of which can be passed through the inner annulus and beneath the primary tank. The increased flow is to aid in cooling the tank bottom. All of the Type III annuli are ventilated under negative pressure by means of exhausters (Type I and II annuli operate under positive pressure).

## Description of Evaporators for Concentrating Waste

Radioactive waste as received and stored in the separations areas tank farms can be reduced to a third or less of its original volume and immobilized as crystallized salt, by successive evaporations of the liquid supernate. Such a dewatering operation has been carried on routinely in F Area since 1960 and in H Area since 1963. The evaporators used for this operation are single-stage "bent-tube" units fabricated of stainless steel. Evaporator enclosure shielding permits the concentration of wastes containing up to 26 Ci of $^{137}Cs$ per liter (~100 Ci/gal). One evaporator is located in each area.

In principle, waste concentration is a straightforward dewatering operation as illustrated in Figure II-25. Original design provided for processing continuously 9 gal/min of waste containing 35% dissolved solids to produce a concentrate with 70% dissolved solids. Cooling the hot concentrate in the receiving tanks causes part of the dissolved solids to crystallize out as a salt cake, after which the supernatant liquid is recycled to the evaporator for further water removal. A cesium removal column (CRC), a vessel packed with ion exchange zeolite, is used to reduce the $^{137}Cs$ content of the overhead condensate before disposal to seepage basins; alternate capability is currently being provided to permit condensate recycle to the canyons for use as process water. The zeolite column is installed in a riser on one of the uncooled tanks, and spent zeolite is disposed of by dumping into the storage tank.

## Leak Detection and Waste Inventory Practices

### *Training and Procedural Control*

Primary training of operating supervision and of operators at the Savannah River Plant is carried out on the job. The supervisors and operators learn the process and their duties while performing assignments under the direct surveillance of experienced supervision. Routine on-the-job training is supplemented by periodic meetings between operating and technical personnel at which technical aspects of the processes are discussed. Operations are performed by following detailed written procedures approved in advance by operating and technical supervision. On-the-job training affords the opportunity to observe these procedures in use while they are being learned. Each supervisor has the opportunity to participate in decisions involving the overall operation many times before he is directly responsible for making decisions.

*Leak Detection*

Of the two principles on which detection of leaked or spilled waste can be based (disappearance of material from its proper location and appearance of material in an improper location), primary reliance at SRP is on the latter principle, because waste inventories are too large for precise measurement of the small inventory differences that would constitute significant leakage. Although rigorous inventory surveillance is practiced as a backup, primary leak detection methods rely on automatic surveillance of those areas into which leaked waste is most likely to migrate, especially the collection sumps provided for this purpose inside the multiple containment barriers.

The annulus of each of the double-wall tanks is equipped with at least two single-point conductivity probes located at the bottom of the annulus on opposite sides of the tank. Type III tanks are equipped with one multilevel and three single-point conductivity probes. When a conductivity probe detects liquid, it activates audio-visual alarms in the waste management control room. Each alarm is investigated, including visual inspection of the annulus, and a formal investigation report is issued to operating and technical supervision to describe each incident and the corrective action. Monthly, all annuli are visually inspected, and the conductivity probes are tested. Each of the eight single-wall tanks is located on a concrete slab with a network of leak collection channels which drains to a common sump. The liquid level in each sump, as measured by differential pressure transmitters, is recorded continuously, and an alarm is automatically activated if the level reaches a preset value. These sumps frequently contain ground water in-leakage and are sampled and pumped out as required.

*Liquid Level Measurement*

**For inventory control and as a backup to the leak detection system, liquid levels inside the tanks are measured and recorded. Each waste tank is equipped with a reel tape (described below) for measuring liquid level in the tank. The liquid level in every tank is read once every eight-hour shift, recorded, and compared with previous readings. Additionally, tank levels are recorded:**

- Every two hours on both the evaporator feed tank and concentrate receipt tank while an evaporator is operating.

- Hourly on both sending and receiving tanks during transfer from one tank to another.

- After each delivery of fresh waste, to compare the quantity received to the quantity sent.

The waste management foreman on shift reviews and signs the data sheets used to record all sump, annulus, and tank level measurements indicated above and any required corrective actions. These data sheets are reviewed by operating and technical supervision. Daily reports on waste management activities are provided to operating and technical management. These reports describe any significant incident shortly after it has happened, facts as they are developed, and followup action.

