DOE/EIS-0062

FINAL
ENVIRONMENTAL IMPACT STATEMENT

(Supplement to ERDA-1537, September 1977)

Waste Management Operations

Savannah River Plant
Aiken, South Carolina

Double-Shell Tanks for Defense
High-Level Radioactive Waste Storage

April 1980

U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C. 20545

1980 WL 94273 (F.R.)

NOTICES

DEPARTMENT OF ENERGY

Office of Deputy Assistant Secretary for Nuclear Waste Management

Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, Savannah River Plant, Aiken, S.C.

Wednesday, July 9, 1980

***46154** Record of Decision

Decision. The decision has been made to complete the construction of the 14 double-shell tanks and use them to store defense high-level radioactive waste at the Savannah River Plant (SRP).

Background. The SRP, located near Aiken, South Carolina, is a major installation of the Department of Energy (DOE) for the production of nuclear materials for national defense. It began operations in the 1950's and is currently the nation's primary source of reactor-produced defense materials. As a byproduct, the SRP operations produce liquid high-level radioactive waste from the chemical processing of fuel and target materials after irradiation in the SRP nuclear reactors.

The high-level liquid radioactive wastes are presently stored in four different types of tanks (Types, I, II, III & IV). In 1974, SRP began a tank replacement programs to (1) accommodate storage of fresh radioactive wastes as they are generated by production operations and (2) replace all older-design tanks with Type III tanks. The new tanks are intended for storage of the waste until long-term disposal/isolation can be implemented. This program was discussed as the base case (Alternative 4) in the Final Environmental Impact Statement on Waste Management Operations, Savannah River Plant, ERDA-1537 (Sept. 1977).

The Federal District Court for the District of Columbia (Natural Resources Defense Council (NRDC) v. Administrator, ERDA/DOE), directed on September 29, 1979, that a supplemental environmental impact statement be prepared to address design and safety alternatives of the ten waste storage tanks authorized in FY 1976 and FY 1977 projects at SRP. DOE published the final environmental impact statement Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, Savannah River Plant, Aiken, South Carolina, DOE/EIS-0062, in April 1980. Notice of its availability was published in the Federal Register by the Environmental Protection Agency on April 18, 1980 (Vol. 45, No. 77, page 26457). The environmental impact statement goes beyond the court requirement in that four additional tanks authorized in an FY 1978 project are also included. On April 30, 1980, the Federal District Court concluded that DOE had fully complied with the Court's order of September 29, 1979, by writing an environmental impact statement that complied with the National Environmental Policy Act (NEPA).

Description of Action. The DOE action is to complete construction and utilize in waste management operations the 14 Type III tanks under consideration in this statement; the 14 tanks are in various stages of construction. The Type III tanks differ from Types I, II, and IV tanks in that the primary tank is heat-treated after filed erection to remove residual stress due to welding. The heat treatment is to help prevent stress corrosion cracking that has been experienced in nine Type I and II tanks which were not heat-treated. No leaks have been detected in any of the nine Type III tanks that are now in servide.

Other major design improvements in Type III tanks include:

Full height steel secondary vessels, rather than 5-ft pans used in Types I and II tanks.

A single roof support column mounted on the foundation pad rather than on the bottom

of the primary tanks.
Air cooling of the center column and bottom of primary tank.
Bottom-supported cooling coils distributed throughout the tank.
Significant engineered safety features are also incorporated in the design to provide for prompt leak detection, ventilation, emergency power, and protection against natural events.
Description of Alternatives. The alternative to completing construction of the 14 Type III tanks for utilization involve stopping the construction in order to consider the following:
1. Thicker and more chemically resistant tank steel,
2. Cathodic protection, and
3. Better waste retrieval equipment and enlarged tank openings to facilitate waste retrieval.
The no-action alternatives were discussed in ERDA-1537 and are not considered in this document.
Basis for Decision. The high level liquid radioactive waste has been and is stored safely in underground Type III tanks that are engineered to provide reliable storage of the waste. This is accomplished through conservative design of the waste tanks, incorporation of engineered safety features, and proper implementation of a prescribed operational and maintenance program.
Thicker steel is not required because thinning due to general corrosion is not a problem and thicker steel would not prevent stress corrosion. The issue of more chemically resistant plates has, in essence, been adopted via the change to a heat-treated steel and post-fabrication stress relief of the primary tanks. These treatments should also eliminate stress corrosion.
Cathodic protection from corrosion was considered in 1972. The benefits of cathodic protection for waste tanks were judged to be small in comparison with the uncertainties and problems of installing such a system in a tank with widely varying contents; while protection may be afforded in one part of a tank, there may be a deleterious effect in another part of the tank.
Although adequate waste removal techniques have been demonstrated, salt and sludge removal and chemical cleaning tests during 1980 will investigate improved methods and will ***46155** demonstrate performance of equipment for waste retrieval.
Enlarged tank openings are not included in these new Type III tanks. The long-shafted pumps that can be used to remove liquid waste, redissolved salt, or sludge slurry from SRP waste tanks are designed to fit into any tank riser two feet or larger in diameter. These 14 Type III tanks contain nine access risers three feet or larger in diameter which can accommodate these pumps. Pumping of all three waste forms has been successfully demonstrated in existing SRP waste tanks, and the equipment was safely retrieved.
Thus, the design alternatives were rejected because no unique advantages were identified for the alternatives and because there are definite disadvantages (cost, delays, and potential problems) associated with the proposed design alternatives.
Discussion of Environmentally Preferred Alternatives. None of the design alternatives would have any environmental advantage over the tanks as presently designed. Incorporation of any of the design alternatives would require modification of the tanks under construction and commitment of additional resources. Also, the preferred alternative will result in taking older design tanks out of service earlier and might result in reduced radioactive releases.
Consolidation in Implementation of the Decision. Completion of construction for utilization of the 14 Type III tanks would maintain operational flexibility and enhance environmental protection by removing waste from older design tanks, some with known leaks. In view of the protective operating procedures and surveillance program to be followed throughout the life of the tanks along with the significantly improved design features, it has been concluded that the tanks are adequate for interim storage of the high-level radioactive waste.
For the United States Department of Energy.
Dated: July 1, 1980.

Sheldon Meyers,

Deputy Assistant Secretary for Nuclear Waste Management.

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EXECUTIVE SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT
WASTE MANAGEMENT OPERATIONS
DOUBLE-SHELL TANKS FOR DEFENSE HIGH-LEVEL RADIOACTIVE WASTE STORAGE
SAVANNAH RIVER PLANT

DOE/EIS-0062

U.S. DEPARTMENT OF ENERGY

(SUPPLEMENT TO ERDA 1537, SEPTEMBER 1977)

1. This final environmental impact statement (EIS) has been prepared in compliance with the September 29, 1979, order of the Federal District Court for the District of Columbia (Natural Resources Defense Council, et al., v. Administrator ERDA/DOE, et al. (D.D.C. Civ. No. 76-1691). The statement analyzes the impacts of the various design alternatives for the construction of fourteen 1.3 million gallon high-activity radioactive waste tanks. The EIS evaluates the effects of these alternative designs on tank durability, on the ease of waste retrieval from such tanks, and the choice of technology and timing for long-term storage or disposal of the wastes.

2. The proposed action is to complete the construction of the 14 tanks as originally planned and use them to store waste. This action will facilitate the continued safe interim storage of waste from the SRP production of nuclear materials and make possible the retirement of 24 tanks of older designs beginning with nine tanks known to have leaks.

3. The design alternatives considered in the EIS are: thicker and more chemically resistant steel plates, an impressed-current, cathodic protection system to guard against stress corrosion cracking, better waste retrieval equipment, and enlarged tank openings to facilitate retrieval. The design alternatives are not proposed because no unique advantages are provided by the alternatives and because each of the alternatives possess definite disadvantages (cost, delays, or potential technical problems).

4. The environmental impacts of current waste management operations at SRP were assessed in ERDA-1537 (September 1977). ERDA-1537 covered interim storage of the high-activity wastes in subsurface tanks. SRP plans to continue existing operations and improve waste management practices in accordance with DOE policies and standards; this plan is Alternative 4 of ERDA-1537. It involves regular assessment of current waste management practices and continued improvement of volume reduction and storage equipment and techniques. Provision of these new tanks (and retirement of older ones) is a major step in the interim waste management program.

5. The U.S. Environmental Protection Agency published a notice of availability of a draft of the EIS (45 FR 4466) on January 22, 1980, and the comment period ended on March 3, 1980. Only four comment letters were received.

6. The EIS was forwarded to the U.S. Environmental Protection Agency on April 11, 1980, and an announcement of its availability will be submitted to the Federal Register.

7. Additional information regarding the EIS may be obtained from Dr. G. K. Oertel, M. S. B-107, U.S. Department of Energy, Washington, DC 20545, telephone (301) 353-3641.

FOREWORD

The Federal action under review is the continued construction and proposed operation of new tanks for high-level radioactive waste at the Savannah River Plant (SRP) near Aiken, South Carolina. The construction of these tanks, which has been substantially completed, was authorized in the FY-1976, 1977, and 1978 Congressional budgets. The Federal District Court for the District of Columbia (Natural Resources Defense Council [NRDC] v. Administrator, ERDA/DOE), directed that this supplemental environmental impact statement (EIS) be prepared to address the design and safety alternatives of the waste storage tanks in FY-1976 and -1977 projects at the Savannah River Plant.* Specifically, the court ordered on September 29, 1979, that:

"ORDERED, the defendents (Secretary, Department of Energy, et al.) will prepare with diligence and with all reasonable speed and file with the Court by no later than April 15, 1980, adequate final supplemental environmental impact statements to ERDA-1537, Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, Aiken, South Carolina, and ERDA-1538, Final Environmental Impact Statement, Waste Management Operations, Hanford Reservation, Richland, Washington, discussing the safety and design alternatives for the Fiscal Years 1976 and 1977 double-shell radioactive waste storage tanks at Hanford and Savannah River.

"FURTHER ORDERED, that the environmental impact statements shall discuss in detail at least those design and safety feature alternatives identified at note 19, page 13 of the Court of Appeals slip opinion, including the reasonably foreseeable environmental effects of these alternatives, their effect on the durability of the tanks or the ease of waste retrieval from such tanks, and the effect, if any, of these design and safety feature alternatives on the choices of a technology for long-term radioactive waste storage and final disposal, and on the timing of such choices."

This statement goes slightly beyond that court requirement in that four additional tanks authorized in a FY-1978 project are also included in the SRP EIS.

* A similar EIS has been prepared for the Hanford Site.

The base document, ERDA-1537, Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, September 1977, gives information on the current SRP waste management operations. This supplemental EIS summarizes, but does not repeat, the information given in ERDA-1537. The format of this supplemental EIS is changed somewhat from that of ERDA-1537 in accordance with recent Council on Environmental Quality (CEQ) Regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR 1500-1508).

Two earlier environmental impact statements were issued to cover construction at SRP of specific additional waste handling and storage facilities. These statements are Future High-Level Waste Facilities, SRP, WASH-1528 in December 1972, and Additional High-Level Waste Facilities, SRP, WASH-1530 in August 1974. Originally each of these projects was expected to include both waste tanks and evaporator, but because of increased costs, they were revised to include three and four waste tanks, respectively, with no evaporators. The environmental impact of the new tanks under construction will be of the same nature and order as those for the previous tanks.

C In the final EIS, significant changes from the draft EIS are indicated by a vertical line in the left margin of the page. Minor editorial and typographical corrections are not identified. If the change is the result of an error (typing error, etc.) in the draft EIS, it is identified with the letter "E." If the change is made to clarify or expand on the draft statement, it is C identified with the letter "C." As an example, if this sentence were added to clarify a section, it would be identified with a vertical line and the letter "C" as shown to the left.

C Four comment leters were received; see Appendix G for DOE responses.

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1.0 SUMMARY

This environmental impact statement was prepared as a supplement to The Final Environmental Impact Statement - Waste Management Operations, Savannah River Plant, Aiken, South Carolina, ERDA-1537, September 1977 as directed by the Federal District Court for the District of Columbia on September 29, 1979. This supplement covers construction and operation of 14 additional high-level waste storage tanks authorized for fiscal years 1976, 1977, and 1978 at the Savannah River Plant.

In the continuing production of nuclear material for national defense at the Savannah River Plant, highly radioactive waste byproducts are generated. These defense wastes are being stored initially as liquids in underground, near-surface storage tanks. After suitable decay of short-lived radioactive isotopes, during which time insoluble constituents settle to the bottom as a sludge, the waste solution is then evaporated and returned to another waste tank where it partially crystallizes to form a soluble salt cake. This volume reduction program, which has been in operation for about 19 years, converts the waste to a form less mobile than the original liquid waste and reduces the number of storage tanks required. Storage of liquid wastes has been conducted safely during the 25 years of operation at the Savannah River Plant. These additional waste tanks are needed to meet forecast production of nuclear materials and to replace 24 older-design tanks which will
C | be removed from service. Nine of these older tanks have leaked.

The storage of liquid waste, salt cake, and sludge in near-surface storage tanks is considered as an interim plan for waste management. Long-term options for the Savannah River Plant wastes are also being investigated. The continuation of a research and development program on the immobilization of the waste for long-term management is considered in the Final Environmental Impact Statement, Long-Term Management of Defense High-Level Radioactive Waste (Research and Development Program for Immobilization), DOE/EIS-0023, November 1979.

The new facilities, now under construction, consist of fourteen 1.3-million-gallon high-activity waste tanks and associated auxiliaries; four tanks are in the F Area and ten in H Area on the basis of forecast production requirements and the need for tank replacement. Design of the tanks will be similar to that of the previous seven Savannah River Plant tanks authorized in fiscal years 1974 and 1975.* The tanks will incorporate the latest technology in fabrication, stress relief, inspection, and acceptance testing. This concept is consistent with the base case in ERDA-1537, i.e., Alternative 4, "Improve Waste Management Practices in Accordance with ERDA Policies and Standards."

Ventilation air is the only normal effluent from the waste tanks. With this air approximately 650 Ci/year of tritium oxide will be released to the atmosphere from the waste tank vapor space. This tritium oxide will result in an average dose commitment to individuals at the plant perimeter of about 0.0009 mrem/year for each new tank. The population annual dose commitment within a 100-kilometer radius of the center of the Savannah River Plant will be about 0.18 man-rem for each new tank. However, since most of these tanks will replace older tanks, this exposure estimate is not an incremental increase in dose. The population dose from atmospheric release from 14 waste tanks is less than 0.5% of the total dose from SRP releases to the atmosphere (135.8 man-rem in 1978) and less than about 0.0001% of the dose received from natural sources by this population (5×10^5 man-rem).

Preferred Alternative

The preferred alternative is to complete construction and utilize in waste management operations the 14 tanks currently under construction. The 14 Type III** double-walled tanks covered in this EIS are in various stages of construction.

Construction of the Type III series of double-walled tanks began in FY-1966. The most important change in Type III tanks compared to those of previous designs is incorporation of a post-fabrication heat treatment of the primary tank to eliminate the high residual stresses induced by seam welding in the field of the many individual steel plates. This heat treatment is to help prevent stress corrosion cracking that has been experienced in nine Type I and II tanks, which were not heat treated. No leaks have been discovered in any of nine Type III tanks that are now in service.

* Additional High-Level Waste Facilities, SRP, WASH-1530 (August 1974) (Tanks 25-28) and Future High-Level Waste Facilities, SRP, WASH-1528 (December 1972) (Tanks 35-37).

** Type III tanks are double-walled steel tanks with the secondary (outer) tank walls rising the full height of the primary tank and with both tanks contained in a cylindrical watertight reinforced concrete vault. Capacity is 1,300,000 gallons. The earlier Type I and II tanks hold about 750,000 and 1,000,000 gallons, respectively, and are of similar basic design except that their steel secondary tanks (or "pans") have walls only five feet high, and their roof supports differ.

Other major design improvements in the Type III tanks include:

- Full-height steel secondary vessels, rather than the 5-ft pans used in Types I and II

- A single roof support column mounted on the foundation pad rather than on the bottom of the primary tank

- Air-cooling of the center column and bottom of primary tank

- Bottom-supported distributed cooling coils

There are two basic needs for the new tanks. First, they will provide interim storage capacity and ensure containment of new high-level waste generated by continued operation of SRP. Second, they will provide improved reliability of storage of high-level waste already generated and in storage.

Significant engineered safety features in the new tanks include:

- Primary and secondary leak detection systems to allow prompt detection and containment of leaks through either barrier

- Ventilation systems to purge combustible gases and maintain vapor space negative with respect to atmospheric pressure

- Emergency power to maintain critical systems if normal power is lost

- SRP design basis earthquake protection to 20% of the acceleration of gravity (0.2 g) at zero period

- Tornado-resistant design greater than SRP design basis

Each waste tank has a capacity of 1,300,000 gallons and is 85 feet in diameter and 33 feet tall. The tank form is two concentric cylinders joined to washer-shaped top and bottom plates by curved knuckle plates. The primary tank sits on an 8-inch bed of insulating concrete within the secondary containment vessel. The concrete bed is grooved radially so that ventilating air can flow from the inner annulus to the outer annulus. Liquid would also flow through the slots, facilitating detection at the outer annulus, if any were to leak from the bottom of the primary tank.

The secondary vessel is 5 ft larger in diameter than the primary to provide an outer 2.5-ft-wide annulus. Its side wall rises to the full height of the primary tank. A channel grid system was installed in the concrete base slab under the secondary container to detect leakage from the secondary container. The grid system drains to a sump for collection and monitoring.

The nested two-vessel assembly is surrounded by a cylindrical reinforced-concrete wall 30-inches-thick.

The enclosure has a 48-inch-thick, flat, reinforced-concrete roof, which is supported by the concrete wall and the central column. The roof reduces the radiation field above the tank to less than the amount permissible for continuous occupancy by operating personnel; hence, no earth overburden is required.

Type III tanks under construction have permanently installed cooling coils. Vertical coils will be bottom-supported and on 3-ft triangular centers. No horizontal coils will be installed. In the nominal design, total heat removal capability is about 6,000,000 Btu/hr, but effectively reaches 10,000,000 Btu/hr for liquid waste in which convective circulation is effective. An example is "as received" waste service (liquid plus about 8% sludge). On the other hand, widely distributed cooling surfaces are necessary in tanks to be used for forming and storing crystallized salt, in which salt deposited on the coils restricts heat transfer.

All plate welds will be radiographically inspected as part of a rigorous Quality Assurance Program. All radiographs are permanently retained. The primary tank will be stress-relieved in place at 1100°F in accordance with the general requirements of the <u>ASME Boiler and Pressure Vessel Code</u>. A full hydrostatic test, consisting of filling each primary tank with water to a depth of 32 feet and allowing it to stand for 48 hours, is conducted after stress-relieving.

The top openings into the Type III tanks and annular spaces are closed with stepped concrete or lead plugs. These openings are used for instrumentation, cooling units, ventilation system connections, and waste transfer connections.

The tank ventilation system is a negative pressure system designed for purging the interior volume at a rate in excess of 100 ft^3/min. Air enters through a High Efficiency Particulate Air (HEPA) filter and is conducted by a 4-inch-diameter pipe through the roof into the waste storage space. Air leaves the storage space via a 12-inch-diameter pipe positioned across the tank from the inlet. The exhaust air passes through a condenser to extract potentially radioactive moisture and a HEPA filter to free it from solid particles; it is then discharged to the atmosphere through an exhaust blower.

The outer annulus between the primary and secondary containers of double-walled tanks is also ventilated. The Type III tanks have the added feature that in addition to the direct ventilation of the outer annulus by a warm air flow, 1000 to 4000 ft^3

of air per minute is drawn through the inner annulus, passes beneath the primary tank through the radial grooves in the concrete base slab, and exhausts into the outer annulus. The new tanks, the subjects of this EIS, have an annulus ventilation system with a capacity of about 8000 ft^3/min, up to about half of which can be passed through the inner annulus and beneath the primary tank, to aid in cooling the tank bottom.

Primary reliance for leak detection is placed on methods that automatically monitor areas into which waste will migrate, especially the collection sumps provided for this purpose inside the multiple containment barriers. Although rigorous inventory surveillance is practiced as a backup, this method is not as sensitive because waste inventories are too large for reliable measurement of small differences that would constitute significant leakage.

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. Since 1959, the most frequent inspections have been visual surveys in the annular spaces, and, to a lesser extent, inside the primary tank. These are made by direct observations through opened access risers and/or inspection holes in the roof.

DOE plans to place the new tanks in service shortly after their completion. Several tanks will serve temporarily as receivers for unprocessed waste supernate currently stored in older-design tanks. This will allow earlier emptying of supernatant liquid and at least some solidified salt from many of the older-design tanks. The new tanks will also provide reliable isolation of the waste from the environment to allow adequate time for the implementation of the long-term waste management program for the SRP high-level waste.

Design Alternatives

The design and safety features advocated (for SRP) by NRDC are: thicker and more chemically resistant steel plates, an impressed current cathodic protection system to guard against stress corrosion cracking, better waste retrieval equipment, and enlarged tank openings to facilitate retrieval. Consideration of cooling coils is not applicable to the SRP because the SRP tanks already have cooling coils.

Thicker steel is not required because the thinning due to general corrosion is not a problem, and thicker steel would not prevent stress corrosion. The Type III tanks under construction are not expected to suffer stress corrosion because the improved steels used are normalized, stress-relieved, and stronger, and because of improved operating controls on the composition of the wastes to minimize corrosion.

Cathodic protection was considered in 1972. The benefits of cathodic protection for waste tanks were judged to be small in comparison to the uncertainties and problems of installing such a
C | system in a tank with widely varying contents and that, while protection may be afforded in one part of the tank, there may be a deleterious phenomenon in another part of the tank. Reliance was continued on use of more-resistant steels and improved tank designs for long-term protection.

Although adequate waste removal techniques have been demonstrated, sludge removal and chemical cleaning tests in progress plus salt removal tests during 1980 will investigate improved methods and demonstrate performance of equipment for waste retrieval.

Enlarged tank openings are not included in these new Type III tanks. The long-shafted pumps that can be used to remove liquid waste, redissolve salt, or slurry sludge from SRP waste tanks are
C | designed to fit into any tank riser 2 feet or larger in diameter. The SRP tanks No. 38-51 contain nine access risers 3 feet or larger in diameter which can accommodate these pumps. Pumping of all three waste forms has been successfully demonstrated in existing SRP waste tanks and the equipment was safely retrieved.

In the preceeding paragraphs, the results of the examination of the three design alternatives were summarized. The design alternatives were rejected because no unique advantages were determined for the alternatives and because there are definite disadvantages (cost, delays, and potential problems) to the proposed design alternatives.

The "No Action" alternatives were discussed in ERDA-1537 and the alternatives were considered to be unacceptable. The "No Action" alternatives would preclude SRP from meeting its mission of producing special nuclear material for national defense and would violate the DOE waste management policies for existing wastes.

Site Characteristics

The Savannah River Plant site occupies a nearly circular area of about 300 square miles (192,000 acres) on the South Carolina side of the Savannah River and is about 100 air miles or 150 river miles from the river's mouth at Savannah, Georgia. Surface eleva-
E | tions range from about 90 to 360 ft above mean sea level. Surface streams drain to the Savannah River. About 70,000 people consume river water processed by two water treatment plants near the river mouth.

Natural background radiation (external and internal) is estimated to result in a dose of about 120 mrem/yr to individuals living in the vicinity of the SRP site. Within 100 km of the SRP perimeter, this background dose ranges from 60 to 450 mrem/yr. About another 100 mrem/yr is received from medical x-rays by the average individual in the general area population.

Environmental Impacts

Utilization of the new waste tanks covered by this Supplemental Environmental Impact Statement will allow the retirement of older-design tanks with a significant improvement in safety and reliability. Apart from the impacts of construction, which are minimal because construction is within areas dedicated to plant operations, the incremental consequences of this action include:

- Added risks of releases during waste transfer operations required to empty tanks to be retired
- Reduced risks of accidental releases from the waste operations because of the improved facilities
- Impacts associated with decontamination and decommissioning of the retired tanks

The waste management operating force will increase from about 50 to 120 people to accomplish the waste removal to new tanks and chemical cleaning of the older-design tanks. After the older-design tanks are retired from high-level waste service, the operating force will decrease to about 65 people. The extra 15 people are due to increased surveillance requirements. Adoption of the alternatives would not change, but would possibly delay the timing of the increased manpower.

Small amounts of radioactivity reach the environment from normal operation of the waste management system. Low concentrations of radioactive material, primarily tritium oxide, are carried by the tank ventilation air to the atmosphere. About 5500 Ci of tritium per year are released to the atmosphere during normal operation of the tank farm and tritium is the only radionuclide from waste tank systems perceptible off the plantsite. The whole body dose from atmospheric release to the population within a
E 150-km radius of SRP is calculated to be 1.3 man-rem/yr. Natural background and medical diagnostic radiation for the same population is 5×10^5 man-rem/yr. The maximum dose to an individual at the plant boundary from inhalation of tritium would be about 9×10^{-6} rem/yr.

Personnel operating the waste tank farms in 1978 averaged an exposure of 0.7 rem/year with a maximum of 2.5 rem/year. The total annual exposure averages about 50 man-rem to tank farm operations personnel.

The total exposure risk to the offsite population from potential accidents and normal operation is 16 man-rem/year with normal operation accounting for 3 man-rem/year.

The risk associated with earthquakes (10 man-rem/year) is the dominant risk. The major contribution to earthquake risk (about 70%) results from the pessimistic assumption of liquefaction of the soil around waste tanks built partially above the normal grade elevation in the waste tank farms. It is also assumed that leakage from damaged tanks could flow rapidly to Four Mile Creek, rather than being deposited in the soil beneath the tank. Most of this risk is attributable to hypothetical IX MM (or more severe) earthquakes which are unlikely to occur; the design basis earthquake based on extensive seismic analysis for SRP and other areas of the southeast is between the VII and VIII MM values.

The offsite population risk (deaths/year) of tank farm operations is negligible when compared with other natural risks experienced by the population in the vicinity of SRP. Waste tank farm accidents and effluents might cause 0.003 latent cancer deaths per year compared to possibly 100 latent cancer deaths/year from natural background and medical diagnostic radiation or 2.4 sudden deaths/year from natural accidents, such as floods or lightning strikes.

The general consideration of the environmental effects of the proposed design alternatives resulted in the evaluation that the environmental effects would not be mitigated by adoption of any of the alternatives. The adoption of design alternatives would have severe effects because of the delay in removing waste from older design tanks, additional costs to implement the alternatives, and for the cathodic protection alternative requiring a total change in the SRP Waste Management program because the waste must be maintained in the liquid form. Additional waste tanks would be required to store this liquid waste.

Adequate methods for removing the wastes from tanks are available. However, tests of improved methods for sludge removal and chemical cleaning are in progress; decontamination factors in excess of 10^3 to 10^4 are expected. Decommissioning impacts cannot be quantified until decommissioning procedures are more completely defined.

There are no known conflicts with national, state, or local plans and programs in the operation of the waste tanks under construction. The plantsite is dedicated as a controlled area for the production of materials needed for national defense.

The only significant adverse effects caused by operation of the new tanks are the small offsite population dose commitment from the release of radionuclides and the commitment of about one acre of land for each waste tank. These effects would not be materially changed by adoption of any of the design alternatives.

2.0 PURPOSE OF AND NEED FOR ACTION

The Federal District Court for the District of Columbia (NRDC v. Administrator, ERDA/DOE), directed that this supplemental environmental impact statement (EIS) be prepared to address the design and safety alternative of the waste storage tanks authorized in FY-1976 and -1977 projects for storing high-level radioactive waste at the Savannah River Plant (SRP).* The pertinent part of the Court Order is reproduced in the Foreword of this Supplement.

At SRP ten tanks are involved in the Court action, four in the FY-1976 project and six in FY-1977. In addition, four tanks being provided in a FY-1978 project are also covered by the statement. These tanks are being built to continue the program begun in FY-1974 at SRP to provide additional waste tanks (1) to accommodate storage of fresh radioactive wastes as they are generated by production operations and (2) to replace with new Type III tanks all older-design tanks beginning with tanks with a history of leakage where practicable. This program was discussed as the base case (Alternative 4) in the Final EIS on Waste Management Operations, Savannah River Plant, Aiken, South Carolina, USDOE Report ERDA-1537 (September 1977). Alternative 4 of ERDA-1537, which is the present waste management plan, provides for continued improvement of waste management practices as improved technology can be developed and equipment can be procured.

This supplement to ERDA-1537, in addition to evaluating the environmental effects of the new waste tanks, specifically addresses the alternative design and safety features for the new tanks as they affect the durability and reliability of these tanks. It also considers any effects of these features on the ease of removal of the wastes from the tanks and on the choice of technology and timing for ultimately processing the wastes for long-term disposal.

* A similar EIS has been prepared for the Hanford Site.

3.0 ALTERNATIVES

3.1 SRP WASTE MANAGEMENT OPERATIONS (Base Case from ERDA-1537)

Current waste management operations at the Savannah River Plant are carried out in accordance with the following U.S. Department of Energy (DOE) policies:

> "...manage radioactive waste in such a manner as to minimize the radiation exposure and associated risk to man and his environment over the lifetime of the radionuclides: (ERDAM 0511),[1] and
>
> "control potential sources of pollution as far below established standards as practical, considering both technology and economics" (ERDAM 0510).[2]

They follow all established standards including those adopted by South Carolina and approved by the Environmental Protection Agency for nonradioactive releases and those specified by DOE for radioactive releases (ERDAM 0524).[3]

The DOE policies quoted above are implemented by a system of administrative controls. These controls include:

- Guides for the annual exposure to individuals in the offplant population caused specifically by release of radioactivity from the Savannah River Plant.
- Operating guides for the release of individual radionuclides from plant facilities.

The waste produced at the Savannah River Plant is presently stored onsite, and the environmental impacts of the waste management operations were analyzed in the base environmental impact statement, ERDA-1537. Releases of radionuclides are prevented if practical, even if the level of activity is below existing guidelines.

