-1 and 204-S-2, were placed with a 2-in. cover of grout extending over the lip of the tank base plates. This material was readily chipped away with a jackhammer. A considerably greater problem was presented by the drain lines of the 204-S-3 and 204-S-4 Tanks. Each drain line traveled through several feet of hard concrete and had to be laboriously chipped out. After several trials the most effective chipping method evolved. The jackhammer was suspended from a pulley system attached to the top of the tank which guided the jackhammer into the concrete mass (Fig. 34). Lead plating was attached to the side of the 204-S-4 Tank to protect workers from the 2-3 rem/h radiation level on the outside surface of the tank. Once a proper system of rigging the jackhammer was achieved, the concrete removal work proceeded rapidly and was completed without excessive radiation exposure to personnel.

## TANK TRANSPORT

Rail and highway options were explored for transporting the tanks to the burial ground. Although a suitable railroad flat car was available, inadequate clearances at one steam line crossing ruled out the rail alternative.

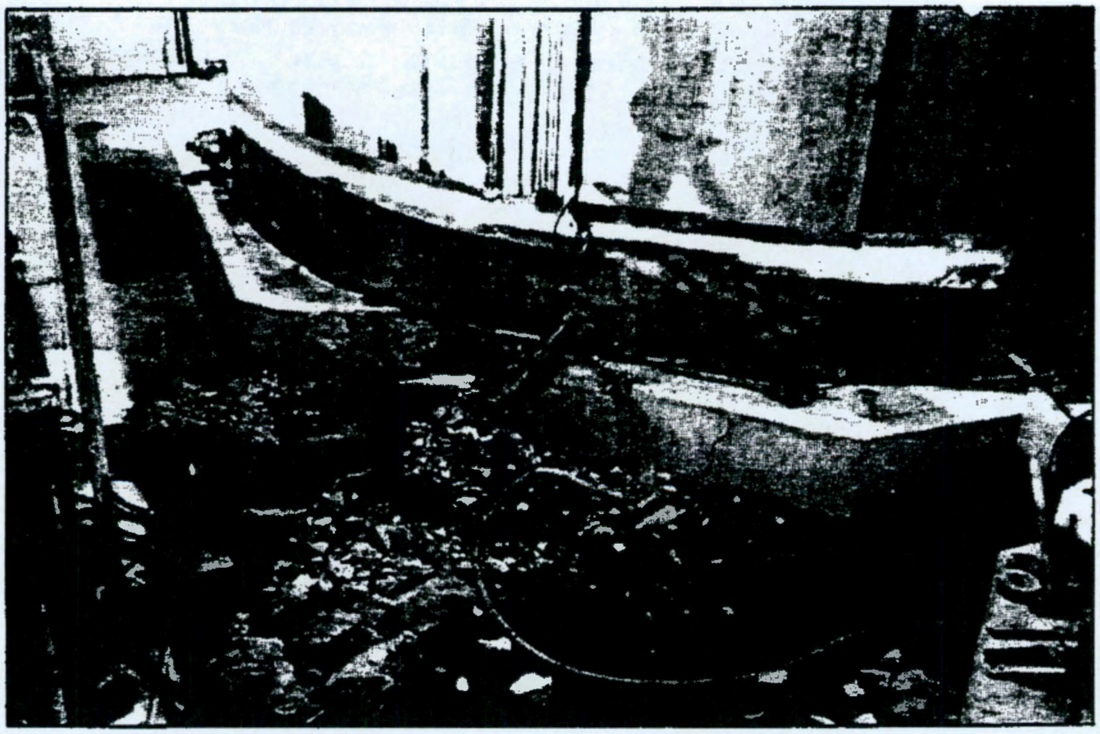


FIGURE 34. Using a Jackhammer to Remove the Tank Drain Line from the Concrete Tank Pedestal. Note the lead sheeting taped to the tank wall to reduce radiation exposure to the jackhammer operator.

Similar clearance problems existed with truck transport, but these problems were more amenable to a cost-effective solution. The route finally selected required construction of a new haul road across a 10-ft-deep section of the Redox railroad cut, and regrading of an abandoned section of road leading to the $UO_3$ Plant, where a paved roadway could be utilized for most of the remaining trip to the burial ground. Numerous wires had to be raised to provide sufficient clearance, and a line crew accompanied each shipment. A final section of regraded dirt road completed the route. The 35-ft-deep burial trench was specially designed to accept the 204-S tanks, although it was made large enough to accept numerous other bulky waste shipments in the future.

The tanks were loaded with a 100-ton capacity crane onto a 100-ton capacity, 13-ft-wide trailer (Fig. 35).