*Automatic Reel Tape.* The automatic reel tape is the primary method for liquid level measurement. The device consists basically of an electrical probe suspended on a cable or tape. The probe is positioned at different levels inside the tank by the actuation of a reel on which the cable or tape is wound. The liquid level is detected when the probe contacts the liquid surface, completing an electrical circuit. Operation of the device is automatic and continuous. The level-seeking circuitry causes the drive motor to lower the probe until the liquid is contacted. The motor stops and an electronic timer is activated. Following a measured time lapse, the drive motor is started in reverse, raising the probe until contact with the liquid is broken. The automatic level-seeking circuitry again causes the drive motor to reverse, lowering the probe until contact is re-established with the liquid at which time the cycle is repeated. The electronic printer in the control room can be set to print each tank level on a 5-, 30-, or 60-minute cycle or to monitor a single tank continuously. For field data sheets the operator merely reads the counter when the probe is contacting the liquid, i.e., when the counter is not moving. The automatic level-seeking feature reduces measurement error by removing the operator judgment factor. The repeatability of measurements with the device is about ±1/16 inch, or 450 gallons.

The automatic reel tape has both a high- and low-level alarm capability. Whenever the readout on the level counter coincides with one of the alarm settings, an alarm will sound. This feature allows detection of both unexpected tank level increases and decreases.

*Secondary Liquid Level Measuring Methods.* Abnormal circumstances are sometimes involved in measuring liquid levels in waste tanks. Salt tanks pose particular problems whenever salt buildup extends above the liquid surface. In such a case, the reel tape probe may contact the salt, giving an erroneous liquid level indication. It is also possible in tanks with exposed salt formations for the probe to contact a pool of liquid isolated by the exposed salt at a different level from most of the liquid in the tank. Salt accumulation on the end of the probe must be considered as a possibility for error. Finally, since the reel tapes operate on the electrical contact principle, the possibility of false level indications due to electronic malfunction, short circuits in worn cables or wiring, etc., is always present.

Because of the possible sources of false level indications with the reel tape system, backup level measuring methods are used (at least quarterly) to determine if a false level is being read and to allow for correction of the error. The most frequently used and most reliable backup is the hand tape method. A metal disk attached to a steel tape is lowered into the tank through a tank riser and the liquid level detected by sight and/or touch. A second backup method determines liquid level by the differential air pressure in submerged bubbler (dip) tubes. This method is complicated by the possibility of pluggage of the dip tubes by salt or sludge and the need to determine the specific gravity of the waste. Stationary conductivity probes, either resting on insulators or suspended by cables, are widely used to detect liquid in normally dry areas.

*Salt and Sludge Level Measurements in Waste Tanks.* The primary methods used to determine both salt and sludge levels are soundings with the hand-held tape and vertical temperature profiles. Salt and sludge soundings are made in the same manner as liquid level measurements with the hand tape and disk, except that weight is added to the disk to help distinguish between the liquid surface and the salt or sludge surface. Vertical temperature profiles are plots of temperature versus distance above the tank bottom obtained by inserting a length-graduated thermocouple wire into existing tank thermowells and measuring the temperature at several position.

Active concentrate receipt tanks without distributed cooling coils and with a bottom layer of crystallized salt usually show a fairly warm and nearly isothermal region due to convective mixing of saturated liquid. A characteristic temperature profile for a tank containing crystallized salt is shown in Figure II-26. The elevated line of zero slope represents the liquid; due to mixing of the liquid by convection currents, the temperature is fairly constant throughout the liquid phase. On the other hand, the immobile salt has a considerable temperature gradient from the surface in contact with the hot liquid to the cooler tank bottom. From the intersections of the slopes of the lines representing the temperature of the salt and liquid phases, the approximate salt level can be determined at the particular orientation of the thermowell.

Similarly, relatively fresh HHW tanks show distinct temperature gradients, except that the heat-producing sludge is hotter than the liquid. A characteristic profile for a tank containing sludge is shown in Figure II-27. The sludge level is determined by the intersection of the temperature lines representing the liquid and sludge phases. For determining the upper level of loose or poorly consolidated sludge, a photometer-like device is lowered into the tank liquid and the suspended sludge is detected by the increased turbidity of the liquid and corresponding decrease in light transmittance.