Current plans for the management of radioactive waste at the Savannah River Plant are presented in "Integrated Radioactive Waste Management Plan - Savannah River Plant"[4] issued by DOE. These plans are updated annually to reflect new technical developments and changes in policies and criteria. The plan presented is consistent with the base case in ERDA-1537, i.e., Alternative 4, "continue existing operations and improve waste management practices in accordance with DOE policies and standards."

High-level liquid radioactive wastes are produced at SRP primarily from chemical separations operations in the F and H Areas. These wastes are stored in large underground tanks in each area. Because the waste can be removed from the tanks as desired, this storage method does not foreclose any of the possible options for long-range management of the wastes. The high-level waste storage areas for radioactive liquids, sludges, and crystallized salts are adjacent to the separations areas and consist of two tank farms linked to the separations areas and to each other by pipelines with secondary containment.

Chemical separations processes in the high radiation (heavily shielded) and low radiation (moderately shielded) processing areas, so-called "hot" or "warm" canyons, generate aqueous waste streams that contain most of the fission products. Those waste streams that come from the hot canyon are high-heat waste (HHW) and those from the warm canyon are referred to as low-heat waste (LHW). This terminology is used to identify the source of the waste and to indicate that LHW will not require auxiliary heat removal, as does HHW. In other respects, LHW is similar to HHW.

The term "high-level liquid waste" includes both HHW and LHW. The wastes are generated in chemical separations operations generally as nitric acid solutions. They are made alkaline with sodium hydroxide and are then transferred by gravity flow from the processing buildings to the waste storage tank farm through underground pipes that are enclosed in a secondary concrete conduit for double containment.

The high-heat waste from the canyon is placed in double-walled tanks equipped with the necessary cooling coils and is aged for one to two years to permit settling and the decay of short-lived fission products. During this period, insoluble materials form a layer of sludge at the bottom of the tank. The sludge is a mixture of oxides and hydroxides of manganese, iron, and some aluminum. Small amounts of uranium, plutonium, and mercury are also present. This sludge contains essentially all of the fission products originally in the irradiated fuel except cesium. After aging, the supernate, containing dissolved salts and the radioactive cesium, is transferred to a continuous evaporator. The condensate from the evaporator is passed through an ion exchange column to remove a small amount of entrained cesium and is then discharged to a seepage basin. The concentrate from the evaporator is transferred to a cooled waste tank where the suspended salts settle. During cooling, additional salt crystallizes. The supernate remaining after crystallization is again returned to the evaporator for further evaporation. This process continues until essentially all the liquid has been converted to a crystallized salt cake.

The low-heat waste is handled similarly to high-heat waste. Typical compositions of the two forms of high-level waste supernates are given in Tables 3-1 through 3-4.

TABLE 3-1

Concentration Range of Major Constituents of LHW Supernates

Constituent	*Concentration, M*
Na^+	0.2 - 11.0
OH^-	0.06 - 7.9
NO_3^-	0.2 - 2.8
$Al(OH)_4^-$	0.01 - 1.1

TABLE 3-2

Concentration Range of Major Radioactive Constituents of LHW Supernates

Constituent	*Concentration Range, Ci/gal*
^{134}Cs	$<6 \times 10^{-6}$ - 10^{-2}
^{137}Cs	5×10^{-5} - 0.1
^{144}Ce	$<8 \times 10^{-5}$ - 10^{-2}
^{103}Ru	$<3 \times 10^{-3}$ - 10^{-2}
^{106}Ru	$<5 \times 10^{-5}$ - 4×10^{-2}
^{90}Sr	8×10^{-7} - 10^{-5}
^{238}Pu	7×10^{-6} - 10^{-4}

TABLE 3-3

Concentration Range of Major Constituents in Aged HHW Supernates

Constituent	*Concentration, M*
Na^+	4.0 - 12.5
NO_3^-	1.6 - 6.4
NO_2^-	0.2 - 3.2
$Al(OH)_4^-$	0.4 - 1.6
OH^-	0.8 - 6.3

TABLE 3-4

Concentration Range of Major Radioactive Constituents of Aged HHW Supernates

Constituent	*Concentration Range, Ci/gal*
^{134}Cs	0.2 - 4.6
^{137}Cs	1.7 - 15
^{103}Ru	ND - 0.2
^{89}Sr	$<10^{-6}$ - 3×10^{-5}
^{90}Sr	2×10^{-4} - 4×10^{-3}

3.2 PREFERRED ALTERNATIVE — CONSTRUCTION AND UTILIZATION OF TYPE III TANKS AS CURRENTLY DESIGNED

In October 1979, 32 tanks were in service for high-level waste storage at SRP. The 32 tanks include three essentially empty tanks designated as emergency spares, but exclude Tank 16. Tank 16 has been retired from service, cleaned of residual sludge, and is now being chemically cleaned. Nine of these tanks were built since 1967 and are of the most recent basic design, designated Type III; the others were constructed in the 1950s and 1960s and are of three different generic designs, designated Types I, II, and IV. In addition, four more tanks of the basic Type III design, but with some improvements in detail, are essentially complete but are not yet in service. (Note that the designation "Type III" refers to the third design series of double-walled tanks; the Type IV" designation was applied to the single-walled, uncooled tanks several years after their design, construction, and initial utilization, which preceded the earliest Type III design.)

The fourteen Type III tanks covered by this EIS are in various stages of construction (see Table D-1). These tanks were funded by three separate projects authorized in Fiscal Years 1976, 1977, and 1978. The proposed action considered by this environmental statement includes completing the construction of the fourteen tanks and then using the tanks to store waste. This action will facilitate the continued safe interim storage of waste from the SRP production of nuclear materials and make possible the retirement from service of tanks of older designs beginning with known leaking tanks.

The design of the Type III tanks evolves from the more than 25 years in waste tank operational experience at the SRP. Major improvements that were adopted in successive series of tanks are listed in Table 3-5. The proposed action is consistent with the base case in ERDA-1537, i.e., Alternative 4, "Improve Waste Management Practices in Accordance with ERDA Policies and Standards."

The locations of the various tanks within the F and H Areas are shown in Figures 3-1 and 3-2. Also shown are the fiscal years in which various groups of tanks were authorized.

3.2.1 Design Features

The design of the Type III tanks is illustrated in Figure 3-3. Basically, the tanks consist of a steel primary container in the shape of a free standing toroid built around a central concrete column which supports the 48-in.-thick concrete roof slab. The primary container has an 85 ft outside diameter, 6 ft 9 in. inside

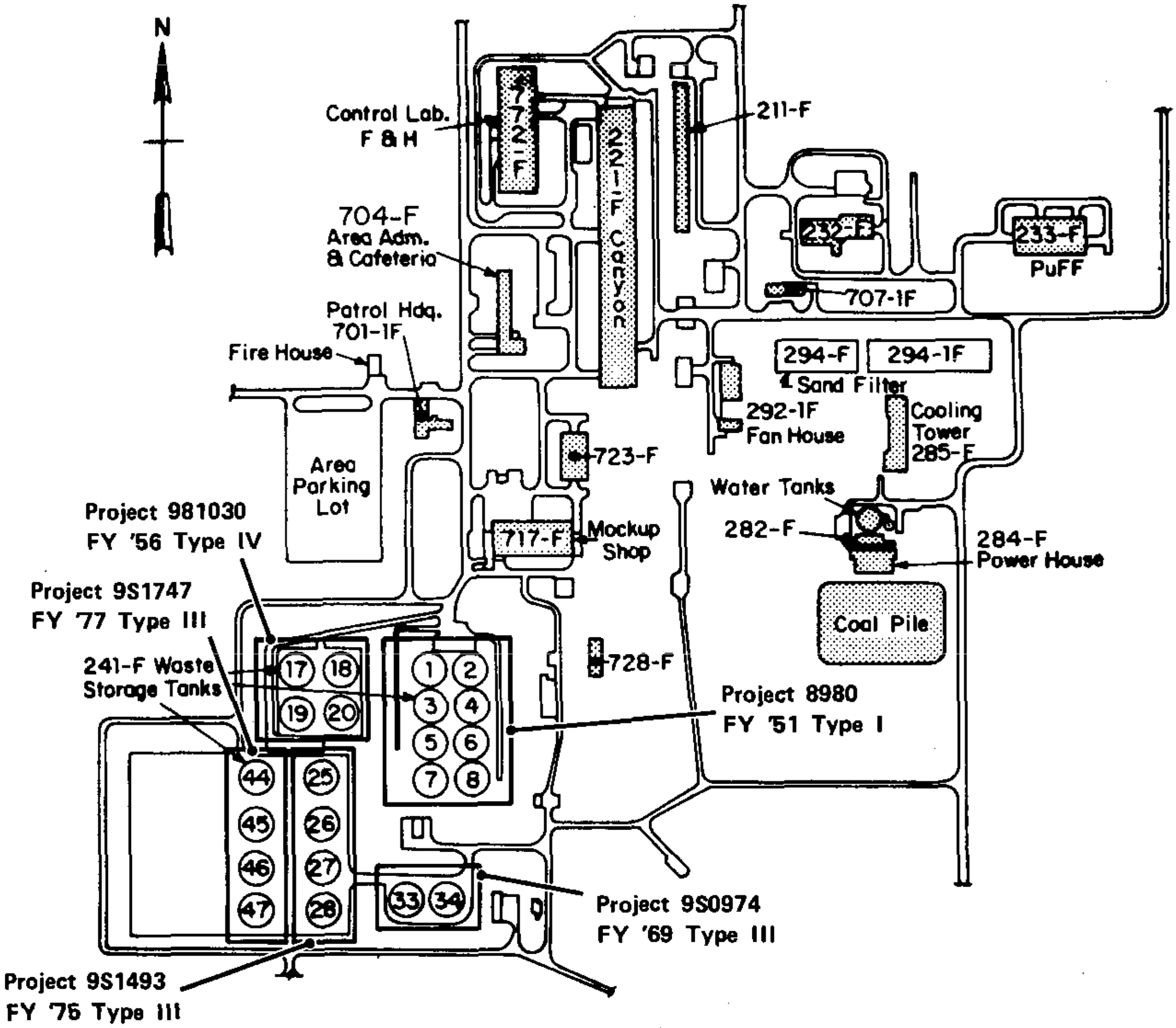

FIGURE 3-1. 200-F Area Waste Tank Locations

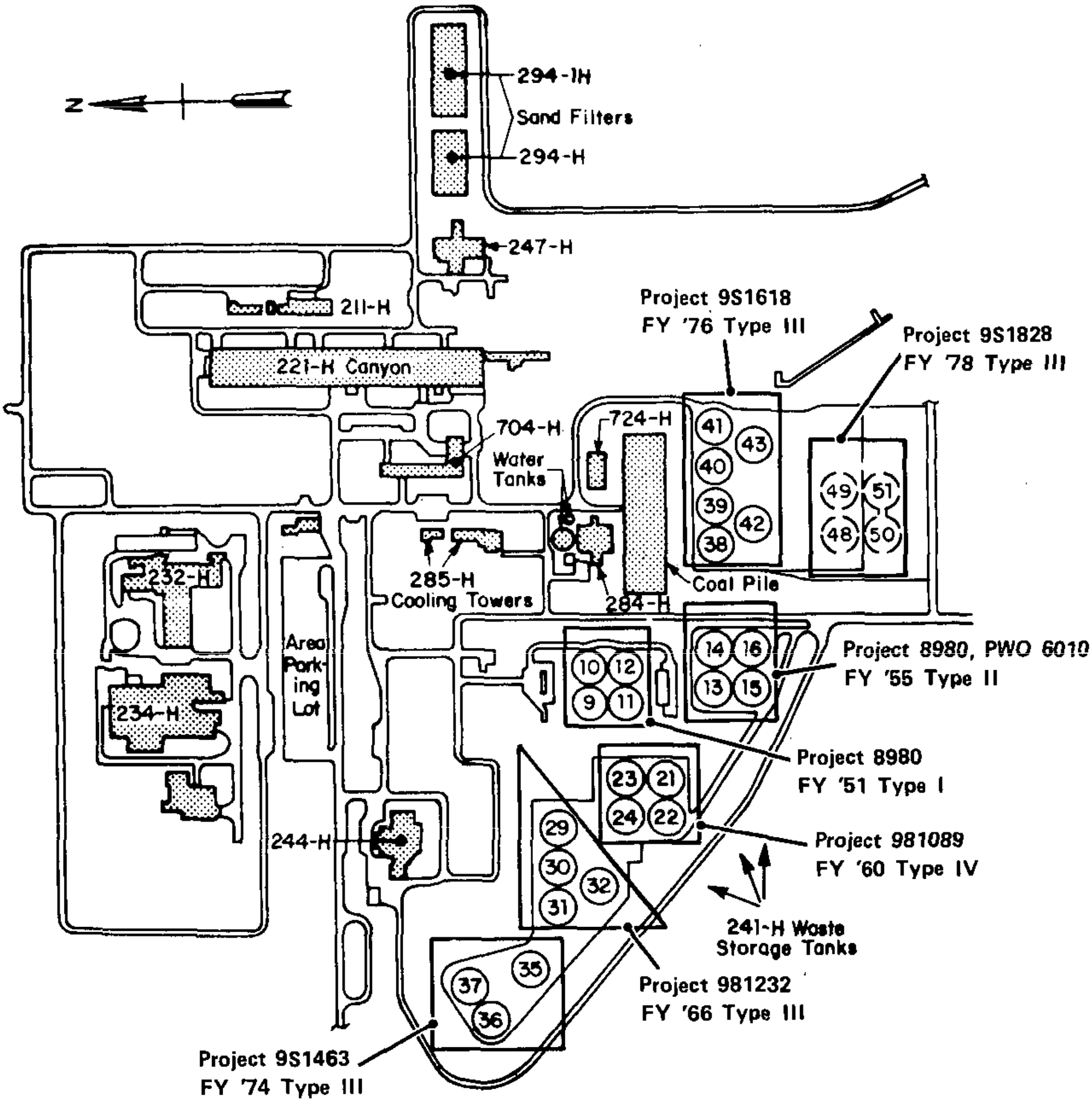

FIGURE 3-2. 200-H Area Waste Tank Locations

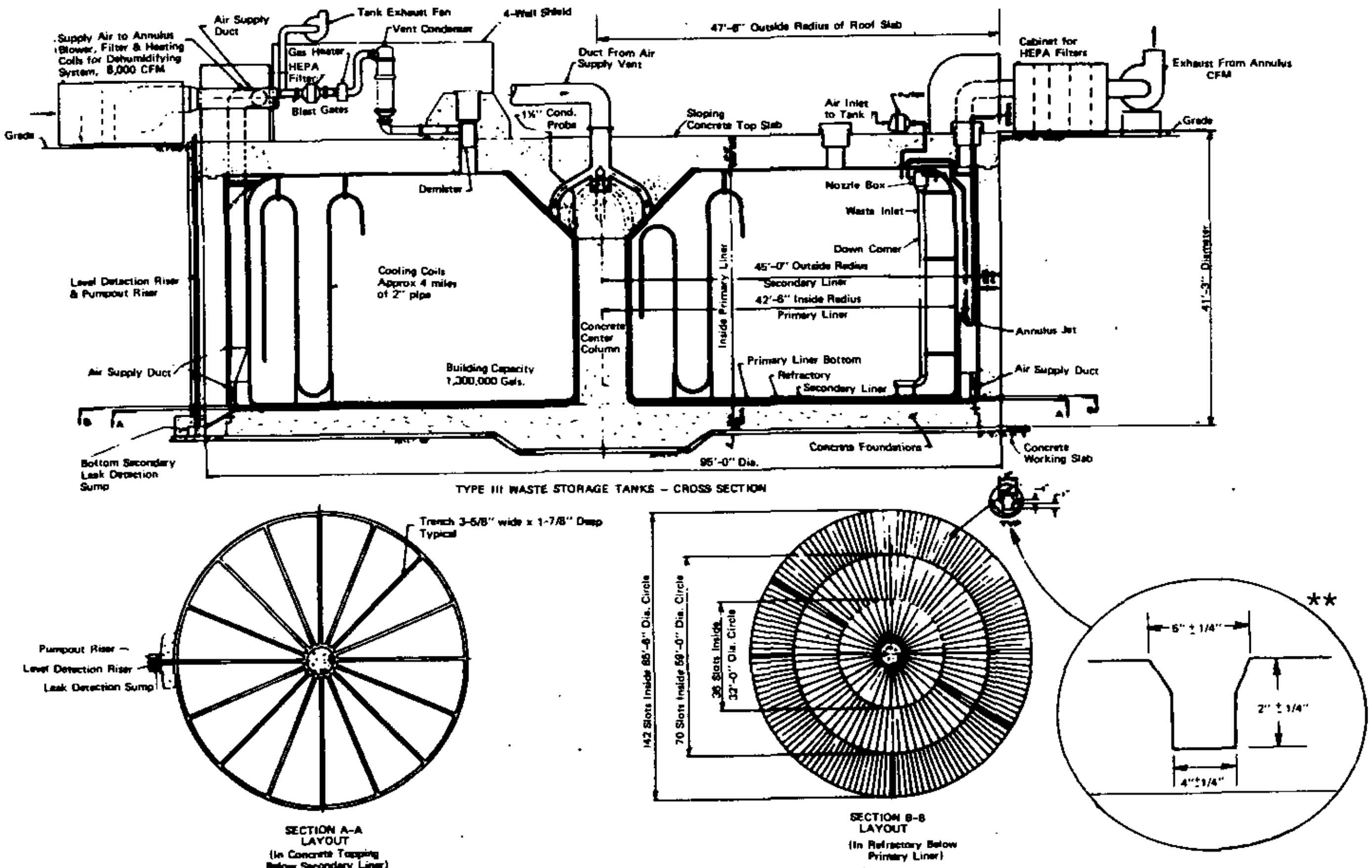

FIGURE 3-3. Type III Waste Storage Tanks
(Building 241-F, Tanks 25 through 28 and 44 through 47)*
(Building 241-H, Tanks 38 through 43 and 48 through 51)*

* Under construction

C| ** Added figure and clarified some dimensions on diagram.

diameter around the central concrete column, and is 33 ft tall; it has a volume of 1,300,000 gallons. The primary container rests on a bed of insulating concrete (8 inches thick). It is contained within a full-height steel secondary container also toroidal in shape, but without a separate steel top. There is a 2-ft 6 in. annulus between the outside of the primary container and the secondary container. The secondary container is encased in a concrete vault ranging from 2.5 to 4 ft thick. Penetrations through the roof provide openings for instrumentation, ventilation, and waste transfers as well as access to the tank space and annulus for inspections and entry of cooling coils. The design is described in greater detail in Appendices A and B and also in Section II-4 of ERDA-1537, Waste Management Operations, SRP.

The Type III tank design drew on the years of operating experience accumulated with the earlier types of waste tanks (I, II, and IV). One of the most important changes was the incorporation of a postfabrication heat treatment to the primary tank to eliminate the high residual stresses induced by seam welding in the field of the many individual steel plates which go to make up a single tank. High residual stress is an essential factor in promoting the stress corrosion cracking which has been experienced in nine of the sixteen Type I and II waste tanks (see Appendix B). The efficiency of the stress-relieving heat treatment applied to all Type III tanks is evidenced by the fact that no leaks have been observed in any of the nine Type III tanks put in service to date (initial service began in 1971).

Other major design improvements incorporated in the successive Type III tanks include full-height steel secondary vessels (vs. the 5-ft high "pans" under the Type I and II primary tanks), air cooling of the center column and bottom of the primary tanks, roof support column mounted on the tank foundation, and bottom-supported, distributed cooling coils. In addition, numerous improvements have been incorporated in instrumentation, surveillance and leak detection facilities, off-gas and spill monitoring, materials of construction, and quality control specifications and surveillance. The initial and subsequent improvements incorporated in the Type III tanks are summarized in Table 3-5 and discussed in the following sections. Additional details concerning design features, quality control practices, and other measures to provide increased assurance against escape of radioactive waste from storage facilities are presented in Appendix A.

3.2.2 Tank Design Improvements and Engineered Safety Features

Specially designed features are provided to mitigate the consequences of abnormal events or postulated accidents. In addition to these engineered safety features, administrative controls provide detailed procedures for performing normal operations and methods for recognizing and correcting abnormal conditions.

TABLE 3-5

Improvements in SRP High-Level Waste Tank Design

Tank Type	*I*	*II*	*III*	*III*	*III*	*III*	*III*	*III*	*III*	*III*
Tank Numbers	*1-12*	*13-16*	*29-32*	*33, 34*	*35*	*36, 37*	*25-28*	*38-43*	*44-47*	*48-51*
Project No.					*74-1-a*	*74-1-a*	*75-1-a*	*76-8-a*	*77-13-d*	*78-18-b*
(DuPont Project No.)	*(8980)*	*(PWO)*	*(1232)*	*(974)*	*(1463)*	*(1463)*	*(1493)*	*(1618)*	*(1747)*	*(1828)*
• Primary Liner Stress Relief			✓	✓	✓	✓	✓	✓	✓	✓
• Single Roof Support Column		✓	✓	✓	✓	✓	✓	✓	✓	✓
• Full-Height Secondary Liner			✓	✓	✓	✓	✓	✓	✓	✓
• Secondary Liner Leak Detection										
a) Radiation Probe Conduits						✓				
b) Collection Channel Grids and Sump							✓	✓	✓	✓
• Primary Liner Steel Specifications	A-285 Grade B →		←		A-516 Grade 70		→	←	A-537 Class I	→
a) As rolled	✓	✓	✓	✓						
b) Normalized					✓	✓	✓	✓	✓	✓
c) Sand- or Grit-Blasted								✓	✓	✓
• Secondary Liner Steel Specifications	A-285 Grade B →		←			A-516 Grade 70				→

TABLE 3-5, Contd

Tank Numbers	*1-12*	*13-16*	*29-32*	*33,34*	*35*	*36,37*	*25-28*	*38-43*	*44-47*	*48-51*
• Fixed Distributed Cooling Coils	✓	✓				✓	✓	✓	✓	✓
• Bottom Support of Cooling Coils Except 32 and 35			✓	✓		✓	✓	✓	✓	✓
• Air-Cooling Under Primary Tank			✓	✓	✓	✓	✓	✓	✓	✓
• Permanently Installed Annulus Jets	*	*	*	*	✓	✓	✓	✓	✓	✓
• Hydrogen Monitors	**		*	*	✓	✓	✓	✓	✓	✓
• Wire Mesh Separators	***	***	✓	✓	✓	✓	✓	✓	✓	✓
• Entry Line Jackets Continuous to Primary Tank					✓	✓	✓	✓	✓	✓
• Fully Shielded Vent Condenser and Filter					✓	✓	✓	✓	✓	✓
• Tank Top Sloped to Drain Rainwater							✓	✓	✓	✓
• Multiple Inspection Ports into Annulus		*			✓	✓	✓	✓	✓	✓

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* Added later.

** Added to Tank 4 only (fresh HHW receiver).

*** Being added to evaporator feed tanks (7 and 13) and tanks scheduled for salt removal (1,2,3,9,10,19,20,22,24).

3.2.2.1 Single Roof Support Column

Improved stress distribution in the primary tank is achieved by mounting the roof supporting column on the foundation pad rather than on the bottom of the primary tank (as in Type I tanks with 12 columns and Type II tanks with one central column) and by providing an annular clearance around the roof supporting column.

3.2.2.2 Full-Height Secondary Liner

Tank design without an annular space was rejected because of the reduction in leak detection capability and the loss of containment capability should the primary containment be breached. A secondary containment other than full-height (vs. 5-ft pan for Type I and II tanks) steel liner was rejected because of the loss of containment capability for high leak rates. Secondary containment permits annulus jets to transfer the leaking material back into the tank before it reaches the environment. Then the tank contents can be transferred to another tank, if required. Spare tank volume is maintained in sound double-walled tanks in each of the two waste tank areas (F and H). This volume is equivalent to the largest volume of waste stored in any one tank.

3.2.2.3 Secondary Containment

All primary transfer systems and storage containers have secondary containment. Transfer lines are jacketed in secondary containers which drain to collection and leak detection boxes. All connections in transfer lines such as diversion boxes, waste tank inlet risers, or evaporator enclosures have secondary containment. The Type III tanks (25-51) have full-height secondary tanks about the primary tank.

In the FY-1974 and subsequent Type III tanks, the packed telescoping joint in the line jackets is eliminated, and the jacket is continuous to the tank interior with a seal weld to the primary tank upper knuckle. This provides greater jacket integrity and permits hydrostatic testing of the jacket. To accommodate expansion, the jacket passes through a slightly larger pipe sleeve welded to the secondary liner and embedded in the concrete vault wall. The annulus between the jacket and the sleeve is packed with asbestos to seal off the tank annulus space from the tank exterior.

3.2.2.4 Leak Detection Systems

Conductivity probes and pneumatic level measuring devices are installed in the secondary container around each Type III waste tank to detect any accumulation of waste due to failure of the primary tank. These devices have visual and audio alarms located in the operating control rooms.

More recently installed transfer lines also have leak collection boxes installed in the transfer line jacket at the low point of the line. In the unlikely event that a leak develops in the transfer line, the waste would drain to the collection box and be detected by a conductivity probe.

3.2.2.5 Secondary Liner Leak Detection

a) Collection Channels and Sump

Beginning with waste tanks constructed under the FY-1975 project, the capability to monitor for leaks in the secondary container was added. This feature will permit verification of the integrity of the secondary container. A grid of interconnected radial channels is formed on the inside of the concrete base slab on which the secondary tank rests. The channels are sloped to drain through a collection pipe to a sump inside the concrete enclosure around the tanks. An access pipe rises to grade from the sump to allow for liquid measurement, sampling, and pumpout of any liquid collected.

b) Radiation Probe Conduits

A gamma monitoring tube network was installed beneath the tank foundation slab of Tanks 36 and 37 (FY-1974, Project 74-1-a) because no leak detection grid (as planned for future Type III tanks) was included in this project. (The gamma monitoring network was not installed under Tank 35, also a FY-1974 tank, because the tank was urgently needed for fresh waste service, and the installation of monitoring tubes would have significantly delayed completion of this tank.)

Twice yearly a gamma radiation detector is passed into the tube liners. Because there is earth and concrete shielding between the tubes and the stored waste, radiation levels in the liner are low, and indications of high radiation would indicate waste in the ground outside the tank. The count rate is observed for any change from background.

Gamma radiation monitoring was replaced by the grid system of channels (Section 3.2.3.5.a) because drainage to the sump can be continuously monitored if desired, as opposed to checks twice per year with the radiation monitor. The grid system was also less expensive and provided perhaps better leak detection capability.

3.2.2.6 Improved Primary Liner Steel Specifications

a) Specially Heat Treated Steel

FY-1976 tanks were constructed with normalized A 516-70 steel. Normalizing is a heat treatment (analogous to annealing) that refines grain size and improves the toughness of the steel plate. A 537-Class 1 steel was used for FY-1977 and -1978 tanks. This steel is supplied only in normalized condition, and the chemical composition is similar to A 516-70 except that minor alloying additions are specified to ensure higher and more uniform strength among various heats of the steel. See Appendix B for additional discussion of the selection of materials.

b) Sandblasting

Tank surfaces are sand- or gritblasted prior to tank fabrication to facilitate inspection requirements. Plate surfaces are inspected for inclusions and laminations. These defects are easier to detect with mill scale removed by the sandblasting. Plate edges are ground clean and smooth to inspect for end laps.

3.2.2.7 Fixed Distributed Cooling Coils

The first seven Type III tanks built were designed to be cooled by up to ten removable cooling bundles containing many vertical pipes spaced a few inches apart. The primary objective of the design change from the distributed coils (on four-foot centers) used in the Type I and II tanks was to make the coils replaceable in the event of failure. For the same reason, the horizontal coils of the earlier tanks were omitted from the Type III models because they could not be made replaceable, and experience had shown that most of the fission product heat from the sludge layer was first transmitted into the supernatant liquid and thence into the vertical coils. Air cooling under the primary tank bottom was provided to ensure that the tank steel does not become overheated.

Close-packed coil bundles are adequate for cooling unevaporated (as received) waste, including a sludge layer several feet thick, because thermal convection circulates the supernatant liquid and carries the heat to the coils. However, in tanks receiving evaporator concentrate, cooling surfaces soon became encrusted with crystallized waste salts and all heat must flow through the deposited salt by conduction, which is relatively inefficient. Hence cooling coils must be distributed as widely and uniformly throughout the tank as possible, so that a maximum volume of solid salt can be accumulated before the salt thickness on any one coil becomes too great to pass its share of the heat to be dissipated.

For this reason, tanks authorized in FY-1974 and subsequently (except Tank 35) have been or are being provided with distributed coils on three-foot triangular centers, sacrificing replaceability for improved efficiency in concentrate service.

Unlike the distributed vertical coils in the Type I and II tanks, which are supported from the tank roof, the distributed coils in Type III tanks are supported from the tank bottom. This change eliminates any possibility of overloading the roof if the accumulated salt mass settles several inches, carrying down the coils embedded in it.

The distributed cooling coil system is designed to cool waste concentrate adequately despite salt encrustations, as discussed above. At maximum salt accumulation the system can remove 1/2 million or more Btu/hr per tank, sufficient to remove both sensible and radiolytic heat from evaporator concentrate. In non-saturated waste solutions, the system has a nominal design rating of six million Btu/hr, and can handle at least ten million Btu/hr for liquid waste in which convection cooling is effective. However, based on experience, an operating limit of 3.5 million Btu/hr is applied to tanks receiving fresh high-heat waste to assure adequate heat removal from the sludge into the supernate.

3.2.2.8 Air Cooling Under Primary Tank

Type III tank ventilation and dehumidification systems not only supply low relative humidity air to the outer annulus space directly but also route part of the air to the inner annulus, and from there it passes beneath the primary tank through radial channels in the concrete base slab and exhausts into the outer annulus. The annulus ventilation system has a capacity of about 8000 cfm, up to half of which can be passed through the inner annulus and beneath the primary tank in tanks for FY-1976, -1977, and -1978, compared to 1000 cfm in earlier Type III tanks. The increased airflow is to aid in cooling the tank bottom. This cooling eliminates the need for horizontal coils near the bottom of the tanks.