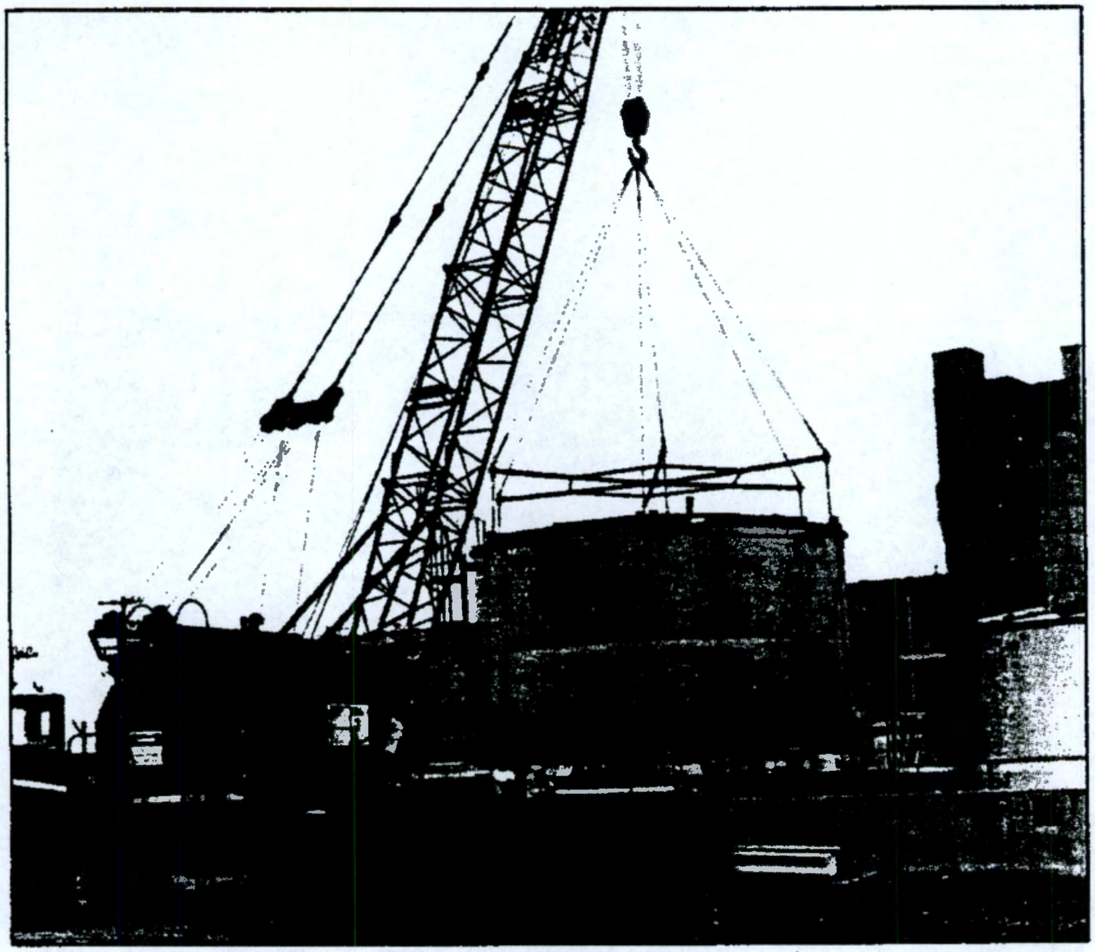


FIGURE 35. Hoisting a Tank out of the Basin with a Crane and Special Six-Point Spreader Bar.

As each tank was picked up, the underside of the vessel was sprayed with a fixative to contain any loose contamination. The lower portion of the tank was wrapped in plastic and taped for transport (Fig. 36). The speed of the shipment was restricted to 5 mph and all road areas were barricaded to keep out other road and rail traffic (Fig. 37 and 38). In the burial ground, the tank was lifted off the truck, a shallow pit for the tank drain line was scooped out by a front-end loader, and the tank was set on the ground. The front-end loader immediately shoved 5 ft of soil against the tank wall to shield personnel from radiation emanating from the tank bottom (Fig. 39). The tank transport operation was carried out efficiently and was completed without mishap.

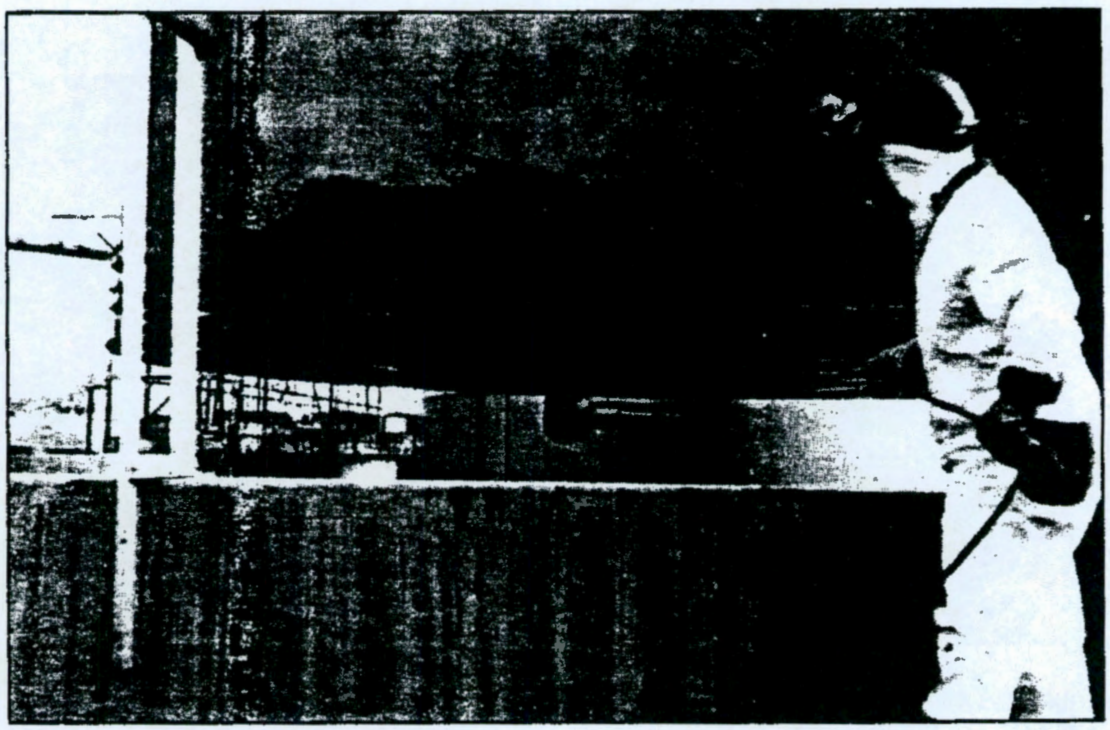


FIGURE 36. Spraying the Underside of a 204-S Tank with a Fixative.

