**U.S. Department of Energy
Washington, DC 20585**

**Environment, Safety and Health
Office of Environmental Audit**

**Environmental Survey
Preliminary Report**

**Savannah River Plant
Aiken, South Carolina**

August 1987

W-1000000

EP

PREFACE
TO
THE DEPARTMENT OF ENERGY
SAVANNAH RIVER PLANT
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of an Environmental Survey at the Department of Energy (DOE) Savannah River Plant (SRP), located at Aiken, South Carolina. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The SRP Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy John S. Herrington, to strengthen the environmental safety and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1988.

The findings in this report are subject to modification based on the results from the Sampling and Analysis phase of the Survey. The findings are also subject to modification based on comments from Savannah River Operations Office concerning the technical accuracy of the findings. The modified preliminary findings and any other appropriate changes will be incorporated into an Interim Report. The Interim Report will serve as the site-specific source for environmental information generated by the Survey, and ultimately as the primary source of information for the DOE-wide prioritization of environmental problems in the Survey Summary Report.

August 1987
Washington, D.C.

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EXECUTIVE SUMMARY

Introduction

This report presents the preliminary findings from the first phase of the Environmental Survey of the United States Department of Energy (DOE) Savannah River Plant (SRP), conducted January 5 through 23, 1987.

The Survey is being conducted by an interdisciplinary team of environmental specialists, led and managed by the Office of Environmental Audit under the Office of the Assistant Secretary for Environment, Safety and Health. Individual team components are being supplied by a private contractor. The objective of the Environmental Survey is to identify environmental problems and areas of associated environmental risk. The Environmental Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. This phase of the Survey involves the review of existing environmental data, observations of the operations carried on at SRP, and interviews with site personnel.

The Survey team developed a Sampling and Analysis Plan to assist in further assessing certain of the environmental problems identified during its on-site activities. The Sampling and Analysis Plan will be executed by a DOE National Laboratory or a support contractor. When completed, the results will be incorporated into the SRP Environmental Survey Interim Report. The Interim Report will reflect the final determinations of the SRP Survey.

Site Description

The SRP occupies an area of about 300 square miles along the Savannah River, principally in Aiken and Barnwell Counties of South Carolina. The SRP is operated by the E. I. du Pont de Nemours and Company (Du Pont) under contract with DOE. The primary function of the SRP is production of plutonium, tritium, and other special nuclear materials for the national defense, for other governmental uses, and for some civilian purposes.

A wide variety of hazardous and radioactive wastes is generated by SRP activities. The over 30 years of operation at the SRP has resulted in contamination of air, soil, surface water, and groundwater. The site management has initiated a number of ongoing remedial actions intended to address these conditions.

Summary of Findings

The major preliminary findings of the Environmental Survey of the SRP site are the following:

- o Groundwater contamination exists from site operations, although groundwater contamination has not been evaluated on a regional, multiaquifer basis.
- o Undetected and continuous leaks from underground storage tanks can occur due to existing underground storage tank management practices.
- o Tritium oxides are being released at the rate of approximately 500,000 Ci/yr. Tritium concentrations in vegetation and animals are known to exist but is not routinely monitored to assess food-chain impacts.
- o Thermal discharges to L-Lake may be causing an imbalance in the aquatic ecosystem, resulting in increased concentrations of thermophilic pathogens (e.g., Naegleria fowleri, Legionella pneumophila, and Aeromonas hydrophila), which may be transported to the Savannah River and present a potential health risk.
- o Emissions of 1,1,1-trichloroethane from the 300-Area may exceed 200 tons/yr. Trichloroethane is toxic and could potentially be regulated as a hazardous air pollutant.
- o Elevated concentrations of various radionuclides in wildlife have resulted from drainage pathways and sources of exposed liquid radioactive wastes. Contaminated animals have been collected off-site.

- o Multiple deficiencies (e.g., uncalibrated equipment, inadequate sample trains and locations) exist within the radioactive emissions monitoring program.

Overall Conclusions

The Survey found no environmental problems at the SRP that represent an immediate threat to human life. The environmental problems identified at SRP by the Survey do confirm that the site is affected by a number of substantial and chronic environmental concerns. These problems vary in terms of their magnitude and risk, as described in this report. Although the sampling and analysis performed by the SRP Survey will assist in further identifying environmental problems at the site, a complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Response actions currently under way or planned at the site will contribute toward meeting this requirement.

Transmittal of Results

The findings of the Environmental Survey of the SRP site were shared with the DOE Savannah River Operations Office (SR), and the site contractor, at the Survey closeout briefing held January 23, 1987. As a result of the formal closeout discussion, SR was asked to provide a copy of any correspondence relating to near-term corrective actions in response to Category IV findings. Those problems that involve extended studies and multiyear budget commitments will be the subject of the Environmental Survey Summary Report and the DOE-wide prioritization.

Within the Office of Environment, Safety and Health, the Office of Environmental Guidance and Compliance has immediate responsibility for monitoring environmental compliance and the status of the SRP Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through the program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1988.

1.0 INTRODUCTION

PRELIMINARY

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, conducted January 5 through 23, 1987, at the United States Department of Energy's (DOE's) Savannah River Plant (SRP) in Aiken, South Carolina. As a Preliminary Report, the contents are subject to revisions, based on Savannah River Operations Office review and comments on the technical accuracy, the results of the sampling and analyses, and other information that may come to the Survey team's attention prior to issuance of the Interim Report. The SRP is currently operated for DOE by the E.I. du Pont de Nemours and Co. (Du Pont).

The SRP Survey is part of the larger DOE-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to identify, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The SRP Environmental Survey was conducted by an interdisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from the DOE Office of Environmental Audit. A complete list of Survey participants and their affiliations is included in Appendix A.

The Survey team focused on all environmental media, using Federal, State, and local environmental statutes and regulations, accepted industry practices, and professional judgment to make the preliminary findings included in this report. The team carried out its activities in accordance with the guidance and protocols in the DOE Environmental Survey Manual. Substantial use of existing information and of interviews with knowledgeable field office and site contractor personnel accounted for a large part of the on-site effort. A summary of the site-specific

Survey activities is presented in Appendix B, and the Survey Plan is presented in Appendix C.

The preliminary Survey findings, in the form of existing and potential environmental problems, are presented in Sections 3.0 and 4.0. Section 3.0 includes those findings that pertain to a specific environmental medium (e.g., air or soil), whereas Section 4.0 includes those that are non-media-specific (e.g., waste management, direct radiation, and quality assurance). Because the findings are highly varied in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further subdivided into four categories within Section 3.0 and Section 4.0.

The criteria for placing a finding into one of the four categories are as follows:

Category I includes only those findings which, based upon the information available to the Team Leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible Environmental Safety and Health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest, the confidence in the finding, based on the information available, is the strongest, and the appropriate response to the finding is the most restrictive in terms of alternatives.

Category II findings encompass one or more of the following situations:

- o Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.
- o Evidence that a health-based environmental standard may be exceeded, as discussed in the preceding situation, within the time-frame of the DOE-wide Survey.

- o Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.
- o Noncompliance with significant regulatory procedures, i.e., those substantive technical regulatory procedures designed to directly or indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits.

Category II findings include those environmental problems where the risk is high but the definition of risk is broader than in Category I. The information available to the Team Leader is adequate to identify the problem but may be insufficient to fully characterize it. Finally, in this category, more discretion is available to the operations offices and program offices as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient near-term response by the operations office may include further characterization prior to any action taken to rectify the situation.

Category III findings encompass one or both of the following criteria:

- o The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.
- o The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category III findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the Team Leader may not be sufficient to fully characterize the problem. Under this category, the range of alternatives available for response, and the corresponding time-frames for response, are the greatest. Environmental problems included within this category will typically require lengthy investigation and remediation phases as well as multiyear budget commitments. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's limited resources are used effectively.

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, State, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is in a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations, even though below those established by regulatory authorities, that nevertheless present a potential for hazard or concern may be classified as an environmental problem. In general, however, conditions that meet regulatory or other requirements, where such exist, should not present a potential hazard and will not be identified as an environmental problem.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to the health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high.

The definition of the term environmental problem is broad and flexible to allow for the wide differences among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk, but are not appropriate for inclusion in Categories I-III. Such findings can be based upon any level of information available to the Team Leader, including direct observations by the team members. Findings in this category are generally expected to lend themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the operations offices and appropriate program office for appropriate action.

Based on the professional judgment of the Team Leader, the findings within categories are arranged in order of relative significance. Comparing the relative significance of one finding to another between media categories is not appropriate or valid. The categorization and listing of findings in order of significance within each media category in this report is only the first step in a multistep iterative process to prioritize DOE's problems.

The next phase of the SRP Survey is sampling and analysis (S&A). Idaho National Engineering Laboratory (INEL), the S&A team for SRP, will begin taking samples in summer 1987. Prior to sampling, an S&A Plan will be prepared by DOE and INEL in accordance with the protocols in the DOE Environmental Survey Manual. The results generated by the S&A effort will be used to assist the Survey team in further defining the existence and extent of potential environmental problems identified during the Survey, and to fill existing data gaps or weaknesses.

An Interim Report will be prepared 8 to 12 weeks after the completion of the S&A effort. The Interim Report will incorporate the results of the S&A effort as well as any changes or comments resulting from the review of the Preliminary Report. Based on the S&A results, the preliminary findings and observations made during the on-site Survey may be modified, deleted, or moved within or between categories. The Interim Report will serve as the site-specific source for information generated by the Survey, and ultimately as the site-specific source of information for the DOE-wide prioritization of environmental problems.

It is clear that certain of the findings and observations contained in this report, especially those in Category II, can and should be addressed in the near term (i.e., prior to the DOE-wide prioritization effort). It is also clear that the findings and observations in this report are highly varied in terms of magnitude, risks, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective action. The information in this Preliminary Report will assist the Savannah River Operations Office in the planning of these near-term responses.

2.0 GENERAL SITE INFORMATION

PRELIMINARY

2.0 GENERAL SITE INFORMATION

2.1 Site Setting

The Savannah River Plant (SRP) is located in portions of Aiken and Barnwell Counties and in a small part of Allendale County, South Carolina. Figure 2-1 is a general location map. The SRP encompasses approximately 300 square miles of land which was originally acquired by the Atomic Energy Commission in 1950. The site was selected, after review of over 100 potential sites, because of its low population density, large supply of cooling water, and low frequency of floods and destructive storms (Dukes, 1984).

The SRP is owned and controlled by the United States Department of Energy (DOE). The site is operated by E.I. du Pont de Nemours and Co. (Du Pont) for the DOE. Construction of the SRP began in 1951 and the major facilities were completed in 1954.

The SRP is bounded on the southwest by the Savannah River and on the west, north, and east by privately and publicly owned, mostly forested land. Augusta, Georgia, is approximately 25 miles northwest of the SRP. Aiken, South Carolina, lies approximately 20 miles to the north. The average population density in the counties that surround the SRP ranges from 23 to 560 people per square mile. Major population centers within approximately a 25-mile radius of the SRP are listed below (Dukes, 1984).

<u>City Name</u>	<u>Distance from SRP in Miles</u>	<u>Direction from SRP</u>	<u>1980 Population</u>
Augusta, GA	25	west-northwest	47,532
N. Augusta, SC	25	northwest	13,593
Aiken, SC	20	north	14,978
Williston, SC	15	northeast	3,173
Barnwell, SC	15	east	5,572
Allendale, SC	26	southeast	4,400
Waynesboro, GA	28	southwest	5,760

Source: Dukes, 1984

GENERAL LOCATION MAP FOR SRP SHOWING SURROUNDING
POPULATION CENTERS

The 6 counties and 8 major communities that surround the SRP have a combined total population of 376,058 (1980 Census).

Population growth has varied in the counties that surround the SRP; however, between 1970 and 1980 all counties experienced growth. The urbanized counties of Aiken, Columbia, and Richmond experienced an annual average growth of 3 percent from 1950 through 1980. Columbia County doubled its number of housing units between 1970 and 1980 and Aiken and Richmond Counties have experienced housing unit increases of 36 percent. The rural counties of Allendale, Bamberg, and Barnwell experienced population declines from 1950 through 1970. Between 1970 and 1980, however, population increased by between 9 and 16 percent.

The land surrounding the SRP is predominantly forested. Farming is prevalent with major crops being cotton, soybeans, corn, and small grains. Beef cattle are also raised.

Two distinct physiographic subregions exist at the SRP (Dukes, 1984). These are the Pleistocene coastal terraces (below elevation 270 feet) and the Aiken Plateau (above elevation 270 feet). The terraces include those listed below.

- o The Wicomico (which is the floodplain of the Savannah River) is covered by a dense swamp forest typically comprised of bald cypress and tupelo gum trees.
- o The Brandywine and Sunderland Terraces have gently rolling topography. They are characterized by both bottomland hardwood forest and loblolly pine, oak, birch, poplar, and gum.

The Aiken Plateau is characterized by hilly upland areas dissected by streams. Longleaf pine forest and scrub oak are the typical vegetation in the upland areas.

The SRP has an extensive timber management program administered by the U.S. Forest Service (USFS). In 1951 the USFS began reforesting over 68,000 acres of old fields. Since then the USFS has managed the harvesting and replanting of the SRP, such that an average of 7 million board feet of sawtimber and 30,000 cords of pulpwood are sold annually.

The climate at the SRP is temperate with mild winters and long summers. The average frost-free season is approximately 246 days. Average monthly temperatures range from 45°F in the month of January to 81°F in the month of July. Summers typically have six days of temperatures greater than or equal to 97°F. Less than 1/3 of the days during the winter months have minimum temperatures below freezing.

The average annual rainfall at the SRP from 1952 through 1978 was about 47 inches (Du Pont, 1982a). The annual precipitation at Augusta from 1941 to 1970 ranged from a maximum of about 42.5 inches to a minimum of 28.05 inches. The maximum monthly precipitation at the SRP was 12.4 inches, recorded in August 1964. Precipitation is usually greatest in March and the least in November. Percentages of annual precipitation by season are shown below.

<u>Season</u>	<u>Percent of annual precipitation</u>
Spring	27
Summer	29
Fall	26
Winter	18

The maximum annual precipitation recorded in Augusta, Georgia, was 73.82 inches. Hourly observations in Augusta show that the rainfall is normally less than 0.5 in./hr. Snowfall and freezing rain are infrequent in the winter in the area. A day with more than 1 inch of snowfall occurs in only one out of five winters. Average daily humidity in the vicinity of the plant ranges from 43 percent to 90 percent.

The SRP lies in a region that averages 8.5 tornadoes per year. Three tornadoes have been confirmed on the plant site or vicinity between 1951 and 1983. Hurricanes also affect South Carolina, with damaging ones occurring approximately once every 7 years. The SRP, however, has experienced hurricane force winds only once, during Hurricane Gracie in 1959.

The average wind speed measured in Augusta, Georgia, for the years 1951-1981 was 3.2 meters/second (m/sec). Calms and winds below 1.5 m/sec were reported to occur about 33 percent of the time. On an annual basis, winds are predominantly from the west-northwest.

2.2 Overview of Major Site Operations

The primary purpose of the Savannah River Plant (SRP) is to produce plutonium, tritium, and other special nuclear materials for use in the U.S. defense program. This objective is accomplished by several production facilities:

- o Fuel and target manufacturing facilities that supply fuel and target assemblies to the site reactors
- o Five nuclear production reactors (two of which are shut down) that supply irradiated target and fuel assemblies to the separations plants and Tritium Facility
- o Two chemical separations plants that recover uranium-235, uranium-238, and plutonium-238 and 239 and other fission products from irradiated fuel and targets (Figure 2-2 summarizes the overall production process)
- o One tritium production facility that recovers molecular tritium from irradiated targets

Other major plant facilities include the Heavy-Water Production Plant (shut down permanently in 1981), the Naval Fuel Material Facility, Savannah River Laboratory, which supports production operations, several test reactors, support facilities such as coal-fired powerplants, and waste treatment and disposal facilities. Currently under construction at the SRP are a Replacement Tritium Facility and a Defense Waste Processing Facility. Figure 2-3 shows the major operational areas at SRP.

The SRP production process begins with fuel and target fabrication in the 300M-Area. These facilities manufacture elements to be irradiated in the reactors. Three major products are extruded:

- o Enriched-uranium/aluminum alloy fuel
- o Aluminum-clad depleted uranium metal targets
- o Lithium/aluminum targets

Source: Dukes, 1984

FLOW CHART OF THE SRP PRODUCTION COMPLEX

FIGURE 2-2

SRP PRODUCTION AREAS

FIGURE 2-3

Target assemblies are placed into the reactors at SRP in order to produce plutonium-239 and tritium. This is accomplished by the absorption of neutrons supplied by the reactor fuel by uranium-238 and lithium-6, respectively, during the controlled fission process. Once the fissioning is completed, the fuel and target assemblies are placed in pools of water to permit decay of short-lived radionuclides.

The reactors are moderated and primarily cooled by recirculating heavy water (D_2O). Secondary cooling is provided by once-through natural water. Each reactor facility consists of the reactor area itself, an assembly area, a disassembly basin, and a moderator purification area. Irradiated fuel and target assemblies are stored in the water-filled disassembly basin until sufficiently cooled to enable further processing. The general reactor process is shown in Figure 2-4. Cooling water for the reactors is provided by the Savannah River.

Once the fuel and uranium target assemblies have decayed sufficiently, they are shipped to one of the Chemical Separations Facilities on the site. The Separations Facilities, or "Canyon" Buildings, process the assemblies. The Separations Facilities dissolve the irradiated fuel and target materials in nitric acid and produce solutions that contain the separated products (e.g., enriched uranium and plutonium) and waste solutions containing process chemical wastes and the fission products. This process generally utilizes solvent extractions and ion exchange for isotope separation and purification. Additional processing takes place to convert the isotope solutions into solid form for eventual shipment off-site. A process flow diagram for the F-Area Separations Facility is shown in Figure 2-5. The H-Area facility recovers enriched, rather than depleted, uranium. A diagram of effluents from the separations processes is also shown in Figure 2-5.

Tritium is produced from lithium/aluminum targets that are irradiated in the reactors. The lithium is converted to tritium by absorption of a neutron and subsequent alpha decay, which produces a helium nucleus. The tritium-containing targets are melted in a vacuum furnace. The melting process releases the tritium, which is contaminated with other isotopes of hydrogen and inert gases (argon, helium). Hydrogen isotopes are separated from inert gases in a palladium diffuser,

FIGURE 2-4

SRP REACTOR PROCESS SYSTEM

Source: Dukas, 1984

FIGURE 2-5

and then the hydrogen isotopes are separated from each other in a thermal diffuser. Tritiated water is decomposed into hydrogen and oxygen in zeolite, uranium, and magnesium beds located throughout the process. Cryogenic distillation systems are used as a final step in this separation process to separate hydrogen isotopes from each other and segregate tritium.

Tritium and deuterium are mixed to specified concentrations and compressed and loaded into reservoirs. Reservoirs in field service for a number of years are returned and unloaded. The tritium is reprocessed in a palladium diffuser to remove helium (a decay product) and is reused or reprocessed.

2.3 State and Federal Concerns

2.3.1 Meetings with Regulatory Officials

Representatives of the Survey team met with the U.S. Environmental Protection Agency - Region IV, the State of South Carolina, and the State of Georgia on November 5, 1986, as a part of the pre-Survey site visit. At this meeting, the Survey objectives and scope for the Savannah River Plant (SRP) were presented and the various representatives were given an opportunity to present their concerns and to suggest areas where emphasis during the Survey should be placed. Generally, the involved agencies expressed a good deal of interest in the Survey and all expressed a desire to receive a copy of the Interim Report.

The agencies shared common concerns regarding the applicability of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to the SRP; groundwater contamination; waste management practices, water quality and use of the Savannah River; effects of the Environmental Survey process on recognized environmental problems and planned actions; the large commercial fishing operation in the Savannah River; F/H-Area seepage basins; thermal discharges; Resource Conservation and Recovery Act (RCRA) Part B permit-issuing process; and the relative size of the SRP as a contributor to environmental degradation within the State of South Carolina.

A summary of the specific points of concern raised by the agencies is as follows:

- o The priority ranking system for Survey environmental problems will not go beyond CERCLA considerations
- o The priority ranking system's consideration of regulatory aspects
- o The Savannah River water quality for drinking and process uses in the Savannah, Georgia, area
- o Operations of the solid waste disposal units
- o The effect of the Survey on previously recognized environmental problems and corrective actions under way or scheduled
- o Commitments to States/Environmental Protection Agency (EPA) on currently recognized problems and corrective actions
- o State's access to the Survey Sampling Plan schedule
- o Fish from the Savannah River being shipped to New York fish markets with possible heavy-metal and radioactive contaminants
- o Savannah River sediments may contain high polychlorinated biphenyls (PCB) and heavy-metal concentrations
- o Overloading of sanitary treatment facilities in the A-, H-, and F-Areas
- o The environmentally unsound and unpermitted disposal of sanitary treatment sludge in a lagoon on the SRP site in the vicinity of the Central Shops Area
- o State/EPA position that groundwater and surface water within the SRP site are waters of the State
- o F- and H-Area Seepage Basins

- o Environmental compliance may be compromised due to less than optimal internal communications between Du Pont management and Du Pont field personnel
- o The age of the entire SRP facility may suggest that equipment is becoming ineffective
- o In general, a portion of the Savannah River does not always meet primary drinking water standards for fecal coliform (although the excess bacteria may not necessarily be due to SRP operations, but may be due to discharges from upstream users)
- o Liquid effluent sample results should be reported as soon as possible to be included in SRP's Discharge Monitoring Reports
- o Opacity exceedances in F-Area
- o Withdrawal of water from the deep aquifer, which may pull contaminated groundwater from the shallow aquifer
- o Water supply equipment does not meet current standards

2.3.2 Federal Compliance Schedules

2.3.2.1 National Pollutant Discharge Elimination System Thermal Compliance Schedule

In November 1982, the Department of Energy (DOE) Savannah River Operations Office was notified by the State of South Carolina's Department of Health and Environmental Control (SCDHEC) that the major SRP thermal discharges would have to attain the State of South Carolina's Class B water quality standards in on-site streams rather than in the Savannah River. These major thermal discharges included those from C-, K-, L- (then undergoing refurbishment), and P-Reactors and the D-Area Coal-Fired Powerplant.

On January 1, 1984, a new National Pollutant Discharge Elimination System (NPDES) Permit issued by SCDHEC that included instream temperature limitations became effective for SRP thermal discharges. To achieve compliance with the temperature limitations identified in the NPDES Permit, DOE and SCDHEC entered into a mutually agreed-upon Consent Order on January 3, 1984, that temporarily superseded the temperature requirements in the NPDES Permit and established a schedule for attaining compliance.

The NPDES Permit was modified on March 19, 1985, to include temperature limitations for Outfall L007 that are related to the restart and operation of L-Reactor. On August 22, 1985, the original Consent Order was amended to address thermal mitigation alternatives and National Environmental Policy Act (NEPA) requirements for C- and K-Reactors and D-Area.

2.3.2.2 Resource Conservation and Recovery Act (RCRA)

Based on a review of the SRP RCRA Part B permit application (Aiken County SCD 890 008 989) the SCDHEC and EPA determined on November 21, 1985, that the application was incomplete and additional data and information were required. This Notice of Deficiency (NOD) determination was followed by a requirement that a revised Part B application be submitted within 30 days. The SRP submitted comments to SCDHEC on the NOD on December 27, 1985; however SCDHEC's review of that information resulted in a determination that SRP had failed to adequately address some of the deficiencies that were cited. As a result, on October 2, 1986, a proposed administrative consent order was forwarded to SRP by SCDHEC with a second NOD. Negotiations between SRP and SCDHEC pursuant to this proposed Consent Order resulted in a compliance schedule for responses to all of the items cited in the proposed order.

Hazardous waste storage practices at the M-Area Liquid Effluent Treatment Facility (LETf) at SRP were also the subject of a proposed settlement agreement signed and forwarded by SR under letter of October 3, 1986 to the SCDHEC Bureau of Solid and Hazardous Waste Management.

During followup investigations by SCDHEC personnel of a leaking drum of acidic plating wastewater at the north pad loading dock of Building 313M, it was determined that various waste materials including hazardous wastes had been stored improperly at the 313M-Building. Based on these investigations and information supplied by DOE, at least eight LETF upsets which have impacted LETF operation occurred since the July 26, 1985, startup of the LETF system. Due to these upsets or incidents and until corrective action was taken, untreated or partially treated wastewater and sludge was intentionally diverted to and stored improperly in drums and other containers. Certain of these wastes, drums of untreated or partially treated wastewater and sludge, were hazardous wastes as defined in R.61-79.261 of the South Carolina Hazardous Waste Management Regulations.

DOE stored drums of wastewater and sludge (some of which were hazardous wastes) on concrete pads and on the ground. Some of the wastewater stored in the drums was not compatible with the drums. Corrosion of one of the drums of wastewater resulted in the leakage of its contents, constituting an unauthorized discharge into the environment.

2.3.3 Significant Audits and Inspections

During the period of July 28 - August 26, 1986, EPA conducted a multimedia inspection of the Savannah River Plant.

The purpose of the inspection was to determine the overall compliance status of the facility. A summary of the findings of the EPA from its inspection report dated January 12, 1987, is listed below.

RCRA

The large majority of the violations and problems detected during the inspection were in the RCRA area. The violations covered a wide range of activities, from regulated units for which no attempt had been made to comply with the regulations to minor technical violations at other units. There appeared to be at least five land treatment and five storage units which were not included on the Part A Permit but should have been regulated units. There were also two other land units

that are regulated under South Carolina law. Most of the violations concerning storage facilities should have been amenable to correction quickly without major capital expenditures. Major deficiencies were noted in the groundwater monitoring systems at all the land units. Some of these deficiencies have been addressed in SCDHEC consent orders with SRP but others will need additional attention.

NPDES Report

The NPDES inspection consisted of an on-site file and records review and sampling of selected outfalls. The field sampling revealed no violations of permitted outfalls and the records review revealed minor deficiencies which should be easily corrected. During the inspection two unpermitted discharges were discovered and the possibility of other was considered likely. These discharges were apparently contained in DOE's permit application but not in the permit issued by SCDHEC. More recent discussion indicated that one of the discharges has subsequently been eliminated and the remaining unpermitted discharge is the only one admitted by DOE. DOE and SCDHEC are currently operating under a consent agreement for the temperature limits on the reactor cooling waste discharges. The compliance status of the Consent Order was not fully evaluated.

Toxic Substances Control Act Report

Currently SRP has no PCB equipment in service. There are two storage areas that appeared to be in compliance, however, SRP was cited for failure to have quarterly inspection records for one PCB transformer.

Drinking Water Report

The Drinking Water inspectors conducted an on-site visit on August 7, 1986. The primary area of concern was the trichloroethylene (TCE) contamination of the Tuscaloosa aquifer which is the source of drinking water for the facility. Two highly contaminated supply wells are no longer being used and all water is being treated through granular activated carbon, resulting in finished water with a TCE concentration below the minimum detection limit.

Air Quality Report

All known, regulated air pollution emission sources at the SRP were observed during the inspection, except for the 56 emergency power diesel generators. The sources inspected included the following:

- 19 Coal-fired Boilers
- 2 Chemical Separators/Metal Recovery Processes
- 2 Waste Incinerators
- 2 Metal Cleaning Processes
- 1 Air Stripper Column
- 1 Concrete Batch Plant

All the air emission sources at the SRP were found to be in compliance except the Concrete Batch Plant.

2.3.4 Legal Actions

On October 17, 1985, the Natural Resources Defense Council (NRDC) and three co-plaintiffs filed a complaint in U.S. District Court against the DOE (NRDC, 1985). The suit was brought to require compliance with RCRA, the South Carolina Hazardous Waste Management Act, and the applicable Federal and State regulations in connection with the treatment, storage, and disposal of hazardous wastes at the SRP. The full text of the complaint is contained in Appendix E.

The action challenges Defendants' failure to (1) identify and include in Notifications and Permit Applications, hazardous waste management activities at a number of waste sites at the SRP; (2) implement adequate groundwater monitoring; (3) develop adequate closure and post-closure plans; and (4) dispose of hazardous wastes from chemical storage tanks properly. The action goes on to state that at least 153 waste management units have been identified at the SRP. Many of these units are pits, basins, landfills, and storage areas that contain and continue to receive large quantities of hazardous wastes regulated under RCRA, including mercury, chromium, lead, and numerous chlorinated organic compounds.

The suit alleges that the Defendants have failed to provide proper notice and apply for a permit in regard to numerous other units, despite formal requests to do so by EPA and SCDHEC. It also asserts failure to comply with interim status standards regarding groundwater monitoring and closure and post-closure care at a number of SRP units. Finally, it states that Defendants have engaged in unauthorized disposal of hazardous wastes from chemical storage tanks.

2.3.5 Government Accounting Office Review

At the request of Senator Ernest F. Hollings, the Government Accounting Office (GAO) examined various aspects of the SRP's radioactive waste management practices. This review was performed by the GAO between October 1984 and January 1986 and reported in July of 1986 (U.S. GAO, 1986). Highlights of the conclusions of the GAO's report are as follows:

GAO's analysis of SRP and State monitoring reports showed that radioactivity contained in the environment outside the plant boundary was well within applicable standards. Within the plant boundary, however, some of the surface streams contained elevated levels of radioactivity, and the soil and groundwater at several waste storage and disposal sites were highly contaminated with radioactivity.

SRP's monitoring report for 1984 also showed that tritium and occasional traces of strontium-90 were the only two radionuclides that could be detected in the Savannah River using routine analytical methods. By using special low-level analysis techniques, SRP was also able to detect very low levels of cesium-137. Although SRP has detected tritium and very low concentrations of cesium-137 at the two downriver public drinking water treatment plants, the average tritium concentrations measured during 1984 were only 8.5 and 12.5 percent, respectively, of EPA's public drinking water standard. The average cesium-137 concentrations measured were considerably less than 1 percent of the drinking water standard.

Except for a small swamp area near the plant site, GAO's analysis of SRP records showed that radioactive releases from SRP's operations have had very little impact outside the plant boundary. While radioactive concentration levels in the environment around SRP are very low, there is a swamp adjacent to the southern boundary of the plant site that was contaminated during the 1960s because of leaks from defective fuel elements in a storage basin at one of the nuclear production reactors. Neither SRP nor South Carolina officials, however, consider it necessary to restrict usage of the swamp or to take remedial actions because no one is living in the area.

SRP's radioactive waste management operations have resulted in elevated levels of radioactivity in surface streams on the plant site, and the soil and groundwater at several waste disposal and storage sites are highly contaminated with radioactivity. Most of the streams contained tritium concentrations which ranged from slightly above to 750 times greater than EPA's public drinking water standard, and tritium concentrations in one of the streams were also greater than DOE's off-site concentration guide. In addition, three streams contained maximum gross alpha and beta radioactivity exceeding EPA's drinking water standard; and, at times, gross beta levels were greater than DOE's off-site concentration guide.

GAO determined that groundwater was highly contaminated with radioactivity at the Low-Level Waste Burial Ground, some of the seepage basins, and the High-Level Waste Tank Farms. The contamination occurred primarily as a result of radioactivity migrating from buried waste, discharges of contaminated liquid waste into the seepage basins, and unintentional spills and leaks of high-level liquid waste.

3.0 MEDIA-SPECIFIC SURVEY FINDINGS AND OBSERVATIONS

PRELIMINARY

3.1 Air

3.1.1 Background Environmental Information

The Savannah River Plant (SRP) is a source of hazardous air pollutants regulated by the State of South Carolina, and radioactive air emissions regulated by both the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). Table 3-1 presents the South Carolina and Georgia State Ambient Air Quality Standards (AAQS) for criteria pollutants. The site is also subject to Federal regulations concerning hazardous and radioactive air pollutants included in the National Emission Standards for Hazardous Air Pollutants (NESHAP). Regulations applicable to individual facilities are summarized in the report sections where the facilities are discussed.

3.1.1.1 Regional Meteorology

Meteorological data are collected from a system of eight 200-foot instrumented towers located adjacent to each of the major production areas, and from the WJBF-TV tower located approximately 9 miles northeast of the plant boundary. The 1,500-foot TV tower is instrumented at 7 levels, and the on-site towers at the 200-foot level only (which is the height of the major production-area stacks). Data collected from the towers include wind speed and direction and turbulence measurements. Temperature measurements taken from the TV tower provide atmospheric temperature data to a height of 1,000 feet. The original on-site towers and instrumentation are about 10 years old. The towers have recently been rebuilt and the instrumentation is scheduled to be replaced in 1987. Acoustic sounders, which measure the atmospheric boundary layer depth, are also scheduled for installation.

Responsibility for the maintenance of the instrumentation, formerly assigned to the individual facilities, has recently been centralized under a single maintenance staff. Routine quality assurance (QA) inspections of collected data are conducted, and an automated QA computer code is also used to verify the data (DOE, 1984). Meteorological data are used, along with tracer dispersion tests, to calibrate site-specific dispersion models. The data are also used by the Emergency Response (WIND) System, which is discussed in Section 3.1.3.2. On-site meteorological data

TABLE 3-1
STATE AMBIENT AIR QUALITY STANDARDS FOR CRITERIA
POLLUTANTS

Pollutant	South Carolina	Georgia
Suspended particulates ($\mu\text{g}/\text{m}^3$) 24 hours Annual geometric mean	250 60	150 75
SO ₂ ($\mu\text{g}/\text{m}^3$) 3 hours 24 hours Annual arithmetic mean	1,300 365 80	1,300 365 80
NO _x ($\mu\text{g}/\text{m}^3$) Annual arithmetic mean	100	100
Lead ($\mu\text{g}/\text{m}^3$) Calendar quarter mean	1.5	1.5 ^a
Ozone ($\mu\text{g}/\text{m}^3$)	235	235
Gaseous Fluorides (As Hf) ($\mu\text{g}/\text{m}^3$) 12 hours 24 hours Weekly mean Monthly mean	3.7 2.9 1.6 0.8	No Standard

^aFederal standard

Sources: Georgia Air Quality Control Rules-Chapter 391.3.1.02

South Carolina Ambient Air Quality Standards-Regulation
No. 52.5 Standard No. 2

are also supplied to the Health Protection Department for use in performing off-site dose calculations.

3.1.1.2 Local Meteorological Data and Atmospheric Dispersion

The average wind speed measured in Augusta from 1951 to 1981 was 10 feet per second. The average wind speed recorded at a height of 33 feet on the TV tower was 8 feet per second from 1966 to 1977. The average monthly wind speed for Augusta is shown in Table 3-2 along with the prevailing wind direction for each month. The monthly and annual average wind speeds for three levels of the TV tower are also shown. Calms and wind speeds below 6.5 feet per second at the 200-foot height occur 15 percent of the time at the H-Area tower and 10 percent of the time at the K-Area tower (DOE, 1984).

The frequency of wind speeds as a function of location for the eight meteorological towers at or near SPR is also included in Table 3-2 (Hoel, 1983). The data indicate differences between the different plant areas. These wind roses also show differences between areas.

Figures 3-1 and 3-2 present the average annual wind direction frequencies from the 200-foot level of two of the eight on-site meteorological stations (Hoel, 1983). Annually, the predominant wind direction is from the west-northwest toward the east-southeast with a secondary maximum from the east-northeast to west-southwest. The west-northwest winds are associated with higher average wind speeds. The predominant wind direction varies with season as follows:

<u>Season</u>	<u>Predominant Wind Direction</u>
Winter	Northwest to Southeast
Spring	West to East
Summer	Toward Southwest through North to Northeast
Fall	Toward Southwest and Southeast

Detailed stability data and seasonal wind roses are presented in Hoel, 1983.

TABLE 3-2

**AVERAGE MONTHLY WIND SPEED FOR AUGUSTA, GEORGIA
1951-1981, AND WJBF-TV TOWER, 1966-1977**

Month	Mean Speed (m/sec)	Prevailing Direction	Tower Elevation (m)		
			10	36	91
January	3.2	W	3.0	4.5	6.1
February	3.4	WNW	2.9	4.6	5.8
March	3.6	WNW	3.3	4.5	5.9
April	3.4	SE	2.8	4.2	5.4
May	2.9	SE	2.5	3.7	5.0
June	2.8	SE	2.4	4.0	4.8
July	2.6	SE	2.0	3.1	4.4
August	2.5	SE	2.1	3.2	4.3
September	2.5	NE	2.1	3.3	4.7
October	2.6	NW	2.4	4.1	5.6
November	2.8	NW	2.4	4.1	5.6
December	3.0	NW	2.7	4.4	6.3
Annual	3.0	SE	2.5	3.9	5.3

Source: DOE, 1984

**Cummulative Frequency of Wind Speeds for Eight Meteorological Towers at
SRP at 200 feet Above Ground Level. (Five Years of Data from 1975-1979).**

Location Speed (MPH)	WJBF TV	A Area	C Area	D Area	F Area	H Area	K Area	P Area
0-2	0.08	0.09	0.12	0.18	0.14	0.15	0.10	0.11
2-4	0.36	0.43	0.46	0.60	0.47	0.55	0.46	0.44
4-6	0.72	0.82	0.82	0.89	0.82	0.89	0.84	0.83
6-8	0.92	0.96	0.96	0.97	0.95	0.97	0.96	0.96
8-12	0.99	0.99	1.00	1.00	1.00	1.00	1.00	0.99
>12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Hoel, 1983

SAVANNAH RIVER PLANT H-AREA WIND ROSE,
1975-1979

FIGURE 3-1

SAVANNAH RIVER PLANT K-AREA WIND ROSE,
1975-1979

FIGURE 3-2

3.1.1.3 Atmospheric Stability and Inversion Characteristics of Site

Atmospheric turbulence is indicated by atmospheric stability classification, with unstable atmospheric conditions generally allowing for greater dispersion of atmospheric emissions than stable conditions. Unstable conditions (stability classes A-C) occur approximately 25 percent of the time in the plant area, stable conditions (stability classes E-G) 50 percent of the time, and neutral conditions (stability Class D) 25 percent of the time (Hoel, 1983). The mixing height (the level of the atmosphere below which pollutants are easily mixed) averages between 3,300 and 6,200 feet, being at a minimum in the winter months. Temperature inversions inhibit atmospheric turbulence and thereby atmospheric dispersion. Data collected in 1974 indicate that about 30 percent of the time, a temperature inversion extended to or beyond the 10- to 1,100-foot layer. About 12 percent of the time, there was an elevated inversion with an unstable layer below; this represents the early morning breakup of a nighttime inversion. About 9 percent of the data showed an inversion at the lower atmospheric levels with an unstable layer above; this represents the transition period between an unstable daytime condition and the onset of a nighttime inversion (DOE, 1984).

The dilution capacity of the atmosphere depends on local wind speed, wind direction variability, mixing depth, and vertical temperature profile. From 1960 to 1970 the plant area had about 50 forecast-days of high meteorological potential for air pollution episodes, or an average of about 5 days per year. Episodes are most frequent in autumn, when large anti-cyclones, which are characterized by low wind speeds, clear weather, and large-scale temperature inversions, become nearly stationary off the Atlantic coast, affecting much of the eastern United States (DOE, 1984).

3.1.1.4 Ambient Air Quality Data/Attainment Status

The States of Georgia and South Carolina operate ambient air quality monitoring stations for criteria pollutants in the vicinity of the SRP. Both states monitor for total particulates, lead, ozone, nitrogen oxides, carbon monoxide and sulfur dioxide. South Carolina air quality data for 1985 are summarized in Table 3-3 for stations in counties near Aiken (SCDHEC, 1986). Air quality throughout South Carolina was better than air quality standards in 1985.

TABLE 3-3

SOUTH CAROLINA AMBIENT AIR QUALITY DATA - 1985

Station Name	County	Nitrogenoxides Annual Avg. ($\mu\text{g}/\text{m}^3$)	Ozone (PPM)		Sulfur Dioxide ($\mu\text{g}/\text{m}^3$)		Total Suspended Particulate ($\mu\text{g}/\text{m}^3$)	
			Highest Hourly	2nd Highest Hourly	Highest 24 Hr.	Annual Avg.	Highest 24 Hr.	Annual Geometric Mean
Beech Island	Aiken				213	15	107	41
Lodge	Colleton		0.092	0.085				
Sandhill/Clemson	Richland		0.116	0.110				
Columbia DHEC	Richland				30	5	86	42
N. Charleston*	Charleston		0.092	0.092	118	13	91	31
Bushy Park	Berkeley		0.084	0.084			70	31
Trenton	Edgefield		0.108	0.108				
Congaree Swamp	Richland	13	0.076	0.076	61	4	48	21
Barnwell	Barnwell	11						
Greer	Greenville		0.103	0.103				

*Ozone and SO₂ Stations in North Charleston are not collocated.

The area in the vicinity of Augusta, Georgia, and Aiken, Barnwell, and Allendale Counties in South Carolina has been designated as "better than national standards" or "unclassified or better than national standards" for all criteria pollutants. However, local air monitoring stations are too distant from the plant boundary to provide an accurate indication of the air quality in the immediate vicinity of the plant and the on-site air quality monitoring system may provide a more accurate indication of local air quality. This is particularly the case with respect to nitrogen oxides and ozone, which are not monitored by the State of South Carolina in Aiken, Barnwell, or Allendale Counties. The on-site monitoring system is discussed and data are summarized in Section 3.1.3.1. With the exception of high ozone concentrations recorded at several stations, on-site air quality has been better than air quality standards since 1982, when the present monitoring network was installed.

3.1.2 General Description of Pollution Sources and Controls

Production, laboratory, and support service operations at the SRP emit a wide variety of regulated/hazardous pollutants to the atmosphere. In general, sources of criteria pollutants (sulfur and nitrogen oxides, lead, carbon monoxide, total particulates, and nonexempt* hydrocarbons) require State operating permits. Existing sources of hazardous or toxic air emissions (e.g., mercury, benzene, hydrochloric acid) are generally exempt from regulations, while new and modified sources are generally required to obtain permits.

* Nonexempt hydrocarbons or volatile organic compounds (VOCs) include components of motor fuels, trichloroethylene, and perchloroethylene. The emissions of these compounds are regulated by the State because they contribute to ambient ozone concentrations. Exempt hydrocarbons such as 1,1,1-trichloroethane and benzene are not regulated by the State as VOCs.

Oxides of sulfur and nitrogen are emitted from the fuel-burning sources, including coal-fired boilers, diesel generators, and waste incinerators. Nitrogen oxides are also emitted from facilities using nitric acid, which include the Separations and Fuel Fabrication Facilities (both Naval Fuels and 300M-Area) and the TNX/CMX-Area pilot plants. The TNX/CMX-Area also emits benzene and other organic compounds. Large quantities of 1,1,1-trichloroethane are emitted from degreasing operations in the 300M-Area, and smaller quantities of trichloroethylene and perchloroethylene are emitted from a groundwater treatment system in the same area. Mercury is used as a pump fluid in the tritium production facility, and also as a catalyst in the 200H-Area dissolution process. Mercury is emitted to the atmosphere from the Tritium Facility and 200H-Area Separations and Waste Management Facilities, which treat mercury-containing wastes. Leaded oil is used as a lubricant in the uranium extrusion press in the 300M-Area, and lead is emitted to the atmosphere from the process. Regulated/hazardous contaminants are also emitted from laboratories and support facilities on the site.

3.1.2.1 Regulated/Hazardous Air Emissions Sources and Controls

Regulated/hazardous contaminants discussed in this section include criteria pollutants with established air quality standards (sulfur and nitrogen oxides, total particulates, lead, and ozone precursors) and pollutants regulated by new source performance standards (NSPS) or as hazardous air pollutants under NESHAP or prevention of significant deterioration (PSD) regulations (e.g., mercury, benzene). Radionuclides, also regulated under NESHAP, are discussed in Section 3.1.2.2. Toxic air pollutants (e.g., 1,1,1-trichloroethane), which are presently unregulated but nonetheless represent potential environmental or human health risk, are also discussed in this section.

Fuel-Burning Sources and Emission Controls

There are seven coal-fired steam plants at the SRP, which provide electric power and/or steam for heating and process operations. The operating data and status of each plant are listed in Table 3-4 (Du Pont, 1986a, 1987a). The 484D Steam Plant is the major source of steam (and some electric power) for the 200F- and 200H-Area Separations Facilities. The 284H Steam Plant is maintained on warm standby as a backup. The 784A Steam Plant provides steam to the 300M-Area Fuel

TABLE 3-4

OPERATING CHARACTERISTICS AND STATUS OF COAL-FIRED STEAM PLANTS

Facility	Boiler Type	Number of Units	Heat Input Per Unit (MMBTU/Hr)	Steam Output Per Unit at Capacity (Lb/Hr)	Status
484D	Pulverized Coal	Four	396/(63MW)	360,000	Operating
784A	Stoker	Two	71.7	60,000	Operating
184C	Stoker	Two	43.8	Unknown	Dismantled
184K	Stoker	Two	194.5	140,000	Operating
184P	Stoker	Two	194.5	175,000 (#1) 130,000 (#2)	Operating Operating
284F	Stoker	Four	71.7	60,000	Shut Down
284H	Stoker	Three	71.7	60,000	Warm Standby

Source: Du Pont, 1986a, 1987a

Fabrication Facilities and 700A-Area laboratories. Other operating steam boilers are located in the P- and K-Reactor Areas.

Coal-fired steam boilers are subject to South Carolina sulfur dioxide and particulate emission standards and opacity (visible emissions) limitations. The sulfur dioxide emission limit of 3.5 pounds per million BTU (lb/MMBtu) heat input is met by the use of low-sulfur coal, and no emission controls for sulfur dioxide are applied to any of the boilers. Particulate and visible emissions from the 484D boilers are controlled by electrostatic precipitators; mechanical cyclone collectors are used to control particulate and visible emissions from the stoker boilers. Compliance tests indicate that all the operating boilers are in compliance with the particulate emission standard of 0.6 lb/MMBtu heat input, with the exception of the 784A boilers. All boilers are in compliance with the visible emission limitation of 40 percent stack opacity.

In autumn 1985, both boilers in the 784A Steam Plant failed the required biannual compliance test for particulate emissions. Actual emissions at 60,000 lb/hr steam load were 0.84 lb/MMBtu and 0.82 lb/MMBtu for boilers one and two, respectively (about 1.4 times the State standard). After minor boiler repairs were made and the dust collectors were cleaned, engineering tests indicated that the boilers still would not pass the compliance test at full load, but would pass at a reduced steam output. An agreement was reached with the State to permit the operation of both boilers at reduced load, until the boilers could be shut down for major overhaul in the summer months. After the boilers were overhauled, both could be operated well within the particulate emission standard at full load. Both boilers have passed formal State compliance tests. Summaries of the particulate emission testing and repairs are included in Tables 3-5 and 3-6 for boilers one and two (Du Pont, 1987b).

Coal-fired boilers emit nitrogen oxides as well as sulfur oxides which contribute to the site-wide inventory of nitrogen oxide emissions. Existing boilers, however, are not subject to emission standards for nitrogen oxides. No emission controls for nitrogen oxides are applied to any of the boilers.

TABLE 3-5

COAL-FIRED BOILER 784-A1
CHRONOLOGY OF PARTICULATE EMISSION TESTING AND REPAIRS

Date	Event	Remarks
8/15/85	Compliance Test - 60,000 lb/hr steam	Failed - (0.84 lb/MMBtu)
8/85-11/85	Boiler Repair	Modify and Tune Controls/Operator Retraining
12/85	Boiler Repair	Cleaned Stack and Collectors
1/20/86	Boiler Repair	Air Leaks
1/21/86	Engineering Test - 60 MLB/HR	Failed - (0.70 lb/MMBtu)
1/29/86	Engineering Test - 45MLB/HR	Failed - (0.65 lb/MMBtu)
1/30/86	Engineering Test - 35MLB/HR	Failed - (0.69 lb/MMBtu)
2/13/86	Engineering Test - 40MLB/HR	Passed - (0.32 lb/MMBtu)
2/20/86	Compliance Test - 40 MLB/HR	Passed - (0.40 lb/MMBtu)
6/86-9/86	Boiler Overhaul	Grate Air Seals Installed
6/86-9/86	Boiler Overhaul	Replaced Coal Feeders
6/86-9/86	Boiler Overhaul	Replaced Grate Keys
9/86	Engineering Test	Severe Air Restriction
10/86	Boiler Repair	Dust Collectors Cleaned
10/31/86	Engineering Test - 60MLB/HR	Passed - (0.32 lb/MMBtu)
12/02/86	Compliance Test - 60MLB/HR	Passed - (0.28 lb/MMBtu)

Source: Du Pont, 1987b

TABLE 3-6

**COAL-FIRED BOILER 784A-2
CHRONOLOGY OF PARTICULATE EMISSION TESTING AND REPAIRS**

Date	Event	Remarks
7/18/85	Compliance Test - 60,000 lb/hr steam	Failed - (0.82 lb/MMBtu)
7/85-11/85	Boiler Repair	Modify and Tune Controls/Operator Retraining
11/22/85	Compliance Test - 60MLB/HR	Failed - (0.76 lb/MMBtu)
12/85	Boiler Repair	Cleaned Stack and Collectors
12/20/85	Compliance Test - 60MLB/HR	Failed - (0.80 lb/MMBtu)
1/15/86	Engineering Test - 45 MLB/HR	Passed - (0.55 lb/MMBtu)
1/15/86	Engineering Test - 35MLB/HR	Passed - (0.50 lb/MMBtu)
1/20/86	Boiler Repair	Air Leaks
1/21/86	Engineering Test - 60MLB/HR	Failed - (0.76 lb/MMBtu)
1/23/86	Engineering Test - 50MLB/HR	Failed - (0.64 lb/MMBtu)
1/30/86	Engineering Test - 45MLB/HR	Passed - (0.53 lb/MMBtu)
2/12/86	Compliance Test - 45 MLB/HR	Passed - (0.48 lb/MMBtu)
9/86-11/86	Boiler Overhaul	Replaced Coal Feeders
12/12/86	Engineering Test - 60MLB/HR	Passed - (0.46 lb/MMBtu)
2/12/87	Compliance Test - 60MLB/HR	Passed - (0.41 lb/MMBtu)

Source: Du Pont, 1987b

The 484D Steam Plant burns approximately 100,000 lb/yr of nonradioactive waste oils generated at the SRP.* Those wastes listed in the Part B Permit Application for the SRP as being suitable for burning at 484D include automotive and engine lubricants, non-PCB transformer oil, gear box oil, kerosene, diesel oil, and fuel oil. Unsuitable wastes include liquid with flashpoints below 100°F, oils containing toxic chemicals, machine cutting oil, extrusion die oils containing lead, chlorinated hydrocarbons, and other solvents (e.g., Klearall 99, Varsol, Ultrasene, and F-101 Safety Solvent). Before waste oil can be received at 484D, the generator must certify that it is free from radioactive contamination and does not contain any of the previously described unsuitable materials. A certification form which verifies the contents of the waste oil shipment is provided to the receiver at the 484D Facility by the generator.

Of the seven facility steam plants, only 784A and 484D Steam Plants were inspected during the Survey. Continuous opacity monitors and flue-gas oxygen analyzers appeared to be in good working order, and actual stack opacity appeared to correspond to the continuous monitor readings. Data collection and reporting were found to be satisfactory. Quality assurance and maintenance/calibration procedures are adequate to maintain functional monitors and to detect opacity excursions and out-of-specification monitor readings (Du Pont, 1982a). The 484D Steam Plant shows good compliance records according to review of collected data (Snell, 1987).

Other fuel-burning equipment at the plant include the propane-fired uranium oxide calciners in the 200F-Area (A-line), the Beta/Gamma Radioactive Waste Incinerator (BGI), also in the 200H-Area, the test incinerator in TNX/CMX-Area, and over 100 small diesel generator sets placed throughout the facility. The calciners and test incinerator are not significant sources of emissions. The BGI will be discussed separately in this section.

* "Nonradioactive" waste oil is defined by the SRP as oil containing less than 0.05 μ Ci/ml tritium contamination.

The site maintains over 100 small diesel generator sets, most of which are emergency or standby to be used in the event of a loss of electric power. The engines range in size from 5 kw to 1000 kw. The engines are periodically tested to ensure their operability. The diesel engines are minor sources of sulfur and nitrogen oxides and particulates and contribute to the site-wide inventory of emissions of these pollutants. The emissions are relatively small with respect to other fuel-burning sources on the site, and controls are not required. Proposed EPA regulations requiring control of nitrogen oxide emissions from recently installed diesel generators have not been promulgated.

Separations Facilities (200F-Area and 200H-Area) Air Emission Sources and Controls

The chemical processes in the 200F- and 200H-Areas (Buildings 221F and 221H and associated facilities) involve dissolving irradiated reactor fuel and target assemblies in nitric acid, and subsequently separating uranium, plutonium, and neptunium isotopes from fission products and waste materials through a multistep organic/aqueous extraction process. The F- and H-Area processes are similar with respect to the process equipment used, but have important differences in the isotopes processed. The F-Area process handles depleted uranium (U-238) while the H-Area process separates enriched uranium (U-235). Mercuric nitrate is used in the H-Area dissolution process as a catalyst for the dissolution reaction. No catalyst is required in the F-Area two-step dissolution process. F-Area has an additional process step to recover depleted uranium as uranium oxide (UO_3). This process is referred to as denitration and takes place in A-Line, outside the 221F building. Both the dissolution and denitration processes emit nitric acid fumes and nitrogen oxides. The first step of the F-Area dissolution process emits ammonia (NH_3), the second step nitrogen oxide. Both the 200F and 200H Area processes have the potential to emit organic vapors from the extraction processes, and the H-Area dissolution process emits mercury to the atmosphere. Emissions of radioactive particulates and gases from the separations processes are discussed in Section 3.1.2.2.

F-Area

The feed rate to the F-Area separations is on the order of 10 metric tons per day (10-20 dissolutions per month). The dissolution of the feed material is a two-step batch process. The first step, using caustic, dissolves the aluminum cladding, and the second step, using nitric acid, dissolves the irradiated uranium. The two dissolution steps are vented separately to separate stacks. The second stack was added to the first step of the process to prevent ammonia (NH_3) emitted from the process from reacting with nitric acid (HNO_3) emitted from the second dissolution step.*

The feed material dissolution is a batch process, and emissions of nitrogen oxides are by nature cyclical. The uranium denitration process is relatively continuous, and emissions of nitrogen oxides are fairly constant. The overall profile of nitrogen oxide emissions for the F-Area separations process main stack (291F) is shown qualitatively in Figure 3-3 (Odum, et al., 1988a).

The approximate ratio of nitrogen oxide emissions from the dissolution and denitration parts of the separations process is 8:1. Nitric acid fumes from both processes are recovered in the F-Area acid recovery unit (ARU) as 50 percent nitric acid, which is recycled back into the facility. The ARU recirculates nitric acid in a tray-type column countercurrent to the process exhaust gases. The acid solution becomes more concentrated by absorbing the nitric acid fumes from the gas stream, and is removed from the column as 50 percent acid. The ARU is not, in the strict definition, an emission control device, but rather an integral part of the separations process. The purpose of the ARU is to recover acid at a fixed concentration, and the recovery efficiency of the column cannot be increased by increasing the liquid flow rate without diluting the acid to a lower concentration. Dilute acid cannot be used in the dissolution process and must be neutralized and disposed of as radioactive waste. An additional limitation on the recovery efficiency of the ARU is the low efficiency for nitrogen oxides (as opposed to nitric acid fumes), which are relatively insoluble in nitric acid. The overall efficiency of the ARU is estimated to be 40 percent.

* This reaction forms ammonium nitrate (NH_4NO_3), which is a solid. The ammonium nitrate can condense on the inside of the stack and adsorb ruthenium and other radionuclides. Periodic discharge of the radioactive solid to the atmosphere would result in local deposition of radionuclides.

FIGURE 3-3

F-AREA NO_x GENERATION

The nitrogen oxide emissions from the 292F stack are subject to a State permit limit of 180 lb/hr as an annual average (Huang, 1986a). The emission limit of 180 lb/hr is based on process mass-balance calculations and facility production schedules. A stack test was conducted in 1983 in response to a proposed process modification, which was expected to increase NO_x emissions from the process (Roberts, 1984, and Clayton Environmental, 1983a). The test data indicate that before installation of the replacement ARU, the maximum emissions during the dissolution portion of the process after modification were up to twice the hourly limit of 180 lb/hr; however, the average emissions for the entire cycle appear to be below the annual emission limit. As the emission limit is an annual average, and the efficiency of the replacement acid recovery column is estimated to be approximately twice that of the old column, nitrogen oxide emissions are expected to be within permit limits. The permit conditions do not require the Separations Facility to monitor nitrogen oxide emissions or report them to the State, so no recent emissions data are available.