3.2.2.9 Permanently Installed Annulus Jets

These are steam-jet eductors used to transfer liquids. All the waste tanks have jets installed in the annulus to provide a ready means to transfer any leakage into the annulus back into the tank before any release to the environment. Then the tank may be emptied if required. The jet steam service is connected when service is required.

3.2.2.10 Ventilation Systems

The ventilation systems that provide an air sweep through waste tanks are designed to maintain the vapor space negative with respect to atmospheric pressure. This negative pressure prevents the release of contaminated air to the atmosphere during normal operation through inadequately sealed risers or tank openings. In the event of loss of forced ventilation or of a loss of cooling which could result in the liquid contents reaching the boiling point, particulate filters on both the exhaust and inlet piping will minimize the release of airborne radioactivity to the atmosphere.

3.2.2.11 Hydrogen and Radioactivity Monitors

Instrumentation to monitor continuously the concentration of hydrogen in the gas mixture within each waste tank and the radioactivity in filtered air leaving the tank was installed in FY-1974 and all later tanks.

a) Hydrogen Monitors

Waste water decomposes into H_2 and O_2 in high radiation fields. In a full, fresh high-heat waste tank (3.5×10^6 Btu/hr), the decomposition is rapid enough to reach the flammable limit in less than half a day unless purge ventilation is maintained.

Hydrogen monitors are included for the new tanks to provide continuous monitoring of the vapor exhausting from the tank to detect any increase in hydrogen content in the tank. The system includes a combustible gas detector, a control unit, a gas sampling system, and an alarm.

The gas in the sample is subject to flameless burning on the face of a catalyst-coated sensing element where a change in electrical resistance, highly specific to the proportion of combustible gas in the sample, takes place. Changes in electrical balance are sensed at the control unit to produce appropriate meter and indicator displays. System alarms produce immediate followup by operating and Health Protection personnel to determine the cause of the alarm.

b) Radioactivity Monitor

A fraction of the tank exhaust air, after filtration, is passed at 3 to 5 cfm through a 3-in.-diameter filter paper. The filter paper is monitored by a photomultiplier tube whose signal is amplified and sent to the tank farm control room. The detector alarms at an increase in radioactivity above background, currently about 1500 c/m beta-gamma, and alerts operating and Health Protection personnel to check for an abnormal condition. The filter paper is routinely changed weekly, if no abnormal conditions occur, and processed through the Health Protection Department counting room to measure and maintain records of low-level radioactive release from the tank.

3.2.2.12 Radiation Monitors

Gamma monitors are strategically located above the waste tanks throughout the tank farm to detect any increase in the atmospheric radioactivity. In addition, a gamma monitor is mounted at each concentrate inlet riser to alert personnel quickly to any surface spill. Each monitor has an alarm in the operating control room.

3.2.2.13 Wire Mesh Separator

Wire mesh separators are installed on Type III tanks. The tank air purge leaving the tanks pass through the separator to remove entrained liquids. The effluent from a separator passes through a water-cooled condenser to remove excess humidity and entrained radioactivity. The condensate is recycled to the tank. The saturated air from the condenser is then heated to a temperature above its dew point to prevent moisture from condensing on and blinding the exhaust filters with subsequent loss of filter efficiency.

3.2.2.14 Automatic Air Blow of Gang Valves

If steam pressure is lost during operation of a transfer jet (steam-jet eductor), the potential for suckback of waste into the gang valve exists. To prevent this, a bypass is installed from
C| the air header to the process side of the gang valve. In case of loss of steam supply, the pressure switch located in the steam supply will signal the automatic valve in the plant air line to air blow the gang valve.

3.2.2.15 Emergency Power

Each waste tank farm is provided with emergency diesels that will provide power to critical systems (such as cooling water pumps, liquid level instrumentation, ventilation, etc.) in the event of loss of normal power.

3.2.2.16 Earthquake Protection

All new waste tanks (FY-1974 project and beyond) and new evaporator facilities are constructed to maintain functional integrity in a design basis earthquake (DBE) producing ground accelerations at the site of 20% of the acceleration of gravity (0.2 g) at zero period. Studies* of the effects of such an earthquake on existing waste storage tanks concluded[5] that (1) the primary containers would not be damaged if fill limits are not exceeded, (2) the secondary metal containers would not be damaged, and (3) moderate cracking of the concrete structures could occur.

3.2.2.17 Tornado and Hurricane Protection

All new waste tanks (FY-1974 project and beyond) were designed to maintain functional integrity in the following design basis** tornado or wind storm:

- 290-mph tangential velocity (230)
- 70-mph transverse velocity (50)
- Average 3-psi ambient pressure drop in 3 seconds (1.5)
- Wind-generated missiles

The numbers in parentheses are the present values for the design basis tornado at SRP based on the referenced Texas Tech** report, but were derived after the waste tank design was adopted. The design basis tornado has an estimated recurrence frequency of less than 10^{-5} per year.

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* Effects of a DBE on underground waste storage tanks were evaluated by John A. Blume & Associates, Seismic Analysis of Waste Storage Tanks, Report DPE-3409, E. I. du Pont de Nemours & Co. (Inc.), Design Division, Engineering Department, Wilmington, DE (1975).

** The design basis tornado for SRP was derived from a study by Texas Tech University, "Development of Windspeed Risk Models for the Savannah River Plant Site," Institute for Disaster Research and Department of Civil Engineering, Lubbock, TX (October 1975).

Detailed evaluation of tornado resistance of the present waste tanks leads to the following conclusions:

- Small high-velocity missiles and massive low-velocity missiles could damage above-ground structures (e.g., ventilation equipment) and disrupt electrical services. Activity release from the waste tank would be minor.

- The primary liner of any double-walled tank may deform below the top knuckle if the annulus pressure exceeds the internal pressure by some specific amount, which ranges from 1.3 to 2.7 psi. Pressure differentials in that range are unlikely, because the area of the annulus vent is about nine times that of the tank vent, and damage would probably increase the areas of the vents.

- Small lightweight plugs could possibly be lifted from the tank and tank annuli and transferred as missiles. It was concluded that waste would not be entrained or aspirated from the tanks because the area of the openings exposed to the liquid is relatively small, and the distance from the ground surface to the liquid surface is large. The riser plugs do not have to be restrained against tornado forces.

Above-ground structures (with the exception of the evaporator) can be assumed to lose their function in the event of a design basis tornado.

The likelihood of release of radioactivity from waste handling and storage equipment as a result of hurricane-generated winds is much lower than for a tornado. The maximum recorded wind speed of 75 mph for the plantsite occurred during passage of hurricane Gracie in 1959, and no significant damage occurred on the plant. This wind speed is about the maximum expected because of the inland location of the plant.

3.2.2.18 Closed Loop Waste Tank Cooling System

The cooling water system is operated at a pressure greater than the hydrostatic head of the waste at maximum fill level. If a leak develops in a cooling coil, the waste will not enter the cooling water system, but rather cooling water will flow into the tank. The proper cooling water pressure is maintained by an elevated surge tank in the closed cooling loop. Heat is removed by a cooling tower.

3.2.2.19 Storm Water Diversion System

Each waste tank farm has a storm water sewer system to route surface water runoff through a monitor before discharge to Four Mile Creek. Because this sewer drainage may become contaminated from surface spills of waste, the system is segregated and continuously monitored with swirl-cell gamma detectors.

The F- and H-Area waste farms are divided into zones, based on the terrain. Each zone is monitored individually, and if any monitor detects radioactivity, the contents of that sewer system are automatically (or manually) diverted to a lined retention basin for further handling. Once it is in the retention basin, the water may be:

- Pumped to natural effluent streams if within guidelines.
- Pumped to seepage basins if this would not exceed the current operating guide limits for such discharges.
- Pumped through a filter-deionizer system for removal of radioactivity with effluent from this system recycled to the retention basin, sent to seepage basins, or released to a plant stream. The filter-deionizer would be regenerated, and the radioactivity collected would be sent to waste tank storage.

A radiation detector is installed in the storm sewer for each zone and is located sufficiently upstream from the diversion gates to allow the necessary response time for operating the sluice gates. The radiation detector will automatically initiate diversion of storm water when gamma activity greater than normal is detected. Although some radionuclides included in liquid waste are not gamma emitters, they are always accompanied by other gamma-emitting fission products. An alarm is sounded and a sample of water is collected automatically when water is diverted.

On signal from a storm sewer monitor, the appropriate storm water sluice gates will operate to divert flow (which otherwise would go to Four Mile Creek) to the retention basin. Sluice gates are driven by electric motors. Manually operated handwheels are provided for emergency use. Storm water sluice gates and water monitors are furnished with emergency power.

The storm water systems are automatically (or manually) diverted to controlled holding areas if they become contaminated to levels that exceed established operating guides. These guides are well within the release limits cited in ERDA Manual Chapter 0524.

3.2.2.20 Monitoring Wells

A system of monitoring wells is provided within and about the radioactive waste storage sites to monitor for leaks from waste tanks, transfer lines, and other tank farm equipment and to monitor possible migration of radionuclides from their storage locations.

Two types of wells are installed: dry wells in which a gamma radiation monitor is inserted to measure increases in radiation dose rates and water wells from which water samples are drawn for laboratory analysis.

Currently there are 73 dry monitor wells and 49 water monitor wells in the F- and H-Area waste tank farms. Thirteen of the water wells are being used to monitor for any leakage from Tank 16 sludge removal and chemical cleaning.

The Health Protection Department personnel routinely collect and analyze samples from the water wells and routinely monitor radiation levels in the dry wells.

3.2.3 Reasonably Foreseeable Environmental Effects

The only significant adverse effects caused by the construction and operation of the new waste tanks will be (1) the small offsite population dose commitment (less than 1.3 man-rem for population living within 150 km of SRP) from release of radionuclides, primarily tritium as water vapor from the waste tanks, and (2) the commitment of about one acre of land for each waste tank for an indefinite period.

Use of the new tanks will provide safer containment for future waste produced as a result of operation of SRP for defense purposes. In addition, these new tanks will allow early retirement of older design tanks, which have a greater potential for adverse environmental effects because they do not have all of the design improvements incorporated in the new tanks.

3.2.4 Effect on Tank Durability

Design of the new waste tanks has incorporated features which help maximize the durability of the tanks for the service*

* Service includes receiving fresh high-level liquid radioactive waste, storing waste while it cools and while a layer of insoluble sludge forms on the bottom of the tank, receiving evaporator concentrate, and storing crystallized salt formed from evaporator concentrate.

for which they will be used. These features include improved steel, stress relief of the steel, full secondary containment, improved ventilation of the tank bottom and annulus, excess cooling capacity, leak detection instrumentation, and continuous gas and radioactivity monitoring.

Continuing operational control of the waste composition sent to the tanks will also contribute to maximum tank durability.

3.2.5 Effect on Ease of Waste Retrieval from the Tanks

Waste retrieval has already been successfully demonstrated from similar tanks, and therefore there is no adverse effect foreseen in the design of the new waste tanks.

3.2.6 Relationship to Long-Term Waste Management Program

The Waste Management Program has required in the past and will require in the future the transfer of liquid, sludge, and salt between tanks to fulfill the requirements of the program. Such transfer, of course, is essential to the long range plans to remove the waste from the tanks for final disposal. Experience gained with the sludge removal and chemical cleaning of Tanks 10 and 16 indicates that the present tank design permits efficient waste transfer and tank cleanout.

Installation of the new tanks is highly desirable for completion of a long range waste disposal program in an efficient manner. In particular, segregation of older waste (both sludge and salt) from more current waste is made possible by use of the new tanks. Another advantage is that the waste is maintained in an easily retrievable condition.

The Department of Energy has published the Final Environmental Impact Statement, Long-Term Management of Defense High-Level Waste (R&D Program for Immobilization), Savannah River Plant (DOE/EIS-0023), November 1979, to analyze the environmental implications of the proposed continuation of a large Federal research and development program directed toward the immobilization of SRP high-level waste. The new waste tanks will provide reliable storage of the waste and allow adequate time to implement the strategy of the long-term management plan.

3.2.7 Waste Tank Utilization Plans

Current plans for utilization of existing and new waste tanks at SRP are shown graphically in Appendix F. This is the January 1980 forecast of tank usage. These forecasts are routinely updated.

Most of the new tanks will be placed in service almost immediately after their completion, with several serving temporarily as receivers for supernate currently stored in older-design tanks. Liquid supernate will be transferred directly from older tanks to the new ones; this transfer will be completed by the end of CY-1981. Direct transfer of supernate, rather than processing it through the evaporators, will make it possible to remove the more mobile liquid from the older tanks earlier than could otherwise be done. Salt dissolution and transfer will begin also in CY-1980 and be essentially complete by the end of CY-1982. Except for the Tank 16 demonstrations, sludge removal operations will not begin until CY-1982; these operations will continue through CY-1987.

Sludge and salt removal, chemical cleaning, decommissioning, and dismantling of waste tanks are discussed in more detail in Appendix C.

3.3 OTHER ALTERNATIVES

As described in Section 3.2, the design of the SRP Type III waste tanks has evolved continuously over a twenty-five year period and has involved the review of a large number of alternative designs with the steady incorporation of advantageous new features and the rejection of others. Construction of the waste tanks in the 1976, 1977, and 1978 SRP projects according to the latest developments in the Type III tank design is now substantially complete. However, the Court requested a rereview of the specific design and safety features of the Type III tanks. The Court-ordered alternatives for SRP are thicker and more chemically resistant steel plates, an impressed current cathodic protection system to guard against stress corrosion cracking, better waste retrieval equipment, and enlarged tank openings to facilitate retrieval.

3.3.1 Thicker and More Chemically Resistant Tank Steel

The alternative of using thicker and more chemically resistant steel plates for the tanks to enhance resistance to corrosion and increase tank life is examined in this section. The use of thicker and more corrosion-resistant steel plates has no effect upon either the ease of waste retrieval or on the choices of technology for long-term waste storage or final disposal. It does have some perceived effect upon tank durability, and therefore on reducing the potential for adverse environmental effects in the event of containment failures.

The tank life predictions are based on the following considerations:

- A survey[6] of the life of large, field-erected, carbon-steel vessels from several hundred cases in industrial and utility service indicated a service life ranging from 40 to 60 years for above-ground steel storage tanks (accessible for inspection and maintenance painting). Buried steel tanks or pipelines in corrosive soil conditions can have extremely short lives of 3 to 10 years. However, in the underground SRP storage tanks, ground contact with the primary and secondary tanks is prevented by the concrete support structure. The dry air in the annulus reduces external corrosion to an even greater extent than for painted field-erected tanks, and the life expectancy of the waste tanks should be at least comparable to these tanks.

- Wall thickness measurements on all Type I, II, and III SRP tanks, some with up to 25 years of service, and measurements of the bottom plate thickness on two SRP tanks have shown no wall thinning due to general corrosion. The ultrasonic method of measurement of tank wall thickness can detect a loss of about 0.03 inch or more, or a general corrosion rate of less than 0.001 in./yr. Test coupons exposed in synthetic and actual waste solutions showed both general and pitting-type corrosion to be insignificant (rates of less than 0.001 in./yr). Examination of one of the cracked tanks (Tank 16H) showed that the stress-corrosion cracks originated on the internal surfaces and that corrosion on the external surface of the steel was minor. Thus, general corrosion appears to be a negligible factor as a life-limiting feature for the SRP waste tanks. It is therefore not obvious that increases in wall thickness or in general corrosion resistance would contribute to an increased life of the SRP tanks beyond the 40-60 year estimate, even if that were required.

The alternative of more chemically resistant plates has, in essence, been adopted via the change to a normalized (heat-treated) steel and postfabrication stress relief of the primary tanks. As described in Appendix B, the corrosion resistance of the steel used in waste tanks has been studied extensively at Savannah River, and the key factor has been found to be stress corrosion. The steel used in the early tanks (ASTM A285-B, not stress-relieved), was susceptible to nitrate stress corrosion. Studies have shown that the Type III tanks (constructed since 1967), which are made of ASTM A516-70 or ASTM A-537 Class I steel and which are stress-relieved after erection, have greatly improved resistance to stress corrosion. No leaks have been observed in Type III tanks in the eight years that they have been in service, whereas leaks were observed in Types I and II tanks in less than one year. Furthermore, improvements in the control of waste composition, which were adopted in 1977, have also reduced the probability of stress corrosion cracking.

The wall thickness specification of the new tanks was based upon consideration of working stress instead of thinning due to corrosion. Based on the measurements mentioned earlier, the thickness of the steel in the tank walls is considered adequate. Adequate resistance to applied mechanical forces basically involve general engineering principles and is primarily a function of design, yield strength of the steel, and section thickness. This aspect of waste tank construction is straightforward, and thicker walls are not required to meet the structural requirements.

3.3.1.1 Reasonably Foreseeable Environmental Effects

The environmental effects of using tanks with thicker walls would be the same as for the waste tanks currently under construction. However, requiring thicker steel walls would entail abandoning the tanks currently under construction and building new tanks. Thus, there would be an incremental impact on construction and demand on land. This would delay the program to empty, chemically clean, and remove from service the Type I and II tanks (nine of which have leaked), and pose a higher potential risk to the environment.

A major impact of requiring thicker steel plates is cost. Stopping construction and not utilizing the tanks under construction would result in the loss of about $80,000,000 already spent or committed. Construction of tanks with thicker walls would cost more than the $126,000,000 authorized for the 14 tanks under construction.

3.3.1.2 Effect on Tank Durability

There is a perceived safety factor in thicker walls; however, fabrication, welding, and stress relief of thicker plates is more difficult and potentially less efficient. Since the experience with SRP tanks in service for periods up to 25 years has shown that there is no problem with general corrosion, thicker steel plates might actually result in lower durability due to the more difficult fabrication problems.

3.3.1.3 Effect on Ease of Waste Retrieval from the Tanks

Tank wall thickness would not have any effect on waste retrieval because waste retrieval equipment is supported by the concrete structure on top of the tank.

E| 3.3.1.4 Effect on Choice of Technology and Timing for Long-Term Radioactive Waste Storage and Final Disposal

There are no foreseeable effects.

3.3.1.5 Advantages and Disadvantages

The advantages and disadvantages of thicker and more corrosion-resistant steel are summarized as follows.

Advantages

- Perceived safety factor due to thicker steel to compensate general corrosion.

Disadvantages

- Delay in implementing interim waste management program
- Difficulty in fabricating, welding, and stress-relieving the steel
- Additional cost for new tanks
- Loss of money already spent on tanks under construction
- Incremental impact due to construction and demand on land

3.3.2 Cathodic Protection

Corrosion of a metal can be defined as loss of metal by a chemical reaction in which the metal is converted to an oxidized state. This reaction is accompanied by loss of electrons from the metal to the surroundings in the form of an electric current. Suppression of this current, by impressing an external electric potential (such as from a battery or rectifier), prevents the corrosion. This process of suppression is called cathodic protection. One method to implement cathodic protection involves the use of an active metal anode (such as magnesium or aluminum) to supply electrons by corroding preferentially to suppress the corrosion of the desirable structure. In essence the active anode forms a battery with the structure to be protected. A combination of chemically inert anodes and power rectifiers to supply an external potential can also be used. In the case of the tanks, the latter method would be employed and the inert anodes would be immersed in the waste solution in the tank and the current impressed between them and the tank.

Cathodic protection is used to protect metal surfaces that are exposed to moist or wet corrosive conditions. Two factors control the effectiveness of cathodic protection: the surface potential of the metal (the amount of force needed to drive electrons from the metal as it is being oxidized or corroded, measured as V[olts] and the current density (the amount of electrical current in milliamperes per unit area resulting from the surface potential on the metal surface). The relationship between these two factors is primarily influenced by the composition of the metal, but it is also influenced by the oxidized corrosion surface layer (rust) on the metal, crevices and pits in the metal surface, stress on the metal, and the temperature of the metal and the surrounding solution. The current flow required for successful cathodic protection alters the chemical compounds where the metal and solution meet, but at the low current densities usually required for satisfactory corrosion control, this effect is insignificant, unless the metal is very sensitive to the altered environment.

Under proper conditions cathodic protection can prevent general and pitting corrosion and the initiation of stress cracks. It cannot, however, prevent propagation of existing cracks. Cathodic protection was considered for SRP waste tanks in 1972.[7] This 1972 study concluded that cathodic protection could be feasible for waste tanks but only after solution of several technical, engineering, and maintenance considerations centering around proper current distribution. After an analysis of the requirement of maintaining uniform electrical potential and current flow, it was concluded that (1) sludge would need to be suspended in the supernate at all times, (2) formation of a salt cake would introduce large uncertainty on the effectiveness of cathodic protection, (3) a system of monitoring for uniform distribution of current potential and flow over a long period of surveillance would be required, (4) a high integrity system to electrically insulate the anode from the tank would be required to prevent electrochemical attack of the tank, and (5) the possibility of accelerated corrosion due to stray currents would need to be evaluated. Many of these requirements, such as those to keep the sludge suspended at all times and not to evaporate the supernate to salt, are in direct conflict with the current SRP interim management program for high-level waste of maintaining waste in solid form to the extent practical and could appreciably increase the hazards in the interim program.

As a result of the improved tank construction including improved materials of construction, stress relief of finished tanks, and better understanding and definition of SRP waste that caused corrosion problems in waste tanks, development of the information necessary to implement cathodic protection was not undertaken. In fact, implementation of cathodic protection in waste tank service was judged to be counterproductive.

3.3.2.1 Reasonably Foreseeable Environmental Effects

The primary environmental effect is the potential problem due to the production of reactive gases with the requirement for sufficient ventilation of the vapor space above the waste in the tanks. Keeping the waste in liquid form would also increase the potential environmental risk.

The consumption of electricity would be negligible.

3.3.2.2 Effect on Tank Durability

A properly designed and adjusted cathodic protection system might eliminate general and pitting corrosion, and enhance tank durability. However, there must be a uniform distribution of current to prevent increased localized corrosion. Therefore, the cathodic protection system may be detrimental because of design, installation, operating, and monitoring problems.

The cooling coils in the waste tanks would be especially susceptible to corrosion problems if the cathodic protection system were not properly adjusted.

3.3.2.3 Effect on Ease of Waste Retrieval from the Tanks

The effect of cathodic protection on waste retrieval is to alter the composition of the waste by electrolytically converting water in the waste to H_2 and O_2, nitrate to nitrite, nitrite to nitrogen or ammonia and converting more sodium hydroxide to sodium carbonate because the increased ventilation will bring more carbon dioxide to the waste surface. Easily platable cations such as ruthenium, copper, and nickel will be reduced to metal on the tank wall and may adhere, thus making their removal difficult.

3.3.2.4 Effect on Choices and Timing on Technology for Long-Term Radioactive Waste Storage and Its Final Disposal

There are no foreseeable effects.

3.3.2.5 Advantages and Disadvantages

The advantages and disadvantages of a cathodic protection system are summarized as follows.

Advantages

- Eliminate general and pitting corrosion

Disadvantages

- Difficult to design and to maintain proper adjustment.
- May not provide uniform distribution of current
- Produces reactive gases
- Possible adverse effect on retrieval of waste

- May produce a steel surface potential conducive to stress cracking
- Use of electrical energy
- Additional studies relating to the engineering and maintenance considerations of ensuring proper electrical potential and current distribution are required
- May require keeping sludge in solution and stopping the salt crystallization program, both of which would increase environmental risk. Additional tanks would be required to store the more dilute waste.

3.3.3 Better Waste Retrieval Equipment and Enlarged Tank Openings

Although adequate waste removal methods have already been demonstrated for routine waste management operations as described in Appendix C, the sludge removal and chemical cleaning program for Tank 16 now in progress and salt removal techniques planned for 1980 are expected to develop more efficient methods to remove the wastes for the waste solidification program. This work includes testing and evaluation of existing equipment as well as development of improved equipment, as appropriate.

The long-shafted pumps that are being used to remove liquid waste, redissolve salt, or slurry sludge from the tanks are designed to fit into any tank riser two feet or larger in diameter. The SRP Type III waste tanks (No. 38-51) contain 9 access risers three feet or more in diameter which can be made available for use in retrieving waste. These risers are distributed over the tank top to provide adequate coverage for waste removal.

Pumping of all three waste products has been demonstrated in existing waste tanks by dissolution and hydraulic slurrying techniques. Therefore, larger riser openings are unnecessary.

There are good reasons to maintain riser openings as small as practical to provide maximum roof strength and to minimize release to the environment from any severe reaction within the tank or releases caused by tornadic winds removing the riser covers.

3.3.3.1 Reasonably Foreseeable Environmental Effects

No significant environmental effects, either positive or negative, are foreseen if the present openings were enlarged by 50%. However, the holes should be as small as practicable to minimize releases of radioactive material to the environment due to a reaction in the tank or as a result of a tornadic wind removing riser covers.

3.3.3.2 Effect on Tank Durability

Enlargement of tank top opening may reduce the stability of the tank top and therefore influence tank durability or the ability to retrieve the waste.

3.3.3.3 Effect on Ease of Waste Retrieval from the Tanks

Present waste retrieval systems involve slurrying and pumping. These systems can be accommodated in the present tank openings. Improved retrieval equipment can be designed to fit the present openings.

3.3.3.4 Effect on Choices and Timing of Technology for Long-Term Radioactive Waste Storage and Its Final Disposal

No effects are foreseen because the openings could be enlarged in the future if required to accommodate improved waste retrieval methods or equipment with essentially no environmental effects.

3.3.3.5 Advantages and Disadvantages

The possible advantages and disadvantages of enlarged tank openings and better waste retrieval equipment are:

Advantages

- Greater flexibility for equipment design
- Higher capacity units (need has not been demonstrated)
- Less time required for waste removal and cleaning (not demonstrated)

Disadvantages

- Possibly decreased tank roof strength
- Larger openings for radioactive material release
- Difficulty of sealing larger openings

3.4 NO ACTION ALTERNATIVES

The "No Action" alternatives were discussed in ERDA-1537 as follows:

Alternative 1 — store no additional radioactive waste onsite as a result of:

- shutdown of production operations, or
- processing of irradiated fuel at another site, or
- shipping all newly generated wastes to an offsite facility for processing and storage (except low-level waste)

Alternative 2 — store no radioactive waste onsite and restore waste management areas to their preplant condition

Alternative 3 — indefinitely continue present waste management practices without additional improvements

Implementation of any of these "No Action" alternatives would either preclude SRP from meeting its mission of producing special nuclear material for national defense or result in violation of DOE Waste Management policies. These "No Action" alternatives are therefore not considered to be consistent with the operation of the SRP and with the objectives of lowest practical radioactive releases and the best use of available technology.

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6. E. O. Kiger. Evaluation of SRP Waste Storage Tanks. DPSPU 73-11-3, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC (1973).

7. "Evaluation and Cost Estimate for Cathodic Protection for Waste Storage Tanks - SRL". Hinchman Co., Corrosion Engineers, France Palms Building, Detroit, MI (May 15, 1972).

4.0 AFFECTED ENVIRONMENT[1]

4.1 GENERAL DESCRIPTION OF SITE AND SURROUNDINGS

4.1.1 General Site Description

The Savannah River Plant, located in South Carolina, occupies an approximately circular site of about 300 square mile area. The site is bounded on the southwest by the Savannah River and centered approximately 25 miles southeast of Augusta, Georgia. It occupies parts of three South Carolina counties (Aiken, Barnwell, and Allendale). Figure 4-1 shows the location of the site relative to population centers within a 150-mile radius.

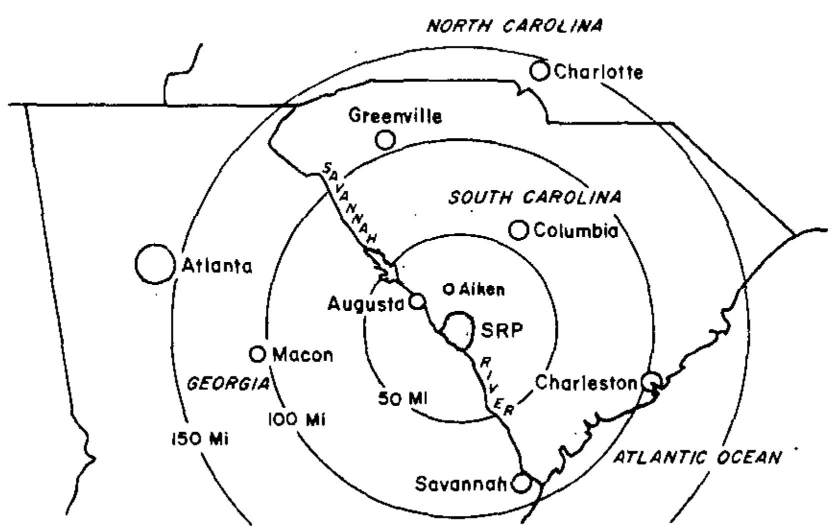

FIGURE 4-1. Location of SRP relative to Surrounding Population Centers

According to the 1970 census, major population centers within about 25 miles of the center of the plant are:

TABLE 4-1

Major Population Centers

City*	Distance, miles	Direction From Plant	Population
Augusta, GA	25	Northwest	59,864
N. Augusta, SC	25	Northwest	12,883
Aiken, SC	20	North	13,436
Williston, SC	15	Northeast	2,594
Barnwell, SC	15	East	4,439
Allendale, SC	26	Southeast	3,620
Waynesboro, GA	28	Southwest	5,530

* Includes incorporated suburban areas.

The plantsite lies on the Atlantic Coastal Plain physiographic province, and is underlain by the Tuscaloosa aquifer from which wells supply water to several operating areas. It has an elevation of between 90 and 360 feet above sea level, and all operating areas drain toward the Savannah River. The nominal elevation at the waste tank farm sites range from 290 to 310 feet above mean sea level.