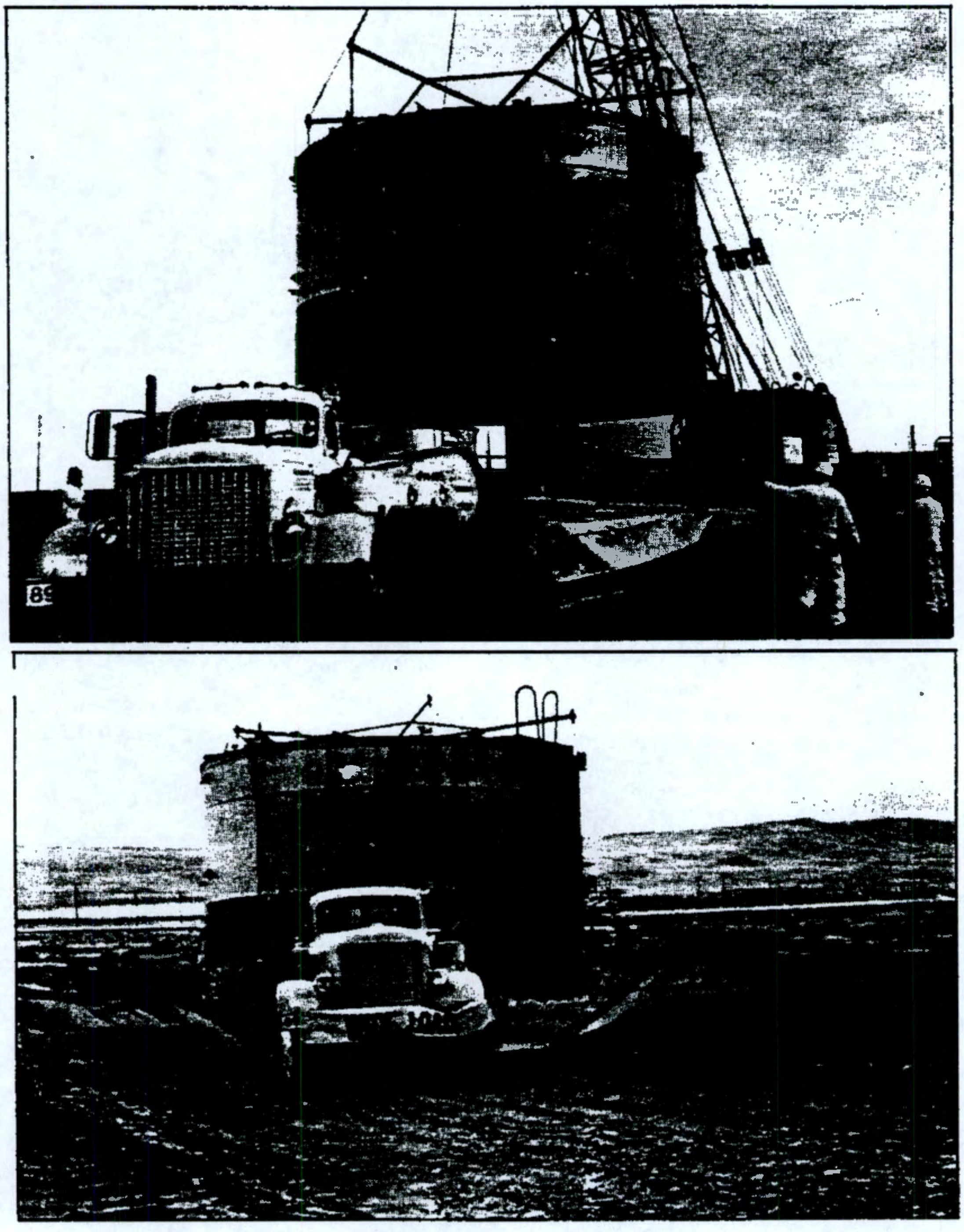


FIGURE 37. Placing the Tank on the 13-ft Wide, 100-Ton Capacity Trailer (top), and Driving Slowly on the Specially Built Haul Road Across the Redox Railroad Cut (bottom).