## Inspection of Waste Storage Tanks

Inspection of equipment used for handling and storing radioactive wastes is difficult because of radiation and contamination problems. However, techniques have been developed for remote inspection and evaluation of the condition of waste tanks. These include visual inspection by means of a periscope, photography, ultrasonic measurement of wall thickness, and corrosion specimens (including excision of a portion of a tank and a failed cooling coil).

Since 1959, the most important and recurrent waste tank inspections (other than routine surveillance) have been visual surveys in the annular spaces, and, to a lesser extent, inside the primary tanks. Many such surveys, especially in such cases as investigation for liquid in the annulus pan after a conductivity-probe alarm signal, are made by direct observation through opened access risers and/or inspection holes in the roof, using either lowered incandescent lights or a mirror-directed sunbeam for illumination.

*Optical Periscope*. For closer and/or more comprehensive inspections a portable optical periscope, composed of up to four ten-foot sections, is extended from grade into the annulus or tank, with the objective lens relatively close to the location of interest. Incandescent lights mounted below the objective lens on the periscope provide illumination for direct viewing and through-periscope photography, using fairly long exposures. Alternate objective lenses (1x and 5x) and an adjustable objective mirror provide viewing angles of 40 and 8 degrees, respectively, centered horizontally, below the horizontal, or vertically downward. Used in a tank annulus at various elevations in a given riser, the periscope affords surveillance of the full height of the primary tank wall from one tangent point to the other (ordinarily twenty to twenty-five feet of tank circumference) at each location. The cooled (annular-type) tanks have four access risers at 90° intervals around the annulus. These risers allow periscope surveillance of 30 to 40% of the wall area of these tanks. Additional inspection ports have been drilled into the annular spaces of Type II tanks 13 through 16, permitting inspection of 70 to 90% of the wall area of these tanks. Similar auxiliary inspection ports are not feasible in Type I tanks because of the 9-ft earth overburden, especially in H Area where the ground water table is above the tank tops. Tank interior viewing with the periscope has been less useful than annulus inspections for evaluation of primary tank leaks and mechanical and metallurgical condition because of greater visual distances, higher lighting demands, and (frequently) poor visual transmissivity (fog) in the tank vapor space. However, in-tank surveillance via periscope has been invaluable in studying the manner, degree, and effects of sludge removal and salt accumulation and removal.

In 1961-1962, following leakage from Tanks 9, 10, 14, and 16, about 134 and 25 leak sites, as defined by accumulations of dried salt, were observed by periscope on the primary tank walls of Tanks 16 and 14, respectively. No leak sites were visible during limited inspections of Tanks 9 and 10, even though these two tanks, like Tanks 14 and 16, contain appreciable amounts of dried waste which has leaked into their secondary pans and thus is visible in the annular spaces. Up to the present time, eight of the Type I and II cooled waste tanks have experienced some leakage from the primary tank to the annular space inside the secondary container, (one tank in F Area and seven tanks in H Area). The observed leaks have occurred through small hairline cracks that are usually adjacent to welds. The rate of this leakage has been very small except for the leakage from Tank 16. Minor leakage was detected in November 1959 from the primary tank to the annular space inside the secondary container and concrete vault of Tank 16. Subsequently, during September of 1960, a large number of very small leaks resulted in a leak rate of about 4 gal/min, and the level of waste in the annular space exceeded the 5-ft height of the steel pan for an estimated period of six hours while a transfer jet was being installed in the annulus to remove the leaked waste. The waste rose above the top of the steel pan liner, and some overflowed into the clearance space between the concrete tank and the steel pan. Leakage from the primary tank was stopped by reducing the liquid level inside the tank below the major leak sites. To prevent possible future overfilling of the tank pans in the event of major primary tank leaks, jets of 75 gal/min capacity have been installed in the annular spaces of the tanks so that leaked liquid waste may be rapidly returned to primary storage. All tank annuli are purged with air to dehumidify the space and evaporate any leakage to dry, immobile salt.