The Savannah River Plant was constructed during the 1950's to produce the special nuclear materials for national defense. The plant facilities (Figure 4-2) consist of three operating production reactors (P, K, and C), two production reactors in standby condition (R and L), a small test reactor in standby condition (U), two separations areas for processing irradiated materials (F and H), a heavy water extraction and recovery plant (D), a fuel and target fabrication facility containing two test reactors (M), the Savannah River Laboratory (a process development laboratory to support production operations and containing two test reactors), the administrative facilities (A), and the many non-nuclear facilities necessary for plant operations.

The major waste storage areas for radioactive liquids, sludges, and crystallized salts are adjacent to the separations areas and consist of two tank farms linked to the separations areas and to each other by pipelines with secondary containment (Figure 3-1 and 3-2).

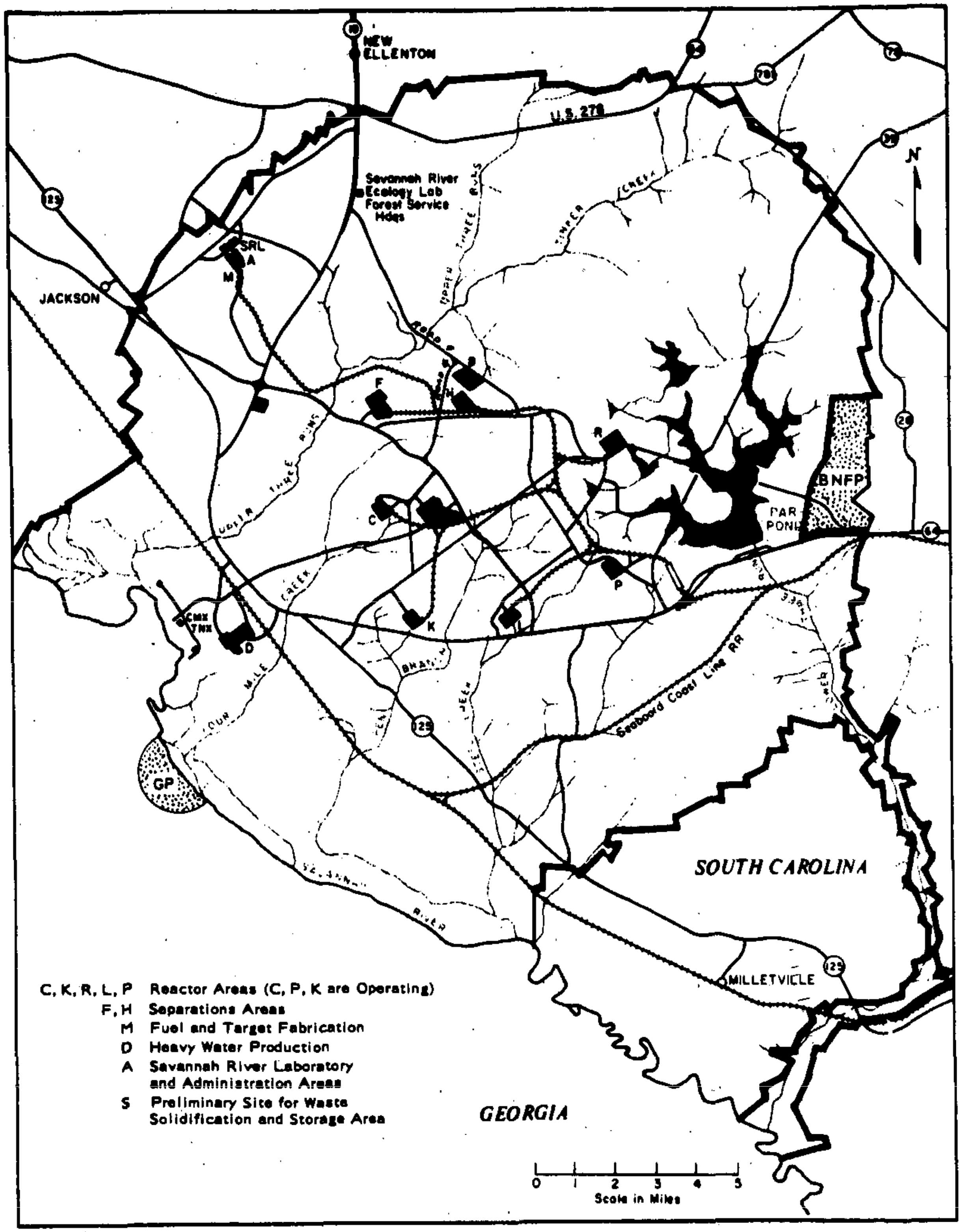

FIGURE 4-2. The Savannah River Plantsite

C | *Map includes United States Forestry Service areas.

In addition, a 195-acre burial ground area located between the F and H separations areas is used for controlled storage of solid radioactive wastes. The reactors, separations areas, and waste storage areas are at least 4 miles from the nearest plant boundary. Figure 4-3 is an aerial photograph of the waste storage areas and several of the major production facilities.

4.1.2 Site Characteristics

4.1.2.1 Introduction

Characteristics of the SRP site that are pertinent to the EIS include the geology, hydrology, meteorology, seismicity, biota, and background radiation. These characteristics are summarized below. A more detailed discussion may be found in ERDA-1537 and C | DP-1323.[1,2]

4.1.2.2 Geology

The plant is located in the Atlantic Coastal Plain geologic province. This province is characterized by flat, mostly unconsolidated sediment of Cretaceous age or younger. About 20 miles northwest of the plantsite is the lower edge of the Piedmont Plateau (the other main geologic province in South Carolina). The Piedmont Plateau is underlain by igneous and metamorphic rocks. The boundary between the two provinces is called the Fall Line. The Fall Line is not a sharp line of contact but a zone of transition from the typical land forms of one province to those of the other.

Geologic formations (Figure 4-4) beneath the Savannah River Plant are the Hawthorn of Miocene age, the Barnwell, McBean, and Congaree of Eocene age, the Ellenton and Tuscaloosa of the Cretaceous age, and bedrock (crystalline metamorphic rock and the Dunbarton Trassic Basin). The sediments that constitute the formations above bedrock are either unconsolidated or semiconsolidated.

The geologic formation that immediately overlies the basement rock is called the Tuscaloosa Formation, and it is 500 to 600 feet thick below the plant. This formation consists of sand and clay and contains several prolific water-bearing beds, which supply over 1000 gallons of water per minute to individual wells.

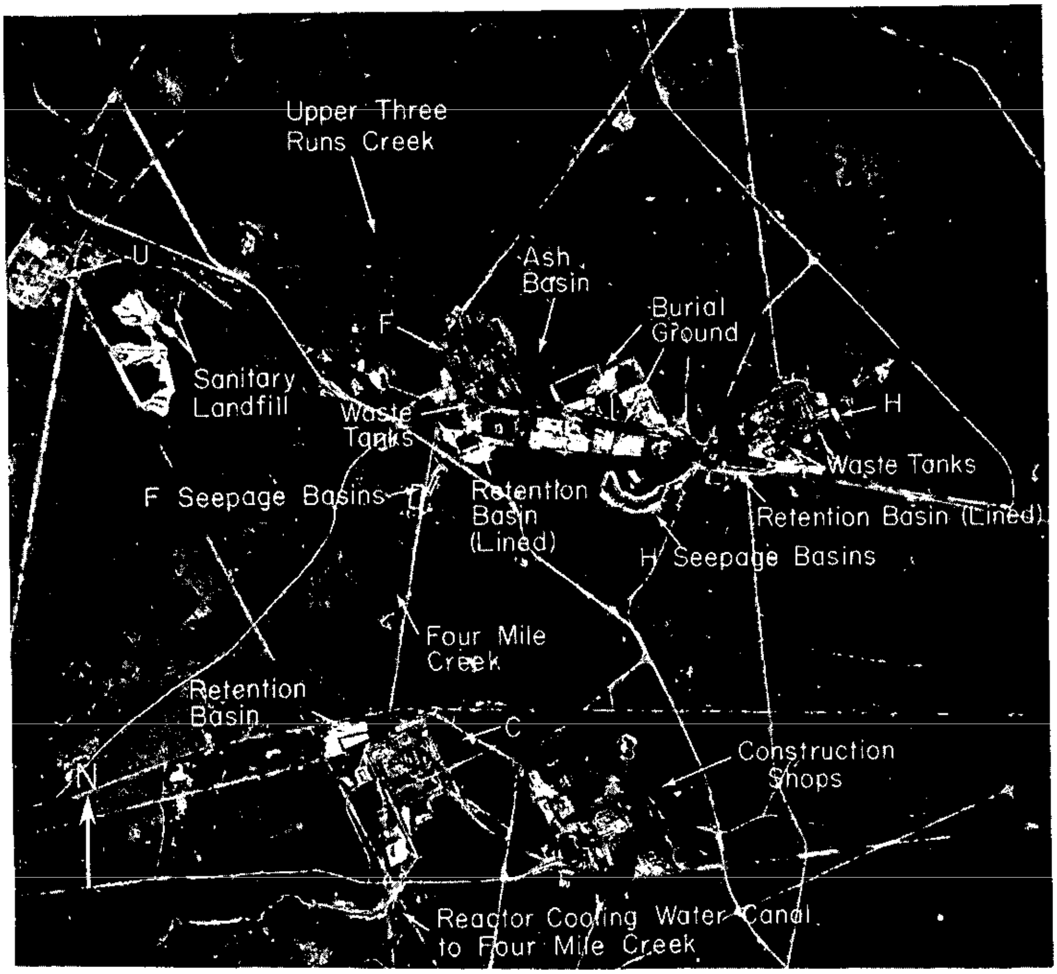

FIGURE 4-3. Main Waste Storage Areas and Surroundings

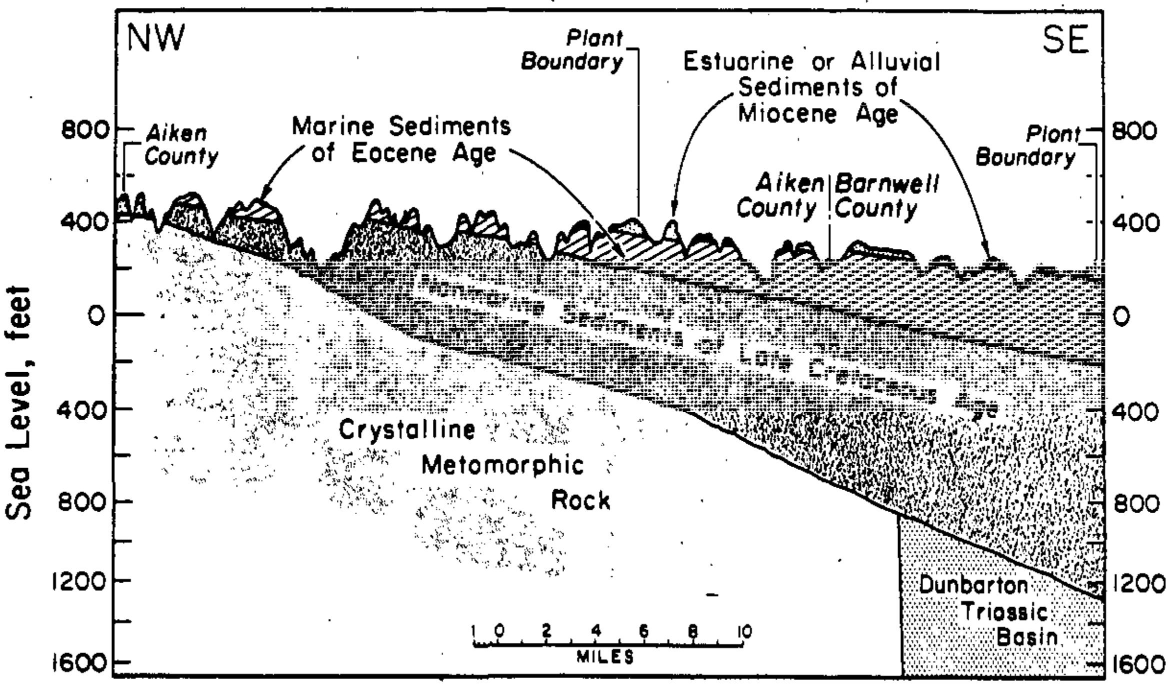

FIGURE 4-4. Profile of Geologic Formations Beneath the Savannah River Plant

Overlying the Ellenton and Tuscaloosa Formations of Cretaceous age are several formations of the Eocene and Miocene age. These formations have a combined thickness of about 350 feet in the central part of the plant. They consist predominantly of compact clayey sand and sandy clay with a few beds of sand and a few beds of hard clay.

4.1.2.3 Hydrology

The top of the new waste tanks in F Area will be at grade level, or 285 feet above mean sea level (MSL). Elevation of new tanks in H Area will be between about 321 feet (top) and 285 feet (bottom). Groundwater at the tank sites in F Area has ranged from a low of 228 feet to a high of 234 feet during the period 1964-1974. In H Area, the water table has ranged from 274 feet to 282 feet. The F Area tank site is near the water table divide between Upper Three Runs Creek and Four Mile Creek (Figure 4-2). Groundwater in this vicinity moves toward Four Mile Creek with an estimated travel time of about 200 years. Should the water table divide shift so that groundwater moves toward Upper Three Runs Creek, it is estimated that the travel time would also be about 200 years. In H Area, groundwater in the vicinity of the waste tank farm moves toward Upper Three Runs Creek with an estimated travel time of between 70 and 350 years.

The flow of the Savannah River at the SRP site averages 10,400 cubic feet per second (cfs) with a minimum flow of 6300 cfs. The elevation of the river rarely exceeds 100 feet (MSL) at flood stage. The location of the waste tank farms is substantially above any recorded flood in the history of this locale. The 100 year flood is less than 138-142 feet above MSL.

4.1.2.4 Local Climate and Meteorology

The climate in the SRP area is temperate with mild winters and long summers. Augusta temperatures average 48°F in the winter, 85°F in summer, and 65°F annually. The average relative humidity is 70%. The average annual rainfall at SRP is about 47 inches. The recorded maximum annual precipitation in Augusta occurred in 1929 (73.82 inches); the minimum occurred in 1933 (28.05 inches).

4.1.2.5 Storms

Two types of major storms, hurricanes and tornadoes, occur in South Carolina.

4.1.2.5.1 Hurricanes

Fully mature tropical cyclones, called hurricanes in the Atlantic and typhoons in the Pacific, are large rotating storms of extraordinary violence. Although hurricanes are neither the largest nor the most intense atmospheric storms, their considerable size and great intensity make them the most dangerous and destructive of all storms.

Thirty-eight hurricanes caused damage to South Carolina in the 275 years of record for an average frequency of 1 every 7 years. The occurrence of a hurricane along the coastal region does not generally mean that the Savannah River Plant will be subjected to winds of hurricane force because SRP is 100 miles inland. Winds of 75 mph were measured by anemometers mounted at 200 feet only once during the history of SRP during passage of Hurricane Gracie to the north of the plantsite on September 29, 1957.

4.1.2.5.2 Tornadoes

Tornadoes are normally characterized as violently rotating columns of air in contact with the ground. Less than 5% of all tornadoes which occur throughout the United States have wind speeds in excess of 200 mph.

The Savannah River Plant is in an area where occasional tornadoes are to be expected. National Weather Service records from 1916 to 1975 show that at least 300 tornadoes have occurred in South Carolina. In 1975, 12 tornadoes struck South Carolina and 22 struck in Georgia. The combined area of Georgia and South Carolina is struck by an average of 25 tornadoes per year.

The probability of a tornado with winds in excess of 250 mph striking a point within the SRP, is estimated to be less than 10^{-5} per year. During the history of SRP, there has been no tornado damage to any production facility. On two occasions, light damage such as displacement of light sheet metal roofing on non-production buildings, window breakage, and tree damage has occurred.

4.1.2.6 Seismicity

The Savannah River Plant is located in an area where moderate damage might occur from earthquakes, based on earthquake risk predictions by the United States Coast and Geodetic Survey. On the basis of three centuries of recorded history of earthquakes, an earthquake of an intensity of VII or higher on the Modified Mercalli (MM) scale would not be expected at the Savannah River Plant. Average acceleration[3] for an Intensity VII earthquake corresponds to 0.13 g. The design basis earthquake (DBE) for SRP incorporates an acceleration of 0.2 g as a safety factor, which is between the VII and VIII MM values (Trifunac and Brady[3] report VIII MM as 0.256 g). Seismic monitors, which were installed in SRP reactor buildings between 1952 and 1955, are set to alarm at 0.002 g (Intensity II) and have not indicated an earthquake shock of this intensity since their installation.

4.1.2.7 Habitats - Vegetation

Plants, birds, and mammals must be considered because of their ability to mobilize and concentrate radioactivity present in the environment and thereby permit it to be dispersed and to enter the food chain of man. The Savannah River plantsite provides a wide variety of protected habitats; hence, the species diversity and populations are both large. In general, the plantsite is a natural preserve for biota typical of the southeastern Coastal Plain. The production and support facilities occupy only a small portion of the plantsite, and wildlife is little affected by them. Radioactive releases are limited to low levels in limited areas and have had no significant effect on the wildlife.

At the time of Government acquisition, about 67% of the land area was forested, and 33% was in croplands and pastures. Cotton and corn were the chief crops. Abandoned fields passed through the annual broadleaf vegetation stage into the perennial grass stage and gradually became more wooded. Most of these abandoned fields have subsequently been planted in pine.

Soils of the SRP site are mostly sandy and low in fertility. Fertility is much greater in the Atlantic Coastal Terrace subregion than on the sandy soils of the Aiken Plateau. Fluvial belts of sandy loams occur along the several streams that cross the area. The soils support bottomland hardwoods on the Savannah River floodplain and along stream bottoms. Principal species in the Savannah River swamp are bald cypress, tupelo gum, black gum, and spanish moss. Hardwood forests, oaks, loblolly pine, and sweet gum occur on the drier bottomland sites. Understory vegetation consists of dogwood, red maple, switchcane, greenbrier, and palmetto bush. Longleaf pine and scrub oak occur over much of the dry upland sites on the Aiken Plateau. Understory wild plum, persimmon, broomsedge, and blackberry occur over the area.

The 166,000 acres of forest on the site are managed as productive woodland for DOE by the U.S. Forest Service. Forests on the site are subdivided into two major working groups: the pine group (108,000 acres) and the bottomland hardwood group (58,000 acres). The remaining 26,000 acres of the SRP site consist of production, service, and aquatic areas excluded from the forest management program.

4.1.2.8 Wildlife

4.1.2.8.1 Mammals

The populations of most species of mammals increased rapidly after the Savannah River Plant was officially closed to the public on December 14, 1952. Most notable expansion was in the deer herd, estimated to be about 20 animals in 1951. A virtual population explosion occurred; the present population is estimated to be greater than 20 deer per square mile or a total of about 5,000 to 8,000 deer on the plantsite.

With the exception of deer, feral hogs, and feral dogs, there is no wildlife predation by man. Small mammals such as mice, rats, and shrews are common in favorable habitats. Animals that are common (C) or abundant (A) on the plantsite are:

Gray fox	(C)	Oppossum	(C)
Raccoon	(C)	Cottontail rabbit	(A)
Bobcat	(C)	Gray squirrel	(A)
Red fox	(C)	Fox squirrel	(C)
Striped skunk	(C)	Beaver	(C)

There are no endangered species of mammals on the Savannah River Plant.

4.1.2.8.2 Birds

Before acquisition of the plantsite by the Government, game birds, particularly quail and dove, were abundant due to extensive use of land for agriculture. The removal of land from agriculture did not immediately decrease the quail population; the population increased and probably reached a record high in the early 1960s, but is declining because the conversion of agricultural fields to forest reduced the carrying capacity of the land.[4]

Wild turkey, although present, were not numerous. The South Carolina Wildlife and Marine Resource Department initiated a stocking program in 1972 and current estimates are that the turkey population has increased to about 400 birds.

Waterfowl are abundant winter residents on Par Pond and in the swamp. Wood ducks are the common nesting water fowl.

Endangered species of birds that are protected on the SRP site are the bald eagle and the redcockaded woodpecker. Biologists have identified more than 200 species of birds on the plantsite.[5] An annual bird census is conducted with the cooperation of the Augusta Audubon Society.

4.1.2.8.3 Reptiles and Amphibians

The SRP site, with its wide diversity of aquatic and terrestrial habitats, supports a diverse population of reptiles and amphibians.[6] Species common to he southeastern Atlantic Coastal Plain are found by intensive sampling programs for ecological research at the site. Zoologists[7,8] have identified 10 species of turtles, 10 species of lizards, 1 species of alligator, 31 species of snakes, 17 species of salamanders, and 26 species of frogs and toads. Alligators (endangered), once rare, are now commonly seen in Par Pond and, to a lesser extent, in some of the effluent streams.

4.1.2.8.4 Fish

Habitats for fish on the plantsite are numerous and diversified. They consist of both natural and thermally stressed flowing streams, ambient and thermally stressed reservoirs, Carolina Bays, abandoned farm ponds, swamp channels, and oxbow lakes. Fish are present throughout the thermally unaffected streams on the plantsite but are restricted to the lower reaches, near the Savannah River swamp and backwater pools, of streams carrying reactor cooling water. Species identified in streams number 36 in Upper Three Runs, 25 in Four Mile Creek, 16 in Pen Branch, 24 in Steel Creek, and 42 in Lower Three Runs.[2]

4.1.2.9 Environmental Park

The plant was designated as a National Environmental Research Park in June 1972. The various portions of the plantsite offer unusual opportunities for observing interactions between large industrial complexes and the environment. There are extensive areas of land protected from heavy traffic patterns, casual visitors, real estate development, and other disruptive influences. Because the land area is owned by the U.S. Government, long-term ecological research can be based at the Park with confidence in the continuation of the existing habitats. Several of the unusual opportunities offered are for observing and comparing the ecosystem changes brought about by heated water, flooding, atmospheric and aqueous emissions from fossil fuel power plants, uptake and retention of low levels of radioactive materials, forest management activities, and other stresses on the environment. Researchers from universities and government agencies are currently taking advantage of these opportunities for study.

4.1.2.10 Background Radiation

Background radiation is the base radiation level to which any dose from plant operations is added. Offsite environmental radiation measurements must take this radiation and its variation into account. Natural background radiation includes both cosmic and terrestrial sources. These sources vary with location but are assumed constant with time within the recorded span of human history.[9] Local penetrating radiation from artificial origins, both fallout from nuclear detonations and prescribed medical exposures, varies with time for the population as a whole, and doses from the latter source vary from one individual to another. External exposure from radioactive fallout appears to be decreasing with time as a result of the nuclear test ban treaty.[10,11]

The calculated annual background radiation dose received by the average person living in the vicinity of the Savannah River Plant is approximately 120 mrem from natural sources. An additional 100 mrem may be received by the average individual from medical x-rays. A breakdown is shown in Table 4-2. The wide range of exposures (excluding those incurred for medical reasons) results primarily from the geologic distribution of naturally radioactive elements near the surface in this region.

4.2 TANK LOCATIONS

F and H Areas are both located on relatively high ground between Upper Three Runs and Four Mile Creek. The locations of the F- and H-Area tank farms and the interarea waste transfer lines are indicated in Figure 4-5. The land contours are such that surface drainage from both F Area and H Area flows toward Four Mile Creek. The ground water table contours are such that drainage from the F-Area tank farm into the ground divides, some flowing toward Upper Three Runs and some flowing toward Four Mile Creek. Drainage from H Area into the ground flows toward Upper Three Runs.

The tank arrangements in each area are shown in Figures 3-1 and 3-2.

TABLE 4-2

Background Radiation Exposure Near SRP

Natural	Estimated Whole Body Dose, mrem Average[a]	Range[b]
Cosmic Radiation	35	30-40
Terrestrial Deposits		
External	55	6-380
Ingested	27	25-30
Total Natural	117	61-450
Artificial		
Medical Diagnostic	101	c
Weapons Fallout		
External	1	
Ingested	4	3-8
Total Artificial	106	
Total Background	223	165-560

a. Central Savannah River Area (within 40 km of SRP perimeter).

b. Within 100 km of SRP perimeter.

c. Only the average used in total range because of high individual variability.

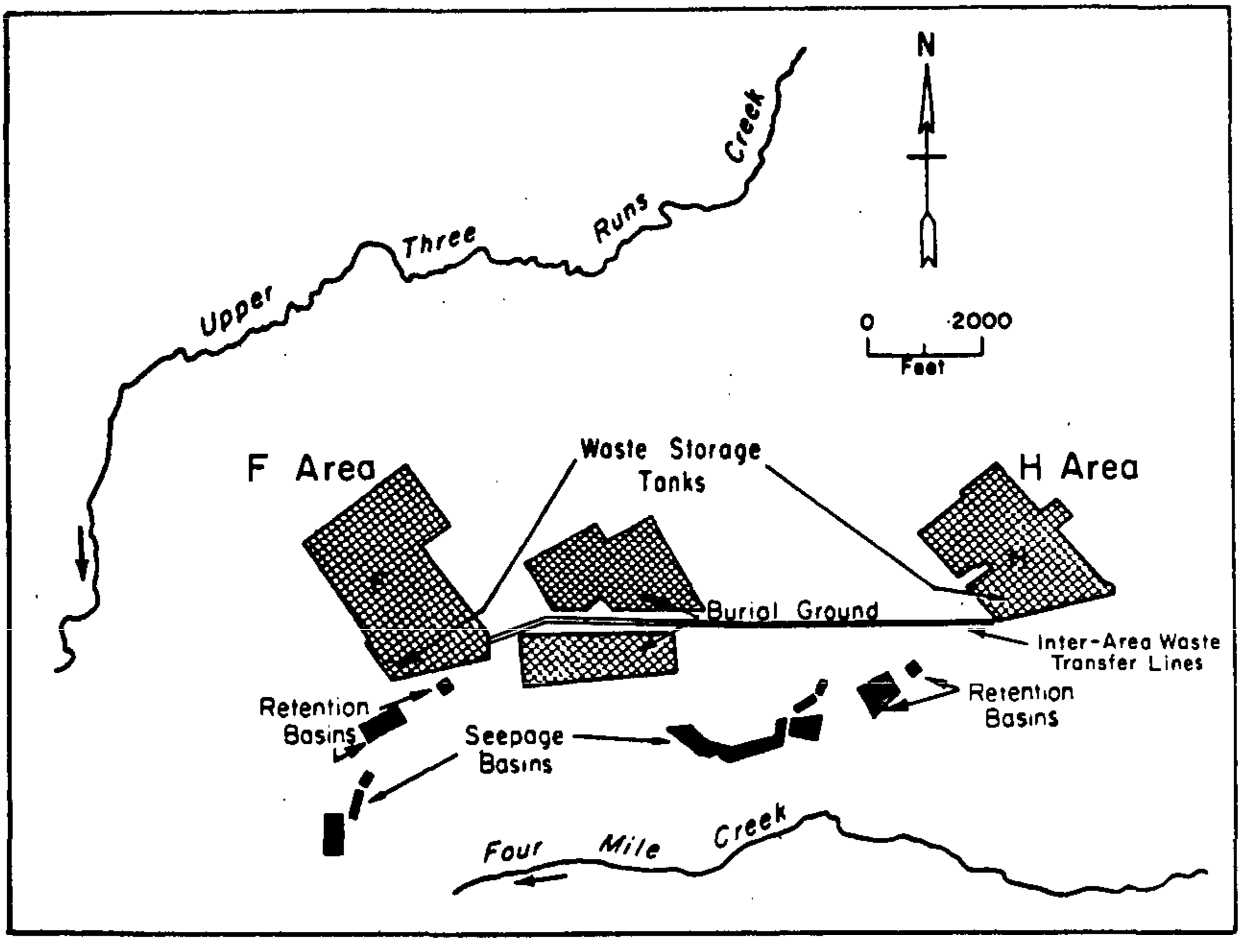

FIGURE 4-5. Relative Locations of Separations Areas and Associated Waste Handling Facilities

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9. "Radiation from Natural Sources." Annex E. in Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, 17th Session, Supplement 16, p. 207, UN Document A/5261 (1962).

10. "Environmental Contamination." Annex B in Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, 21st Session, Supplement 14, p. 57, para. 64, UN Document A/6134 (1966).

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5.0 ENVIRONMENTAL IMPACTS

The environmental impacts of the proposed action and potential alternatives are discussed in this section. The new waste tanks are needed for the retirement of older-design tanks with newer, more reliable tanks with improved monitoring capability and will provide interim storage capacity for wastes generated by continuing production operations. Apart from the impacts of construction, the incremental consequences of this action include:

- Added risks of releases during waste transfer operations required to empty tanks to be retired
- Reduced risks of accidental releases from the waste operations because of the improved facilities
- The impacts associated with decontamination and decommissioning of the retired tanks

No significant difference in operating force or use of land or demand for other resources is expected as a result of either adopting the proposed action or any of the design alternatives. Because of this, the effects of radiological releases are emphasized in the discussion on environmental consequences.

This EIS supplements the information on environmental effects contained in ERDA-1537, which provides detailed analyses of the impacts of waste management operations including abnormal operations and accidents. This statement covers only the use of the tanks for interim storage of radioactive wastes at SRP. The possible processing of these wastes for ultimate disposition and the potential use of the tanks in these operations will be covered in a future environmental document for the long-range waste management program.

5.1 PREFERRED ALTERNATIVE

The preferred alternative is to complete construction of the 14 waste tanks as presently designed and to incorporate these tanks in the SRP waste management operations.

5.1.1 Construction

The bottoms of new waste tanks are located about three feet above the highest recorded water table in the area. In H Area the bottom of a new tank is about seven ft below normal ground elevation, placing the top of the four-ft-thick concrete shield atop the tank about 35 ft above normal ground elevation. In F Area, the water table in the tank farm area is lower and the tanks are below ground with the top of the concrete shield at normal ground elevation.