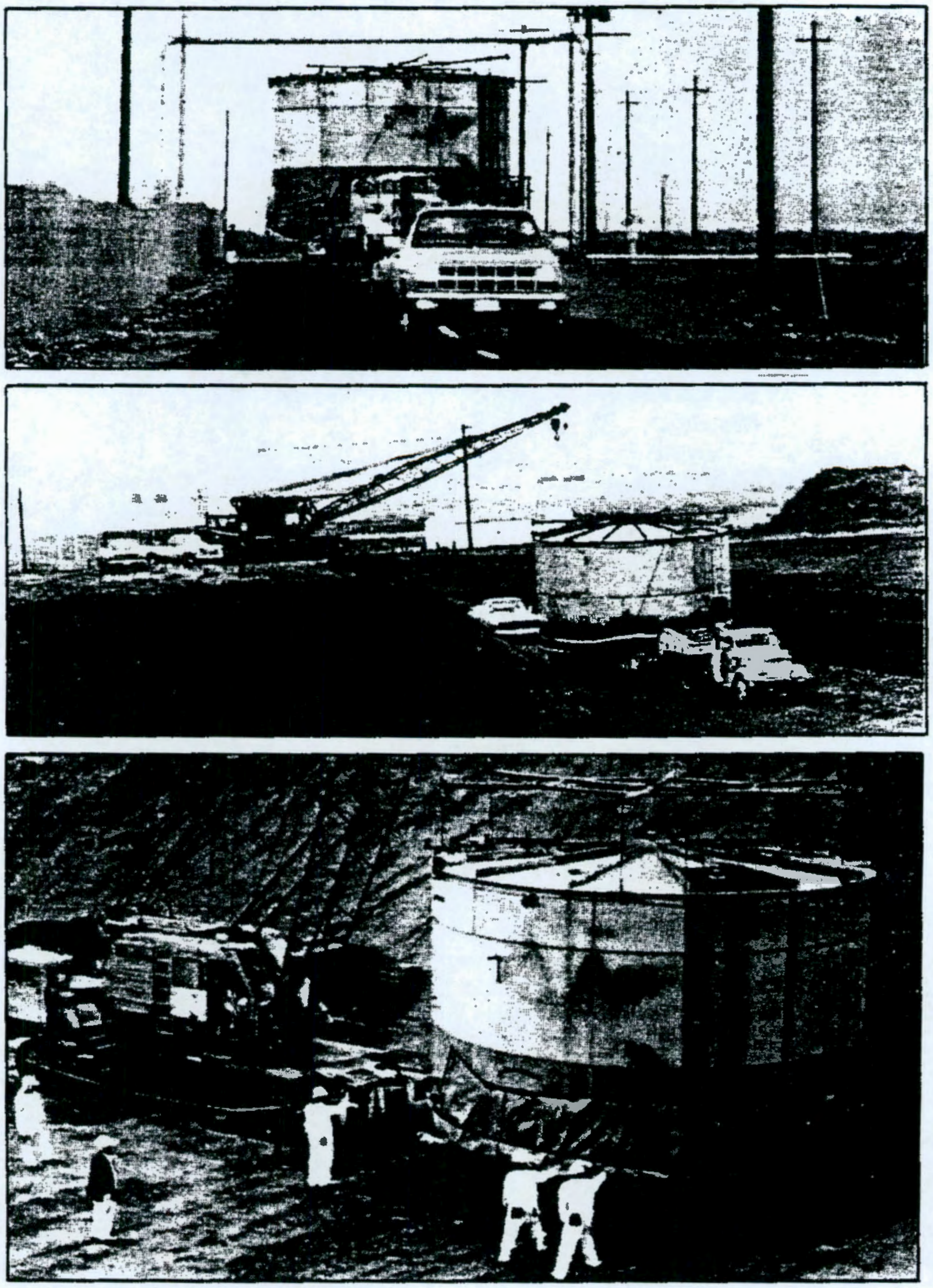
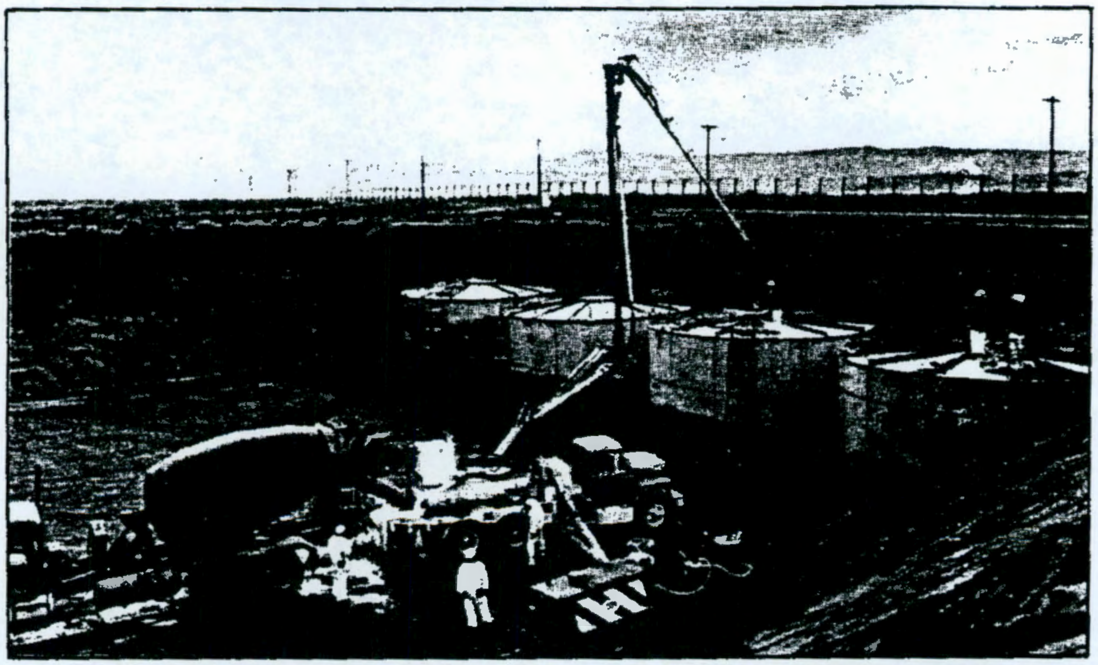


FIGURE 38. Transport and Unloading of a 25-ft Diameter Tank.

FIGURE 39. Backfilling Around Tanks with a Front-End Loader. Each tank received a preliminary 5-ft backfill to shield personnel from the radiation emitted by the sludge remnants, and to reduce stresses during internal fill.

TANK FILL AND BURIAL

Several options were considered for filling the tanks before final backfill and burial. Storage of other radioactive waste inside the empty vessels offered attractive incentives for efficiently utilizing costly burial space, but was ultimately rejected due to the high cost of cutting suitable openings into the tanks and the difficulties of providing adequate radiological controls during loading or dumping operations. The tanks were filled by pumping 6-12 in. of super-plasticized concrete into each vessel to seal floor contamination, and then adding sand on top of the hardened concrete (Fig. 40). New 6-in. holes were cut into the roof of each tank as needed to give each tank at least six sand-fill openings. Sand was transported from the spoil pile by front-end loader to a conveyor belt which could be positioned to reach fill openings. A hollow sand cone built up around each opening as sand drained into the tank, forming a natural funnel. This technique served to fill each tank to the roof. Although some void spaces necessarily remain in each tank, the tank roof is considered adequately supported to minimize the chance of future subsidence of the final 15 ft. of backfill. The tank section of the burial trench is presently fully backfilled to grade level.