In February 1986, the emissions from the 292F stack became subject to a 40 percent opacity limitation applicable to industrial process (noncombustion) emission sources (Odum, 1986b). At that time the opacity consistently exceeded the regulatory limit during the dissolution portion of the process, even though nitrogen oxide emissions were within the permit limit of 180 lb/hr.* (The only contributor to the plume opacity is nitrogen oxide.) The SRP reached an agreement with the State on a compliance plan to meet the new regulation. Operation of the ARU as an emission control system, using fresh water instead of recirculated acid, was demonstrated as capable of meeting the opacity limit, but was considered an unacceptable option by SRP and by the State because of the large amount of radioactive waste generated. As an alternative, the Separations Facility replaced the old ARU with a rebuilt spare unit and cleaned the cooling coils on the unit.

*Note that opacity limitations and measurement techniques were originally developed for fuel-burning sources of particulate emissions. The opacity of a chemical plume such as a nitrogen oxide plume cannot be correlated with the emission rate. As opacity does not accurately indicate the level of emissions, opacity excursions may be regarded as a compliance issue.

This increased the column recovery efficiency from 20 percent to 40 percent and the concentration of the recovered acid from 35 percent to 50 percent. Installation of an automatic process control system on the unit, scheduled for 1989, is expected to further increase the recovery efficiency. Opacity readings are presently in the 25 percent to 35 percent range during dissolution, and close to 5 percent at other points in the process (primarily emissions from the denitrators) based on readings taken by qualified plant personnel (Wierzbicki, 1986; Odum, 1986b).

The uranium denitrators are equipped with jet evacuators, which bypass the ARU and exhaust directly to the sand filter and stack in the event of a process upset. The opacity of the stack plume in the event of a bypass is very likely to exceed the 40 percent limit, and the facility has agreed to report any use of the evacuators for more than 6 minutes to the State as an opacity excursion. Use of the evacuators is unlikely to result in exceedance of the annual average emission limit of 180 lb/hr.

H-Area

The feed rate to the H-Area separations process is on the order of 100 kg/day. Feed material dissolution is a single-step batch process using nitric acid with mercuric nitrate as a catalyst. H-Area does not operate a denitration process. Emissions of nitric acid fumes and nitrogen oxides from the dissolution process are cyclical, as are the dissolver emissions in F-Area, but are much lower in magnitude because of the lower process throughput. Nitric acid fumes from the process are recovered in the H-Area ARU; however, recycled nitric acid is not used in the H-Area process, in order to maintain product purity.

The nitrogen oxide emissions from the 292H stack are subject to a State permit limit of 25 lb/hr as an annual average, and also to the previously discussed opacity limit of 40 percent (Huang, 1986b). The emission limit is based on process mass balance calculations and facility production schedules. Stack test data indicate that the average emissions during the dissolution process were approximately twice the hourly limit of 25 lb/hr and maximum emissions were 100 lb/hr (Clayton Environmental, 1983a). The average emissions from the separations process as a whole are expected to be well below the hourly limit (as an annual average) as the process does not continuously emit nitrogen oxides. The facility is not required to

monitor nitrogen oxide emissions or report them to the State. The H-Area separations process has experienced no difficulty in complying with the opacity limit of 40 percent.

As mentioned earlier, mercuric nitrate is used as a catalyst in the H-Area dissolution process. Mercury vapors are emitted from the dissolvers, process waste evaporators, and catalyst makeup tank. All mercury emissions are through the 292H Stack. The Separations Facility initiated a characterization program in 1984 to identify mercury sources and to determine the emissions of mercury from the stack. Monitoring data were collected from January 1985 through April 1985, using a gold-foil mercury vapor analyzer. Annual emissions of mercury in 1985 were calculated to be 64 lb/yr based on the first-quarter emission and plant operating data. Annual emissions at maximum plant capacity would have been approximately 100 lb/yr in 1985 (Franklin, 1985). Recent mercury emissions data are unavailable because the mercury monitor has been out of service.

Mercury consumption in the H-Area dissolution process was approximately 5,000 pounds in the first quarter of 1985. The atmospheric emissions of mercury were less than 50 pounds during this period, indicating that nearly all of the mercury consumed in the process is incorporated into the liquid waste. Liquid wastes from the H-Area Separations process are either concentrated in the waste evaporators in the 241H-Area, or disposed of in the H-Area Seepage Basins. The waste management evaporators are discussed separately in this section.

In early 1985, the H-Area Separations Facility initiated a mercury-reduction program, and since that time significant reduction in mercury consumption during the dissolution process has been achieved. The facility could not identify a suitable substitute for mercury in the process. Projected consumption for 1987 is 1,100 pounds of mercury, the reduction from previous years being the combined result of process optimization and a reduced production rate for 1987 from 1985 and 1986 levels (Du Pont, 1987c). Atmospheric mercury emissions can be expected to be reduced from 1985 estimates because of reduced mercury consumption.

New sources of mercury emissions are subject to state PSD regulations requiring preparation of an air quality impact assessment and application of emission controls if emissions will exceed 200 lb/yr. Existing facilities such as the H-Area Separations Facility would not be subject to the regulations unless emissions are increased by more than 200 lb/yr. Although not subject to PSD regulations, the facility intends to transmit mercury emissions data to the State once sufficient data are collected. The SR may apply for a permit modification for the 292H Stack emissions to include mercury emissions.

At the time of the Survey, the mercury monitor used to measure emissions from the 292H Stack was off the site for repair and could not be observed. According to the facility operators, it will be reinstalled upon its return to the site.

Organic emissions from F-Area and H-Area extraction processes have not been measured but are expected to be minimal based on process characteristics and physical data. Both processes use a mixture of N-Paraffins (similar to kerosene) and tributyl phosphate (TBP) as the organic extractant. The vapor pressure of the mixture components is less than 5×10^{-4} mm Hg at 68°F (20°C) and the amount of evaporation of the solvent to the F-Area and H-Area process vessel vents at this vapor pressure is expected to be small. The exhaust is near ambient temperature.

Beta/Gamma Radioactive Waste Incinerator (230H)

The Beta/Gamma Radioactive Waste Incinerator (BGI) is a dual-chamber controlled air incinerator that burns low-level liquid and solid radioactive waste. The solid waste burned includes paper, plastic, wood, and other box-type wastes. Liquid wastes include spent solvent from the separations process (kerosene/TBP) and waste oil, which is used as an auxiliary fuel when solid wastes are being burned. Most of the stockpiled spent solvent (about 140,000 gallons) has been incinerated. Diesel fuel is used as an auxiliary fuel and for startup. There is one auxiliary fuel burner in each of the two incinerator combustion chambers. Liquids are fed into the incinerator through atomizers, and solids are fed through a ram-feeder. The incinerator is controlled by temperature monitors and automatic burner controls to maintain the desired air/fuel ratio and temperature in each chamber. The normal operating temperature range is 850°F to 1100°F. The rated capacity of the

incinerator is 300 lb/hr of liquid waste or 400 lb/hr of solid waste. The State operating permit for the incinerator limits the feed rate to 400 lb/hr of solid waste, which may contain up to 10 percent plastics, and also allows the burning of polyvinyl chlorides (PVCs), rubber, and spent solvent (Huang, 1986b).

Waste oils acceptable for burning in the BGI include automotive and engine lubricants, non-PCB transformer oil, gear box oil, kerosene, diesel oil, and fuel oil. Unsuitable wastes include liquids with flashpoints below 100°F, oils containing toxic chemicals, machine cutting oil, extrusion die oils containing lead, chlorinated hydrocarbons, and other solvents (e.g., Klearall 99, Varsol, Ultrasene, and F-101 Safety Solvent). Before the waste oil can be received at the BGI, the generator must certify that it is free from radioactive contamination and does not contain any of the previously described unsuitable materials. A certification form which verifies the contents of the waste oil shipment is provided to the receiver at the BGI by the generator.

The radioactive nature of the waste burned requires extensive particulate controls. Controlled air incinerators, by design, generate relatively small quantities of flyash when burning solid waste; most of the ash is removed from the incinerator bottom. Combustion of liquids generates more flyash and less bottom ash, as the particulates are of finer size and therefore more easily entrained in the flue gas. The hot flue gas (about 1000°F) passes through a quench tower, where the temperature of the gas is reduced to about 400°F using a water spray. The water evaporates to steam by cooling the gas, and no liquid effluent is generated.* The cooled gas then enters a baghouse, which removes entrained particulates. The gas then passes through banks of High-Efficiency Particulate Air (HEPA) filters as a final particulate removal step before exiting the stack. Particulate emissions from the incinerator, with respect to their regulated/hazardous constituents, are minimal. Radionuclide emissions (particulate and gaseous) from the incinerator are discussed in Section 3.1.2.2.

* Note that as no liquid effluent is generated by the quench process, no acid gases are removed from the flue gas in the quench tower. Acid gases remain entrained in the gas with the vaporized quench water, and the quench tower cannot therefore be considered a scrubber.

The major regulated/hazardous pollutants emitted from the incinerator are:

- o Hydrochloric acid (HCl)
- o Nitrogen oxides (NO_x)
- o Sulfur oxides (SO_x)
- o Phosphorus pentoxide (P₂O₅)

With the exception of nitrogen oxides, emissions from the incinerator are directly related to the composition of the waste and amount of auxiliary fuel burned, which, by the nature of the waste disposal process, are extremely variable.

Nitrogen oxide emissions from fuel-burning sources are primarily a function of the combustion temperature, residence time, and excess oxygen, and are only indirectly related to the waste composition. Regulated/hazardous emissions from the incinerator are tested semi-annually to comply with State permit requirements. The permit limits emissions of hydrochloric acid to 30 lb/hr; emissions have historically been below this limit because of the small amount of chlorinated plastics (e.g., PVC) burned. Incineration of plastics has been avoided in order to minimize corrosion of process equipment. The BGI is expected to increase the feed rate of plastics in the future.

As no acid gas emission controls are applied to the incinerator exhaust, the BGI must control the feed rate of chlorinated plastics to control the hydrochloric acid emission rate. This is done by administrative procedures that include x-ray inspection of all box-type wastes received at the BGI, and removal of any large plastic items (e.g., plastic suits) found. As previously mentioned, only nonchlorinated waste oils are burned in the BGI.

No permit limits apply to emissions of other regulated/hazardous substances from the BGI. However, the emissions are subject to an opacity limit of 2 percent (Huang, 1986b). The BGI has not experienced any difficulty in meeting the opacity limit. Sulfur dioxide emissions, primarily from sulfur in auxiliary fuel and any rubber products burned, and nitrogen oxide emissions are low. Phosphorus pentoxide, which is emitted when TBP is burned, is a very fine solid, and is controlled to some extent by the particulate control system. Tetraethyl titanate is added to the solvent to fix the phosphorus, and most of the phosphate from the solvent is recovered as incinerator ash.

The incinerator was not operating during the Survey because of an accident involving introduction of Halon, a fire suppressant, into the combustion air. The resulting emissions of bromine and fluorine were detected by workers in a construction area near the incinerator. This incident, although far from a typical occurrence, indicates that the facility has the potential to affect local air quality under upset conditions such as inadvertent charging of large amounts of chlorinated plastics, which would result in increased hydrochloric acid emissions and increased ground-level concentrations during adverse (stable) meteorological conditions. During normal operation within permitted limits the regulated/hazardous emissions from the facility are not significant with respect to other air emissions sources at the site.

Naval Fuel Materials Facility (247F) Air Emission Sources and Controls

The recently completed Naval Fuel Materials Facility (FMF) converts enriched uranium hexafluoride (UF_6) into fuel material for naval reactor cores. The process will not be described in detail in this report, as many of the process steps and some of the raw materials used in the process are classified. The process emits small quantities of nitric, sulfuric, and hydrochloric acids; nitrogen oxides; ammonia; chlorine; and uranium from several stacks and vents. The FMF has dedicated scrubbing systems on various processes to control emissions of acids, ammonia, and particulate uranium; these are described in detail in the facility construction permit filed with the State (Du Pont, 1982b) and in Appendix G (Manci, 1987). The FMF emits regulated/hazardous constituents from the following three major emission points:

- o Main facility stack
- o Finishing vents
- o Waste treatment facility vents

Regulated/hazardous emissions are summarized in Table 3-7 (Du Pont, 1982b). The emissions are well controlled, and are not significant with respect to other air emissions sources at the site. The FMF will receive a final operating permit from the State upon completion of final testing. The permit is not expected to require the monitoring or reporting of emissions.

TABLE 3-7

NAVAL FUEL MATERIALS FACILITY
STACK AND VENT RELEASE RATES

FMF MAIN FACILITY STACK RELEASE RATES			WASTEWATER TREATMENT FACILITY VENT RELEASE RATES			FINISHING VENT RELEASE RATES		
Chemical	Average Flow Rate (q/hr)	Average Flow Rate (Lb/Hr)	Chemical	Average Flow Rate (q/hr)	Average Flow Rate (Lb/Hr)	Chemical	Average Flow Rate (q/hr)	Average Flow Rate (Lb/Hr)
NO ₂	200	4.4 x 10 ⁻¹	NH ₃	400	8.8 x 10 ⁻¹	HCL	20	4.5 x 10 ⁻³
H ₂ SO ₄	7.3 x 10 ⁻³	1.6 x 10 ⁻⁵	Long Chain Alcohol	1200	2.6	U	1.0 x 10 ⁻⁴	2.3 x 10 ⁻³
HNO ₃	7.3	1.6 x 10 ⁻²	Formaldehyde	54	1.2 x 10 ⁻¹			
Cl ₂	110	2.4 x 10 ⁻¹	AlF ₃	3.6 x 10 ⁻¹	7.9 x 10 ⁻⁴			
HCl	50	1.1 x 10 ⁻¹	Al(OH) ₃	3.6 x 10 ⁻¹	7.9 x 10 ⁻⁴			
SiF ₄	2	4.4 x 10 ⁻³	Al(NO ₃) ₃	3.3	7.2 x 10 ⁻³			
U	3.2 x 10 ⁻⁴	7.1 x 10 ⁻⁷	NaNO ₃	4.5	9.9 x 10 ⁻³			
CO	29	6.4 x 10 ⁻²	NaCl	6.8 x 10 ¹	1.5 x 10 ⁻¹			
CH ₃ OH	140	3.1 x 10 ⁻¹	U	3.0 x 10 ⁻⁴	6.6 x 10 ⁻⁷			
NH ₄ Cl	1.2 x 10 ⁻²	2.6 x 10 ⁻⁵						
NH ₃	300	6.6 x 10 ⁻¹						

Source: Du Pont, 1982b

Waste Management Tank Farms and Evaporators Air Emission Sources and Controls

There are two evaporators in each of the 200F and 200H Waste Management Areas. The evaporators are used to process radioactive liquid wastes generated by the process facilities to reduce the waste volume prior to storage in the 200F- and H-Area Tank Farms. The liquid waste is concentrated by evaporation of water from the waste using heat supplied by low-pressure steam. The waste is pumped into the evaporator vessel from a feed tank, and recirculated through a reboiler where heat is applied to the waste. The water vapor generated is recovered by a series of mist de-entrainers (bubble cap trays) and water-cooled condensers. The condenser exhausts to the main vessel vent and through HEPA filters to the atmosphere. The evaporator building ventilation system is exhausted through a separate HEPA filter unit to a stack.

The concentrated waste liquid is pumped from the evaporator to a storage tank, from which it is transferred to the Radioactive Waste Storage Tanks in the 200-Areas. The recovered evaporator condensate, which is contaminated with strontium, cesium, and other radionuclides and toxic metals including mercury, is disposed of as low-level radioactive liquid waste (LLW) in seepage basins. The low-pressure steam used to supply heat to the evaporator is also condensed to liquid. The steam condensate is generally nonradioactive.

Each evaporator has two stacks that are sources of both radiological and regulated/hazardous air emissions. These are:

- o Vessel vent - main process exhaust for evaporator/condenser system
- o Building exhaust - ventilation system exhaust for evaporator process areas

Radionuclide emissions from the evaporators and tank ventilation systems are discussed in Section 3.1.2.2.

Regulated/hazardous air emissions from the evaporators and tank farm ventilation systems have not been characterized. The liquid wastes in the H-Area Tank Farms contain mercury, which may be released to the environment through the tank ventilation systems and the evaporator vessel vents. As mentioned previously in the 200H-Area discussion, mercury is regulated as a hazardous air pollutant. Most

of the mercury used in the H-Area dissolution process is incorporated into the liquid waste from the process. The fresh (aged 6 months) waste contains approximately 0.5 g/L mercury hydroxide (DOE, 1982). This waste is concentrated in the evaporators, and mercury is recovered from the evaporator condensers in 1,000-gram bottles and returned to the process (Du Pont, 1980). Mercury recovery averages 17 liters per year (about 500 lb) from the 241-1H evaporator, and 3 (liters per year from the 242H evaporator. No mercury is recovered from either F-Area evaporator. The mercury recovery efficiency of the condensers is not known.

Mercury may also evaporate directly from the waste into the tank air space, and be exhausted to the atmosphere through the tank ventilation systems. The sludge solids stored in the tanks are approximately 1.6 weight percent mercury hydroxide. The potential for emissions of mercury from the tank ventilation systems other volatile regulated/hazardous substances from the tank farms and waste evaporators is not known.

Fuel and Target Fabrication Facility Air Emission Sources and Controls (300M-Area)

Uranium and lithium/aluminum alloy are extruded and machined into fuel elements and targets in the 313M-, 320M- and 321M-Buildings. Aluminum-clad depleted uranium targets are fabricated in Building 313M, enriched uranium/aluminum alloy fuel in 321M and lithium/aluminum targets in 320M. Major potential emissions and emission sources of regulated/hazardous air contaminants include nitrogen oxides and nitric acid fumes from acid etching, cleaning and plating operations, 1,1,1-trichloroethane vapors from vapor degreasers, and metal fumes from extrusion operations. Emissions of particulate uranium from 300M-Area facilities are discussed in Section 3.1.2.2.

Emissions of 1,1,1-trichloroethane from three vapor degreasers (one in each of 313M-, 320M-, and 321M-Buildings) are on the order of 200 tons/yr, based on facility purchasing records (Du Pont, 1987d). Evaporation of solvent from the degreasers is controlled by use of refrigerated condensers ("cold traps") and degreaser tank covers. Vapors from the degreasers are vented to the atmosphere through hood exhausts. Local ventilation of degreasers is required for worker

safety. Used solvent is recycled in a solvent still or in the degreaser and reused. The facility is pursuing a program to eliminate the use of 1,1,1-trichloroethane in the 300M-Area (Schuyler, 1986; Green, 1986).

Each of the vapor degreasers was inspected during the Survey. Ventilation of the degreasers is more than adequate for the purposes of worker protection, as both degreaser lip exhausts and hoods are used. However, at the time of inspection, covers were found to not be in place, and at least one of the cold traps was out of service. Both these situations can greatly increase the rate of solvent evaporation and thereby solvent emissions to the atmosphere. This is especially the case when a high degreaser ventilation exhaust rate is applied.

Vapor degreasers using trichloroethylene and perchloroethylene are subject to State regulation requiring the use of covers, cold traps, and/or other methods to minimize solvent emissions. Trichloroethane and several other solvents are not subject to these regulations because they are "exempt" solvents, meaning that they do not contribute to ambient ozone concentrations and photochemical reactions.

Nitric acid is used for metal cleaning and etching in both the uranium fuel element and uranium target processes (321M and 313M, respectively). Nitric acid and nitrogen oxide emissions from the 321M cleaning room are exhausted uncontrolled to a stack, and maximum emissions are estimated by the facility operators to be 8 lb/hr based on stack tests (Clayton Environmental, 1983b). Nitric acid and nitrogen oxides from the 313M plating line are presently uncontrolled. An automated plating line to be started up in early 1987 to replace the existing line is equipped with a water scrubber. Emissions from the final etching and core recovery processes are exhausted to a separate stack and controlled by a water scrubber. This scrubber suffers from corrosion problems, and is scheduled to be replaced. Maximum emissions are estimated by the operators to be 14 lb/hr based on stack tests (Clayton, 1983b). A diagram of the present 313M-Building ventilation system is included in Figure 3-4.

Nitrogen oxide emission limits are included in the facility operating permits for the 313M- and 312M-Building processes, and correspond to the maximum calculated emission rates of 14 lb/hr and 8 lb/hr, respectively. No credit is taken in the permit limitation for the scrubber efficiency of 50 percent. The actual maximum

FIGURE 3-4

300M-AREA BUILDING 313M VENTILATION/SCRUBBER SYSTEM

nitrogen oxide emissions from the 321M- and 313M-Building stacks were 7.94 lb/hr and 5.57 lb/hr, respectively. Average emissions were 2.6 lb/hr and 3.0 lb/hr (Clayton Environmental, 1983b). The facility is not required to monitor emissions or report them to the State. Nitrogen oxide emissions from the Fuel and Target Fabrication Facilities are low with respect to fuel-burning sources and Separations Facilities at the site, and contribute on the order of 20 tons/yr to the site nitrogen oxide inventory. Addition of the control system on the new plating line and replacement of the existing water scrubber will reduce emissions substantially from present levels.

Emissions of metal fumes may potentially arise from the extrusion of lithium/aluminum alloy and aluminum-clad uranium billets in the extrusion presses in Buildings 320M and 321M, respectively. A three to one mixture of oil and lead powder is used as a lubricant in extruding uranium billets. About nine quarts of leaded oil per day are used when the process is operating. Approximately 6 tons of lead were used in the process in 1985. Lead consumption was 4.5 tons in 1986 and 0.7 tons in the first five months of 1987. The leaded waste oil is stored in RCRA-permitted facilities. No lubricant is used in the lithium/aluminum extrusion process. The potential for emissions of lead, a regulated air pollutant, and other metal fumes to the atmosphere from the extrusion processes has not been assessed.

Both extrusion presses were observed in operation. The 320M Extrusion Press is not separately ventilated, and fumes from the process exhaust into the building ventilation system. Fumes were minimal during operation and barely visible. The 321M Extrusion Press is ventilated through a hood to a roof vent, which rises about 35 feet above the 321M-Building and has an exhaust rate of 12,000 CFM. Fumes from the extrusion process were visible, and may contain measurable amounts of lead from vaporization of the leaded oil lubricant. Industrial hygiene studies indicate that worker exposure to metal fumes from the 321M Extrusion Press are minimal, and not an occupational hazard. Lead concentrations were less than the detection limit of $5.3 \mu\text{g}/\text{m}^3$ in worker exposure tests (Wlornicki, 1985). The ambient air quality standard for lead is $1.5 \mu\text{g}/\text{m}^3$ (quarterly mean). New and modified sources that emit more than 1,200 lb/yr of lead are subject to additional regulatory requirements under the PSD regulations and are required to prepare an air quality impact assessment.

300M-Area Groundwater Treatment System (Air Stripper)

A groundwater treatment system, consisting of an air stripper column, and groundwater wells and associated pumps and piping, is located in the 300M-Area and has been in operation since 1985. Groundwater contaminated with chlorinated solvents (primarily trichloroethylene and perchloroethylene) is countercurrently contacted with air in a packed column, evaporating the solvents into the air stream. The cleaned water is pumped to a surface discharge point, and the solvent-laden air stream is exhausted uncontrolled to the atmosphere. The air stripper has a capacity of 400 gallons per minute (gpm) of groundwater, and emits approximately 7.9 lb/hr of chlorinated solvents to the atmosphere, roughly equivalent to 35 tons/yr (Boone, 1987a; Boone, 1987b). Solvent emissions are calculated from inlet and outlet water analyses, as these are more accurate than exhaust gas concentration measurements.

Both trichloroethylene and perchloroethylene are regulated by the State of South Carolina as VOCs and both are toxic substances. EPA has proposed to list both compounds as hazardous air pollutants under NESHAP. The State operating permit for the air stripper contains an emission limit of 7.9 lb/hr and 35 tons/yr. The State regulatory limit above which new sources of VOCs are required to prepare an air quality impact assessment is 40 tons/yr. The site may propose to operate the existing air stripper at a higher emission rate or may propose to add additional air strippers, at which time a permit revision and/or air quality impact analysis may be required by the State. A permit revision and air quality impact analysis may also be required if either organic compound is listed as a hazardous air pollutant by EPA. No data for ambient air concentrations of organic compounds in the 300-M Area are available.

Tritium Production Facility (200H-Area) Air Emission Sources and Controls

Lithium/aluminum alloy targets are irradiated in the reactors, where some of the lithium is converted to tritium. The tritium-containing targets are melted in a furnace in the 232H-Building where the tritium is released into the tritium separation process. The tritium is separated from other hydrogen isotopes and nonhydrogen gases and recovered as product in Building 232H. The tritium is packaged by a high-pressure process in Building 234H. The major potential

emissions and emission sources of regulated/hazardous air contaminants are mercury vapors from mercury-containing process pumps used to transport tritium and other gases through the process, and metal fumes from the target furnace. Emissions of tritium and tritium oxide from the Tritium Production Facility are discussed in Section 3.1.2.2.

Mercury pumps are presently used in tritium processes in both the 232H- and 234H-Buildings. These pumps release mercury into the process streams through volatilization and entrainment. Mercury is removed from various points in the process by gold-foil traps. Mercury forms an amalgam (alloy) with gold preferentially over other metals, and as mercury-containing gases are passed over cartridges of gold foil, the mercury is removed from the gas onto the foil. The gold traps function as process equipment, to remove mercury from the product. They are not, in the strict definition, emission control devices, although they do control mercury releases from the process. The efficiency of the traps has not been estimated. No controls are applied at the process stacks.

The Tritium Facility has the potential to emit significant quantities of mercury to the atmosphere. A proposed stack-testing program for the Tritium Facility stack emissions was not completed, and mercury emissions from the facility have not been characterized. Mercury is a toxic substance and is regulated as a hazardous air pollutant under NESHAP, and is also regulated under PSD regulations. Under the PSD regulations, new and modified sources that emit more than 200 lb/yr are subject to regulatory requirements and required to prepare an air quality impact assessment. Existing sources are not subject to these requirements. The NESHAP regulations are facility-specific and do not apply directly to the tritium production process. The tritium facility has the potential to emit more than 200 lb/yr of mercury, however, and although not a regulated source, the facility may be a significant source of emissions.

The site has initiated a mercury reduction program, and some mercury pumps have been replaced with oil diaphragm-type pumps, thereby reducing the inventory of mercury in process equipment, and the potential for mercury emissions. Potential emissions will be further reduced upon startup of the Replacement Tritium Facility (RTF), which will not use mercury-containing pumps. The RTF will entirely replace the high-pressure packaging process in Building 234H. The State of South

Carolina has advised the SRP that the RTF will not require any air emissions permits from the State for regulated/hazardous emissions (with the exception of the diesel generators associated with the facility) as regulated/hazardous emissions from the facility are minimal (Hoisington, 1987; Guidry, 1986). A permit for radionuclide emissions under NESHAP is being prepared.

200S-Area Air Emission Sources and Controls

200S-Area is the future site of the Defense Waste Processing Facility (DWPF). A concrete batch plant (270 yd³/hr) is located in 200S-Area to provide concrete for the construction effort. The batch plant was cited by EPA during a 1986 inspection for failure to meet the State opacity limit of 40 percent for stack and fugitive emissions (EPA, 1986a). The opacity excursions were caused by operation of the pressure-relief vent on the cement storage silo, which emits directly to the atmosphere. The increased pressure was caused by blinding of the filter bags in the cement silo baghouse, which is the primary control system for particulate emissions from the facility. The bags have since been replaced, and additional controls have been applied to bring the batch plant into compliance with the opacity standard.

TNX Facilities (600-Area) Air Emission Sources and Controls

The TNX Facility provides process development support to the SRP, primarily at present in the area of radioactive waste management. Most of the work in progress at TNX is in support of the DWPF. Support services are also provided for the H-Area Effluent Treatment Facility (ETF) and for the F- and H-Area Separations processes. Major development groups at TNX include the following:

- o Defense Waste Processing Technology Group (DWPT)
- o Actinide Technology Division (ATD)
- o Interim Waste Technology Group (IWT)

The DWPT Group has been responsible for the development of processes in support of the DWPF. The development processes at TNX use simulated waste materials obtained from vendors, which do not contain radioactive materials. The in-tank precipitation process will remove cesium, strontium, and plutonium from

radioactive salt solutions by the addition of tetraphenyl borate and sodium titanate. The Precipitate Hydrolysis Experimental Facility (PHEF) in Building 682T separates simulated precipitated waste material, which is a salt solution containing tetraphenyl borate, benzene, mercury, and other constituents, into aqueous and organic fractions. The organic fraction, containing approximately 90 percent benzene, is transferred off the site for incineration. The aqueous fraction becomes the feed to the Slurry Receipt Adjustment Tank (SRAT) and Slurry Mix Evaporator (SME) in Building 672T. In the SRAT, formic acid is added to the aqueous stream to reduce mercury and other metals. The aqueous stream is combined with simulated sludge after which the mixture is concentrated by evaporation which volatilizes the mercury in the mixture. The overhead stream containing mercury is processed in the Organic Removal Demonstration Plant (ORDP). The salt concentrate is fed to the SME, where it is further concentrated and mixed with glass frit to create feed for the scale melter in Building 675-T.

The PHEF emits benzene to the atmosphere from tanks and process equipment which process simulated wastes containing benzene and tetraphenyl borate. The benzene emissions from the facility are subject to a State permit limit of 1.6 lb/hr as an annual average. Process tanks are required to be controlled by condensers which maintain a maximum temperature of 59°F. The temperature of the condensers is monitored by temperature gauges. The permit conditions do not require the facility to monitor benzene emissions or report them to the State, so no emissions data are available.

Actual sludge wastes stored at the SRP contain approximately 1.6 percent by weight mercury hydroxide (DOE, 1982). The PHEF and SRAT/SME process simulated wastes containing mercury, and can potentially emit mercury to the atmosphere. The State operating permit for the PHEF does not regulate mercury emissions from the process. Potential emissions of mercury from process tanks will be controlled by the condensers used to control benzene emissions.

The scale melter, located in Building 675T, converts the prepared feed from the SRAT/SME to molten glass. The mixture of glass frit and simulated waste is heated in a glass furnace and transferred to stainless-steel canisters by a vacuum pan technique. The filled canisters are blasted with glass frit to remove external contamination. The used frit is collected and returned to the feed preparation system and added to the glass melter.

The nature of the glass melter process requires a complex and highly efficient offgas treatment system. The full-scale melter, to be constructed as part of the DWPF, will process actual wastes containing plutonium, strontium, cesium, and other radionuclides, rather than the simulated wastes being processed at the TNX scale melter. The scale melter offgas system consists of a quench unit, steam atomized scrubbers and condensers, high-efficiency mist eliminator, and HEPA filter. Mercury, which is not solidified in the glass process, is removed in the condensers and reused. The estimated particulate removal efficiency for the scale melter offgas system is $(1-8/10^9) \times 100$ percent (Allen, no date). The mercury removal efficiency is estimated to be 99 percent (DOE, 1982).

The scale melter emits benzene and other organics to the atmosphere through the off gas system. The State of South Carolina is presently in the process of writing an operating permit for the DWPF melter system at TNX (Dunaway, 1987). It is expected that benzene and possibly mercury emissions will be regulated, but it is not known what emission limits will be assigned. Particulate emissions from the facility are not significant, as the particulate removal efficiency of the offgas system is very high. The potential for mercury emissions from the scale melter is not high, both because of the low concentration of mercury in the waste and low process throughout, and because of the offgas system efficiency. The full-scale DWPF, however, having much higher throughput than the TNX system, has the potential to emit greater than 800 lb/yr of mercury to the atmosphere, based on operation 8,000 hr/yr (DOE, 1982).

The IWT Group operates a test incinerator (referred to as the SHIRCO Incinerator), which provides operating information to be used in design of a full-scale alpha radioactive waste incinerator and/or full-scale hazardous solid waste incinerator. The test incinerator presently burns shredded cellulose and plastic waste, which does not contain radioactive materials. The heat source for the primary and secondary combustion chambers of the incinerator is electric heating elements; fuel is not burned in significant quantities. Particulate emissions from the test incinerator are controlled by a coated metal prefilter and three banks of HEPA filters, as would be the case for a full-scale incinerator burning alpha radioactive waste. The incinerator is permitted by the State of South Carolina, and is restricted to a total waste feed rate of 20 lb/hr. The opacity of the exhaust is limited to 20 percent under the permit conditions. The permit does not limit the

type of plastic waste burned, nor does it contain any limits on HCL emissions. Particulate emissions from the incinerator are insignificant. Emissions of HCL have not been characterized, but are not expected to be significant, considering the waste throughput limitation of 20 lb/hr.

The test incinerator or a larger, full-scale unit may be installed in one of the SRP production areas in the future. At that time a modification of the permit may be required by the State, which may include limits on HCL emissions as well as opacity limitations.

The ATD Group supports the separations processes at the SRP and operates a facility that tests process equipment for F- and H-Areas. This facility, located in Building 677T, is presently on standby. Process equipment is tested using depleted uranium solutions, nitric and formic acid, organic solvents (including benzene) and other chemicals, and the operations emit small quantities of these to the atmosphere. The facility and associated laboratory hoods and chemical storage tanks are vented through ducts and fans to a central 50-foot stack. The stack exhaust was tested in 1984, when the ATD facility was operating, to determine the emissions of depleted uranium, nitric and formic acids, and benzene (Entropy Environmentalists, 1984). Emission data are summarized below:

<u>Constituent</u>	<u>Average Emissions</u>
Formic Acid	<0.3 lb/hr
Nitric Acid	<0.037 lb/hr
Depleted Uranium	<0.00074 lb/hr
Benzene	<0.022 lb/hr

The emissions from the TNX 50-foot stack are not presently covered by any State permit, and no emission limits apply to the ATD facilities. At the time the facility resumes operation, a permit may be required by the State.

Savannah River Laboratory (700A Area)

Regulated/hazardous emissions from Savannah River Laboratory (SRL) were not assessed in detail during the Survey. No data are available concerning regulated/hazardous emissions from the laboratories. According to SRP, emissions

are not expected to be large, based on facility operations. The site has initiated a site-wide air emission inventory study which is expected to be completed in 1988.

3.1.2.2 Radionuclide Air Emissions and Controls

Tritium and Tritium Oxide Air Emission Sources and Controls

Tritium and tritium oxide emissions to the atmosphere are the predominant radionuclide releases from the site. According to site dose calculations, atmospheric emissions of tritium oxide account for the major portion of the maximum individual off-site dose of 0.90 mrem from SRP atmospheric sources. Molecular tritium is not readily absorbed into the environment, and routine releases do not represent a significant portion of the total dose (Zeigler et al., 1986). The off-site dose from routine atmospheric releases is approximately 1 percent of the DOE derived concentration guide (dose limit) of 100 mrem/yr and 4 percent of the EPA NESHAP standard of 25 mrem/yr. Accidental releases have resulted in a maximum dose of approximately 1 percent of the dose limit (Zeigler et al., 1985).

Approximately 50 percent of the tritium oxides released to the atmosphere are emitted from the C-, K-, L- and P-Reactors, the remaining 50 percent are emitted primarily from H-Area sources. Sources of atmospheric tritium oxide emissions include the Tritium Production Facility (232/4/8H), the Heavy-Water Rework Facility (420D), the reactor disassembly and seepage basins (through evaporation), and the Receiving Basin for Off-Site Fuels (RBOF) Facility (244H). Total atmospheric emissions of tritium oxides in 1985 were approximately 500,000 curies. In addition, 180,000 curies of molecular tritium were emitted, primarily from the Tritium Production Facility.

Removal of low concentrations of tritium oxides from exhaust gases is technologically difficult. Ethylene glycol scrubbers or recombiner/condenser systems can be used to remove tritiated water from exhaust gases, but are costly at low concentrations. No such systems have been applied to tritium sources at SRP. Tritium emissions from reactor stacks at the SRP are controlled by moisture separators. Emissions from the reactors and from tritium facilities are controlled by administrative procedures, work practices, and control of process equipment and

operating parameters. Technologies for the removal of tritium from reactor heavy-water moderator, which reduce evaporative losses, have been developed and applied to commercial facilities in Canada and Europe (IAEA, 1981). Similar systems have been considered for use at the SRP, but have not been applied, as cost-benefit analysis by SRP has not shown them to be cost effective (Dukes and Benjamin, 1982).

L-, P-, and K-Reactors

Tritium oxides, natural (light) water, and corrosion products/fission products accumulate in the deuterium oxide (heavy water) reactor moderator over time through various nuclear reactions, corrosion of process equipment, and fuel failures. Light water and corrosion products degrade the quality of the moderator, and tritium oxides and fission products increase its activity. A sidestream from the recirculated moderator is purified by filtration and ion exchange, which removes solids and corrosion and fission products. Some of the moderator sidestream is distilled to remove light water. No facilities are presently in place to remove tritium from the moderator.

Fuel and target assemblies are removed from the reactor by the discharge machine, which draws the assemblies onto a deposit and exit conveyor located in a water-filled canal. The discharge machine can be cooled by either heavy or light water. The assemblies are stored in a water-filled disassembly basin at each reactor, and are rinsed in the discharge machine to limit the amount of activity transferred to the disassembly basin. Rinsewater is collected and distilled in the Heavy-Water Rework Facility (420D). Some tritium and fission products enter the disassembly basin with the irradiated fuel and target elements. The tritium and fission product concentration of the disassembly basin water is controlled by periodically discharging some of the water to the reactor seepage basins and adding fresh water to the basins.

Atmospheric emissions of tritium arise from the evaporation of tritiated moderator into the reactor ventilation system, and from the reactor disassembly basins and seepage basins. Approximately 30 percent of the seepage basin tritium inventory evaporates, based on equations in Horton et al. (1971). The amount of tritium evaporated from the seepage basins is calculated from the liquid effluent

concentration and flow rate. Evaporation of tritium from the seepage basins is a fugitive emission source, and is not subject to process or administrative controls. Emissions from reactor and disassembly ventilation systems are directly related to the concentration of tritium in the moderator, and the amount of moderator lost to the systems.* Emissions of tritium oxide to the reactor ventilation system are controlled by moisture separators, which recover evaporated reactor moderator. Evaporation from the disassembly basins is not controlled.

The disassembly basin areas are not ventilated through stacks, as are the reactor areas, but through multipoint building exhaust systems. Tritium releases are estimated from tritium concentrations monitored in the air in the disassembly basin area and supply fan rates, and large errors may result from inaccurate flow estimation (Zeigler, 1986). A ventilation improvement program is in progress, which will replace existing fans and increase the ventilation rates from the disassembly areas.

The reactor areas have the potential for accidental (nonroutine) tritium releases in the event of a moderator spill or leak.

Tritium Production Facility

The Tritium Production Facility emits tritium from process operations in 232H, 234H-, and 238H-Buildings, and has the potential for accidental (nonroutine) tritium releases, primarily due to maintenance operations on tritium-containing process equipment. The majority of releases occur from the 232H-Building and 234H-Building, which contain the Tritium Production and Packaging Facilities, respectively. The 238H-Building contains the Tritium Recovery Facility and is a smaller source of tritium emissions.

* Note that L-Reactor was started up with fresh moderator containing no tritium. Tritium concentration in the L-Reactor moderator is therefore lower than that of the other reactors, and the tritium emissions will take several years to reach equilibrium levels. (DOE, 1984).

Tritium is produced from lithium/aluminum targets that are irradiated in the reactors. The lithium is converted to tritium by absorption of a neutron and subsequent alpha decay. The tritium-containing targets are melted in a vacuum furnace in the 232H-Building. The melting process releases the tritium, which is contaminated with other isotopes of hydrogen and inert gases (argon, helium). Hydrogen isotopes are separated from inert gases in a palladium diffuser, and hydrogen isotopes are separated from each other in a thermal diffuser. Tritiated water is decomposed to hydrogen and oxygen in zeolite, uranium, and magnesium beds located throughout the process. Cryogenic distillation systems are used as a final separation process to separate hydrogen isotopes from each other and produce tritium, which is transferred to the 234H-Building for packaging.

Tritium and deuterium are mixed to specified concentrations in the 234H-Building and compressed and loaded into reservoirs. Reservoirs in field service for a number of years are routinely returned and unloaded. The tritium is reprocessed in a palladium diffuser to remove helium (a decay product) and reused or transferred to the 232H-Building for further reprocessing. Connections between the reservoir and loading manifold are leak tested with argon gas containing tritium. Process lines and equipment are evacuated and filled with argon before being disconnected. Waste gases are passed through catalyst and zeolite beds to recover tritium as tritium oxide. The zeolite beds are regenerated in Building 232H. Catalyst beds are replaced or regenerated using atmospheric air.

Emissions of tritium to the atmosphere occur from both routine process and fugitive sources and accidental releases. Process and fugitive sources include the lithium/aluminum target furnace ventilation system, the cryogenic distillation and stripping processes, and building losses (e.g., releases from lines and gaskets). The major cause of accidental releases is maintenance operations which require opening pumps, process lines, and other equipment, which may contain tritium. Failure of high-pressure lines in the 234H reservoir loading process is also a potential source of accidental releases. Tritium oxide spills may be allowed to evaporate rather than be collected, to reduce the worker exposure hazard. These emissions would be vented to the building ventilation system and then to the process stacks.

The Tritium Production Facility has made significant modifications to processes and procedures in the 232H- and 234H-Buildings to reduce routine and accidental releases and worker exposure. The target furnace has been isolated with an inert

gas-filled hood, which limits furnace charge and discharge losses. Sensitive pressure sensors have been installed to detect the presence of water in process lines. The lines can then be flushed with argon to remove the water before maintenance activities begin, reducing the tritium losses and exposure hazard. The purge gas is vented to a stripper for recovery of tritium. The Tritium Production Facility has also improved storage procedures for tritiated oil, reducing emissions of tritium by about 500 Ci/day. These and other modifications have resulted in a reduction in tritium losses from the 232H-Building of about 50 percent after March 1986.

The 234H-Building process has a greater potential for a large, short-term tritium release because of the higher operating pressure of the loading process. In response to one such release in 1974, a hold tank was installed to provide the capability of diverting highly contaminated stack gas back into the process. Other systems are in place to provide the capability for diversion of high-pressure gas to a hold tank in the event of a line failure. Loading manifolds are hooded and the reservoirs returned from the field are emptied in bell jars to provide secondary containment of any releases that may occur.

The process and procedure modifications at the Tritium Production Facility resulted in a significant reduction in both routine and accidental releases in 1986 over 1985 and previous years. Total releases of tritium from the facility in 1986 were approximately 242,000 curies, about 70 percent of the facility annual release guide for 1986 of 345,000 curies.* The 1987 release guide establishes an objective release of 295,000 curies and is based on expected production (lower than 1986) and maintenance activity and process improvements. The Tritium Production Facility exceeded its annual release guide in each year from 1981 to 1985, in part because of accidental releases, and a total of 375,000 curies were released during 1985 (Zeigler et al., 1986). In 1985 three accidental releases resulted in emissions of about 35,000 curies of tritium to the atmosphere (Zeigler et al., 1986). In 1984 several accidental releases, including one release over 50,000 curies, totaled about 100,000 curies (Zeigler et al., 1985). The largest accidental release in 1986 was 3,500 curies. The SRP is required by DOE to report releases greater than 10,000 Ci/day.

* The tritium release guide and the reported emissions of tritium include all tritium sources in H-Area (the Tritium Production Facility, the Separations Facility and the receiving basin for off-site fuels). Tritium emissions from the Tritium Production Facility represent the major portion of the tritium releases from H-Area.

The 232H-Building has two 200-foot stacks, the 234H- and 238H-Buildings each have one 200-foot stack. The 232H and 234H stacks are equipped with Kanne chambers and tritium form monitors to determine the concentrations of molecular tritium and tritium oxide in the exhaust gases. Exhaust gas from the 238H-Building is assumed to be in the oxide form. Stacks are sampled at the 50-foot level with the exception of the 234H Stack. In this stack, samples are drawn from the two exhaust plenums at the base of the stack (a sample line at the 50-foot level was damaged during construction work and has not been replaced). Stack flows are not routinely measured, which results in uncertainty in estimated tritium release rates. The estimated release rate from the 234H Stack may also be inaccurate because samples from both exhaust plenums are drawn to a single tritium monitor, and the exhaust rates in the two plenums are not routinely measured.

Separations Facilities (221H/221F)

Small amounts of tritium are released from the Separations Areas during fuel and target reprocessing. Emissions are not monitored, but are calculated based on the irradiation history of the fuel. Releases of tritium from the Separations Facilities are included in the annual release guide for the Tritium Production Facility.

Waste Tank Farms and Evaporators (241/2H 241/2F)

The storage and treatment of high-level wastes (HLW) from the process facilities occurs in the waste management areas of the 200F- and 200H-Areas. These areas contain a total of 51 underground waste storage tanks in two farms (241F and 241H), located in F- and H-Areas, respectively. Each tank farm area contains two evaporators (242F, 241-16F and 242H, 242-16H, respectively). There are four basic types (I, II, III, IV) of HLW storage tanks. All tanks except eight uncooled type-IV tanks have an annular area between the steel tank and concrete vault that is ventilated. The tank ventilation systems are sources of both radionuclide and regulated/hazardous emissions.

Separate ventilation systems are provided in the waste tanks for the annulus and the vapor space above the waste. A demister and HEPA filter are provided on the vapor space exhaust. Provisions have been made for adding HEPA filters on the

annulus exhausts, if necessary, and in the case of tanks that have leaked, this has been done. Both exhausts are monitored for particulates and radiolodine. Tritium oxide vapor is released from the tanks in the vapor space exhaust. It is not routinely measured. A review conducted by the SRP Health Protection (HP) Department in 1983 of the 11 tanks most likely to contain tritium indicated that the annual tritium releases to the atmosphere from the tank farms are less than 100 Ci/yr (Zeigler, 1986).

The tank farm evaporators are steam heated and operate at atmospheric pressure. An integrally mounted, three-tray, dry bubble-cap column provides de-entrainment of suspended concentrate droplets from the effluent vapor stream. The vapor is condensed in a water-cooled condenser that is vented through a filter to the atmosphere. The 242-16F and 242-16H Evaporators have wire-mesh separator pads in addition to the bubble caps to improve de-entrainment.

Condensate from the evaporator is monitored continuously for radioactive carryover by a gamma monitor. If the radioactivity level exceeds a pre-set reading, the condensate is diverted to a waste storage tank; otherwise, the condensate is pumped through a cesium-removal column to reduce the Cs-137 content, analyzed and then pumped to a seepage basin, or returned to a waste tank for reprocessing.

Receiving Basin for Off-Site Fuels Facility (244H)

The RBOF Facility receives and stores fuel elements and targets in a water filled basin. Ion exchange resins from the process areas are also regenerated at this facility. Storage and handling of target elements result in small releases of tritium to the building exhaust and process vessel vent; targets are generally handled twice per week and emissions of tritium are therefore sporadic in nature. The tritium concentration of the exhausts is monitored with Kanne chambers. Rated fan capacities, estimated to be approximately 15 percent higher than actual flows, are used to calculate release rates. Releases of tritium from the RBOF Facility are included in the annual (Emissions) release guide for the Tritium Production Facility.

Beta/Gamma Radioactive Waste Incinerator (230H)

Low-level tritiated waste oil generated in the Tritium Facility is burned as auxillary fuel in the Beta/Gamma Incinerator (BGI) when solid wastes are being incinerated. The maximum concentration of tritium in the waste oil burned in the BGI is 0.05 $\mu\text{Ci/ml}$. A tritium monitoring system is scheduled to be installed on the BGI stack in 1987, at which time incineration of tritiated waste oil of higher concentration generated in the Reactor Areas and presently stored at the burial ground may be allowed. The 1987 annual release guide for the incinerator is 22 Ci/yr of tritium.

Heavy-Water Rework Area (400D)

The Heavy-Water Rework Area consists of the Rework Facility (420D), Drum Wash and Storage Building (421-2D), and Laboratory (772D). The 420D Rework Facility receives diluted heavy water (HW) from on- and off-site users and upgrades (concentrates) the HW by separation of the light water (H_2O) and HW (D_2O) by a distillation process. Most of the HW received is contaminated with tritium oxide (HTO or T_2O) of 100 $\mu\text{Ci/ml}$ or greater. The HW is received in 55-gallon drums and the drums are decontaminated in the Drum Wash Facility and Storage Building (421-2D). Analyses of various process and effluent samples for the 400-Area and/or the Reactor Areas are analyzed at the 772D laboratory.

Tritium releases to the atmosphere result from normal process operations and evaporation of contaminated liquids through the ventilation systems. Tritiated HW evaporated from leaks is released to the atmosphere through a 70 foot stack. Exhaust vapors from tanks and drums pass through an ammonia cooled condenser; they are then vented into the exhaust stack. The concentration of tritium releases is monitored continuously with Kanne chambers. Dehumidifiers are used to collect daily samples, which are analyzed for tritium at the 772D laboratory. Rated fan capacities are used to calculate release rates.

The atmospheric tritium releases for 1985 were split nearly evenly between the three facilities and totaled 1,960 curies as compared to the 1985 release guide of 3,600 curies.

Noble Gas Air Emission Sources and Controls

Sources of noble gases in stack effluents are the reactor facilities and separations facilities. The major gas in effluents is krypton-85, which is produced by the fission process during reactor operation. Smaller quantities of Kr-85m, Kr-87, and Kr-88 are produced by the sample process. Xenons (Xe-131m, Xe-133, and Xe-135) are also fission product noble gases. Argon-41 is an activation product, produced through neutron capture by stable argon in Reactor Facility air. As a result of their inert chemical nature, the noble gases produced in the fuel elements slowly migrate out of the fuel elements and enter reactor moderator and eventually the air surrounding the reactor core. Both the fission product and activation product gases are then exhausted through the Reactor Building ventilation systems.

During dissolving of irradiated fuel elements, residual noble gases are liberated. Because of the cooling time allowed between removal from the reactor and the separations process, the gases with shorter half-lives decay to negligible levels before release, leaving only Kr-85 and Xe-133. These gases are released through the Separations Building exhausts (291F and 291H Stacks).

The inert nature of noble gases precludes their removal from effluent streams, except by costly techniques such as cryogenic freezeout. This technology is not practical for handling large effluent volumes. Considering the relatively low population doses associated with noble gas releases and the difficulties and costs inherent in removal of inert gases from air streams, no special exhaust effluent treatment or control procedures are applied to the noble gas radionuclides.

Other Gas and Vapor Emissions Sources and Controls

The fission process creates several isotopes of iodine (I-129 and I-131), which exist in vapor form at ambient (room) temperature, and ruthenium (Ru-103 and Ru-106), which may be present in vapor form at slightly elevated temperatures. In addition, neutron capture by stable nitrogen and oxygen in reactor components (primarily the moderator) and the air blanket surrounding the reactor tank produces C-14. This radionuclide may be present in various forms, including gaseous CO₂. These radionuclides (iodines, rutheniums, and C-14) are the only gaseous and vapor emissions of radiological significance other than tritium and the noble gases.

During reactor operations, small amounts of the generated iodine and ruthenium fission products escape from defects in the fuel elements and portions may enter the Reactor Building atmosphere. As the ruthenium isotopes will be in particulate form under the air temperature conditions normally present in this area, I-129 and I-131 are the only gaseous fission products of significance (particulate ruthenium is removed by HEPA filters). To remove iodine from the Reactor Building stack effluents, the exhaust ventilation systems have been equipped with carbon filters. These filters remove all but a very small fraction (5×10^{-5}) of the iodine present in Reactor Building air effluents. As a result of the relatively small amounts of C-14 generated, there are no control systems in place to remove $^{14}\text{CO}_2$ from exhausted Reactor Building air. Sampling of discharges of this radionuclide is not performed; the annual releases of C-14 from the reactor facilities are calculated, based on design and operating parameters of each specific reactor.

In the F- and H-Area Separations Facilities, the irradiated reactor fuel and target elements are dissolved in nitric acid to separate and recover the desired uranium and transuranic (TRU) products. Lithium-aluminum targets are melted in a furnace to recover tritium. These processes liberate the residual iodine, ruthenium, and C-14 (most of the I-131 decays during the fuel cooling period). Gases and vapors of these radionuclides will be generated in the dissolving process, primarily in the F-Area, where enriched fuel is dissolved. The exhaust from the dissolving process is equipped with a silver nitrate absorber for iodine vapor control and a fiberglass particulate filter. In the F-Area, there is also a uranium denitrator/acid recovery process, which has the potential for iodine releases; this system has no additional effluent controls. Both F- and H-Areas have recycle vessel vents, sumps, and chemical feeds, which are exhausted through fiberglass filters. Exhausts from the dissolver, denitrator/acid recovery, recycle vessel vents, sumps, and chemical feeds are discharged through 200-foot stacks.

Ruthenium 103 and 106 may be released as vapors through the same system as described above for iodine. Because of the 39.5-day half-life of Ru-103, most of this radionuclide decays during the fuel cooling time before separations processes are initiated. There are no control systems on the F- and H-Area exhausts specifically intended to remove ruthenium vapors; however, unless the temperature of the discharged gases remains sufficiently elevated, the ruthenium will be in particulate form and will be removed by the particulate filtering systems.

There are no controls to remove radioactive carbon dioxide from separations areas exhaust streams or to monitor the release of the gas. Releases of C-14 are calculated based on target fuel radiation history and annual throughput.

Particulate Sources and Controls

Essentially all operations at the SRP that involve processing of radioactive materials have a potential for generating airborne particulate contamination. These radioactive particulates include fission products, activation products, unirradiated fuel and target material (uranium), and TRU. The various operations that generate these contaminants and the systems used to control stack releases to the environment are discussed in this section.

M-Area

This area fabricates enriched uranium/aluminum (U/Al) alloy reactor fuel and depleted uranium metal targets for use in the SRP production reactors. Enriched uranium operations, conducted in the 321M-Building, include furnace casting, machining, extrusion, and cleaning of U/Al billets. All processes in this building that have potential for generating airborne particulates are filtered through HEPA filters; some operations are also equipped with chip collectors or prefilters at the work area.

In the 313M-Building, depleted uranium cores are canned in aluminum for use as target elements in the production reactors. There is also an autoclave pressure test facility for the finished elements. Only the autoclave test operation has been found to generate significant airborne activity in 313M-Building exhausts. There are no air filtration or cleaning systems in use to remove radioactive particulates from air effluents from this building. A new radioactive waste compactor facility has recently been added to this building. The compactor exhaust is equipped with HEPA filtration.

Building 322M is the Metallurgical Laboratory. Test specimens from other M-Area operations and some irradiated material are examined in this building. Exhaust air is filtered through HEPA filters before discharge.

Reactor Areas

The fission process results in generation of a variety of fission products within the reactor fuel and target assemblies, activation products within reactor components, and other materials in the immediate vicinity of the reactor core, including the air blanket. A small fraction of the particulate fission and activation products generated, uranium fuel and target material, and TRU (Pu-238 and Pu-239) generated within the fuel and target material become airborne during reactor operation and handling of irradiated assemblies. Removal of the particulates from the reactor process building air effluent is accomplished by demisters and HEPA filters. Because of the low potential for airborne particulate contamination in the disassembly-basin area, the exhaust from this area is not treated to remove particulates. Monitoring has indicated that only very low levels of U-234, U-238, and Pu-238 particulates are normally detectable in reactor stack discharges (Zeigler et al., 1986).

3.1.3 Environmental Monitoring Program

3.1.3.1 Regulated/Hazardous (Criteria) Pollutant Ambient Air Quality Monitoring Program

Six ambient air quality monitoring stations are operated on the plant site by Zedek Corporation, a private contractor. These stations monitor for nitrogen oxides (NO_x) sulfur dioxide (SO_2), ozone* (O_3) and total suspended particulates (TSP). The locations of the monitoring stations are illustrated in Figure 3-5 (Zedek Corporation, 1986a). The stations monitor for different constituents as follows:

STATION	NO_x	SO_2	O_3	TSP
614-36G	NO_x	SO_2	O_3	TSP
**614-37G		SO_2		
614-38G	NO_x			TSP
614-39G	NO_x	SO_2	O_3	TSP
614-40G	NO_x	SO_2		TSP
614-41G	NO_x			TSP

* Ozone concentrations are related to the amount of nitrogen oxides and volatile hydrocarbons in the ambient air.

** Station 614-37G is inside the 400D-Area perimeter fence and was originally installed to monitor SO_2 and H_2S concentrations from the now shut down deuterium oxide process. The station is not considered a PSD station because of its location.

AMBIENT AIR QUALITY MONITORING STATION LOCATIONS FIGURE 3-5

The purpose of the ambient Air Quality Monitoring Program is to provide the site with current air quality data and to provide pre-construction monitoring data which would be required if the site is required to obtain a PSD permit for a new or modified facility.