For each new H Area tank, about 10,500 cubic yards of soil are excavated during construction and about 44,000 cubic yards of backfill are used for the compacted, sloped mound around the tank. In F Area, about 42,500 cubic yards of soil are excavated for each new tank and about 27,500 cubic yards used to backfill around the tank. The special backfill, selected to allow controlled compaction to a density greater than the surrounding undisturbed soil is hauled from another site. Excess soil from the excavation is spread over the surrounding terrain, usually in low-lying areas not adjacent to streams, and sown with grass. Where erosion is possible, the soil is sprayed with asphalt to provide stabilization until the grass cover is established.

The new waste tanks are located in an existing tank farm complex; thus, their presence will not significantly alter the appearance of the surroundings. The ground at the waste tanks is graded for compatibility with the surrounding tanks and connecting roads. The area occupied by a waste tank with all its associated auxiliaries is approximately one acre.

No significant amount of liquid waste is produced during construction of the waste tanks and the evaporator. Solid (nonradioactive) wastes are discarded in a landfill operation used for the entire plant. Construction runoff and other discharges are in compliance with applicable environmental regulations.

Construction materials to be used - concrete, steel, and some stainless steel (for waste transfer lines) - are plentiful enough that the impact on natural resources is insignificant.

5.1.2 Releases and Radiation Dose from Normal Operation

Small amounts of radioactivity reach the environment from normal operation of the SRP waste management system.

In ERDA-1537, these waste farm releases were combined with releases from other operations in the 200 Areas, and the specific impact of the waste farm operation could not be evaluated. For this reason, the personal exposure and releases from the waste farm are described separately in this section.

The total annual releases from the waste farms are summarized in Table 5-1. In general, these releases are a function of the operation of the waste farms as a whole, and depend on the total quantity of wastes stored and the number of tanks in service. Thus, the routine releases should not be greatly affected as the new tanks are put in service and older ones retired, except for the small additional loads imposed in cleaning out tanks to be retired and in transfers between tanks. Low concentrations of radioactive materials are carried by the tank ventilation to the atmosphere. Also low concentrations of radioactivity are carried to the seepage basins with the evaporator overheads or after ion exchange treatment. The only activity from the waste tanks system that is perceptible off the plant site is tritium.

5.1.2.1 Tritium to Air and Water

Tritium that reaches the waste tanks originates as a fission product or from neutron capture by heavy water moderator adhering to the lattice elements removed from the ractor. The amount of tritium handled in the waste system in a given year is a function of irradiation and process schedules and of the fraction removed by canyon evaporators before the waste solutions reach the tanks. The waste handling system approaches an equilibrium state in which tritium added to the storage tanks in the fresh waste from fuel processing operations approximately equals the amount lost from the system by decay or releases. Approximately 8000 Ci/yr of tritium, determined by a balance across the waste management system, is released to the environment from waste handling operations. Of that total, about 5500 Ci/yr is released to the atmosphere by evaporation via the waste tank ventilation purge used to prevent the accumulation of hydrogen and by evaporation from the
C seepage basin. The maximum atmospheric release occurs from tanks storing fresh, unevaporated waste and is estimated to be about 650 Ci/yr from each such tank. This release results in an annual dose commitment of 0.0009 mrem to an individual at the plant boundary. The remainder of the tritium (2500 Ci) enters the seepage basin groundwater pool. The tritium migrates to an onsite creek which discharges into the Savannah River. About one-third of the tritium entering the groundwater decays before reaching the river. The tritium is diluted well below drinking water levels by the average river flow of 10,400 cfs.

The whole body dose from atmospheric release to the population within a 150-km radius of the center of SRP is calculated to be 1.3 man-rem per year. The maximum dose from inhalation of airborne tritium to a hypothetical individual residing at the plant boundary would be 9×10^{-6} rem. Allowing for decay of tritium released into the groundwater from the seepage basins, the population dose to the 70,000 people downstream who use Savannah River water is calculated to be 1.0 man-rem per year. The dose from this tritium to a hypothetical individual residing at the plant boundary and taking all his water from the river would be 2×10^{-5} rem.

TABLE 5-1

Annual Releases[a] from Normal Operations in the Waste Farm

Radionuclide	Ci/yr To Atmosphere	 To Seepage Basins	 To Plant Streams	Dose to Offsite Population, man-rem
Tritium	5500 (Calculated)	2500 (3-4 pCi/L)	1700 (0.4 pCi/mL)	1.3 (Atmospheric) 1.0 (Streams)[c]
Cesium-137[c]	N.D.[d] (0.01 μCi/day)[g]	~2 (0.2 pCi/L)	N.D. (7 pCi/L)	-
Strontium-90[c]	N.D. (0.01 μCi/day)[g]	0.1-1.0[f] (14 pCi/mL)	0.008-0.8 (7.8 pCi/L)	0.083 (Streams)[c]
Short-lived[c] (^{51}Cr, ^{58,60}Co ^{89}Sr, ^{95}Zr-Nb, ^{103,106}Ru, ^{124,125}Sb, ^{131}I, ^{141,144}Ce, and ^{147}Pm)	N.D.	<34	N.D.	-

a. Sensitivity of analysis depends on volume of sample, detection instrument used, background count on instrument used, and length of count.

b. Numbers shown in parenthesis are sensitivities for routine analyses.

c. Total from all sources within the Chemical Separations Areas. The quantity attributed to waste farm operations is less than half the total.

d. Not detectable.

e. Due to releases from evaporator operations; not due to waste tank releases.

f. 0.45 curies in 1978.

g. Combined beta and gamma total dose.

5.1.2.2 Releases from Tank Ventilation

A negligible amount of activity other than tritium is released from the tank ventilation system in normal operation. The waste tanks are purged with air (100 cfm or more) to prevent the accumulation of radiolytically generated hydrogen, and the air is exhausted through filters. Air samples from the filter outlets have never shown any significant activity except during one 24-hr period when moist, contaminated air bypassed a condenser resulting in a release through the filter of less than 1 Ci of ^{137}Cs. However, unusual radiation levels from some filters (up to 9 R/hr) show that sizable amounts of activity (2 to 3 Ci) have reached the filters. The released activity becomes dispersed into the ventilation air most noticeably during transfers of solution into tanks. Then the filters collect the radionuclides as the ventilation air passes out through them.

5.1.2.3 Exposure to Operating Personnel

Normal operations in the waste tank farms result in a total annual exposure to operating personnel of about 50 man-rem. The maximum individual exposure in 1978 was 2.5 rem with an average of about 0.7 rem per year. The limit for personnel exposure is 5 rem/yr given in USERDA Manual, Chapter 0524, "Standards for Radiation Protection."

5.1.3 Releases from Abnormal Operations or Accidents

As indicated above, ERDA-1537 provides a comprehensive review of SRP experience in the release of radioactivity due to abnormal events. This review included analyses of the response of these facilities to severe accidents or natural events. These results are summarized in Tables 5-2 and 5-3 taken from ERDA-1537 which show that none of the credible occurrences have significant risks of unacceptable offsite dose commitments.

The incremental risks during transfer operations that are brought about by the proposed action are also small. As indicated in Table 5-2, the spills that could occur with appreciable likelihood have no perceptible offsite effects. Even a very large, but unlikely spill is shown to produce a maximum whole body dose commitment of only 7.1 rem which is substantially smaller than the 25 rem emergency dose guideline.

TABLE 5-2

Risk Factors for Surface Spills

Incident	Estimated Releases of Fission Products	Calculated Consequence Factor, Max Potential Offsite Dose, rem		Estimated Probability Factor,[a] Events per Year
		Body	Bone	
Small miscellaneous leaks	Much less than 1 Ci	-	-	Several/yr
Leaks from flanges and evaporators	10 Ci of ^{137}Cs	-	-	0.1
Sludge spill due to hose or pipe rupture	200 Ci of ^{90}Sr	-	-	0.05
Spill due to pluggage of tank inlet	200 Ci of ^{137}Cs	-	-	0.05
Spill following explosion in waste evaporator	7.2×10^3 Ci of ^{137}Cs	1.9	-	10^{-5} to 2×10^{-4}
Spill following explosion in waste tank	1.5×10^2 Ci of ^{90}Sr and 1.5×10^4 Ci of ^{137}Cs	3.9	1.0	10^{-4}
5-minute HHW spill	10^3 Ci each of ^{90}Sr and ^{137}Cs	0.3	6.8	0.005

a. Values indicate only the probability of occurrence of a spill. The probability for ingestion after the spill is much lower.

TABLE 5-3

Risk Factors for Atmospheric Releases

Incident	Estimated Releases of Fission Products	Calculated Consequence Factor, Max Potential Offsite Dose, rem	Estimated Probability Factor,[a] Events per Year
Overheating of tank	<1 Ci of ^{137}Cs	1×10^{-4} (body)	0.05
Release from filter in tank ventilation system	2 Ci of ^{137}Cs	2×10^{-4} (body)	0.02
Evaporator explosion	7 Ci of ^{137}Cs	1×10^{-3} (body)	10^{-4} to 2×10^{-3}
Hydrogen explosion in waste tank (plugs, lift, filters rupture)	11 Ci of ^{144}Ce 14 Ci of ^{106}Ru 0.5 Ci of ^{90}Sr 52 Ci of ^{137}Cs 0.005 Ci of ^{238}Pu	7×10^{-3} (body) 5×10^{-2} (bone) 7×10^{-2} (lung)	10^{-3}
Hydrogen explosion in waste tank (roof collapse)	110 Ci of ^{144}Ce 140 Ci of ^{106}Ru 5 Ci of ^{90}Sr 520 Ci of ^{137}Cs 0.05 Ci of ^{238}Pu	7×10^{-2} (body) 5×10^{-1} (body) 7×10^{-1} (lung)	10^{-4}

a. Values indicate only the probability of occurrence of a spill. The probability for ingestion after the spill is much lower.

5.1.3.1 Risks to Offsite Population

Accident risks to the offsite population in Ci/yr and man-rem/yr were calculated by multiplying the probability of the accident times the consequence of the accident in curies released offsite or dose to the offsite population. The total risk is 16 man-rem/yr. Of that total, the risk from normal operations accounts for 3 man-rem/yr. Risks for all analyzed accidents are listed in Table 5-4.

The risk of an accident type is best determined by considering more than one magnitude or level of consequences for the accident because most accidents can yield a wide range of consequences. The risk of the accident over the range of consequences may then be found by summing the products of probability and consequence for each consequence level. Consequence levels were generated by considering different levels of containment damage (e.g., from earthquakes) or different degree of success in containing a given spill (e.g., different percentage of the spill passing through the storm water system) or both. The curie-risk for normal operations is the sum of the curies of each radionuclide effluent per year, and the risk in man-rem per year is the sum of the corresponding population dose commitments.

The risk associated with earthquakes (10 man-rem/yr) is the dominant accident risk. The major contribution to earthquake risk (about 70%) results from the highly conservative assumption that liquefaction is possible in the soil around waste tanks built partially above the normal grade elevation in the waste tank farms. Most of this risk is attributable to IX MM earthquakes. Liquefaction is assumed to cause the earth to slump away from these tanks. Leakage from damaged tanks is assumed to flow rapidly to Four Mile Creek, rather than being deposited in the soil beneath the tank. About 2% of the earthquake risk results from damage to the tank farm evaporators during an earthquake between Intensity VII and VIII, the design basis earthquake. The remainder results from collapse of the roofs of waste tanks during earthquakes of Intensity IX or greater.

Several comparisons can be made to put tank farm risks in perspective. Table 5-5 summarizes the offsite risk from tank farm operations and accidents compared to the risks from natural background radiation, medical diagnostic radiation, all malignancies, and natural accidents, e.g., floods and lightning. Comparisons with natural background and medical diagnostic radiation are based on population dose to the combined population groups of 2,300,000 within a 150-km radius of SRP and 70,000 downstream Savannah River water users. The dose commitment to the combined population group from natural background and medical diagnostic radiation is calculated to be 5×10^5 man-rem/yr. Normal tank farm operations plus postulated accidents add an average of 16 man-rem/yr to this total or 0.003%.

TABLE 5-4

Accident Risks to Offsite Population

Accidents	Ci/yr			Man-rem/yr		
	Atm	Surf.	Total	Atm	Surf.	Total
1 Earthquake	2×10^{-3}	1×10^{1}	2×10^{1}	1	1×10^{1}	1×10^{1}
2 Overflow of Waste Tank	-	1	1	-	1	1
3 Large Liquid Release from Waste Tank Riser	-	2	2	-	8×10^{-1}	8×10^{-1}
4 Filter Fire	6×10^{-2}	-	6×10^{-2}	6×10^{-1}	-	6×10^{-1}
5 Overflow of Diversion Box	-	7×10^{-1}	7×10^{-1}	-	6×10^{-1}	6×10^{-1}
6 Overflow of Pump Pit	-	6×10^{-1}	6×10^{-1}	-	2×10^{-1}	2×10^{-1}
7 Waste Tank Explosion	1×10^{-1}	1×10^{-2}	1×10^{-1}	7×10^{-2}	6×10^{-3}	8×10^{-2}
8 Overflow of CTS Pit	-	1×10^{-1}	1×10^{-1}	-	8×10^{-2}	8×10^{-2}
9 Overflow of Evaporator Cell	-	5×10^{-2}	5×10^{-2}	-	3×10^{-2}	3×10^{-2}
10 Tornado	3×10^{-4}	8×10^{-3}	8×10^{-3}	1×10^{-2}	6×10^{-3}	2×10^{-2}
11 Pump Tank Explosion	8×10^{-5}	5×10^{-2}	5×10^{-2}	3×10^{-5}	2×10^{-2}	2×10^{-2}
12 Above-Ground Release from Process Line	-	7×10^{-3}	7×10^{-3}	-	6×10^{-3}	6×10^{-3}
13 Evaporator Explosion/Eruction	1×10^{-4}	1×10^{-3}	1×10^{-3}	1×10^{-3}	6×10^{-4}	2×10^{-3}
14 Meteorite	3×10^{-3}	-	3×10^{-3}	2×10^{-3}	-	2×10^{-3}
15 Release During Equipment Removal from Waste Tank	3×10^{-5}	3×10^{-3}	3×10^{-3}	4×10^{-4}	2×10^{-3}	2×10^{-3}
16 Release from Segregated Water System	-	4×10^{-3}	4×10^{-3}	-	2×10^{-3}	2×10^{-3}
17 CTS Tank Explosion	4×10^{-7}	3×10^{-3}	3×10^{-3}	2×10^{-6}	2×10^{-3}	2×10^{-3}
18 Release from Boiling Waste Tank	5×10^{-5}	3×10^{-5}	1×10^{-4}	6×10^{-4}	1×10^{-5}	6×10^{-4}
19 Airborne Release from Diversion Box	4×10^{-5}	-	4×10^{-5}	2×10^{-4}	-	2×10^{-4}
20 Leak Through Evaporator Cell	-	4×10^{-4}	4×10^{-4}	-	2×10^{-4}	2×10^{-4}
21 Spill from CTS Cleanout Port	-	3×10^{-4}	3×10^{-4}	-	1×10^{-4}	1×10^{-4}
22 Activity By-passes Waste Tank Filter	5×10^{-6}	3×10^{-6}	8×10^{-6}	2×10^{-5}	6×10^{-7}	2×10^{-5}
23 Overflow of Overheads Tank	-	4×10^{-5}	4×10^{-5}	-	2×10^{-5}	2×10^{-5}
24 Airplane Crash	2×10^{-7}	1×10^{-6}	1×10^{-6}	2×10^{-6}	6×10^{-7}	3×10^{-6}

TABLE 5-5

Comparison of Risks to the Offsite Population

Cause of Death or Health Effects[a]	Man-rem/yr	Deaths/yr	Total Somatic Health Effects[b] (Fatal and Nonfatal Cancers)
All tank farm accidents and effluents	16	0.003[c]	0.0064
Natural background and medical diagnostic radiation	5×10^{5}	100[c]	200
All malignancies		2800[c]	
Natural accidents		2.4[d]	

a. A population of 2,300,000 within a 150-km radius of SRP for airborne releases, and 70,000 downstream Savannah River water users for waterborne releases.

b. Estimated at 400 per 10^{6} man-rem.[1]

c. Latent cancer deaths.[2]

d. Sudden accidental deaths from floods, lightning, etc.

C The comparison of total somatic health effects per 10^6 man-rem of whole body exposure, resulting in cancers in Table 5.5, is from the EPA dose-effect relationship factor.[1] The health effects include both fatal and nonfatal malignancies. The emotional and financial stress of a nonfatal malignancy could be similar to the death impact and is therefore a significant consideration.

The health dose-effect relationship factors reported by the EPA[1] are neither upper nor lower estimates of probability characterized as "the most likely estimate" in the BEIR[2] report; that is, they are averages of the relative and absolute risk models considered in the BEIR report.

Comparisons with all malignancies and natural accidents are based on estimated death rates in the same combined population group. These comparisons are based on the statistical factor of 200 latent cancer deaths per 10^6 man-rem whole body exposure.[2] This factor predicts, for example, that if one million persons each received a one-rem whole-body dose, 200 would die at some time earlier than they would had they not received the dose. Based on the offsite population risk of 16 man-rem/yr, the estimated offsite death rate from waste tank farm operations is 3×10^{-3} latent cancer deaths/yr or 3 persons in 1000 years.

For comparison, death rates from all malignancies were obtained from cancer death statistics for Georgia and South Carolina. These statistics show the death from all malignancies is about 116.3 per 100,000 population per year. Therefore, for the combined population group for which tank farm doses were calculated (2,370,000) about 2800 cancer deaths/yr may occur. The calculated potential offsite cancer deaths from tank farm operations contribute 1×10^{-4} to this total.

The comparison of offsite risk from the tank farms from natural accidents involves a comparison between long-term cancer deaths and short-term or sudden natural accident death. The death rate resulting from natural accident such as floods and lightning has been estimated to be one death per 10^6 population per year.[3] Therefore, the death rate in the combined population group for which tank farm accidents were calculated is about 2.4 sudden deaths per year from natural accidents.

These comparisons, summarized in Table 5-5, show that the offsite population risk of waste tank farm operations is negligible when compared to other natural risks experienced by the population in the vicinity of SRP.

C 5.1.3.2 Emergency Planning*

The emergency planning and response activities of the Department of Energy's Savannah River operations office (SR) are divided into two catorgies: 1) maintenance of an emergency planning program in support of operational activities of the Savannah River Plant (SRP) and 2) external support to state and local governments and private industry under the DOE Radiological Assistance Program.

The plantwide preparedness program at SRP is a co-custodial program shared by SR and its major contractors on the plantsite. Program reviews and evaluations are conducted by SR. In addition to pre-emergency response planning for radiation-related emergencies, there is a comparable degree of preparedness and planning for nonradiological incidents, including chemical releases or spills, industrial accidents, natural disasters, terrorist threats or acts, and national emergencies.

Each operating area and the major production facilities within each area maintain emergency plans and procedures. Provisions of these plans are consistent throughout the plantsite and comply with a basic document establishing plantwide preparedness criteria. SRP emergency plans identify the potential credible emergencies that may occur within the operation of the area or facility for which the plan establishes action(s) to contain the incident, protect plant personnel, assess the impact of the incident on the environment and the offsite population, protect the offsite population, and otherwise minimize the effects of the incident.

The degree to which SRP resources are applied to emergency response operations depends upon the magnitude of incident and the effectiveness of containment. As the consequences of an incident escalate, the scope of plans, procedures, manpower, and equipment required to deal with the incident increases. Emergency declarations escalate with an incident and are made for Facility Emergencies, Area Emergencies, and Plant Emergencies. Under each plan, i.e., facility, area, and general plant procedure, there is a clearly defined emergency response organization.

Emergency actions outside of incident areas, post-emergency actions, and followup are controlled from the plant Emergency Operating Center (EOC). The EOC is the primary control point for emergency operations on the SRP site. All plantwide warnings and

* This section was added in response to recommendation received from the Department of Health, Education, and Welfare (page G-3).

C emergency announcements are issued from the EOC. It is from this facility that offplant warnings and announcements to state/local officials are initiated.

Data used to implement the offsite warning plan is derived from a combination of release information. Once assembled, the values provided from this information are compared to state reporting requirements and if necessary, state/local authorities are advised. Notifications and alerts from SRP to the states of Georgia and South Carolina follow the provisions of memoranda of understanding where DOE, the state radiological health organizations, and the state preparedness organizations are signatory parties. Under these agreements, SR has committed to notifying the states as prescribed in their respective radiological emergency response plans. Authorization to release an offplant warning announcement rests with the SR Manager or his designee.

Continuing coordination and liaison with state/local authorities during emergency and post-emergency conditions are provided from either the EOC or (at the discretion of the SR Manager) the Offsite Communications Center (OCC). The OCC is located in Aiken, South Carolina. The OCC provides, in addition to a "near site EOC," an alternate location for management to assemble in the event that access to SRP is not possible or practicable.

In the event that SRP resources require augmentation from outside organizations, agreements have been entered into with local authorities to provide the type of assistance needed. All such agreements are emergency in nature and range from medical assistance to emergency transportation.

Evaluation and assessment of emergency planning and response at SRP is conducted through a program of drills, tests, subsystem exercises and total system exercises, all of which are on scheduled intervals. (Exercises and drills are generally unannounced). As a minimum, a plantwide total systems exercise is conducted on an annual basis.

5.1.4 Decommissioning

The 14 new tanks provide sufficient storage space so that wastes can be removed from all Type I, II, and IV tanks by about 1988 according to the present program plan (see Section 3.2.7). A total of 23 older design tanks will be available for decommissioning at that time.

Decommissioning of waste tanks has not yet been attempted at SRP, but studies are now underway with Tank 16, as described in Appendix C, to develop detailed procedures for decontamination and dismantling these structures.

The environmental consequences of these operations will be largely the radiation exposure to operating personnel and land commitment for disposal of the residual materials. These impacts, which will be subjected to further environmental review, cannot be quantified until the decommissioning procedures are more completely defined (refer to Appendix C). Decommissioning is independent of all alternatives.

5.2 OTHER ALTERNATIVES

Three design alternatives were considered in the preparation of this supplemental environmental impact statement to ERDA-1537, i.e., thicker and more chemically-resistant steel plates, an impressed current cathodic protection system to guard against stress corrosion cracking, and better waste retrieval equipment and enlarged tank openings to facilitate retrieval.

Implementation of any of the design features would require backfitting of tanks already under construction and near completion. Beside the additional construction impact and demand for resources, the projected gains, if any, need to be balanced with increased risks for delaying waste transfer from the earlier design tanks.

For example, adoption of the thicker steel plates for tank walls will involve abandoning or disassembling of the tanks currently under construction. Then new tanks would have to be constructed. This would delay the transfer of waste from older tanks to the more reliable tanks as presently constructed and increase the possiblity of lack of reliable storage space for freshly generated waste.

5.2.1 Thicker and More Chemically Resistant Tank Steel

As indicated in Section 3.3.1, the selection and heat treatment of the primary tanks, along with the management of waste compositions, should result in an estimated tank life of 40 to 60 years. Based on SRP experience, general corrosion resistance is not a factor in determining the tank life.

5.2.1.1 Reasonably Foreseeable Environmental Effects

The major impact of adopting this alternative would involve the construction of new tanks probably costing much more than the approximate $126,000,000 appropriated for the fourteen tanks under construction. A second impact is the loss of $80,000,000 already spent or committed on the construction of the new tanks.

Additional land would be committed if new tanks were constructed unless the present construction was removed and the same land reused. This replacement would increase costs.

The environmental effect would be the small offsite dose from tritium, primarily as water vapor, released from the waste tank vents and would be the same for any tank wall thickness.

The abnormal occurrences (leaks, explosions, etc.) that might happen to waste tanks and their results would be the same for any tank wall thickness.

5.2.1.2 Effect on Tank Durability

There is a perceived, but undemonstrated, gain of safety and tank durability because of thicker and more chemically-resistant tank walls.

5.2.1.3 Effect on Ease of Waste Retrieval from the Tanks

No effect.

5.2.1.4 Effect on Choice of Technology and Timing for Long-Term Radioactive Waste Storage and Final Disposal

None foreseen.

5.2.2 Cathodic Protection

Studies revealed that successful application of cathodic protection for SRP tanks would be contingent on the satisfactory results of additional studies. However, because of the expected high reliability of the Type III tank design, the benefits to be gained by cathodic protection were evaluated to be small compared to the uncertainties and problems of installation of such protection and the adverse effects on waste volume reduction plans.

5.2.2.1 Reasonably Foreseeable Environmental Effects

Installation of the cathodic protection system would cause a delay in completing the waste tanks. The delay and increased cost for installing the cathodic protection equipment would impact on the availability of more reliable new tanks. Resultant costs and time limitations would increase the risk of a less than satisfactory installation. For example, a nonuniform distribution of current could cause "hot spot" corrosion, and a potential leak from the waste tank. The situation is complicated by the fact that cathodic protection requires the waste to be stored in liquid form. Corrective action would necessitate the removal of waste from the leaky tank to avoid any environmental impact. The leak would probably not be repairable.

The generation of reactive gases poses a potential for explosion with the subsequent release of radioactive material to the environment and requires adequate ventilation of the tank vapor space.

5.2.2.2 Effect on Tank Durability

Properly designed and installed, a cathodic protection system could help avoid corrosion that might shorten the life of a tank.

However, an improperly designed and installed cathodic protection system could drastically shorten the life of a tank. Nonuniform waste characteristics can cause current flow patterns that could result in accelerated corrosion of the waste tanks.

5.2.2.3 Effect on Ease of Waste Retrieval from the Tanks

The cathodic protection system could interfere with waste retrieval by reducing easily platable metal cations to metal which would plate out on the tank wall. The plated metal would be difficult to remove during waste retrieval or decommissioning.

5.2.2.4 Effect on Choice of Technology and Timing for Long-Term Radioactive Waste Storage and Final Disposal

None foreseen.

5.2.3 Better Waste Retrieval Equipment and Enlarged Tank Openings

Adequate waste retrieval has been demonstrated in routine waste management operations and Tank 16 sludge removal and chemical cleaning tests. Control measures utilized in waste retrieval include leak containment and detection and filtered tank ventilation exhausts. Monitoring of personnel, filtered tank air, and groundwater have not detected any releases to the environment. Therefore, no environmental improvements are foreseen in changes from the present waste retrieval equipment or for the provision of enlarged tank openings.

5.2.3.1 Reasonably Foreseeable Environmental Effects

Enlarged tank top openings are not expected to add any environmental effects unless there are slightly increased emissions from sealing problems.

As waste retrieval equipment is improved, the result could possibly be a further reduced risk of releasing radioactive material to the ground or to the atmosphere during waste retrieval.

5.2.3.2 Effect on Tank Durability

Enlargement of the tank top opening may reduce the stability of the tank top and therefore influence tank durability or the ability to retrieve the waste.

Improved waste retrieval equipment will have no effect on tank durability.

5.2.3.3 Effect on Ease of Waste Retrieval from the Tanks

Enlarged tank openings would provide greater flexibility in design and utilization of equipment for improving efficiency of waste retrieval and tank cleaning.

Improved waste retrieval equipment could possibly enable the waste to be moved more rapidly and efficiently and would allow more rapid and effective cleaning of the tanks.

Using improved equipment, when developed, would reduce the potential for normal or accidental releases of radioactive material to the environment and would reduce the radiation dose received by personnel performing the waste removal and tank cleaning.

5.2.3.4 Effect on Choice of Technology and Timing for Long-Term Radioactive Storage and Final Disposal

None foreseen.

5.3 NO ACTION ALTERNATIVES

The preferred alternative includes all of the improvements in tank design, monitoring, and controls developed during the 25 years of high-level waste storage which are thought necessary for safe and reliable operation. The "No Action" alternatives violate DOE waste management policies. The Department of Energy is committed to storing radioactive wastes in tanks with the most recent improvements in design and monitoring to the extent economically and technically practicable until permanent disposal technology is developed and implemented.

The "No Action" alternatives were considered in ERDA-1537. Even with additional operational control and monitoring to prevent releases to the environment, continued use of older tanks is less reliable than using tanks of the improved design, and does increase the risk of abnormal occurrences. Therefore, the "No Action" alternatives are unacceptable.

5.4 SOCIOECONOMIC EFFECTS

This section deals with the influence of the preferred alternative and other alternatives, including no action, on the community. Construction of the tanks has been in progress for about 4 years and the effects on the surrounding communities has already taken place without any apparent adverse effect.

5.4.1 Operating Effects

The waste tank farm operating force before waste retrieval and tank cleaning began was about 50 people. An increase to a peak of about 120 people in 1982 is forecast for waste retrieval, tank cleaning, and full operation of four evaporators. This increase will occur, although at a later time, regardless of the design alternative selected. After this peak, the force will decrease to about 65 people when tank cleaning is complete and only two evaporators are operating. The difference between 50 and 65 people is due to a planned increase in surveillance requirements; not because of the new tanks.

5.4.2 Decommissioning

The strategy for decommissioning tanks is being developed and will be subjected to separate environmental review.

5.4.3 Effect of the Alternatives

5.4.3.1 Preferred Alternative

The effects are already described.

5.4.3.2 Thicker and More Chemically-Resistant Tank Steel

This alternative would cause a significant impact financially because of the money already expended and increased cost of new thicker wall tanks.

The same relative number of people would be utilized to construct the new tanks and the operating force buildup would be delayed.

5.4.3.3 Cathodic Protection and Better Waste Retrieval Equipment and Enlarged Openings

Implementation of these alternatives will have minimal impact on socioeconomic issues. Implementation would require additional materials and some significant retrofitting, resulting in increased costs, short term manpower increases and program delays, including a delay in removing older-design tanks from service. While these factors do not impact significantly on socioeconomic issues, they would impact on the waste management program because of the delay in availability of new waste storage capacity.

5.5 RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS

There are no known conflicts with national, state, or local plans and programs in the operation of the waste tanks under construction. The plantsite was set aside by the U.S. Government in 1950 as a controlled area for the production of materials needed for national defense. It is not open to the public except for guided tours, controlled deer hunts, controlled through-traffic along S.C. Highway 125 (SRP Road A), the Seaboard Coast Line Railroad, and along U.S. highway 278 at the north edge of the site, and authorized environmental studies.