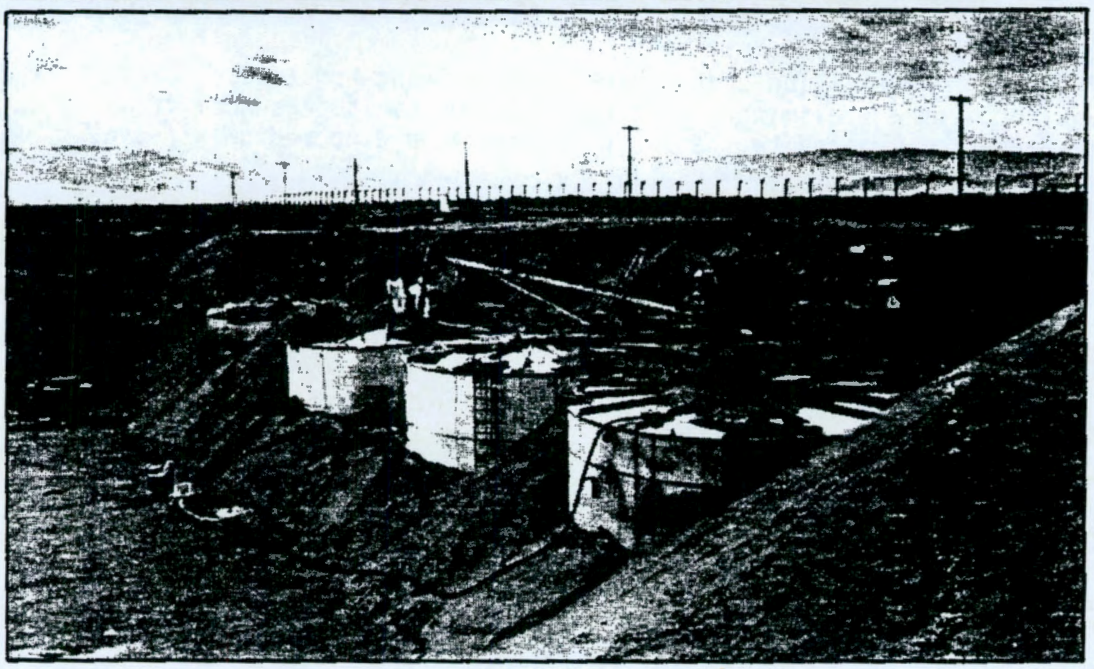


FIGURE 40. Filling the 204-S Tanks with Concrete and Sand. A concrete pumping truck (top) poured 10-20 yd of concrete into each vessel to seal the sludge remaining on the tank floors with a concrete cap. A front-end loader and conveyor belt then proceeded to fill the vessels with sand through six openings cut into the tank tops.

## REMOVAL OF TANK CAR DRAIN PAD AND RAIL SIDING

The tank car drain pad and the railroad track on either side of the pad were removed. The area had been the scene of several contamination incidents in the past and contained surface contamination. During the shutdown/standby phase, maintenance forces totally covered the drain pad with polyurethane foam to seal remaining contamination and to prevent the intrusion of rain water or birds and animals. The D&D workers proceeded with total dismantling by partially excavating the pad and piping, cutting the rails, and sealing the pipelines. The entire concrete pad was lifted out of the ground in one piece, wrapped in plastic, and trucked to the burial ground (Fig. 41 and 42). The railroad tracks were chipped out of the asphalt surrounding the 204-S area. Rails, ties, and contaminated soil were shipped to the burial ground.

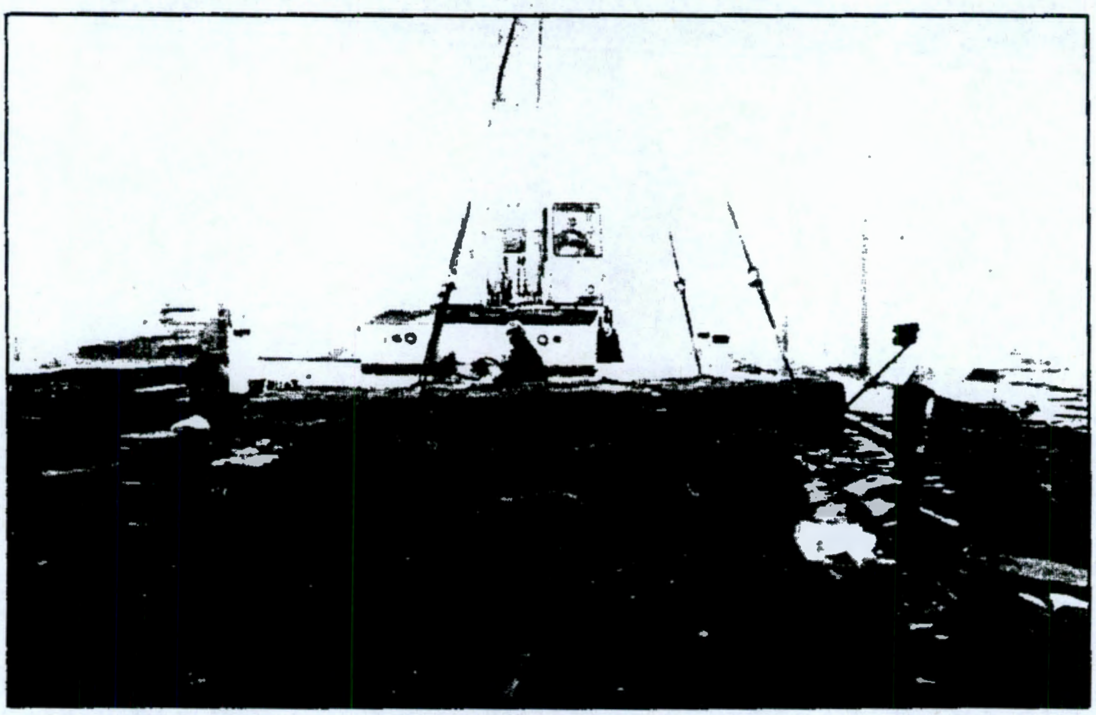


FIGURE 41. Lifting the Concrete Tank Car Drain Pad Out of the Ground.