The station equipment includes continuous NO_x , SO_2 , and O_3 analyzers. All stations except 614-37G have co-located standard "Hi Vol" total particulate samplers. Data from the continuous analyzers are recorded on a strip chart and a data logger at 5-minute intervals. The total particulate samplers are operated for 24 hours every 6 days as required by PSD monitoring procedures. Filters are collected and weighed at an off-site facility. Each continuous analyzer is automatically calibrated using certified calibration gas, and each is calibrated by the station operator each quarter. Quarterly Quality Assurance audits are conducted by Zedek Corporation and by the State. The SRP participates in a voluntary EPA audit program for the particulate samplers. Data summaries are sent to the State of South Carolina quarterly, and to the State of Georgia annually.

Three of the six monitoring stations (614-38G, 614-39G, and 614-41G) were visited during the Survey, and equipment condition, data collection, and QA procedures were found to be satisfactory.

On-site ambient air quality data for 1985 are summarized in Table 3-8 (Zeigler et al., 1986), and summaries for the second and third quarters of 1986 are included in Tables 3-9 and 3-10 (Zedek Corporation, 1986a; 1986b). Ambient concentrations of NO_x , SO_2 , and particulates are shown to be well below applicable standards. Concentrations of ozone, however, were higher than the annual standard of 120 ppb on one day in 1985 and also in 1982 and 1983 (Ashley et al., 1985). This is not a violation of the State Air Quality Standard for ozone. Exceedance of the standard for 1 day each year is allowed by regulations. According to the site, the State of South Carolina has also recorded high ozone concentrations at an off-site monitoring station.

High concentrations of ozone are generally the result of sources of ozone-generating volatile hydrocarbons. The SRP has several sources of emissions of hydrocarbons, including the groundwater stripper, the laboratories, fuel storage facilities and on-site vehicles. High ozone concentrations have been attributed by

TABLE 3-8
ON-SITE AMBIENT AIR CONCENTRATIONS

Pollutant	Quarter	EPA Measuring Interval	EPA Ambient Air Standard	SRP Measuring interval	Ambient Air Concentrations ^a					
					36G	37G	38G	39G	40G	41G
SO ₂ (ppb)	1st	3 hr	500	3 hr	25	230	---	20	114	---
		24 hr	140	24 hr	13	43	---	10	49	---
		Annual	50	Quarterly	4	5	---	23	63	---
	2nd	3 hr	500	3 hr	23	142	---	26	64	---
		24 hr	140	24 hr	8	24	---	9	27	---
		Annual	50	Quarterly	1	3	---	2	2	---
	3rd	3 hr	500	3 hr	25	35	---	19	33	---
		24 hr	140	24 hr	4	6	---	4	9	---
		Annual	50	Quarterly	0	1	---	0	---	---
	4th	3 hr	500	3 hr	25	35	---	25	54	---
		24 hr	140	24 hr	10	9	---	9	11	---
		Annual	50	Quarterly	1	---	---	2	2	---
Ozone (ppb)	1st	1 hr	120	1 hr	82	---	---	77	---	---
	2nd	1 hr	120	1 hr	103	---	---	121	---	---
	3rd	1 hr	120	1 hr	113	---	---	119	---	---
	4th	1 hr	120	1 hr	59	---	---	60	---	---
	Annual	1 hr	120	1 hr	---	---	---	---	---	---
NO ₂ (ppb) ^b	1st	Annual	30	Quarterly	4	---	5	5	5	4
	2nd	Annual	30	Quarterly	3	---	2	1	3	2
	3rd	Annual	30	Quarterly	2	---	1	1	1	0
	4th	Annual	30	Quarterly	3	---	3	3	2	2
Total Suspended Solids (ug/m ³)	1st	24 hr	250	24 hr	100	---	100	66	47	62
		QGM ^c		QGM ^c	33	---	27	29	30	33
	2nd	24 hr	250	24 hr	43	---	57	42	39	55
		QGM ^c		QGM ^c	31	---	34	28	28	30
	3rd	24 hr	250	24 hr	48	---	55	48	41	52
		QGM ^c		QGM ^c	30	---	30	26	29	29
	4th	24 hr	250	24 hr	29	---	32	26	25	27
		QGM ^c		QGM ^c	19	---	21	18	17	19

^a 1, 3 and 24 hr values are maximum values, quarterly values are averages

^b Specific data for NO and NO_x was discontinued because necessary data can be obtained from the NO₂ measurements.

^c Quarterly Geometric Mean.

--- No measurements taken.

Source: Zeigler et al., 1986b

TABLE 3-9
AMBIENT AIR QUALITY DATA SUMMARY FOR THE PERIOD APRIL TO JUNE 1986

Station	Parameter	Units	Avg.	EPA Std.	Hourly Max.	EPA Std.	Occurred	24 HR Max.	EPA Std.	Occurred	3 HR Max.	EPA Std.	Occurred
36G	NO ₂	ppb	2	30	--	--	--	--	--	--	--	--	--
36G	SO ₂	ppb	1	50	--	--	--	9	140	4/11	27	500	4/3 R:11
36G	O ₃	ppb	--	--	82	120	6/16 R:01	--	--	--	--	--	--
36G	TSP	pg/m ³	44.3	60	--	--	--	74.9	250	4/08	--	--	--
37G	SO ₂	ppb	3	50	--	--	--	12	140	6/24	40	500	4/12 R:13
38G	NO ₂	ppb	2	30	--	--	--	--	--	--	--	--	--
38G	TSP	pg/m ³	46.4	60	--	--	--	77.2	250	6/07	--	--	--
39G	NO ₂	ppb	2	30	--	--	--	--	--	--	--	--	--
39G	SO ₂	ppb	2	50	--	--	--	9	140	6/24	38	500	4/15 R:07
39G	O ₃	ppb	--	--	92	120	5/02 R:13	--	--	--	--	--	--
39G	TSP-Rout.	pg/m ³	48.0	--	--	--	--	74.5	250	4/14	--	--	--
39G	TSP-Coll.	pg/m ³	47.8	--	--	--	--	74.3	250	4/14	--	--	--
40G	NO ₂	ppb	1	30	--	--	--	--	--	--	--	--	--
40G	SO ₂	ppb	2	50	--	--	--	10	140	5/26	30	500	6/18 R:18
40G	TSP	pg/m ³	47.8	60	--	--	--	77.7	250	6/07	--	--	--
41G	NO ₂	ppb	1	30	--	--	--	--	--	--	--	--	--
41G	TSP	pg/m ³	44.1	60	--	--	--	72.3	250	4/08	--	--	--

Source: Zedek Corporation, 1986a

TABLE 3-10
 AMBIENT AIR QUALITY DATA SUMMARY FOR THE PERIOD JULY TO SEPTEMBER 1986

Station	Parameter	Units	Avg.	EPA Std.	Hourly Max.	EPA Std.	Occurred	24 HR Max.	EPA Std.	Occurred	3 HR Max.	EPA Std.	Occurred
36G	NO ₂	ppb	1	30	--	--	--	--	--	--	--	--	--
36G	SO ₂	ppb	1	50	--	--	--	8	140	7/17	23	500	9/27 R:12
36G	O ₃	ppb	--	--	89	120	7/30 R:13	--	--	--	--	--	--
36G	TSP	µg/m ³	--	60	--	--	--	57.8	250	8/06	--	--	--
37G	SO ₂	ppb	1	50	--	--	--	8	140	9/29	29	500	8/05 R:14
38G	NO ₂	ppb	2	30	--	--	--	--	--	--	--	--	--
38G	TSP	µg/m ³	--	60	--	--	--	83.0	250	9/11	--	--	--
39G	NO ₂	ppb	1	30	--	--	--	--	--	--	--	--	--
39G	SO ₂	ppb	1	50	--	--	--	7	140	8/28	22	500	9/06 R:06
39G	O ₃	ppb	--	--	95	120	7/30 R:15	--	--	--	--	--	--
39G	TSP-Rout.	µg/m ³	--	--	--	--	--	148.3	250	7/13	--	--	--
39G	TSP-Coll.	µg/m ³	--	--	--	--	--	136.0	250	7/13	--	--	--
40G	NO ₂	ppb	1	30	--	--	--	--	--	--	--	--	--
40G	SO ₂	ppb	2	50	--	--	--	12	140	8/25	41	500	8/25 R:07
40G	TSP	µg/m ³	--	60	--	--	--	113.9	250	8/06	--	--	--
41G	NO ₂	ppb	0	30	--	--	--	--	--	--	--	--	--
41G	TSP	µg/m ³	--	60	--	--	--	84.7	250	9/11	--	--	--

Source: Zedek Corporation, 1986b

the SRP to meteorological conditions and the possible influence of natural sources of hydrocarbons (e.g., vegetation) (Zeigler et al., 1986). The relative impacts of SRP VOC emissions and natural sources of ozone and ozone precursors on ambient ozone concentrations are not known.

Off-site particulate monitors operated by the State of South Carolina have also recorded high concentrations. These have been attributed to the open burning of scrap lumber on the site, and also from tree pollen in the spring months. Open burning of lumber is permitted by the State, provided advance notification is provided by the site.

3.1.3.2 Radioactive Pollutant Air Monitoring Program and Data

Ambient Air Concentrations

The SRP operates a system of on-site, perimeter, and remote environmental air monitoring stations. There are 9 stations on the site, 13 stations around the plant perimeter, and 12 stations approximately 25 miles from the plant center. Stations are spaced to provide coverage of each 30° sector on the perimeter and at the 25-mile distance. In addition, there are air monitoring stations approximately 100 miles from the plant at Savannah, Georgia; Macon, Georgia; Columbia, South Carolina; and Greenville, South Carolina. Because of the negligible effect of SRP releases 100 miles from the site, these latter 4 stations provide surveillance of world-wide airborne activity for reference purposes.

The environmental air sampling stations consist of an 85 L/min carbon vane pump, which draws air through a 2-inch-diameter Gelman AE particulate filter and a 5 percent TEDA charcoal cartridge, at a flow rate of approximately 70 L/min. Flow is monitored by a rotameter; there is a running time meter to record actual pump operating time. A smaller vacuum line from the same pump draws about 100 cm³/min of air through a silica gel cartridge. A second cartridge, in series with the primary silica gel cartridge, contains a color indicator to provide indication of moisture breakthrough. Flow rate in this silica gel collector is checked and adjusted, as required, at the time of routine station servicing, using a portable rotameter. Sampling equipment is protected from the weather and from tampering by being located inside small enclosure buildings and security fences, as appropriate, based on the station location.

In addition to the air sampling equipment, the environmental monitoring stations have rainwater collection pans. The rainwater flows from the collection pan, through an ion exchange column, into a 20-liter Nalgene bottle.

Environmental stations are serviced by the SRP HP Department weekly; particulate filters and charcoal cartridges are replaced weekly, tritium cartridges are replaced biweekly, ion columns are replaced monthly, and water samples are collected weekly from selected stations. Filter papers and rainwater are analyzed for gross alpha and gross beta activity. Charcoal cartridges are analyzed for I-131. Silica gel cartridges are analyzed for tritium. Rainwater ion exchange columns are analyzed by gamma spectrometry for detectable gamma emitters. Monthly analyses of composite filters are performed for perimeter, remote, and selected on-site stations for radionuclides with long half-lives (e.g., Be-7, Sr-89/90, Zr-Nb-95, Ru-106, Cs-137, and Ce-144).

Radionuclide concentrations measured at the perimeter and remote stations were very low during 1985. As would be expected, concentrations of tritium, measured by on-site stations near the Separations Areas and burial grounds, were substantially higher than those measured at other stations. The minimum, maximum, and average concentrations of alpha, beta, and tritium in air and rainwater measured at the environmental stations are summarized in Table 3-11 (Zeigler et al., 1986).

The data from the environmental stations are not used for annual calculations of population doses because of the low levels of activity measured. Dose calculations are based on stack release data and dispersion modeling with the remote and perimeter stations primarily used to confirm calculated concentrations and to assist in tracking accidental releases.

Radioactive Pollutant Air Sampling Program and Data

Exhausted air from facilities and operations having the potential for generating airborne radioactivity is monitored or sampled to determine the concentrations and total atmospheric releases. The SRP HP Department is responsible for the stack effluent monitoring program. A variety of monitoring and sampling equipment and

TABLE 3-11
SUMMARY OF 1985 MEASUREMENTS OF RADIOACTIVITY IN ENVIRONMENTAL AIR AND RAINWATER
AMBIENT AIR CONCENTRATIONS

Station Location	Gross Alpha (pCi/m ³)			Gross Nonvolatile Beta (pCi/m ³)			Tritium (pCi/m ³)		
	minimum	maximum	average	minimum	maximum	average	minimum	maximum	average
100 mile radius	0.08 ± 0.15	3.1 ± 1.2	1.2 ± 1.1	6.3 ± 1.8	28 ± 2.9	14 ± 8.3	0.00 ± 5.6	23 ± 4.2	10 ± 15
25 mile radius	0.00 ± 0.80	3.5 ± 1.2	0.98 ± 1.1	0.5 ± 2.4	38 ± 3.7	13 ± 8.7	-8.4 ± 3.8	130 ± 4.6	33 ± 49
Plant perimeter	0.10 ± 0.70	4.0 ± 1.2	1.0 ± 1.1	0.96 ± 2.6	73 ± 4.7	14 ± 10	2.9 ± 3.9	770 ± 18	120 ± 210
On plant	0.00 ± 0.70	3.5 ± 1.1	1.1 ± 1.1	3.7 ± 2.7	73 ± 4.7	15 ± 14	6.9 ± 4.6	1400 ± 190	790 ± 3200

† Guideline for comparison (DOE order 5480-1A for concentrations in air in unrestricted areas)

Alpha (based on Pu-239) 2.0 fCi/m³

Beta (based on Sr 89/9) 9.0 x 10² pCi/m³

Tritium 2.0 x 10⁵ pCi/m³

RAINWATER CONCENTRATIONS

Station Location	Gross Alpha (pCi/m ²)			Gross Nonvolatile Beta (pCi/m ²)			Tritium (pCi/mL)		
	minimum	maximum	average	minimum	maximum	average	minimum	maximum	average
100 mile radius	8.2	39	23 ± 25	620	1400	880 ± 640	-0.81 ± 0.30	0.99 ± 0.29	0.21 ± 0.78
25 mile radius	4.5	27	16 ± 14	540	1800	970 ± 720	-0.42 ± 0.29	12 ± 0.40	1.2 ± 3.0
Plant perimeter	<2.7	36	18 ± 21	450	1200	950 ± 390	-0.25 ± 0.29	48 ± 1.1	4.4 ± 11
On plant	12	50	26 ± 23	780	1400	1100 ± 410	-0.23 ± 0.29	410 ± 18.4	25 ± 91

†† Guidelines for comparison Tritium 2000 pCi/ml (DOE Order 5480 for concentrations in water)

20 pCi/ml (EPA Drinking Water Standard)

Source: Ziegler et al, 1986b

techniques are used, depending upon various effluent stream characteristics, including potential contaminants, routine discharge concentrations, and the potential for accidental releases.

Procedures and equipment are described in detail in "Health Protection Department Air Effluent Monitoring" (Du Pont, 1986). In general, a portion of the exhaust stream is withdrawn through a probe inserted into the stack. Withdrawal is accomplished using dedicated vacuum pumps, with provisions for emergency power (and for critical systems, backup pumps). The normal sampling rate is 5 ft³/min (142 L/min); higher volumes of air are withdrawn for systems that require splitting of the sample stream for redundant or special monitoring. Flow rates are indicated on in-line rotameters.

Collection and monitoring systems consist of various combinations of particulate filters, charcoal cartridges, silica gel cartridges, flow-through ionization chambers, and flow-through gamma spectrometry chambers. Exhaust stacks with higher levels of activity or potential for large accidental releases of radionuclides are provided with continuous real-time monitoring. Sampling periods also differ, based on atmospheric release potential.

Appendix H summarizes the stack radiological effluent monitoring program at the SRP.

With several exceptions, analyses of collection media and calculations of atmospheric releases are performed by the HP Department. Exceptions are calculations of Kr-85 from Separations Areas and C-14 from Reactor Facilities, which are performed by accountability personnel. Results are summarized monthly, and plant or facility releases are compared with annually established release guides. Table 3-12 lists the 1985 annual SRP radionuclide atmospheric discharges. As can be noted from this table, the major radionuclide releases are tritium, noble gases (krypton, argon, and xenon), and C-14. Iodine and particulate releases are small fractions of these other radionuclides.

TABLE 3-12
1985 ATMOSPHERIC RELEASES

Nuclide Gases and Vapors	Curies Released
H-3 (oxide)	4.87E- + 5
H-3 (molecular)	1.80E- + 5
H-3 Total	6.67E- + 5
C-14	7.60E + 01
Ar-41	5.20E + 04
Kr-85	6.50E + 5
Kr-85m	1.30E + 03
Kr-87	1.10E + 03
Kr-88	1.30E + 03
Xe-131m	5.00E + 00
Xe-133	4.60E + 03
Xe-135	1.80E + 03
I-129	6.50E-02
I-131	6.02E-02

Source: Zeigler et al., 1986b

TABLE 3-12 (CONTINUED)

1985 ATMOSPHERIC RELEASES

Nuclide Particulates	Curies Released
Se-75	9.03E-06
Sr-89.9C	1.77E-03
Zr-95	2.92E-02
Nb-95	4.87E-02
Ru-103	1.10E-02
Ru-106	4.33E-02
Cs-134	3.00E-03
Cs-137	6.18E-03
Ce-141	3.65E-03
Ce-144	5.11E-02
Os-185	5.80E-04
U-235.238	2.64E-03
Pu-238	5.44E-04
Pu-239	5.11E-04
Cm-242.244	2.46E-04
Am-241.243	4.26E-04

Source: Zeigler et al., 1986b

Special Radiological Monitoring

On several occasions in 1984 and 1985, special nonroutine monitoring of tritium in the environment were conducted by the SRP in response to short-term unplanned releases of tritium and tritium oxide to the atmosphere. In the event of an accidental release of tritium or another radionuclide, meteorological data and stack emissions data are used by the WIND system to predict the direction and dispersion of the plume (Garret et al., 1983). Data from the National Weather Service System are also available, and provide additional forecast capability to the WIND system in the event of an unplanned release. A system is being installed to directly transmit stack release data to the WIND system computer.

In response to the tritium releases, atmospheric samples are taken in the area predicted to be covered by the plume using portable tritium forms monitors. Vegetation and surface water samples are generally taken in the same locations as the air samples. Monitoring is conducted on the site near the plant perimeter and at remote off-site locations along the path of the plume. Dose calculations are based on release data and the results of monitoring.

Atmospheric tritium concentration data for two unplanned releases in 1984 are summarized in Tables 3-13 and 3-14 (Zeigler et al., 1985). Routine atmospheric tritium concentration data for 1984 and 1985 are summarized in Table 3-11. Tritium concentrations were elevated to several orders of magnitude above background levels in the areas in the path of the plume after both the 1984 releases, and elevated atmospheric concentrations were measured 100 miles from the plant. These and other 1984 and 1985 accidental releases also resulted in elevated tritium levels in milk, vegetation, and surface water. Tritium concentration data for vegetation for 1984 and 1985 nonroutine releases are summarized in Section 3.2.

TABLE 3-13
ATMOSPHERIC TRITIUM DATA, MARCH 23, 1984 7500 Ci RELEASE

Sampling Location	Midpoint Sampling Times		Forecast Plume Arrival Elapsed Hours	Distance, Miles	HTO, pCi/m ³	HT, pCi/m ³	%HTO
	Clock	Elapsed Hours					
Ehrhardt	10:05	4.25	5.17	39	3200 ± 200	170 ± 60	95
	11:05	5.25			490 ± 60	70 ± 20	88
	11:37	5.78			770 ± 160	190 ± 50	80
Hwy 64 at 42	12:35	6.75		47	23 ± 12	1 ± 1	96
	13:07	7.28			16 ± 9	8 ± 6	67
Hwy 15, 3 mi S of Canadys	14:30 15:03	8.67 9.22		62	6050 ± 120 1900 ± 100	300 ± 20 380 ± 30	95 83
Hwy 15 at Edisto River	14:30 15:01	8.67 9.18		63	240 ± 50 200 ± 40	13 ± 7 11 ± 6	95 95
Hwy 27, 3 mi N of Hwy 61	16:33 17:03	10.72 11.22	10.17	79	334 ± 7 226 ± 11	2040 ± 40 214 ± 5	14 51
3 mi E of Givhans	16:28 17:00	10.63 11.17	10.17	80	109 ± 5 30 ± 4	11 ± 2 12 ± 2	91 71
Hwy 52 at 78	18:22	12.53	11.67	96	194 ± 6	4330 ± 50	4
Hanahan	18:33	12.72		103	2130 ± 60	2280 ± 40	48
Shem Creek	19:25 19:57	13.58 14.12		109	258 ± 5 50 ± 5	4770 ± 50 43 ± 3	5 54
Hwy 17 at 41	19:30	13.67	13.17	111	6 ± 3 19 ± 4	245 ± 5 1750 ± 30	2 1

The average atmospheric tritium concentration measured by routine monitoring in 1985 was 33 ± 49 pCi/m³ at a 25 mile radius of the plant, and 10 ± 15 pCi/m³ at a 100 mile radius

Source: Zeigler et al., 1985b

TABLE 3-14

ATMOSPHERIC TRITIUM DATA, SEPTEMBER 2-3, 1984 43,800 Ci RELEASE

Sampling Location	Time	Distance Miles	HTO pCi/m ³	HT pCi/m ³	% HTO
Aiken, SC	01:12	20	88	6	93.64
Trenton, SC	01:31	36	82	44	64.94
Ward, SC	02:16	41	41	3	93.98
Batesburg, SC	02:31	44	3519	261	93.11
Union, SC	03:51	53	1656	57	96.67
Intersection of Highways 113 & 378 (Lake Murray)	04:00	56	3412	189	94.75
	04:35		2077	56	97.37
I-26 at Irmo, SC	05:20	64	2745	151	94.79
	05:55		886	33	96.41
Highway 215, 5 Mi N at I-20	06:21	69	2692	93	96.66
Blythewood, SC	07:23	77	15871	171	98.93
Intersection of Highways 34 & 196	08:29	84	4837	371	92.88

The average atmospheric tritium concentration measured by routine monitoring in 1985 was 33 ± 49 pCi/m³ at a 25 mile radius of the plant and 10 ± 15 pCi/m³ at a 100 mile radius.

Source: Zeigler et al., 1985

3.1.4 Findings and Observations

3.1.4.1 Category I

None

3.1.4.2 Category II

None

3.1.4.3 Category III

1. Tritium Concentrations Elevated Above Background. Atmospheric emissions of molecular tritium and tritium oxides are resulting in elevated concentrations of tritium above background levels in ambient air, rainwater, vegetation, and wildlife on the site and in the vicinity of the plant.

Recent environmental monitoring data (Zeigler et al., 1985, 1986) show average tritium concentrations in ambient air, rainwater, and vegetation on the site and in the vicinity of the plant to be well above background levels measured 100 miles from the plant. Average concentrations of tritium in air and vegetation at the plant perimeter are approximately an order of magnitude higher than background levels, according to 1985 monitoring data. Ambient air, vegetation, and rainwater samples taken in response to unplanned release of tritium oxides show concentrations of tritium up to 100 times higher than those of routinely collected samples. Historical data (Evans, 1969) indicate that tritium concentrations in deer collected on the site are also elevated above background. No current data concerning tritium concentrations in animals collected in the plant vicinity are available.

Environmental monitoring data for nonroutine ambient air tritium concentrations are summarized in Tables 3-13 and 3-14 in Section 3.1.3.2. Routine data for tritium in ambient air and rainwater are summarized in Table 3-11. Data for routine vegetation sample collection, unplanned release vegetation sample collection, and historical data for routinely collected deer samples are discussed in Section 3.2.

Routine tritium releases from air emissions sources at the SRP contribute approximately 70 percent of the total off-site maximum individual dose of 0.9 mrem/year, approximately 1 percent of the DOE off-site dose guideline, and 4 percent of the EPA standard of 25 mrem/yr. Recent studies indicate that organically bound tritium in food has different dose effects than tritium in water, and that presently used dose models may underestimate the dose from the food pathway by as much as a factor of 4 (Travis, 1984). Modification of the dose calculations to account for organically bound tritium would significantly increase the calculated dose; however, the maximum individual dose would still be only a few percent of the DOE guideline of 100 mrem/yr and EPA standard of 25 mrem/yr. Although routine releases do not represent a large dose to the general public, these releases contribute to elevated concentrations in the environment above background, and are therefore a cause for concern*. Atmospheric emissions of tritium oxides also contribute to elevated tritium concentrations in surface water and shallow groundwater, through deposition and rainout. The primary contributors to elevated tritium levels in surface water and groundwater are surface water and seepage basin discharges. Tritium concentrations in animals will be determined as part of the Sampling and Analysis program.

2. Potential Increased Dose From Unplanned Tritium Releases. Accidental tritium releases have the potential to significantly increase off-site doses to individuals, by increasing tritium concentrations in ambient air, surface water, vegetation, milk, and meat.

A release of 7,500 curies of tritium from the Tritium Production Facility in 1984 resulted in a maximum calculated off-site dose of 0.06 mrem. The maximum calculated dose from consumption of milk from the center line of the plume was 0.2 mrem. A release of 43,800 curies of tritium, also from the Tritium Production Facility, later in 1984 resulted in a maximum calculated off-site dose of 1.6 mrem. This is 1.5 times higher than the 1985 maximum dose from routine releases of 0.9 mrem.

* Tritium oxide follows the water cycle in the environment, and monitoring of accidental releases indicates that elevated concentrations resulting from such releases dissipate rapidly.

In both instances, doses estimated from bioassay data were significantly lower than the calculated dose. Both releases occurred during atmospheric inversion conditions which minimized plume dispersion and maximized the off-site impact of the release. Several accidental releases from the Tritium Facility (the largest 19,400 curies), resulted in maximum calculated off-site doses from 0.01 to 0.07 mrem. One release resulted in an on-site dose of 0.7 mrem, based on bioassay data from construction workers in the 200S-Area in the path of the plume.

Since 1985 the SRP has initiated process and procedural changes to minimize both accidental and routine tritium releases, and has significantly reduced both overall releases and the potential for accidental releases. Completion of the Replacement Tritium Facility in 1990 will further reduce actual and potential emissions.

Although the potential for large accidental releases of tritium from the SRP has been significantly reduced in recent years through process and procedural changes (primarily at the Tritium Facility), accidental releases remain an environmental concern because of the potential for increased concentrations of tritium in the environment and the potential for increased dose to the public (historical accidental releases are discussed in Section 3.1.3.2). It has been suggested that present bioassay procedures based on urine samples may underestimate the organic complement of the dose from molecular tritium (Murphy, 1984). This would be most significant in the event of a large accidental release of molecular tritium.

3. Uncharacterized Emissions of Mercury. Atmospheric mercury emissions from the Tritium Facility and Waste Tank Farms and evaporators have not been characterized, and may represent significant sources of environmental contamination and a potential human health risk (also see Finding 3 in Section 3.2.4.3).

Atmospheric emissions of mercury at SRP may have contributed to deposition on soils and surface waters in the vicinity of the sources. Surface water and soils contaminated with mercury may represent an environmental or human

health risk and may require remedial action. Atmospheric emissions of mercury may also be contributing to elevated ambient air concentrations of mercury.

Mercury is regulated as a toxic air pollutant by the State of South Carolina and by EPA under the NESHAP and PSD regulations. Under the PSD regulations, new and modified sources that emit more than 200 lb/yr of mercury are subject to regulatory requirements and are required to prepare an air quality impact assessment. Each of the uncharacterized mercury emission sources has the potential to emit more than 200 lb/yr. Although these existing sources would not be subject to PSD requirements even if emissions exceed the regulatory limit, the fact that new sources are required to prepare an impact assessment indicates that the potential impact from these sources is considered significant by regulatory authorities.

4. Failure to Monitor Reactor Stacks for Some Contaminants. Samples from reactor stack effluents are not being analyzed for several long half-life radionuclides. These radionuclides may accumulate in the environment, resulting in uptake in food chains, and increased population doses.

Reactor stack effluent samples are analyzed for a wide variety of particulate and gaseous radionuclides. However, analyses are not performed for three radionuclides: carbon-14 (C-14); iodine-129 (I-129); and technetium-99 (Tc-99); known to be contaminants in the effluents. Hypothetical atmospheric releases of C-14 are calculated based on reactor operating parameters, but agreement of this calculated value with actual releases has not been verified over an extended operating time period. These three radioactive materials have long half-lives (the shortest half-life is about 5,700 years for C-14) and therefore may accumulate in the environment over long periods of time.

Sampling and analyses will be conducted to determine the concentrations of these three radionuclides in reactor stack effluents.

5. Elevated Ambient Air Concentrations of Ozone. Emissions of volatile hydrocarbons from the SRP may be contributing to elevated ozone concentrations on the site and in the vicinity of the plant.

On-site ambient air monitoring indicates that ambient ozone concentrations have exceeded the ambient standard of 120 ppb in 1982, 1983, and 1985 (1 day each year) but not in 1986 (based on three quarters). Data for 1985 are summarized in Table 3-8 (Zeigler et al., 1986). According to the SRP, the State of South Carolina has also recorded high ozone concentrations at off-site monitoring stations. Exceedance of the 120 ppb standard 1 day per year is allowed by State Air Quality Regulations. The area in the vicinity of the plant is presently considered in attainment with the ozone standard; however, the single ozone monitoring station operated by the State in the plant vicinity is not close enough to the plant to provide an accurate indication of the air quality in the immediate area of the plant. On-site data indicate that the area in the vicinity of the plant may not actually be in attainment of the State ozone standard.

Elevated ozone concentrations in the atmosphere are generally the result of photochemical reactions between volatile hydrocarbons and nitrogen oxides. Volatile hydrocarbons are emitted from the 300M-Area groundwater stripper, fuel storage facilities, laboratories, and on-site motor vehicles. (Note that 1,1,1-trichloroethane, emitted from the 300M-Area, is not photochemically reactive.)

The 300M-Area groundwater stripper permit allows emissions of approximately 15 tons/yr of volatile hydrocarbons. Requirements for controlling emissions from such sources vary with the attainment status of the area for ozone, and with State and local regulations. The State has not required control technology for air emissions from the stripper, or from fuel storage facilities or laboratories (motor vehicle emissions are not subject to site-specific controls).

The impact of anthropogenic sources of ozone, relative to long-range transport and natural sources, at the SRP is not known and it is unclear whether VOC emissions from the SRP are significantly affecting ambient ozone concentrations. Elevated ozone concentrations were recorded in 1982 and 1983, before the startup of the groundwater stripper. High concentrations historically have been recorded only in the summer months,

which is an indication that natural sources and meteorological conditions may be significant contributing factors. Natural sources of hydrocarbons (e.g., vegetation) can also contribute to ambient ozone concentrations, particularly in forested areas, and long-range transport is known to contribute to ambient ozone concentrations in the eastern United States (EPA, 1986b).

6. Inadequately Controlled Solvent Emissions to the Atmosphere. Atmospheric emissions of 1,1,1-trichloroethane, a toxic air pollutant, from degreasing operations in the fuel and target fabrication facilities (313M, 320M, and 321M) are not adequately controlled, and represent a potential source of environmental contamination and human health risk.

Emissions of 1,1,1-trichloroethane from the 300M-Area are on the order of 200 tons/yr. Vapor degreaser covers are not always used and refrigerated cold traps designed to control solvent evaporation have experienced maintenance problems and are not always in service. Both conditions contribute to increased solvent evaporation. Local ventilation designed to control worker exposure may be overbalanced, also resulting in increased evaporation of solvent.

Use of covers, cold traps and proper ventilation is required by the State of South Carolina for control of emissions from vapor degreasers using trichloroethylene or perchloroethylene and the degreasers would not meet State regulations were one of these solvents used. Vapor degreasers using 1,1,1-trichloroethane are not subject to State regulations because the solvent is not an ozone precursor. Although the State does not presently regulate 1,1,1-trichloroethane emissions from vapor degreasers, controls such as covers and cold traps are used to limit solvent evaporation as a matter of good engineering practice, regardless of the solvent used. More importantly, however, 1,1,1-trichloroethane is a toxic substance and may in the future be regulated by EPA as a hazardous air pollutant. EPA has not, at present, proposed any numerical emission limits for processes using 1,1,1-trichloroethane. The facility is now pursuing a program to eliminate the use of the solvent entirely.

3.1.4.4 Category IV

1. Deficiencies in Stack Monitoring and Sampling Equipment and Procedures.

Numerous deficiencies exist with equipment and procedures related to the radiological stack monitoring and sampling program. As a result, the accuracy of current and historic atmospheric release data is uncertain.

Reviews of data, reports, and correspondence, discussion with site personnel responsible for various aspects of the stack monitoring program, and inspections of stack sampling and monitoring systems identified numerous deficiencies in the systems. Many of the deficiencies are already known to the site staff. A November 1986 interoffice memo (Zeigler, 1986) described numerous stack monitoring problems in detail. Deficiencies noted during this Survey include:

- a. Sampling probes - inappropriate single nozzle probes are used in some areas; probes are not inspected on a routine schedule; some probe designs are not consistent with ANSI 13.1. Some probes are not permanently installed in stacks and ducts, but are loosely supported and subject to movement and misalignment.
- b. Sampling lines - large-diameter lines do not provide for adequate particulate transport velocity; some systems have long lines (up to 150 feet) between the probes and filter collection systems; many right-angle bends and some 180° bends were noted in some lines and probes; material was observed to have settled out in some sampling lines; corrections for line losses are known and are not routinely included in calculations; moisture was observed in lines on several systems.
- c. Sample filter holders - particulate filter holders in some areas do not appear to be airtight, nor do they tightly hold the filter in place. Air in-leakage and flow of sample air around (rather than through) the filters may bias the results of sampling.

- d. Sample probe location - sample ports on the 200-foot process stacks are at the 195-foot level. High turbulence at the stack exit may bias the sampling results.
 - e. Flow meters - for some systems, sample flow meters are not being calibrated annually; no calibration dates or set points are included on most flow meters; several rotameters were observed to contain solid or liquid residues.
 - f. Stack flow - discharge volumes or velocities in many stacks are estimated from design data; with few exceptions, recent system measurements have not been performed.
 - g. Sampling rates - sampling is not isokinetic on many stacks; certain systems do not have data to substantiate isokinetic sampling.
 - h. Leak testing - there is no policy or procedure for leak testing stack sampling systems.
 - i. Calculations - a review of one facility revealed errors in calculations, including use of improper stack volumes and failure to consider the detection capabilities of measuring equipment.
2. Deficiencies in Perimeter Radiological Air Monitoring Stations. Deficiencies were noted in equipment at the perimeter radiological air sampling stations, which may affect the quality of the data collected. As a result, the accuracy of current and historical air monitoring data is uncertain.

Inspections of four perimeter stations were conducted along with personnel who were performing routine sample collection. It was noted that the sampling intake and pump exhaust are both located inside the same enclosure. This situation will result in recirculation of a portion of the sampled air back through the filter collector.

Leak testing of three sampling systems was performed by blocking the filter housing inlet. With the inlet blocked, the flowmeters on two of the three systems continued to indicate air-flow rates of 50 percent or greater of the flow rate without the filter inlet blocked. This indicates that there is air leakage around the filter housing hoses or hose connections of these sampling systems.

Although the flow meters on the particulate sampler were marked as having been calibrated within the past 6 months, there was no calibration information on the small (150 cm³/min) flow meter used to set the flow through the silica gel cartridge systems. Personnel performing the perimeter station servicing stated that they were doubtful that this flow meter had been calibrated within the established 6-month period.

3. Lack of Sampling of Nitrogen Oxide Emissions for Compliance Purposes. Nitrogen oxide emissions from the Separations and Fuel and Target Fabrication Facilities are not routinely sampled or monitored, and the facilities' compliance with State permit limitations (based on mass balance calculations) cannot be adequately documented.

The 291H and 291F Separations Facilities' stacks are subject to both nitrogen oxide emission limitations and an opacity limit. State operating permits for the facilities do not require sampling or monitoring of nitrogen oxide emissions from any of the sources. The opacity of the stack plumes is routinely monitored; however, as the opacity of the plume is not directly convertible to a nitrogen oxide emission rate, the opacity readings cannot be used to demonstrate compliance with nitrogen oxide emission limitations.

3.2 Soil

3.2.1 Background Environmental Information

This section presents information on background levels of contaminants in soil and certain other environmental media that may incorporate contaminants from the soil. The purpose of this information is to provide a baseline, against which the reader may compare the concentrations of various contaminants occurring in the soil, vegetation, milk, food, and wildlife from the vicinity of the Savannah River Plant (SRP).

Background soil concentrations of most radionuclides generated or processed at the SRP are not routinely determined or available in literature. However, as part of the SRP environmental monitoring program, soil samples are obtained from Clinton, South Carolina, and Savannah, Georgia, about 100 miles from the site. The radionuclide concentrations in these samples are assumed to be representative of background levels. Concentrations in samples obtained during 1985 are presented in the 1985 Environmental Report (Zeigler et al., 1986b); they were:

Radionuclide	Average Concentration (pCi/g) $\pm$ 2 Std. Dev.
Sr-90	0.04 $\pm$ 0.06
Cs-137	0.37 $\pm$ 0.07
Pu-238	0.001 $\pm$ 0
Pu-239	0.010 $\pm$ 0

Myrick et al. (1983), have compiled background soil concentrations of naturally occurring members of the uranium and thorium decay series. Although this study did not include samples from South Carolina, data for three other southeast states, the United States, and the world are presented (see Table 3-15). Vegetation and certain foodstuffs are indicators of radionuclide contamination in soil and are therefore collected as part of a comprehensive environmental monitoring program. Vegetation samples, obtained 100 miles from the SRP, may be considered representative of typical background levels. Values for selected radionuclides obtained from the 1985 SRP Environmental Report are:

TABLE 3-15
BACKGROUND SURFACE SOIL CONCENTRATIONS (pCi/g $\pm$ 2 STD Dev)

Location	Ra-226		Th-232		U-238	
	Range	Mean	Range	Mean	Range	Mean
Alabama	0.47-1.4	0.82 $\pm$ 0.62	0.36-1.5	0.77 $\pm$ 0.71	0.51-1.1	0.85 $\pm$ 0.36
Georgia	0.46-1.6	0.88 $\pm$ 0.77	0.28-3.4	1.1 $\pm$ 1.9	0.48-1.6	0.85 $\pm$ 0.72
North Carolina	0.48-1.2	0.78 $\pm$ 0.48	0.42-1.5	0.92 $\pm$ 0.83	0.39-1.6	0.87 $\pm$ 0.71
U.S.	0.23-4.2	1.1 $\pm$ 0.48	0.10-3.4	0.98 $\pm$ 0.46	0.12-3.8	1.0 $\pm$ 0.83
World	0.49-1.98	0.79	0.22-1.31	0.65	0.33-1.32	0.66

Source: Myrick et al., 1983

<u>Radionuclide</u>	<u>Average Concentration (pCi/g) $\pm$ 2 Std. Dev.</u>
Gross Alpha	0.12 $\pm$ 0.24
Nonvol. Beta	14 $\pm$ 11
H - 3	0.51 $\pm$ 0.77 (pCi/ml water)
Cs - 137 + 134	0.07 $\pm$ 0.30
I - 131	1.1 $\pm$ 4.8

The U.S. Environmental Protection Agency (EPA) monitors background levels of selected radionuclides in milk. A summary of 1985 data for the southeast region is presented in Table 3-16.

Additional information on background levels of radionuclides and nonradioactive contaminants in environmental media discussed in this section was not available.

3.2.2 General Description of Pollution Sources and Controls

The major pathway for potential contamination of soil is through routine and accidental airborne releases. Over 1.3 million curies of activity were released to the atmosphere from the SRP during 1985 (Zeigler, 1986b). Most of this activity was from the Separations Area, specifically the 200F-Area and 200H-Area main stacks on the reprocessing facilities. Almost all of this activity was in the gaseous or vapor state (tritium, noble gas, or C-14) with less than 1 curie as particulates. Residual radionuclide contamination may also be present from previous atmospheric releases. Soil is primarily an indicator of particulate radionuclides, while tritium, C-14, and iodine are of concern when incorporated into vegetation, milk, and foodstuffs. Noble gases do not deposit on soil and are not incorporated into vegetation and foodstuffs.

The SRP contains numerous on-site areas of radionuclide contamination, resulting from past spills (Stephens, 1984), waste disposal (seepage basins and burial sites), and contaminated drainage pathways (Steel Creek, Four Mile Creek, and Upper Three Runs Creek) due to routine and accidental liquid effluent discharges. These areas are continuing or potential sources for further on-site and off-site soil contamination, through surface water and groundwater transport. However, the total activity levels and areas of potential contamination are small, compared to those related to the airborne pathway. More detailed discussions of these sources are presented in Sections 3.3, 4.1, and 4.5.

TABLE 3-16
BACKGROUND RADIOACTIVITY IN MILK - 1985
pCi/l $\pm$ 2 STD DEV

Location	Cs-137	Ba-140	I-131	Sr-90	Sr-89
Montgomery, AL	4 $\pm$ 7	-1 $\pm$ 8	3 $\pm$ 7		
Atlanta, GA	2 $\pm$ 7	-1 $\pm$ 9	4 $\pm$ 7		
Charlotte, NC	6 $\pm$ 18	4 $\pm$ 18	3 $\pm$ 14		
Charleston, SC	5 $\pm$ 7	2 $\pm$ 8	2 $\pm$ 7		
EPA Region 4 (S.E. US) Composite		--	--	2.4 $\pm$ 0.6	0 $\pm$ 1
Minimum Detectable Levels (MDL)	10	10	10	1	5

(1) Data reported by EPA were at or below their reported MDL for monthly samples. Annual results for concentrations and the 2 Sigma standard deviations were obtained from the arithmetic mean of monthly values.

Source: EPA Environmental Radiation Data Reports #41, 42, 43, 44, and 45, 1985-1986.

3.2.3 Environmental Monitoring Program

3.2.3.1 Soil

This section describes the SRP soil monitoring program and summarizes the radiological conditions noted. Surface soil samples are collected annually by SRP from four quadrants at 2,000 feet from both the F- and H-Area main stacks and from four locations on the plant perimeter. At each site, 10 soil cores, 5 cm deep, are taken at intervals of 30 cm. Soil cores are composited by location and analyzed for Sr-90, Pu-238, Pu-239, and gamma-emitting radionuclides.

Concentrations measured in samples obtained during 1985 are presented in the 1985 SRP Environmental Report (Zeigler, 1986b). As would be expected, radionuclide concentrations were generally higher in the vicinity of the 200-Areas than at the plant perimeter. The highest levels noted around the 200-Areas were: Sr-90, 0.37 pCi/g; Cs-137, 1.28 pCi/g; Pu-238, 0.068 pCi/g; and Pu-239, 0.091 pCi/g. Samples from the plant perimeter were not significantly different from background samples (samples taken 100 miles from the site), with the exception of the Sr-90 levels, for which the maximum and average perimeter concentrations were 0.25 pCi/g and 0.12 pCi/g, respectively, as compared to the average "background" level of 0.04 pCi/g. Soil samples are not routinely analyzed for nonradioactive contaminants.

3.2.3.2 Vegetation

The SRP vegetation sampling program and results are as follows. Vegetation samples are collected routinely (2 to 5 times annually) from the vicinity of the 200F- and 200H-Areas, the plant perimeter, and at 25 and 100 miles off the site. Grass (Bermuda, if available) is the vegetation of choice for this sampling, because of its importance as a pasture crop and its year-round availability. Samples are analyzed for gross alpha, nonvolatile beta, tritium, and gamma-emitting radionuclides. The results of this monitoring (Zeigler, 1986b) indicate that tritium is the only radionuclide of possible SRP origin present at detectable concentrations or above typical background levels. Concentrations near the Separations Area ranged up to 130 pCi/ml, while the maximum and average concentrations at the plant perimeter were 53 pCi/ml and 8.9 pCi/ml, respectively. At 25 miles from the site, the maximum concentration was 12 pCi/ml with an average of 2.3 pCi/ml. For comparison, the average background level at 100 miles from the site was 0.51 pCi/ml.

During 1985, vegetation samples were also collected from the vicinity of the seepage and retention basins in the 100- and 200-Areas and the radioactive waste burial ground (RWBG). Results of this sampling (Zeigler, 1986b) indicate that concentrations of alpha and nonvolatile beta in vegetation from the retention and seepage basins are comparable to those in off-site vegetation; trace amounts (up to 2.6 pCi/g) of Sr-89/90 were measured in these samples. Several vegetation samples from the radioactive-waste burial ground contained above-background concentrations of radionuclides. The maximum levels were: gross alpha, 21 pCi/g; nonvolatile beta, 17,000 pCi/g; Cs-137, 33 pCi/g; and Sr-90, 356 pCi/g. Analyses for tritium were not performed.

On four occasions in 1985, special vegetation sampling was performed following accidental, short-term releases of tritium or fission products to the atmosphere. Dates of these releases were January 4, January 24, January 31, and March 27; results of vegetation samplings are presented in the 1985 SRP Environmental Report (Zeigler, 1986b). Tritium levels, measured in on-site vegetation collected soon after the releases, were relatively high, ranging up to 61,800 pCi/ml following the March 27th release. Subsequent sampling indicated reductions in vegetation tritium levels by approximately a factor of 5 within 4 days. Plant perimeter and off-site vegetation samples contained significantly lower levels of tritium; the highest levels at the plant perimeter and 25-mile radius were 970 pCi/ml and 590 pCi/ml, respectively, following the March 27th release. Analyses of samples, following the January 4, 1985, fission product release from the 291-F stack, did not identify above-background nonvolatile beta concentrations in on-site or off-site vegetation.

3.2.3.3 Milk

Procedures for monitoring milk from the environment of the SRP are described in this section. Milk is routinely sampled at 6 dairies within a 25-mile radius of SRP, and at a major distributor of milk produced in the area. Concentrations of Sr-90, I-131, and Cs-137, measured in 1985 milk samples, were comparable to background levels determined by EPA (see Table 3-16). Only tritium concentrations were above background levels in milk collected during 1985 (Zeigler, 1986b). Levels of tritium ranged from less than 0.3 pCi/ml to 6 pCi/ml with an average of 1 pCi/ml. The 50-year dose commitment, calculated by SRP, based on milk consumption of 0.5 L/day for 1 year with an average tritium concentration of 1 pCi/ml is about 0.05 mrem.

3.2.3.4 Food

Farm products representing the food categories of leafy vegetables, fruit, grain, poultry, eggs, and meat are collected at 14 localities in the 6 counties surrounding SRP. Procedures and data related to this program are summarized in this section. Six sampling locations are near the plant perimeter and 8 are at a distance of approximately 25 miles. With the exception of grains, all foods are prepared as though for human consumption (i.e., peelings, seeds, and other inedible parts are removed). Wheat, containing the whole grains only, and oats, containing both grains and husks, are processed unwashed.

With several exceptions, the radionuclide concentrations reported in the 1985 SRP Environmental Report (Zeigler, 1986b) were below the detection limits of the procedures. These exceptions were Sr-90 (up to 0.38 pCi/g - wet weight) in several samples of collards, plums, and barley and tritium (up to 14 pCi/ml of free water) in individual samples from most food products categories. The highest level of tritium was also encountered in a sample of collards. SRP dose calculations indicate that consumption of 140 lb/yr of collards containing 2 pCi/g of tritium would result in a 50-year dose commitment of less than 1 mrem.

3.2.3.5 Site Wildlife

A wide variety of indigenous and migratory wildlife inhabits the environs of the SRP. Radionuclides released to the atmosphere, drainage streams, and seepage and retention basins from SRP operations may become incorporated in the food chain, drinking water supply, and habitat of these animals. This section describes the monitoring program and results for various wildlife species. Two important animal species at SRP from a standpoint of potential human radiation doses are deer and wild hogs. Annual public hunts are conducted on plant property to control the deer and hog populations. In 1985 these hunts yielded 1,022 deer and 78 hogs. Because of the potential for radionuclide contamination, the SRP Health Protection (HP) Department monitors all hunt-killed deer and hogs for gamma emitters. The maximum allowable concentration of Cs-137 in animals to be released for public consumption is 100 pCi/g. For comparison, the highest Cs-137 levels measured in deer and hog tissues taken during the 1985 season were 30 pCi/g and 11 pCi/g, respectively (Zeigler, 1986b). The SRP has calculated that the adult 50-year dose

commitment from eating all of the edible meat from the deer containing 30 pCi/g of Cs-137 would be 18 mrem. Cesium concentrations in these animals have remained fairly constant over the past few years.

Thyroids are collected from selected deer and analyzed for I-131 and I-129. Analyses during 1985 did not measure any detectable I-131; I-129 levels ranged from 0.01 to 31 pCi/g. Deer are not analyzed for certain other radionuclides that could be present at concentrations significant from the standpoint of dose to the potential consumer; an example of such a radionuclide is H-3. A.G. Evans (1969) of the Savannah River Laboratory (SRL) reported H-3 concentrations in site deer as high as 54.5 pCi/ml of body water. This report also described findings indicating that some of the H-3 was incorporated in organic compounds in the flesh and would therefore have a longer biological half-life than H-3 in the oxide (water) form. Animals which may have eaten vegetation, contaminated to high levels by accidental H-3 releases, would be expected to contain higher concentrations of H-3 in flesh.

With the exception of the annual deer and hog hunts, the SRP is closed to public hunting. Other terrestrial animals are therefore not a likely source of food for the local population. This has been demonstrated by previous analyses which have not identified significant uptakes of radionuclides of SRP origin. On occasion, migratory waterfowl have been collected and analyzed for gamma-emitting radionuclides. In 82 ducks analyzed during 1985, Cs-137 was the only radionuclide attributed to SRP operations. The highest concentration was 16 pCi/g in a duck collected from Pond B.

Another animal that has recently received attention because of radionuclide contamination is the turtle. Turtles inhabiting areas with high concentrations of radioactivity in water, sediment, and vegetation have been found to accumulate Cs-137 and Sr-90. The Savannah River Ecology Laboratory (SREL) and SRP HP Department are conducting various studies on radionuclide levels in turtles. Some contaminated turtles have been captured off the site, near the northwest property boundary. In 1983 the SRL Seepage Basins were fenced to prevent intrusion by turtles or other animals. Data presented in Table 3-17, illustrate the levels of radionuclides noted in 8 of the 655 turtles collected from the site during 1985.

3-17
TURTLE DATA - 1985

WHOLE TURTLE					
TRAPPING LOCATION	DATE	SREL IDENTIFICATION	WEIGHT, g	SEX	THYAC, c/m
700 SB	7/08/85	BIMV	492	F	1,000
Lodge Lake	7/22/85	BHNX	1,044	M	15,000
Lost Lake	7/09/85	KOQ	466	M	600
Lost Lake	6/29/85	MWX	364	M	600
Lost Lake	9/25/85	NOP	1,006	M	500
Four Mile Creek	10/16/85	AHQ7	4,318	F	400
Lost Lake	10/21/85	NOX	1,788	F	9,500
Lost Lake	10/25/85	IKM	742	M	900

TURTLE FLESH					
Location & ID	Sample Weight, g	pCi/g, Wet Weight (± 2 STD Dev)			
		Alpha	Beta	Sr-90	Cs-137
700 SB (BIMV)	40	0.2 ± 0.3	19 ± 2.3	10 ± 2.6	1 ± 1
Lodge Lake (BHNX)	57	0.2 ± 0.3	110 ± 5	100 ± 6.6	4 ± 2
Lost Lake (KOQ)	37	0.2 ± 0.3	7 ± 1.6	3 ± 1.9	2 ± 1
Lost Lake (MWX)	19	0.3 ± 0.4	7 ± 1.5	3 ± 2.1	0.03 ± 1
Lost Lake (NOP)	55	0.15 ± 0.30	5 ± 1.3	4 ± 1.7	2 ± 1
FMC (AHQ7)	274	0.08 ± 0.15	4 ± 1.4	3 ± 1.0	3.7 ± 1.1
Lost Lake (NOX)	56	0.15 ± 0.3	37 ± 3	24 ± 0.8	2.9 ± 1.2
Lost Lake (IKM)	39	0.30 ± 0.37	18 ± 2.2	8 ± 1.8	1.2 ± 1.2

Source: Zeigler, 1986b

TABLE 3-17
TURTLE DATA
PAGE TWO

TURTLE SHELL					
Location & ID	Sample Weight, g	pCi/g, Wet Weight ($\pm$ 2 STD Dev)			
		Alpha	Beta	Sr-90	Cs-137
700 SB (BIMV)	---	2 ± 0.9	$1,300 \pm 17$	670 ± 14	46 ± 3.7
Lodge Lake (BHNX)	---	24 ± 2.9	$16,000 \pm 59$	$7,600 \pm 47$	$1,000 \pm 16$
Lost Lake (KOQ)	---	1 ± 0.7	620 ± 12	360 ± 12	74 ± 6.7
Lost Lake (MWX)	---	2 ± 0.7	580 ± 11	400 ± 12	25 ± 2.9
Lost Lake (NOP)	34	1.6 ± 0.73	560 ± 11	440 ± 13	31 ± 2.7
FMC (AHQ7)	127	0.53 ± 0.46	250 ± 7	210 ± 9	60 ± 2.9
Lost Lake (NOX)	60	19 ± 2.4	$8,500 \pm 43$	$4,100 \pm 31$	350 ± 9.6
Lost Lake (IKM)	28	4.3 ± 1.2	$1,300 \pm 17$	650 ± 12	81 ± 10

-- Data not recorded

TABLE 3-17
TURTLE DATA
PAGE THREE

TURTLE FLESH					
Location & ID	Sample Weight, g	pCi/g, Wet Weight ($\pm$ 2 STD Dev)			
		Alpha	Beta	Sr-90	Cs-137
700 SB (BIMV)	15 ^a	9.4 $\pm$ 1.7	1,600 $\pm$ 19	1,800 $\pm$ 40	86 $\pm$ 8
Lodge Lake (BHNX)	8 ^a	62 $\pm$ 4.3	14,000 $\pm$ 55	12,000 $\pm$ 100	470 $\pm$ 18
Lost Lake (KOQ)	6 ^a	4.7 $\pm$ 1.2	674 $\pm$ 12	600 $\pm$ 24	25 $\pm$ 5
Lost Lake (MWX)	8 ^a	2.5 $\pm$ 0.9	440 $\pm$ 10	510 $\pm$ 22	17 $\pm$ 5
Lost Lake (NOP)	8 ^a	3 $\pm$ 9.07	740 $\pm$ 19	610 $\pm$ 17	63 $\pm$ 4
FMC (AHQ7)	33 ^a	0.53 $\pm$ 0.46	310 $\pm$ 8	110 $\pm$ 5	9 $\pm$ 2
Lost Lake (NOX)	12 ^a	17 $\pm$ 2.3	7,700 $\pm$ 41	3,200 $\pm$ 27	540 $\pm$ 12
Lost Lake (IKM)	5 ^a	6.4 $\pm$ 2.0	1,400 $\pm$ 25	990 $\pm$ 22	190 $\pm$ 26

Tritium levels are not measured in the turtle flesh. In an interoffice memo from E. Heath to A. Garrett (Heath, 1986), analyses on a turtle trapped in the vicinity of the H-Area were described. This turtle contained up to 44,000 pCi/g of Sr-90 in the shell, 13,000 pCi/g of Sr-90 in the head, and 3,600 pCi/g in the flesh. Although this species of turtle (the pond slider) is not generally eaten by man, there are reports that it has been eaten by humans; other animals are known to eat this species of turtle. If this turtle were to be eaten, the calculated 50-year committed dose to an individual consuming 1 pound of flesh from it would be 80 mrem. Unpublished SREL studies have identified effects on blood systems of turtles having high radionuclide levels.

3.2.4 Findings and Observations

3.2.4.1 Category I

None

3.2.4.2 Category II

1. Soil and Sediment Contamination from Radioactivity Released to Steel Creek. Past reactor effluent discharges into Steel Creek have resulted in Cs-137 contamination of soil in the floodplain and sediments along the creek bed.

Contamination is also present in swamp areas, portions of which are on private property known as the Creek Plantation Swamp. Contamination in these locations is a source of direct radiation exposure and is a potential source of future contamination of other soil, sediment, and environmental media along this drainage pathway. See finding # 3 in Section 3.3.4.2.

3.2.4.3 Category III

1. Sediment Contamination Along an H-Area Drainage Stream. A previous liquid waste spill in the 241H-Area Tank Farm resulted in Cs-137 contamination of soil and sediment along a drainage ditch.

This contamination may potentially enter Four Mile Creek and the Savannah River. See finding # 5 in Section 3.3.4.3.