A maximum of 700 gallons of alkaline waste rose above the top of the 5-ft-high steel pan liner of Tank 16. Intensive investigation and monitoring over the intervening years confirm that most of this 700 gallons was contained in the concrete vault and the quantity of waste leakage into the soil was limited to a few tens of gallons of waste containing about 7 Ci of radioactivity per gallon (primarily $^{137}$Cs). Because the tank bottom is below the surface of the water table, the radioactivity that reached the soil also immediately reached the ground water. The soil in this area contains clay with a significant ion exchange capacity, and consequently during the ensuing 16-year period the radioactivity has moved only a few additional feet. The limited migration has been confirmed by extensive sampling and testing with encased wells. The radioactivity level in the ground water 15 ft from the edge of the concrete pad under Tank 16 is about 10 times normal background, 5 to 15 pCi/l, and between $2 \times 10^{-4}$ and $4 \times 10^{-4}$ Ci of radioactivity is estimated to have moved beyond this point. Continued use of Tank 16 was restricted to a reduced volume (below the worst cracks) until it was removed from liquid storage service in early 1972. Further details on leakage from Tank 16 may be found in DP-1358.[13]

Investigation of the cracking in Tank 16 showed: (1) that stress-corrosion cracking in welded areas of the tank was a likely cause, and (2) that full stress relief of the tanks after fabrication would eliminate this type of stress cracking. All observed tank leaks have occurred at hairline cracks that are usually adjacent to welds. Corrosion samples exposed to waste in the waste tanks and in simulated waste prepared in the laboratories indicate that stress-corrosion cracking is the most likely explanation of the leaks. The design for the Type III tanks, previously described, evolved as a result of these investigations.

A continuing, comprehensive waste tank inspection program was begun in November 1971 to provide an up-to-date evaluation of the condition of the waste tanks. Periscope inspections, wall thickness measurements, and corrosion specimens indicate that no significant general corrosion of the carbon steel tanks is occurring. Pitting corrosion, which was observed in an excised section of a Tank 2 cooling coil, has not been observed during periscope inspections of the tank walls.

During the period November 1971 to January 1973, periscope inspections were made in the annular spaces of all the double-wall tanks (Tanks 1-16 and 29-34), and in-tank inspections were made of all the single-wall tanks (Tanks 17-24). Conditions were about as expected at all tanks except Tanks 14, 15, and 16. Leak sites in Tank 15 were observed for the first time, and leak sites not visible during similar inspections in 1961-1962 were found at Tanks 14 and 16. In addition, salt deposits on the walls at previously observed leak sites were thicker than before, indicating seepage during at least part of the intervening 10-year period.

Tank 16, which has by far the greatest number of individual cracks, has been emptied except for a small heet of wet sludge.

Periscopic and photographic inspections (described below) are a continuing program. Double-wall tanks with a history of leakage are inspected through a selected annulus-top opening at least once a year and through all such openings at least every two years; all other double-wall tanks, two and four years, respectively. In March 1974, a single salt-encrusted leak site was observed at the top horizontal weld of Tank 11, and in April 1974, a single dried leak site was discovered at a vertical weld on Tank 12. Comparison with earlier periscopic and photographic examinations indicates that these deposits did not exist or were insignificant in 1972. Both leak sites are inactive, and the dried waste salt is confined to a small area on the tank wall. Subsequent inspections of these and other tanks have shown no change except for a few additional inactive leak sites on Tank 14 that were not seen in the 1972 inspections.

A number of figures are included to show the range of conditions of tank walls and annular spaces. Figures II-28 and II-29 are photographs taken by periscope in the Tank 16 annular space in 1962 and 1972. The growth of deposits at leak sites is evident. Also, there are additional leak sites visible in the 1972 photograph. These photographs depict the tank which has the greatest number of leak sites, and which has leaked the most. Figure II-30 is a direct photograph picture of the Tank 10 annulus. Tank 10 has leaked less than Tanks 16, 14, and 9, but more than Tanks 1, 11, 12, and 15. Figure II-31 shows the annular space of Tank 13, which is typical of the fourteen nonleaking double-wall tanks in service.

Single-wall tanks are inspected internally above waste level through a selected access riser at least once a year and through all such risers at least every two years. Figure II-32 shows the interior of Tank 21, a single-wall tank. This picture shows construction chalk marks adjacent to a vertical weld seam and other indications that the surface of the steel is in generally good condition.

A summary of the periscope inspections made between November 1971 and December 1972 is shown in Table II-13.