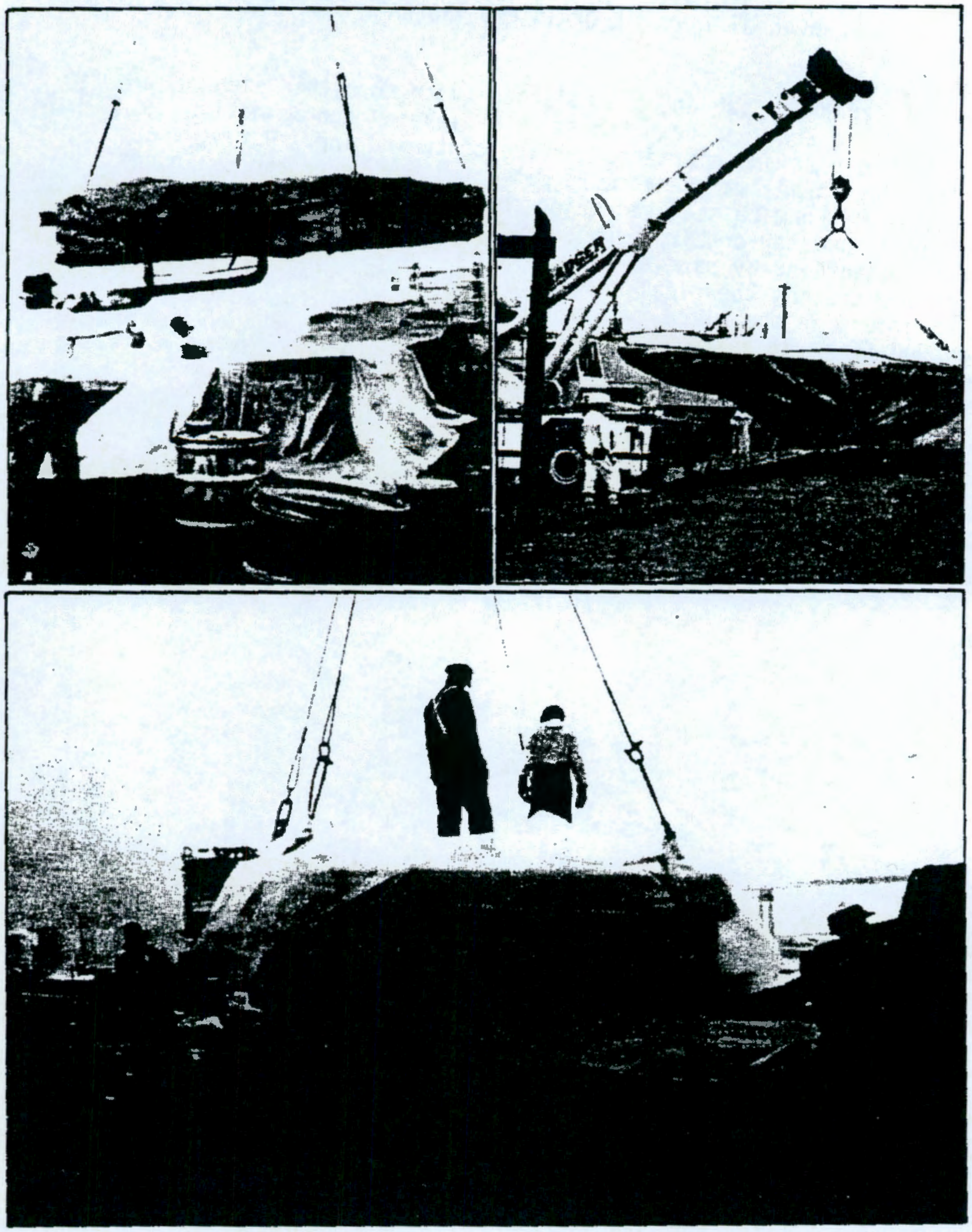


FIGURE 42. Plastic-Wrapping and Loading of the Tank Car Drain Pad for Transport to the Burial Ground.

## FINAL BACKFILL

Following transport of the 204-S tanks and rail equipment to the burial ground, the site was prepared for backfilling by carrying out several important preparatory operations.

- All surface contamination was removed from areas scheduled to receive less than 2 ft of clean backfill. This involved the removal of the top soil from much of the western half of the fenced site as well as from the railroad track area. About 30 $y^3$ of more highly contaminated soil were transported to the burial ground, while the remainder was pushed into the 204-S Basin remnants.
- All remaining open pipelines to the site were isolated. Isolation was carried out using the most practical available means: installing screwed caps and blank flanges, or cutting sections out of the line and pouring grout plugs.
- The 204-S Basin walls were sprayed with a fixative to seal all contamination and were then demolished to the existing grade level with a wrecking ball (Fig. 43 and 44). The basin walls facing the railroad tracks were demolished below grade level by trenching alongside the wall to allow entry for the ball. All wrecking activities were carried out from the outside, pushing the debris into the basin and avoiding potential contamination of the ball, with the exception of the central dividing wall, where the ball had to be brought into the basin area.
- All site perimeter fencing was removed.

The final backfill was carried out with earthmovers (scrapers), bulldozers, and graders (Fig. 45). Scrapers picked up dirt from a spoil pile adjacent to the railroad tracks a few hundred feet north of the site. The areas occupied by the former 203-S, 204-S, 205-S facilities received 2-10 ft of clean soil. The new fill was graded and compacted, and seeded with perennial wheatgrass. Final activities included placing concrete markers with plates identifying the site and indicating the presence of underground contamination.