2. Radionuclide Uptake in Animals. Analyses have identified elevated concentrations of radionuclides, originating from the SRP in animals collected on- and off-site. In some cases these radionuclides may be contributing significant radiation doses to the animals themselves, and may also be resulting in doses to members of the general public who consume the contaminated animals.

Radionuclides released to the atmosphere, drainage streams, and seepage and retention basins result in contamination of the food chain, drinking water supply, and habitat of many indigenous and migratory animals in the environs of the SRP. Samples of water, milk, vegetation, foodstuffs, deer, wild hogs, fish and other aquatic animals, small fur-bearing mammals, and reptiles are routinely obtained from locations both on- and off-site. Results of analyses are available in the annual SRP Environmental Monitoring Reports and have been discussed in previous sections. Most samples obtained off the site have radionuclide concentrations that are typical of those encountered in nature. As would be expected, higher levels of activity in vegetation typically occur in the vicinity of the F- and H-Separations Areas, RWBG and seepage and retention basins, and along contaminated drainage pathways such as the Steel Creek delta region and Creek Plantation Swamp. Predominant radionuclides are H-3, Cs-137, and Sr-90. High concentrations of H-3 have also been measured in vegetation, downwind of the release point, following large accidental releases.

Tritium, Cs-137, and Sr-90 have also been identified at elevated concentrations in animals on or near the site; in addition, I-131, I-129, and miscellaneous alpha and nonvolatile beta emitters have been measured in certain animal tissues. However, all major radionuclides from a standpoint of potential population doses are not routinely measured or associated radiation doses evaluated. Of particular concern are radionuclide levels in animal species that may be consumed by the public (specifically deer and hogs).

Special sampling will be conducted to further evaluate contamination levels of several additional radionuclides and in additional animal species.

3. Uncharacterized Emissions of Mercury. Atmospheric mercury emissions from the Tritium Facility and Waste Tank Farms and evaporators have not been characterized (also see Finding 3 in Section 3.1.4.3). These emissions may represent significant sources of environmental contamination through fallout onto the soil and therefore a potential human health risk by direct contact and by biomagnification in flora and fauna that may be consumed.

Atmospheric emissions of mercury at SRP may have contributed to deposition on soils and surface waters in the vicinity of the sources. Surface water and soils contaminated with mercury may represent an environmental or human health risk and may require remedial action. Atmospheric emissions of mercury may also be contributing to elevated ambient air concentrations of mercury.

Mercury is regulated as a toxic air pollutant by the State of South Carolina and by EPA under the NESHAP and PSD regulations. Under the PSD regulations, new and modified sources that emit more than 200 lb/yr of mercury are subject to regulatory requirements and are required to prepare an air quality impact assessment. Each of the uncharacterized mercury emission sources has the potential to emit more than 200 lb/yr. Although these existing sources would not be subject to PSD requirements even if emissions exceed the regulatory limit, the fact that new sources are required to prepare an impact assessment indicates that the potential impact from these sources is considered significant by regulatory authorities.

3.2.4.4 Category IV

1. L-Reactor Storage Pads. The long-term unsecured storage of approximately 17,000 cubic feet of radiologically contaminated equipment at the L-Reactor storage pads has created a potential for contamination of storm-water runoff into streams and, possibly, groundwater with Cs-137, Co-60, and other radiological contaminants. Also, contamination of soil with these substances in the vicinity of the 8 pads south of L-Reactor was recorded. Hand-held micro-R meter readings near one pad registered 5 mR/hr. Although sampling and analyses by SRP around some of these sites has shown the level of existing soil contamination to be low and not posing a danger to human health, the improper abandonment of this equipment represents poor management practice.

3.3 Surface Water

3.3.1 Background Environmental Information

Natural surface-water bodies on or adjacent to SRP are shown in Figure 3-6. These bodies include the Savannah River, Savannah River Swamp, and six on-site streams: Upper Three Runs Creek (UTRC), Beaver Dam Creek (BDC), Four Mile Creek (FMC), Pen Branch (PB), Lower Three Runs Creek (LTRC), and Steel Creek (SC). Additionally, several smaller creeks feed these six streams; Tims Branch and Tinker Creek feed Upper Three Runs Creek; Indian Grave Branch feeds Pen Branch; and Meyers Branch feeds Steel Creek. With the exception of Tinker Creek, all these surface-water bodies receive effluent from the SRP operations. Consequently, thermal, biological, chemical, and radiochemical affects can be observed in the on-site streams. Carolina Bays, which are naturally occurring pond formations found in parts of the southeast, are scattered throughout the site. With few exceptions, these bodies of water do not receive effluents; they serve as natural habitats for many species of wildlife on the site.

Two manmade surface-water bodies are found at SRP: Par Pond and L-Lake. These impoundments serve as cooling-water reservoirs for P- and L-Reactors, respectively. Par Pond is a closed cooling loop receiving makeup water from the Savannah River; L-Lake is a once-through cooling pond that discharges to the Savannah River via Steel Creek.

3.3.1.1 Savannah River and Savannah River Swamp

As can be seen in Figure 3-6, the Savannah River and Savannah River Swamp border the site on the southwest boundary, flowing in a southeasterly direction for 16 km. The river serves as the boundary between Georgia and South Carolina at this point. The Savannah River basin is one of the major river systems in the southeast. Its watershed is greater than 27,400 km² and occurs in portions of North Carolina, South Carolina, and Georgia. The U.S. Geological Survey (USGS) divides the basin into nine hydrologic units as shown in Figure 3-7. The SRP is located in unit 6 which contains 29.5 km² of open water and 509.2 km² of wetlands. The SRP site comprises 13.9 percent wetlands of which 2.7 percent is open water.

SRP PRODUCTION AREAS AND EFFLUENT STREAMS

FIGURE 3-6

THE SAVANNAH RIVER BASIN SHOWING USGS HYDROLOGIC UNITS FIGURE 3-7

The Savannah River Swamp is separated from the main flow of the Savannah River by a 3-meter-high natural levee along the river bank. Four Mile Creek, Pen Branch, Steel Creek, and Beaver Dam Creek empty into the swamp. A portion of the water from BDC and FMC enters the Savannah River through two breaches in the levee during most of the year. The remaining portion of their combined flow moves in a southeasterly direction through the swamp, and joins the flow from PB and SC, and eventually discharges into the Savannah River near Steel Creek Landing. This flow pattern is substantially altered during flooding when the river water enters the swamp. Under these conditions, flow from the SRP streams hugs the eastern shore of the river.

Creek Plantation Swamp is an off-site swamp area located southeast of the SRP; Specifically, it is located between Steel Creek Landing and Little Hell Landing as shown in Figure 3-6. This area is mostly uninhabited. Access is limited to occasional hunters and fishers.

The river is classified as a Class B water of the State under South Carolina's Department of Health and Environmental Control (SCDHEC) Regulation R.61-19. Class B water is used for secondary contact recreation, as a source of drinking water after conventional treatment, for fishing, and for industrial and agricultural uses. Table 3-18 provides a summary of Class B water standards.

The Savannah River is used as a drinking water source at one on-site and two downstream off-site locations. The 400D-Area Water Treatment Facility (on-site) provides water for drinking and industrial uses. The Cherokee Hill Water Treatment Plant located at Port Wentworth (Savannah, Georgia) provides water for industrial and manufacturing purposes as well as 20,000 adult consumers working at that location. The Beaufort and Jasper Counties Water Treatment Plant (South Carolina) provides water to 50,000 consumers of all ages. As will be discussed further in Section 3.3.3.3, water is monitored for radioactive constituents at these facilities. Table 3-19 provides typical background levels for radioactivity including tritium (H-3) for southeastern U.S. surface water. All Tritium (H-3) is assumed to be present due to SRP operations. However, alpha concentrations to 2.6 pCi/L and beta concentrations to 5.1 pCi/L are attributed to naturally occurring radium and thorium that are known to exist in the SRP geographic area.

TABLE 3-18

**SOUTH CAROLINA WATER QUALITY STANDARDS
FOR CLASS B WATERS**

Fecal Coliform

Not to exceed a geometric mean of 1,000/100 ml based on five consecutive samples during any 30-day period; not to exceed 2,000/100 ml in more than 20% of the samples examined during such period.

pH

Range between 6.0 and 8.5, except that specified waters may range from pH 5.0 to 8.5 due to natural conditions.

Temperature

Shall not exceed a weekly average temperature of 90°F (32.2°C) after adequate mixing as a result of heated liquids, nor shall a weekly average temperature rise of more than 5°F (2.8°C) above temperatures existing under natural conditions be allowed as a result of the discharge of heated liquids unless an appropriate temperature criterion or mixing zone has been established.

Dissolved Oxygen

Daily average not less than 5.0 mg/liter with a low of 4.0 mg/liter, except that specified waters may have an average of 4 mg/liter due to natural conditions.

Source: SCDHEC Regulation R. 61-19.

TABLE 3-19
RADIOACTIVITY IN SOUTHEAST U.S. SURFACE WATER - 1985
(PCI/L ($\pm$ 2 Std. Dev.))

Location	Source	Alpha	Beta/Gamma	Tritium
SRP Control Sample ⁽¹⁾	Edisto River	0.48 $\pm$ 0.50	1.2 $\pm$ 1.2	560 $\pm$ 480
Broad River, SC ⁽²⁾	Broad River	---	---	200 $\pm$ 200
Dothan, AL ⁽²⁾	Chattahoochee River	---	---	200 $\pm$ 200
Decatur, AL ⁽²⁾	Tennessee River	---	---	400 $\pm$ 200
Southport, NC ⁽²⁾	Atlantic Ocean	---	---	200 $\pm$ 200
Charlotte, NC ⁽²⁾	Catawba River	---	---	600 $\pm$ 200
Hartsville, SC ⁽²⁾	Lake Robinson	---	---	1500 $\pm$ 200
Allendale, SC ⁽²⁾ (downstream of SRP)	Savannah River	---	---	3000 $\pm$ 200

(1) Background sample location used by SRP

(2) Samples taken from surface waters downstream of operating nuclear facilities--data from EPA Environmental Radiation Data Reports 41, 42, 43, and 44-45.

Source: Zeigler, 1986b

The Savannah River is used extensively in SRP operations. Since the 1950s the SRP has been withdrawing about $28.3 \text{ m}^3/\text{sec}$ (450,000 gpm) of water from the river for cooling purposes. This secondary cooling water is used mainly to cool the reactor primary coolant (heavy water, D_2O) and after usage is returned to the Savannah River by the on-site stream systems: FMC (C-Reactor), PB via Indian Grave Branch (K-Reactor), and SC via L-Lake (L-Reactor). The river flow rate is about $290 \text{ m}^3/\text{sec}$ (4.5×10^6 gpm). Therefore, approximately 10 percent of the river volume is diverted from the river through the reactors and returned to the river via the on-site stream systems; these discharges, which are 10 to 20 times the natural stream flows, cause the SRP streams to overflow their original banks along much of their length.

The Savannah River is also used for sport and commercial fishing. Therefore, water quality has been a concern of the State to ensure continuation of this activity. Elevated levels of mercury (Hg) were measured in the river in the late 1960s and early 1970s. It was determined that the source of the Hg contamination was an upstream industrial complex in Augusta, but due to the distribution of river water through the SRP, some Hg was found in the on-site streams and sediments. Water quality data for 1985 are summarized in Table 3-20.

3.3.1.2 SRP Streams

All of the SRP streams are considered by the State to be Class B waters. However, none of the streams are used as drinking water sources, for recreation, or for fishing. The streams are receiving waters for wastewater generated from SRP operations. Five of the six primary streams have received or are receiving cooling water. Consequently, thermal effects can be observed along the stream corridors and deltas; these streams are categorized as reference, mildly thermal, thermal, or post-thermal depending on the stream history. All six on-site streams receive process and nonprocess waters containing chemical and radioactive contaminants. A summary of the water quality data for streams can be found in Tables I-1 and I-2 of Appendix I. See Section 3.3.3.2 for a discussion of surface-water monitoring.

Upper Three Runs Creek drains a watershed of approximately 492 km^2 . It is the only stream on the SRP with headwaters originating off the site. It is also the largest and longest SRP stream, flowing in a southwesterly direction as shown in Figure 3-6. Tims Branch and Tinker Creek are the two main tributaries.

TABLE 3-20
SAVANNAH RIVER WATER QUALITY

Parameter	Units	Average Composition	
		Above Plant (R-2)	Below Plant (R-10)
Temperature	Degrees C	18	19
pH	pH	6.2 - 7.6	6.1 - 7.6
Dissolved O	mg/l	9.6	9.6
Alkalinity	mg/l	19	20
Hardness	mg/l	5.9	6.0
Conductivity	μmh/cm	82	69
Turbidity	NTU	5.4	5.0
Suspended solids	mg/l	9.3	12
Volatile solids	mg/l	2.9	2.9
Total dissolved solids	mg/l	55	59
Total solids	mg/l	64	71
Fixed residue	mg/l	6.6	9.2
COD	mg/l	15	13
Cl	mg/l	6.6	6.6
NO ₂ + NO ₃ - N	mg/l	0.5	0.53
SO ₄	mg/l	6.5	6.5
Total P	mg/l	0.10	0.09
Al	mg/l	0.16	0.17
NH ₃	mg/l	0.13	0.10
Ca	mg/l	4.6	4.7
Cu	mg/l	<0.01	<0.01
Cd	mg/l	<0.01	<0.01
Mg	mg/l	1.3	1.3
Mn	mg/l	0.10	0.07
Hg	μg/l	<0.20	<0.02

Source: Zeigler et al., 1986b

TABLE 3-20
SAVANNAH RIVER WATER QUALITY
PAGE TWO

Parameter	Units	Average Composition	
		Above Plant (R-2)	Below Plant (R-10)
Ni	mg/l	<0.10	<0.10
Na	mg/l	10	8.6
Total Fe	mg/l	0.34	0.52
Pb	mg/l	<0.01	<0.01
Cr	mg/l	<0.01	<0.01
Zn	mg/l	0.04	0.03
Fecal Coliform	Colonies/ 100 ml	7,800	250
γ-BHC	μg/l	<0.009	<0.009
σ-BHC	μg/l	<0.009	<0.009
β-BHC	μg/l	<0.014	<0.014
Aldrin	μg/l	<0.009	<0.009
2,4-D	μg/l	<0.027	<0.027
M. Parathion	μg/l	<0.01	<0.01
Heptachlor epoxide	μg/l	<0.008	<0.008

Source: Zeigler et al., 1986b

Upper Three Runs Creek has never received thermal effluents and is, therefore, considered a reference stream. It does, however, receive process water discharges from fuel fabrication and laboratory operations via Tims Branch and from F- and H-Area operations directly.

Use of this stream is restricted by criteria established as part of the SRP's Stream Management Program. The stream is divided into three regions. Region 1 is located between the headwaters and Tinker Creek confluence. No discharges of any type are allowed in this region, in order to preserve an area for aquatic study and to provide an on-site stream area from which "background" conditions can be measured. Region 2 is located between Tinker Creek and Road C. Use of this region is controlled; a site committee review and approval is required before new effluent streams can be discharged to this section of the creek. Both stream data and aquatic toxicity tests are used in conjunction with National Pollution Discharge Elimination System (NPDES) and National Environmental Policy Act (NEPA) requirements to determine whether effluent can be discharged to the creek. Region 3 is the lower section of the creek below Road C; effluents can be discharged to this region if waters meet NPDES and NEPA requirements.

Beaver Dam Creek is a small stream conveying thermal effluents from the D-Area Coal-Fired Powerplant (see Figure 3-6). Before 1982, it also received cooling waters from the Heavy-Water Facility. This stream is considered mildly thermal. It receives process water discharges from the Water Treatment Facility, which has been a source of several chemical spills, such as sulfuric acid, to the creek in the past. The stream also received coal flyash basin effluent discharges. As a result, the swamp area at the mouth of the creek has been impacted by thermal and chemical effluents; the total area of stressed vegetation was 1.60 km² as of 1985. Flow from BDC joins that of FMC before reaching the Savannah River.

Four Mile Creek together with BDC drains a watershed of 59 km². Four Mile Creek flows for 24 km in a southwesterly direction before emptying into the Savannah River via the swamp. (See Figure 3-6.) The stream receives 0.6 m³/sec of process effluent from the F- and H-Areas as well as 11.3 m³/sec of thermal discharges from C-Reactor when this facility is operating. In addition, this creek receives storm runoff from the waste burial ground, 643-G and 643-7G. Four Mile

Creek has been considered a thermal stream, but recovery of the area may occur if C-Reactor remains on standby indefinitely. Due to the large flow rate of the reactor effluent and loss of vegetation due to thermal effects, upstream erosion has occurred, contributing to the formation of a delta area within the Savannah River Swamp. Both the stream corridor and delta area have been impacted by the thermal discharges and erosion. As of 1985, the total affected area (i.e., loss of vegetation including trees) for the corridor was 0.93 km² and for the delta was 3.57 km².

Pen Branch, along with Indian Grave Branch, drains a watershed of 55 km². It flows roughly parallel to FMC as shown in Figure 3-6. Pen Branch receives effluent process and cooling water from K-Reactor via Indian Grave Branch. Combined stream flows before cooling water is introduced are 0.17 to 0.31 m³/sec. Cooling water increases stream flow by 10.5 m³/sec. This water commonly exceeds 70°C at the point of release into the creek. Typically, stream channels exceed 45°C in the summer months. Therefore, PB is considered a thermal stream and as such, the stream corridor and delta area have been impacted. Total affected area as of 1985 was 0.93 km² along the stream corridor and 1.52 km² at the delta.

Steel Creek and its main tributary, Meyers Branch, drain a watershed greater than that of PB. Before construction of L-Lake in 1985, the stream flowed southwesterly and southerly for 17.1 km. This stream received process and cooling waters from P-Reactor from 1954 to 1963 and from L-Reactor between 1954 to 1968. Thermal impacts to both the stream corridor and delta occurred. In 1968 after shutdown of L-Reactor, about 1.50 km² of wetlands had been affected in the corridor and, in the delta, about 1.25 km² of wetlands had been affected. During the period that L-Reactor was shut down, wetland recovery occurred and in 1985, the total affected area was reduced to 0.83 km² and 0.82 km² for the stream corridor and delta, respectively. For this reason, Steel Creek is considered a post-thermal stream.

Lower Three Runs Creek drains a 299 km² watershed, the second largest watershed on the site. As can be seen in Figure 3-6, it is the southernmost drainage system, flowing southerly and southwesterly for 32 km before emptying into the Savannah River. In 1958, the headwaters of LTRC were impounded to form Par Pond which is used as a cooling-water reservoir for P-Reactor and originally for R-Reactor. (R-Reactor was shut down in 1964.) Since 1954, flow and temperature into the creek have varied. Resulting wetland losses have not been extensive; consequently, this stream is considered a reference stream rather than post-thermal. Lower Three Runs Creek does not receive any process water directly.

3.3.1.3 Man-Made Surface-Water Bodies

Par Pond and L-Lake are impounded surface-water bodies used for thermal mitigation of P- and L-Reactor cooling-water effluents. These waters also receive process water discharges from these reactor areas. Currently, aquatic biological data are being used in studies needed to comply with Clean Water Act section 316(a) and (b) demonstrations.*

Par Pond was formed by impounding headwaters of LTRC with an earthen dam completed in 1958 (see Figure 3-6.) Both LTRC and Savannah River water, pumped into the pond, are used to maintain water levels in the 2,600-acre impoundment; cooling water from the reactor is recirculated in this closed-loop system. The thermal effects on the aquatic ecosystem are primarily limited to the Hot Arm of Par Pond. The Hot Arm includes Pond C, the receiving water for thermal effluents. Fish kills during restart occur in Pond C, but there is no evidence of similar kills in Par Pond.

* The SCDHEC has required that Clean Water Act section 316(a) and (b) demonstrations be conducted for Par Pond and L-Lake. This study is required whenever discharge temperatures cause the stream temperature to exceed 90°F and/or the rise in stream temperature is greater than 5°F above ambient stream temperature. The objective of the study is to demonstrate that the temperature excess does not affect the existence of a balanced indigenous biological community (316(a)) and that impingement of aquatic life does not occur (316(b)).

L-Lake, a once-through cooling system, was formed by impounding SC with an earthen dam, forming a 1,000-acre lake; construction was completed in 1985. In addition to SC waters, the lake was filled with 110 million gallons of water diverted from Par Pond to provide L-Lake with an initial source of lake species, thus accelerating the development of a biologically balanced community. Water from L-Lake flows to SC and eventually to the Savannah River.

The SCDHEC permit for L-Lake requires that the lower 50 percent of the lake surface not exceed 90°F averaged over a 5-day period; typically more than 68 percent of the lake is below 90°F. Power levels for L-Reactor are determined by lake temperatures, which are monitored with a remote sensor system.

Two design improvements have been made since L-Lake construction. First, a jetty was constructed in the upper lake near the outfall to divert influent cooling waters to previously unused sections of the lake and hence increase surface area for heat transfer.

The upper 35 percent of the lake is the hotter portion and in this region, thermophilic microorganisms such as Naegleria fowleri, Legionella pneumophila, and Aeromonas hydrophila are found. Naegleria, an amoeba which can encyst, attacks the human nervous system after entering the body via the respiratory system either in water, aerosols or dust; encephalitis-like symptoms occur. The disease may result in death. Legionella causes Legionnaire's disease and Aeromonas causes red sores in fish that can be transmitted to humans after prolonged exposure. As a result, access to this lake region is restricted. There is the potential for these microorganisms to overflow to Steel Creek and eventually to the Savannah River.

3.3.2 General Description of Pollution Sources and Controls

This section presents a description of potential pollution sources and controls for the water media. Specifically, processes from which effluents are discharged to surface water will be described. Stream treatment, monitoring, and control will be discussed. Finally, aboveground tanks and pipes and the degree of containment for each will be identified.

3.3.2.1 Water Treatment

Water at the SRP is taken from the Savannah River and wells. The Reactor Areas use river water for service and cooling water and well water for a drinking water supply. The D-Area Powerhouse uses river water for both process and domestic uses. The balance of the SRP uses wells for both process and domestic uses. D-Area process and potable water undergoes sedimentation, filtration, and pH adjustment. The potable water is also treated with polyphosphate and is continuously chlorinated. The process water used for cooling is chlorinated for 4 hours every other day for biological control. Water used for boiler makeup is demineralized prior to use. Precipitates from the sedimentation process are pumped to the ash basin, the filter backwash is directed to a lined basin, and the demineralized regenerants are neutralized prior to discharge into the ash basin.

Process and cooling waters for the Reactor Areas are pumped from the river into large reservoirs (186-Basins) in each of the Reactor Areas. This water is untreated except for chlorination 1 hour per day. Water used for boiler makeup in the C-, K-, and P-Areas is demineralized prior to use. Neutralized regenerants are discharged through an outfall.

Well water used for domestic purposes is chlorinated in all areas. Some areas provide additional treatment in the form of degasification and pH adjustment. The M-Area also uses granular activated carbon adsorption to remove organic contamination present in the groundwater in this area.

3.3.2.2 Sewage Treatment

Sanitary wastes at the SRP are treated primarily using Clow packaged treatment plants. Seventeen plants are located in 12 areas as listed in Table 3-21; individual units range in size from 12,000 gal/day to 60,000 gal/day capacity. Influent material is sent to a sludge holding tank before transfer into the aeration chamber. Air is bubbled through this mixed aeration zone. Material is then hydraulically transferred to a quiescent clarifier. Clear liquid overflows to a chlorine contact chamber and is discharged through an NPDES-regulated outfall. Sludge from the clarifier is returned to the aeration chamber; optionally, the sludge can be returned to the sludge holding tank (see Figure 3-8). Periodically, the sludge is removed

TABLE 3-21

SEWAGE TREATMENT SYSTEMS AT THE
SAVANNAH RIVER PLANT

Location By Area	Number of Units*	Capacity	
		Gal/Day	gpm
A	2	65,000	45
F ‡	2	30,000 60,000	21 42
H ‡	1	60,000	42
S	2	12,000	8
G	2	30,000 40,000	21 28
P	2	12,000 10,000	8 7
L	1	35,000	24
K	1	24,000	17
C	1	55,000	38
D	1	12,000	8
U	1	25,000	17
TNX	1	20,000	14

* Units are packaged sanitation systems by Clow®

‡ Installation of an additional unit is planned

Source: Personal communications with S. Willis, 1987.

Source: Personal communications with S. Willis 1987

FLOWSHEET FOR PACKAGED SEWAGE TREATMENT UNITS

FIGURE 3-8

from the unit and sent to a lagoon in the Central Shops Area. Hydraulic overloading of the treatment facilities in the A-, F-, and H-Areas has occurred. New treatment units are scheduled for installation in these areas to ameliorate the problem.

In addition to the packaged treatment plants, septic tanks and tile fields are used currently in areas where population served does not justify the installation of a packaged unit. Before installation of the packaged units at the locations listed in Table 3-21, septic tanks and tile fields were used; with the exception of the Imhoff tank in the TC/U-Area, these inactive systems have not been decommissioned and are a potential pollution source.

3.3.2.3 Water Discharges

Production Reactors (100-Area)

Three reactors (K, L, and P) are presently operated, primarily to produce plutonium-239 (Pu-239) and tritium (H-3) for nuclear weapons. R-Reactor has been shut down since 1964 and will probably never be restarted. C-Reactor was shut down for an indefinite period in 1985.

The large amount of heat generated by the nuclear reactions in the reactors is transferred in heat exchangers, in a once-through cooling system, from heavy-water coolant to water pumped directly from the Savannah River (C-, K-, and L-Reactors) or from Par Pond (P-Reactor). The cooling water that flows back to the river from C- and K-Reactors releases much of its heat to the atmosphere along the way. Similarly, hot water returned to Par Pond is cooled by evaporation and heat transferred to the atmosphere. Hot water from L-Reactor is cooled by evaporation and heat transfer to the atmosphere as it passes through L-Lake before being released to SC and the Savannah River. Thermal impacts along stream corridors and deltas have occurred from release of cooling water from C- and K-Reactors (see Section 3.3.1.2).

Liquid releases other than cooling water from the C-Reactor Area flow to a tributary of FMC. Those from the K-Reactor Area drain to a tributary of Indian Grave Branch. P-Reactor Area liquid effluents drain to tributaries of either Par Pond or Meyers Branch. L-Reactor Area liquid effluents drain to Steel Creek.

Process drains within the reactor buildings are directed to sumps within the building or discharged directly to an outfall. In general, process drains that have the potential to be contaminated are directed to sumps and the collected water is sampled and analyzed prior to disposal. If the wastewater is uncontaminated, it is pumped to the environment through an outfall without treatment. If the wastewater is contaminated with radioactivity, then the sumps are pumped into a tank trailer and taken to the General-Purpose Evaporators in the 200-Area. Presently, the sumps are emptied via 1-inch Tygon® tubing. A more permanent, hard-piped system is in the planning stages. Heat exchangers are cleaned periodically using oxalic acid. The waste from this cleaning is discharged untreated to NPDES outfalls.

The disassembly basins are used to store the target and fuel assemblies from the reactor until the activation products have decayed to a point where they can be transported to the F- and H-Areas for processing. Water purity in the disassembly basins is maintained by filtering and demineralizing a sidestream from the basin. The sand filters used in this process are backwashed to a settling tank where the clarified water is recycled and the solids are taken by waste management for disposal in the Radioactive Waste Burial Ground (RWBG). The demineralizers are portable units that are taken to the Receiving Basin for Off-Site Fuels (RBOF) Facility where they are regenerated by waste management. The regenerant wastes are pumped to tanks in the Tank Farm.

Prior to 1961, secondary cooling water and disassembly-basin effluents from L- and P-Reactors were discharged to Steel Creek. Since that time, various changes in reactor liquid effluent discharges have been made. Presently, except for occasional diversions into upper Steel Creek, P-Reactor cooling water is released into Par Pond, and P-Reactor disassembly-basin purgewater is the only regular effluent into upper Steel Creek. L-Lake was constructed along the creek floodplain and currently receives all L-Reactor liquid effluents, which ultimately flow to the Savannah River via Steel Creek. Cooling and process waters are discharged through NPDES-regulated outfalls including four outfalls for C-Area, five outfalls for K-area, three outfalls for L-Area, and six outfalls for P-Area. Stormwater and nonprocess water is discharged through monitored, nonregulated outfalls. (Note: Analytical test results of water samples taken at monitored, nonregulated outfalls are not reported to the State, but are used for process control.)

The principal sources of tritium, cesium-137 (Cs-137), and cobalt-60 (Co-60) in the environment at the SRP have been reactor effluent discharges to on-site streams. Radionuclide releases associated with reactor operations are derived primarily from disassembly-basin water releases; other direct sources include heat exchanger cooling water and spent fuel storage. Historically these releases have been the major source of radioactivity released to on-site streams.

Total liquid releases of radionuclides from the Reactor Areas to on-site streams account for 56 percent of the total H-3, 100 percent of the total Co-60, 1 percent of the total Sr-90, and 7 percent of the total Cs-137 released at the SRP during 1981-1984.* Releases of H-3 from C-Reactor accounted for 26 percent of the total H-3 released to Four Mile Creek. No cesium-137 (Cs-137) was released from C-Reactor, although historically releases of these radiochemicals have occurred. Outcropping of H-3 from shallow groundwaters encompassing the K-Area containment basin constituted 70 percent of the total release of H-3 to Pen Branch. Direct liquid release from K-Reactor accounts for the remaining 30 percent of H-3 released. No significant releases of other radiochemicals were measured, although historically such releases have occurred. Releases of H-3 from L-Reactor accounted for only 6 percent of the total released to Steel Creek, while releases from P-Reactor accounted for the remaining 94 percent. Releases of Co-60, Sr-90, and Cs-137 to Steel Creek all originated from L-Reactor; prior to the use of seepage basins for disassembly purge, releases of these radiochemicals, especially from P-Reactor, were significantly higher.

Coal-fired steam plants are associated with C-, K-, and P-Reactors, with two boilers at each plant. L-Reactor does not have a steam plant associated with it and draws steam from the other reactor plants and/or D-, F-, and H-Areas. Floor drains from the powerplant discharge to ash and coal-pile runoff basins. Storm and nonprocess waters are discharged through monitored NPDES discharge points. Cooling-tower blowdown is also discharged through an NPDES-regulated point.

* Source: Lower, M.W. "Radionuclide and heavy metal Transport," Comprehensive Cooling Water Study, Volume III. Fraction of radionuclides were calculated based on the inventory provided in this study.

Most of the oil and chemical storage facilities in the Reactor Areas have secondary containment. A few storage tanks, such as the bulk-oil storage tanks, have earthen dikes for containment. Secondary containment for neutralization tanks for demineralizer regenerants is planned, but not yet in place. New secondary containment basins have been constructed for acid and caustic tanks located in the unloading area near the Water Treatment Facilities.

Chemical Separations Facilities (200-Area)

In the Chemical Separations Areas (200F and 200H), three major operations occur from which process or cooling water is discharged to surface water. These operations include chemical separations, power operations, and waste management.

Cooling-water streams are discharged from the chemical separations processes. These streams are diverted through delay basins for monitoring. If radioactive contamination occurs, an alarm is sounded and Health Protection (HP) Department personnel sample the effluent. Water can then be diverted to the lined retention basin or seepage basin if necessary. Otherwise water is cooled in cooling towers and discharged. Cooling tower water is treated with a chlorine derivative once a day for 1 hour. Nonprocess waters drain via internal sewers from the Canyon Building, canyon exhaust fan house, canyon exhaust filters, control lab, Manufacturing Building, Equipment Delivery Building, Metallurgical Building stack, and Refrigeration Building through NPDES-regulated outfalls. Process water from neutralization of demineralizer regenerants, wastewater from the Chemical Feed building, and water from the Laundry Facility are also discharged through NPDES-regulated outfalls. Both FMC and UTRC receive process and nonprocess water through eight regulated outfalls in the F-Area and nine regulated-outfalls in the H-Area. The Separations Area has caused no thermal impacts on SRP streams, although the two outfalls receiving cooling water do approach and occasionally exceed the 90°F temperature limit during the summer months. Storm and nonprocess waters are discharged to monitored, nonregulated outfalls in both areas.

About 34 percent of the total H-3, 99 percent of the total Sr-90, and 93 percent of the total Cs-137 released to the surface water at the SRP between 1981 and 1984 resulted from F- and H-Area operations.* Both direct liquid releases from the process effluents and migration from the F- and H-Area Seepage Basins to FMC occurred. About 1 percent of the total H-3 release to the creek was due to direct release while 73 percent was attributed to migration from the basins. About 93 percent of the Sr-90 migrated from the Seepage Basins and 7 percent was directly released. About 67 percent of the Cs-137 was directly released while 33 percent was desorbed from the streambed. The source of the desorbed material was soil contaminated when high-level waste (HLW) overflowed to the ground in 1967; flow from the 242H-Area evaporator to Tank 9 was restricted by formation of crystals in the line.

Coal-fired powerplants (power operations) are associated with F- and H-Area facilities with four boilers at the F-Powerhouse and three boilers at the H-Powerhouse. Liquid effluents from these facilities are diverted to coal-pile runoff basins, ash basins, monitored outfalls, or regulated outfalls.

Waste management operations include the use of evaporators to reduce the volume of waste in the Tank Farms. Steam condensates and evaporator overheads are monitored for radioactivity and then released to outfalls or basins as appropriate. Stormwater from the Tank Farm Area is diverted and continuously monitored for radioactivity as well.

Recent evaluation of the floor drains using dye tests in the processing plants has indicated that the drains were connected to the sanitary rather than the process sewer. As a result, some drains have been plugged to prevent accidental release to the environment. For example, the first-level drains in the H-Area Canyon Building were plugged to prevent release to the sanitary system. Blocking drains in the rinse area of the Tritium Facility has been considered. Dye testing has not been used on all drains, however, and there is potential for accidental discharge through drains that have unidentified discharge points.

* Source: Lower, M.W. "Radionuclide and heavy metal Transport," Comprehensive Cooling Water Study, Volume III. Fraction of radionuclides were calculated based on the inventory provided in this study.

Spill containment projects are currently under way in the F- and H-Areas; these projects focus on containment basins around chemical feed and waste storage tanks. Until these projects are completed, potential for accidental releases to the environment remains high. Another source of potential spills is the large number of overhead pipes running from the processing building to the evaporators and recycling tanks. These pipes have no secondary containment. Spills have been reported from ruptures in these pipes in the past and pipe failure continues to be a concern for the future. Spill containment is planned but not completed for acid and caustic tanks in the Water Treatment Facilities as well.

Fuel and Target Fabrication (300M-Area)

The Fuel and Target Fabrication Facility manufactures elements to be irradiated in the reactors. The process can be described as a series of metal-finishing operations such as chemical etching and stripping as well as plating. Spent rinsewaters generated from these operations are treated in the Dilute Effluent Treatment Facility (DETF) before release to an unnamed tributary of Tims Branch through Outfall M004. The DETF plus the Chemical-Transfer Facility (CTF) comprise the Liquid Effluent Treatment Facility (LETFF) for M-Area. The DETF operations include pH adjustment of rinsewaters followed by solid/liquid separation. Filtrate is discharged through the outfall after holdup and sampling to ensure that NPDES requirements can be met; the filter cake, which is considered a hazardous waste, is drummed and shipped to the waste slurry storage tanks. (See Section 4.1.1.1 for details on hazardous waste.) Washdown water used to clean work areas is diverted to sumps and pumped to the CTF. At the CTF, waste coolant, aluminux, and caustic are transferred to a waste caustic holdup tank, and waste nitric and waste phosphoric acids are sent to two separate waste acid holdup tanks. These materials are neutralized and sent to 500,000-gallon storage tanks. Supernatant from these storage tanks is scheduled to be grouted and disposed of in the future. During the interim, plans are being made to reduce the volume of stored waste by discharging small quantities of the supernatant to the DETF for treatment and release to surface water.

Large quantities of chemicals are stored and handled in the M-Area. These chemicals are listed in Table 3-22. Containment of feed chemical and waste chemical tanks divert the material to sumps in case of spills to avoid direct release to surface waters. In some instances, sump valves have failed and chemicals have been released, but generally in nonreportable quantities.

TABLE 3-22
CHEMICALS STORED IN THE 300M-AREA

Aluminum Fluoride	Filterbestos
Lithium Fluoride	Nickel Carbonate
Hydrogen Peroxide	Sodium Bicarbonate
Drawbench Oil, CIRCO "XXX"	Aluminux
Butyl Stearate	Nickel Sulfate
Argon	Nickel Chloride
Isopropyl Alcohol	Boric Acid
Super Cel	Activated Charcoal
Lithium	Lead Powder
A532 Hydraulic Oil	Aquadag
Nitric Acid 51%	Fiske #604 Lubricant
Phosphoric Acid	Sodium Hydroxide
Sodium Nitrate	Aluminum Sulfate
1,1,1-Trichloroethane	Sulfuric Acid

Source: Personal communications with P. Mahoney, 1987.

Water is also discharged through Outfall M005 from the air stripper. The air stripper is used to remove organic contaminants found in groundwater. The water tends to have a naturally low pH and has caused some pH compliance problems periodically at Outfall A014, which is downstream of both the combined M004 and M005 Outfall streams. Tims Branch, which empties into region 2 of UTRC, is the receiving water for all three outfalls. A trebler sampler is located upstream of Outfall A014 to sample for uranium. Uranium concentrations are also determined at Outfall M004 and reported to the State on NPDES monthly reports. Storm and nonprocess waters are discharged to monitored, nonregulated outfalls.

Heavy-Water Production and Recovery (400D-Area)

The Heavy-Water Facility previously extracted heavy water from river water by a hydrogen sulfide process, and purified it further by distillation. At present, only the heavy-water rework unit is operating to purify reactor moderator. A large coal-fired powerplant is also located in the 400-Area, along with two ash-disposal basins, a coal pile, and a coal-pile runoff basin. In addition, a Water Treatment Facility and a Waste-Oil Burning Facility are located in this area. All wastewater is released to either BDC or the Savannah River through seven NPDES-regulated outfalls. Storm and nonprocess waters are discharged to monitored nonregulated outfalls.

The most significant radioactive release from the 400D-Area is tritium from the reprocessing of degraded reactor heavy water (D_2O) coolant. About 10 percent of the total H-3 released from SRP operations to surface water is released from D-Area operations.* Tritiated heavy water evaporated from leaks is released to the atmosphere through a 70-foot stack. Exhaust vapors from tanks and drums pass through an ammonia-cooled condenser and are vented into the exhaust stack. Aqueous releases are analyzed before discharge to BDC. The discharge rate is adjusted to meet limits on tritium concentrations in the effluent sewer. These limits are determined by the operating contractor and are dependent on data from historic releases and regulatory release limits/doses.

* Source: Lower, M.W. "Radionuclide and heavy metal Transport," Comprehensive Cooling Water Study, Volume III. Fraction of radionuclides were calculated based on the inventory provided in this study.

There are four coal-fired boilers associated with the powerplant. Water is used to slurry coal ash and convey it to the ash basins. A coal-pile runoff basin was constructed in 1978 to contain the runoff from coal piles.

Construction is currently under way to tie all floor drains in the powerplant into a central sump to prevent accidental releases to the environment. This project is scheduled to be completed by June 1987. Other spill-containment projects are also planned, and include the Neutralization Facility. In the past, several spills from the Water Treatment Facility occurred. The largest was a 3,000-gallon spill of sulfuric acid.

CMX-TNX Facilities (600T-Area)

The CMX-TNX Semiworks Area is located near the Savannah River adjacent to the Heavy-Water Production and Recovery Plant (400D-Area). The purpose of the TNX Facilities is to study chemical processing problems and test production-scale equipment. Tests are conducted with nonradioactive substitutes for radiochemicals or natural uranium. The test equipment includes such units as dissolvers for uranium metal, evaporators, mixer-settlers for solvent extraction, centrifuges, tanks, pumps, and large furnaces. The CMX Building has nine flow loops and associated equipment for non-nuclear tests of portions of hydraulic systems of SRP reactors. Pilot-scale tests on the Defense Waste Processing Facility (DWPF) continue at TNX, where simulated nonradioactive salt supernatant and sludge are used in the testing process. Cooling water and other wastewaters from these facilities are discharged to the Savannah River through five NPDES-regulated outfalls; storm and nonprocess waters are released through several monitored outfalls. Cooling water and steam condensate discharged through one outfall intermittently increase the outfall water temperature to nearly 90°F, but no thermal impacts are evident.

Two seepage basins have been used to handle waste discharges from TNX. The Old TNX Seepage Basin was used from 1958 to 1980; it contained contaminants such as acid, mercury, cyanide, nickel, silver, chromium, copper, curium, plutonium, uranium, thorium, and radium. In 1981, the basin was filled with soil and a clay cap

was placed over the top according to regulatory guidelines. Extensive well monitoring continues on soils in the basin and nearby swamp, as do analyses of local groundwater. This seepage basin discharged through Outfall X002; stressed vegetation was observed in this outfall delta. Characterization of this area has been completed and is reported in the Environmental Information Document (Kingley et al., 1986a).

The New TNX Seepage Basin handles simulated sludge and salt supernatant generated from DWPF testing. This basin has been operational since 1980 and is scheduled to be replaced by a Treatment Facility in late 1988. Concurrent with the construction of this facility, a characterization study of the New TNX Seepage Basin will be performed pursuant to its subsequent closure. Potential contaminants in the new basin include barium, chromium, nickel, chloride, nitrate, lead, sulfate, and organics (Kingley et al., 1986b). The process sewer, which is the influent to the basin, is sampled at several points for pH, chloride, nitrogen, and other NPDES parameters. However, the overflow discharge from the New TNX Seepage Basin (X013A) is not an NPDES-regulated outfall.

Both the Old and the New TNX Seepage Basins have been cited in the Natural Resources Defense Council (NRDC) lawsuit. In addition, Outfall X013A was cited in the recent U.S. Environmental Protection Agency (EPA) Multimedia Report (EPA, 1987). EPA was concerned that this outfall was not NPDES regulated.

Administration, Technical, and Shops (700A-Area), Savannah River Laboratory

The Savannah River Laboratory (SRL) performs research and development work related to plant changes, upgrades, improvements, and waste management. The main SRL building contains offices, laboratories, shielded high-level cells, a fabrication laboratory, and a scientific library. Both process and nonprocess water is discharged from these facilities.

Process water discharged from the laboratory operations includes effluent collected from labs, the Engineering Annex, Compressor Building, Control House, Manipulator Repair Shop, pollution control stack, electrode position processes, and the Laser Research Facility. Nonprocess cooling water is discharged from the cooling tower, Chlorine Building, Cafeteria, Refrigeration Building, animal holding pens, and Fire Station.

Waterborne effluents are released to Tims Branch through 10 outfalls, to a Carolina Bay through 3 outfalls, and seeps to the ground through 12 outfalls. Only 6 six of the 25 monitored outfalls are regulated, under the current NPDES Permit.

A coal-fired powerplant with three boilers is associated with the SRL Facility. Internal sewers as well as external runoff from the boiler house are discharged to Outfall A008. This outfall is not an NPDES-regulated discharge. Effluent is discharged to a nearby wetland area.

Ordinary waste chemicals that are not contaminated beyond trace levels and which do not contain radioactive materials are discharged from the various buildings and enter a common vitreous pipeline that empties into an open ditch outside the east perimeter fence. Nonradioactive wastes from SRL operations consist mainly of small amounts of chemicals that are flushed into the low-level drains. This waste flows into Tims Branch, where it is diluted with cooling water and storm drainage.

Defense Waste Processing Facility (DWPF-Area)

A new facility, the DWPF, is being constructed in S-Area (adjacent to H-Area) to (1) convert the radioactive material in the high-activity waste from the Separations Areas into a borosilicate glass matrix that can be shipped to a Federal repository in the future, and (2) dispose of the salt solution, containing a small amount of radioactivity and hazardous concentrations of heavy metals, as concrete monoliths in the neighboring Z-Area. This facility is scheduled for completion in 1989. At this time, waterborne effluent is being generated from sanitary treatment and construction activities such as the concrete batch plant and shops. Wastewater from the concrete batch plant is treated by adjusting pH in a pond and releasing the water through an outfall. Wastewater from the shop flows through an oil/water separator before discharge through an outfall.

When the DWPF is operational, the only source of liquid radioactive release will be the condensate from the DWPF general-purpose evaporator. Monitored condensate will be pumped to FMC by pipeline.

Liquid wastes will include chemically contaminated wastewater and sanitary wastewater. Chemically contaminated wastewater will originate from ash basin effluent, coal-fired spills and washdown, coal-pile runoff, and chemical contamination of rainwater runoff. Streams from these sources will be collected, blended, and treated in a Chemical and Industrial Waste Treatment Facility before being discharged to the environment. Secondary effluent from the sewage-treatment plant will be disposed of by spray irrigation on land.

Central Shops (CS-Area)

The Central Shops Area (CS-Area) has a variety of functions, including equipment storage, painting, carpentry, automotive repair, asphalt storage, blacksmithing, construction storage, concrete mixing, structural iron working, coal sampling, and Fire Department training. All these functions are performed in support of SRP operations and maintenance.

The SRP HP Department maintains 19 environmental monitoring sampling points within the CS-Area. NPDES monitoring of the four regulated outfalls includes cooling water, sanitary wastewater, vehicle wastewater, concrete batch plant wastewater, and Automotive Shop wastewater.

Wackenhut Services, Inc. (700-TC/U-Area)

Wackenhut Services, Inc., which provides security services for the SRP, has a ground support facility for the Helicopter Support Facility in the area TC-2 Pad. These facilities include a hangar with administrative offices and operations space, a helicopter takeoff/landing pad and parking/refueling area, an access road with a vehicle parking area, and ground support equipment. In addition, the University of Georgia has laboratory facilities in this area (SREL).

Sources of surface-water discharges include artificial streamwater from the laboratory, sanitary wastewater, boiler blowdown, and Water Treatment Facility discharges. These streams are discharged through three NPDES-regulated outfalls.

Railroad Classification Yard (Y-Area)

The Y-Area is located off Road B near Barnwell, South Carolina. It consists of many railroad tracks and a switching yard where railroad cars are classified by destination. This area also contains a track maintenance building, track scale house, and locomotive shop. One NPDES outfall for locomotive washwater is regulated.

Stormwater Runoff

Stormwater on the SRP site is controlled in some areas where the possibility of contamination with chemicals or radioactivity is great, but uncontrolled in most areas. Controlled areas include containment basins or sumps for chemical or hazardous waste storage areas and areas such as the Tank Farms. As stormwater is collected in sumps or containment basins, it is sampled to ensure that the water is adequately treated before release to surface waters. Stormwater from the Tank Farm areas is monitored for radioactivity and can be diverted to the retention basin if activity is detected.

Uncontrolled areas include 17 outfalls that are not regulated under the NPDES Permit as well as open storm ditches near 3 closed Burning/Rubble Pits (631-1G, 3G, and 5G), one active scrap lumber burn site (631-2G), and the Low-Level Waste Burial Ground (643-G and -7G). Only one stormwater outfall is regulated under NPDES (Outfall E010). In 1984, these uncontrolled stormwater runoff discharges were monitored in the Stormwater Monitoring Program required by the South Carolina Department of Health and Environmental Control (SCDHEC) for renewal of the NPDES permit. Parameters such as flow, temperature, pH, total suspended solids (TSS), oil and grease, surfactants, N as NO_3 , heavy metals, organics, and pesticides were measured. Site personnel indicated that no problems were identified and that the State was satisfied with the results.

3.3.3 Environmental Monitoring Program

The following subsections describe the five environmental monitoring programs conducted at SRP to monitor surface-water quality. These programs include

NPDES Monitoring, Surface Water Monitoring, Drinking Water Monitoring, Fish Monitoring, and Sediment Monitoring.

3.3.3.1 NPDES Monitoring

Currently, SRP has 71 outfalls regulated by the NPDES Permit administered by SCDHEC under Permit Number SC 0000175. Table 3-23 describes the outfalls by location, effluent source, receiving waters, and sample parameters. Approximately 110 additional outfalls are monitored for process control, but results are not reported to the State since these outfalls are not NPDES-regulated.

All NPDES-regulated outfall samples are collected by the SRL's HP personnel in this self-monitoring program and are analyzed by Environmental Testing, Inc., an off-site contractor. One exception is analysis for fecal coliform in sanitary wastewater samples. This test is conducted on the site at the 772D-Laboratory, since this sample must be run within 24 hours of collection. Frequency of sampling is dictated by the permit, but in general, once-a-month sampling is conducted. Some of the 4,000 or more parameters measured, however, may be obtained daily, weekly, quarterly, or annually.

Various techniques are used to collect samples, depending on permit requirements. Stream pH is measured in the flowing stream and in a grab sample. Volatile organics are collected in glass vials with personnel ensuring that air is not entrained into the sample. Both instantaneous grab and 24-hour grab samples are taken to measure other parameters such as oil and grease, TSS, heavy metals, anions, or organics. Sample bottles are prepared for the sampling team by the laboratory. Sample preparation and preservation techniques as well as chain-of-custody were appropriate, although improvements in these procedures have been recommended in the 1986 EPA Multi Media Report (EPA, 1987). (See Section 4.4 for further discussion.)

TABLE 3-23 NPDES-REGULATED OUTFALLS

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
A-AREA	A001	Process Sewer--Internal sewer from labs, engineering annex, compressor bldg., control house, manipulator repair shop, pollution control stack; external runoff	TB	BOD, TSS, O&G, T
	A003	Nonprocess cooling water--Internal sewer from chlorine bldg; cooling tower, cafeteria, refrigeration bldg; external runoff	TB	TSS, O&G, Cr, T
	A005	Nonprocess cooling water--Steam condensates, steam cleaning, animal holding pens, and cooling water	TB	BOD, Fecal, TSS, O&G, T
	A011	Nonprocess cooling water--Internal sewer from fire station, training school & lab bldg, laboratory office, control house; external runoff	TB	TSS, O&G, T
	A014	Process water--From electrode position, cooling wastewater, laser research facility wastewater, and treated groundwater	TB	BOD, TSS, Cr, TCE, Tetrachloroethylene, 1,1,1-Trichloroethane, T
	A015	Sanitary wastewater	TB	BOD, TSS, Fecal

(a) BDC = Beaver Dam Creek; FMC = Four Mile Creek; IGB = Indian Grave Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Three Runs Creek

(b) Flow and pH are measured at all outfalls with one exception. pH is not measured for outfall T001. TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biological Oxygen Demand TCE = Trichloroethylene

Source: NPDES Permit #SC0000175

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE TWO

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
C-AREA	C001	Nonprocess cooling water--Internal sewers from reactor building, engine house, cooling water pump house, misc. bldgs; external runoff	FMC	TSS, O&G, Fecal, T
	C003	Nonprocess cooling water--Internal sewers from reactor bldg, engine house, filter/softener plant	FMC	TSS, O&G, T
	C004	Process water--Includes C-reactor cooling water, service wastewater, neutralization water	FMC	TSS, O&G, T
	C004A	Sanitary wastewater	FMC	BOD, Fecal, TSS
D-AREA	D001	Process sewer--Includes cooling water, neutralization water, and internal drains from heavy water facilities	BDC	TSS, O&G, H ₂ S(d), T
	D001A	Sanitary wastewater	BDC	BOD, TSS, Fecal
	D001B	Coal pile runoff	BDC	Al, Fe, Mg, Mn, SO ₄ , Zn, TSS
	D001C	Ash basin discharge	BDC	O&G, TSS
	D003	Nonprocess cooling water--Includes powerhouse washdown water and water treatment, plant wastewater	SR	TSS, O&G
	D005	Overflow from filter backwash surge basin	SR	TSS
	D006	Process sewer--Includes cooling, powerhouse washdown, and heavy water process water	SR	TSS, O&G, T, Fecal

(a) BDC = Beaver Dam Creek; FMC = Four Mile Creek; IGB = Indian Grave Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Three Runs Creek

(b) Flow and pH are measured at all outfalls with one exception; pH is not measured for outfall T001 TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biological Oxygen Demand; TCE = Trichloroethylene; H₂S = Hydrogen Sulfide; Al = Aluminum; Fe = Iron; Mg = Magnesium; Mn = Manganese; SO₄ = Sulfate; Zn = Zinc

(c) Applies only if heavy water plant is in operation

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE THREE

Location	Outfall Number	Effluent Source	Receiving ^(a) Water	Sample Parameters ^(b)
DWPF	DW001	Effluent from concrete batch plant	UTRC	TSS
	DW002	Oil/water separator	UTRC	O&G
	DW003	Sanitary wastewater	UTRC	BOD, TSS, Fecal
	DW004	Nonprocess cooling water to be added 1989	UTRC	BOD, TSS, O&G, T, Cl
F-AREA	F001 and F002	Nonprocess cooling water--includes internal sewer from canyon bldg, control lab, and cooling tower; external runoff	UTRC	TSS, O&G, T
	F003	Nonprocess cooling water--includes internal sewer from manufacturing bldg, equipment delivery bldg, and metallurgical bldg stack; external runoff	UTRC	BOD, TSS, O&G, T
	F003A	Sanitary wastewater	UTRC	BOD, TSS, Fecal
	F005	Nonprocess cooling water and steam condensate from internal sewers in the refrigeration and metallurgical bldgs, external runoff	UTRC	TSS, O&G, T
	F007	Ash basin discharge	UTRC	TSS, O&G
	F008	Process sewer--includes neutralization, cooling, steam condensate, and process wastewater from chemical feed bldg, powerhouse, sewage treatment plant, laundry, coal pile runoff basin, ash basin, and cooling tower; external runoff	UTRC	TSS, O&G, T

- (a) BDC = Beaver Dam Creek; BDC = Four Mile Creek; GB = Indian Grave Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannan River; TB = Tins Branch; UTRC = Upper Three Runs Creek
- (b) Flow and pH are measured at all outfalls with one exception. pH is not measured for outfall F001. TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biological Oxygen Demand; TCE = Trichloroethylene; Cl = Chlorine

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE FOUR

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
F-AREA (CONTINUED)	F008A	Sanitary wastewater	UTRC	BOD, TSS, Fecal
	FS001 and FS002	Nonprocess cooling and greenhouse water	UTRC	Fecal
H-AREA	H002	Nonprocess cooling water and steam condensate from manufacturing bldg, storage & process facility, and reclamation bldg; external runoff	UTRC	TSS, O&G, T
	H004	Nonprocess cooling water and steam condensate from canyon bldg; external runoff	UTRC	TSS, O&G, T
	H006	Nonprocess cooling water from canyon stack, canyon exhaust fan house, canyon exhaust filters, and additional canyon sand filter; external runoff	UTRC	TSS, O&G, T
	H007	Nonprocess cooling water and cooling tower blowdown	UTRC	TSS, O&G, T, Cl
	H008	Process sewer including cooling water steam condensate, neutralization, and powerhouse wastewater; external runoff	FMC	TSS, O&G, T, Fecal
	H008A	Ash basin discharge	FMC	TSS, O&G
	H012	Process sewer from internal sewers in manufacturing bldg, receiving basin for offsite fuel, chemical feed bldg, reservoir & pumphouse, and retention basin; external runoff	FMC	TSS, O&G, SO ₄ , T

(a) BDC = Beaver Dam Creek; FMC = Four Mile Creek; IGB = Indian Grave Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Three Runs Creek

(b) Flow and pH are measured at all outfalls with one exception; pH is not measured for outfall T001 TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; Cl = chlorine; BOD = Biological Oxygen Demand; TCE = Trichloroethylene; SO₄ = Sulfate

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE FIVE

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
H-(CONTINUED)	H013	Sanitary wastewater	FMC	BOD, TSS, Fecal
	H016	Process wastewater from effluent treatment facility (future use)	UTRC	NH ₃ , Mn, NO ₃ , T, U, TOC, Al, Ni, TSS, Zn, Hg, Pb, Cu, Cr, O&G, BOD
K-AREA	K001	Stormwater that receives some cooling water	IGB	TSS, SO ₄ , O&G, T
	K006	Nonprocess cooling water from powerhouse, includes ash sluice leakage and powerhouse wastewater; external runoff	IGB	TSS, O&G, T
	K008	Nonprocess cooling water from reactor bldg, engine house, emergency diesel generator and fuel oil storage, and standby powerhouse external runoff	IGB	TSS, O&G, T
	K010	Nonprocess cooling water from reactor bldg, basin deionizers, engine house, He storage tank, and cooling water pump house; external runoff	IGB	TSS, O&G, T
	K011	Process sewer from internal sewer in reactor bldg, cooling water effluent pump, filter and softener plant, clarification plant, and precipitators	IGB	TSS, O&G, T
	K012	Sanitary wastewater	IGB	BOD, TSS, Fecal

(a) BDC = Beaver Dam Creek; FMC = Fort Meigs Creek; IGB = Indian Gravel Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Toccoa River; CR = Lower Toccoa River; CR = Lower Toccoa River; CR = Lower Toccoa River.