The Savannah River is a valuable natural resource. The continuing waste management operations have no major effect on the use of this resource because normal thermal and radioactive releases are small, and accidental releases are extremely unlikely.

The areas used for the waste tanks are barren spots within existing waste tank farm areas with no historically significant features. Further, based on our experience with excavation in the immediate vicinity and archaeological surveys, the likelihood of any archaeological interest is small.

There are no foreseeable impacts on land-use plans for any of the alternatives.

5.6 UNAVOIDABLE ADVERSE EFFECTS

The only significant adverse effects caused by operation of the waste tanks as part of the overall waste management facilities are (1) the small offsite population dose commitment from release of radionuclides, primarily tritium as water vapor from the waste tanks, and (2) the commitment of about one acre of land for each waste tank for an indefinite period.

Annual atmospheric tritium releases from the vapor space of waste tanks and evaporation of water from fresh waste receipts result in an average whole body dose commitment at the Savannah River Plant boundary of about 2.3×10^{-6} mrem and a dose commitment to the total population living within a 100-km radius of the plant center of about 0.46 man-rem.[4] This is not an incremental release associated only with the new tanks, but rather the release resulting from management of the total waste volume. In 1978, the dose commitment from all plant sources to the population within 100 km of the plant center was 135.8 man-rem (119.2 man-rem from ^{3}H).[5] Some dose to the population is unavoidable because complete elimination or recovery of these releases is technically and economically impractical.

NOTE: The doses compared here are for 100 km because the plant monitors and reports radioactive releases for that distance and covers about 700,000 people (1970 census). The values in Section 5.1.2.1 are from an analysis covering 150 km and about 2.3 million people are covered (1970 census).

None of the alternatives would have any significant adverse effect if all design and adjustments are correct. The preferred alternative would result in taking older-design tanks out of service earlier, and could conceivably result in reduced radioactive releases for this reason.

If new thicker wall tanks were built, additional land and resources would be committed.

5.7 RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

The 14 new waste tanks and auxiliaries will utilize existing land and water resources at the Savannah River Plant. These facilities will be within the controlled-access 200 Areas.

Continuing studies of strategies of ultimate decontamination and decommissioning of retired waste facilities are part of the programs at SRP and other DOE sites. These studies, in addition to ensuring safety, will stress surveillance, maintenance, and restriction in the future use of these sites. The storage of liquid waste, salt cake, and sludge in near-surface storage tanks is considered an interim plan for waste management. Work is under way to define acceptable long-term storage methods and, until such methods are chosen, the waste will continue to be stored in retrievable form. A decision on waste immobilization for long-term storage is expected in the early 1980's with potential startup of the waste solidification facilities in the late 1980's.

The major impact of the alternatives would be longer use of the older-design tanks with their potential for abnormal occurrences, despite surveillance and monitoring, because they do not take advantage of improved design and equipment included in the fourteen new tanks.

5.8 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Permanent commitments of natural resources to operation of the new waste tanks are relatively small. Production of steam for the waste tanks requires the consumption of about 50 tons of low sulfur coal per year per waste tank. This compares to about 3200 tons of coal per year for each of the four waste tank farm evaporators.

Water and materials (such as chemicals or fuels which are burned, consumed, or altered during use), are used during the construction and operation of waste tanks. Table 5-6 lists those resources used in significant amounts to construct a waste tank.

TABLE 5-6

Significant Resources Used During Construction of a Waste Tank

Resource	Per Tank
Water, m^3	2500
Materials	
Concrete, m^3	2500
Steel, metric tons	1350
Lumber, m^3	360
Argon, m^3	30,000
Propane (liquid), L	16,000
Diesel Fuel, gal	30,000
Gasoline, gal	15,000

As described above, the tanks occupy only a small fraction of the total land area occupied by the plantsite. It is conceivable that even these areas could be reclaimed in the future, but it may not be technically or economically practical to do so. About 1 acre of land is committed for each waste storage tank for high-level liquid wastes.

5.8.1 Thicker and More Chemically Resistant Tank Steel

This alternative would have the greatest impact on commitment of resources. The tanks under construction could not easily be retrofitted with thicker steel plates. An additional commitment of land and resources approximately equal to those already committed would be required because all fourteen tanks would have to be redesigned and rebuilt.

5.8.2 Cathodic Protection System

This alternative would require modification of the existing tanks for the placement of anodes and wiring. For effective cathodic protection, large, high-current power supplies would be required. Operation of the system would require electrical power. None of these resources is considered recoverable.

5.8.3 Better Waste Retrieval Equipment and Enlarged Openings

This alternative would require modification of the tank tops to enlarge the present openings. A significant expenditure would be required at this stage of construction to accomplish this modification. Despite careful design, the modification might result in structural damage to the tanks.

REFERENCES

1. Radiological Quality of the Environment in the United States, 1977. Report EPA-520/1-77-009, U.S. Environmental Protection Agency, Washington, DC (1977)

2. The Effects on Populations of Exposure to Low Levels of Ionizing Radiation. Report of the Advisory Committee on the Biological Effects of Ionizing Radiations. Division of Medical Sciences, National Academy of Sciences - National Research Council (1972).

3. C. Starr, M. H. Greenfield, and O. F. Housknecht. "A Comparison of Public Health Risks: Nuclear vs. Oil-Fuel Power Plants." Nuclear News (October 1972).

4. Environmental Statement, Future High Level Waste Facilities, Savannah River Plant, Aiken, South Carolina. USAEC Report WASH-1528 (December 1972).

5. Environmental Monitoring in the Vicinity of the SRP. Report DPSPU 79-30-1, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC, (1978).

6.0 LIST OF PREPARERS AND REVIEWERS OF DRAFT AND FINAL SUPPLEMENT EIS

Table 6.1 provides a listing of preparers of the draft and final supplemental EIS to the Final EIS, Waste Management Operations, SRP (ERDA-1537), November 1977 and their areas of responsibility. Table 6.2 lists the professional qualifications for each preparer. Table 6.3 provides a list of reviewers who had significant input to the EIS.

TABLE 6-1

List of Preparers

Name	Area of Responsibility												
	Section							Appendices					
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	A	B	C	D	E	F
R. T. Huntoon	X	X	X	X	X		X	X	X				
J. S. Murdock	X	X	X	X	X	X	X					X	X
D. J. Coon			X					X					
R. L. Hooker										X			
D. B. Jett			X								X		
B. S. Johnson			X					X					
G. H. Street										X			
J. C. Tseng	X	X	X		X	X							
R. C. Webb					X								

TABLE 6-2

Professional Qualifications and Responsibilities

NAME

Richard T. Huntoon

EDUCATION

BS and MS Metallurgical Engineering, Carnegie Institute of Technology, Pittsburgh, PA

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Manager, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Laboratory, Aiken, SC

1 year - Managed effort on environmental analysis to support SRP programs

27 years - Performed, supervised, and managed R&D programs in support of all phases of production activities at the Savannah River Plant, including fuel fabrication, radiation damage, corrosion, hydrogen embrittlement, radioisotopic heat source development, and others

EIS RESPONSIBILITIES

Provided management review and preparation of the supplement to the Final EIS, Waste Management Operations, SRP, ERDA-1537 covering new waste tanks under construction at SRP

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

TABLE 6-2, contd

NAME

John S. Murdock, Jr.

EDUCATION

BS General Engineering, University of Maine, Orono, ME

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

1.5 years - Safety and environmental analysis and planning related to defense waste immobilization at SRP and interim storage of spent fuel from nuclear power reactors

24.5 years - Radiation protection at SRP in the Health Physics Department at SRP with experience in all facilities (reactor, chemical separations, fuel fabrication, heavy water production and spent fuel and defense waste storage)

1.5 years - SRP Separations Department in production and Personnel Department as an Employee Counselor

EIS RESPONSIBILITY

Coordinated preparation of supplement to the Final EIS, Waste Management Operations at SRP, ERDA-1537 covering new waste tanks under construction at SRP

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

TABLE 6-2, contd

NAME

Don J. Coon, Jr.

EDUCATION

BS Chemical Engineering, University of Delaware, Newark, DE

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Process Engineer, Waste Management Programs, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

5 years - Liaison between Plant and the Engineering Department in the design and construction of new tanks, evaporators, and transfer facilities for liquid radioactive waste storage and volume reduction

10 years - Technology development and technical assistance for liquid radioactive waste storage and volume reduction and solid waste burial

6 years - Technical assistance in heavy water production, tritium recovery, and chemical processing of spent nuclear fuels

EIS RESPONSIBILITY

Reviewed and up-dated descriptions of SRP facilities for liquid radioactive waste storage and volume reduction

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

WASH-1167, Compaction of Radioactive Solid Waste, June 1970

TABLE 6-2, contd

NAME

Robert L. Hooker

EDUCATION

BS Chemical Engineering, Georgia Institute of Technology, Atlanta, GA

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

2 years - Research and development related to solid waste disposal programs

16 years - Technical Assistance to plant operation related to solid and liquid waste management

6 years - Engineering design of equipment for experimental physics reactors

3 years - Engineering tests of experimental and plant prototype equipment for chemical separations plant

EIS RESPONSIBILITY

Prepared section on Decontamination and Decommissioning of Waste Tanks

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

TABLE 6-2, contd

NAME

David B. Jett

EDUCATION

BS Chemistry, University of South Carolina, Columbia, SC

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Area Supervisor, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

15 years - Supervision and management of production facilities including reactor raw materials (fuels) fabrication, test reactor operation, separation and concentration of radioisotopes including transuranic element concentration, design, fabrication and startup of three new production facilities

10 years - Directed and coordinated the design of major waste management facilities including 21 new waste tanks and verification of fabrication details during the construction phase

EIS RESPONSIBILITY

Participated in development of the draft charge EIS for the design and construction of waste tank facilities; specifically design alternatives considered and the chronology of tank construction

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

TABLE 6-2, contd

NAME

Ben S. Johnson, Jr.

EDUCATION

BS Chemical Engineering, West Virginia University, Morgantown, WV

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, Waste Management Technology, Waste Management Programs, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

18 years - Supervision/guidance of technical assistance and process improvement to radioactive waste management operations at SRP

8 years - Supervision of technology development and technical assistance in the field of chemical separations processing of irradiated reactor fuel and targets (Savannah River Laboratory)

4 years - Technical assistance and process improvement in heavy water production

6 years - Chemical process instrumentation engineering and development

2 years - Technical assistance in the production of ammonia, methanol, and related products

EIS RESPONSIBILITY

Contributing author of portions of Section 3.2 and Appendix A

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

Principal compiler and editor of TWM-74-2, "Integrated Aqueous Waste Management Plan - Savannah River Plant," December 1974; contributor to subsequent upgrading and revisions of this document (SR-TWM-76-1, SRO-TWM-77-1, SRO-TWM-78-1)

TABLE 6-2, contd

NAME

Gary H. Street

EDUCATION

BS Chemical Engineering, Auburn University, Auburn, AL

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Technical Supervisor, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC

1 year - Supervisor of Waste Management Technology groups responsible for waste removal program and tank inspection

12 years - Technology development and technical assistance related to heavy water production

6 years - Design and modification of facilities for chemical separations and waste management

EIS RESPONSIBILITY

Author of Appendix C on Waste Removal

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

TABLE 6-2, contd

NAME

John C. Tseng

EDUCATION

BS Aeronautical and Astronautical Sciences, Massachusetts Institute of Technology, Cambridge, MA
MS Environmental Health Engineering, Northwestern University, Evanston, IL

CERTIFICATION

Professional Engineer - State of Illinois

PROFESSIONAL DISCIPLINE AND EXPERIENCE

March 1977 - Present

Environmental Engineer, Department of Energy-Savannah River Operations Office, Aiken, SC

- Radiological protection of the Savannah River plant operations
- Compliance with the National Environmental Policy Act
- Identification and coordination of environmental research related to radiological protection
- Advise management of the Nuclear Regulatory Commission licensing process

August 1972 - March 1977

Environmental Engineer, Sargent and Lundy Engineers, Chicago, IL

- Licensing of commercial nuclear power reactors
- Coordination of environmental compliance activities for construction and operation of both nuclear and fossil power plants
- Design and management of environmental radiological monitoring program
- Assessment of environmental impacts due to construction and operations of both nuclear and fossil power plants

TABLE 6-2, contd

EIS RESPONSIBILITY

Helped prepare and review supplement to final EIS, Waste Management Operations at SRP, ERDA-1537

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

C TABLE 6-2, contd

NAME

Robert C. Webb

EDUCATION

University of South Carolina, Aiken, South Carolina.
Political Science/Public Administration
Second Semester Senior - Expected graduation date is December 1980.

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Comprehensive emergency preparedness, planning and response operations on state/local and federal government levels. Nuclear emergency planning and response operations on state and federal government levels and private industry.

Telecommunications management for voice systems.

1975 to Present: Staff specialist for DOE-SR in emergency planning and telecommunications management

Communications Management Specialist - Project coordinator for upgrade of SRP telephone system. Preparation of DOE-SR/SRP telecommunications budget. Contract management and overview of SRP emergency planning program.

Emergency Planning Specialist - Contract management and overview of the SRP emergency planning program.

Member - Federal Region IV Radiological Emergency Planning Advisory Committee. Provides federal planning guidance to state/local government concerning response to fixed nuclear facility emergencies/incidents.

Member - Region IV Interagency Regional Preparedness Committee for National Emergency Planning.

1972 to 1975: State/local civil preparedness planning with the South Carolina Disaster Preparedness Agency.

Deputy Operations Officer - Assistant to Director of Operations, Plans and Training Division. Responsible for annual program paper preparation for South

C TABLE 6-2, contd

PROFESSIONAL DISCIPLINE AND EXPERIENCE - Robert C Webb (contd)

Carolina, maintained state/federal interagency liaison for nuclear preparedness planning and maintained the State Emergency Operating Center. Supervision of five field coordinators.

Field Coordinator - Maintained state/local preparedness plan for Emergency Welfare Services. Liaison officer for South Carolina with American National Red Cross, Salvation Army, and Mennonite Disaster Services.

EIS RESPONSIBILITY

Prepared Section 5.1.3.2, Emergency Planning.

PUBLISHED PAPERS OR REPORTS (related to Waste Management)

None

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List of Reviewers

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M. S. Crosland	- Office of General Counsel, Department of Energy, Washington, DC.
T. L. Davis	- Waste Management Design and Construction Liaison Organization, Waste Management Programs, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC.
E. S. Goldberg	- Waste Management Project Office, Department of Energy, Savannah River Operations Office, Aiken, SC.
C. A. Kouts	- Division of NEPA Compliance and Affairs, Office of Environmental Compliance and Overview, DOE, Washington, DC.
W. F. Lawless	- Waste Management Project Office, Department of Energy, Savannah River Operations Office, Aiken, SC.
E. J. Lukosius	- Waste Disposal Technology, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Laboratory, Aiken, SC.
O. M. Morris	- Waste Management Programs, Waste Management Technology, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC.
J. C. Vinson	- Office of Chief Counsel, Department of Energy, Savannah River Operations Office, Aiken, SC.

7.0 GLOSSARY

ALARA	As low as reasonably achievable
annulus	Space between the primary and secondary tanks of the double-shell tanks
anode	positive charged electrode
ANSI	American National Standards Institute
aquifer	underground source of water
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
background radiation	the radiation in man's natural environment including cosmic rays and radiation from the naturally radioactive elements both inside and outside man and animal
Btu	British Thermal Unit
Canyon Building	a heavily shielded process building
caustic	usually sodium hydroxide; implies high pH (alkaline range)
caustic/nitrate	a molar ratio of caustic to nitrate in the high-level waste
CEQ	Council on Environmental Quality
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	Curie, the basic unit used to describe the intensity of radioactivity
cm	centimeter
c/m	counts per minute
CY	calendar year

	°C	degree Centigrade (Celsius)
	°F	degree Fahrenheit
	DBE	Design Basis Earthquake
	decommissioning	removal from service; decontamination of a nuclear facility
	decontamination	the selective removal of radioactive material from the surface or from within another material
	DOE	Department of Energy
	DWPF	Defense Waste Processing Facility
E	EDTA	ethylenediaminetetracetic acid
	eductor	a steam jet
	EIS	Environemntal Impact Statement
	EMF	Electromotive Force
	ERDAM	ERDA Manual (now called DOE Manual)
	F and H Area	Chemical Separations Areas
	ft	feet, foot
	ft^3	cubic feet
	FY	Fiscal Year
	g acceleration	acceleration of gravity
	gamma rays	high-energy, short-wavelength, electromagnetic radiation emitted by a nucleus
	gal	gallon
	g/L	gram per liter

ha	hectare
HEPA	High Efficiency Particulate Air
HEPA filter	High Efficiency Particulate Air filter
hr	hour
in.	inch
km	kilometer
knuckle	transition area between the bottom and wall of the double-shell tank
kwh	kilowatt-hour
m	meter
M	million
MM	Modified Mercali
man-rem	the total radiation dose commitment to a given population dose
maximum individual	a hypothetical individual located such that he or she receives the maximum possible radioactive dose
mg	milligram
microbiota	microorganisms
g	microgram
mil	1/1000 inch
mill scale	oxidized layer left on the steel by the milling process
Molar	M, a measure of concentration used by chemist
mph	miles per hour
mrem	millirem, 10^{-3} rem
MSL	Mean Sea Level
MT	Metric ton, tonne = 2200 lb
mv	millivolt

NAAQS	National Ambient Air Quality Standard
NAS	Natinal Academy of Sciences
NBS	National Bureau Standards
NDTT	Nil Ductility Transition Temperature
NEPA	National Environmental Policy Act
NERP	National Environmental Research Park
NRDC	National Resources Defense Council
PEIS	Programmatic Environmental Impact Statement
pH	a measure of the acidity or alkalinity of a solution
psi	pounds per square inch
radionuclide	an unstable isotope of an element, which decays and emits radiation
refractor	heat resistant material
rem	roentgen equivalent man, unit of dose of an ionizing radiation
SCC	Stress Corrosion Cracking
self-boiling waste	high-level waste that boils spontaneously because of its high concentration of short-lived radionuclides
Seismic acceleration	acceleration caused by earthquakes
sludge	the solid matter that settles out of the high-level waste
sluice	dissolution and removal of high-level waste with water

sorb, sorption	assimilation of a gaseous or liquid substance either interstitially or on the surface of a solid
source term	the quantities of radionuclide present in the waste given for a specific accident
specific gravity	density (mass per unit volume) of a material relative to the density of water
SRP	Savannah River Plant
SSE	Safe Shutdown Earthquake
stress corrosion	chemical corrosion such as of pressure vessels that is accelerated by stress concentration, either built into or resulting from a load
supernatants	the liquid portions of the high-level waste
thermally stress-relieved	heating of fabricated primary tanks to relieve its internal stresses
thermocouples	devices to measure temperature by converting temperature differences to an electrical signal
transport, transport mechanisms	movement of radionuclides to the environment
viscosity	the degree to which a fluid resists flow
yr	year

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APPENDIX A

DESIGN OF TYPE III TANKS

Over the past 29 years, 51 tanks of four different basic designs have been built at the Savannah River Plant to store high-level nuclear wastes. Construction of these tanks is summarized in Table A-1; 27 of the tanks are of the most recent, or Tank III design, including the 14 tanks that are the subject of this environmental statement.

The Type III tank design was developed after an investigation of leaks from earlier Type I and Type II primary tanks. At the time of the investigation (1965), four primary tanks had leaked. Five more tanks have developed leaks since then, so leaks now affect five Type I and four Type II tanks. The conclusions of the investigation were that the primary leak-producing mechanism was stress corrosion cracking at sites in or near the weld seams and that stress relieving after fabrication should eliminate the cracking. For the Type III tanks, means were provided for heating each finished tank to relieve the stresses generated during fabrication. In addition, stress patterns were minimized by mounting the roof-supporting column on the foundation pad rather than on the bottom of the primary tank (as in Type I and II) and by providing an annular clearance around the roof-supporting column. Each Type III primary tank holds 1,300,000 gallons, is 85 ft in diameter, and is 33 ft high.

Structure

Each primary vessel of a Type III tank is made of two concentric carbon steel cylinders joined to washer-shaped top and bottom plates by curved knuckle plates (see Figure 3-3). Plate thicknesses are as follows:

Top and bottom	1/2 inch
Upper knuckle	1/2 inch
Outer wall	
Upper band	1/2 inch
Middle A band	5/8 inch
Middle B band	3/4 inch
Lower band	7/8 inch

TABLE A-1

High-Level Nuclear Waste Tanks at SRP

Number	Location	Type	Project Number	Construction Period	Type of Construction*
1-8	F	I	8980	1951-1953	Double wall - cooled
9-12	H	I	8980	1951-1953	Double wall - cooled
13-16	H	II	8980 P.W.O.	1955-1956	Double wall - cooled
17-20	F	IV	981031	1958	Single wall - uncooled
21-24	H	IV	981089	1962	Single wall - uncooled
25-28	F	III	951493 (75-1-a)	1975-1978	Double wall - cooled
29-32	H	III	981232	1967-1970	Double wall - cooled
33-34	F	III	950974	1969-1972	Double wall - cooled
35-37	H	III	951463 (74-1-a)	1974-1977	Double wall - cooled
38-43	H	III	951618 (76-8-a)	1976-1980	Double wall - cooled
44-47	F	III	951747 (77-13-d)	1977-1980	Double wall - cooled
48-51	H	III	951828 (78-18-b)	1978-1981	Double wall - cooled

* Tanks 32 and 35 have removable, roof-supported cooling coils. Tanks 30, 33, and 34 have bottom-supported deployable cooling coils. Tanks 29 and 31 have some deployable and some close-packed cooling assemblies, all bottom supported. All other cooled tanks have permanently installed cooling coils, roof-supported in Types I and II and bottom-supported in Type III tanks.

Inner wall (at column)	
Upper band	1/2 inch
Lower band	5/8 inch
Lower knuckle	
Outer	7/8 inch 1 inch in Tanks 29 through 32 only
Inner (at column)	5/8 inch

Tanks built before 1974 were made of hot rolled ASTM A516-Grade 70 steel. All later tanks are fabricated with equivalent steels (either A516-Grade 70 or A537-Class I) with the added specification that the plates be supplied in the normalized condition. The normalizing heat treatment (similar to annealing) serves to optimize notch toughness of the plates and hence resistance to brittle fracture of vessels fabricated from them. See Appendix B.

Each primary tank sits on an 8-inch bed of insulating concrete within a secondary carbon steel containment vessel. The concrete bed is grooved radially so that ventilating air can flow from the inner annulus to the outer annulus. Liquid would move through the slots, and any leak from the tank bottom or center annulus wall would probably be detected at the outer annulus.

The secondary vessel is 5 ft larger in diameter than the primary vessel, with an outer annulus 2-1/2 ft wide. The secondary vessel is made of 3/8-inch steel throughout. Its sidewalls rise to the full height of the primary tank. The nested two-vessel assembly is surrounded by a cylindrical reinforced concrete enclosure with a 30-inch wall. The enclosure has a 48-inch flat reinforced concrete roof which is supported by the concrete wall and also a central column that fits within the inner cylinder of the secondary vessel.

Because of a high water table, the tanks in H Area are elevated above natural grade and surrounded with mounded earth. The water table in F Area was lower than at H Area, and the tanks in F Area were installed with their tops flush with natural grade. Because the tanks are above predicted water tables, only standard waterproofing was applied to the concrete enclosure. The highest measured water table is at least 3 ft below the tank bottoms. The 48-inch concrete covers for these tanks reduce the radiation field above any of them with high-heat waste in the tank to less than the amount permissible for continuous occupancy by operating personnel, hence no earth overburden is required.

Cooling

Type III tanks constructed after 1975 are provided with permanently installed, bottom-supported, vertical coils on 3-foot triangular centers. Unlike Type I and II tanks, the Type III tanks do not have horizontal coils near the tank bottom; in these tanks the bottoms are cooled by forced air flow underneath. The nominal heat removal capacity of these coils is 6 x 10^6 Btu/hr. Uniformly distributed cooling coils were selected for these tanks to make them suitable for storing all types of wastes.

Bundles of closely spaced coils are satisfactory for cooling liquid wastes, including fresh waste with maximum heat output, because convection circulates the liquid and thereby carries the heat from remote regions of the tank to the widely spaced bundles. However, in tanks receiving evaporator concentrate, cooling surfaces soon become encrusted with crystallized waste salts, and all heat must flow through the deposited salt by conduction, which is a relatively inefficient process. Hence, the coils must be distributed as widely as practical throughout the tank, so that a maximum volume of solid salt can be accumulated before the salt thickness on any one coil becomes too great to pass its share of the heat to be dissipated.

In Tanks 32 and 35, unsaturated liquid waste is cooled by cooling-coil bundles (Figure A-1) that are suspended in the tank through risers in the roof. A maximum of 10 cooling units can be inserted in each tank. Each unit has a heat removal capacity of 600,000 Btu/hr, and there are five in each tank.

Because installation of uniformly distributed cooling coils in Type III tanks already in service is not practical, those now in concentrate service (Tanks 29, 31, 33, and 34) are being provided with deployable coolers, which are inserted through the roof ports and then expanded horizontally to distribute their cooling surfaces more widely than is the case with the consolidated bundles. Two models of deployable coolers are in use. The early model, of which four units are installed in Tank 33 and seven in Tank 34, has 11 double-pipe (hairpin) elements in a conical configuration with a base diameter of 24 ft. The latest model deploys at both top and bottom into a cylindrical configuration 16 ft in diameter, with 20 single-pipe elements. Figure A-1 shows the basic configurations of the three types of insertable coolers. Both deployable models are nominally 30 ft high, although most units have somewhat shortened elements in order to clear the salt layers already on the bottoms of the tanks at the time of installation. Fifteen cylindrical units are currently in service in Tanks 29(4), 30(2), 31(2), 33(4), and 34(3). Three units were originally installed in Tank 31, but one unit is not operable. Three additional units are funded for installation in Tank 30.

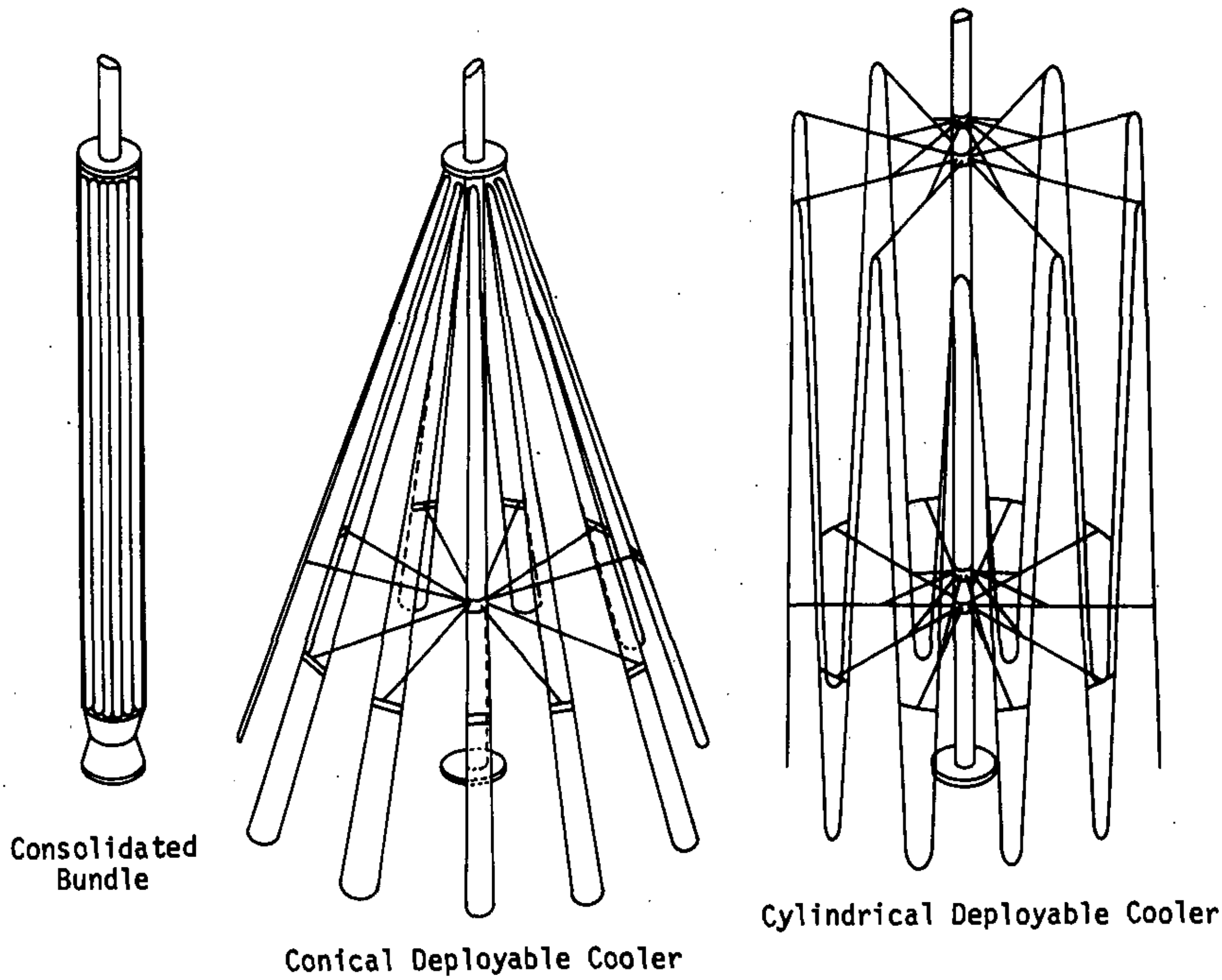

FIGURE A-1. Insertable Coolers for Type III Tanks 29 through 35

In addition to the deployable coolers cited above, Tanks 29 and 31 each have five close-packed bundles (similar to Figure A-1) that were installed before development of the deployable coolers.