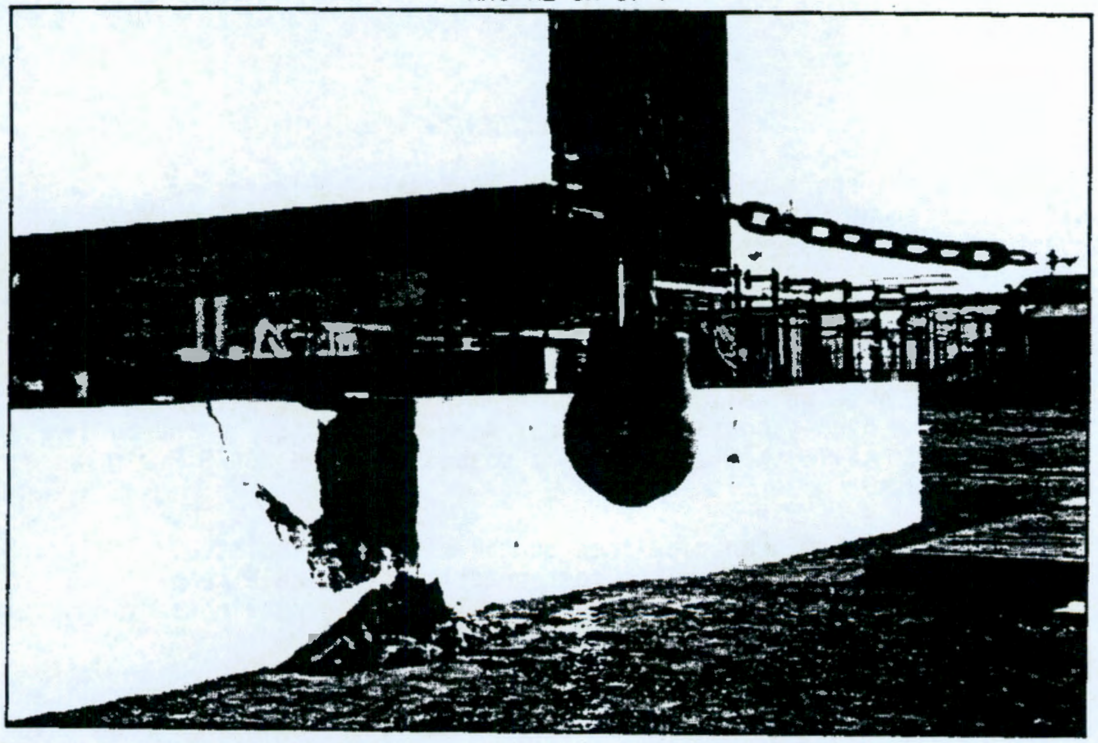


FIGURE 43. Initiating 204-S Tank Basin Demolition with a Wrecking Ball.

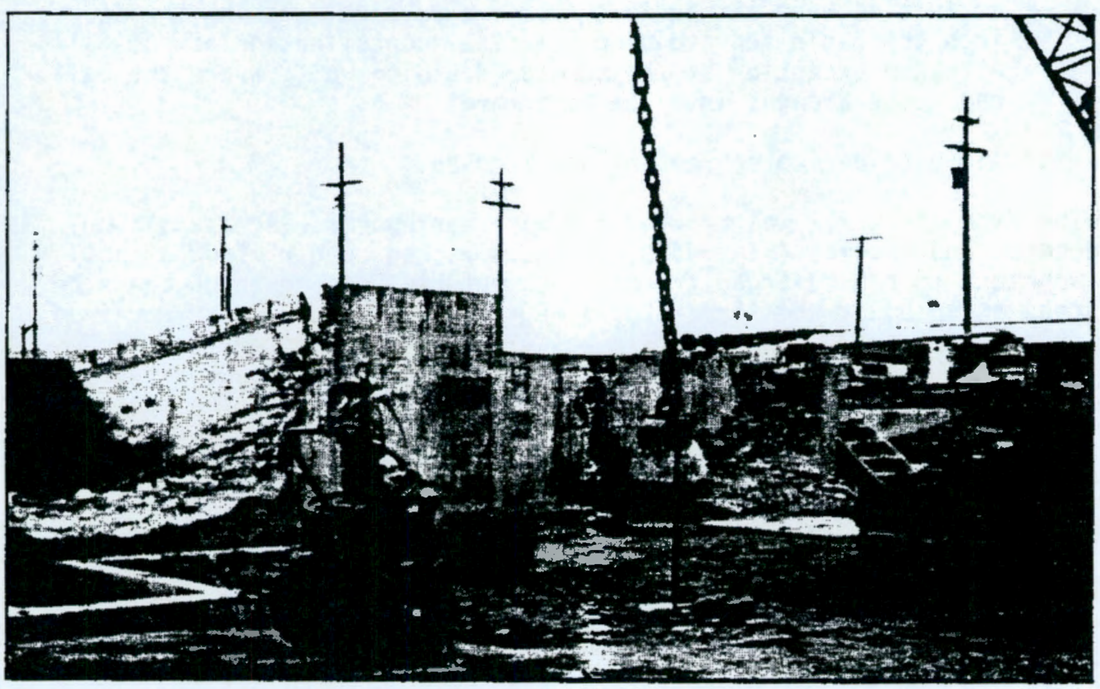


FIGURE 44. The 204-S Pumphouse and Basin Demolition. Steel reinforcing bars were cut with a welding torch (foreground) after demolition of the concrete.

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FIGURE 45. Backfilling the 203-S, 204-S, 205-S Site with a Scraper (top) and Performing Final Contouring with a Bulldozer and Grader (bottom). After final grading, the area was mulched and seeded with wheatgrass to stabilize the soil.