(b) Flow and pH are measured at all outfalls with the exception of outfall K001. TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biological Oxygen Demand; TOC = Total Organic Carbon; NH₃ = Ammonia; Mn = Manganese; NO₃ = nitrate; U = uranium; TOC - Total Organic Carbon; Al = Aluminum; Ni = Nickel; Zn = Zinc; Hg = Mercury; Pb = Lead; Cu = Copper; Cr = Chromium; SO₄ = Sulfate

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE SIX

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
L-AREA	L007A	Sanitary wastewater	SC	BOD, TSS, Fecal
	L008	Nonprocess cooling water	SC	TSS, O&G, T
	L010	Stormwater	SC	O&G, TOC, COD
M-AREA	M004	Treated wastewater from liquid effluent treatment facility	TB	Al, Pb, Ni, Cu, Cr, Cd, Zn, CN, Ag, U, NO ₃ , PO ₄ , O&G, TSS
	M005	Water discharged from air stripper	TB	TCE, Tetrachloroethane
P-AREA	P005	Ash basin discharge	MB	TSS, O&G
	P007	Nonprocess cooling water from reactor bldg, engine house, powerhouse, and standby pump house; includes powerhouse wastewater and external runoff	MB	TSS, O&G, Al, Fe, T
	P013	Process sewer including neutralization, reactor process, and cooling water; external runoff	SC	TSS, O&G, T
	P014	Sanitary wastewater	SC	BOD, TSS, Fecal
	P019	Reactor cooling water	PP	TSS, O&G, T
	PP001	Storm and cooling water	PP	TSS, O&G, T

(a) BDC = Beaver Dam Creek; FMC = Four Mile Creek; IGB = Indian Grave Branch; MB = Meyers Branch; PB = Perm Branch; PP = Pat Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Three Runs Creek

(b) Flow and pH are measured at all outfalls with one exception; pH is not measured for outfall T001 TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biological Oxygen Demand; TCE = Trichloroethylene; Al = Aluminum; Pb = Lead; Fe = Iron; Ni = Nickel; Cu = Copper; Cr = Chromium; Cd = Cadmium; Zn = Zinc; CN = Cyanide; Ag = Silver; U = Uranium; NO₃ = nitrate; PO₄ = Phosphate

TABLE 3-23 NPDES-REGULATED OUTFALLS
PAGE SEVEN

Location	Outfall Number	Effluent Source	Receiving(a) Water	Sample Parameters(b)
CENTRAL SHOPS	S002	Nonprocess sewer including automotive shop and cooling wastewater	FMC	BOD, TSS, O&G, Fe, Al, T
	S008	Stormwater and some cooling water	PB	TSS, O&G, T
	S011	Sanitary wastewater	PB	BOD, TSS, Fecal
	SU14	Nonprocess cooling water and vehicle washrack wastewater	PB	TSS, O&G, T
TGU AREA	T001	Artificial stream water	UTRC	Flow only
	T005	Boiler blowdown, cooling water, and neutralized acid solution	UTRC	BOD, TSS, O&G, T
	T007	Sanitary wastewater	UTRC	TSS, BOD, Fecal, Cl
TNX AREA	X004	Cooling water from pilot plant bldg	SR	TSS, O&G, T
	X008	Nonprocess wastewater from glass filter bldg, chemical semiworks bldg, engineering test facility, domestic water well, and cooling tower blow down	SR	TSS, O&G, Al, Fe, T
	X011	Stormwater	SR	Flow only
	X013	Sanitary wastewater	SR	BOD, TSS, Fecal
	X014	Process discharge from ORF and ETP	SR	TOC, BOD, Benzene, Phenol
Classification Yard	Y001	Nonprocess wastewater including cooling water and locomotive wash water	MB	BOD, TSS, O&G, T

(a) BDC = Beaver Dam Creek; FMC = Four Mile Creek; PB = Indian Grave Branch; MB = Meyers Branch; PB = Pen Branch; PP = Par Pond; SC = Steel Creek; SR = Savannah River; TB = Tim's Branch; UTRC = Upper Three Runs Creek
(b) Flow and pH are measured at all outfalls with one exception on pH is not measured for outfall T001. TSS = Total Suspended Solids; O&G = Oil and Grease; T = Temperature; BOD = Biochemical Oxygen Demand; TOC = Trichloroethylene; Fe = Iron; Al = Aluminum; Cl = Chlorine

In addition to required monitoring of the NPDES-regulated outfalls, both regulated and nonregulated outfalls may be monitored at the discretion of the area's environmental personnel or outfall custodians for process control purposes. Environmental and Chemical Science Inc., on-site personnel, or General Engineering Laboratory routinely collect this process control information. Sample parameters are selected by outfall custodians. In general, parameters include temperature, flow, pH, oil and grease, and TSS. In some cases, individual custodians have installed additional monitoring systems, such as pH meters, upstream of the outfall to more accurately identify sources of effluents creating compliance problems at their outfall.

Since many processes on the site generate cooling waters with elevated temperatures, NPDES-regulated outfalls have included temperature compliance points. The primary thermal streams of concern are generated from reactor operations and the 400D-Area power plant. These streams can be in excess of 70°C at the point of discharge. In addition, cooling water or steam condensates from powerhouse operations or other heat exchange operations such as evaporation are discharged in at least one outfall per area. These waters do periodically exceed the 90°F temperature limit required by the NPDES; in general, the exceedances occur in the summer months when ambient temperatures are higher.

Currently, the site is operating under a temperature variance as part of the 1984 Consent Order and Memo of Understanding. (See Section 2.3 for details.) Until the site completes its obligations on thermal mitigation as required by the Consent Order, temperature compliance points have been reduced to six locations: FMC, BDC, and SC at the Savannah River, Par Pond below the dam in LTRC, mid L-Lake, and below the L-Lake dam in SC. By approximately March 1990, the temperature compliance points will again be enforced at designated outfalls. At that time, thermal mitigation projects for the reactors and required thermal studies are scheduled for completion.

Review of the NPDES reports indicated about 99 percent compliance. No trends in noncompliance were observed. Sanitary wastewater outfalls were the type of outfall most commonly out of compliance with pH, BOD, and TSS exceedances.

3.3.3.2 Surface Water Monitoring

The SRP operations release radioactive and chemical contaminants to the SRP streams and the Savannah River. These releases originate directly from the operating facilities or indirectly from seepage basins. Releases to surface water are monitored at NPDES-regulated outfalls (see Section 3.3.3.1), nonregulated outfalls receiving storm and nonprocess water, and in the SRP streams and the Savannah River.

Monitoring activities are conducted at several sites along the streams and river to identify and control releases as well as to evaluate the effect of SRP operations on water quality. Sampling locations are shown in Figure 3-9. Stations are located to provide point source monitoring as well as multi-source monitoring within various on-site streams. Along the upper reach of FMC for example, 10 separate radiological monitoring stations are employed to monitor and evaluate releases from the Separations Areas' point source and contributions from the F- and H-Areas Seepage Basins and Low-Level Radioactive Waste Burial Ground through shallow groundwater outcroppings.

Radionuclide monitoring stations were established before plant startup at five Savannah River locations. Two of these river stations, upriver and downriver of SRP, are the focus of weekly radioactivity monitoring for concentrations of gross alpha, gross beta, tritium, and specific gamma-emitting radionuclides in river water.

Similarly, routine monitoring of SRP streams has been conducted for radioactivity since before plant startup to determine the total inventory of radionuclides in the streams. Total maximum quantity of radionuclides released through 1984 that have been decay corrected are as follows: 4.69 Ci of Co-60, 62.90 Ci of Sr-90, 0.0187 Ci of Cs-134, 378.71 Ci of Cs-137, and 0.09 Ci of Pu-238. The largest inventory is Cs-137 that was released to SC from P-Reactor (165.2 Ci) and to LTRC from R-Reactor (131 Ci).

Tritium concentrations are also monitored. Historically, tritium transport in streams and the river has decreased since 1964, when approximately 143,000 Ci

STREAM AND RIVER SAMPLE LOCATIONS

FIGURE 3-9

were transported to the Savannah River. In 1985, about 22,260 Ci of tritium were transported in the streams from direct releases and migration. Total tritium transported in the river was 24,100 Ci (Zeigler et al., 1986b). Tritium concentrations in the SRP streams can be summarized as follows: 2,700 pCi/L in UTRC, 28,000 pCi/L in BDC, 300,000 pCi/L at the discharge point from the Low-Level Radioactive Waste Burial Ground to FMC, 1,100,000 pCi/L in FMC below 200-Area operations, 20,000 pCi/L in PB, 9,200 pCi/L in SC, and 3,300 pCi/L in LTRC. In general, these values reflect concentrations of tritium as the SRP streams cross Road A and represent stream composition at the lower regions of the creeks before they enter the Savannah River. Some sampling points indicated tritium concentrations as high as 5,200,000 pCi/L; this concentration was measured at Indian Grave Branch, which receives effluents primarily from K-Area. Drinking water limits for tritium are 20,000 pCi/L; DOE guidelines are 2,000,000 pCi/L H-3. Therefore, concentrations of tritium in the SRP streams exceed both standards in some locations.

Although the streams are monitored at various locations for radioactivity, in general, the outfalls are not monitored for radionuclides. This type of monitoring is not required by the NPDES Permit with one exception: uranium is reported for Outfall M004 (wastewater released from the LETF). There is a Trebler located upstream of the A014 Outfall, which receives water from Outfall M004; the Trebler is used to collect composite samples of water that are analyzed for uranium. These values are not reported to the State, however.

Water quality data for the SRP streams are summarized in Appendix I. Comparison of the streams with the Savannah River and Region 1 of UTRC (control sampling point for comparison) indicates that the streams receiving cooling waters have concentrations of chemical constituents similar to those of the Savannah River, probably because of the distribution of Savannah River water through the reactors and subsequent discharge to the SRP streams.

3.3.3.3 Drinking Water Monitoring

Drinking water is monitored both at the SRP and downstream of the SRP at two public water treatment facilities located at Beaufort and Jasper Counties, South Carolina, and at Port Wentworth near Savannah, Georgia. Samples of raw and finished treatment water at these two facilities are collected daily and composited monthly. The samples are analyzed for tritium (H-3), alpha, and nonvolatile beta. In 1985, alpha concentrations in the raw water for both plants averaged 0.12 pCi/L and finished water averaged 0.07 pCi/L. This concentration is less than the concentration in the Edisto River (0.48 pCi/L) which is used as a control sample (see Table 3-19). It is consistent with the concentration found in other regional water sources (Zeigler et al., 1986b). Nonvolatile beta concentrations averaged 1.6 pCi/L in both raw and finished water at both facilities. This concentration is comparable to concentrations in the Edisto River; it appears to be higher than other regional drinking water sources that have concentrations ranging from 0.23 to 1.3 pCi/L. However, up to 2.6 pCi/L alpha and 5.1 pCi/L beta can be attributed to naturally occurring radium and thorium that are known to exist in the geographical area of the SRP (Zeigler et al., 1986a). Tritium concentrations averaged 3,000 pCi/L with a maximum of 4,500 pCi/L at both facilities in raw and finished water. Concentration of H-3 in the downstream water is an order of magnitude greater than H-3 found in the Edisto River or in other regional drinking water sources as a result of the SRP operations. (See Table 3-19).

On the SRP site, a total of 25 domestic systems exist, but only 14 systems are designated as public water supplies. Except for the D-Area drinking water, which is supplied by the Savannah River, well water is the source of drinking water.

All drinking water on the site is routinely monitored for bacteriological, chemical, and radiochemical parameters. Selected parameters are reported monthly to the State for the D-Area only, since this facility uses surface water rather than well water as a source. Residual chlorine and bacteriological analysis from daily water samples is included in the report to the State.

Well water is sampled daily, usually for pH and residual chlorine. Weekly bacteriological analysis is also performed. All bacteriological tests are conducted on the site at the 772D-Laboratory; this laboratory has interim permit status from the State. In addition to routine sampling of these parameters, TSS, color, alkalinity, conductivity, corrosivity, metals, anions, and volatile organics are reported annually for all major wells. Radiological parameters are reported quarterly. In the 700A-Area, monthly monitoring for chlorocarbons (i.e., chlorinated hydrocarbons) is conducted to ensure that contaminated groundwater is not entering the domestic water supply. These samples are taken at the well and at two drinking water systems located in 784A and 735A. All reported parameters for drinking water supplied by wells are for internal site use only and are not reported to the State.

3.3.3.4 Sediment Monitoring

Sediments in SRP streams, the Savannah River, and the Savannah River Swamp, including Creek Plantation Swamp, are routinely monitored for both radiological and chemical constituents. Radiological monitoring has been conducted since 1975 at six locations above, adjacent to, and below the SRP. In addition, nine stream locations have been monitored since 1977; SC, PB, FMC, and LTRC are included, with UTRC used as a control. Special radiation measurements were also conducted in 1971, 1973, and 1982 on the LTRC floodplains to assess radionuclide inventory in these sediments. Radioactive constituents of concern include Co-60, Sr-90, Cs-137, Pu-238, Pu-239, and Pu-240. Data on K-40, a naturally occurring material, are also collected. Sediment monitoring programs help ensure that unknown or unpredicted changes in the inventory are not occurring.

Both routine and accidental radioactive releases have occurred over the years, contributing to the inventory of material in stream sediments. Most notable was the release of 25 curies of Cs-137 and 1 curies Co-60 to SC prior to 1961. The source of this material was shielding and cooling water contaminated by failed fuel elements. Both the SC corridor and the off-site swamp area (Creek Plantation Swamp) were contaminated.

Creek Plantation Swamp is monitored to determine whether changes in radiological conditions are occurring. Comprehensive radiation measurements, including thermoluminescent dosimeter (TLD) gamma radiation measurements, contamination distribution by aerial radiation measurements, and analysis of vegetation, soil, and fish samples, are conducted every 5 years. The last examination was conducted in 1985 in conjunction with the L-Reactor startup. In 1985, the TLD radiation measurements ranged from 0.16 to 01.97 mR/day (Zeigler et al., 1986a). Direct radiation is discussed in Section 4.3. During the 1985 examination, analysis of swamp sediments indicated that the following maximum concentrations of radiochemicals were present in the top 8 cm: 110 pCi/g Cs-137, 0.05 pCi/g Pu-238, and 0.36 pCi/g Pu-239. In 1974, Cs-137 was present in concentrations of up to 527 pCi/g. (Values are given on dry weight basis.)

Streambed and floodplain sediments in on-site floodplains have historically received radionuclide releases from SRP operations in excess of levels normally associated with global fallout. Radionuclide concentrations in the Savannah River floodplain generally do not indicate any radioactive contributions from the SRP operations, with the only exception occurring in the off-site Creek Plantation Swamp sediments.

In the on-site streams, Co-60, Sr-90, Cs-137, Pu-238, Pu-239, Pu-240, and K-40 have been detected. Between 1983 and 1985, slightly elevated concentrations of Co-60 (0.02 to 3.4 pCi/g) was detected in FMC downstream of the Separations Area. In one location in SC, 26 pCi/g Co-60 was found in samples taken in 1983. (Gladden et al., 1985) Between 1977 and 1985, Sr-90 was found in the FMC floodplain in concentrations up to 13.8 pCi/g.

3.3.3.5 Fish and Seafood Monitoring

Savannah River fish are collected upriver, adjacent to, and downriver of the SRP, and at the mouth of the Savannah River. These fish are analyzed by gamma spectrometry. Results of the analyses on 223 fish collected during 1985 are presented in Table 3-40 of the 1985 Environmental Report (Zeigler et al., 1986a). Cesium-137 was the only gamma-emitting radionuclide detected; measurable

levels were found in 33 of the 223 fish collected. Except for two fish, Cs-137 concentrations in fish were 1 pCi/g or less. The two fish with concentrations greater than 1 pCi/g were both crappie that were collected adjacent to SRP. The maximum Cs-137 concentration in these two fish was 4.4 pCi/g. The average concentration in fish collected adjacent to SRP in 1985 was 0.11 pCi/g. Assuming an annual consumption of approximately 25 pounds of fish containing 0.11 pCi/g of Cs-137, the HP Department has calculated a 50-year dose commitment of 0.06 mrem.

On-site fish were trapped in SRP streams, Par Pond, and Pond B. Cesium-137 was the only man-made gamma-emitting radionuclide detected in fish. The maximum concentration of Cs-137 in stream fish was 6 pCi/g in a bream collected from SC at Road A. (See Table 3-40 of the 1985 Environmental Report; Zeigler et al., 1986b). Cesium-137 concentrations in fish from Par Pond and Pond B were elevated. These ponds contain higher Cs-137 levels as a result of past and/or current discharges from reactor facilities. The maximum and average concentrations of Cs-137, measured in fish from Pond B during 1985, were 100 pCi/g and 52 pCi/g, respectively. The highest level in fish from Par Pond was 48 pCi/g. Access to SRP streams and ponds is restricted, and no use of fish for food is allowed. Fish in Pond B and Par Pond are isolated and cannot escape to the river.

A review of historic fish monitoring data indicates that concentrations of Cs-137 generally decreased in most plant stream and pond fish between 1971 and 1979. However, the higher than normal Cs-137 levels in some fish from both on the site and off the site is undoubtedly due to SRP activities. Since 1979, concentrations of Cs-137 in fish have remained fairly constant according to the 1985 Environmental Monitoring Report (Zeigler et al., 1986b).

In addition to monitoring river and pond fish, edible seafood such as crabs, oysters, whiting, and croaker were collected at the river mouth near Savannah, Georgia, and analyzed by gamma spectrometry. These analyses indicated Cs-137 concentrations in all seafood collected were less than the minimum detectable concentration of approximately 0.3 pCi/g.

Fish and seafood are not routinely analyzed for other than gamma-emitting radionuclides. Tritium concentrations in aquatic animals are assumed to be the same as the average tritium concentrations in the water from which they are collected.

3.3.4 Findings and Observations

3.3.4.1 Category I

None

3.3.4.2 Category II

1. Potential for Sediment Contamination from the New TNX Basin. The intermittent overflow from the New TNX Seepage Basin may be contaminating sediment beyond the basin area.

Flow from the basin overflow combines with the sanitary wastewater outfall into a watercourse that is not clearly defined. Consequently, water velocity is reduced and a marshy area is forming; formation of the marsh increases the potential for heavy metals present in the basin overflow to contaminate soils.

In the fourth quarter of 1985, sediment samples were taken from areas beneath and areas adjacent to the basin. Five sampling locations were selected; three within the basin, one in the outfall gully, and one in a pristine area. Sediment cores were taken to a depth of 1.5 m. Chemical analysis data for the cores within and adjacent to the basin indicated that elevated levels of barium, nickel, chromium, lead, nitrates, phosphate, and sodium were detected in the top 0.15 m of sediments. Phenol and thorium were detected in one layer of sediment cores outside the basin. (Note that nine layers of sediment cores were analyzed.) Extraction Procedure (EP) toxicity tests performed on sediment samples indicated that concentrations of each of the metals analyzed for were below 1 percent of the guideline concentration provided by the EPA.

This basin is active, however, and has continued to receive process effluents that have occasionally exceeded established drinking water standards for cadmium, chromium, lead, and mercury. Furthermore, this is the only active basin on the site that is known to be discharging and not regulated by the SRP NPDES permit. Finally, it is one of the sites named in the NRDC lawsuit.

Sampling and analysis in the drainage course is planned to determine whether contamination of the sediments is occurring.

2. Potential for Contamination of Surface Water from Inadequate Spill Containment. Uncontrolled discharge of pollutants to the surface waters is possible from several areas of the SRP due to inadequate containment around storage tanks and processing equipment. Degradation of the environment in stream corridors and deltas could result.

Although all operating facilities have tanks and loading areas that are not fully contained, the 200-Area Separations Facility has the greatest potential for spills. A number of spills occurred at SRP during the on-site portion of the Survey, including a significant spill in the 200-Area which required soil to be excavated. The 200-Area includes the General Purpose Evaporators, Recovery Units, storage tanks, A-Lines, and associated piping systems. (See Section 3.3.2 for details on 200-Area pollution sources.) Collection and treatment of low-activity liquid wastes from the Separations Facility operations is conducted in the 211F and 211H Tank Farm Areas. Liquid wastes containing both radiological and chemical contaminants could be spilled from tanks, loading (transfer) areas, and piping in the Tank Farm Areas.

If sufficient volume is spilled or storm runoff is occurring at the time of the spill, radioactively contaminated liquids will enter nearby storm drains. Storm drain systems in these areas are not provided with continual monitoring and holdup or diversion capabilities. Therefore, radioactive liquids entering these drains may reach site surface drainage streams outside the Separations Areas and, eventually, the Savannah River. Such occurrences may result in contamination of drainage pathway sediments, in addition to the surface-water contamination.

A report listing known locations of radioactive surface contamination (Stephens and Ross, 1984) identified eight locations that resulted from previous spills in 211 and A-Line facilities of the F- and H-Separations Areas. Contaminated soil, resulting from a recent spill from a 211H-Area sump, was being remediated at the time of the Survey.

3. Radioactive Contamination of Sediments. Contamination of sediments in the Steel Creek corridor and in the off-site swamp area below SC (i.e., Creek Plantation Swamp) has occurred due to past reactor effluent discharges. The stream sediments are a source for off-site migration of radioactivity. Dose rates in the swamp area would be above the DOE guidelines for an unrestricted area if the swamp were populated.

Prior to 1961, secondary cooling water and disassembly-basin effluents from L- and P-Reactors were discharged to SC. Between 1961 and 1973, approximately 276 curies of Cs-137 were released to the creek. Approximately 200 curies of that amount were released in effluents from the P-Reactor disassembly basin during a period from 1964 to 1968. The source of contamination was failed fuel elements stored in the basins at this facility. Releases of the activity resulted in contamination of sediments along the SC drainage pathway, including the swampy area downstream of the confluence of SC with the Savannah River.

Cesium-137 concentrations as high as 2,600 pCi/g have been reported in the sediments along the floodplain; contamination has been found as deep as 1 meter below the surface. In 1985, Cs-137 levels of 91 pCi/g in sediment from the SC delta and up to 114 pCi/g from the Creek Plantation Swamp were measured. These concentrations exceed the guidance level of 15 pCi/g Cs-137, typically used by the Nuclear Regulatory Commission (NRC) for release of land areas for unrestricted use by the general public. The off-site swamp area is largely uninhabited and inaccessible except for occasional hunters or fishermen.

4. Potential Contamination of Wetlands. Washdown water from the 700A-Area Powerhouse may be contaminating sediments in a wetland area below Outfall A008.

The A008 Outfall consists of discharges from both internal and external sewers at the 300/700-Area Powerhouse and the overflow from service and domestic water storage tanks. This outfall is not NPDES-regulated, although a permit request was submitted to the SCDHEC in 1980. The permit request was rejected because the wetland area was not connected with any other surface water. It is anticipated that this type of outfall will be regulated under a new permit.

At the time of the Survey, team members observed a flow of about 450 gpm of water that was blackened by suspended solids. A review of the monitoring data for the outfall indicated that more than 75 percent of the monthly samples taken at this outfall over the previous year had a pH greater than 9.0.

Sampling and Analysis for heavy metals, oils, and organics will be conducted to determine the potential for contaminating the receiving wetlands.

3.3.4.3 Category III

1. Contamination of Swamp near Old TNX Basin. Chemical and radiochemical contamination has migrated from the Old TNX Basin to the old outfall discharge delta. The result of this migration has been a loss of forest canopy that appears to be spreading in a southerly direction.

The Old TNX Basin was built to receive wastewater from pilot-scale chemical processing tests; it was closed in 1981. Water in the basin was discharged to a swamp area that sits below the basin, the basin was backfilled and capped, and monitoring wells were placed around the site. Basin sediments contained cerium-243, cerium-244, plutonium-239, plutonium-240, radium-228, thorium-228, uranium-235, silver, chromium, copper, nickel, cyanide, and mercury. Inventories indicate that the basin contained 0.5 Ci of radioactivity, primarily depleted uranium, and 318 kg mercury.

The gully and delta area were characterized in 1984 (Kingley et al., 1986a). Contaminants in the swamp sediment included chromium, mercury, radium-228, thorium-228, H-3, uranium-235, and uranium-238. Results indicated that radionuclide contamination was concentrated along the discharge gully leading away from the basin; presence of this contamination along the gully was confirmed by a Survey team member with a field instrument. The mercury contamination was concentrated in spots throughout the swamp and chromium contamination was fairly well dispersed. All contamination detected in the swamp was localized in the top 0.6 meter of sediment.

Vegetation and water samples were also taken during the characterization study. Mercury uptake was localized in the plant roots at concentrations greater than 10 ppm; chromium was also found in vegetation. Swamp water contained about 50 times the maximum contaminant level (MCL) proposed by EPA for mercury and 700 times the MCL proposed for gross beta. Gross alpha, radium, silver, copper, chromium, and cyanide were also found in this water at elevated levels.

Stressed vegetation was observed in the delta. Based on comparison of aerial photographs, this stressed area appears to be increasing in size along a seasonal waterway. It is not clear whether the additional area of stressed vegetation was caused from a spread of chemical contaminants or beaver activity in the area.

Sampling and Analysis will be conducted in the delta to determine the cause for extension of the area with stressed vegetation.

2. Potential Human Health Problem from Thermophilic Pathogens. Populations of thermophilic microorganisms are greater in the upper 35 to 50 percent of L-Lake than those populations found in similar regional lakes, because of the elevated water temperatures in the mixing zone. Consequently, a balanced indigenous ecosystem may not exist, resulting in the site's inability to meet 316(a) demonstrations and posing a potential health problem to human populations both on- and off-site.

Specifically, three pathogenic microorganisms can be found in L-Lake: Naegleria fowleri, Legionella pneumophila, and Aromonas hydrophila. Naegleria is introduced into the body through the respiratory system and attacks the nervous system, causing encephalitis-like symptoms that are usually fatal. Naegleria is present in warm fresh water systems throughout the United States, particularly in the southeast, and its growth is increased by elevated water temperatures. It can exist as a viable organism in both pathogenic and nonpathogenic forms and it can encyst. Researchers do not know what conditions cause the microorganisms to exist as either of the two forms. Furthermore, they are not sure of the conditions that can be withstood by the cysts or whether Naegleria can be transmitted to wildlife.* Investigations are under way to answer these types of questions. Legionella, which causes Legionnaire's disease, and Aromonas, which causes red sores in fish that can be transmitted to humans after prolonged exposure, are also found in the lake. (See Section 3.3.1.3 for discussion).

Currently, precautions are taken by on-site personnel collecting water samples from L-Lake and the associated outfall. At the outfall, water may become an aerosol, allowing the viable pathogen Naegleria to enter the human respiratory system. As a result, personnel avoid the area or are required to wear masks when in the area. Both on-site and off-site personnel may potentially be exposed to pathogenic Naegleria by inhaling dusts containing the cysts. The cysts could potentially be transported by water or air currents to the shores of the lake, along the Steel Creek corridor, floodplain and delta area, or to the Savannah River.

Based on current information, there is no evidence of such migration nor has there ever been a death, either on the site or off the site near SRP, attributed to this organism. However, L-Lake has been operating only since 1985 and large populations of the microorganism may not have had time to migrate downstream. With time and an increase in lake population, the possibility of such migration may increase. Therefore, the real potential for off-site exposure is not known. Legionella and Aromonas may pose less of a health threat to off-site personnel, because these microorganisms do not appear to encyst and the populations should be reduced as the water temperature drops and dilution occurs in the Savannah River.

* Personal communications with SRL personnel on January 20, 1987.

3. Thermal Impact on SRP Streams. Four SRP streams and associated wetlands have been impacted by thermal discharges from reactor operations and 400D-Area power operations. The impact has included loss of forest canopy and stream erosion. Since these wetland areas serve as a natural breeding ground for many species, loss of wetlands is a sensitive environmental issue.

Thermal impact is evidenced by loss of forest canopy along the stream corridors and deltas. (See Section 3.3.1.2 for details on canopy loss.) Different flow rates, temperature levels, and geomorphologies have affected the rates of loss and regrowth in these impact areas. Canopy loss has been due to (1) elevated water temperature and subsequent reduction in dissolved oxygen; (2) changes in water levels that vary due to changes in reactor operating levels, and changes in river level fluctuation due to a dampening effect from construction of dams; and (3) increased erosion and sedimentation that are caused by both loss of vegetation and dramatic increases in stream flow during reactor operation (Tinney and Ezra, 1986).

Recent trends suggest that the BDC delta has stabilized and is in the early stages of recovery. Steel Creek delta is more fully recovered, since L-Reactor was shut down in 1988 and L-Lake is currently used to mitigate thermal affects. The FMC and PB deltas, however, have not stabilized and canopy loss appears to be increasing annually (Tinney and Ezra, 1986).

At this time, the site is operating under a Consent Order until various thermal mitigation activities can be completed. A thermal mitigation study, a 2-year comprehensive cooling water study, a Clean Water Act section 316 (a) and (b) study of Par Pond, and preparation of an EIS have been completed (South Carolina Consent Order 84-4-W, (Thermal Consent Order August 22, 1984).

4. Stressed Vegetation in the 400-D Area. Contaminated surface water from the 400D-Area Power Facility appears to have caused stressed vegetation in two locations.

The first impacted area is located north of the ash basin (488D). It is a wedge-shaped region less than 0.5 hectare in area. All vegetation is dead and blackened; the soil and a small quantity of surface water have a yellowish appearance. The source of the surface water is most likely runoff from the coal rejects that have not been properly graded on the ash-basin surface or seepage from the ash basin when it was active. (See Section 4.5.2 for related finding.) The second area of stressed vegetation is in the BDC delta where approximately 8 to 10 hectares have been affected by coal flyash basin effluent discharges.

Sampling and analysis in the area north of the ash basin is planned to determine the type of contamination present.

5. Potential Contamination of Surface Water from 241H Area Tank Spill. A previous liquid waste spill in the 241H-Area Tank Farm resulted in Cs-137 contamination of soil and sediment along a drainage ditch that currently discharges through Outfall H008. This contamination may potentially enter Four Mile Creek and the Savannah River. (See Section 4.1.1 for a description of the tank farm.)

In May 1967, a spill of radioactive liquid waste occurred from Tank 9 in the 241H Tank Farm. A description of the incident in Waste Management Operations, Final Environmental Impact Statement (ERDA-1537, September 1977) indicates that "up to several hundred" curies of activity reached a storm sewer outfall, where it was retained by a temporary dam. Water from this impoundment was transferred to a seepage basin, and the drainage stream was rerouted. A report by Stephens and Ross (1984), indicates that the majority of the contaminated soil was excavated and the new streambed banks were covered with asphalt. The area near this outfall, then known as Outfall 52, has been marked with concrete pylons, identifying it as a radioactively contaminated site. The Stephens and Ross report indicates 5-10 curies of activity remain at this area; the marker pylons observed during the on-site Survey indicate 200 curies of Cs-137. It is not clear whether the marker pylon figures indicate the total amount of contamination in the initial spill or the residual after cleanup.

Monitoring by the Survey team, using a Ludlum micro-R meter, identified elevated direct radiation levels along the banks of the drainage stream. The highest radiation levels, 4 to 5 mR/hr, appear to be associated with sediments, accumulated on the south side of the stream, approximately 50 feet downstream of the outfall. These findings indicate that residual contamination is present along this stream. This contamination may potentially enter the waters and sediments of FMC and the Savannah River through erosion and/or leaching.

Sampling and Analysis is planned to determine radionuclide levels in stream sediments.

6. Contamination of Surface Waters with Tritium. Releases of wastewaters containing tritium to on-site streams, lakes, and seepage basins are resulting in elevated concentrations of tritium in surface waters on the site and in the river adjacent to the site. Plans to discontinue use of seepage basins could result in an increase in these concentrations, subsequently increasing the dose to off-site populations via drinking water.

Many of the SRP streams exceed the drinking water standard of 20,000 pCi/L tritium (used as guidance, not regulation) and in some areas exceed the DOE guidelines of 2,000,000 pCi/L. This observation was made in the U.S. General Accounting Office's report (GAO, 1986) and is documented in the Environmental Monitoring Report (Zeigler et al., 1986b). Elevated concentrations of tritium in the on-site surface waters are not technically a violation of the EPA drinking water standards because of the restricted nature of the site, and the standards applicability to "public water systems" (FR 41 28402). However, several states have set a precedent of applying health-based standards to on-site portions of surface waters to which pollutants are discharged, regardless of the fact that such waters will not be used by or even accessible to the public. For example, the State considers SRP streams to be Class B waters and has applied some health-based standards such as fecal coliform, to the on-site streams.

Tritium is released to the streams directly or through migration from seepage basins. Of the 25,030 Ci of tritium released in 1985, 18,910 Ci or 75 percent was attributed to migration from seepage basins (Zeigler et al., 1986b). Future plans for wastewater treatment include installation of wastewater treatment facilities and elimination of the seepage basins. Currently, the basins provide holdup time for wastewater that allows some decay of tritium before release to on-site streams. Elimination of these basins could increase the concentration of tritium released to the streams, eventually increasing the concentration of tritium in the river. Since the river water is used as a drinking-water source downstream of the SRP, doses to off-site populations could increase with this potential increase in tritium concentrations. In 1985, concentrations of tritium at the downstream water treatment facilities averaged 3,000 pCi/L with a maximum of 4,500 pCi/L.

3.3.4.4 Category IV

1. Contamination of Stormwater Runoff. The stormwater runoff ditch in the TC/U-Area near the helicopter pad is inadequately designed, causing water to back up during heavy rains into a fueling pit and sump, resulting in contamination of this water with Jet A fuel.

Contaminated water must then be pumped to a drum for storage or allowed to flow to the environment through an unregulated outfall. If the water is allowed to flow to the outfall, uncontrolled release of Jet A fuel to the environment could occur. If the water is drummed, a suitable storage and handling procedure would be required to avoid accidental release of the water to the outfall. (See finding #3 in Section 4.1.2.2 for a related finding in TC/U-Area.) At the time of the Survey, a suitable procedure had not been established for handling this wastewater. Previously, the problem was compounded by collection of stormwater on the pad itself that emptied to the sump, resulting in mixing of fuel and water. Construction of a new pad that segregates fuel and water was to begin during the site visit, but the original stormwater runoff ditch was not going to be altered as part of this work.

2. Potential Contamination of Surface Water from Drainage Systems. Drainage system information for some areas on the site was not complete, and as a result, problems with discharges to outfalls were identified only after an uncontrolled release of chemical or radioactive material to surface waters has occurred.

In areas such as the F- and H-Area, where construction was heavy, pipe plugging was observed on three occasions during the Survey team visit. In one case, a containment wall around the H-Area Coal Pile had been temporarily removed. During a heavy storm, one of the stormwater runoff pipes became plugged and diverted water upward through a grating, across the ground where the containment wall had been, and down a nearby grating to an adjacent sewer line. This water then filled the coal pile runoff basin and overflowed to a normally dry outfall. The pH of this water was low. In a second case, stormwater flow near the F-Area Tank Farm overflowed the drainage system and emptied into a closed acid/caustic basin, washing away a corner of the basin. In a third incident, clay pipes used to transport liquid effluents to the acid/caustic basins were observed to be broken, allowing unknown leachates to enter the basin. The primary concern is that release of stormwater in tank farm areas be controlled to avoid inadvertent transport of radioactive material to the nearby surface waters. Both adequate drainage and complete knowledge of the drainage system are required to ensure this control.

3. Potential for Release of Radioactivity to Surface Water. Water discharged from the air stripper flows to Tims Branch through Outfall M005. This outfall is not monitored for radioactivity; consequently a potential for release of radioactivity to surface water exists.

Uranium in solution was discharged to the same seepage basin in the M-Area to which chlorocarbons were discharged. Since chlorocarbons subsequently contaminated groundwater via the seepage basin, it appears possible that uranium could have also entered groundwater through this pathway.

Uranium is monitored at a Trebler above Outfall A014 through which both the air-stripper water (via M005) and the LETF wastewater (via M004) flow. LETF wastewater is also a potential source for uranium and is monitored for uranium before release. However, the air-stripper water is not monitored prior to release.

PRELIMINARY

3.4 Hydrogeology

3.4.1 Background Environmental Information

3.4.1.1 Geology

The SRP lies within the Atlantic Coastal Plain Physiographic Province. This province is underlain by a wedge of unconsolidated and semi-consolidated sediments that begin at the Fall Line*, 20 miles northwest of the SRP, and increase in thickness to the southeast. These sediments overlie crystalline bedrock and/or Triassic sedimentary rocks. The sediments that overlie the bedrock in the vicinity of the SRP are on the order of 1,000 feet thick (Christensen and Gordon, 1983), and consist of gravel, sand, clay, and limestone.

The SRP is located on the Aiken Plateau, which is a relatively flat surface dissected by tributary streams of the Savannah River. The Aiken Plateau slopes to the southeast from the Fall Line and is bounded by the Savannah and Congaree Rivers to the southwest and northeast, respectively. The Plateau slopes from an elevation of about 650 feet near the Fall Line to an elevation of approximately 250 feet at the southeastern edge.

Figure 3-10 depicts a generalized geologic profile across the SRP from northwest to southeast. Each of the geologic units (except the bedrock) depicted on Figure 3-10 is discussed below. It should be noted that the nomenclature for many of the geologic formations underlying the SRP is changing. The formations discussed herein are based on those contained in Christensen and Gordon (1983) and Zeigler et al. (1986b).

* The Fall Line is typically the area where the crystalline rocks meet the edge of the Coastal Plain sediments. It is characterized by the occurrence of falls or rapids in large rivers.

GENERALIZED NW TO SE GEOLOGIC PROFILE ACROSS THE SAVANNAH RIVER PLANT FIGURE 3-10

1. Tuscaloosa Formation. The Tuscaloosa is the thickest formation at the SRP. It is on the order of 600 feet thick and consists of fluvial and estuarine deposits of sand, silt, and clay. The Cretaceous-age Tuscaloosa has been subdivided in the SRP area into specific units. These units are shown on Figure 3-11, which also presents a correlation between the site terminology and other stratigraphic interpretations of the South Carolina Coastal Plain (Christensen and Gordon, 1983). Figure 3-12 relates the units to the approximate age. The Tuscaloosa, therefore, consists of (from the bottom up):
 - o a basal unit of sandy clay about 40 feet thick
 - o a 300-foot-thick, medium to coarse sand
 - o a 40-foot-thick clay
 - o a 150-foot-thick, medium to coarse sand
 - o a 60-foot-thick clay, clayey sand, or sandy clay
2. Ellenton Formation. The Ellenton Formation is late Cretaceous or Paleocene in age and ranges from 0 to 100 feet thick near SRP. The Ellenton does not exist near the northwest boundary of the SRP. The Formation consists of an upper part comprised of gray silty to sandy clay and a lower part comprised of a medium to coarse clayey sand.
3. Congaree Formation. The Congaree Formation is a Claiborne-age, grey, green, and tan sand with layers of clay. In the northwestern portion of the SRP, it is a tan clayey sand. A green clay layer exists at the top of the Congaree. The clay layer appears to be continuous in the central portion of the SRP and discontinuous in the northwestern portion. The Congaree is approximately 120 feet thick.
4. McBean Formation. The McBean Formation is also of Claiborne age and is comprised of an upper and lower unit. The lower unit consists of a tan to white calcareous clayey sand. The upper unit consists of tan clayey sand.

GENERALIZED STRATIGRAPHIC SECTION AT SRP WITH TENTATIVE CORRELATION OF STRATIGRAPHIC TERMINOLOGY OF THE SOUTHWESTERN SOUTH CAROLINA COASTAL PLAIN

FIGURE 3-11

SYSTEM	SERIES		FORMATION	APPROXIMATE AGE (in millions of years)
Quaternary to Tertiary	Recent to Pliocene		Recent Alluvium Wicomico Formation; Sunderland Formation; Coharie Formation; Hazlehurst Formation	0-2
Tertiary	Miocene		Hawthorn Formation	24
	Eocene	Jackson Age	Barnwell Formation	39
		Claiborne Age	McBean Formation and Congaree(?) Formation	47
Cretaceous(?)	Upper		Ellenton Formation	70
Cretaceous	Upper		Tuscaloosa Formation	70
Triassic	Upper		Newark(?) Group	240
Paleozoic and Precambrian(?)			Basement Rock of the Carolina Slate Belt and Charlotte Belt	> 600

Source: Modified from Siple, 1967

STRATIGRAPHIC UNITS IN THE VICINITY OF AIKEN
AND BARNWELL COUNTIES, S.C.

FIGURE 3-12

The McBean is approximately 80 feet thick. Void spaces, a result of solution activity, have been encountered in the calcareous lower unit although no calcareous zones are known to exist in the northwestern portion of the SRP.

5. Barnwell Formation. The Barnwell Formation is Jackson (upper Eocene) in age. The Barnwell ranges in thickness from 0 in northeastern Aiken County to approximately 90 feet in southeastern Barnwell County. It consists primarily of clayey sands and sandy clays. Toward the center of the SRP, the Barnwell consists of a basal tan clay 10 to 15 feet thick, a silty sand from 0 to 40 feet thick, and a clayey sand 0 to 100 feet thick.
6. Hawthorn Formation. The Hawthorn Formation is Tertiary in age and ranges in thickness from 0 in northwestern Aiken County to about 80 feet in southern Barnwell County. The Formation consists of tan, reddish-purple and grey sandy clay with coarse gravel, limonitic nodules, and kaolinitic material.
7. Surficial Formations. Surficial Formations have been classified as:
 - o Tertiary alluvium of Pliocene age consisting of sand and gravel
 - o Terrace deposits of Pleistocene age
 - o Holocene alluvium consisting of poorly sorted sand, clay, and gravel

3.4.1.2 Hydrogeology.

The Coastal Plain sediments beneath the SRP contain the major water-bearing units. The sediments "...constitute a multilayer hydrologic system in which there are retarding beds and beds that transmit water more readily. Hydraulic properties vary for each of the hydrostratigraphic units, depending on their lithology." (Christensen and Gordon, 1983).

Groundwater flow direction is typically controlled by the depth of stream incision of the Aiken Plateau. As a result, the flow regime varies such that:

- (1) Shallow groundwater flow is governed by the location (depth) of small creek valleys.
- (2) Intermediate-depth groundwater flow is governed by the incision of the major tributaries to the Savannah River.
- (3) Deep groundwater flow (e.g., the Tuscaloosa Formation) is governed by the Savannah River valley.

The multilayer hydrologic system, therefore, results in lateral flow, which varies in direction with depth. In addition, both downward and upward vertical gradients occur within the SRP. According to Zeigler et al., (1986b), groundwater head decreases with increasing depth in the northwest portions of the SRP. This results in the potential for direct recharge of water to deeper sediments. At other areas of the SRP, there is an upward vertical gradient (or head reversal) between the Tuscaloosa and the Congaree Formations. The demarcation between areas of downward and upward vertical gradient at the SRP is still a subject of study.

Examples of the differences in head with depth are shown in Figures 3-13 and 3-14. Figure 3-13 depicts the vertical head relationships near M-Area in the northwestern portion of the site. Figure 3-14 depicts the head relationships near the center of the SRP. Additional changes in head relationships and flow regime impacts also occur in areas of groundwater withdrawal.

A discussion of each Coastal Plain geologic formation and its water-bearing properties is presented below.

1. Tuscaloosa Formation. The Tuscaloosa consists of an upper (150 feet thick) and a basal (300 feet thick) aquifer unit. A confining bed occurs at the top and base of the Tuscaloosa and also separates the upper and lower aquifers (refer to Figure 3-13). The Tuscaloosa has an average transmissivity of 118,000 gallons per day per foot (gpd/ft) with a reported range of between 50,000 and 200,000 gpd/ft. The Tuscaloosa is the most significant water-bearing formation at the SRP and in the region of the SRP. It serves as a major source of groundwater for industrial and drinking water supplies. Typical well yields can exceed 1,000 gallons per minute (gpm).

Source: Modified from Christensen and Gordon, 1983

VERTICAL HEAD RELATIONSHIPS NEAR M-AREA FIGURE 3-13

VERTICAL HEAD RELATIONSHIPS NEAR THE CENTER OF
THE SAVANNAH RIVER PLANT IN 1972

FIGURE 3-14

Groundwater flow within the Tuscaloosa generally proceeds from the recharge area (north of SRP) toward the discharge area (Savannah River valley). Figure 3-15 depicts the piezometric surface and direction of flow of groundwater of the Tuscaloosa Formation. Typical flow velocity was calculated by Siple (1967) at 180 feet per year (ft/yr) for the Tuscaloosa.

2. Ellenton Formation. The Ellenton Formation is hydraulically connected to the underlying Tuscaloosa and as such has not been separately defined. The lower portion of the Ellenton is permeable enough to be considered an aquifer. The upper portion of the formation likely acts as a confining bed in conjunction with a clay at the base of the Congaree. Data from the SRP indicate that the overlying Congaree and Ellenton are poorly connected hydraulically.

Piezometric maps, well yields, flow velocities and flow directions for the Ellenton have not been developed. It is assumed that the Ellenton flow direction is similar to that of the Tuscaloosa. Wells that are screened in the Tuscaloosa frequently are also screened in the Ellenton. Few wells are reported to be screened exclusively in the Ellenton.

3. Congaree Formation. The Congaree Formation forms a productive aquifer that is second only to the Tuscaloosa in the SRP area in terms of yield. The sand layers in the Congaree constitute the major producing zones. The green clay at the top of the Congaree (where it is present) allows for a major head difference between the Congaree and the overlying McBean. Median hydraulic conductivity for the Congaree is reported to be 37 gallons per day per ft² (gpd/ft²). However, values up to 1,000 gpd/ft² have been reported.

Flow in the Congaree is depicted in Figure 3-16. General flow is directed toward either Three Runs Creek or the Savannah River valley. Well yields have been observed at up to 660 gpm. The wells in the municipal well field at Barnwell, South Carolina have Congaree wells with reported yields as high as 400 gpm (Christensen and Gordon, 1983). A typical flow velocity for the Congaree is estimated to be 44 ft/yr.

PIEZOMETRIC SURFACE OF TUSCALOOSA FORMATION FIGURE 3-15

PIEZOMETRIC SURFACE OF THE CONGAREE FORMATION AT THE SAVANNAH RIVER PLANT ON MAY 11, 1982 FIGURE 3-16

4. McBean Formation. The McBean Formation is not considered a prolific aquifer at the SRP. Most of the formation is made up of clayey sands with median hydraulic conductivities of 3.2 gpd/ft² for the upper sand and 1.7 gpd/ft² for the lower "calcareous zone". Although not typically used for industrial or municipal supplies, the McBean does supply domestic wells. Yields of wells screened in the McBean were not reported in the information reviewed.

Downward flow from the McBean to the Congaree is impeded (at least in some areas of the site) by the green clay at the top of the Congaree. Lateral flow in the McBean is governed by the incision of local creeks such that the groundwater flow in the McBean is divided into subunits. This is exemplified on Figure 3-17, which shows the general flow directions of the McBean in the Separations Areas at the SRP. Note that flow is toward the incised valleys of FMC and UTRC. Velocity of groundwater has been estimated at approximately 12 ft/yr in the upper McBean and 7 ft/yr in the lower McBean.

5. Barnwell Formation. The Barnwell contains up to 100 feet of clayey sands that are known to provide adequate water supplies to domestic wells. It is not known to be used for municipal or industrial supplies. The reported median hydraulic conductivity is 1.0 gpd/ft² with a sand lens exhibiting a hydraulic conductivity of approximately 7 gpd/ft².

The Barnwell Formation typically serves as the water table aquifer at the SRP. Surface topography and incisement of small stream valleys govern groundwater flow. This is depicted in Figure 3-18, which shows the water table elevation contours in the Separations Areas at the SRP. Typical groundwater velocity for the Barnwell is estimated at 4 ft/yr. In the following sections of this report the term "shallow aquifer" typically is within the Barnwell Formation.

FIGURE 3-17
PIEZOMETRIC SURFACE OF THE UPPER PART OF
THE McBEAN FORMATION IN THE SEPARATIONS AREAS
AT THE SAVANNAH RIVER PLANT

Source: Modified from Christensen and Gordon, 1983

Source: Modified from Christensen and Gordon, 1983

**AVERAGE ELEVATION OF THE WATER TABLE IN THE SEPARATIONS
AREAS OF SAVANNAH RIVER PLANT DURING 1968**

FIGURE 3-18

6. Hawthorn and Surficial Formations. The Hawthorn and other surficial formations are not typically saturated at the SRP. As a result, they generally are not considered as aquifers although they may contain perched water. However, the Holocene Alluvium that occurs in the channels of the Savannah River and its main tributaries is typically saturated but is currently unused for groundwater supply.

3.4.1.3 Groundwater Use

In 1979 Christensen and Gordon (1983) performed a study of major groundwater users within a 20-mile radius of the SRP (Christensen and Gordon, 1983). This study resulted in the identification of 38 users of groundwater, which is pumped in excess of 5,000 gpd. This study found that:

- o Domestic water supplies principally use the Barnwell, McBean, and Congaree Formations.
- o Municipal and industrial water supplies are typically withdrawing groundwater from the Tuscaloosa Formation in Aiken County.
- o In Barnwell and Allendale Counties, some municipal users withdraw from the shallower McBean and Congaree Formations.

The total use of groundwater by the major withdrawers was close to 22 mgd. Table 3-24 presents a summary of municipal and industrial pumpers, which was compiled by Christensen and Gordon (1983). Figure 3-19 indicates the locations of the users. The SRP alone was pumping 6.4 mgd in 1979; by 1983 it was pumping in excess of 11 mgd. Table 3-25 summarizes SRP pumping rates by site area from 1968 through 1983.

The pumping of the Tuscaloosa at SRP is sufficient to change the upward vertical gradient from the Tuscaloosa to the Congaree in the vicinity of the pumping wells. Additionally, where the "head reversal" does not exist, the pumping tends to accentuate the downward vertical gradient.

Table 3-24

Pumpage for Industrial Supplies

Map Location*	User	Distance From Center of SRP (miles)	Population Served	Average Daily Use** (million gal/day)	Water-Bearing Formation	Type of Source
	Aiken County, Savannah River Plant					
20	A Area	6	2,131	1.52	Tuscaloosa	4 wells
21	F Area	2	800	1.73	Tuscaloosa	5 wells
22	H Area	0	825	2.53	Tuscaloosa	5 wells
23	U Area	4	110	0.11	Tuscaloosa	2 wells
24	Central Shops	7	600	0.22	Tuscaloosa	3 wells
25	TNX	8	50	0.05	+	1 well
26	Class. Yd	6	35	0.108 + +	+	1 well
27	U.S. Forest Service	7	70	+	Tuscaloosa	1 well
28	Graniteville Company	20	2,156	+	Tuscaloosa	1 well
29	J. M. Huber Company	18	+	2.23	Tuscaloosa	1 well
30	Augusta Sand & Gravel	22	+	0.95	Tuscaloosa	1 well
31	Cyprus Mines Corp.	20	+	0.375	Tuscaloosa	1 well
32	Florida Steel Corp	20	+	0.02	Tuscaloosa	1 well
33	Valchem	18	+	0.108	Tuscaloosa	1 well
	Allendale County					
34	Sandoz Co., Inc.	18	+	2.88	Tuscaloosa	1 well
	Barnwell County					
35	E. T. Barwick Ind.	16	400	0.25	Tuscaloosa	2 wells
	Future Industrial Supplies					
36	Barnwell NFP	11	450	0.29	Tuscaloosa Congaree	1 well 1 well
37	A. W. Vogtle NPS	15	+	0.04	Tuscaloosa Congaree	2 wells 3 wells

Source: Christensen and Gordon, 1983

* See Figure 3-19

** Data gathered in 1979

+ Data not available

+ + Pump capacity, not groundwater use

Table 3-24

Pumpage for Industrial Supplies
Page Two

Map Location*	User	Distance From Center of SRP (miles)	Population Served	Average Daily Use** (million gal/day)	Water-Bearing Formation	Type of Source
	Aiken County, Savannah River Plant					
1	City of Aiken	21	28,000	2.0	Tuscaloosa	Springs
2	Town of Jackson	10	3,152	0.175	Tuscaloosa	2 wells
3	Town of New Ellenton	8	4,000	0.300	Tuscaloosa	2 wells
4	Town of Langley	19	1,330	0.130	Tuscaloosa	2 wells
5	College Acres	13	1,264	0.065	Tuscaloosa	3 wells
6	Bath Water Dist.	19	1,239	0.325	Tuscaloosa	2 wells
7	Beech Island	17	4,500	0.300	Tuscaloosa	3 wells
8	Talatha	7	1,200	0.040	Tuscaloosa	2 wells
9	Breezy Hill	20	4,500	0.233	Tuscaloosa	4 wells
10	Burnettown	19	1,200	0.150	Tuscaloosa	2 wells
11	Montmorenci	14	4,232	0.423	Tuscaloosa	2 wells
12	Warrenville	19	788	0.300	Tuscaloosa	4 wells
13	Johnstown Howlandville Gloverville	19 19 19	1,560 1,232 1,440	0.144 0.100 0.144	Tuscaloosa	1 well
14	Belvedere	24	6,300	0.362	Tuscaloosa	5 wells
	Barnwell County					
15	Barnwell	16	6,500	4.0	Congaree	11 wells
16	Williston	12	3,800	0.700	McBean-Tuscaloosa	4 wells
17	Blackville	20	2,975	0.300	Tuscaloosa	3 wells
18	Hilda	22	315	0.009	Tuscaloosa	1 well
19	Elko	14	315	0.010	McBean	1 well
	Burke County, GA					
38	Girard	20	210	0.020	Tuscaloosa	3 wells

Source: Christensen and Gordon, 1983

* See Figure 3-19

** Data gathered in 1979

+ Data not available

+ + Pump capacity, not groundwater use

LOCATIONS OF MUNICIPAL AND INDUSTRIAL USERS
WITHIN A 20-MILE RADIUS OF THE CENTER OF
THE SAVANNAH RIVER PLANT

FIGURE 3-19

Table 3-25

Pumping Rates by Area at SRP, 1968 through 1983

Area	No. of Wells	Average Continuous Pumping Rate (gallons/minute)															
		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
A	4	1307	1471	1406	1241	1346	1361	1132	1142	1118	1164	1059	1091	1168	1360	1355	1600
F	6	1706	1792	1789	1625	1505	1531	1396	1023	1193	1210	1201	1318	1364	1404	1439	200
H	5	1467	1494	1585	1607	1567	1648	1599	1526	1724	1653	1762	1785	1822	1946	1989	2200
CS	3	70	65	65	65	65	65	90	95	115	150	150	150	150	150	150	200
D	2	220	210	200	190	180	0	0	0	0	0	0	0	0	0	0	0
U	2	150	150	150	100	100	100	100	100	75	75	75	75	75	75	75	50
C	2	0	0	0	0	0	0	0	0	0	0	0	0	0	75	200	300
K	2	0	0	0	0	0	0	0	0	0	0	0	0	0	75	200	250
L	2	0	0	0	0	0	0	0	0	0	0	0	0	0	75	75	250
P	2	0	0	0	0	0	0	0	0	0	0	0	0	0	75	200	350
TNX	3	35	5217	35	35	35	35	35	35	35	35	35	35	35	160	385	300
Total		4820		5233	4863	4798	4740	4327	3916	4240	4252	4482	4454	4614	5395	6068	7700
Total in millions of gallons per day		6.94	7.51	7.54	7.00	6.91	6.83	6.23	5.64	6.11	6.12	6.45	6.41	6.64	7.77	8.74	11.09

Source: Christensen and Gordon, 1983

3.4.2 General Description of Pollution Sources and Controls

3.4.2.1 Sources of Groundwater Pollution

Sources of groundwater pollution at the SRP consist of both characterized waste disposal areas and areas where the potential for contamination exists as a result of site operations. Over 160 known or potential sources of groundwater contamination exist at the SRP. The types of sources at the SRP of known or potential groundwater contamination include:

- o Seepage basins/retention basins
- o Ash basins/ash piles
- o Burning/rubble pits and/or other pits
- o Various landfills/burial grounds/waste sites
- o Coal piles/coal-pile runoff basins
- o Spill areas
- o Savannah River Laboratory (SRL) oil test site
- o Sludge disposal areas
- o Other miscellaneous sites.

Details on these sources are included in Sections 4.1 and 4.5.

The major identified sources of groundwater contamination at SRP include the:

- o M-Area Basin and associated chlorocarbon spills
- o F-, H- and K-Area Seepage Basins
- o Radioactive and Mixed Waste Burial Grounds.