*Direct Photography.* Apparatus and techniques are in use and under continuing development to supplement periscopic inspections with direct photography using a shielded camera and electronic flash (strobe) lamps lowered directly into the tank vapor space or spring-powered film advance, and permits multiple successive exposures without manual access to the camera. The camera assembly, including close-fitting lead shielding, a shutter release solenoid, and one or more remotely rechargeable strobe lamps, is tailored for passage through a 5-inch-diameter access port. It is suspended by a flexible, reinforced rubber steam hose which allows enough flexibility for easy handling on the tank top and enough torsional rigidity to provide positive orientation (azimuth) control of the camera line of sight. An azimuth-indexed support bearing at grade level and detachable stops along the supporting hose facilitate rapid entry, positioning, and removal of the assembly in and from the tank or annulus. This is needed to minimize film fogging due to the often intense gamma field that is encountered. Swinging of the camera on its flexible support hose does not affect picture clarity because of the short duration of the strobe flashes. Picture resolution, clarity, and color are generally superior to the best of the pictures taken through the periscope; they are much superior where radiolytic film fogging is not serious or where low light levels, degradation of optics, and/or poor focusing result in low quality periscope pictures. The chief disadvantage of the direct photography inspection technique is the delay before finished photographs are available. This disadvantage is not serious for ordinary prescheduled inspections conducted for record purposes, especially where abnormalities are not suspected; any unusual conditions which show up in the photographs can be re-examined by periscope in the detail warranted, with or without further direct photography of the specific area of interest. A wide-angle camera in an articulated mounting to give a downward field of view was developed in 1974-75 for scanning service. A single picture from this camera, fitted with four electronic flash units, encompasses almost all of the tank wall area covered by a score or more of closeup pictures obtained by panning the horizontal-looking camera at several elevations. Use of the wide-angle camera for routine annulus inspections substantially increases the practical frequency of inspection of the approximately 120 tank annulus access ports available. Figure II-33 shows a typical wide-angle photograph of the Tank 15 annulus.

*Wall Thickness Measurements*

Ultrasonic equipment has been used to measure the thickness of the primary wall of the double-wall waste tanks. Two types of instruments have been used: (1) in 1967 and 1969, an analog-type instrument was used with which the reading was interpreted from a display on a cathode ray tube, and (2) in 1972 through 1975, a similar, but more accurate, digital thickness gage was used. The measurements, summarized in Table II-14, indicate no significant thinning of the tank walls. The presence of pits or stress corrosion cracks would not likely be detected by this technique.

Equipment has also been designed and demonstrated for penetrating waste salt or sludges at the bottom of tanks and obtaining bottom thickness measurements. Measurements have been taken on the bottoms of Tanks 21, 22, and 23. All measurements indicated no thinning of the bottom plate.

## SOLID RADIOACTIVE WASTE STORAGE SITE (BURIAL GROUND)

### Facility Description

One centrally located solid radioactive waste storage site (Figure II-34) is used to store all radioactive solid waste produced at the Savannah River Plant as well as occasional special ERDA shipments from offsite. This storage site occupies 195 acres between the F and H separations areas approximately 6 miles from the nearest plant boundary. The original area of 76 acres, which began to receive waste in 1953, was filled in 1972, and operations were shifted to a 119-acre site contiguous to the original area. A paved road to its entrance and many unpaved roads inside the fenced area provide access for trucks, the usual transportation mode for solid waste. Three railroad spurs permit shipments of large pieces of contaminated process equipment from the plant's operating areas.

The relatively level land and the specially selected Bahia grass cover effectively control surface erosion at the storage site. Surface drainage ditches channel the runoff of rainwater (47 in. per year) to provide further erosion control. Soils underlying the storage site consist of nearly a thousand feet of mostly unconsolidated sands, clayey sands, sandy clays, and clays (see Section II-C). The principal surface and near surface soils are clayey sands averaging about one-third clay. The mean water table is at a depth of about 45 ft. During a normal year, the fluctuation across the mean level is about 2 ft; the extreme variation noted was in 1960 when the water table rose ∿7 ft above the normal mean. Standard burial trenches are 20 ft deep. The rate of downward migration of percolate water in undisturbed soil near the burial site is ∿7 ft/yr and the lateral flow of water in the saturated zone at the water table ∿40 ft/yr.[14] Along the major subsurface flow path from the high beta-gamma (solid waste containing relatively high levels of primarily beta-gamma emitters, as described below) waste trenches in the burial site to the nearest onsite stream (Four Mile Creek), a distance of 0.5 miles, the projected travel time for water is ∿70 years.

The solid waste storage site is divided into sections for accommodating various levels and types of radioactivity in waste materials: transuranium (TRU) alpha waste, low beta-gamma waste, and high beta-gamma waste (high beta-gamma and low beta-gamma solid radioactive wastes are those containing primarily beta-gamma emitters which are segregated according to radiation measurement). Examples of the materials in storage include:

- Contaminated equipment - obsolete or failed tanks, pipes, jumpers, and other process equipment from the fuel separations plants.