# DECONTAMINATION AND DECOMMISSIONING PROJECT CLOSEOUT

The 203-S, 204-S, 205-S project was completed three months ahead of schedule and well below budget. The project has demonstrated the capability of the organizations involved to carry out a D&D project with a high level of competence.

Long-term benefits of the decontamination and decommissioning work include the virtually complete elimination of the potential environmental hazards posed by the obsolete facilities, the substantial costs savings in operations (e.g., pumping and evaporation of rain water), and the reduced surveillance and maintenance costs. Equally important benefits include the elimination of radiation exposure to operating, surveillance, and maintenance personnel, as well as the value of experience gained by the D&D team for future projects.

Personnel radiation exposure was kept well within Rockwell's established exposure guidelines of 300 mrem/wk and 1.25 rem/calendar quarter. Most exposure was encountered during the sluicing and concrete chipping operations at Tank 204-S-4. At no time were the exposure guidelines exceeded, and on only a few days were the guidelines approached.

Total cost for the D&D project was $1.025 million. This cost figure includes all charges for D&D workers, craft support, transportation, earth moving, burials, engineering support, radiation monitoring, laundry, overhead charges, and rentals. Originally projected costs totalled $1.3 million. Part of the $275,000 funding and manpower savings were utilized for decontamination and decommissioning of three smaller facilities: the 292-T Building, the 801-C Steam Line, and the 2707-BY Building, all completed by April 1, 1984.

A large volume of scrap and waste material, totalling 55,015 $ft^3$, was transported to the radioactive waste burial ground. The four 204-S tanks contributed three-fifths of the waste volume, with a bulk of 33,380 $ft^3$. The remaining 21,633 $ft^3$ consisted of waste materials ranging from decontamination rags to piping to railroad ties. Approximately 9 Ci of mixed fission products were buried. The bulk of the fission products, including 1.8 Ci of $^{90}Sr$, 3.8 Ci of $^{106}Ru$, and 1.9 Ci of $^{137}Cs$, were contained in Tank 204-S-4. A total of 43 lb of $^{232}Th$ were disposed of in the other three 204-S tanks. An estimated 0.2 Ci of mixed fission products remain in buried piping, concrete, and soil in the 203-S, 204-S, 205-S area.

The 203-S, 204-S, 205-S area currently contains only one aboveground feature: the main steam line to the Redox Plant (Fig. 1 and 44). Underneath the 2-ft (or deeper) layer of clean soil, a number of large radioactive and nonradioactive structures remain: the 203-S Basin, the remnant of the 204-S Basin, the 205-S Vault, the 205-S Building base pad, the still-active concrete pipe encasement from the Redox plant to the tank farm system, and the Redox chemical sewer as shown in Figure 46. Various isolated underground piping and electrical conduit systems also remain. Documentation for the current configuration of the site is maintained in the Hanford drawing files.

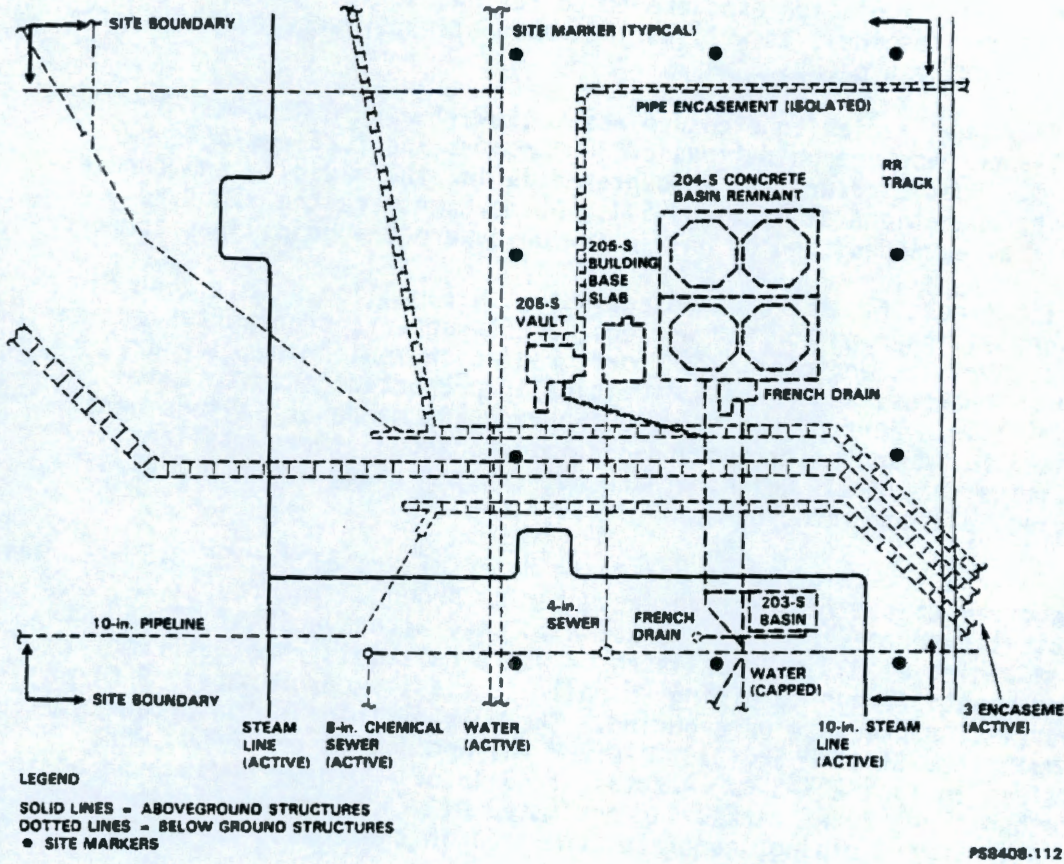


FIGURE 46. Major Underground Structures Remaining at the 203-S, 204-S, 205-S Site After Decontamination and Decommissioning.

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