Each of these sources has a major contaminant plume identified within the groundwater regime. However, these are not the only sources that have impacted the groundwater. In excess of 30 sites have impacted groundwater. Table 3-26 summarizes the known sources of groundwater contamination at the SRP. Evidence of these impacts is included in the discussion in Section 3.4.3.2 and additional information is presented in Appendix J.

TABLE 3-26

**SOURCES OF GROUNDWATER POLLUTION
(SITES WHERE GROUNDWATER HAS BEEN
IMPACTED BY SITE ACTIVITIES)**

1. R-Area Seepage Basins
2. F-Area Seepage Basins
3. H-Area Seepage Basins
4. P-Area Seepage Basins
5. K-Area Seepage Basins
6. C-Area Seepage Basins
7. Ford Building Seepage Basins
8. Old TNX Basin
9. K-Area Containment Basin
10. M-Area Basin and Spills
11. Radioactive and Mixed Waste Burial Grounds
12. F-Area Tank Farms
13. H-Area Tank Farms
14. F Canyon Building
15. SRL Seepage Basins
16. Chemicals, Metals, and Pesticides Pits
17. Silverton Road Waste Site
18. K-Area Acid and Caustic Basin
19. F-Area Acid and Caustic Basin
20. L-Area Acid and Caustic Basin
21. P-Area Acid and Caustic Basin
22. R-Area Acid and Caustic Basin
23. Metallurgical Laboratory
24. A-Area Burning/Rubble Pit
25. C-Area Burning/Rubble Pit
26. F-Area Burning/Rubble Pit
27. K-Area Burning/Rubble Pit
28. P-Area Burning/Rubble Pit
29. Metals Burning Pit
30. Old F-Area Seepage Basin
31. New TNX Basin
32. L-Area Oil and Chemical Basin
33. A-Area Waste-Oil Basin

3.4.2.2 Controls of Groundwater Pollution

There are two principal sites where controls have been instituted to mitigate groundwater contamination. These sites are the M-Area Chlorocarbon Plume and the Chemicals, Metals, and Pesticides (CMP) Pits. Each site is discussed in more detail below.

1. M-Area Remediation. In April of 1985 the SRP began operation of an air stripper in conjunction with 11 groundwater extraction wells. This system was designed to remove volatile degreaser solvents from the groundwater. The degreasers consisted mainly of trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane. The groundwater plume extends over a 1-mile length with the major vertical extent of contamination occurring in the Barnwell, McBean, and Congaree Formations. These formations are above the important regional aquifer that exists within the Tuscaloosa Formation. Contaminants in wells around the basin in the M-Area indicate that not only solvents have reached the groundwater, but also solutions containing heavy metals, nitrates, and radioactivity.

Cleanup of the groundwater is planned to continue until the level of chlorocarbons is acceptable to the State of South Carolina. To date, approximately 63,000 pounds of organics have been removed from the groundwater. The system operates 24 hours per day with a capacity of 400 gpm. Steps are currently planned to institute additional controls such as capping, excavating and backfilling, and stabilizing for the source areas of the contamination.

2. CMP Pits. The CMP pits were used primarily for disposal of nonradioactive volatile organic solvents and pesticides. Because of the potential for groundwater contamination, these pits were remediated in 1984 and 1985. The remediation consisted of the excavation of wastes and contaminated

soils, installation of a recharge system* (for future cleanup if necessary), backfilling of pits, and installation of a synthetic membrane cap. It is estimated that 99.5 percent of all waste originally in the pits was removed. Approximately 1,055 pounds of organic constituents are thought to remain.

Low levels of organic constituents have been detected in the groundwater samples obtained from monitoring wells at the CMP pits. Groundwater monitoring is continuing.

3. Other Sites. The SRP is in the process of preparing a site-wide Groundwater Environmental Impact Statement. This process is resulting in the generation of Environmental Information Documents (EIDs). The EIDs are designed to compile data for assessing soil and groundwater contamination and evaluate the closure options for various waste disposal facilities. As such, the EIDs are providing the SRP with potential groundwater controls (closure options) for many waste sites. However, implementation of these controls has not begun.

* The recharge system was designed so that water could be introduced (through a series of manholes and subgrade drains) into the base of the former pit area in order to flush contaminants out. A series of extraction wells would be installed adjacent to the pits to collect the "flushed" water.

3.4.3 Environmental Monitoring Program and Data

3.4.3.1 Savannah River Plant Monitoring Programs

General Description

On-site groundwater monitoring and reporting has been conducted in a routine manner since 1951. This surveillance program has been continuously maintained to determine the concentrations of radionuclides in the environment of the plant. The scope of the Environmental Monitoring Program at SRP has increased significantly during the years since plant startup. The types of wells sampled, the procedures for sampling, and the analytical procedures used in the laboratories are representative of these changes. Additionally, the National Environmental Policy Act (NEPA) and the Resource Conservation and Recovery Act (RCRA) have added further parameters and requirements to the monitoring program. Data are typically summarized in an annual report, titled "Savannah River Plant, Environmental Report", and special reports such as the "M-Area Groundwater Investigation", which is supplemented periodically with technical information. A discussion of the number of wells, their distribution, well construction details, and specifics on the individual aspects of the monitoring programs are presented in the following sections.

Well Locations

Over 5,000 wells exist at the SRP. These consist of:

- o Approximately 600 wells that existed prior to the construction of the SRP
- o Wells drilled during construction of the SRP
- o Wells installed for geologic and hydrogeologic studies
- o Foundation test wells
- o Water supply wells
- o Monitoring wells

Information on all wells is contained in a computerized central file. However, no map of all well locations exists, nor does a listing of wells by the aquifer monitored.

Current estimates by the SRP indicate that over 1,000 wells need to be properly abandoned. This fact was confirmed by observing the wells that were abandoned, open to the atmosphere, and in a deteriorated condition. Although a well abandonment program exists, it is not extremely active. Additionally, the existing well maintenance program is purely reactive; no preventive or proactive measures are currently undertaken.

According to Olson (1987), 576 wells are currently used in the SRP monitoring programs. These programs are conducted by the Health Protection (HP) Department. Table 3-27 presents a summary of the number of active wells dedicated to the monitoring program. A total of 804 wells are included as part of the Chemical Monitoring Program and 252 wells are part of the Radioactive Monitoring Program. Approximately 51 additional on-site wells are sporadically used for monitoring drinking water (see Table 3-28). Approximately 10 off-site production wells are also monitored. These programs, plus other specialized groundwater monitoring programs, are discussed in the following sections.

Wells in the HP chemical or radioactive programs are numbered according to the facility they are designed to monitor and the sequence in which they were drilled. Additionally, the leading symbol indicates the area in which the well is located. The following is a breakdown on what the well number indicates:

- o Coal-Pile Runoff Containment Basins: The well number has the area in which the basin exists and the code CB. An example would be CCB for the C-Area Coal-Pile Runoff Containment Basin, KCB for the K-Area Coal-Pile Runoff Containment Basin.
- o Rubble Pits: The code is RP and is preceded by the area code. Examples would be CRP for C-Area Rubble Pit and LRP for L-Area Rubble Pit.
- o Seepage Basins: The code is SB and is preceded by the area code. An example would be KSB for K-Area Seepage Basin.

TABLE 3-27
Active Well Summary
Health Protection Monitoring Wells

Chemical Monitoring Program	Number of Wells
Acid/Caustic Basin Wells: FAC, KAC, LAC, PAC, RAC	20
Background Wells: ABW, GBW	2
Burning and Rubble Pit Wells: ABP, ARP, CRP, CSR, DBP, FBP, KRP, LRP, PRP, RRP	40
CMP Pit Wells: CMP	20
Coal Runoff Containment Basin and Ash Basin Wells: ACB, CCB, DCB, FCB, HCB, KAB, KCB, PCB	33
F Canyon Wells: FCA 1N, 2D, 9D, 10A, 10D, 16A, 16D	7
Landfill Wells: LFW	15
Seepage Basin Wells: AMB, ASB, FNB, FSB, HSB, LSB, MSB, XSB, YSB	84
Silverton Road Wells: SRW	30
Waste Oil Retention Basin Wells: AOB, CSO, DOB, LCO	12
Other Site Wells: BRD, CDB, CSA, FAL, HCA, HR3, HR8, HWS, HXB, KDB, LDB, NGB, PDB, SCA	41
Total of Chemical Monitoring Program	304

Chemical and Radioactive Monitoring Programs	Number of Wells
Reactor Seepage Basin Wells: CSB, KRB, KSB, PSB	22
Other: SBG	5
Total of Chemical and Radioactive Monitoring Programs	27

Source: Olson, 1987

Table 3-27
Active Well Summary
Health Protection Monitoring Wells
Page Two

Radioactive Monitoring Program	Number of Wells
Burial Ground/Grid Wells: BG, MGA, MGC, MGE, MGG	77
F Canyon Wells: FCA (all 14 FCA wells are under this program)	14
R-Area Wells: RSA, RSB, RSC, RSD, RSE	49
Seepage Basin Wells: F, H	28
Tank Farm Wells: FTF, HTF	60
Z and ZW Wells	23
214-H Well	1
Total of Radioactive Monitoring Program	252
Total of all Wells (Less 7 FCA wells duplicated in both programs)	576

Table 3-28
DRINKING WATER WELLS MONITORED* BY HEALTH PROTECTION AT SRP

905-6G	905-101F
905-7G	905-104L
905-10G (Jackson Barricade)	905-105L
	905-107G (Railroad Yard)
905-11G (Pistol Range)	S-Area T.C. Well
905-20A	
905-26G (Railroad Yard)	
905-28G	905-109G (Road 2 @ 125)
905-29L	905-110G (Road 3 @ 125)
905-31A	905-111G (Road 4 @ 125)
905-44H	905-112G (Domestic Well A Area)
905-45H	905-113G (Pistol Range)
905-48H	905-114G (681-3G pumphouse)
905-53A	
905-59U	905-26G (Railroad Yard)
905-66H	
905-67U	
905-68A	
905-71G (Central shops)	
905-72G (Central shops)	
905-74G (Williston Barricade)	
905-79F	
905-80H	
905-82A	
905-83G (Central shops)	
905-85G (681-1G Pumphouse)	
905-86G (Forestry)	
905-87H	
905-88H	
905-89G (Par Pond Lab)	
905-90C	
905-91C	
905-92P	
905-93P	
905-94K	
905-95K	
905-96K	
905-97G (CMX-TNX)	
905-99A (SREL Process Well)	
905-100F	

*Monitoring is sporadic and variable.

Source: Data summaries obtained on-site from R. Turner,
January 1987

- o Acid/Caustic Retention Basins: The code is AC and is preceded by the area code. An example would be KAC for the K-Area Acid/Caustic Retention Basin.
- o Ash Disposal Basins: The code is AB and is preceded by the area code. An example would be KAB for the K-Area Ash Disposal Basin.
- o Background Wells: The code is BG or BW and is preceded by their location. An example would be NBG for the Naval Fuels Background Well.
- o Sanitary Landfill: The code is LFW which stands for Landfill Well.
- o Burning/Rubble Pits: The code is BP and is preceded by the area code. An example would be ABP for the A-Area Metals Burning Pit.
- o Other Wells: The codes are designed to indicate the facility being monitored and the area in which the monitoring is taking place. Some examples are: FAL, F-Area A-Line; HXB, Heat Exchanger Repair Facility Basin; and AMB, A-Area Metallurgical Laboratory Seepage Basin.

Distribution of Wells

With the exception of the wells used for nonmonitoring purposes, most site wells are drilled where it is apparent that operations of a facility could allow liquid waste to infiltrate into the ground. Therefore, all major facilities at SRP have monitoring wells, with the majority being around facilities that discharge large volumes of contaminated water. The aquifer which contains the major amount of contamination and which has the largest number of monitoring wells is the shallow aquifer. The shallow aquifer is typically less than 150 feet below the land surface. There are relatively few monitoring wells in the deep aquifer and knowledge of the migration of contaminants into and through the deep aquifer is limited. Most of the site production and domestic wells utilize the deeper aquifers. The Tuscaloosa is the aquifer most commonly used on the site for the production wells. Thirty-three wells are currently used for water supply at the SRP.

Well Construction

Early wells used for monitoring of radioactivity were generally constructed of steel casing of varying thicknesses and having diameters from 4 to 8 inches. However, site personnel indicate that casing materials varied as did construction details. In some cases, aluminum fuel rod casings were used for monitoring well construction. Screens were sometimes constructed of stainless steel and the lengths varied. Lead packers were used as seals between the steel casing and the screen. Because the wells were built by different groups and used to monitor different contaminants, the "as built" details of many wells are unknown.

The installation of monitoring wells around waste disposal sites changed in order to comply with RCRA. In order that monitoring facilities and wells complied with Federal and State requirements and could be relied on to give consistent data, a new set of procedures were designed. All wells are now drilled and installed in accordance with procedures and specifications designed and written by Du Pont. These new procedures require that "shallow" wells be constructed of 4-inch-diameter TriLoc schedule 40 polyvinyl chloride (PVC) (wide threads) without the sealing gasket. Screens would either be stainless steel wire wrap with a 0.016-inch slot size or PVC with slot cuts of 0.016 inch. This size screen is based upon the gravel pack that is used in all wells. For "deep" wells over 150 feet, black carbon steel casing having a wall thickness of 0.237 inch and a diameter of 4 inches is used. Well screens are 4 inches in diameter and are constructed of either all stainless steel or stainless steel wire-wrapped schedule 40 PVC pipe. It is estimated that in excess of 1,000 monitoring wells have been constructed on the plant site.

Site Programs

The majority of groundwater monitoring at SRP is carried out by various groups within HP. Health Protection is responsible for chemical, radiological and drinking water monitoring programs.

Groundwater monitoring is also associated with specific programs or site areas. The frequency of monitoring and the parameters selected for analysis are determined by an individual custodian or environmental coordinator of a particular site or group of sites. Guidance on these selections is provided by environmental staff in the Energy and Environment (E&E) Department.

At present, the SRP is attempting to consolidate all groundwater monitoring programs so that sampling, analysis, and coordination are the responsibility of one group. Up until 1986, the programs were extremely fragmented. Some programs still operate somewhat independently from the consolidated program.

Chemical Monitoring Program

Groundwater is monitored at 46 waste sites as part of the Chemical Monitoring Program. Four of these sites are RCRA hazardous waste sites. Additional wells in this program include background wells, containment basin wells, wells outside the F-Area Canyon Building, etc. A total of 304 wells are included in the program. The specifics regarding sampling parameters and frequencies are part of an 80+ page document and are not presented in this report. Typically, waste site wells are monitored once yearly for the parameters shown on Table 3-29 and quarterly for:

- o pH
- o Temperature
- o Specific conductivity
- o Total organic carbon (TOC)
- o Total organic halogens (TOH).

The parameters that are monitored may be changed (usually increased) and sampled more frequently if site-established "flagging levels" are exceeded. Sampling for the Chemical Monitoring Program began in 1981 in response to RCRA requirements. Sampling is conducted by a subcontractor to SRP with SRP giving direction and assistance to the subcontractor. Sampling procedures and protocol were observed while they were being conducted.

TABLE 3-29
TYPICAL ANALYTICAL PARAMETERS MONITORED YEARLY IN GROUNDWATER IN
THE CHEMICAL MONITORING PROGRAM

Coliform	Sodium
pH	Lead
Specific conductivity	Selenium
Temperature	Chloride
Turbidity	Fluoride
Silver	Nitrate
Arsenic	Sulfate
Barium	Gross alpha
Cadmium	Gross beta
Chromium	Radium
Iron	Phenols
Mercury	TOC
Manganese	TOH

Source: Ziegler et al., 1986b

The RCRA groundwater sampling is from the newer type PVC wells. Most wells in the Chemical Monitoring Program have dedicated submersible pumps, which are left in the well. Samples are obtained from the pump discharge line at the surface after purging. Purging volumes are calculated based on casing volumes and monitored by flow meters dedicated to each well. In general, the RCRA sample program follows U.S. Environmental Protection Agency (EPA)-established protocols for chain of custody, field measurements, and sample handling. However, the following was noted:

1. Purge water from the wells is discharged directly to the ground surface, which may create surface contamination, especially where radionuclides are the contaminants;
2. The use of submersible pumps and the aeration of sample water as it is discharged to sample bottles may affect analytical results for volatile organics; and
3. The flow meters dedicated to each well are never checked for accuracy and no routine program is in place to calibrate these flow meters.

In addition, EPA conducted a RCRA site inspection in July 1986 and reviewed the Groundwater Monitoring Program. The Survey team received the EPA review on February 13, 1987, and EPA had the following findings with regard to the adequacy of SRP's RCRA Sampling and Analysis Plan:

1. In guidance on groundwater sampling, EPA has stated that submersible pumps should not be used to sample wells where volatile organics are of concern. SRP contends that it has conducted a study that shows that it is obtaining the best sampling results by using submersible pumps. A report on the results of this study was obtained by EPA for further study.
2. When determining the metal content of groundwater samples collected for RCRA, EPA policy requires that the sample be analyzed for total metals. SRP's plan calls for groundwater samples to be analyzed for dissolved metals only. It does not require analysis for total metals. This does not meet EPA policy.

3. Many of the groundwater samples collected for SRP's RCRA Program are radioactive. SRP's plan does not contain any procedure for screening these samples before they are shipped to off-site laboratories, although Du Pont states that it is standard operating procedure (SOP) to screen all samples before they leave SRP. If there is a standard procedure, it should be included in the plan to ensure that samples are screened.
4. Regarding sampling, it is standard practice at SRP to discharge directly to the ground all water removed during the monitoring well evacuation process. Depending upon the level of contamination at a particular well, this evacuated water could pose a potential threat to health and the environment. SRP's procedures should be revised so that evacuated water that poses a potential threat is collected and properly disposed of.

Radiological Monitoring Program

Groundwater is monitored at approximately 17 major site areas as part of the Radiological Monitoring Program (see Table 3-27). A total of 279 wells are included in this program. Sampling frequency varies from monthly to yearly depending on the area monitored and the well location. The parameters most commonly monitored are:

- o Gross alpha
- o Nonvolatile beta
- o Tritium

Limited additional analyses are also performed on selected wells primarily located in the Tank Farms and the K Seepage Basin Areas. These analyses are for:

o Cr-51	o Sb-125
o Co-60	o Cs-134
o Zr-95, Nb-95	o Cs-137
o Ru-103	o Ce-144
o Ru-106	o Sr-89,90

Radiological monitoring is conducted primarily by HP personnel. This sampling effort was begun in the early 1950s as part of the health protection efforts at the SRP. Data have been reported each year since the start of plant operation. The program was reviewed for expansion in 1970 to include off-site wells. At present both on-site and off-site data are reported.

Sampling procedures and protocol were also observed for the Radiological Monitoring Program. Collection of samples was observed during a typical monthly sampling event performed by HP personnel. The sampling of on-site wells is generally performed by obtaining water samples from the discharge lines of pumps dedicated to each well. Pumps have variable capacities ranging from a few gallons per minute to several hundred gallons per minute from industrial and domestic wells. Procedures and protocols are consistent with the Chemical Monitoring Program. During the sampling, it was observed that published procedures (Du Pont SOPs) were not always followed when samples were retrieved from the wells. For example:

- o The electrical water level-tape was not wrapped in aluminum foil as per procedure.
- o A pH meter was used that was not the one prescribed in the Procedure Manual.
- o No information was included in the Procedure Manual for the specific conductance meter.
- o No procedures were available for use of a hand pump in place of Freon for the samplers.

Drinking Water Monitoring Program

Drinking water supplies are routinely monitored at 22 on-site locations and 14 off-site locations. The primary constituents monitored include gross alpha, nonvolatile beta, and tritium. The specifics regarding this program are discussed in Section 3.3.

M-Area Monitoring

In 1979, work began in the M-Area to determine if contamination by degreasers had occurred in the shallow aquifer. RCRA-type wells were installed around the M-Area Settling Basin, Lost Lake, A-Area Coal-Pile Runoff Containment Basin, SRL Seepage Basins, and the Silverton Road Waste Site. The first round of samples was collected from these wells in 1981 and they showed contamination around the M-Area Settling Basin and the Silverton Road Waste Site resulting from degreasers. As a result, extensive drilling has taken place to define the contamination by degreaser solvent in the soil and groundwater in and around the M-Area. The present sampling consists of 14 wells that are sampled quarterly. The chemical parameters vary from well to well but include as a minimum:

- o Specific Conductance
- o Barium
- o Sodium
- o Nitrate as Nitrogen
- o Tetrachloroethylene
- o Total Organic Halogens
- o pH
- o Chromium
- o Nickel
- o Lead
- o Total Organic Carbon
- o Trichloroethylene

Present results indicate that high levels of contaminants still exist in the shallow aquifer beneath the M-Area.

Other Special Studies

The following is a listing of Environmental Research and Management Programs at SRP that relate directly or indirectly to groundwater monitoring and remedial work currently being performed.

- (1) M-Area Settling Basin and vicinity interim stabilization action
- (2) Waste Site Characterization Program
- (3) Waste Management and Groundwater Protection Environmental Impact Statement

- (4) Site-Wide Hydrogeologic Baseline Investigation
- (5) Groundwater Flow Modeling Program
- (6) Speciation and transport of heavy metals and radionuclides
- (7) Water Chemistry.

3.4.3.2 Savannah River Plant Environmental Monitoring Data

Until 1979, when it was decided that RCRA-type wells were to be constructed on the SRP, data were collected from any well available regardless of the condition of the well or the procedures used to collect the samples. Since that date, standardized wells have been constructed, standard sampling procedures are being followed, and specific laboratories are used for the analyses. The end result is that data before 1979 do not appear to be of much value in that they are scattered and at times not representative of the media. Data since 1979 are far more acceptable and more clearly demonstrate what is occurring in the groundwater as a result of SRP activities.

However, up until 1984, when many wells were replaced, galvanized steel wells were still in general use in the Chemical Monitoring Program. These wells were found by the SRP to affect the water quality analyses for metals. Also, prior to the third quarter of 1984, no groundwater samples for metals analyses were filtered.

Historic Practices

In the early years of operation of the SRP, most liquid waste was discharged to streams or swampy areas around the various facilities. As time passed, these practices were discontinued and seepage basins, settling ponds, tanks, containment basins, and retention basins were constructed to hold the liquid discharges. As a result of these facilities, downward migration of contaminants occurred until they entered the local groundwater beneath the various facilities. The contaminants then migrated toward the nearest downgradient surface body of water. As a result, extensive monitoring of groundwater takes place at SRP, studies have been

conducted to determine the direction and rate of groundwater flow, and a study of the downward rate of migration of contaminants into deeper aquifers is being considered. Since radiological and nonradiological contaminants are in the shallow aquifer and the groundwater rate of movement is slow, monitoring of contaminants in the groundwater can be expected to continue for many years after new technology replaces the existing discharge methods.

Data Handling, Coordination, Distribution, and Interpretation

Most of the analytical data generated in the sampling program is maintained in HP's computer data base at SRP. Results provided by the prime subcontractor laboratory (Envirodyne Engineers) for the Chemical Monitoring Program are transmitted to the SRP in computer-ready diskettes. Other programs on the site are in the process of upgrading their procedures in order to incorporate into the HP (chemical program-type) data base. The SRP goal is to have all analytical data from the Chemical and Radioactive Monitoring Programs and other specialized programs in a site-wide data base.

Once entered into the data base, the analytical data can be manipulated. At present, these data are organized such that facility custodians or environmental coordinators routinely receive:

- o Computer printouts of quarterly analytical data
- o Computer printouts of analytical data that exceed the SRP flagging criteria
- o Quarterly reports of data for all wells.

The interpretation of analytical data, trends, and water level fluctuations is the responsibility of the facility custodians. This procedure has, in the past, resulted in a somewhat fragmented approach to groundwater assessments. At any given area within the SRP, there may be three or more custodians responsible for various facilities with groundwater monitoring. As a result, although an area might have an extensive groundwater monitoring program in place (at multiple facilities), there may be no overall interpretation of the data for the area as a whole. This phenomenon is currently being addressed by the site groundwater coordinator.

Monitoring Data

Numerous general site documents and specific reports on groundwater data and assessments were reviewed. In addition, computer printouts of quarterly groundwater analytical data were obtained.

These printouts included data from 1984 through the second quarter of 1986. In addition, a printout of all flag values was also obtained. A description of the flagging criteria listed by constituent is included as Table 3-30.

Two flagging criteria levels were established by SRP in the first quarter of 1986. The first flag was chosen to identify chemical constituents above detection or background levels, and the second flag to identify chemical constituents at a slightly higher analytical level.

The first-level criteria set the trigger concentrations at the current analytical detection limits or above the approximate background concentration level for each constituent in SRP groundwaters.

The second-level trigger concentrations are higher and are usually set at one-half of the EPA's Interim Primary Drinking Water Standards (DWS), or if no DWS exist, at some appropriate level based on regional values.

Based on the data review, the following subsections were developed. Each subsection discusses the general type of facility involved and then discusses the individual facilities. Each discussion is intended to be brief and presents only general information on groundwater flow (if appropriate) and contaminants. Tables on groundwater contaminants are included in Appendix J for most sites. These tables were developed from the "flagged" computer printouts. Additional data are included from the EIDs.

Seepage Basins

The first seepage basin to be used at the SRP was constructed in 1954 and was used to discharge liquid radioactive waste from the F-Area. Basins were constructed at

TABLE 3-30
FLAGGING CRITERIA USED BY SRP FOR GROUNDWATER ANALYSES*

Parameter	Unit	First Level		Second Level	
		Criteria	Standard	Criteria	Standard
Ag	µg/L	2.0	DL	25	1/2 DWS
As	µg/L	1.0	DL	25	1/2 DWS
Ba	µg/L	50	~2x BG	500	1/2 DWS
Be	µg/L	2.0	DL	20	10x DL
Cd	µg/L	2.0	DL	5	1/2 DWS
Cl	µg/L	10,000	~ 2x BG	125,000	1/2 IIDWS
Conductivity	umho/cm	50	~2x BG	Trend vs. Time	
Cr	µg/L	4.0	DL	25	1/2 DWS
Cu	µg/L	20	~2x BG	500	1/2 IIDWS
Cn	µg/L	5.0	DL	100	1/2 USDWS
F	µg/L	500	1x8 NDWS	2000	1/2 NDWS
Fe	µg/L	150	1/2 IIDWS	300	IIDWS
Hg	µg/L	0.4	2x DL	1	1/2 DWS
Mn	µg/L	25	1/2 IIDWS	50	IIDWS
Na	µg/L	5,000	~2x BG	Trend vs. Time	
Ni	µg/L	8.0	2x DL	175	1/2 IHA
NO ₃ (as N)	µg/L	3,000	~2x BG	10,000	DWS
Pb	µg/L	20	~2x BG	25	1/2 DWS

Source: Olson, 1986B

BG = Approximate Background Concentration at SRP.

DL = Analytical Detection Limit.

DWS = U.S. Environmental Protection Agency's (EPA) Primary Drinking Water Standards.

IHA = EPA Interim Health Advisory.

IIDWS = EPA's Secondary Drinking Water Standards.

NDWS = New Drinking Water Standard.

SDWS = U.S. Public Health Drinking Water Standard.

* All tables showing G-W contaminant data in Section 3.4.3.2 or appendix use these flagging criteria.

TABLE 3-30
FLAGGING CRITERIA USED BY SRP FOR GROUNDWATER ANALYSES*
PAGE TWO

Parameter	Unit	First Level		Second Level	
		Criteria	Standard	Criteria	Standard
pH	---	---		Trend vs. Time	
Phenol	µg/L	2.0	DL	Trend vs. Time	
Se	µg/L	2.0	DL	5.0	1/2 DWS
SO ₄	µg/L	10,000	~2x DL	125,000	1/2 IIDWS
TOC	µg/L	5,000	~2x BG	25,000	10x BG
TOH	µg/L	5.0	DL	25	5x DL
Zn	µg/L	250	~2x BG	2,500	1/2 IIDWS
Gross Alpha	pCi/L	5	~2x BG	15	DWS
Gross Beta	pCi/L	10	~2x BG	50	10x BG
Ra-226/228	pCi/L	2.5	~2x BG	5	DWS
Tritium	pCi/L	10,000	1/2 DWS	20,000	DWS
Endrin	µg/L	0.014	DL	0.10	1/2 DWS
Lindane	µg/L	0.018	DL	2.0	1/2 DWS
Methoxychlor	µg/L	0.10	DL	50	1/2 DWS
Silvex	µg/L	0.10	DL	5.0	1/2 DWS
Toxaphene	µg/L	0.64	DL	2.5	1/2 DWS
2,4,D	µg/L	0.38	DL	50	1/2 DWS
Triclene	µg/L	1.0	DL	2.5	1/2 DWS
Perclene	µg/L	1.0	DL	5.0	1/2 DWS
111-TCE	µg/L	1.0	DL	100	1/2 DWS

Source: Olson, 1986B

BGT = Approximate Background Concentration at SRP.

DL = Analytical Detection Limit.

DWS = U.S. Environmental Protection Agency's (EPA) Primary Drinking Water Standards.

IHA = EPA Interim Health Advisory.

IIDWS = EPA's Secondary Drinking Water Standards.

NDWS = New Drinking Water Standard.

SDWS = U.S. Public Health Drinking Water Standard.

* All tables showing G-W contaminant data in Section 3.4.3.2 or appendix use these flagging criteria.

other facilities until 1962, at which time there were a sufficient number to handle liquid radioactive waste being generated by the operations at SRP. The original use of the basins was to control the release of low-level radioactive liquid waste to surface streams. However, over time the basins received nonradioactive liquid waste such as acids, bases, phosphates, and organic solvents. Contaminants in wells around the various basins indicate that besides radioactive liquid discharges, lead, halogens, and other metals were also in the groundwater as a result of discharges to the basins.

The seepage basins represent major sources of groundwater contamination. The groundwater plumes associated with the K-, F-, H- and P-Basins released over 18,900 curies of tritium to surface water via seeps and springs in 1985. Appendix J tables J-1 through J-13 present groundwater analytical data on the various seepage basins. Table J-9 presents data on the L-Area disassembly basin.

Containment Basins

Containment basins were designed to accept liquid flow from the reactors if something occurred that required them to dispose of the D₂O and cooling water. The basins are large and will hold in excess of 100 million gallons. The only basin currently receiving low-level radioactive waste is the 100K Containment Basin. This basin has been used since it first received an unintentional release in the mid-1970s. The seepage basin used before that time is no longer receiving liquid waste. The containment basin has monitoring wells that indicate that tritium, lead, manganese, and halogens have reached groundwater from the operation of the containment basin. Appendix J Table J-14 shows data from the K-Area Basin.

M-Area Settling Basin

The M-Area Settling Basin was constructed in 1958 when it was determined that it was not good practice to discharge effluent from Fuel and Target Fabrication Facilities that contained uranium directly into a surface stream. The waste streams also contained volatile organic solvents (trichloroethylene, tetrachloroethylene, and 1, 1, 1-trichloroethane) that were used as metal degreasers. From 1952 to 1982, the M-Area used an estimated 13,000,000 pounds

of chlorinated degreasing solvents. From this large quantity, it was estimated that 2,000,000 pounds may have been discharged to the sewer to M-Area Settling Basin and about 1,500,000 lb were discharged to the A14 Outfall. Caustic solutions and acid solutions discharged to the basin were made up of sodium hydroxide and nitric acid. In 1982 all waste effluent from the M-Area was discharged to the settling basin. The settling pond was removed from service on July 16, 1985. Wells around the settling basin indicate that lead, manganese, halogens, nitrates, iron, sulfate, gross alpha, nonvolatile beta, endrin, tetrachloroethylene, and trichloroethylene have reached the groundwater from the operation of the settling basin. See Appendix J Table J-15 for groundwater contaminant data.

The settling basin represents only one source of volatile organic solvents that has created one of the largest contaminant plumes on the site. The contaminant plume in M-Area for volatile organics is shown in Figure 3-20. Current data suggest that the volatile organics may have reached the Tuscaloosa (deep) aquifer.

CMP Pits

The CMP Pits were utilized between 1971 and 1979 for the disposal of non-radioactive volatile organic solvents and pesticides. In 1984 an estimated 99.5 percent of the wastes were excavated and a synthetic cap placed over the site. Contaminated soils were also removed. Low levels of organics have been noted in the groundwater. Three downgradient wells were determined to have statistically significant increases in pH, conductivity, sulfate, nitrate, sodium, and zinc when compared to upgradient. Other constituents that have been reported above background levels are shown in Appendix J Table J-16.

Acid/Caustic Retention Basins

Acid/Caustic Retention Basins were first constructed in the early 1950s. Acid and caustic solutions were used to regenerate ion exchange units used for water purification at the various operations on the plant. The sulfuric acid and sodium hydroxide were discharged directly to the basins through acid-resistant, but not caustic-resistant, feeder lines. The acid and caustic solutions were to mix in the basins and then discharge to the environment by overflow into surface water or infiltration into the groundwater. As mixing basins, the ponds were less than

Source: Modified from Marine and Bledsoe 1984

FIGURE 3-20

CONTOUR MAP OF VERTICAL AVERAGED CONCENTRATION
OF TOTAL DEGREASER SOLVENTS FROM FLUID SAMPLES
FOR APRIL-JULY 1984

successful, with the caustic solutions stratifying on top of the acid solutions. The basins were taken out of service in 1982 when neutralization systems were installed. Besides acids and bases, metals, halogens, and radioactive wastes were also discharged to the basins, as indicated by their presence in groundwater. Appendix J Tables J-17 through J-20 present groundwater data on four of the basins.

Silverton Road Waste Site

Very few historic data are available for the Silverton Road Waste Site. The date of initial disposal is unknown. The site was closed in 1974. It is assumed that this site received drums, tanks, construction debris, metal shavings, etc. Groundwater monitoring has taken place since 1982; 30 wells are installed at the site. Groundwater samples from the wells indicate that major contaminants originating from the site include trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, trichloromethane, and lead. Other metals and radionuclides may also be present. Appendix J Table J-21 presents a summary of the groundwater chemistry data.

Radioactive Waste Burial Ground

This site began receiving waste in 1953 and remains in use today. The site is 195 acres in size and has accepted low- and intermediate-level radioactive waste, radioactive mixed waste, and transuranic (TRU) waste. Seventy-seven wells are currently used to monitor the Radioactive Waste Burial Ground (RWBG) although there are 125 wells in the area. Significant groundwater contamination has occurred. The largest single contaminant plume is comprised of tritium, an estimated 36,800 curies. This plume contributes an estimated 200 Ci/yr to Four Mile Creek via surface seeps. In fact, one well in the burial ground had a tritium concentration in groundwater of 1,022 Ci/L. (Drinking water standard is 20,000 pCi/L).

Contaminants found in the groundwater at the RWBG include gross alpha, nonvolatile beta, mercury, lead, cadmium, and possibly organic solvent chemicals. Radionuclides include Co-60, Sr-90, Cs-137, Pu-238 and Pu-239.

Sanitary Landfill

The Sanitary Landfill was opened for operation in 1973 when it was determined that open burning of waste was not a good practice. Approximately 3,500 tons of waste are buried each year in the landfill. The operation of the landfill is permitted under South Carolina law. In 1980 the first phase of the landfill was filled and in 1984 phase 2 was filled. Phases 3 and 4 opened in 1984 and are currently in operation. Fifteen wells are used to monitor groundwater at the landfill. Wells around the active portion of the landfill indicate higher-than-normal levels of metals, which include iron, manganese, and lead. Conductivity and total organic carbon (TOC) in several wells may indicate breakthrough to the groundwater of leachates from the landfill. Elevated levels of total organic halogens (TOH) were also indicated. Appendix J Table J-22 presents groundwater analytical data compiled by the Survey team.

Tank Farms

The Tank Farms are located in the F- and H-Areas and are used for the storage of high-level radioactive liquid wastes.

F-Area - The groundwater beneath the F-Area Tank Farm is monitored by 27 wells. Fourteen wells have been in use since the 1970s, with the remaining 13 wells placed in operation in 1984 and 1985. Elevated levels of nonvolatile beta have been found in several wells and are assumed to be the result of a tank overflow that occurred in 1961. The beta has been identified as Ru-106 and Cs-137. Contaminants reaching the groundwater are expected to discharge into either UTRC or FMC. All wells showed tritium levels above background with one well having a maximum of 170,000 pCi/L.

H-Area - The groundwater beneath the H-Area Tank Farm is monitored by 32 wells. Several wells were assumed to be poorly grouted and allowed surface water to enter the wells. These wells were taken out of service and 15 new wells were placed in service in 1985. Several wells show elevated levels of alpha and nonvolatile beta and they are assumed to be the result of a spill at Tank 13 in 1984 and 1985, although one well showed the elevated level prior to the spill. All wells showed elevated levels of tritium with one well having in excess of 300,000 pCi/L.

Burning/Rubble Pits

Burning/Rubble pits were used from 1951 until recently. They were generally shallow excavations which received miscellaneous trash, oil, degreasers, drummed solvents, etc. Forty wells monitor 10 pit areas; there are 15 pits in all.

The monitoring well placement at the Burning/Rubble Pits is representative of many other sites at the SRP. Wells at the pits (usually four) were placed somewhat indiscriminantly in the shallow aquifer at various places surrounding the pit. This approach has resulted in:

- o Wells located such that no well or only one well is actually located downgradient of the facility
- o Wells located at distances from the facility which would fail to indicate contamination
- o Lack of understanding of the component of vertical flow and potential for vertical contaminant movement.

Due to these deficiencies, the EFD documentation of statistically significant contaminant concentrations at various waste sites is suspect.

Major contaminants discovered at the Burning/Rubble Pits include: metals, halogens, specific conductivity, pH, sodium, TOC, and volatile organic chemicals. Radionuclides have also been discovered. Appendix J Tables J-23 through J-32 present groundwater contaminant data for the burning/rubble pits. Although the data may be suspect, SRP has found the following chemical constituents statistically significant in groundwater in downgradient wells at the pits.

o pH	o Specific conductivity
o Barium	o Lead
o Magnesium	o Manganese
o Sodium	o Sulfate
o TOC	o Nitrate
o TOH	o Copper
o Nickel	o Chloride

Waste Oil Basins, Oil and Chemical Basin, Chemical Basins

These sites include the:

- o Miscellaneous Chemical Basin
- o Road A Chemical Basin
- o L-Area Oil and Chemical Basin
- o D-Area Oil Seepage Basin
- o 716-A Motor Shop Seepage Basin
- o Fire Department Hose Training Facility.

The Miscellaneous Chemical Basin and the Fire Department Hose Training Facility have no monitoring wells installed. The basins received waste oil and miscellaneous chemicals. Groundwater contaminants found at the monitored basins include volatile organics, halogens, metals, and some radionuclides. Appendix J Tables J-33 through J-36 present analytical data from these sites.

Coal-Pile Runoff Basins and Ash Basins

There are 7 coal pile runoff containment basins and 10 ash basins at the SRP. The seven coal pile basins and the K-Area ash basin have groundwater monitoring systems. A total of 33 wells comprise the systems at these locations. The coal pile basins were installed to contain runoff from coal storage piles. All basins were completed in 1981. Ash basins receive ash sluicewater from the powerhouses and most are located near the coal-pile basins.

Groundwater contaminants typically associated with the coal-pile basins, include metals, sulfate, halogens, TOC, and radionuclides. Appendix J Tables J-37 through J-44 present groundwater analytical data for the basins. It should be noted that in some cases upgradient wells are contaminated at the basins and other sources may be responsible.

Ford Building Seepage Basin

This 150,000-gallon-capacity seepage basin, which was constructed in 1964, received wastewater from the repair of slightly contaminated equipment from

throughout the plant. As of 1983, the basin had received 334,000 gallons of wastewater containing limited amounts of radioactivity, surfactant, oil, and grease. Wells near the facility show high TOH and above-detection levels of chromium, nickel, and phenol.

F-Canyon

In order to determine if any leakage was occurring from the 221F-Building, a series of 14 wells (6 deep wells that monitor the groundwater and 8 shallow wells that monitor perched water at the base of the concrete pad) were constructed. Elevated levels of radioactivity, metals, halogen, and nitrates were the major constituents found in groundwater (See Appendix J Table J-45). The radioactivity consisted of alpha emitters and nonvolatile beta. Strontium-90 was one of the radionuclides found in the analysis of the groundwater.

Other Sites

Groundwater is also monitored at various other locations at the SRP. These locations include (but are not limited to):

- o Background wells at A-Area, Hawthorne Fire Tower, Naval Fuels, S-Area
- o Heat Exchanger Repair Facility Basin
- o Hazardous Waste Storage Facility
- o Hydrofluoric Acid Basin
- o Central Shops Burnable Oil Basin
- o F-Area A-Line
- o H-Area Retention Basin
- o Z and ZW Wells
- o Other site areas

Most of these wells, including the background wells, have some groundwater chemical constituents that are elevated. Appendix J Tables J-46 through J-54 present groundwater contaminant data for selected sites noted above.

Many sites at the SRP do not monitor groundwater. Foremost among these are:

- o Miscellaneous Chemical Basin
- o General Reactor Areas
- o SRL Oil Test Site
- o Sludge Disposal Lagoon
- o Ash Basins
- o Gunsites

There are approximately 162 waste sites at SRP not including potential sites of contamination from production areas, spills, septic tanks and leach fields, and airborne contaminants.

Summary of Monitoring Program

The following represent general conclusions regarding the SRP Groundwater Monitoring Program based on the previous discussion.

- (1) Most waste sites that have groundwater monitoring exhibit elevated levels of chemical constituents, indicating impact from the facility.
- (2) Many waste sites that are monitored typically have wells only in the shallow aquifer. In some cases, these wells are located such that groundwater contamination could be missed. Vertical gradients have not been defined.
- (3) Groundwater is not monitored at many waste sites that could be impacting groundwater.
- (4) Well construction is questionable in some cases.
- (5) Division of responsibility for data interpretation has resulted in a fragmented approach to groundwater data review.

(6) Sampling techniques may influence analytical results for volatile compounds.

(7) Over 1,000 wells are estimated to be potential conduits for surface contamination to reach groundwater due to their age, state of deterioration, and original construction.

3.4.4 Findings and Observations

3.4.4.1 Category I

None

3.4.4.2 Category II

1. Potential Groundwater Contamination from Abandoned Wells. Potential groundwater contamination may occur as a result of old and abandoned wells at the SRP that have not been properly closed.

Of the over 5,000 wells on the site, it is estimated by site personnel that over 1,000 of these wells have not been properly abandoned. Groundwater could be contaminated through deteriorating casings and improper construction techniques, by allowing surface contaminants to migrate downward into the well. Cross contamination from contaminated shallow groundwater to deeper zones could also occur.

Wells most likely to fall within the category include:

- o Old wells drilled prior to acquisition of the site
- o Old production wells
- o Old monitoring wells
- o Wells used in miscellaneous studies

Additional examples include the following items.

- (a) At the SRL Oil Test Site, a rusted well casing was discovered which was unlocked, open to the atmosphere, and the construction details were not known.
- (b) At Gunsites 52 and 72, former production wells (abandoned) were observed. At Gunsite 52, the well was open to the atmosphere and unprotected. At Gunsite 72, the well was artesian and flowing at the surface.
- (c) At the F-Area Seepage Basins, numerous old deteriorating monitoring wells were observed.

2. Potential Groundwater Contamination from Waste Sites. The potential for groundwater contamination of shallow and deeper aquifers exists as a result of known monitored and unmonitored waste sites.

Four specific issues relate to this problem. Each issue is listed below and addresses the basis for the finding.

- (a) There are numerous waste sites which, based on the nature of disposal, are potential sources of groundwater contamination but which are not monitored. Examples of these sites include:
 - (1) The Miscellaneous Chemical Basin, where liquid chemicals were disposed of on the ground;
 - (2) The SRL Oil Test Site, where solvents, oil, and unknown chemicals were discharged to the ground; and
 - (3) The Sludge Disposal Lagoon, where sewage sludge is dumped in an open pit.

Other areas are also of concern, such as the reactor areas and ash basins, since little or no monitoring takes place in these areas.

(b) Wells are located at some waste sites such that contaminant plumes might not be identified. Wells are located such that:

- (1) They exist at distances from the facility which might preclude a timely indication of contamination (see Figure 3-21); and
- (2) No wells or only one well is located downgradient of the facility (see Figures 3-22 and 23).

(c) Wells are screened in the shallow groundwater at many sites, but at many sites no wells have been installed to detect vertical migration of contaminants. Downward vertical gradients are known to occur in most areas of the site. Contaminants may be entering deeper aquifers but could go undetected. Sites where only shallow monitoring occurs include (but are not limited to) the:

- (1) Burning/Rubble Pits
- (2) Some seepage basins
- (3) Acid/Caustic Basins.

(d) There has been no centralized evaluation of contamination on a site-wide multi-aquifer basis. Major contaminant evaluations have been completed for specific areas on the site, but no "big picture" has been obtained. Wells currently exist that could provide the necessary data and the site is planning to mitigate this deficiency.

Items (b) and (c) above will be addressed in the sampling and analysis phase of the Survey. Samples are proposed to be taken from existing wells on a site-wide basis. Additionally, two new wells are proposed to assess potential plumes not currently identified.

A-AREA RUBBLE PIT SHOWING LOCATION OF WELLS
SURROUNDING PIT

FIGURE 3-21

G-AREA CENTRAL SHOPS BURNING/RUBBLE PITS AND
GROUNDWATER MONITORING WELLS—SHOWING WELLS
GENERALLY UPGRADIENT OF THE FACILITIES

FIGURE 3-22

K-AREA BURNING/RUBBLE PIT AND GROUNDWATER
MONITORING WELLS—SHOWING ONE DOWNGRADIENT
WELL NEAR FACILITY

FIGURE 3-23

3.4.4.3 Category III

1. Contamination of Groundwater. Groundwater (predominantly in the shallow aquifer) has become contaminated by radionuclides, volatile organic compounds (VOCs), metals, and other chemical constituents. The contaminated areas are located throughout the site.

At least 33 separate waste sites are confirmed as sources of groundwater contamination. (See Table 3-26.) The major areas of groundwater contamination include the sites listed below.

- (a) The M-Area Plume represents one of the largest known contaminant plumes on the site. The plume has impacted all the major site aquifers down to the Tuscaloosa. The axis of the plume is over 1 mile in length. Site drinking water wells have been contaminated with volatile organics such as trichloroethylene and tetrachloroethylene. Additional contaminants include metals, sulfate, nitrate, and radionuclides. Concentrations of organics in groundwater have exceeded 250,000 µg/L for tetrachloroethylene and 150,000 µg/l for trichloroethylene. To date, over 63,000 pounds of organics have been extracted from the groundwater.
- (b) Seepage Basins in K-, F-, H-, and P-Areas have groundwater plumes that are generally comprised of radionuclides. These plumes released over 18,900 curies of tritium to surface waters via seeps and springs in 1985. Metals and halogens also are contained within portions of these plumes. Maximum groundwater concentrations for tritium, gross alpha, and nonvolatile beta for two of these areas are included below.

<u>Area</u>	<u>Tritium*</u>	<u>Gross Alpha*</u>	<u>Nonvolatile Beta*</u>
F	40,000,000	57	1,500
H	51,000,000	67	24,000

* pCi/L

(c) The Radioactive Waste Burial Ground has a number of contaminant plumes. The largest single plume contains an estimated 36,800 curies of tritium, which contributes 200 Ci/yr of tritium to FMC via surface seeps. The highest tritium concentration in groundwater is found at the burial ground, where Well A5 had a concentration of 1,022 Ci/L. Contaminants found in the groundwater at the Radioactive Waste Burial Ground include:

Co-60

Mercury

Sr-90

Cadmium

Cs-137

Organic solvents

Pu-238,239

Lead

3.4.4.4 Category IV

1. Groundwater Sampling Program. The accuracy of historic groundwater data collected in the Groundwater Sampling Program is suspect.

This is due to:

- o Construction of older monitoring wells
 - o Historic sampling procedures
- a) Older monitoring wells were constructed of galvanized steel casings which could affect metals analyses. In addition, early wells were constructed of various metals and not installed in a manner consistent with currently accepted practice.
 - b) Purging did not occur until early 1984 so that stagnant water was likely analyzed. Metals were not filtered prior to analysis before 1984.
2. Mislabeling of Wells. The Survey team found that wells numbered in the field did not correspond to the site plans.

At the P-Area Rubble Pit, Wells PRP 2 and PRP 3 are reversed. This also occurred at the CMP Pits where Wells CMP-9B and 9C appear reversed. This mislabeling may lead to incorrect reporting of sample data.

3. Monitoring Wells Data Gap. A data gap exists such that wells on the site cannot be identified by the geologic unit in which the well is screened. As a result, the number of wells in a particular geologic unit is not known nor does a site-wide map of groundwater wells exist.

4. Purge Water Discharged to Ground. A potential environmental/health hazard exists as a result of purging of contaminated groundwater directly on the ground surface.

The Survey team and EPA both observed the SRP sampling effort. It is SRP standard practice to discharge well purgewater directly to the ground surface. If the groundwater is contaminated (especially with radionuclides), it could result in surface contamination and human exposure.

5. Sample Acquisition. The way in which volatile organic samples are obtained may affect analytical results.

Volatile organic analyses may be affected by the use of submersible pumps for sampling and the aeration that occurs at the discharge sampling port at the well head.

6. Potential for Incorrect Purging Volumes. The potential exists for purging volumes to be incorrect.

Purge volumes are calculated based on dedicated flow meters mounted at each well. The meters are not calibrated after their initial installation, which could result in purging volumes being incorrect.

4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

PRELIMINARY

4.1 Waste Management

4.1.1 General Description of Pollution Sources and Controls

This section describes currently generated wastes and active waste management units at the Savannah River Plant (SRP). The wastes described include all solid wastes as well as all hazardous and radioactive liquid wastes. These wastes have been grouped for discussion into the following four categories: hazardous wastes (HW), mixed wastes, radioactive wastes, and nonhazardous wastes. Hazardous wastes include all nonradioactive wastes defined as hazardous under Subtitle C of the Resource Conservation and Recovery Act (RCRA). Mixed wastes include wastes that are both hazardous and radioactive. Radioactive wastes are those that are only radioactive. Finally, nonhazardous wastes are all nonradioactive wastes not regulated under Subtitle C of RCRA.

4.1.1.1 Hazardous Waste

This section describes the current generation and management of HW at the SRP. Included is a discussion of the sources of HW and the facilities used to manage them. The source discussions include each of the operating areas that generate HW and identify the types and quantities of wastes generated as well as the disposition of these wastes. The facilities discussion describes each of the facilities at SRP used to treat, store, or dispose of HW.

Hazardous wastes constitute a relatively minor waste stream at the SRP compared to mixed and radioactive wastes. Presently, total HW generation at SRP is approximately 4,000 ft³/yr. The total inventory stored at the site is approximately 60,000 ft³. The RCRA Part B permit application for SRP lists 26 hazardous wastes that may be generated at the site. These wastes, and the quantities stored, are listed in Table 4-1.

At present, management of HW at SRP generally involves collection at the point of generation, temporary storage at satellite and staging areas, and transfer to permitted storage facilities. There are no permitted RCRA treatment or disposal

TABLE 4-1

HAZARDOUS WASTES LISTED IN SRP PART B PERMIT APPLICATION

Waste Description	Basis for Designation*	Total in Storage First Quarter 1984
Reactive metals	R	5,400 lb
Mercury contaminated materials	T	5,481 lb
Sodium dichromate	T	1,600 lb
Miscellaneous metals	T	11 lb
Miscellaneous laboratory chemicals	T, I	2,783 lb
Pesticides and herbicides	T, I	4,295 lb
Machine coolant	T, I	25,800 lb
Tear gas concentrate (liquid)	R	200 lb
Acids	C	7,350 lb
Alkalies	C	25,154 lb
Miscellaneous nonhazardous waste	A	500 lb
Nitrates	I, T	30,200 lb
Spent paint solvents	T	70,695 lb
Other paint solvents	T	9,980 lb
Varnish and thinner	I	8,400 lb
Miscellaneous solvents	I	810 lb
Toluene, isopropyl alcohol mixture	I	15,450 lb
Waste oil (non-burnable)	T	16,500 lb
Waste oil, lead mixture	T	19,200 lb
Halogenated degreasing solvents	T	31,137 lb
Spent halogenated solvents	T, I	450 lb
Naphtha and methylene chloride mixture	I	180 lb
CMP pits soil	T	1,630 yd ³
CMP pits waste liquids	T, I	Unknown
DWPF simulated waste sludge	T	Unknown
Lead smelter waste and lead/soil mixture	T	Unknown

R = Reactive

T = Toxic

I = Ignitable

C = Corrosive

A = Administrative decision

Sources: U.S. DOE, 1985a

facilities at SRP. The ultimate disposition of most of the HW presently being stored at SRP is to be determined.

The HW management program at SRP places the primary responsibility for waste segregation on the generator. The generator is responsible for ensuring that HW are not mixed with nonhazardous or radioactive wastes. Segregation activities for hazardous and nonhazardous wastes is generally limited to listing of acceptable wastes on nonhazardous waste collection containers. For radioactive wastes, the generator must certify that the waste does not contain HW.

Hazardous wastes at SRP are generated by the following: 300M-Area, TNX-Area, the active Reactor Areas (100C-, K-, L-, and P-), TC/U-Area, Savannah River Laboratory (SRL), and construction/maintenance activities. Hazardous waste generation for each of these sources is described below.

300M-Area. The 300-M Area, or the Raw Materials Department, produces and inspects all major reactor components (i.e., fuel rods and targets).

Hazardous wastes are generated from nickel plating; vapor degreasing using 1,1,1-trichloroethane; caustic etching; and acid treatment using nitric and phosphoric acids. Aqueous plating, acid, and caustic wastes are processed at the Liquid Effluent Treatment Facility (LETF). Treatment includes neutralization and precipitation to remove inorganic contaminants. The LETF is not considered a RCRA HW treatment facility because it is a totally enclosed treatment unit. The LETF does, however, generate RCRA hazardous wastes in the form of waste slurry and filter roll-off. These wastes are presently being stored in tanks and metal boxes, respectively. Vapor degreasing wastes include waste solvents from recovery still bottoms. These wastes are stored in drums in storage buildings. Other HW generated at the 300M-Area include leaded oil from the 321M extrusion press; lithium-aluminum dross from the production of targets; lathe coolant from the 321M Building; and miscellaneous wastes (rags, applicators, etc.) associated with these operations. These wastes are stored in containers at staging areas and then transferred to storage facilities. Table 4-2 summarizes HW generated at the 300M-Area, along with their associated points of generation, generation rates, and present dispositions.

TABLE 4-2

M-AREA HAZARDOUS WASTE INFORMATION

Waste Name	Point(s) of Generation	Generation Rate	Disposition
1,1,1-trichloroethane	Bottoms from recovery still	61 drums/year	Permitted storage buildings
Spent caustic and acids*	320-M and 321-M	Unknown	LETf
Leaded oil	321-M extrusion press	155 drums/year	Permitted storage buildings
Li-Al dross	320-M target fabrication	24 drums/year	Permitted storage buildings
Lathe coolant (Freon)	321-M machining	Unknown	Evaporation
DETf filter roll-off	DETf filter presses (341-M)	Unknown	Stored in B-25s** at M-Area
LETf slurry	LETf crystallizer and A/C filters (313-M)	40,000 gallons/month	Permitted storage tanks at M-Area

* Not hazardous wastes as such, since they are processed through the LETf.

** B-25s are 90 ft³ sealable metal boxes used for waste storage and disposal.

Hazardous waste control/management facilities in the 300-M Area consist of two staging areas (at the 313M and 321M Buildings) and one satellite area (at the 320M Building) for drums prior to their transfer to the permitted storage buildings; storage tanks for LETF waste slurry (six 35,000-gallon and two 500,000-gallon tanks); and an open-top underground tank beneath the 321-M extrusion press used to accumulate leaded oil prior to transfer to drums. The satellite and staging areas are used for temporary storage and accumulation of HW prior to shipment to permitted storage facilities. The tanks are used to store the waste slurry while a decision is awaited on the ultimate disposition of this waste.

TNX-Area. The TNX-Area* provides research and development (R&D) support to SRP's Waste Management and Separations programs. Although the R&D facilities are both numerous and complex, only two HW streams are generated at present (and one of these is non-routine). They are:

- o Excess glass frit (non-routine): Raw-material glass frit is used primarily to vitrify simulated wastes as part of R&D efforts to support the planned Defense Waste Processing Facility (DWPF). Various frit formulations are used; when the formulation changes, excess frit must be disposed of. One of the formulations tested characteristically hazardous due to Extraction Procedure (EP) lead (i.e., D008). Drums of this waste are currently stored in the TNX Area awaiting off-site treatment for lead fixation.
- o Waste organics (routine): Prior to vitrification, simulated wastes are processed through the Precipitate Hydrolysis Experimental Facility (PHEF). This process generates both an aqueous waste (which is subsequently vitrified) and an organic waste. The latter is approximately 90% benzene, with lesser concentrations of complex aromatics such as tetraphenylborate. This waste is drummed, staged, and stored in HW storage buildings.