Construction Inspection and Testing

These waste tanks were designed and constructed under increasingly rigorous Quality Assurance plans as requested by DOE. Design of the vessels according to the ASME Code, Section VIII for the construction of pressure vessels ensures that the mechanical requirements are satisfied.

All butt welds on the primary tanks, except welds on the horizontal roof surface, and all butt welds on the secondary tanks joining bottom plates, knuckle plates, and the lowest courses of center-column and outer-wall plates are radiographically inspected. Defects are corrected, and then they are rechecked radiographically. Beginning with the FY-1974 tanks, all plate welds in the secondary tanks are radiographically inspected. All spots on the inside or outside of the primary tanks or the inside of the secondary tanks, where clips or lugs were removed or where other excisions were made, are examined by magnetic particle or liquid penetrant techniques. Any defects are repaired. All butt welds on the secondary tanks are vacuum leak-tested. All welds in the bottom assemblies of the primary tanks, including knuckle rings and lowest course welds, are vacuum leak-tested before each bottom assembly is lowered into final position; these welds are then tested a second time after the stress-relieving operation. A full hydrostatic test, consisting of filling each primary tank with water to a depth of 32 ft and allowing it to stand 48 hours, is conducted after stress relieving. Circumferential welds in the pipe loops of the cooling coils are radiographed. The assembled piping is tested hydrostatically to 500 psi and halide leak-tested at 30 psi.

Tank surfaces are sandblasted to remove mill scale and facilitate inspection for inclusions and laminations. Plate edges are ground clean and smooth to inspect for end laps.

Surface Protection

No special surface protection treatment was applied. Rusting of annulus chamber surfaces exposed to air is controlled by maintaining the temperature of the air a few degrees above the dew point. Keeping the tank warm also inhibits interior rusting prior to its being placed in service.

Stress Relieving

The primary tank is stress-relieved in place after all burning, cutting, welding, and other high-temperature work below the liquid fill line has been completed. Full stress relief at 1100°F is accomplished in accordance with the general requirements of the ASME Boiler and Pressure Vessel code.

Tank Instrumentation

The top openings into the Type III tanks and annular spaces are closed with stepped concrete plugs (lead plugs in a few cases), and the openings are used for instrumentation, cooling units, or ventilation system connections. The principal instrumentation provided for each tank consists of:

- Liquid Level. The amount of liquid waste is determined by two different systems in each tank. One system uses a conductivity probe on the end of a tape reeled in or out by a motor drive, with both local and remote readout in the Control Room. Hand-held steel tapes serve as a backup system.

  For Tanks 29 through 34, four stationary conductivity probes are provided, one in each quadrant, for determining the presence of liquid in the annulus. Three of the probes are single-point devices, and the fourth is a multipoint probe that can obtain an approximate determination of the liquid level in the annulus as well as the indication of leakage. A pneumatic dip-tube system is also provided. Later Type III tanks have a
C single-point probe in each quadrant and a single-point probe in the center column annulus. Evidence of leakage into annulus, as well as tank high- and low-liquid level in any of these waste tanks, is signaled to the tank farm control house.

- Temperature. Temperature measurements are obtained from thermocouples located in and around the waste tanks. See Tables A-2 and A-3 for locations and alarm settings. Thermocouples are grouped and referenced to alarm modules according to tank service and thermocouple location. This arrangement provides maximum ease and flexibility in changing alarm settings.

  A stainless steel thermowell is installed in each of four tank-top plugs, spaced 90° apart, on each Type III waste tank. Seven thermocouples are installed in each thermowell spaced from 1 inch from the bottom of the tank to about 26 feet from the bottom.

  Temperatures are recorded in the control house, and recorders are equipped with high-temperature alarms.

TABLE A-2

Currently Specified Thermocouple Locations

Location	Thermocouples Per Tank
Annulus air in	1
Annulus air out	1
Purge vent	1
Purge condenser air out	1
Purge condenser CW out	0
Cooling water supply	1
Cooling water return	1
Tank contents (Risers D1 through D4)	21-28
Primary liner sidewalls	6
Primary liner knuckleplate	4
Primary liner bottom	12
Secondary liner bottom	2
Working slab bottom	2
	60

TABLE A-3

Temperature Alarm Set-Points by Tank Service or Contents

Thermocouple Location or Service	Alarm Temperature, °C
Cooling water supply Purge condenser cooling water outlet	<5
Cooling water return	>80
Lower primary liner knuckleplates	<21
HLW, LLW, and sludge tank vents HLW and LLW contents 10 ft and above HLW and LLW primary sidewalls 10 ft and above	>65
HLW and LLW contents below 10 ft	>135
HLW and LLW primary sidewalls below 10 ft HLW and LLW primary bottoms	>180
Salt and feed tank vents	>90
Salt tank contents Salt tank primary sidewalls and bottoms	>100
Feed tank contents Feed tank primary sidewalls and bottoms	>90
Sludge tank contents Sludge tank primary sidewalls and bottoms	>135

- Pressure and Flow. The water supply line to the cooling units for each tank is equipped with a pressure gage, and connections for a portable flowmeter are provided. Each cooler is equipped with a pressure relief valve on the outlet piping and a pressure gage on the inlet. In the tank vapor space ventilation system, tank static pressure, pressure downstream of the filters, and differential pressure across the demister can be measured for each tank. Differential pressure switches are installed to signal vent exhauster failures and plugged filters.

Ventilation

The ventilation systems for Type III primary tanks are negative-pressure systems designed for purging the interior volume at a rate in excess of 100 cfm. In a typical installation, air enters through a HEPA filter and is conducted by a 4-inch pipe through the roof into the waste storage space. Air leaves the storage space by way of a 12-inch riser pipe positioned across the tank from the inlet. The exhaust air first passes through a demister in the riser, which intercepts droplets and returns them to the tank. Then the air passes through a condenser to extract potentially radioactive moisture, through a heater to raise the air temperature above its dew point (to prevent water vapor condensing on the HEPA filters), and through a HEPA filter to remove solid particles. The air is finally discharged to the atmosphere through an exhaust blower. Tanks 35 through 37 (and all future tanks) have systems that continuously monitor the radioactivity level and hydrogen concentration in the tank purge exhaust air.

The ventilation and dehumidification systems for Type III tank annuli differ from those installed in annuli Types I and II tanks in that, in addition to the warmed air flow directly into the outer annulus, approximately 1000 cfm of air is drawn through the inner annulus, passes beneath the primary tank through the radial grooves in the concrete base slab, and exhausts into the outer annulus. Beginning with Tanks 35 through 37, the annulus ventilation system will have a capacity of about 8000 cfm, up to about half 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). Tanks 35 through 37 (and later tanks) also have radiation detectors to monitor the concentration of radioactivity continuously in the annulus exhaust.

Waste Inlet and Outlet Piping

One 3-inch-diameter, Schedule 40, stainless steel waste transfer pipeline is connected to each tank from diversion boxes except Tank 43H and Tank 26F, which have two. The pair of transfer lines running from the diversion box to the encasement wall of each tank is enclosed in an 8-inch-diameter, Schedule 20, carbon steel pipe jacket. The jacket goes through the tank encasement wall. The slope of the waste transfer lines is such that they are free draining (without pockets). The jacket piping drains to a leak detection box fitted with a probe for detecting liquid.

In the first six Type III tanks (29 through 34), two 3-inch-diameter inlet lines bridge the tank annulus within a jacket. The jacket tube consists of two pieces, a 10-inch-diameter, Schedule 20, carbon steel pipe that is telescoped into a 12-inch-diameter, Schedule 40, carbon steel pipe. The outer end of that jacket assembly is embedded in the tank's concrete encasement, and the joint between the two telescoped sleeves is sealed with asbestos packing that can slip slightly to allow for thermal expansion. The jacket pipe and the two inlet lines are welded individually to the outside surface of the tank.

In the FY-1974 and subsequent Type III tanks, the packed telescoping joint in the line jackets is eliminated, and the jacket is continuous to the tank interior, being seal welded to the primary tank upper knuckle. This provides greater jacket integrity and permits hydrostatic testing of the jacket. To accommodate expansion, the jacket passes through a slightly larger pipe sleeve welded to the secondary liner and embedded in the concrete vault wall. The annulus between the jacket and the sleeve is packed with asbestos to seal off the tank annular space from the tank exterior.

The two inlet lines enter the primary tank through the top knuckle; each terminates in a connector flange a few feet inside the tank, about one foot above the tank's normal fill line, and under a tank top riser. Thermal expansion of the waste inlet lines, outside the primary tank, is accommodated by free space in the jacket and bends in the lines at a short distance from the tank. A steam jet can be connected (within the tank) to either of the inlet lines to permit withdrawal of supernate liquid waste from the tank.

Each tank is also equipped with a stubbed-off spare inlet line for unprocessed waste and an inlet and outlet line for the recirculating waste concentrate loop. The spare inlet line and the concentrate lines are 2-inch-diameter stainless steel pipe.

The design for all of these is similar to that for unprocessed waste transfer lines described above, except that smaller jacket pipes are used (6-inch and 8-inch diameter).

The lines for unprocessed waste (fresh or aged) and for the concentrate inlet and outlet lines each terminate in connector flanges within the tank, under tank risers. Service nozzles for steam or air and flush water, respectively, are mounted in the same supporting framework. Adapter assemblies can be inserted into a tank through a riser to make connections for appliances such as waste inlet downcomers, steam eductors and waste-out transfers, and concentrate inlet drop valves. The connections are gasketed flanges that are designed to be tightened by applying torque to screw stems which are accessible in the riser, and which activate clamping mechanisms on the flanges.

Leak Detection

The primary means for detecting leaks from the primary vessels is the same for all double-walled tanks: instrumented and visual surveillance for liquid in the secondary pan or liner under the annular space between the free-standing primary tank and the secondary vessel. Conductivity probes, supplemented by pneumatic bubbler tubes (dip tubes), are installed in each tank annulus to provide automatic early warning if liquid accumulates in the annulus. Evidence of leakage into the annulus, as well as changing liquid level in any of these waste tanks, is signaled to the tank farm control house. Four access risers in each tank annulus permit direct visual inspection of limited regions of the annulus pan. An optical periscope and direct photography are also used for annulus inspection. Beginning with the FY-1974 tanks (Tanks 35 through 37), Type III tanks are provided with 14 similar annulus inspection ports (plus the four large risers); these will permit inspection by periscope and direct photography of 100% of the primary wall outer surface. The methods for inspection and the significant results to date are summarized in Section II-A of ERDA-1537.

Beginning with the waste tanks constructed under FY-1975 Project 75-1-a, an additional improvement in leak detection capability is provided (Figure 3-3) which permits verification of the integrity of the secondary tank. A grid of interconnected radial channels is formed on the inside of the concrete base slab on which the secondary tank rests. The channels are sloped to drain through a collection pipe to a sump outside the concrete enclosure around the tanks. An access pipe rises to grade from the sump to allow for liquid measurement, sampling, and pumpout of collected liquid. This system is similar to that under the single-wall tanks

(Type IV). No such system was included in the Type I and II tanks or the early Type III tanks.

A gamma monitoring tube network was installed beneath the tank foundation slab of Tanks 36 and 37 (FY-1974, Project 74-1-a) because no leak detection gridwork (as planned for all future Type III tanks) was included in this project. A gamma monitoring tube network was not installed under Tank 35 because the tank was urgently needed for fresh waste service, and the installation of monitoring tubes would have significantly delayed availability of the tank. The gamma monitoring system is a series of 3-inch steel C tubes, welded smooth, and lined with polyethylene. At least twice a year, a gamma radiation detector is inserted into the liner to monitor for leakage outside the secondary container.

APPENDIX B

SELECTION OF MATERIALS

The material for the primary containers in the waste tanks must provide two main functions: it must resist the mechanical forces exerted on the vessel by its contents; and it must resist chemical attack or *corrosion* by these contents.

Design of the vessels according to the ASME Code, Section VIII, for the construction of pressure vessels and the use of materials approved by that Code ensures that the mechanical requirements are satisfied. This practice has been followed for each successive series of tanks. However, three different specifications of steel have been used to obtain improved performance and reliability as technology improved over the years. These steels are as follows:

- A 285 Grade B — an intermediate-strength carbon steel intended for welded pressure vessels. It may be made by any of the customary steelmaking practices; *austenitic* grain size is not specified. Toughness is also not specified. This steel is used in Tanks 1 through 16.

- A 516 Grade 70 — a fine-grain-size carbon steel for welded pressure vessels. This grain size may be provided in the normalized heat treatment where improved notch toughness is important. It is used for Tanks 25 through 37. The steel for Tanks 25 through 28 was normalized, but that for Tanks 29 through 34 (actually constructed earlier) was not.

- A 537 Class I — a heat-treated carbon-manganese-silicon steel of fine-grain size for fusion welded pressure vessels. Grade I must be normalized. This steel has very good notch toughness. It is used for Tanks 38 through 51.

The specifications for each of these steels are summarized in Table B-1.

TABLE B-1

Steel Specifications for SRP Waste Tanks

Chemical Composition, %	A-285 Grade B	A-516 Grade 70	A-537 Class I*
Carbon, max	0.22	0.28	0.24
Manganese	0.98 max	0.79-1.30	0.64-1.46
Phosphorus, max	0.035	0.035	0.035
Sulfur, max	0.040	0.040	0.040
Tensile Requirements			
Tensile Strength, ksi	50-70	70-90	70-90
Yield Strength, min. ksi	27	38	50
Elongation in 8 in., %	25	17	18
Nil Ductility Transition Temperature, max °F	**	As rolled** Normalized, -10	-10

* A-537 will contain minor amounts of the following alloying constituents not to exceed

Copper	0.35%
Nickel	0.25%
Chromium	0.25%
Molybdenum	0.08%

** Not specified.

CORROSION

Four distinct forms of corrosion attack may be observed in systems such as the waste tanks.

- General corrosion — the surface is attacked uniformly resulting in a gradual thinning of the structure.
- Pitting — the surface is attacked at very localized sites forming relatively deep pits or crevices. Pitting may cause very rapid penetration of the structure.
- Beachline attack — the metal is attacked more rapidly at the liquid-air (vapor) interface.
- Stress corrosion cracking (SCC) — under the influence of an internally or externally imposed stress and a slightly corrosive environment, the metal cracks at an externally imposed load much lower than its normal tensile strength.

Significant general corrosion has not been observed in the waste tanks as evidenced by the inspection program (both wall thickness measurements and direct observation), as well as by the performance of in-tank corrosion coupons.[1]

Apparent stress corrosion cracking has been observed in six of the nine tanks in which salt deposits have been found in the annular space; SCC is presumed to be responsible for the leaks in the other three. Pitting (and possibly beachline attack) has not appeared to be a problem in the waste tanks themselves, but has caused leaks in about 10% of the cooling coils installed in Types I and II tanks.[2] These corrosion mechanisms have been studied in the laboratory in an effort to select better materials of construction for new tanks and to control operating conditions to prevent additional failures.[1]

Stress Corrosion

Stress corrosion cracking occurs in many metals and alloys. In most of the cases, neither significant corrosion nor stress alone would cause structural failure, but together they can.

Mild steels (a generic name for a class of steels that contains less than about 0.3% carbon) are susceptible to SCC in nitrate solutions as well as in caustic solutions and several other environments.[3] The precise mechanism for this form of failure is not universally agreed upon, but it is no doubt related to the fact that in a crevice or a crack the chemistry of the system can be very different from that in the bulk solution. The most generally accepted mechanism is that the stress maintains a crevice in which the solution is aggressive towards the metal. The chemistry of the solution at the crack tip has been shown to be significantly different from that of the bulk solution by measurements of the pH — an indication of the concentration of hydrogen ions or the relative concentration of acid. Laboratory measurements have shown the pH in the crack tip region to be about 3, acid, while the bulk solution was near neutral, a pH of 7.[4] A solution with a pH of 3 readily corrodes mild steel. A characteristic of this type of cracking is that it is intergranular. That is, the grain boundaries of the metal are preferentially attacked. Intergranular corrosion is the type of attack observed in the SRP waste tank cracking. This evidence, along with electrochemical behavior of the steel, indicates that the cracking in waste tanks has been caused by nitrate stress corrosion.

Waste Composition and Cracking

The waste supernate is basically an alkaline nitrate solution. Although either nitrate or caustic ions can cause mild steel to stress crack, the presence of either will inhibit cracking by the other. Also, nitrite, NO_2^-, is known to inhibit nitrate crack growth,[5] and its concentration in the SRP waste increases with aging. Therefore, the SRP waste solutions contain species that can both cause and inhibit stress corrosion cracking of the mild steel tanks.

Laboratory studies in which specimens are forced to crack by applied tensile loads have led to an understanding of the conditions required for stress corrosion cracks to develop in the waste tanks, and provide a basis for controlling the waste compositions to avoid SCC. During most waste storage operations, technical standards require that the composition of the wastes be controlled as shown in Table B-2. A maximum NO_3^- concentration is specified to limit the maximum aggressiveness of the supernate. The concentration of inhibitors, OH^- and NO_2^-, is maintained at specific minimum levels depending on the NO_3^- concentration. These levels of OH^- and NO_2^- have been shown to prevent crack initiation even in highly stressed specimens.

The temperature of fresh supernate is maintained at less than 70°C. Since stress corrosion is a thermally activated process, this relatively low temperature requirement will also inhibit the initiation and growth of cracks. The temperature limit specifically applies to fresh waste only because aged and evaporated waste contain sufficient OH^- and NO_2^- to inhibit SCC by themselves.

Data from these same laboratory studies confirmed that A 516-70 steel used in Type III waste tanks is less susceptible to cracking than the A 285-B steel used in Types I and II tanks and that the supernates from salt receiver tanks are of the least aggressive compositions, while fresh wastes (high nitrate) are of the most aggressive ones.[6] A 537-I steel has essentially the same corrosion behavior as A 516-70 steel.[7]

TABLE B-2

Required Minimum OH^- and NO_2^- Concentrations in SRP Wastes

Concentration, M		
NO_3^-	OH^-	$OH^- + NO_2^-$
3-5.5	0.3	1.2
1-3	0.1 $[NO_3]$	0.4 $[NO_3]$
<1	0.01	—

Residual Stresses and Heat Treatment

Besides a chemically aggressive environment, the other necessary condition for SCC is the presence of tensile stresses in the metal. In large engineering structures, there are generally three types of stresses: (1) working stresses due to the load the structure was designed to carry, (2) reaction stresses — long range stresses due to fabrication, and (3) residual stresses — short range stresses due to fabrication procedures such as welding and deformation to make parts fit together.

Working stresses in such structures have been traditionally designed to be low, about 1/2 or less of the yield stress of the material in accordance with the ASME Boiler and Pressure Vessel Code;[8] this is the case for the SRP waste tanks. Reaction stresses are difficult to estimate quantitatively. However, even though the waste tanks are large, they are simple structures, basically free-standing right-circular vessels, that are built on stable, reinforced concrete pads. Therefore, the reaction stresses in the tanks from such phenomena as settling should be very low.

The tanks are made by welding individual preformed plates together. Since welding involves heating the metal to its melting point with subsequent cooling and solidification, contraction of the metal occurs in a localized, relatively small region. This thermal contraction is nonuniform and leads to built-in stresses that can exceed the yield stress of the material.

Cracks in the waste tanks have been predominantly associated with welds. Cracks form at right angles to the weld bead. They grow a short distance from the weld, then stop. The largest observed crack in a waste tank is six inches long.[9] Cracks stop growing as a result of the rapid decrease of the tensile stress with distance from the weld. These residual welding stresses can be relieved by uniformly heating a structure to a sufficiently high temperature (approximately 1100°F in mild steels) to allow the metal to relax because its strength decreases at elevated temperatures. Such heat treatment eliminates SCC by removing the stress.

FRACTURE TOUGHNESS

Mechanical failure of an engineering structure, such as a waste tank, may be plastic or brittle. Engineering experience and well-understood design criteria have minimized the susceptibility of most structures to plastic failure by overloading. For example, the common engineering practice of fixing the design stress at one-half the yield stress of the material, as in the waste tanks, makes plastic failure improbable. However, brittle fracture at overall stresses less than the yield stress is possible in structures that contain flaws (or so-called "stress raisers"), such as stress corrosion cracks.

Brittle fracture depends on the local conditions in a structure such as the state of stress, flaw size, temperature, and toughness of the material.[10] Brittle fracture may occur by two different modes, ductile or brittle, that reflect differences in the mechanism of fracture on the atomic level. In the case of mild steels, the temperature is very important because the steels exhibit sharp transitions in toughness in a narrow temperature range. At temperatures above the transition the mode of failure would be ductile, and below, brittle. The transition temperature of the steel depends on processing history, chemical composition, and thickness. For example, a normalizing heat treatment of as-rolled plate will lower its transition temperature by at least 30°C. Normalizing consists of heating the steel to 1650°F (about 900°C) and cooling it in air.

Brittle fracture in a ductile mode has been analyzed and requires a flaw 1 to 2 feet long with stresses equal to the yield stress of the steel.[11] The longest known crack in an SRP waste tank is six inches. Since cracks would leak so rapidly before growing to a length of 1 to 2 feet, the waste would have to be transferred to a spare tank before gross failure could occur in this mode.

Brittle fracture in a brittle mode can occur below the transition temperature, and be initiated by relatively small flaws.[12] Therefore, the transition temperature of the steel used in the waste tanks is important.

The toughness of the steel (and thus resistance to brittle fracture) used to build each successive group of tanks has improved concurrently with the evolution of understanding of brittle fracture of large structures. The toughness of the materials as measured by the nil ductility transition temperature (NDTT) is given in Table B-2. Initially, for the Types I and II and early Type III tanks, as-rolled steel was used, and the NDTT was not specified. (In fact, the drop weight test used to measure the NDTT was not developed until 1958-1960, and was not in general use until the mid-1960s.)[13] For these tanks, fracture control is being achieved by ensuring that the steel temperature is above the NDTT by adjusting the temperature of the annulus ventilation air. For the Type III tanks constructed after 1974, normalized steel with specified maximum NDTT will be used. A low enough NDTT is being specified (-10°F maximum, see Table B-1), so that maintaining the minimum tank wall temperature given in Table B-3 will eliminate brittle fracture as a credible failure mechanism.

TABLE B-3

NDTT of Steels Used in Waste Tank Construction

Tank Design	Material, Steel Alloy	Maximum NDTT, °C	Minimum Tank Wall Temperature, °C
Types I and II	A 285-B	20*	20
Type III			
Prior to FY-1974	A 516-70 as-rolled	15**	20
FY-1974	A 516-70 normalized	-18**	15
After FY-1974	A 537 Class I	-45***	10

* Data for A 285-C, see Reference 2.

** Unpublished data from Metal Properties Council.

*** Unpublished data from Lukens Steel Co.

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APPENDIX C

WASTE REMOVAL AND DECOMMISSIONING

Waste Removal

The 14 new Type III tanks together with existing Type III tanks are expected to provide interim storage of SRP waste until plans are put in operation for long-term waste management. The principal option being considered is the removal of the wastes from these tanks, followed by immobilization of the bulk of the radioactivity in an inert solid form for ultimate storage in a geologic repository. Efficient and safe processes for removing the wastes from the tanks are required to implement this program; such processes have been developed and are being demonstrated in SRP storage tanks. Design of facilities is also in progress to provide for waste removal from all the older generation tanks (Types I, II, and IV) and transfer to the Type III tanks.

Waste management practices at SRP result in wastes of two major types in addition to the readily removable liquid supernate. One is a settled sludge containing oxides and hydroxides of iron, manganese, and aluminum plus most of the fission products from the irradiated fuel, except cesium. This sludge is about 70% solids with the remainder being the supernatant liquid. The other form is a damp, crystallized salt mixture of mostly sodium nitrate, sodium nitrite, and sodium aluminate. These two types are largely formed (or collected) and stored in separate tanks.

On past occasions the settled waste, or sludge, has been transferred between tanks by breaking it up with high-velocity jets of water and pumping out the resulting slurry with centrifugal pumps. Up to 95% of the sludge was removed, but significant volumes of water were added to the inventory, and the evaporator capacity would be taxed if this method were used for a series of transfers.

Recently improved techniques have been developed to remove a higher percentage of the sludge with less addition of water to the system. For example, more than 98% of a 22-inch layer of aged sludge was removed from Tank 16 by low-pressure hydraulic slurrying using recirculated supernate and three long-shaft centrifugal pumps installed through tank top risers.[1] The arrangement is shown schematically in Figure C-1, and the appearance of the tank bottoms before and after slurrying is shown in Figure C-2. Inspection equipment locations (camera and periscope) are also shown for information. The slurry was transferred to another tank using a long-shaft centrifugal transfer pump. Most remaining sludge was in a dilute heel (2 inch depth) and can be readily removed by additional slurrying.

Some residual sludge will remain as difficult-to-dissolve material, solids left in crevices, and deposits on walls and cooling coils above the slurrying step liquid levels. This material will be removed by chemical cleaning in which hot water and oxalic acid will be sprayed into the tops of waste tanks using rotary spray jets. The liquid accumulating in the tanks will be mixed using the slurry pumps installed for sludge removal and transferred to other waste tanks. Tests of these procedures are now in progress.

Salt deposited in waste tanks can be readily dissolved in water. Earlier, salt removal was demonstrated using steam jets to circulate fresh water to contact salt. This method was slow and required the liquid to be cooled before transfer. Two alternate methods of salt dissolution are being considered for salt removal from the older generation tanks, i.e., density gradient and mechanical agitation. In the density gradient method a vertical well is hydraulically mined into the salt cake. Water is added to the tank to cover the salt. As the salt dissolves, higher density supernate flows by gravity into the well, bringing lighter unsaturated liquid into contact with the elevated salt. Material with the maximum density is removed by jet from the well bottom as fresh water enters the tank top. This process is currently being demonstrated in Tank 10.

In the mechanical agitation method, unsaturated liquid is made to dissolve the salt cake by circulation of a liquid layer above the salt using a long-shaft centrifugal pump. The dissolved salt is transferred by jet. Salt removal by mechanical agitation is expected to provide the fastest dissolution rate and result in the least addition of fresh water to the waste inventory. In addition, this method can slurry the sludge mixed in with the salt in the tanks. This could enable both the salt and the sludge to be removed with the same equipment. This technique will be demonstrated in Tank 19 during FY-1980.

All of these methods are applicable to the new tanks under construction.

Although optimum methods and procedures have not yet been selected, these successful demonstrations of waste removal show that none of the options for long-range management are foreclosed

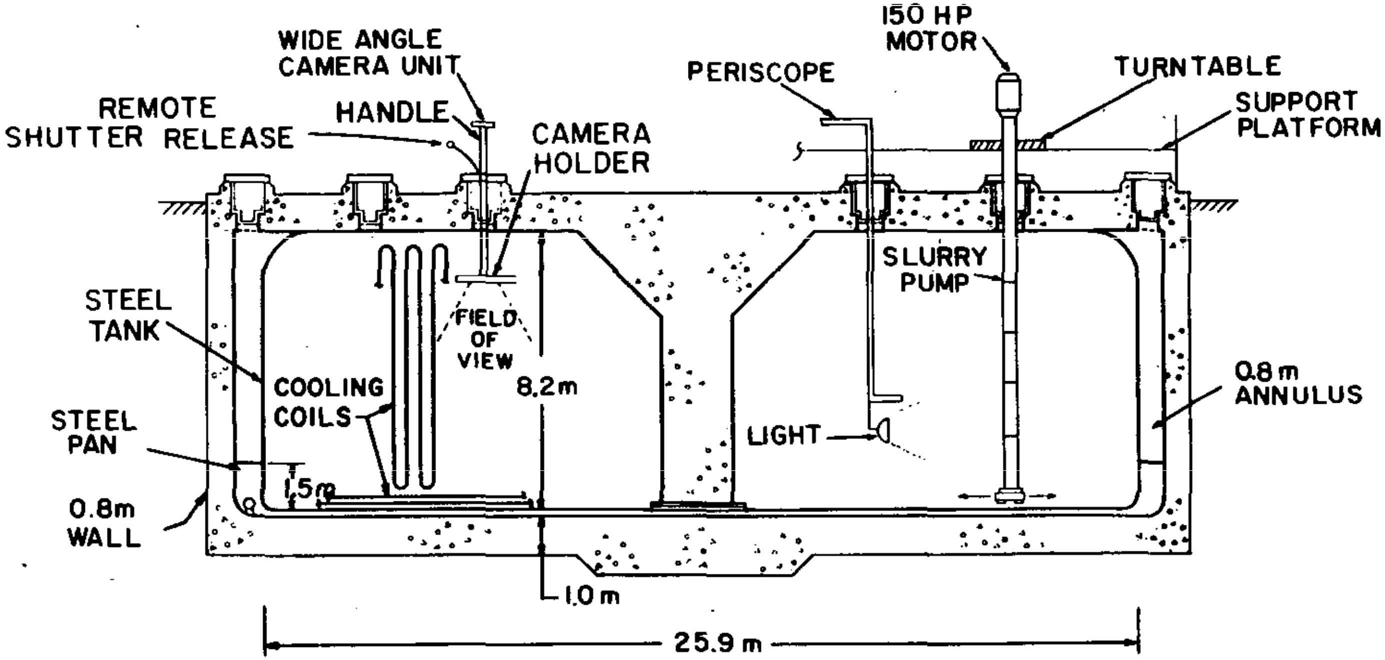
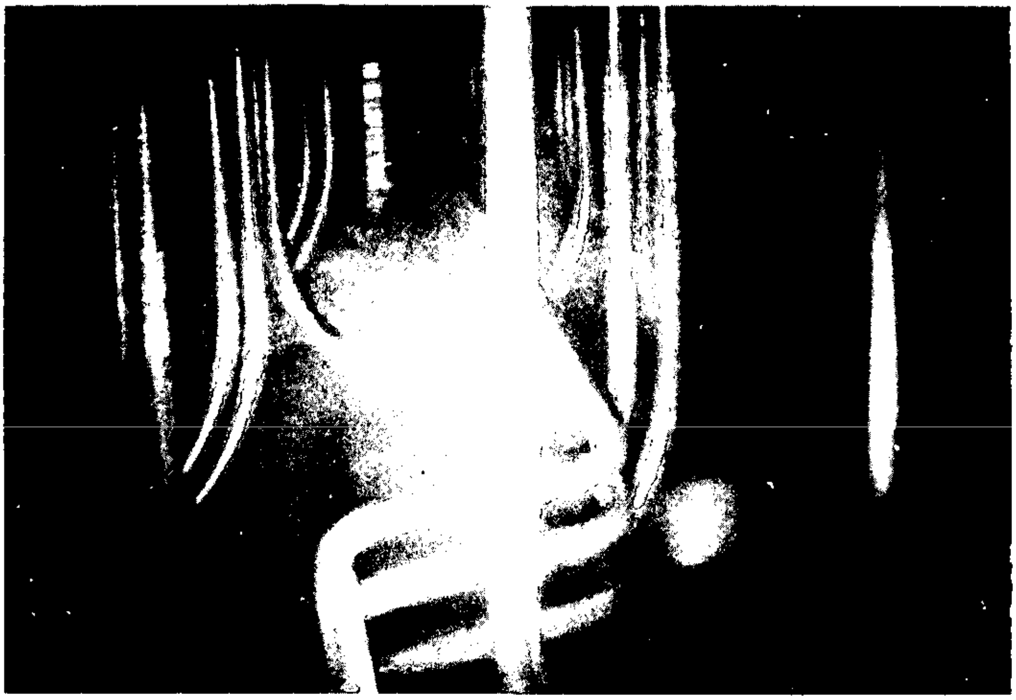


FIGURE C-1 TANK DIMENSION AND EQUIPMENT LOCATIONS



Periscopic View from Riser 1 after First Slurry Transfer

Wide-Angle View from Riser 1 after Hydraulic Cleaning

FIGURE C-2. Views of Riser 1

by interim storage in the newer Type III tanks. Future removal of waste for processing can be accomplished when required using proven processes and equipment.