- Reactor and reactor fuel hardware - fuel components and housings not containing irradiated fuel, and spent deionizer resins.

- Spent lithium-aluminum targets - the waste target alloy after tritium has been extracted.

- Oil from gas displacement pumps in the tritium facilities - before burial, oil is placed in drums containing an absorbent material.

- Mercury from gas pumps in tritium facilities - before initiation of recycling in 1968, deteriorated and contaminated mercury was buried with primary containment by one-liter polyethylene bottles.

- Incidental waste from laboratory and production operations - small equipment, spent air filters, clothes, analytical waste, decontamination residues, plastic sheeting, and gloves.

- Occasional shipments from offsite - tritiated waste from Mound Laboratory, $^{238}$Pu process waste from Los Alamos Scientific Laboratory and Mound Laboratory, and debris from two U. S. military airplane accidents in foreign countries.

Accurate records are kept of the contents, radiation level, and storage location of each load of waste. Shipments are described and recorded, and permanent computerized records are maintained on duplicate magnetic tapes. The exact location of the burial trenches is defined by use of a 100-ft grid system laid out in 1962 (Figure II-35). The 100-ft grids are further divided into twenty-five 20-ft squares.

## Storage Modes

### *General*

The predominant storage mode for solid radioactive waste is burial in earthen trenches. Trenches are normally 20 ft deep and 20 ft wide. Criteria for selection of trench sites include:

- Ground water table at least 10 ft below the bottom of prospective trenches.

- Absence of perched ground water tables which would cause leaching of buried waste.

- Soil containing enough clay so that excavations will stay open without support.

- Topography conducive to level trenching and controlled surface water runoff.

Waste emplacements are covered promptly with soil to reduce radiation exposures and the potential of fire and wind-blown contamination. When a trench is nearly filled with waste, it is backfilled with soil. The minimum soil cover is 4 ft, but it must be sufficient to reduce surface radiation to 6 mR/hr or less.

*TRU Waste*

Transuranic waste was originally buried in plastic bags and cardboard boxes in earthen trenches designated specifically for this waste. At Savannah River beginning in 1965, TRU waste was segregated according to TRU content into two categories, retrievable and nonretrievable, and additional containment was added for retrievable waste. Waste containing greater than 0.1 Ci per package was placed in prefabricated concrete containers and then buried. These retrievable containers were 6 ft in diameter by 6.5 ft high. Waste that did not fit into the prefabricated concrete containers was encapsulated in concrete. Transuranium waste from the Savannah River Laboratory was buried in cubical concrete containers. Waste containing less than 0.1 Ci per package was buried unencapsulated in alpha trenches.

In 1974, the storage procedures were modified to reflect new ERDA criteria[1] governing retrievable storage of solid transuranic waste. Transuranium wastes contaminated to greater than 10nCi/g are now stored, protected from contact with water-saturated soil, in containers that can be retrieved intact and free of external contamination for at least twenty years from the time of storage. Combustible and noncombustible wastes are stored in separate containers. Polyethylene-lined galvanized drums are used as the primary container; waste packages containing more than 0.1 Ci are additionally protected by closure in concrete cylinders. Containers are stored on a concrete pad and covered with 4 ft of earth (Figure II-36). In accordance with ERDA Manual 0511,[1] canyon equipment and other bulky wastes contaminated with transuranium nuclides to greater than 10 nCi/g and also intensely contaminated with gamma emitters are stored directly in earthen trenches protected from contact with water-saturated soil.

*Beta-Gamma Waste*

Waste contaminated with beta-gamma emitters is separated into two categories for burial: low beta-gamma and high beta-gamma. Low beta-gamma waste is defined as waste measuring less than 50 mR/hr at 3 in. from an unshielded package and less than 50 mR/hr at 10 ft from the truck load. This waste is disposed of in low beta-gamma waste trenches (Figure II-37). Scrap unirradiated uranium is also classified as low beta-gamma waste, but it is buried in separate trenches. Irradiated reactor fuel housing components, tritium waste (classified as high beta-gamma waste because of induced activity associated with the Li-Al melts from the process facility), and miscellaneous waste in cardboard boxes are segregated and buried in separate trenches.