* The acronym "TNX" originated from an earlier facility at Hanford, which used trinitroxylenes as a solvent.

Hazardous waste control facilities in the TNX-Area consist of drum staging/satellite areas southwest of Building 679-T; and south of Building 674-T (numerous drums).

TC/U-Area. Wackenhut Services, Inc. (WSI), a direct Department of Energy (DOE) contractor, is the custodian for this area. The primary functions performed at TC/U are vehicle* maintenance/fueling and the storage of munitions. These activities generate several HW streams; these, together with their points of generation, inventory, and anticipated disposition(s), are summarized in Table 4-3. Plans call for separation of jet fuel from water using an oil/water separator with the fuel being returned to the vendor. Waste oil is stored on the site and then disposed of by incineration in the 400D-Area Powerhouse. Degreasing solvent is obtained from a vendor operation and returned to the vendor. The disposition of outdated tear-gas cartridges and some unknown wastes is presently unknown.

Weapons cleaning is conducted by WSI at the following locations:

Building 707 in 400 Area
SATA Range, Building 661-G
ATTA Range, Building 617-G
TC1
Motor Pool, Building 703-7G

Weapon cleaning is performed using petroleum naptha solvent. Waste petroleum naptha solvent is stored in 25-gallon drums in satellite areas at the above locations. This waste is stored for a maximum of 60 days and is picked up for off-site disposal by a contract hauler.

Hazardous waste control/management facilities at the TC/U-Area consist of one satellite drum storage area on the helicopter pad itself (for jet fuel spills) and a second drum storage area (for all other HWs).

* Including helicopters

TABLE 4-3 TC/U-AREA HAZARDOUS WASTE INFORMATION

Waste Name	Point(s) of Generation	Approximate Inventory*	Disposition(s) (anticipated)
Jet fuel spills/precipitation	Helicopter pad	12 drums	<ul style="list-style-type: none"> • Du Pont construction's oil-water separator • Return to vendor
Waste oil	Vehicle maintenance	6 drums	400-D powerhouse
Spent degreasing solvent (Safety-Kleen)	Vehicle maintenance	300 gallons	Return to vendor
Outdated tear-gas cartridges	Munitions storage	6 drums	Unknown
Miscellaneous drums	(unknown)	4 drums	Unknown

* As of January 1987.

Reactor Areas. The only nonradioactive HW generated in the Reactor Areas (100C-, K-, L-, and P-Areas) is waste motor oil. This oil comes primarily from the diesel engines used to provide backup power for the primary reactor coolant pumps. Waste oil is pumped from the Reactor Building basements (where the generators are located) to HW staging areas located outside the reactor buildings. Waste oil is also generated at the 100-Area Powerhouses. The oil is stored at the staging areas in either 55-gallon drums or 500-gallon skid tanks prior to disposal. Waste oil staging areas are located at the following locations: 108-2C in 100C-Area; 108-1K, 108-3K, and 184K in 100K-Area; 108-2L in 100L-Area; and 108-1P and 184-P in 100P-Area. Waste oil from the reactor areas is disposed of by combustion in the 400D-Area Powerhouse.

Savannah River Laboratory. Hazardous wastes generated at SRL consist of small quantities of miscellaneous laboratory chemicals and spent solvents. These wastes are stored in 55-gallon drums at two staging areas (773-A and 776-9A Buildings) prior to shipment to the HW storage buildings.

Construction and Maintenance. Construction activities are conducted by two groups, the construction staff within SRP and staff from Savannah River Construction (SRC). SRP construction and maintenance staff are primarily assigned to individual facilities and perform minor construction and maintenance. Wastes generated from these activities are generally minor and are included as miscellaneous HW associated with individual facilities. For the most part, construction and maintenance wastes from within most facilities are radioactively contaminated and are handled as radioactive or mixed waste.

Major construction and maintenance activities are the responsibility of SRC. These activities are primarily conducted in the Central Shops Area of the 700-Area. Wastes generated are waste motor oil, lathe coolant and cuttings, and degreaser and paint solvents. The motor vehicle shop (716-Building) is the largest generator of waste oil at SRP. Waste oil at this facility is stored in an underground tank prior to being shipped to the 400D-Area in 500-gallon skid tanks. Approximately 500 gal/mo of waste oil are shipped from the facility to the 400D-Area where the oil is burned in the 400-Area Powerhouse. Waste degreaser solvent (e.g., stoddard solvent) from the 716 Building is currently being stored in 55-gallon drums. SRP is investigating whether the Part B permit will allow this

degreaser solvent waste to be combined with waste oil for combustion. Waste fuel (gas and diesel) is mixed with waste oil for combustion. The flash point of the waste oil/fuel mixture is kept above 100°F.

Waste oil is also generated at the Maintenance Shop (717 Building), the E & I Motor Shop (722-4A Building), and the Railroad Classification Yard Shop. These facilities all have staging areas, where oil is stored in 55-gallon drums or 500-gallon skid tanks prior to shipment to the 400D-Area. The 717 Building also generates waste lathe coolant and approximately 1 drum/yr of titanium chips from machining titanium; these are stored at a staging area at the 711-A Building prior to transfer to the HW storage buildings.

Paint shops at the 725-A and 710-G Buildings generate paint solvent wastes. These wastes consist of a mixture of methyl ethyl ketone, xylene, Varsol, lacquer thinner, and Freon. These mixed solvents are stored in 55-gallon drums at staging areas prior to shipment to the HW storage buildings.

Major construction activities are also under way at the construction site of the DWPF. These activities generate some HW in the form of waste oils and solvents. These wastes are stored at a covered staging area on the site prior to transfer to the HW storage facilities.

Hazardous Waste Management Facilities. In addition to the satellite and staging areas at individual facilities, there are several other facilities at SRP used for the management of HW. These facilities include the hazardous waste storage buildings, which are used for long-term storage of HW pending final disposition; and the 484D-Powerhouse, which is used to burn waste oil. These facilities are described below.

There are four buildings at SRP constructed for storage of HW. Building 710-U, located in the 700 TC/U-Area, is a totally enclosed building having an area of approximately 5,000 ft². The building has been in HW service since 1980, and has a total capacity of approximately 1,100 palletized, double-stacked 55-gallon drums (DOE, 1985b). The building is divided into two storage bays, one for toxic wastes (primarily 1,1,1-trichloroethane sludge and leaded oil) and the other for ignitable wastes (primarily ferric nitrate and paint solvents). The storage bays are diked and

each drains to a 300-gallon sump. There is no fire containment wall around the ignitable waste bay.

There are three HW storage buildings in the 600G-Area. Building 709G is a partially enclosed metal building having a total area of approximately 12,000 ft² and a total capacity of approximately 1,900 drums (DOE, 1985b). The facility is divided into six diked storage bays, five for toxic or reactive wastes and one for ignitable wastes. The ignitable waste bay is surrounded on three sides by a 6-foot-high concrete block wall. Each storage bay drains to a separate 300-gallon collection sump.

Building 709-4G is a totally enclosed metal building having a total area of approximately 12,000 ft² (DOE, 1985b). The facility consists of a single storage area which is used primarily for storing contaminated soil contained in 90 ft³ metal storage boxes, which are referred to as B-25 boxes. The building presently contains 489 such boxes, triple stacked. Drainage within the storage area is to a 300-gallon sump.

Building 709-2G is a new totally enclosed metal building which has yet to be used for waste storage. The building has an area of approximately 13,000 ft² and a capacity of approximately 2,800 drums (DOE, 1985b). The facility is divided into six storage bays, including an ignitable waste bay which is completely enclosed by a concrete firewall. The facility also includes a redrumming area. It is currently undecided whether Building 709-2G will be used to store RCRA HW or by-product mixed wastes.

The 484-D Powerhouse in the 400D-Area is used to burn approximately 100,000 lb/yr of certain combustible nonradioactive HW. Those wastes listed in the Part B Permit Application for SRP as being suitable for burning at 484-D include automotive and engine lubricants, non-PCB transformer oil (less than 50 ppm polychlorinated biphenyls [PCB]) gear box oil, kerosene, diesel oil, and fuel oil. Unsuitable wastes include fluids with flash points below 100°F, oils containing toxic chemicals, machine cutting oil, extrusion dye oils containing lead, chlorinated hydrocarbons, and solvents (e.g., Klearall 99, Varsol, Ultrasene, and F-101 Safety Solvent).

Waste oils are transported to the 400D-Area from remote staging areas and transferred to a 2,000-gallon storage tank located within a diked storage area. Before the waste oil can be received at 484-D, the generator must certify that it is free from radioactive contamination and does not contain any of the previously described unsuitable materials.

4.1.1.2 Mixed (Radioactive and Hazardous) Wastes

This section discusses the generation and management of mixed radioactive and HW at SRP. At the time of the Environmental Survey, mixed wastes at SRP were divided into two categories, "mixed wastes" and "by-product mixed wastes." "Mixed wastes" were defined as RCRA HW, contaminated with low levels of radioactivity, and not excluded from regulation under RCRA. These wastes are generated at the Tritium Facility and SRL. "By-product mixed wastes" were defined as hazardous radioactively contaminated wastes excluded from regulation under RCRA because they are by-products from the production of special nuclear material. These wastes are generated at the Active Reactor Areas (100C-, K-, L-, and P-) and the Separations Areas (200F- and H-). Since the on-site portion of the Survey, DOE has issued a final rule, which eliminates the by-product exclusion for mixed wastes. Under this rule, the hazardous portion of all mixed wastes must be regulated under RCRA. At the time of the Environmental Survey, the "byproduct" mixed wastes were not considered to be subject to RCRA hazardous waste storage requirements. As a result of the recent DOE byproduct waste rule, the wastes are presently being stored out of compliance with RCRA requirements (i.e., greater than 90 day storage, storage in unpermitted facilities).

The following sections describe the sources of mixed wastes at SRP, including the waste types and quantities associated with each source. Waste management facilities specifically associated with a source or generator are also described. This discussion is then followed by a description of general mixed waste management facilities that serve more than one source.

Tritium Facility. The Tritium Facility in the 200H-Area generates several mixed wastes. Approximately 260 gal/yr of tritium-contaminated waste oil is generated from vacuum pumps. Tritium concentrations in the oil range from less than 0.2 mCi/L to greater than 100,000 mCi/L, with over 95 percent of the oil having less than 400 mCi/L. Currently, tritium-contaminated waste oil is stored at the Mixed Waste Storage Facility (MWSF), Building 643-29G, in stainless steel containers. There is a satellite staging area at the 232-H Building for oil storage prior to transfer to the MWSF. The oil cannot presently be incinerated in the beta/gamma incinerator (BGI) because that facility does not have a tritium monitor. Some low-level tritiated oil (0.05 mCi/L) is presently burned in the incinerator. The SRP annual release guide for tritium emissions from the BGI is 22 Ci. Installation of a tritium monitor is scheduled for 1987.

Other mixed wastes generated at the Tritium Facility are radioactive solid wastes contaminated with lead or mercury. These wastes are currently stored at the MWSF in sealed steel boxes. The Tritium Facility also has a total inventory of 70 gallons of tritium-contaminated mercury which is used in pumps. At present, this mercury is stored in 35-gallon stainless steel vessels for reuse. With the planned replacement of mercury pumps by alternate equipment, this mercury and the pumps will become mixed wastes.

The Tritium Facility also owns 118 stainless steel casks which contain a total of approximately 340 tons of lead. These casks are currently being stored on a reactor storage pad, just outside the Reactor-Area, and will eventually have to be disposed of as mixed wastes.

Savannah River Laboratory. Mixed waste generated at SRL consists of scintillation fluid contained in small plastic vials. Radiochemistry laboratories at SRL generate approximately one 1 of these wastes every 2 months. These wastes are stored in drums at the MWSF. Solid mixed wastes generated at SRL also include low-level radioactive solid wastes contaminated with lead and mercury. These wastes are presently stored in B-25 boxes, which are 90 ft³ sealable metal boxes. Other mixed wastes generated at SRL consist of low-level liquid radioactive wastes containing hazardous materials. These wastes are stored temporarily in the low-level waste (LLW) tanks at SRL and periodically trucked to the General Purpose Evaporator at the 211-F building (Du Pont, 1986a). These tanks are discussed in Section 4.1.1.3.

Reactor Areas. Mixed wastes generated at the Reactor Areas include approximately 5,000 gal/yr of radioactive waste oil. This oil comes from primary coolant pumps within the Reactor Buildings and contains small amounts of tritium. The oil is transferred from the pumps to 55-gallon drums and stored in staging areas outside the Reactor Buildings prior to transfer to the Radioactive Waste Burial Ground (RWBG). At the RWBG, the oil is transferred to a 25,000-gallon underground storage tank (UST). This will be incinerated in the future once installation of the tritium monitor on the BGI stack is completed. The average concentration of tritium in the oil stored in the tank must be kept below 0.05 mCi/L.

Other mixed wastes from the Reactor Areas include radioactive solid waste contaminated with lead. These wastes include such things as lead shielding and counterweights from regulated areas. Prior to March 1986, these wastes were buried at the RWBG. At that time, burial of mixed wastes at the RWBG was halted and these wastes are now being stored in metal B-25 boxes at the points of generation.

Separations Area. Solid mixed wastes from the Separations Areas are similar to those from the Reactor Areas, and consist of waste oil and lead wastes from regulated areas. Radioactive waste oil is transported to the RWBG for storage in UST's. Lead waste is stored in B-25 boxes at the point of generation.

The Separations Areas also produce large quantities of liquid mixed wastes. These wastes consist primarily of nitric acid recovery unit (ARU) overheads, waste storage system evaporator overheads, and General-Purpose Evaporator overheads. The generation rate for these wastes at F-Area averages approximately 56,300,000 gal/yr, with a maximum rate of 1,000,000 gal/day. The average and maximum generation rates for H-Area are 53,700,000 gal/yr and 1,280,000 gal/day, respectively. Results of chemical and radiological analyses for these F-Area and H-Area wastes are given in Tables 4-4 and 4-5, respectively. As shown in these tables, the primary radionuclide in both waste streams is tritium, with lesser concentrations of cesium, ruthenium, zirconium, niobium, plutonium, strontium, uranium, and americium. Nonradioactive constituents are primarily sodium and nitrate.

TABLE 4-4

F-AREA SEEPAGE BASIN INFLUENT CHARACTERISTICS

Constituent ^a	Concentration (mg/liter except pH)		
	Average	Maximum	Minimum
Na	790	1,900	110
Ca	0.5	1.78	0.01
Fe	1.7	24	0.01
Zn	0.3	1.15	0.001
NH ₄	24	30	9
Ba	0.01	0.05	0
K	0.67	1.11	0.11
Al	0.78	1.99	0
Mn	0.016	0.04	0
Mg	0.060	0.16	0
NO ₃	1,220	6,740	90
CO ₃	131	180	0
NO ₂	2	16	0
Cl	1.2	9.6	0
SO ₄	4.6	31	0
F	1.5	12	0
Si (total)	7.1	39	0.6
Si (<0.45 µm)	5.0	22	0.4
P	2.2	4.4	0.92
pH	2.93	12.8	1.52
Pb	0.12	0.55	0
Hg	0.004	0.012	0
Cr	0.013	0.08	0
Cu	0.010	0.04	0

TABLE 4-4
F-AREA SEEPAGE BASIN
INFLUENT CHARACTERISTICS
PAGE TWO

Constituent	Average Concentration (pCi/liter)	Constituent	Average Concentration (pCi/liter)
Am-241*	308	Pu-239*	308
Ce-141	1,540	Ru-103	30,800
Ce-144	1,540	Ru-106	308,000
Cm-242*	154	Sr-89	3,080
Cs-134	6,200	Sr-90	6,200
Cs-137	62,000	Tritium	b
I-131	15,400	U-235*	2,080
Nb-95	62,000	U-238*	2,080
Pm-147	7,690	Zr-95	62,000
Pu-238*	308		
Total α			3,080

* emitters (all others are B - γ emitters)

Samples taken at the F-Area Trebler station on:

a 09/23/83 10/21/83 11/11/83
 09/30/83 10/28/83 12/09/83
 10/14/83 11/04/83 12/16/83

b Tritium was not included in this specific study; however, an approximate concentration based on 1983 data is 101,608,900 pCi/liter

Source: DOE, 1985c

TABLE 4-5

H-AREA SEEPAGE BASIN INFLUENT CHARACTERISTICS

Constituent ^a	Concentration (mg/liter except pH)		
	Average	Maximum	Minimum
Na	17.6	61.5	6.1
Ca	28	239	1.25
Fe	5.1	25	0.01
Zn	3.1	26.5	0.01
NH ₄	8	28.0	2
Ba	0.08	0.41	0
K	1.0	1.7	0.63
Al	3.2	12.4	0
Mn	0.560	3.20	0
Mg	1.3	4.45	0.15
NO ₃	538	1,950	67
CO ₃	47	180	0
NO ₂	1	7.8	0
Cl	1.1	4.15	0
SO ₄	3.9	11.9	0
F	0.1	1.1	0
Si (total)	6.3	16.3	2.78
Si (<0.45- μ m)	6.1	16.3	2.7
P	0.6	1.23	0.09
pH	2.37	5.48	1.96
Pb	0.18	0.54	0
Hg	0.043	0.28	0
Cr	0.072	0.36	0
Cu	0.43	2.7	0

TABLE 4-5
H-AREA SEEPAGE BASIN
INFLUENT CHARACTERISTICS
PAGE TWO

Constituent	Average Concentration (pCi/liter)	Constituent	Average Concentration (pCi/liter)
Am-241*	13	Pu-238*	60
Ce-141	3,333	Pu-239*	40
Ce-144	17,333	Ru-103	50,000
Cm-242*	6.7	Ru-106	50,000
Cm-244*	6.7	Sb-124	1,333
Co-58	6,670	Sb-125	1,333
Co-60	6,670	Sr-89	3,300
Cr-51	33,300	Sr-90	6,670
Cs-134	10,000	Sr-95	6,670
Cs-137	60,000	Tritium	b
I-131	3,333	U-235*	33
Nb-95	13,300	U-238*	33
Pm-147	10,000	Zr-95	6,670
Total α			1,333

* α emitters (all others are β - γ emitters)

a Samples taken at the H-Area Trebler station on:

09/23/83	10/14/83	12/09/83
09/30/83	10/21/83	12/16/83
10/07/83	12/02/83	

b Tritium was not included in this specific study; however, an approximate concentration based on 1983 data is 60, 128, 250 pCi/liter

Source: DOE, 1985d

The hazardous classification of the F-Area waste is characteristic corrosivity, due to pH fluctuations outside the 2.0-12.5 range (i.e., D002). The 200H-Area waste is also characteristically corrosive, in addition to occasional exceedances of the EP levels for both chromium and mercury (D007 and D009, respectively).

These wastes are discharged to seepage basins in the F- and H-Areas, respectively. The F- and H-Area Seepage Basins have received aqueous mixed waste from F- and H-Area, respectively, since 1955. Both the F and H systems consist of three basins connected in series*; these are illustrated in Figures 4-1 and 4-2, respectively. Dimensions and volumes of all basins are provided in Table 4-6. The average influent rates to the basins (including rainfall) are (DOE, 1985c; DOE, 1985d):

- o F-Area = 56.3×10^6 gal/yr

- o H-Area = 53.7×10^6 gal/yr

Hazardous constituent inventories released to the F-Area Seepage Basins since 1955 include 974 lb of mercury and 3,090 tons of nitrate (Killian et al., 1986a). Respective inventories for the H-Area Basin are 3,981 lb of mercury and 2,900 tons of nitrate (Killian et al., 1986b). Inventories of radionuclides discharged to the F- and H-Area Seepage Basins are given in Tables 4-7 and 4-8, respectively.

The basins are designed and operated to allow wastewater to percolate through the soil at the sides and bottoms. The seepage eventually enters the groundwater, crops out, and enters the Savannah River via Four Mile Creek (FMC).

Groundwater contamination associated with both sites consists primarily of tritium, sodium, and nitrates, with occasional elevated levels of mercury, manganese, cadmium, and lead, as described in Section 3.4.3. Groundwater monitoring at the F-Area Seepage Basin has identified gross alpha, nonvolatile beta, lead, radium, zinc, cadmium, chromium, iron, manganese, nitrate, total organic carbon (TOC), pH, total organic halogen (TOH), barium, and mercury at levels above the flagging criteria identified in Section 3.4.3. These monitoring data are summarized in Appendix J, Table J-4. Monitoring at the H-Area Seepage Basins has identified lead, TOH, tritium, cadmium, gross alpha, nonvolatile beta, mercury, manganese, nitrate, radium, pH, zinc, and iron above flagging criteria. These monitoring data are summarized in Appendix J, Table J-6.

* H-Area Basin 3 (see Figure 4-2) was taken out of service in 1962, and replaced by Basin 4.

Source: DOE, 1985c

F-AREA MIXED WASTE BASIN SYSTEM

FIGURE 4-1

A-AREA MIXED WASTE BASIN SYSTEM

FIGURE 4-2

TABLE 4-6

F-AND H-AREA BASIN SYSTEMS DIMENSIONS AND VOLUMES

Area	Basin	Depth (feet)	Top Dimensions		Bottom Area (A)	Working Volume (x 10 ⁶ gallons)
			Length	Width		
F	1	280	90	10.7 ^a	0.34	1.6
F	2	530	90	10.7 ^a	0.69	8.1
F	3	720	310	11.2 ^a	4.44	17.5
Subtotals					5.47	22.2
H	1	240	90	90 ^d	0.29	1.1
H	2	460	110	9 ^d	0.79	2.80
H	3 ^b	480	350	17 ^e	b	b
H	4	2,400	c	8 ^a	9.47	26.0
Subtotals					10.55	29.91

- a Additional 2 feet of freeboard
b Inactive; removed from service in 1962
c Width varies from 130 to 430 feet
d Depth at overflow pipe
e No freeboard present

Sources: DOE, 1985c; DOE, 1985d

TABLE 4-7

INVENTORY OF RADIONUCLIDES RELEASED TO F-AREA SEEPAGE BASINS

Radionuclide	First Year of Measurement	Cumulative Original Release (Ci)	Decay Corrected to December 31, 1985 (Ci)
^3H	1955	2.7×10^5	1.5×10^5
^{60}Co	1969	1.2×10^{-1}	1.54×10^{-2}
^{89}Sr	1971	6.2×10^{-1}	2.2×10^{-3}
^{90}Zr	1955	4.13×10^1	2.31×10^{-1}
^{95}Nb	1971	6.77×10^1	2.6
^{99}Tc	1971	5.35×10^1	1.1×10^{-1}
^{129}I	Estimated	1	1
^{103}Ru	Estimated	2	2
^{106}Ru	1971	1.78×10^1	1.2×10^{-1}
$^{124,125}\text{Sb}$	1955	1.08×10^3	3.9
^{106}Ru	1973	8.0×10^{-2}	9.5×10^{-4}
^{131}I	1971	700	$< 2.7 \times 10^{-3}$
^{134}Cs	1971	6.92×10^{-1}	2.2×10^{-2}
^{137}Cs	1955	2.12×10^2	1.35×10^2
^{141}Cs	1971	7.03×10^{-2}	2.7×10^{-8}
^{144}Ce	1971	3.92	1.4×10^{-1}
^{147}Pm	1955	1.15×10^2	9.2×10^{-1}
Natural U	1955	12.6	12.6
^{238}Pu	1967	1.53	1.36
^{239}Pu	1955	5.64	5.64
$^{241,243}\text{Am}$	1977	2.16×10^{-1}	2.15×10^{-1}
$^{242,244}\text{Cm}$	1975	3.12×10^{-1}	2.36×10^{-1}
Total Volume (liters)	1955	4.21×10^9	
Total Volume (gallons)		1.11×10^9	

Source: Killian et al., 1986a.

TABLE 4-8
INVENTORY OF RADIONUCLIDES RELEASED TO H-AREA SEEPAGE BASINS
(1954-1985)

Radionuclide	First Year of Measurement	Cumulative Original Release (Ci)	Decay Corrected Release Through December 31, 1985 (Ci)
³ H	1955	3.3x10 ⁵	1.5x10 ⁵
⁵¹ Cr	1971	1.1x10 ²	3.8x10 ⁻¹
⁵⁸ Co	1971	2.72	2.0x10 ⁻³
⁶⁰ Co	1969	4.91	1.77
⁶⁵ Zn	1974	2.84	1.5x10 ⁻²
⁸⁹ Sr	1971	7.97	3.7x10 ⁻⁷
⁹⁰ Sr	1955	42.9	2.69x10 ¹
⁹⁵ Zr	1971	8.53	2.3x10 ⁻²
⁹⁵ Nb	1971	12.6	2.1x10 ⁻²
⁹⁹ Tc	Estimated	0.5	0.5
¹⁰³ Ru	1971	14.8	6.1x10 ⁻⁴
¹⁰⁶ Ru	1955	5.59x10 ²	5.09
¹²⁹ I	Estimated	0.4	0.4
¹³¹ I	1955	1400	<1x10 ⁻⁴
¹³⁴ Cs	1971	6.5	4.65x10 ⁻¹
¹³⁷ Cs	1955	1.57x10 ²	1.12x10 ²
¹⁴¹ Ce	1971	2.62	5.4x10 ⁻⁸
¹⁴⁴ Ce	1971	40.4	2.0x10 ⁻¹
¹⁴⁷ Pm	1955	45.5	1.17
Natural U	1955	1.40	1.40
²³⁸ Pu	1967	2.38	2.13
²³⁹ Pu	1955	1.96	1.95
^{241,243} Am	1977	5.07x10 ⁻²	5.04x10 ⁻²
^{242,244} Cm	1973	7.12x10 ⁻²	5.19x10 ⁻²
Total volume (liters)	1955	5.30x10 ⁹	
Total volume (gallons)	1955	1.40x10 ⁹	

Source: Killian et al., 1986b.

Sediment sampling conducted at F-Area Basin 3 in 1983 indicated elevated levels of arsenic, iron, mercury, lead, titanium, and tungsten (DOE, 1985c).

Chemical separations activities in both the F- and H-Area Canyon Buildings generate high-level liquid radioactive wastes. Previously, these wastes were considered exempt from RCRA under by-product exclusion. Under the new DOE by-product rule, however, it is likely that the waste will be regulated under RCRA as mixed wastes. While the wastes have not specifically been tested for hazardous characteristics, it is likely that they will be hazardous by characteristics of corrosivity and EP toxicity. These wastes are broken down into "High Activity Waste" (HAW) and "Low Activity Waste" (LAW).

HAW wastes are generated from the decladding and dissolution of fuel elements and targets, and from the first cycle of solvent extraction for uranium and plutonium removal. First cycle wastes are evaporated, with the overheads sent to nitric ARUs. The evaporator and acid recovery bottoms, as well as other HAW, are neutralized and sent to the high-level-waste (HLW) tank farms. These wastes contain a variety of fission products. The major chemical components of the neutralized wastes are given in Table 4-9.

LAW are generated from the second solvent extraction cycles, solvent recovery systems, and plutonium finishing operations. The LAW are first evaporated, with the overheads being sent to nitric ARUs, and the evaporators and acid recovery bottoms neutralized and sent to the high-level-waste tank farms. These wastes are also contaminated with fission products, but not to the extent of the HAW. The major chemical components of the neutralized wastes are given in Table 4-10.

Approximate flow rates to each tank farm are 1.16×10^6 gal/yr in 200F-Area and 1.52×10^6 gal/yr in 200H-Area. Average radiological characteristics of high-level wastes (HLW) stored in tanks are given in Table 4-11.

In brief, there are 22 tanks in 200F-Area and 29 tanks in 200H-Area, all of which are used to receive and/or process HLW. A process description is as follows:

TABLE 4-9
MAJOR CHEMICAL COMPONENTS OF NEUTRALIZED HIGH
ACTIVITY WASTES

Component	Approximate Percentage
Water	63.7
Sodium Nitrate	228.2
Sodium Hydroxide	3.8
Sodium Sulfate	3.1
Ferric Hydroxide	1.2

TABLE 4-10
MAJOR CHEMICAL COMPONENTS OF NEUTRALIZED LOW
ACTIVITY WASTES

Component	Approximate Percentage
Water	62.0
Sodium Nitrate	27.5
Sodium Aluminate	6.2
Sodium Hydroxide	3.6
Sodium Sulfate	0.4
Mercuric Oxide	0.3
Ferric Hydroxide	0.1

TABLE 4-11

AVERAGE RADIOLOGICAL CHARACTERISTICS OF
FRESH^a HIGH LEVEL WASTES

Radionuclide	Activity, Ci/gal	Radionuclide	Activity, Ci/gal
⁹⁵ Nb	105	²⁴¹ Am	1×10^{-3}
¹⁴⁴ Ce- ¹⁴⁴ Pr	68	⁹⁹ Tc	5×10^{-4}
⁹⁵ Zr	60	²³⁹ Pu	3×10^{-4}
⁹¹ Y	47	¹⁵⁴ Eu	1×10^{-4}
⁸⁹ Sr	36	⁹³ Zr	1×10^{-4}
¹⁴¹ Ce	12	²⁴⁰ Pu	6×10^{-4}
¹⁴⁷ Pm	12	¹³⁵ Cs	4×10^{-5}
¹⁰³ Ru	10	¹²⁶ Sn- ¹²⁶ Sb	1×10^{-5}
¹⁰⁶ Ru- ¹⁰⁶ Rh	4	⁷⁹ Se	1×10^{-5}
⁹⁰ Sr	3	²³³ U	2×10^{-6}
¹³⁷ Cs	3	¹²⁹ I	1×10^{-6}
¹²⁹ Te	2	²³⁸ U	6×10^{-7}
¹²⁷ Te	2	¹⁰⁷ Pd	5×10^{-7}
¹³⁴ Cs	1	²³⁷ Np	4×10^{-7}
¹⁵¹ Sm	8×10^{-2}	¹⁵² Eu	2×10^{-7}
²³⁸ Pu	1×10^{-2}	²³⁴ Pu	6×10^{-8}
²⁴¹ Pu	2×10^{-3}	¹⁵⁸ Tb	6×10^{-8}
²⁴⁴ Cm	1×10^{-3}	²³⁵ U	3×10^{-8}

Source: DOE, 1979.

a After reprocessing fuel that has been cooled six months after discharge from reactor.

HLW is placed into double-walled tanks equipped with cooling coils, and is aged for 1 to 2 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 is transferred to a continuous evaporator. The condensate from the evaporator is passed through an ion exchange column to remove the entrained cesium, and is then discharged to the seepage basins. The concentrate from the evaporator is transferred to a cooled waste tank, where the suspended salts settle. The supernate remaining after crystallization is then returned to the evaporator. This process continues until essentially all the liquid has been converted to a crystallized salt cake (DOE, 1980).

The system also includes inter-area waste transfer lines, which enable the transfer of wastes between 200F- and 200H-Areas. The lines (2 ea.) are constructed of 3-inch 304L stainless steel, each of which is encased in a 4-inch carbon steel jacket. The lines are approximately 2 miles long, and slope downward toward each area from a high point approximately midway between the two areas.

The contents of the HLW tanks will eventually be processed in the DWPF, which will generate a vitrified waste form for disposal at an off-site Federal repository; and the proposed Saltstone Facility, which will generate a solid waste form for on-site disposal.

The Receiving Basin for Off-Site Fuels (RBOF)

The RBOF facility is used to decontaminate and remove oxide scale from lithium-aluminum targets prior to shipment to the Tritium Facility, to regenerate ion exchangers used at the Reactor Areas, and to store fuel assemblies from off-site reactors. Target decontamination and scale removal results in generation of liquid radioactive mixed waste consisting of 10 percent phosphoric acid and 1 percent sodium dichromate. This waste is neutralized and sent to a radioactive waste tank in the 200H-Area tank farm. The RBOF also generates acid and caustic wastes from ion exchanger regeneration. These wastes are sent to the 200H-Area Tank Farm or sent to the 200H-Area general purpose evaporator if the activity is less than 40,000 counts per minute (cpm).

Mixed Waste Management Facilities

The MWMF is located in the southeast corner of the RWBG (see Figure 4-3). The building is a 60' x 60' x 20' high prefabricated metal structure on a concrete pad. It is designed to store up to 25 concrete containment casks, or 300 metal containers varying in capacity from 50 to 100 ft³ each (DOE, 1986c). Mixed wastes stored (or to be stored) in the MWSF include scintillation fluids; oil containers; and miscellaneous wastes and process equipment contaminated with oil, cadmium, lead, and mercury. At present, the primary radionuclide present in wastes stored at the MWSF is tritium. Other radionuclides are not present in significant amounts because the site has not been used to store wastes formerly classed as "by-product" mixed wastes. With the new DOE by-product rule, it is likely that this facility will begin receiving other types of mixed wastes. Because tritium is the main radiocontaminant, resultant beta emissions do not penetrate container walls, and the dose rates are negligible. SRP plans to store no more than 400,000 curies in the MWSF. Wastes will be stored in this unit until they can be treated or disposed of in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) regulations and policies.

The Mixed Waste Oil Storage Tank (S-32) is a UST located along the north perimeter of the RWBG (see Figure 4-4). It has been in service since 1975 for the storage of tritiated waste oil and currently contains approximately 19,000 gallons of oil. Tank specifications are as follows (DOE, 1986c):

- o Capacity - 25,000 gallons.
- o Materials of construction - 3/8" thick carbon steel, externally triple coated with bitumastic paint.
- o Dimensions - 10' 6" diameter x 38' 10" long.
- o Secondary containment - 64-gallon collection sump and 30-mil polyvinyl chloride (PVC) liner.

A detailed drawing of the tank is provided in Figure 4-4.

FIGURE 4-3

LOCATION OF MIXED WASTE STORAGE FACILITY
643-29G AND WASTE OIL STORAGE TANK S-32

Source: DOE, 1986a

Source: DOE, 1986a

WASTE OIL STORAGE TANK S-32

FIGURE 4-4

Tritiated waste oil is currently being generated at a rate of 6500 gal/yr. Waste oil has been designated as hazardous by DHEC (see South Carolina Hazardous Waste Management Regulations, R.61-79.261, Appendix IX, Hazardous Waste No. 8888). Complete waste characteristics are listed in Table 4-12. The wastes will eventually be burned in either the existing BGI, or the proposed Consolidated Incineration Facility (CIF).

4.1.1.3 Radioactive Waste

This section discusses generation and management of radioactive wastes at SRP. Initially, solid radioactive wastes generated at SRP are described, followed by a description of the RWBG used to dispose of these wastes. Generation and disposal of liquid wastes is then described, including those generated at the Separations Areas, SRL, TNX, and the Reactor Areas. The discussion closes with a description of the BGI, which is used to incinerate combustible solid and liquid radioactive wastes.

Solid Radioactive Waste. The largest volume of solid radioactive wastes generated at SRP consists of LLW. 950,000 ft³ of these wastes are generated each year. These wastes, which are referred to as job control wastes, consist of solid wastes from regulated areas, and include small equipment, spent air filters, protective clothing, analytical wastes, decontamination residues, plastic sheeting, and gloves. Generators are responsible for ensuring that these wastes contain no lead, cadmium, mercury, other hazardous materials, or free liquids.

Most job control wastes are disposed of by burial at the RWBG. These wastes are packaged in either steel drums or B-25 boxes. A small portion of the job control wastes generated in the H-Area are incinerated in the BGI. These wastes are packaged in cardboard boxes and trucked to the incinerator.

Other solid radioactive wastes include bulk contaminated material (e.g., soils contaminated from spills of radioactive liquids), large construction/demolition debris, large contaminated equipment, and spent crucibles from tritium recovery. Bulk material and contaminated debris are generally disposed of by burial in trenches. Radioactively contaminated soils are disposed of by burial in trenches at the RWBG. Soils which are not radioactively contaminated, but which are from

TABLE 4-12
CHARACTERISTICS OF TRITIATED WASTE OIL IN TANK
S-32

Chlorine content	450 mg/l
Heat content	19,511 BTU/lb.
Sulfur	0.20 weight percent
Tritium	0.04 Ci/ml
Arsenic	<0.05 mg/l
Barium	2.50 mg/l
Cadmium	<0.01 mg/l
Chromium	<0.10 mg/l
Lead	<0.10 mg/l
Mercury	<0.001 mg/l
Selenium	<0.60 mg/l
Silver	<0.01 mg/l
Total Halogens	450 mg/l
Flashpoint	142° F.
PCBs	<2.0 mg/l

Source: DOE, 1986a

within regulated areas (i.e., radiation zones) are disposed of by spreading over closed disposal trenches. Contaminated equipment includes reactor hardware and ion exchangers from the Reactor Buildings, and process equipment from the Canyon Buildings. These wastes are buried in trenches or stored above ground. Spent crucibles from tritium recovery consist of steel crucibles containing lithium-aluminum alloy. These crucibles are capped, sealed with epoxy, shipped to the RWBG in shielded trailers and buried in intermediate-level waste disposal trenches.

Solid wastes having greater than 10 nCi/g of alpha contamination are classed as transuranic (TRU) wastes. Approximately 30,000 ft³/yr of these wastes are generated at SRP, mostly from plutonium handling areas. Small TRU wastes are packed in polyethylene-lined galvanized drums and large wastes are packed in 3/4-inch-thick carbon steel boxes. These wastes are stored at the RWBG for eventual disposal at the Waste Isolation Pilot Plant (WIPP) site in New Mexico. Storage areas include a concrete pad for drums containing less than 0.5 Ci, concrete culverts for drums containing more than 0.5 Ci, and trenches for large wastes.

All radioactive solid waste generated at SRP (other than the small amount incinerated at the BGI), as well as periodic shipments from other DOE facilities, are managed (stored or disposed of) at the RWBG. This 195-acre site is located between the 200F- and H-Areas. The original area, designated 643-G, comprises approximately 76 acres due south of the active area (see Figure 4-5). This area was used for the first 20 years of SRP's operation (i.e., 1952-1972) (Du Pont, 1986c). The active site, designated 643-7G, comprises approximately 119 acres immediately north of the old area.

In addition to the radioactive wastes previously described (i.e., job control wastes, bulk wastes, contaminated equipment), the site also receives some wastes shipped from off the site. These include tritiated waste from Mound Laboratory, and Pu-238 process waste from Los Alamos National Laboratory Mound Laboratory and the Pinellas Plant.

Source: Jaeger, et al., 1986

BURIAL GROUNDS SHOWING ZONES FILLED TRENCH ALPHA, INTERMEDIATE AND LOW-LEVEL BETA-GAMMA WASTE, AND SOLVENT STORAGE AND THE BOUNDARY OF 643-28G MWMF

FIGURE 4-5

The types of storage/disposal facilities at the RWBG are specific to the category of wastes being managed. Facility types are as follows:

- 1) **Shallow Land Burial (SLB) Trench:** Trenches for storing intermediate-level wastes (ILW*), bulky, non-containerized LLW**, and containerized off-site wastes. These trenches are excavated 20 feet wide, 20 feet deep, and up to 1,000 feet long. The SLBs are covered with soil shortly after waste emplacement to maintain radiation control and to minimize the potential for contaminant migration.
- 2) **Engineered Low-Level Trench (ELLT):** Since mid-1984, newly-generated LLW has been containerized in metal boxes or metal drums, and is currently stored in ELLTs. These trenches are much wider, approximately 135 ft, than SLB trenches, and provide more efficient space utilization by allowing equipment to drive into the excavation and stack the waste packages. Each ELLT has a service life of approximately 1.5 yr. Approximately 10^6 ft³/yr of LLW is disposed of at the RWBG, or roughly 95 percent by volume of all wastes received at the facility. (This includes bulk LLW disposed of in the SLB trenches).
- 3) **TRU Waste Pads:** TRU wastes*** are stored in containers that can be retrieved intact and free of external contamination for at least 20 years from the time of storage. Combustible and noncombustible wastes are stored in separate containers. Polyethylene-lined galvanized drums are used as the primary container; waste packages containing more than 0.5 Ci are additionally protected by enclosure in large concrete cylinders that can hold up to 14 drums. Containers, including concrete cylinders, are stored on a concrete pad with a monitoring sump, and covered with 4 feet of earth. (Canyon equipment and other bulky wastes contaminated with TRU nuclides to greater than 10 nCi/g, and also intensely contaminated with gamma emitters, are stored directly in SLB trenches.)

* ILW is defined by SRP as those wastes which contain 10-100 nCi/g alpha activity, and exhibit radiation levels greater than 300 mR/hr.

** LLW is defined by SRP as those wastes which contain less than 10 nCi/g alpha activity, and exhibit radiation levels less than 300 mR/hr.

*** TRU waste is defined by SRP as waste which contains isotopes with atomic numbers above 92, half-lives in excess of 20 years, and having a total alpha activity greater than 100 nCi/g.

- 4) Greater Confinement Disposal (GCD): GCD is a recently upgraded method of ILW disposal. GCD provides a method for encapsulating the waste in concrete/grout and monitoring the solidified waste forms for water-leaching of any radionuclides. The demonstration facilities provide cylindrical holes (20 have been constructed) that are 7 feet in diameter and 30 feet deep; and a trench (currently under construction) with cells that are 50 feet wide, 25 feet long, and approximately 30 feet deep. Waste packages are emplaced in the holes or trench and concrete/grout is poured around the containers for stabilization.
- 5) Solvent/Oil Storage: Degraded organic solvent from the Separations areas and radioactively contaminated oil from reactors and the Tritium Facility have been stored in 10 bitumastic-coated mild steel tanks (25,000-gallon capacity each) that were installed in 1975. These tanks include the S-32 Waste Oil Tank previously described and nine identical tanks. At present, one tank contains waste solvent, seven tanks contain less than one-half inch of solvent heels, one tank contains radioactively contaminated oil, and one tank has never been used. Actively used tanks are monitored weekly for leaks by measuring the tank liquid level. The yearly generation rates of solvent and oil are approximately 2,000 gallons and 6,500 gallons, respectively. A program to incinerate waste solvent has been under way since construction of the BGI. The only solvent now remaining contains greater than 50,000 disintegrations per minute per milliliter (dpm/ml) alpha contamination and cannot presently be incinerated. Oil incineration is scheduled to begin shortly. Approximately 19,000 gallons of oil are currently in storage at the 643-7G Burial Ground.
- 6) Mixed Waste Storage Facility: This is discussed in Section 4.1.1.2.
- 7) Mixed Waste Management Facility (MWMF): Some of the wastes previously sent to the RWBG contain materials that may be classified hazardous under RCRA. Accordingly, a portion of the RWBG, the 643-28G MWMF, was designated for closure under RCRA (see Figure 4-5). The 643-28G MWMF consists of an area where candidate mixed wastes were placed prior to June 1983. This area has individual trenches that

have been grouped together and are planned to be closed under a revised closure plan. Candidate mixed wastes placed in the MWMF trenches include scintillation fluids, waste lubricating oil held on absorbent material and sealed in 55-gallon drums, lead, and tritiated mercury.

Routine RWBG operations were interrupted on March 10, 1986, when results from an independent testing laboratory showed that metallic lead was a RCRA hazardous waste. Disposal operations for all radioactive waste containing lead or any other listed hazardous substance were discontinued, and a plan was implemented to ensure that all other wastes disposed in the RWBG are certified free of cadmium, lead, and mercury.

Separations Depleted Uranium. Since 1964, SRP has used the Enriched/Depleted process with enriched uranium fuel elements processed at the 200H-Area and depleted uranium targets processed at the 200F-Area. This process results in the generation of depleted UO_3 at the 200F-Area via the following steps:

The 221-F Canyon Building produces a 90 g/L solution of uranyl nitrate, which is concentrated to 425 g/L by evaporation. A second step (hydrate evaporation) converts the solution into a molten salt with a specific gravity of approximately 3.0. This material is denitrified by further heating and agitation, and then degassed to drive off the resulting NO_x . Finally, the molten material is allowed to solidify, followed by crushing to a powder and packaging in standard or galvanized 55-gallon drums depending on whether storage is to be inside a building or outside on a storage pad. Approximately 15-18 drums/day of UO_3 are generated, with the following specifications (partial list):

- o UO_3 - 97 percent by weight
- o Total U - 80.1 - 80.9 percent by weight
- o Pu - <10 ppb
- o U-235 - 0.17 - 0.18 percent by weight (based on total U)
- o Gross beta activity - 0.07 dpm/g
- o Gross gamma activity - 0.41 dpm/g

Approximately 32,000 drums of UO_3 are currently being stored in nine different locations site wide, as summarized in Table 4-13. Although this material is

TABLE 4-13
SUMMARY OF DEPLETED UO₃ STORAGE
AS OF AUGUST 8, 1986

Building	Number of Drums in Storage, 8-12-86
728-F	3,553
730-F	2,165
105-R	4,019
704-R	4,422
714-7G	8,255
772-7G	2,080
772-8G	1,103
221-12F	1,205
200-F Area Regulated Pads*	5,077

*Outside Storage Area

technically not a waste (since SRP does not plan to discard it), there are no immediate plans for its use. In the short term, SRP will construct two large storage buildings in 200F-Area, and consolidate all storage activities there.

Separations Areas. The 200-Area separations processes use an organic solvent mixture to extract uranium and plutonium from aqueous solutions. The solvent used in the 200F-Area Canyon Building consists of 30 percent tributyl phosphate (TBP) and 70 percent normal paraffin hydrocarbon (NPH), which is similar to kerosene. The 200H-Area canyon solvent is 7.5 percent TBP and 92.5 percent NPH. These solvents are periodically discarded. The discarded ~~spent~~ solvent contains low levels of radioactivity. Both areas generate approximately 1,000 gallons of spent solvent each year. Waste solvent is stored in underground tanks at the RWBG, as previously described, and is disposed of incineration at the BGI.

Savannah River Laboratory. Low- and high-level liquid radioactive wastes are also generated at SRL. Low-level wastes are stored temporarily in tanks, then transferred to tankers and trucked to the 200F-Area General-Purpose Evaporator. Low-level waste tanks consist of four 5,000-gallon underground tanks and one 10,000-gallon above-ground tank. High-level liquid wastes are stored in six 5,000-gallon underground tanks. All underground radioactive waste tanks at SRL are located in concrete cells with secondary containment sumps. Underground waste piping to the tanks also has secondary containment, which drains to the tank sumps. The underground waste pipes are constructed of stainless steel and were hydrostatically tested for leakage in early 1986. Wastes stored in the tanks are periodically removed and trucked to the 211-F General-Purpose Evaporator for disposal.

Reactor Areas. Liquid radioactive waste from the Reactor Areas consists of disassembly-basin water and sump drainage. Water from the fuel disassembly basins is treated by sand filtration to remove particulates, and by ion exchange to remove dissolved radionuclides. The treated water, which is contaminated primarily with tritium, is discharged to the Reactor Area seepage basins. Annual discharges from all reactor areas contain approximately 5,900 Ci of tritium. Low-level radioactive sump drainage, which is generated primarily from distillation of D₂O moderator, is pumped to stainless steel trailer tanks for transport to the 200-Area General-Purpose Evaporators.

The reactor seepage basins are the only active radioactive waste disposal sites in the Reactor Areas. These basins are designed to allow low level radioactive liquid wastes to infiltrate and evaporate. The 100C-Area has three seepage basins with areas of 0.32, 0.30, and 0.32 acres and volumes of 530,000, 740,000, and 980,000 gal, respectively. During 1985, these basins received a total discharge of 3,700,000 gal of disassembly-basin purge water and have received a total of 27,000, gal of purge water (Pekkala, Holmes, and Marine, 1986). The 100P-Area has three seepage basins with areas of 0.32, 0.34, and 0.49 acres and volumes of 530,000, 740,000, and 1,560,000 gal, respectively. During 1985, these basins received a total discharge of 6,250,000 gal of disassembly-basin purge water and have received a total of 45,000,000 gal of purge water (Pekkala, Holmes, and Marine, 1986). The 100L-Area has one seepage basin having an area of 0.32 acres and a volume of 530,000 gal (Ross and Green, 1983). The 100K-Area seepage basin is inactive. Liquid wastes from this area are disposed of by discharge to one corner of the K-Area 50-million gallon containment basin. The total inventory of radionuclides received by the reactor seepage basins is summarized in Table 4-14.

TNX-Area. The pilot activities at the TNX-Area involve primarily nonradioactive feedstocks and wastes (see Section 4.1.1.1). However, the Actinide Technology Division (ATD) Facilities generate small quantities of depleted uranium solutions. This waste is accumulated in a portable tank in the ATD Area, and eventually transported to the 200F-Area HLW Tank Farm. Miscellaneous solid job control waste is also generated in the ATD Area. These wastes are placed in B-25 boxes, and disposed of in the RWBG.

Beta/Gamma Incinerator (BGI). The BGI is used to dispose of combustible low level radioactive wastes. The BGI consists of a two-stage combustion unit followed by a spray quench tower, baghouse, and high-efficiency particulate air (HEPA) filters for air pollution control. Both liquid wastes and solid boxed wastes can be handled by the facility. The capacity of the BGI is 10 to 38 gal/hr for liquid wastes and 400 lb/hr for solid wastes. Solid wastes must not contain any noncombustibles (e.g., metal wastes), and waste boxes are x-rayed prior to combustion to check for such materials. To avoid corrosion problems, the facility minimizes combustion of solid wastes which contain PVC or other materials which form hydrochloric acid upon combustion. The BGI is permitted for air emissions of 30 lb/hr of chlorine. At

TABLE 4-14

SUMMARY OF RADIOACTIVE RELEASES TO
REACTOR SEEPAGE BASINS* (Ci)

Isotope	C	K	P	R
$^3\text{H}^{**}$	3.5E + 04	1.2E + 02	4.5E + 05	2.0E + 03
^{35}S	7.7E-03	--	2.4E-03	--
^{51}Cr	1.6E-03	--	1.0E-03	--
^{60}Co	5.1E-02	2.6E-03	7.2E-02	7.6E-02
^{89}Sr	7.1E-06	--	5.1E-05	--
^{90}Sr	2.5E-01	1.4E-02	2.5E + 00	1.0E-02
$^{95}\text{Zr-Nb}$	3.4E-04	--	1.1E-03	--
$^{103,106}\text{Ru}$	1.6E-04	--	1.1E-03	5.5E-08
$^{124-125}\text{Sb}$	3.4E-03	--	1.1E-02	--
^{134}Cs	1.5E-03	--	8.9E-03	--
^{137}Cs	1.2E + 00	7.8E-02	1.1E + 01	4.7E + 02
$^{141,144}\text{Ce}$	1.1E-02	--	3.9E-02	--
^{147}Pm	5.0E-03	5.4E-05	1.7E-02	2.0E-03
^{239}Pu	--	--	--	3.0E01
Alpha Emitters (unidentified)	3.8E-03	--	9.4E-03	--

* Release values cumulative through 1985. All values are decay corrected.

** Most of the tritium is believed to have left the basins via the atmospheric pathway or the groundwater pathway.

Source: Pekkala, Holmes, and Marine, 1986

present, no tritium-containing solid wastes can be incinerated because of the lack of a tritium monitor for the stack. Liquid wastes must contain less than 0.05 mCi/L of tritium.

The BGI has primarily been used to dispose of spent canyon solvent (TBP/NPH mixture) stored in USTs. The unit will now be used more for incineration of waste oil and solid wastes. The BGI is also being used as a development unit to generate design and operating data for the planned CIF.

The BGI generates low-level solid wastes in the form of ash, spent fabric filter bags, and spent HEPA filters. The amount of ash generated depends on the waste incinerated. Canyon solvent generates a relatively high volume of ash because tetrabutyl titanate must be added to the solvent to fix phosphate. The resultant volume reduction (volume of waste to volume of ash) is only 3.5 to 1. The volume reduction with boxed solid wastes is up to 100 to 1. Presently, approximately 80 drums of ash are generated monthly and disposed of at the RWBG.

4.1.1.4 Nonhazardous Waste

This section describes management of nonradioactive, nonhazardous solid wastes generated at SRP. These wastes consist of refuse, sewage sludge, and powerplant ash. Refuse includes paper, plastic, cafeteria waste, and construction debris. The wastes are disposed of in a sanitary landfill, a sewage sludge lagoon, or ash disposal piles and basins, depending on waste type. These disposal facilities are described below.

Sanitary Landfill: Refuse disposal occurs at the SRP Sanitary Landfill. The landfill, which is permitted by SCDHEC, is located near the 700 TC/U-Area. The facility occupies an area of approximately 32 acres and receives approximately 160 yd³/day of waste. An adjacent 39-acre expansion was recently approved by SCDHEC and will be opened shortly.

An examination of solid wastes received by the landfill was performed in 1984 (Dames and Moore, 1984). The results of that examination are presented in Table 4-15. The high percentage of oily dirt noticed during the examination was apparently the result of spill cleanup activities and was not believed to be representative of normal landfill operations.

Waste segregation to prevent disposal of unauthorized wastes (i.e., hazardous or radioactive wastes) is the responsibility of waste generators. Dumpsters used to collect waste prior to disposal are labeled with a list of acceptable wastes. Additional containers are provided for salvageable materials (e.g., most nonhazardous metals).

The site uses the trench method of disposal. Wastes are placed in unlined disposal trenches, compacted with heavy equipment, and covered at the end of each day with 6 inches of clean soil. The disposal trenches are 20 feet wide, 12 to 14 feet deep, and approximately 500 feet long. Each trench has sufficient capacity to last approximately 5 weeks. At closure, the disposal area will be covered with 1 foot of compacted soil followed by 1 foot of topsoil. The compacted soil cover is required by permit to have a permeability less than 1×10^{-5} cm/sec.

The sanitary landfill also receives asbestos waste from construction activities. These wastes are double bagged in plastic and are disposed of in a separate trench. Asbestos wastes are not compacted and are covered at the end of each day.

Sewage Sludge Lagoon. Sewage sludge is generated at the 17 on-site sewage treatment plants and is presently disposed of at the sewage sludge lagoon. The lagoon is an unlined impoundment located just south of the Central Shops Area. The site was originally used to dispose of sanitary wastewater from the Central Shops Area but has been used for sludge disposal since 1972 or 1973.

Sludge is pumped from the treatment plants and hauled by truck to the lagoon. No analysis or monitoring of the sludge is performed prior to disposal. After placement in the lagoon, the sludge dewateres due to infiltration and evaporation of liquid. No treatment or stabilization occurs prior to disposal.

TABLE 4-15

SUMMARY OF SANITARY WASTE COMPOSITION
OBSERVED DURING 1984 SURVEY

Waste	Percentage
Paper	37
Glass	<1
Plastic	8
Ferrous Metals	11
Nonferrous Metals	<1
Wet Garbage	4
Oily Dirt	13
Other Rubber Concrete Wood Insulation Sheetrock/Plastic	26

Source: Dames and Moore, 1984

The lagoon is rapidly approaching its capacity and has even occasionally overflowed in the past. Closure plans call for the dewatered sludge to be excavated from the lagoon and applied to land reclamation sites near 100-K Area and Par Pond. The lagoon will be closed once an alternative sludge disposal plan submitted to SCDHEC is approved. This plan involves future sludge disposal by application to borrow pits in the 200-F and H-Areas.

Ash Disposal Basins. Powerplant ash is generated through combustion of coal at the 700A-, 400D-, 200H-, 100K-, and 100P-Areas. Reported ash generation rates for these areas are 5,000; 65,000; 13,000; 18,000; and 18,000 yd³/yr, respectively (Du Pont, 1983). The 200F-Area Steam Plant, which generated 15,000 yd³/yr of ash, has been permanently shut down. Ash at the 700A-Area is handled dry and disposed of in a 2-acre pile. Ash at the other areas is disposed of by sluicing ash/water slurries to above-ground basins. The ash settles out and the water is discharged from the basins through National Pollutant Discharge Elimination System (NPDES)-permitted outfalls. The ash disposal system at 400D-Area consists of a series of two active basins and one standby basin, occupying a total area of approximately 93 acres. The 200H-, 100K- and 100P-Area systems each consist of one active basin, having areas of approximately 15, 7, and 13 acres, respectively. The 200H-Area Steam Plant is presently maintained on warm standby, and is not normally operated. Summary data for the ash disposal facilities are presented in Table 4-16.

4.1.2 Findings and Observations

4.1.2.1 Category I

None

4.1.2.2 Category II

1. Inadequate Storage/Disposal of Sanitary Sewage Sludge. Sanitary sewage sludge is presently disposed of in an unlined lagoon which results in release of sludge contaminants to the soil and possibly to the groundwater.