DECONTAMINATION AND DECOMMISSIONING

When waste tanks are retired from normal service, they might be placed in alternate use, in custodial care, or decommissioned. One potential alternate use for the waste tanks is for disposal of residual salt, i.e., the nitrate/nitrite salt remaining after the bulk of radioactivity has been removed from high-level liquid waste and converted to solid form in the proposed Defense Waste Processing Facility. The degree of decontamination required for such service has not been established and will depend on the level of radioactivity in the salt itself. Evaluation of the use of the tanks for salt storage is in progress as part of the long-term waste management program.

A National Decontamination and Decommissioning Program has been established by the U.S. Department of Energy. The lead organization for this program is United Nuclear Corporation under the direction of the Richland Operations Office. This program sponsors and coordinates research and development of technologies for decontamination and decommissioning (D&D). Research and development work to be initiated at the Savannah River Plant includes preparation of a site D&D plan, selection of a facility (e.g., a waste tank) for decommissioning demonstrations and the eventual operational D&D of this facility. Current plans are to extend the studies of tank cleaning now in progress at Tank 16 to include chemical cleaning and dismantlement of the tank.

Tests with oxalic acid solutions will establish the level of cleaning that can be achieved in preparation for dismantlement. Various other reagents are being evaluated for cleaning carbon steel. A short length of cooling coil has been removed from Tank 16 and will be used in these studies. One particular reagent which will be tested is oxalic acid-hydrogen peroxide solution. This reagent is reported to be an effective cleaning agent for carbon steel.[2] The techniques used for dismantlement will depend on the degree of cleanliness (decontamination) achieved.

Decontamination and decommissioning (D&D) of high-level, liquid-waste, storage tanks has not been attempted to date. However, D&D of highly radioactive facilities have been accomplished (e.g., the Elk River reactor). Although D&D of waste tanks will require different techniques, no insurmountable difficulties are anticipated. D&D of Tank 16 will be used to demonstrate this capability.

REFERENCES

C| 1. Demonstration of Radioactive Sludge Removal from SRP Storage Tank. SRP Report DPSPU 79-30-11, E. I. du Pont de Nemours & Co. (Inc.), Savannah River Plant, Aiken, SC (September 1979).

2. A. B. Meservey. Peroxide-Inhibited Decontamination Solutions. USAEC Report ORNL-3308, Oak Ridge National Laboratory, Oak Ridge, TN (December 14, 1962).

APPENDIX D

CHRONOLOGY OF TANK CONSTRUCTION

Major Milestones

The major milestones for construction of Tanks 38 through 51 covered by this Environmental Statement are shown in Table D-1.

Scheduled Start of Construction

These milestones are essentially those established for the original project authorizations.

The previous waste tank project, 75-1-a for Tanks 35, 36, and 37, was delayed by significant increases in cost problems due to unexpectedly large escalation rates for materials and labor. Congressional approval of changes in scope was required before beginning work. In addition, delays in obtaining steel increased construction time and further increased construction costs.

Design of improved safety features played a minor part in delaying Waste Tank Project 75-1-a. The safety feature under review was the design of an improved system to monitor for leaks in the secondary container. Several designs were investigated. The one eventually chosen consists of a channel grid system on top of the tank foundation slab with drainage to a sump for monitoring. This leak detection system provides good coverage and prompt response.

During the evaluation of leak monitoring concepts, Tank 35 was built without provision for leak detection from the secondary container and a gamma monitoring tube network was installed in Tanks 36 and 37. However, this latter system was rejected when it was found to be no more effective and much more expensive than the channel grid system ultimately selected for the FY-1976 and later tanks.

TABLE D-1

E| Dates of Major Milestones (Waste Tank Construction)

Tank No.	Project	Construction Starting Date	Date of Site Preparation, Excavation, and Base Slab Completion	Date of Primary and Second Tank Erection and Stress Relief	Roof Pour	Construction Completion
38	1618 FY-1976	3/76	10/6/76	11/18/77	6/20/78	8/80
39	1618 FY-1976	3/76	10/27/76	1/6/78	7/6/78	8/80
40	1618 FY-1976	3/76	11/10/76	4/21/78	10/3/78	8/80
41	1618 FY-1976	3/76	10/20/76	5/31/78	11/2/78	8/80
42	1618 FY-1976	3/76	10/13/76	3/8/78	8/10/78	8/80
43	1618 FY-1976	3/76	11/3/76	9/13/78	2/15/79	8/80
44	1747 FY-1977	12/76	4/13/77	9/29/78	1/31/79	3/80
45	1747 FY-1977	12/76	4/10/77	8/1/78	2/9/79	3/80
46	1747 FY-1977	12/76	4/4/77	7/11/78	1/17/79	3/80
47	1747 FY-1977	12/76	3/30/77	6/22/78	12/19/78	3/80
48	1828 FY-1978	12/77	5/17/78	7/20/79	1/80	3/81
49	1828 FY-1978	12/77	5/31/78	8/22/79	2/80	3/81
50	1828 FY-1978	12/77	6/6/78	11/1/79	3/80	3/81
51	1828 FY-1978	12/77	6/13/78	12/1/79	4/80	3/81

APPENDIX E

MAJOR DIFFERENCES BETWEEN SRP AND HANFORD TANKS

1.0 Summary

The most recent designs for high-level waste tanks at the Savannah River Plant (SRP) and at Hanford are similar in principle. Both designs utilize a double-shell concept to contain and shield high-level wastes. However, the waste stored in the SRP tanks exhibits heat generation and radionuclide concentration characteristics that are higher than the Hanford waste by a factor of fifteen. Processing of Savannah River waste does not presently include cesium or strontium removal steps as does the current Hanford waste management procedure. The inherent difference in the waste requires different provisions for heat removal at the two sites. Wastes at both plants are evaporated to achieve a volume reduction.

Differences in the environment between Hanford and SRP tanks exist but do not contribute to notable differences in design. The SRP tanks are located in a wet climate with a shallow groundwater level. Hanford tanks are situated in a dry climate with groundwater levels in excess of 150 ft below the tanks.

A summary of the characteristics of each design is included in Table E-1.

2.0 Tank Structure

The basic tank structures of SRP and Hanford tanks are similar in concept; both tanks include a cylindrical primary tank contained with a secondary liner enclosed in concrete. The SRP tanks employ a concrete center post to support the flat roof as shown in Figure 3.3. The Hanford tanks utilize a self-supporting dome-shaped roof. Both designs employ a gridwork of slots in the insulating concrete and the base concrete to remove leakage from the primary and secondary tanks. Cooling air is routed through the slots in the insulating concrete and up through the annulus to remove heat.

TABLE E-1

Summary of Current Design of HLW Tank Characteristics at Hanford and SRP*

Element	Hanford	SRP
Volume	1.0 m gal	1.3 m gal
Design	ASME Sec. VIII, Div. 2	ASME Sec. VIII, Div. 1
Design Life	50 years	40 to 60 years
Heat Generation Rate, maximum	50,000 Btu/hr	3,000,000 Btu/hr
Heat Removal, max design value	100,000 Btu/hr	6,000,000 Btu/hr
Earth Cover	6.5 feet minimum	None
Roof Type	Self-supporting dome	Flat with supporting center column
Live Load	40 lb/ft^2 plus 50 tons concentrated	275 lb/ft^2
Steel Type — Primary Tank	ASTM A-537, Class I carbon steel σ_y - 50,000 psi	ASTM A-537, Class I carbon steel σ_y - 50,000 psi
Specific Gravity of Waste, max	2.0	1.8
Annulus Air Flow	800 cfm	8,000 cfm
Max Primary Tank Skin Temperature	200°F	None specified, probably will be below 70°F
Water-Cooled Coils	None	3 to 3.5 miles of pipe per tank

* References:

C| <u>Final Environmental Statement, Waste Management Operations, Savannah River Plant, Aiken, South Carolina</u>. USERDA Report ERDA-1537, U.S. Energy Research and Development Administration, Washington, DC (1977).

Letter, J. F. Albaugh, A. W. Akerson to A. G. Lassila, Trip Report, Wilmington, Savannah River Information Exchange on Waste Storage Tanks (November 24, 1975).

Telecon - J. F. Albaugh, Rockwell Hanford Operations, to D. Coon and B. Osborne, Savannah River Project (October 24, 1979).

Design of SRP tanks was based on ASME Sec. VIII, Div. 1, while Hanford tanks were designed in accordance with Div. 2. Both designs included stress relieving the primary tank after fabrication. Nearly identical nondestructive testing procedures were used to verify integrity.

The SRP tanks do not require earth cover for shielding. A 48-in. thick, flat, concrete roof provides adequate shielding. Hanford tanks utilize less concrete thickness in the dome but are buried beneath a minimum of 6.5 ft of earth cover.

3.0 Ventilation and Cooling

The higher heat generation in SRP tanks requires special provisions for cooling. The maximum heat generation is expected to be on the order of 3,000,000 Btu/hr from fresh high-level liquid waste. With the ventilation airflow, each SRP tank is designed to remove 6 million Btu/hr. This is compared to a heat removal rate of 100,000 Btu/hr for Hanford tanks. Annulus ventilation flow rates are 8,000 cfm for SRP tanks and 800 cfm for Hanford tanks. The difference in cooling capacity reflects the different heat generation rates of the wastes stored in the tanks.

4.0 Leak Detection

Both SRP and Hanford tanks have similar leak detection provisions which alarm in a manned facility. In addition, automated liquid level gauges provide supplementary data on the loss of liquid from the primary tank. Both designs include sumps to collect liquid from the slots in the base concrete (secondary liner leakage).

APPENDIX F

WASTE TANK UTILIZATION FORECAST

C| Figures F-1 and F-2 show the most recent forecast for utilization of SRP waste tanks for years 1979 through 1989.

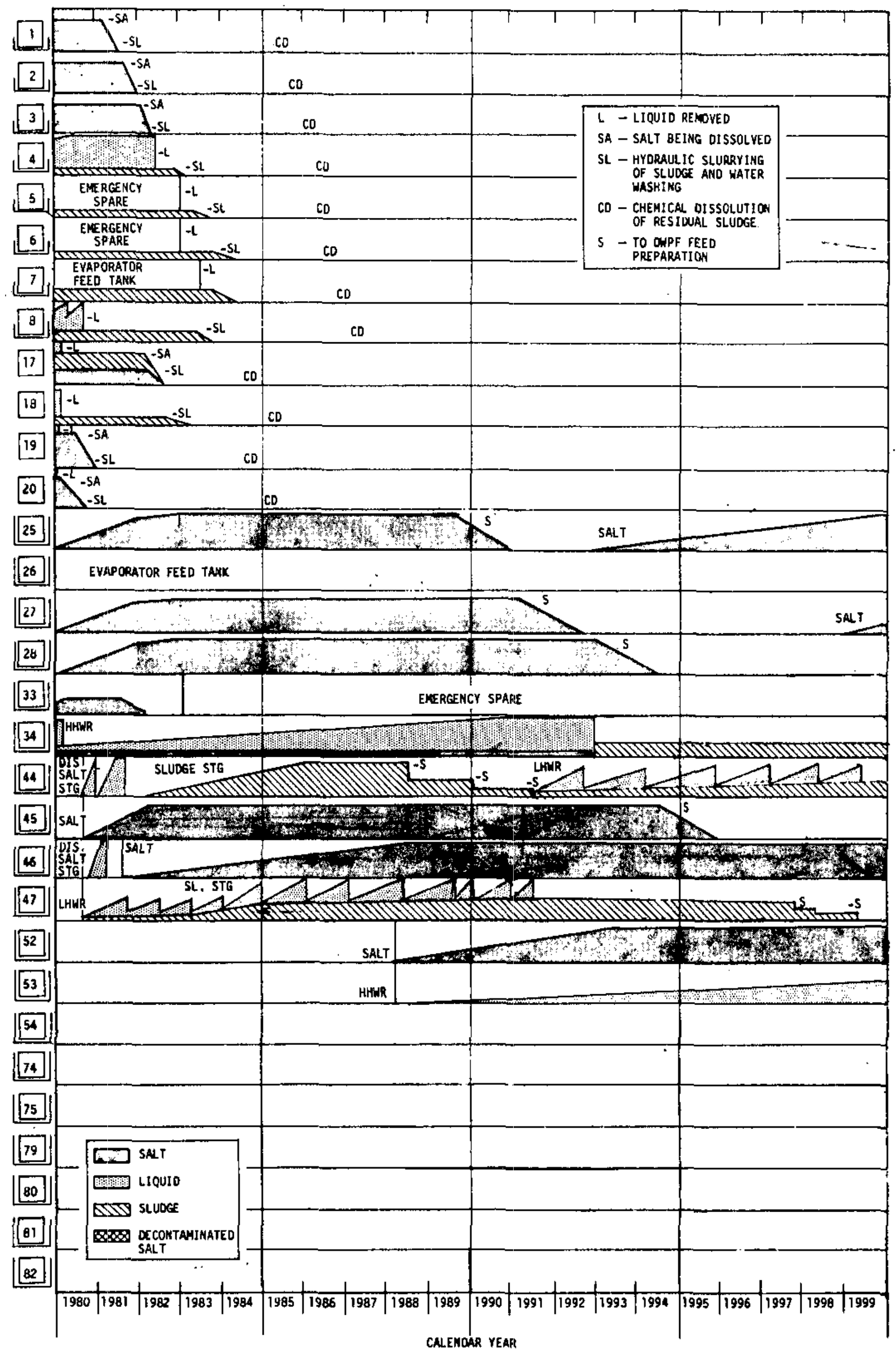


FIGURE F-1. F-Area Waste Tank Utilization

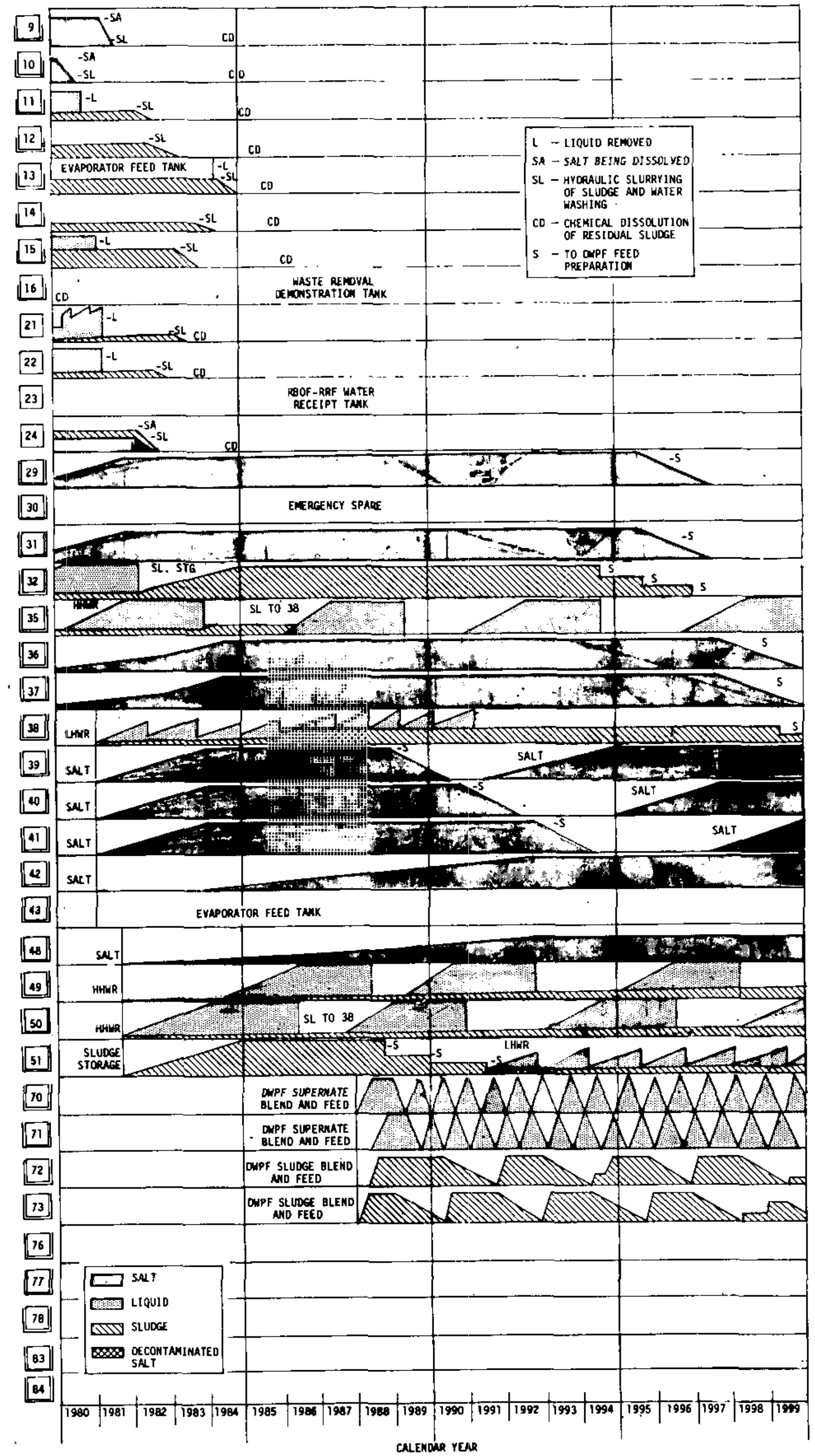


FIGURE F-2. H-Area Waste Tank Utilization

APPENDIX G

COMMENT LETTERS AND DOE RESPONSES

Four letters were received commenting on the draft version of this EIS. The letter and responses are contained in this appendix.

Organization	Page No. Copy of Letter	Response to Comments
1. Environmental Protection Agency, Washington, D.C.	G-2	G-7
2. Department of Health, Education, and Welfare, Public Health Service, Atlanta, Georgia	G-3	G-8
3. National Science Foundation, Washington, D.C.	G-4,5	G-9,10
4. United States Department of Interior, Washington, D.C.	G-6	G-11

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 29 1980

OFFICE OF THE ADMINISTRATOR

Dr. Goetz K. Oertel, Director
Division of Waste Products
Office of Nuclear Waste Management
Mail Stop B-107
Washington, D. C. 20545

Dear Dr. Oertel:

In accordance with Section 309 of the Clean Air Act, as amended, the U.S. Environmental Protection Agency (EPA) has reviewed the draft supplemental Environmental Impact Statement (EIS) "Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, Aiken, South Carolina (DOE/EIS-0062-D).

We find that the EIS adequately addresses the environmental issues and we agree that the use of double-shell tanks for storage on an interim basis is a beneficial action.

On the basis of our review, we have rated the action and the document as LO-1 (Lack of objections and an adequate analysis). The classification and date of EPA's comments will be published in the Federal Register.

Please contact Ms. Betty Jankus of my staff at 202/755-0770 should you have any questions about this matter.

Sincerely yours,

William N. Hedeman, Jr.
Director
Office of Environmental Review

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

March 8, 1980

Dr. G. K. Oertel
U.S. Department of Energy
M.S. B-107
Washington, D.C. 20545

Dear Dr. Oertel:

The Draft Environmental Impact Statement (Supplement to ERDA-1537, September 1977), Waste Management Operations, Savannah River Plant, Aiken, South Carolina, has been reviewed by the Bureau of Radiological Health, Food and Drug Administration. We are submitting their comments on behalf of the Public Health Service.

1. Our assessment of the design and alternative support the conclusion that the design alternatives would not provide sufficient improvements to outweigh the disadvantages and warrant their incorporation into the presently designed tanks. From the data presented in the statement, it is our judgment that the design of the tanks under construction provides features that assure that the normal release rates of radioactive material will maintain potential exposure well within present radiation protection standards.

2. The statement does not contain specific information on emergency planning and coordination with the South Carolina State radiation emergency plan. Because of the potential public health impact from abnormal operations or accidents, Section 5.1.3 should be expanded to include a discussion of the facility's emergency plan as it relates to the high-level radioactive waste storage tanks. Such a discussion is important at this time in view of the public's concern regarding potential exposure to low levels of radiation.

Thank you for the opportunity of reviewing this draft document. We would appreciate receiving two copies of the final statement when it is issued.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

March 5, 1980

Mr. Sheldon Meyers
Acting Deputy Assistant Secretary
for Nuclear Waste Management
Department of Energy
Washington, DC 20585

Dear Mr. Meyers:

Several individuals at the National Science Foundation have reviewed the DEIS's on Double-Shell Tanks for Defense High-Level Radioactive Waste Storage at both the Hanford Site (DOE/EIS-0063-D) and the Savannah River Plant (DOE/EIS-0062-D). The reviewers felt the DEIS's were quite similar, so the following comments refer specifically to the Savannah River Plant site:

1. The present volume does not describe safeguard measures and procedures. (Perhaps the original document covers this point.) Physical protection of radioactive materials is necessary to minimize the possibility of saboteurs . The present double-shell tanks may have some advantages on this score, too. More information on this issue may be necessary.

2. A more comprehensive failure analysis could be helpful. The present description of potential failures (leaking is only one mode) and procedures to be taken during the failures is not comprehensive enough to assure confidence.

3. How do they assure the quality assurance of these tanks? Presumably, these tanks are field-erected. Are there any accepted initial and periodic inspection procedures during and after the construction?

4. It could be helpful if the role of the proposed tanks in the overall nuclear waste management were described. This technology may be transferable to the management of civilian cases, if the future development allows some sort of chemical separation. Does the Savannah River Plant program incorporate some experimental or demonstrative tests?

5. The old tanks do need to be replaced.

6. The new design is a significant improvement.

7. Operation of the old tank farm has been exemplary in terms of safety (if all the facts are known).

8. Backup volume ("spare volume," p. 21, 3.2, 2.2) seems to be skimpy. It should probably be increased to twice the maximum single tank storage volume.

One reviewer expressed the sincere desire that such temporary (semi-permanent) means of storing radioactive waste would eventually be superseded by a more satisfactory long-term method.

Sincerely yours,

Adair F. Montgomery

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Chairman
Committee on Environmental Matters

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-80/79

MAR 19 1980

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Assistant Secretary for Nuclear
Waste Management
Department of Energy
Washington, D.C. 20585

Dear Mr. Meyers:

The Department of the Interior has reviewed the draft environmental statement for Waste Management Operations, Savannah River Plant, Barnwell and Aiken Counties, South Carolina. We have the following comments.

Because of the importance of potential groundwater impacts, the environmental statement should include typical values for the coefficients of transmissivity and storage for aquifers and formational units that might be affected or any other data that would permit assessment of groundwater velocities. A water-table map of the vicinity of the tanks is needed; the map should show the locations of the tanks and of streams that would intercept any groundwater that might become contaminated.

We suggest also that the potential for overfilling the tanks, which would result in release of radionuclides to the environment, should be assessed, inasmuch as this has occurred at least once in the past from an earlier style of tank.

We hope these comments will be of assistance.

Sincerely,

James H. Rathlesberger
Special Assistant to
Assistant SECRETARY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

FEB 29 1980

Office of the
Administrator

RESPONSE

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Washington, D. C. 20545

No response required.

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Sincerely yours,

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Sincerely yours,

/s/ Frank S. Lisella

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

RESPONSE

1. No response required.

2. Section 5.1.3 was expanded to include Section 5.1.3.2, Emergency Planning. SRP is actively working with the states of South Carolina and Georgia in planning and coordinating the necessary emergency response.

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

March 5, 1980

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Acting Deputy Assistant Secretary
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2. A more comprehensive failure analysis could be helpful. The present description of potential failures (leaking is only one mode) and procedures to be taken during the failures is not comprehensive enough to assure confidence.

3. How do they assure the quality assurance of these tanks? Presumably, these tanks are field-erected. Are there any accepted initial and periodic inspection procedures during and after the construction?

RESPONSES

1. The safeguard measures for the waste tank farms are described on pages III-101 and 102, "Sabotage, Diversion of Fissionable Materials, and Acts of War" in ERDA-1537, Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, Aiken, S. C., September 1977.

Revision of the document was not required.

2. A comprehensive analysis of all failure modes was performed for the waste storage system and is only summarized in Section 5.1.3, "Releases from Abnormal Operations or Accidents" (Tables 5.2, 5.3, and 5.4). Greater detail is presented in ERDA-1537, "Potential Effects of Abnormal Operation of Waste Storage and Handling Facilities" beginning on page III-82.

Revision of the document was not required.

3. These waste tanks were designed and constructed under increasingly rigorous Quality Assurance plans. The SRP Quality Assurance Policy was developed and accepted by DOE based on the intent of 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. Refer to page A-6 of this EIS for a summary of the inspection and testing during construction.

Upon completion of construction, formal procedures are followed by the operating organization to inspect, check-out and run-in the equipment under expected operating loads, etc. before the equipment is accepted and placed in service. The post-operation inspection program is described in ERDA-1537 beginning on page II-102.

Revision of the document was not required.

4. It could be helpful if the role of the proposed tanks in the overall nuclear waste management were described. This technology may be transferable to the management of civilian cases, if the future development allows some sort of chemical separation. Does the Savannah River Plant program incorporate some experimental or demonstrative tests?

5. The old tanks do need to be replaced.

6. The new design is a significant improvement.

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8. Backup volume ("spare volume," p. 21, 3.2, 2.2) seems to be skimpy. It should probably be increased to twice the maximum single tank storage volume.

One reviewer expressed the sincere desire that such temporary (semi-permanent) means of storing radioactive waste would eventuslly be superseded by a more satisfactory long-term method.

Sincerely yours,

Adair F. Montgomery
Chairman
Committee on Environmental Matters

4. The SRP waste management plan for high-level liquid waste is fully described in ERDA-1537 beginning on page II-64. As part of this plan, these new waste tanks will provide reliable, interim storage of the waste until a final decision is made for the permanent disposal of the waste. Appendix F in this document gives the specific schedule for use of the SRP waste tanks.

   The new waste tanks were designed and are being built specifically for the SRP waste and waste management program and therefore have limited commercial applicability.

   Appendix C of this document discusses the SRP demonstrations and tests currently underway or planned for waste removal and tank decommissioning which ultimately may be of value for civilian waste management programs.

   Revision of the document was not required.

5. No response needed.

6. No response needed.

7. No response needed.

8. The backup volume (minimum of one tank per area) is considered sufficient because of the flexibility of the operation. Spare volume in each area is equivalent to the largest volume of waste stored in any one tank. The inter-area waste transfer lines are available for transfer of waste between the tank farm areas so that all available spare tanks are available to either area as necessary. This spare volume requirement is covered in ERDA-1537 on page II-71.

   Refer to the answer for comment 4 for the role of the new tanks in the SRP waste management program.

   Revision of the document was not required.

The program for the long-term management of waste is under active study and development. Refer to DOE/EIS-0023, Final Environmental Impact Statement, Long-Term Management of Defense High-Level Radioactive Wastes (Research and Development Program for Immobilization), Savannah River Plant, Aiken, S. C., November 1979. Also see Appendix 1, Long-Range Waste Management Program in ERDA-1537.

Revision of the document was not required.

UNITED STATES DEPARTMENT OF THE INTERIOR

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-80/79 MAR 19 1980

Mr. Sheldon Meyers, Acting Deputy
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We hope these comments will be of assistance.

Sincerely,

/s/ James H. Rathlesberger

James H. Rathlesberger
Special Assistant to
Assistant SECRETARY

RESPONSE

The hydrology, dose commitment, and methods for determining environmental radiation dose are all adequately covered in ERDA-1537, Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, September 1977. The disussion of the design alternatives in this supplemental EIS did not require reviewing the hydrological data. Refer to the following sections and pages in ERDA-1537: Hydrology (II 138-152), Ground Water (II-146), Dose Commitment (III 28-35), Transportation of Liquid Radioactive Waste (III-136), and Appendix G, Releases to Liquid Effluents on page G-6. In addition, see the following figures for facility location and water table information (Figures II-13, 14, 15).

The subject of spills from waste tanks during waste transfers and leaks from tank failures or overfilling is covered in ERDA-1537 in Abnormal Operations on pages III 82-95. Improved instrumentation (reel tapes) and administrative controls of transfers should prevent overfilling the tanks.

Revision of the document was not required.