*Solvent*

Degraded solvent from the chemical separations areas is stored in underground tanks at the burial ground. The present inventory of 150,000 gallons contains about 45 Ci of TRU nuclides ($^{238}Pu$, $^{239}Pu$, $^{244}Cm$) and about 50 Ci of fission product nuclides (predominantly $^{106}Ru$). The solvent storage facility consists of six bitumastic-coated, mild steel tanks of 25,000-gallon capacity, which were installed in 1975. Each tank has a sump with liquid level monitored weekly for leaks. In addition, two older 25,000-gallon mild steel tanks are used to store solvent with the lowest level of radioactivity. The liquid level in all eight tanks is measured weekly to detect leaks. The expected rate of waste solvent generation is about 5,000 gallons per year. A study is underway to develop means to dispose of the waste solvent.

*Mercury*

Before 1968, deteriorated and contaminated mercury was buried in plastic bottles and 5-gal steel containers in underground trenches. Mercury in excess of 10 tons[15] was buried in this manner until processes were initiated to decontaminate and recycle mercury. Studies to determine the possible environmental effects[15] conclude that colloidal suspension is the dominant mode for transport of mercury, but that the maximum contribution to nearby Four Mile Creek would be about 0.2 ppb. This level is less than the drinking water standard of 2 ppb (Table III-26). Measured concentrations in SRP streams are less than the analysis sensitivity (1 ppb).

## Quantity of Waste

The estimated volume and curie content of waste buried in 1975 is listed in Table II-15. The total estimated volume and curies of waste in storage are summarized in Table II-16. More detail is presented in Table 5 in Appendix A.

## Routine Surveillance

An extensive surveillance program has been underway since startup of the waste storage site to monitor possible migration of radionuclides from their storage locations. The first monitoring wells (perimeter wells) were installed by the U.S. Army Corps of Engineers in 1956. Monitoring emphasis has increased over the years of operation, and additional wells were installed in 1963 (boreholes) and 1969 (trench wells). Most of the monitoring is concentrated on the initial 76-acre tract which was filled with waste in 1972. In 1973, installation began and is continuing of an extensive network of monitoring wells (grid wells) in and around this tract. Well locations are shown in Appendix E, Figure E-7.

Characteristics of these four types of wells are outlined below:

- Perimeter Wells: Five wells were installed in 1956 and six additional wells were installed in 1960. These wells have 3-in.-diameter steel pipes penetrating 20 ft into the mean water table. Two of the additional wells were installed near the solvent storage tanks, and two others in the direction of ground water flow from the vicinity of the solvent tanks. The bottom 10 ft are screened. The wells are sampled quarterly. Thirty-five new wells are scheduled for completion in 1976.

TABLE II-15

Solid Waste Buried in 1975 from SRP Operations[a]

| *Radio-nuclide* | *Earthen Trenches* | | *Retrievable Storage* | | *Total* | |
|---|---|---|---|---|---|---|
| | *Volume, $m^3$* | *Curies* | *Volume, $m^3$* | *Curies* | *Volume, $m^3$* | *Curies* |
| $^{252}Cf$ | 4 | - | 40 | 1.5 | 44 | 1.5 |
| $^{244}Cm$ | | - | 10 | 50 | 410 | 50 |
| $^{238}Pu$ | 420[b] | [b] | 40 | 4,190 | 483 | 4,330 |
| $^{239}Pu$ | 770 | - | 80 | 160 | 850 | 160 |
| $^{237}Np$ | 50 | - | 10 | 0.4 | 60 | 0.4 |
| $^{238}U$ | 540 | 1.2 | 1 | - | 541 | 1.2 |
| $^{235}U$ | 220 | 0.002 | 3 | - | 223 | 0.002 |
| $^{3}H$ | 1,000 | 59,500 | - | - | 1,000 | 59,500 |
| Fission Products | 6,470 | 65,500 | 2 | 90 | 6,470 | 65,600 |
| Activation Products | 320 | 71,500 | 10 | 400 | 330 | 71,900 |
| Totals | 10,200[b] | 197,000[b] | 200 | 4,900 | 10,400 | 202,000 |

*a.* Volumes and curies rounded to no more than 3 significant figures.

*b.* These totals do not include a process vessel vent filter in a 23 $m^3$ steel tank estimated to contain less than 140 Ci $^{238}Pu$ which is buried in an earthen trench. This filter also contains an estimated 6000 Ci of fission products. Such equipment is excluded from surface storage by ERDA Manual Chapter 0511.