TABLE 4-16

**SUMMARY OF OPERATIONAL DATA FOR ASH DISPOSAL
FACILITIES**

Facility Number	Status	Area (Acres)	Annual Volume Received (yd ³)
188-K	Active	7	18,000
188-P	Active	13	18,000
288-H	Active	15	13,000
488-D	Standby	44	65,000
488-1D	Active	34	65,000
488-2D	Active	14	N/A
788-A	Active	2	5,000

Sources: Ross and Green, 1983
Christensen and Gordon, 1983

Sewage sludge from all of SRP's 17 package treatment plants has been disposed of in an unlined lagoon located due south of the Central Shops Area since 1972 or 1973. After the sludge is deposited in the lagoon, dewatering occurs with excess moisture infiltrating the soil column. The site is also uncovered, allowing rainfall to leach contaminants from the sludge solids. There is presently no program to sample the sludge prior to disposal or to monitor groundwater for possible contamination from sludge disposal.

Sampling and analysis will include sampling of groundwater to identify groundwater contamination resulting from sludge disposal.

2. 400D-Area Basin Dike. The containment dike on the 400D-Area ash disposal basins has experienced excessive seepage and subsequent erosion in the past. Such erosion could lead to failure of the dike with resultant contaminant releases and impacts on fish, wildlife, and water quality.

Large quantities of ash (approximately 65,000 yd³/yr) from the operation of SRP's main powerplant (484D) are sluiced into two disposal basins on the southeast side of the 400D-Area. The basins' southern dike has experienced excessive seepage and subsequent erosion several times in the past. The erosion was of such an extent that repairs were implemented. The erosion was inspected by geotechnical specialists from the U.S. Army Corps of Engineers (COE). The COE specialists concluded that there was no immediate danger of catastrophic dike failure, but that additional repairs and improvements to the dike were needed. These repairs and improvements are presently being designed by the COE and are scheduled to be implemented during 1987.

The two active basins at the 400D-Area have a combined capacity of almost 200 million gallons of water and ash. Past erosion of the dike indicates the potential for failure of the dike and uncontrolled release of part or all of the contents of the basins. Such a release would result in the discharge of large quantities of sediments (i.e., ash) to Beaver Dam Creek and adjoining wetlands, and possibly to the Savannah River. The

release of sediments would adversely impact aquatic life. In addition, the release of large quantities of ash would likely increase the concentrations of heavy metals in the water and in benthic sediments.

3. Waste Management at Wackenhut. Management of HW at Wackenhut is presently out of compliance and presents the potential for release of hazardous materials to the environment.

The HW management program at the TC Area is inadequate in such areas as waste characterization; personnel training; inspections; labeling; and observance of the 90-day storage limitation. In addition, at least one drum of wastewater/jet fuel was observed to be leaking on an undiked outdoor storage pad. This situation represents major regulatory noncompliance areas, as well as a strong potential for groundwater and/or surface-water contamination by wastes which, in many cases, lack adequate characterization.

4.1.2.3 Category III

1. Storage of Depleted Uranium. Depleted uranium, in the form of UO_3 powder, is generated in the 200F Area and stored in drums. Because of the continued accumulation of these drums, the lack of a final disposition for this material, and the age and condition of the drums, there is a potential for release of this material to the environment.

Depleted uranium oxide powder is produced as a by-product of the chemical separations process in the 200F area. While this material is not technically considered to be a waste, it presently has no use and has been accumulated in drums since 1964. At present, there are no immediate plans for the disposition of this material, and there are approximately 33,000 drums currently being stored on outdoor concrete pads, and in numerous buildings throughout the site. Many of the "indoor" drums are over 20 years old, and many show extensive external corrosion. The drums each weigh approximately 1,500 lb and are typically triple-stacked, placing significant stress on the bottom rows. Moreover, the tight method of emplacement permits inspection of only about 10 percent of the drums.

Continued degradation of these drums could cause leakage of the UO_3 powder, which may result in its release to the air and/or surface water.

4.1.2.4 Category IV

1. Potential Erosion of Contaminated Soil. Closed areas of the RWBG have not received final cover in the form of final vegetation. As a result, the potential exists for erosion of contaminated soil with subsequent release to surface waters.

Areas of the RWBG are used for trench disposal of radioactively contaminated bulk material, including contaminated soils from spill cleanup activities. Materials placed in trenches are covered with soil to reduce exposure to radiation and isolate the material in the trenches. Uncontaminated soil from within regulated areas (i.e., radiation zones) is sometimes used as cover for trenches. As observed during the Environmental Survey, many of these closed trenches lacked final cover in the form of final vegetation. Chiefly as a result of the lack of vegetative cover, and possibly as a result of the use of soil from within regulated areas as final cover, the potential exists for erosion of radioactively contaminated soil by surface runoff. Since surface runoff flows directly to the RWBG ditch, there also exists the possibility of surface-water contamination.

2. Storage of Ignitable Wastes. Drummed ignitable HW are currently stored in storage bays lacking adequate firewall containment. A fire in these bays could spread to adjoining toxic and/or reactive wastes and cause a release to the air and/or surface-water bodies.

Drummed ignitable HW are stored in at least four bays within the three-building RCRA storage facility (i.e., Buildings 710-U, 709-G, and 709-4G). These bays are immediately adjacent to containers of both toxic and reactive HW; separation consists of only low curbs and, in one case, a 6' high cinderblock wall. A fire within any of the subject areas is very likely to cause rapid overheating and failure of adjacent containers, resulting in

the release of toxic and/or reactive wastes to both the air and surface-water bodies. A large release resulting from general failure of containers presents the potential to exceed the containment capacity of the storage facilities, with subsequent releases to the environment.

3. Storage-Area Containment. Several HW drum staging and satellite areas lack secondary containment (i.e., concrete bases, dikes, and sumps). As a result, spills/leaks of these wastes would tend to migrate readily to groundwater and/or surface water.

A total of 46 hazardous and mixed waste satellite and staging areas were identified at the SRP. Many of these, especially smaller ones, consist only of a roped-off area on asphalt, and lack any secondary spill containment. Others have some containment, but the capacity may be inadequate. Any spills or leaks of hazardous or mixed wastes at these areas present the potential for releases of contaminants to the environment through runoff to surface water and/or infiltration to groundwater.

4.2 Toxic and Chemical Materials

4.2.1 General Description of Pollution Sources and Controls

This section of the report addresses the acquisition, control, and distribution of potentially toxic chemicals and materials used on the Savannah River Plant (SRP) site. The focus is on the ability of the site to identify potentially toxic materials and the safeguards enacted to ensure that they are stored and used in a manner that precludes any uncontrolled release to the environment. An understanding of the toxic chemicals and materials used on the front end of the process provides an insight into how and when potential hazardous waste (HW) may be generated as a byproduct of the site operations and into the potential characteristics of these wastes.

Special attention is provided on the management of polychlorinated biphenyls (PCBs), asbestos, and pesticides because of the known hazards posed by these particular materials when released to the environment and the special regulatory programs in force to control these materials.

4.2.1.1 Toxics Management

Background. The management of toxic materials falls under the responsibility of several groups that will be described in detail in this section. The overall policy for toxic materials management in the workplace is established by the Industrial Hygiene (IH) Group within the Health Protection (HP) Department. This policy (DPSOL 40-5) guides implementation by the operations personnel. The plant operations personnel are responsible for carrying out the policy, and IH monitors and checks compliance in an oversight role.

Procurement. In the procurement of process chemicals and materials, each requester must use Form OSR 4-456, which describes the exposure potential of the requested material and its intended use so that IH can complete its review. All materials must be approved before the Purchasing Department can proceed. This is the first check in the procurement system to make sure that the IH Group is aware of all chemicals or materials used on the site, and the proper Material

Safety Data Sheets (MSDSs) have been obtained to identify hazards and proper handling and use. The Chemical Coordinator in each process/plant area checks the procurement request to ensure that proper IH review has been completed before forwarding the request to procurement. The Materials Control Group in procurement is the next level of screen, and they can refer requisitions to IH for review if there is any question about the materials being procured. These procedures are outlined in detail in DPSOL 40-5-105, "Purchase Approval Program: Chemical and Physical Agents", April 28, 1986. The use of these procedures was reviewed and appropriate personnel were knowledgeable of the procedure. Records maintained by IH demonstrated that the procedure was being implemented.

Inventory Control. Inventory controls on toxic chemicals and materials are maintained in two locations. The Procurement Department maintains an inventory of all ordered and purchased materials and can determine total annual purchases of any material on its computer inventory system. The Central Stores operation also has a separate computer system to track all materials received and disbursed through the storeroom warehouses.

Receiving and Distribution. Receipt and distribution of chemicals and materials is accomplished in one of two ways. First, all bulk material shipments (i.e., truck load, tanker truck, or railroad car) are sent directly to the plant operator and do not physically pass through Central Stores. These transactions are not maintained on the Central Stores computer inventory system. Some smaller shipments (e.g., drums of materials) go to Central Stores for delivery and receipt, but are rerouted on the original truck to the plant operator to avoid double handling. All other small-quantity orders of SRP materials are delivered and disbursed from Central Stores.

At SRP, some hazardous/toxic materials have been designated for limited distribution. Only a restricted list of personnel are allowed to obtain certain of these materials from Central Stores and/or supervisory approval is required. Signature controls are used to limit access to toxic or hazardous materials to authorized personnel who have a need for the materials.

Savannah River Construction (SRC) uses a separate procurement system with its own warehouse and inventory controls. SRC obtains mostly building and construction materials and does not typically handle large quantities of toxic materials, outside of some solvents, paints, and oils.

For all hazardous and radioactive shipments of materials off the SRP site, SRP has enacted a "Remember How You Treat Hazardous Materials" (RYTHM) program to ensure that packaging meets applicable standards. The RYTHM program tracks all outgoing shipments of hazardous and radioactive materials and provides an inspection of the packaging in accordance to regulations. The number of packaging defects is tracked and used as an indicator of plant conformance. The number of package problems has been substantially reduced over the last several years.

Identification of Hazards. The IH Group has the primary responsibility from a staff organization to manage the toxics program, but the plant operators or line organizations are required to implement the program. The IH Group has assembled a comprehensive set of MSDSs for all known toxic chemicals and materials used on the site, including multiple copies of MSDSs for the same materials produced by different manufacturers or distributors.

The IH Group conducts evaluations of plant operations to monitor the usage of toxic chemicals on both a routine and an "as requested" basis. These evaluations include a review of storage and use, and can encompass monitoring of workplace air to determine occupational exposures and the need for personnel protective equipment.

The IH approval and monitoring of procurement requests for new and continuing uses of chemicals and materials is a sound practice. This system allows IH to be aware of all existing and new uses of chemicals on the site so that they may be safely stored, handled, and disposed.

SRP has recently developed a "Chemical/Hazardous Material Tracking System" that is a computer-based inventory of all potentially hazardous/toxic chemicals in use at the site. This system provides hazardous characteristics of the chemicals and details about quantities used and stored at various locations at the facility. IH can use this program to track specific chemical applications and usage on the site.

Chemical Coordinators have been designated in each major operations/process area of SRP to function as a central point of contact for all chemical usage in that area. The Chemical Coordinators should know of all chemicals and materials used in their area, manage the procurement and storage of these materials, and are responsible for obtaining all MSDSs pertinent to their operation. All the Chemical Coordinators on the site are members of the Chemical Coordinators Committee that meets to discuss and solve chemical handling, storage, use, and disposal problems on the site. The Chemical Coordinators Committee operates under the direction of the IH Group and is a mechanism to disseminate information and solve problems related to toxic materials usage on the site.

The IH Group is the focal point for SRP efforts to find substitute or alternative process chemicals to be used instead of their more toxic counterparts currently in use. The IH Group has been successful in the past in providing substitutes such as using trichloroethane (TCA) for trichloroethylene (TCE) in the 300M-Area operations. Several additional substitutions are under study but require more data before the alternative can be accepted.

Hazard training is offered through the IH Group to Plant Operations personnel to identify potential chemical and materials handling problems.

4.2.1.2 Toxic Chemical Storage

Raw materials and process chemicals are maintained in one of three basic types of storage on the SRP: Central Stores, bulk tanks, and satellite storage at the production facilities.

Central Stores. Central Stores manages the majority of all materials that support the operations at SRP. Only small quantities of chemicals are stored in Central Stores, either in the General Warehouse, Oil Storage Building, Paint Shed, or Bulk Storage Warehouse. Most of these chemicals are stored in 1- or 5-gallon containers or smaller quantities. Only the Oil Storage Building contains significant quantities of 55-gallon drums, and that facility is diked and locked.

Central Stores operates a smaller chemical storage operation in the basement of the Savannah River Laboratory (SRL) building to handle small quantities of a wide variety of chemicals, acids, solvents, and other materials that are used in the laboratory operations. The storage in the laboratory chemical area is clean and well organized, with no evidence of any leakage or spills.

Bulk Purchases. Bulk raw and process materials are generally shipped directly to the plant operators, bypassing the Central Stores operation. These materials are delivered in tank trucks and railroad cars or in large drum lots. Drum lots are stored at satellite storage areas usually in a portion of the production building until needed. Many of the bulk liquid chemicals are stored in above-ground and underground tanks.

SRP owns and operates approximately 75 underground storage tanks (USTs,) all of which are used (or intended to be used) for petroleum products. The USTs range in size from less than 250 to 20,000 gallons. A computerized tank inventory is maintained, which provides the following information for each tank:

- o Energy and Environment (E&E) Department identification number
- o Tank age (in years)
- o Tank capacity (in gallons)
- o Materials of construction
- o Internal/external protection (yes or no)
- o Substance stored - common name and Chemical Abstract (CA) Number (where applicable)

Locations of all USTs are depicted in SRP's Spill Prevention, Control, and Countermeasure (SPCC) Plan. Tank inventories are maintained by periodic level measurements using either a calibrated stick or a sonic level sensor (i.e., Veeder-Root's TLS-250 system). Procedures for inventory control, emergency response, and tank retirement have been established by DPSP-85-1126.

Operations Storage. The final type of storage facilities are satellite storage areas where drums or bags of process chemicals are stored near the production facilities. These facilities are generally clean, well organized, and have a high turnover so that containers of materials do not have a chance to age significantly (which lessens the risk of leaks).

4.2.1.3 Polychlorinated Biphenyls

Procedures. The identification, control, removal, and disposal of PCBs at SRP is governed by a comprehensive policy (Du Pont, 1982). This policy addresses all aspects of proper PCB control, including industrial hygiene, personnel protection, employee training, emergency procedures, employee training, and waste disposal.

Further guidance on storage and disposal of PCBs has also been established in "Control and Disposal of Polychlorinated Biphenyls (PCBs)", DPSOL-S-9549, August 2, 1986 (Du Pont, 1986). Storage facilities have been provided on the SRP site, while disposal occurs at commercial disposal facilities off the site.

PCB status reports are prepared on an annual basis to document the amount of PCB materials in use, in storage, and disposed of. Currently, SRP does not have any PCB transformers or capacitors in operation on the site.

Identification, Testing, and Labeling. In 1979, SRP started a program to identify potential PCB equipment and contaminated items. At that time (1976-1977), SRP estimated approximately 700 PCB or PCB-contaminated transformers, 7-12 extrusion presses, 1,500 capacitors, and various hydraulic oils (containing PCBs) on the site. Since that time, SRP has tested a wide range of electrical transformers and capacitors, hydraulic fluids, motor oils, and heat transfer fluids. This program was extensive and included construction equipment, forklift trucks, garage lifts, and hydraulically operated valves.

PCB electrical equipment was provided with labels during the initial inventorying process, but the labels were removed when equipment was replaced or refilled. During this time, green "non-PCB" labels were affixed to some electrical equipment to avoid confusion during maintenance, operation, or emergency

situations. Some of the green "non-PCB" labels remain, but by and large are no longer needed to differentiate between PCB and non-PCB equipment and have been removed.

PCB Audit. The U.S. Environmental Protection Agency (EPA) conducted a multimedia audit at SRP on July 29-30, 1986. The Toxic Substances Control Act (TSCA) portion of the audit concentrated primarily on the handling and management of PCBs. Other than an administrative violation regarding the lack of an inspection form for a transformer, EPA could not find any problem with the SRP program (EPA, 1987).

Removal, Retrofit, and Refill. An effort was initiated to change out, retrofit, and/or refill all PCB equipment and fluids. By 1983, all PCB transformers were removed from service, in 1984 all in-service PCB capacitors were removed, and in 1985 all PCB-contaminated transformers were taken out of service. The only known PCB-contaminated equipment or fluids still in use at SRP are fluorescent light ballasts. These small light ballasts are normally not regulated, but SRP has indicated that it will continue to treat these items as PCB-contaminated equipment at least for the near future. Excluding those nonregulated items and materials in storage for disposal, SRP declared it was PCB-free on July 18, 1986.

SRP requested the PCB status of South Carolina Electric and Gas Company (SCEGC) equipment located on the site. A letter from SCEGC on December 13, 1984, indicated that none of its 14 transformers and circuit breakers on the site (34,337 gallons of oil) contained any PCBs.

SRC uses a number of transformers (30-40 units) for temporary construction purposes. A review of their records performed by the Survey team demonstrates that all present equipment is non-PCB.

A number of transformers at the SRP site were treated by Sunohio to reduce the level of PCBs below 50 parts per million (ppm). The documentation of this process was reviewed by the Survey team and found to be complete.

Storage. Storage of waste PCB-contaminated items occurs at two locations on the SRP site. The first site is Building 740-1A, located in the Salvage Yard. This metal building has a diked, concrete floor, is secured, has spill cleanup materials, and has protective equipment. Signs are posted outside the building indicating that PCBs are stored at that location. Detailed inventory records are kept of all materials sent to this storage building and shipped from the building to off-site disposal operations. Very few drums (6 in total) remained at this storage location during the Survey. The drums were in excellent condition, the floor of the building was dry, there was no evidence of spills, and the drums were neatly arranged to facilitate inspection. Inspections of the drums were undertaken on a regular basis (at least weekly) and the inspection records were complete.

The second storage site for PCBs is in Building 643-29G in the RWBG. A sign is on the outside of the building which states that PCBs are stored inside. The PCBs stored at this location are radioactively contaminated and are being held until DOE develops a suitable disposal method. No free liquids are allowed in these containers; all liquids have been pre-absorbed on vermiculite. Currently, commercial disposal firms will not accept radioactively contaminated PCBs. These PCBs are stored in metal drums (approximately 10-12 drums total) inside a concrete container [called a transuranic (TRU) hat]. The building is diked and secured, and no evidence of leakage was visible.

Spills and Cleanups

There have been several spills and/or cleanups of PCB liquids documented at the SRP site. These include the following:

- o December 8, 1981 - transformer leaks in Salvage Yard during transport; approximately 100 gallons of liquid; required 44 drums of soil to be excavated and disposed of
- o April 13, 1982 - motor carrier assisting in Sunohio transformer retrofit spilled 1 liter of liquid; contained within the truck

o 1985

- Building 320-M extrusion press sump found to contain 7,000 gallons of liquid; surface film tested at 10,000 ppm PCB; required 103 drums of materials to complete cleanup; cleanup conducted from April to June, 1986.

In both of the major spills described above (Salvage Yard and 320-M Building), South Carolina Department of Health and Environmental Control (SCDHEC) was notified and it monitored and approved the cleanup operations. In the Building 320-M cleanup, the following cleanup standards were employed: soil <50 ppm; water <0.5 ppb; and concrete walls <50 ppm. The minor spill (motor carrier) was too small to require an extensive cleanup. Because these spills were responded to rapidly and cleanup efforts were thorough, there is no reason to believe there is any remaining threat to the environment from these activities.

There is little chance of any significant spills of PCBs in the future because only a small quantity (15-20 drums) remain in the storage locations (radioactive and nonradioactive) and these are well maintained. Furthermore, there are no known PCB liquids in the current operating equipment or in the Central Stores.

Disposal. The SRP uses commercial off-site firms for the disposal of PCBs, except for PCBs contaminated with radioactivity. The latter type of PCBs are not accepted by commercial firms, and SRP continues to store these wastes in Building 643-29G in the RWBG, awaiting the development of a DOE-wide PCB-disposal facility.

Shipments to off-site disposal operations are accompanied by waste manifests to track the wastes from SRP to the disposal site. Copies of manifests are maintained in the Salvage Yard office. Manifest records are complete and can be traced back to the SRP storage records for PCBs.

The site has used SCA Chemical Services in Model City, New York (landfill); Waste Management of Alabama in Emmele, Alabama (landfill); and Rollins Environmental Services in Deer Park, Texas (incinerator) for disposal services. Certificates of Destruction were obtained for materials sent to the Rollins incinerator in Texas.

The only documented on-site disposal of PCB-contaminated materials was the contaminated soils removed during the cleanup of Building 320-M. All of these materials contained less than 50 ppm PCB (35 ppm actual) and were disposed of in the site sanitary landfill in agreement with the directions provided by SCDHEC.

Waste oils are burned on the SRP site at the 400-D Area Powerplant (Building 484-D). Approximately 2,000-2,500 gallons of waste oils are burned in this manner every month. PCB concentrations in these waste oils are spot checked and must be below 50 ppm to be acceptable in this facility. Spot checking of these waste oils appears to be adequately controlled by SRP because there are no known sources of PCBs remaining on the site. The maximum radioactivity content is also limited to 0.5 μ Ci/ml. The waste oil burning forms used at the powerplant were reviewed by the Survey team and no concentrations of PCBs above 50 ppm were noted. The laboratory analytical forms from the SRP laboratories were attached to confirm the concentrations of PCBs.

4.2.1.4 Asbestos

Background. The SRP was constructed in the early 1950s when construction materials normally included asbestos for insulating purposes. Consequently, asbestos materials are extensively contained in pipe and vessel insulation, general building insulation, gaskets and packing, and siding and roofing (primarily asbestos-cement or Transite). SRP no longer allows asbestos-containing materials to be purchased or installed on the facility.

As long as the asbestos-containing materials within the buildings are in good condition (i.e., there is no impact on workers), they remain in place. There is no systematic, site-wide asbestos removal program in force at SRP. These materials are removed, as necessary, during renovation projects or normal maintenance and repair.

SRP handles refractory ceramic fibers (RCF) in the same manner as asbestos in terms of personal protection, removal, labeling, and bagging.

Procedures. SRP controls the management of asbestos under DPSOL 40-5-102, which was most recently revised on January 6, 1987. This procedure addresses asbestos hazard information; exposure controls; removal, demolition, and renovation operations; work practices; employee training; and gaskets, insulation, and cement asbestos. Monitoring during asbestos removal projects is conducted in accordance to procedure DPSOL 193-5-105.

Annual physicals, in addition to preplacement and termination medical examinations, are required for all workers who handle asbestos.

An Asbestos Removal Notice Form is required to be sent to the E&E Department before any asbestos project is undertaken. For projects involving over 260 linear feet or 160 square feet of friable asbestos, more information must be provided in Part B of this form. All asbestos jobs must have an approved job plan signed by the HP Senior Supervisor, Custodian, Safety Engineer, Area Industrial Hygienist, and by an "asbestos-competent person."

Asbestos-removal projects are required to have engineered controls to limit the spread of airborne fibers. Personal protective clothing is required to protect the workers. Appropriate masks and respirators are specified by HP for each project, based on the hazard potential.

These asbestos procedures are applicable to SRP, SRL, and SRC. SRP personnel remove limited quantities of asbestos in their maintenance and repair work. The bulk of the asbestos is removed by SRC and its subcontractors, who perform the majority of the new construction and renovation work.

Initial training and an annual update are required for all workers who handle asbestos. This program provides an introduction to recognizing asbestos, health effects, protective controls, respirators, and medical surveillance. Further training is required of supervisory personnel to better control major asbestos-removal projects. This training consists of a comprehensive EPA-approved course, and qualifies the worker as an "asbestos competent person." An "asbestos competent person" is required to supervise all asbestos projects other than "small scale, short duration operations which take 8 manhours or less."

Identification and Testing. The IH Group within HP maintains the capability to sample for asbestos in air. The IH Laboratory can count asbestos fibers and provide a gross identification of asbestos fibers, but they send the samples off the site to identify the types of fibers present. The site is preparing to install new equipment that will allow identification of the types of asbestos to be performed on the site.

Once asbestos fibers are identified, the appropriate signs are posted in the work site prior to initiating the work, to inform the workforce of the potential hazard.

Removal and Handling. Removal operations are conducted within plastic "greenhouse" enclosures to limit the spread of airborne asbestos. Air concentrations are measured by IH to determine personal protection requirements. All removed asbestos is placed in double bags, sealed, and marked with an appropriate label. Radioactively contaminated asbestos is segregated from nonradioactive asbestos for handling and disposal purposes. Double-bagged asbestos wastes are placed in special dumpsters (i.e., labeled "For Asbestos Wastes Only" and sealed) on the plant site for removal to the appropriate burial ground. Asbestos-contaminated work clothing is bagged, sealed, and labeled like asbestos waste for disposal.

Removal projects are carried out by either maintenance personnel at SRP, or North Brothers or other subcontractors for SRC.

All asbestos removal projects require that all workers be approved for this type of work and complete the standard SRP training for asbestos. For all major projects (larger than 8 manhours), an "asbestos competent person" is required to supervise all work activities. Subcontracts for work performed by off-site companies require workers to be trained and a "competent" person assigned for major projects.

The quantities of asbestos removed at the SRP site for the two most recent years are presented below:

<u>Year</u>	<u>Asbestos</u>		<u>Transite</u>
	<u>Linear Feet</u>	<u>Square Feet</u>	<u>Square Feet</u>
1984	81,144	50,737	100,147
1985	41,925	9,081	295,235

(through end Nov.)

Quantities vary from year to year depending upon the renovations scheduled and the age of the buildings, but the removal of Transite is the largest volume of waste generated.

Disposal. Nonradioactively contaminated asbestos is placed in a separate trench in the sanitary landfill. These wastes are not compacted and are covered with 6 inches of clean soil.

Radioactive asbestos wastes are disposed of in the RWBG according to the level of contamination present.

An inactive asbestos disposal site, located in the C-Area, was closed on September 15, 1984. The area consists of about 5 acres of land and was covered with 6-12 inches of clay and 3 inches of topsoil. The area has a cover of vegetation and is graded to promote runoff. It appears to be well stabilized and no breaches in the cover were observed.

4.2.1.5 Pesticides

Procedures. There are three primary users of pesticides (i.e., herbicides and insecticides) on the SRP: SRP itself; Savannah River Forest Service (SRFS), and the Savannah River Ecology Laboratory (SREL). SRP uses herbicides extensively for control of weeds and vegetation along fences, within security areas, and in hard-to-mow areas. Insecticide services are contracted to an outside firm on an annual contract. SRP personnel apply much of the herbicides, but Burke Contracting is also used to supplement SRP staff. Currently, Borden Pest Control performs the insecticide services. SRP and contractor personnel are supervised by certified pesticide applicators. SRP has five certified applicators. Pesticide Activity Reports (ORS 2-105) are prepared for each day that pesticides are used, showing the type of pesticide, application rate, application area, and personnel in charge. Table 4-17 shows the types of pesticides currently in use or stored at the SRP.

TABLE 4-17

PESTICIDES USED AND/OR STORED AT SAVANNAH RIVER PLANT

Name of Pesticide	Remarks
Spike 3G	90% of all usage
Spike 5 and 6	dry granular
Hyvar	ground sterilant
Roundup	selective broad leaf

"SRP Pesticide Control", DP SOP-329, September, 1979, is the primary policy and procedure for pesticide usage at the SRP. The pesticide program at SRP is controlled by a Pesticide Committee that must approve the procurement of all pesticides and off-site contractors before the Procurement Department can proceed on these items. Appropriate personnel protective equipment is provided, as necessary (e.g., face shields, aprons, respirators, gloves).

The SRFS uses pesticides mainly to assist in its forest management program (i.e., control of undesirable, competing vegetation). The SRFS no longer uses any aerial application of pesticides. Ground spraying and direct injection into the trees are the methods currently employed.

The SRFS has extensive procedures and guidelines in place for the proper control of pesticides. Four SRFS employees are Certified Pesticide Applicators. Subcontractors are also used to apply pesticides, and these applicators are required by contract to be Certified Pesticide Applicators. Records of pesticide applications are documented on the Forest Service form, "Herbicide Treatment and Evaluation Record".

Table 4-18 shows the types of pesticides used or stored at the SRFS location.

The usage at the SREL is very limited - mostly for insect and rodent control. These services are provided through an outside contractor. The contractor has Certified Pesticide Applicators to supervise the pesticide applications.

Storage. The pesticides used by SRP are stored in Building 709-G, which is also used to store HW in adjacent bays. The pesticide storage bay is separated from the rest of the building by a concrete block wall. The doors to the storage area are locked and the entire building is surrounded by a locked fence. Warning signs are posted on the exterior of the building indicating storage of pesticides. Pesticides are stored in their original plastic or metal containers (i.e., 1- or 5-gallon size) that appear in good shape and are stacked on pallets. The interior of the building is diked with no outside drains. Several of the sprayers are stored in the building and they contained no liquids and did not show signs of leakage. Safety equipment and spill materials are available.

TABLE 4-18

**PESTICIDES USED AND/OR STORED AT SAVANNAH RIVER
FOREST SERVICE**

Name of Pesticide	Remarks
Tordon 101R	Injected into trees (Picloram)
Tordon 101 Mixture	Kudzu control
Pronone 10G	oak and hardwood control (pellet)
Velpar L	liquid (Hexazinone)
Rodeo	grass control (Glyphosate)
Roundup	grass control (Glyphosate)
Garlon 3A and 4	injected into trees (substitute for Tordon) Trizlopyr
Lindane	Insecticide (Benzene Hexachloride)
Dimecron	(Phosphamidon)
Dursban	termiticide (Chlorophyrifos)
Rhodamine	dry

Pesticides are mixed at the storage building or in the field. Containers are triple rinsed and buried in the landfill. Rinsate from containers and equipment is reapplied to the application area.

There was no indication of any spills or leakage of containers in the storage area. The locked building prevented unauthorized usage of the pesticides.

Pesticides used in the SRFS program are stored on their property in Building 760-10G. This small shed contains a small quantity of pesticides and manual application equipment. Spill cleanup materials were available and a prominent sign was posted outside the building indicating that pesticides were stored within. Safety equipment is also available in the storage building. The inventory of pesticides was also posted outside and the building was locked to prevent unauthorized access. Pesticides are stored in their original containers (i.e., glass, plastic, and metal) and on pallets. Several of these pesticides have been in storage for a long time and are no longer used. The SRFS and SRP are making efforts to contact manufacturers and other potential users to remove these older pesticides.

The interior of Building 760-10G is diked and sloped to a central sump. There were no signs of recent spills or leaks inside or outside the building. Much of the mixing and pour-up of pesticides occurs at the job site. Containers are triple rinsed, crushed, and sent to the SRP landfill. Rinsate from containers and equipment is reapplied to the application area.

Another potential pesticide storage building controlled by the SRFS is in the TC/U-Area, which was also investigated. This building is in poor repair and is designated the Paint and Fertilizer Building. The number on the building was difficult to read because of fading of the number and is either 5-830 or S-830. A sign on the outside of the building indicates that pesticides are stored within. The building was locked and upon entry only tree identification spray paint cans, lime, and boron were found. No traditional pesticides were found within the building, although the boron was previously used as a fungicide on tree stumps. Boron is stored in substantial quantities and the SRFS representative said it is no longer in use.

Spills and Leaks. There are no records to indicate that any significant spills or leaks of pesticides have occurred on the site in the past. No visible evidence of spills or leaks was observed during the inspection of the operations and storage areas on the SRP.

Disposal. As previously stated, the procedure used for disposal of pesticide containers is to triple rinse, crush, and place them in the sanitary landfill. Rinsate from container or equipment cleanup is placed in the application equipment to be uniformly sprayed back onto the application area.

Obsolete and out-of-date products are held in the storage area until a suitable disposal method can be identified. The SRP procedure for disposing of pesticides involves several steps that encourage reuse of the materials. The first step is to contact the manufacturer to determine if the chemical is still in use by others and to inquire if the manufacturer will take it back. The second step is to determine if any other organization within the site or any outside parties have a use for the chemical. If all avenues of investigation of reuse potential fail, then the pesticide is declared a waste and disposed of according to regulations.

No problems have been uncovered concerning the disposal of pesticide containers at the SRP Central Landfill. There are no indications of any other active disposal sites for pesticides on the site.

The Chemicals, Metals, and Pesticides (CMP) Pits, as the name implies, previously received quantities of pesticides. There are no records of the types of materials received or the quantities, but an early SRP Industrial Hygiene - Hazardous Materials guideline (DPSOL 158-2, Appendix E, June 1978) indicated that the following pesticides were suitable for disposal at the CMP Pits:

Ammate X	Kormex
Chlordane	Malathion
2,4,D Amine	Rotenone
DowPon C	

The chemical hazards associated with these pits were recognized by the SRP and efforts were undertaken to clean them up. The contaminated waste and soil were excavated, placed in drums, and are currently stored in the Hazardous Waste Building awaiting disposal. An underdrain system was installed, the area backfilled, and monitoring wells placed around the site. SCDHEC participated in the cleanup efforts. The cleanup is considered complete and no further environmental effects should be observed from pesticide wastes at that site. A more complete discussion of the CMP pits and the remedial action are contained in Section 4.5 of this report.

4.2.2 Findings and Observations

4.2.2.1 Category I

None

4.2.2.2 Category II

1. Underground Storage Tanks for Process Chemicals. Due to the number, size, and spatial distribution of the USTs, significant quantities of petroleum products could be leaking to the subsurface soil and/or migrating to the groundwater.

SRP has approximately 75 USTs used to store petroleum products. The present inventory control system used for the majority of these tanks (i.e., calibrated stick) is inadequate to detect leaks of less than 50 gallons (or 1 percent of capacity, whichever is greater) occurring on a weekly basis. The age, materials of construction, and the characteristics of the stored materials indicate a high potential for leakage of these tanks.

The sampling and analysis team will conduct leak testing on some of the USTs to determine the integrity of the tank structures and the potential to release contaminants to nearby soils and groundwater.

4.2.2.3 Category III

None

4.2.2.4 Category IV

1. Leaking Hazardous Raw Materials. Waste material containers stored in Building 733-1A are leaking onto the floor and potentially could be released outside the building.

Used or surplus oils (a hazardous waste as defined by SCDHEC) are being stored in Building 733-1A of the Central Stores with new stock. Many of these 5-gallon containers have leaked onto the floor or have deteriorated to the point that they are potential leakers. Additionally, there are a number of 55-gallon drums of hazardous process chemicals (i.e., oils and solvents) that are also leaking or are potential leakers due to their poor condition. The materials placed in this warehouse were arranged so that adequate aisle space was not maintained and it was difficult to inspect the condition of all the drums of materials. The probability of release of pollutants to the environment is small because the building has dikes around the interior and no outlet to sewers or storm drains was observed.

2. Unlabeled Hazardous Raw Materials. Unlabeled chemical drums in Building 733-1A may lead to confusion during accidents or emergencies in enabling workers to make the appropriate response.

Many of the drums in the Oil Storage Building 733-1A of Central Stores did not have manufacturer's label or hazardous materials label. This condition is not in compliance with the SRP Occupational Safety and Health Administration (OSHA) Hazard Communication Program or DPSOL 40-5-116 (Appendix), which requires clear labels on all hazardous materials. The only indication of the contents of these drums was hard-to-read, handwritten numbers placed on the drums. These numbers indicated Du Pont Stock Control numbers. In the event of a spill or emergency, the emergency response personnel would be required to read the number from the drum, look up the number in the inventory, and then cross-reference the chemical to the MSDS. This time-consuming process may cause safety problems and delay proper response in an emergency.

3. Chemical Storage. Chemicals stored in conjunction with paper and office products in Building 713-1A are not properly segregated and stored for adequate inspection.

Containers of chemicals such as roof patching, Cimcool, potassium permanganate, and aluminum hydroxide are intermixed with paper and office supplies in Building 713-1A, the Bulk Storage Warehouse of Central Stores. A spill or accident involving these chemicals would be difficult to contain with paper products stored in the same location. There was no diking or containment evident during the inspection.

4. Rusted Containers in Paint Warehouse. Building 733-A, the Paint Warehouse in Central Stores, contains several drums and cans of turpentine that are rusted and corroded and could potentially be leakers, presenting a safety and fire hazard.

5. Forest Service Pesticide Storage. Approximately 1 to 3 inches of unidentified liquids were observed by the Survey team in the bottom of the sealed sump within the diked area of the U.S. Forest Service Pesticide Storage Building (#760-10G).

No detectable leaks of pesticide were observed in the building. The U.S. Forest Service representative stated that the bottom of the sump was above the groundwater table, but no explanation could be provided on the source of the liquid.

6. Savannah River Construction Paint Storage. A liquid substance was observed on the floor of the Paint Storage Building (no number) of the Paint Shop Area of Savannah River Construction Division.

The wooden shed had heating and air conditioning to store temperature-sensitive paints and solvents. The building had a wooden floor with no containment. The liquid observed on the floor could not be identified and the source of the liquid could not be ascertained because the containers were stacked too close together and there was no aisle space.

4.3 Direct Radiation

4.3.1 Background Environmental Information

Direct external radiation is defined as exposure to gamma photons, x-rays, and beta particles coming from radiation sources or radioactive material outside the body. This does not include radiation from ingested or inhaled radioactivity. The effects of radioactive materials in the soil, water, and air have been previously described in Section 3.0 of this report. This section presents information on background levels from direct radiation.

Background radiation is considered to be the radiation arising from radioactive material or radiation sources other than the one directly under consideration (which in this case is direct radiation emanating from SRP). Background radiation is always present and has two major components, cosmic and terrestrial. The cosmic component is produced by interactions of high-energy radiation from outer space with the earth's atmosphere and varies depending upon the altitude above sea level. Background radiation levels from the cosmic radiation component vary in the U.S. from 26 mrem/yr at sea level to 125 mrem/yr in Colorado (NCRP 45-1975). Throughout the SRP area, the contribution of cosmic radiation to the total background radiation is essentially constant at approximately 32 mrem/yr (Zeigler et al., 1986b).

The terrestrial radiation component of background radiation is due to over 50 naturally occurring radionuclides, mainly potassium-40 (K-40) and members of the uranium-238 (U-238) and thorium-232 (Th-232) decay series, in the earth's crust. This terrestrial component will vary in intensity, depending upon such factors as local geologic formations and ground moisture.

Since World War II, there is a third source of background radiation caused by man-made radionuclides, such as cesium-137 (Cs-137) and strontium-90 (Sr-90), which have been distributed throughout the world as fallout from atmospheric nuclear detonations. This source, which has been decreasing from about 10-15 mrad/yr

since above-ground testing stopped in the United States, is usually included in the terrestrial component and presently constitutes a few mrad/yr. The terrestrial component of background in the United States generally varies by region from 15 mrad/yr along the Atlantic and Gulf coastal plains to 140 mrad/yr in the Colorado area (NCRP No. 45, 1975).

Within a 50-mile radius of the SRP, which is a relatively small area when compared to the entire United States, the terrestrial background levels vary widely from town to town from approximately 23 to 121 mR/yr, as evidenced by total background radiation levels of 51 to 153 mR/yr, which are discussed later in the SRP environmental monitoring program in Section 4.3.3.

The U.S. Environmental Protection Agency (EPA) maintains a network of background radiation monitoring stations throughout the country. Gamma radiation levels measured during 1985 at the three stations in the southeast U.S. closest to the SRP were:

<u>Location</u>	<u>Total Bkgd mR*/year</u>
Montgomery, AL	74
Barnwell, SC	76
Columbia, SC	82

Source: EPA Environmental Radiation Data, Reports #41, 42, 43, 44, and 45.

In the 1985 SRP Environmental Report, the average annual external direct radiation dose in the vicinity of the SRP was estimated as 69.6 mrem (32 mrem from cosmic, 33 mrem from terrestrial, and 4.6 mrem from weapons test fallout).

* One roentgen (R) or one rad of gamma radiation is equivalent to one rem (which accounts for biological effects).

4.3.2 General Description of Pollution Sources and Controls

This section describes the facilities (or areas) that are major sources of direct radiation at the SRP, the controls used to reduce radiation at the SRP, and the methods used to reduce radiation exposure to members of the public. Most facilities at the SRP conduct operations that involve the production of radiation and/or the processing of radioactive materials. The methods used to control (i.e., reduce) direct radiation exposure are shielding, distance, and time. The SRP places shielding material between the source and the receptor, maintains large distances between the source and the receptor, and/or limits the time the receptor stays in the radiation zone. The SRP, like most facilities, relies mainly on the first two methods to maintain radiation exposures to members of the public below the regulatory limits and as low as reasonably achievable (ALARA).

Since gamma radiation from a point source varies inversely with the square of the distance from the source, high-level facilities (where large quantities of radioactive materials are handled and where external direct radiation is of concern) were located near the center of the SRP (4 miles or more from the closest site boundary). In addition, these facilities are normally heavily shielded to protect the workers and the public.

Examples of high-level facilities are the 100-Area production reactors (C-, K-, L-, and P-), which are shielded; the 200-Area Fuel Separations Facilities (F- and H-), which are heavily shielded; the 200-Area High-Level Radioactive Waste Storage Tanks, which are buried to provide shielding; and the Radioactive Waste Burial Grounds, also located in the 200-Area. The Defense Waste Processing Facility (DWPF), which is presently under construction in the 200-Area, also will have heavy shield walls. More detail is provided on the Reactors and Separation Facilities in Section 2.2, and the High-Level Waste Tanks, Radioactive Waste Burial Grounds, and DWPF in Section 4.1.1.3.

Facilities located near the site boundary generally do not handle radioactive materials or the materials that are handled do not pose a direct radiation concern. An example of these is the TNX-Facility, near the Savannah River, which is a test facility for new equipment. Although the facility has used some radioactive materials in the past to test new equipment, it does not normally do so now. The

400D Heavy Water Rework Facility, also located near the Savannah River, cleans up and reconcentrates heavy water contaminated mostly with light water (normal water) and tritium. Although this facility handles radioactive material, it is not a direct radiation concern since the material is a low-energy beta emitter. The 300M-Area, located near the northwest site boundary, processes primarily non-irradiated uranium fuel and target material. The adjoining 700A-Area, which is the main administration area, includes the Savannah River Laboratory (SRL), which does handle gamma-emitting radioactive materials. However, the quantities handled are small, compared to the 100- or 200-Areas, and radioactive materials are handled in hot cells (shielded cells) or other appropriately controlled and shielded facilities.

As a result of distance and/or shielding, little, if any, direct radiation from SRP facilities is measurable at the site boundary. Direct radiation, which may be present at the site boundary or other areas accessible to the general public, would be the result of atmospheric releases of radionuclides, primarily noble gases.

One source of direct radiation exposure that is not a facility but should be discussed is the Savannah River Swamp. An area of approximately 5 square miles bordering the Savannah River (part of which is off the site on private property known as the Creek Plantation Swamp) was contaminated with gamma-emitting radionuclides, mostly Cs-137, in the 1960s. Radiation levels of 0.2-1 mR/day (up to 354 mR/yr) have been measured in the swamp. The only exposure control method that can reasonably be applied to limit exposure is to limit the time of personnel in the area. Public access to that portion of the swamp on the SRP site can be limited, but access to that portion on private land cannot be limited (see Sections 4.3.3 and 4.3.4 for more details).

4.3.3 Environmental Monitoring Program

The SRP maintains an extensive system of thermoluminescent dosimeters (TLDs) for monitoring gamma radiation levels in the environs of the plant. Gamma radiation levels were measured continuously with TLDs at the following locations:

- o Ninety-two locations at fences around SRP facilities (on-site)
- o Eight on-site air monitoring stations
- o Seventy-nine locations at 1-mile intervals around the SRP boundary (Figure 4-6)
- o Thirteen air monitoring stations around the SRP boundary
- o Twelve air monitoring stations at a 25-mile radius of SRP
- o Four air monitoring stations at 100 miles from SRP
- o Four locations near the Allied General plant
- o Sixteen locations near the Vogtle nuclear powerplant, which is being constructed across the Savannah River from the SRP
- o Sixty-two locations in cities and towns within 50 miles of SRP (Figure 4-7)

In addition, TLD radiation measurements were also made in the off-site Creek Plantation Swamp, which is contaminated due to previous Cs-137 discharges from reactor facilities. Added together, the above TLDs provided environmental surveillance at more than 290 locations in an 8,000-square-mile area in the vicinity of the SRP.

Radiation levels measured during 1985 by the TLD monitoring network are summarized and detailed tables are provided in the SRP 1985 Environmental Report (Zeigler, et al., 1986b). As would be expected, the on-site measurements were higher than the perimeter and off-site measurements. The average gamma exposure level at the fencelines of the various SRP facilities ranged from 66 mR/yr at C-Area to 398 mR/yr at H-Area. The maximum single location was at corner 2 of H-Area fence; the 1985 exposure level at this location was 1898 mR/yr. Exposure levels measured at the 8 on-site air monitoring stations ranged from 69 to 375 mR/yr during 1985. Again, the highest level was in the H-Area. In general, there was an increase of about 22 percent in the exposure level near the H-Area in 1985, due to increased radiation from process equipment in the 211-H Canyon.

SRP TLD PLANT PERIMETER LOCATIONS

FIGURE 4-6

TLD MONITORING LOCATIONS IN CITIES AND TOWNS NEAR SRP FIGURE 4-7

At the 79 perimeter monitoring locations, the exposure levels ranged from 47 to 110 mR/yr during 1935. The highest level was at monitoring station 49 (which previously has had elevated levels) on the southeast boundary. Adjacent stations showed levels comparable to average background levels during the year; the reason for this higher measurement at station 49 has been attributed by SRP monitoring personnel to a natural variation in background. The perimeter monitors were in the range of background levels monitored during that year and previous years.

Gamma radiation measurements obtained at the 13 perimeter air monitoring stations were also comparable to background, ranging from 51 to 84 mR/yr, with an average of 66 mR/yr. At the twelve 25-mile-radius air monitoring stations, the gamma radiation level ranged from 55 to 84 mR/yr. At the four 100-mile-radius air monitoring stations (located in Greenville and Columbia, South Carolina, and Macon and Savannah, Georgia), the gamma radiation range was 62 to 117 mR/yr.

All of the gamma radiation levels at the air monitoring stations were within the ranges observed during the past few years and are considered by SRP as reflecting only natural variations in background radiation. Since the 100-mile stations are too far from SRP to be influenced by gamma radiation (even from the airborne gamma-emitting radioactive material normally emitted by the SRP), it can be seen that there is a wide variation in background radiation levels in the South Carolina - Georgia area surrounding the SRP.

Radiation measurements around the Allied General Nuclear Plant Site in South Carolina and the Vogtle Nuclear Power Site in Georgia were within the range of values observed at plant perimeter and 25-mile-radius locations. During the monitoring period, the recently constructed Vogtle power reactor had not yet been brought critical for the first time.

TLDs were placed both inside and outside public buildings at 62 locations (Figure 4-7) within a 50-mile radius of SRP. During 1985, radiation levels inside buildings ranged from 51 to 197 mR/yr, while those outside the buildings ranged from 55 to 153 mR/yr. Radiation levels at the Saluda, South Carolina, and the Sylvania, Georgia, locations, approximately 50 and 35 miles from the SRP, respectively continue to be significantly higher than the other locations. These

ranges compare favorably with 1984 ranges of 51 to 183 mR/yr inside buildings, 55 to 153 mR/yr outside buildings, and measurements taken in a granite structure (the South Carolina State Capitol) in 1974 that ranged from 95 to 350 mR/yr (Du Pont, 1985e).

Differences between inside and outside measurements are attributed primarily to natural radioactivity in the construction materials, with brick, granite, and concrete contributing to higher radiation measurements than other materials. The higher radiation levels inside buildings may also be due to the buildup of radon and thoron that occurs in well-insulated, airtight buildings. The wide range in values between locations reflects the wide variations in background radiation in the South Carolina-Georgia area.

Radiation surveillance of the Savannah River Swamp, approximately 5 square miles bordering the Savannah River below the SRP boundary between SC and Little Hell Landing, has been conducted annually since 1972. The swamp was contaminated in the 1960s with approximately 25 Ci of Cs-137 and less than 1 curie of Co-60. The source of this activity was failed fuel elements that leaked small amounts of radioactivity into water that was used to shield and cool irradiated fuel elements. Periodically a portion of the fuel storage basin water containing the Cs-137 and Co-60 was discharged to Steel Creek. The radioactivity settled in the swamp during periods when the river was high and Steel Creek flowed across the swamp before entering the river at Little Hell Landing. The failed fuel elements were removed from P-Area fuel storage basins in 1970.

Comprehensive radiological measurements, including TLD gamma radiation measurements and analyses of vegetation, soil, and fish samples, were made annually between 1974 and 1977 along 10 monitoring trails cut into the swamp (Figure 4-8). The frequency of conducting comprehensive measurements was then reduced to every 5 years because no significant changes in radiological conditions were found. Interim monitoring was provided by annual TLD surveillance measurements along the 10 transects. The 1985 comprehensive monitoring was conducted earlier than usual to ensure that no significant change had occurred before the startup of L-Reactor in October 1985, since secondary cooling water from L-Reactor is now discharged to Steel Creek via the newly created L-Lake.

FIGURE 4-8

RADIOACTIVITY DEPOSITED IN THE SAVANNAH RIVER SWAMP

During 1985, the gamma radiation levels in the swamp ranged from 0.16 to 0.97 mR/day. Figure 4-8 shows the location of the radioactivity in the swamp with the 10 monitoring trails, and Table 4-19 presents the monitoring data for 1972-1983, 1984, and 1985. Aerial monitoring for cesium-137 contamination was performed by EG&G in 1982. The results depicted in Figure 4-9 show the extent of the cesium-137 contamination, the pathways and the radiation level due only to the cesium-137 contamination (Berry, 1986).

As is evident from the data, few significant changes are noted in these measurements from year to year. The maximum level measured during 1985 (0.97 mR/day) is equivalent to an annual whole-body dose of 354 mrem. This exceeds the current DOE guideline for maximum dose to a member of the public at the site boundary or off the site. (The levels were reduced in 1985 from 500 mrem/yr to 100 mrem/yr. See Appendix K for criteria.) However, the off-site swamp is uninhabited and largely inaccessible except for occasional hunters or fishermen. Under the current situation, it is unlikely that an individual would receive a dose in excess of the 100 mrem/yr limit under a reasonable exposure scenario. However, since the SRP does not control the area, it cannot restrict access and therefore cannot ensure that this is the case.

4.3.4 Findings and Observations

4.3.4.1 Category I

None

4.3.4.2 Category II

None

4.3.4.3 Category III

1. Radiation Levels in the Savannah River Swamp. Past effluent discharges from P-Reactor to Steel Creek have contaminated (mostly with Cs-137) the Savannah River Swamp, part of which is on private property known as the Creek Plantation Swamp. The direct radiation level resulting from the contamination (levels exceed 350 mR/yr) exceeds current DOE guidelines of 100 mrem/yr.

Table 4-19
Savannah River Swamp, Steel Creek to Little Hell Landing, TLD Radiation Measurements

River Mile	Trail Number	Distance From River (Meters)	mR/Day		
			Average Annual Results 1972-1983 ^a	October ^b 1984	September 1985
141.5	1	0	0.26 + 0.03	0.19 + 0.02	0.33 + 0.03
		178	0.34 + 0.06	0.30 + 0.03	0.34 + 0.03
		358	0.51 + 0.08	0.46 + 0.04	0.44 + 0.04
		550	1.09 + 0.17	—	0.93 + 0.07
		656	1.37 + 0.27	0.95 + 0.07	-0.97 + 0.07
140.8	2	805	0.17 + 0.03	0.18 + 0.02	0.17 + 0.02
		0	0.22 + 0.03	0.23 + 0.02	0.24 + 0.02
		207	0.25 + 0.03	0.26 + 0.02	0.26 + 0.02
		406	0.25 + 0.03	—	0.27 + 0.02
		598	0.25 + 0.02	0.27 + 0.02	0.25 + 0.02
		798	0.33 + 0.04	0.34 + 0.03	0.32 + 0.03
		945	0.57 + 0.05	0.49 + 0.04	0.49 + 0.04
136.3 to 140.8	3	975	0.18 + 0.02	0.19 + 0.02	0.16 + 0.02
		0	0.23 + 0.02	0.22 + 0.02	0.22 + 0.02
		281	0.26 + 0.05	0.25 + 0.02	0.25 + 0.02
		627	0.23 + 0.01	0.22 + 0.02	0.22 + 0.02

-- No analysis.

a The average values are accompanied by a plus or minus (+) limit value, which is the standard deviation of the average.

b The individual 1984 through 1985 results are accompanied by a ± value which represents the statistical counting error at the 95% confidence level.

Table 4-19 (continued)
Savannah River Swamp, Steel Creek to Little Hell Landing, TLD Radiation Measurements

River Mile	Trail Number	Distance From River (Meters)	mR/Day		
			Average Annual Results 1972-1983 ^a	October ^b 1984	September ^b 1985
139	4	0	0.27 ± 0.03	0.23 ± 0.02	0.29 ± 0.03
		293	0.30 ± 0.04	0.32 ± 0.03	0.29 ± 0.03
		380	0.38 ± 0.06	0.45 ± 0.04	0.40 ± 0.03
		515	0.40 ± 0.07	0.37 ± 0.03	0.37 ± 0.03
		580	0.81 ± 0.09	0.74 ± 0.05	0.72 ± 0.05
138.5	5	729	0.29 ± 0.16	0.24 ± 0.02	0.23 ± 0.02
		0	0.23 ± 0.03	0.25 ± 0.02	0.21 ± 0.02
		534	0.34 ± 0.04	0.32 ± 0.03	0.30 ± 0.03
		573	0.57 ± 0.05	0.49 ± 0.04	0.40 ± 0.03
		640	1.04 ± 0.12	0.91 ± 0.07	0.22 ± 0.06
137	6	773	0.25 ± 0.03	0.25 ± 0.02	0.24 ± 0.02
		0	0.24 ± 0.03	0.27 ± 0.02	0.25 ± 0.02
		549	0.32 ± 0.03	0.33 ± 0.03	0.30 ± 0.03
		701	0.64 ± 0.12	0.56 ± 0.04	0.52 ± 0.04
		772	0.80 ± 0.12	0.69 ± 0.05	0.67 ± 0.05
		817	0.27 ± 0.04	0.26 ± 0.02	0.260 ± .02

— No analysis.

a The average values are accompanied by a plus or minus (+) limit value, which is the standard deviation of the average.

b The individual 1984 through 1985 results are accompanied by a + value which represents the statistical counting error at the 95% confidence level.

Table 4-19 (continued)
Savannah River Swamp, Steel Creek to Little Hell Landing, TLD Radiation Measurements

River Mile	Trail Number	Distance From River (Meters)	mR/Day		
			Average Annual Results 1972-1983 ^a	October ^b 1984	September ^b 1985
136.3	7	0	0.23 ± 0.03	0.25 ± 0.02	0.29 ± 0.03
		579	0.23 ± 0.06	0.25 ± 0.02	0.21 ± 0.02
		945 ^c	0.61 ± 0.30	0.40 ± 0.03	0.35 ± 0.03
		976 ^d	0.25 ± 0.01	0.26 ± 0.02	0.25 ± 0.02
135.7	8	0	0.22 ± 0.02	0.26 ± 0.02	0.23 ± 0.02
		168	0.25 ± 0.03	0.28 ± 0.03	0.26 ± 0.02
		279	0.23 ± 0.04	0.34 ± 0.03	0.24 ± 0.02
		445	0.25 ± 0.02	0.28 ± 0.03	0.24 ± 0.02
		612	0.25 ± 0.03	0.28 ± 0.03	0.21 ± 0.02
		814	0.38 ± 0.05	0.36 ± 0.03	0.34 ± 0.03
		884	0.60 ± 0.04	0.62 ± 0.05	0.51 ± 0.04
135.5	9	915	0.24 ± 0.02	0.27 ± 0.02	0.23 ± 0.02
		0	0.23 ± 0.02	0.24 ± 0.02	0.24 ± 0.02
		512	0.42 ± 0.05	0.43 ± 0.03	0.38 ± 0.03
		621	0.54 ± 0.10	0.54 ± 0.04	0.49 ± 0.04
		671	0.66 ± 0.08	0.66 ± 0.05	0.58 ± 0.04
		769	0.21 ± 0.02	0.22 ± 0.02	0.21 ± 0.02

— No analysis.

- a The average values are accompanied by a plus or minus (±) limit value, which is the standard deviation of the average.
b The individual 1984 through 1985 results are accompanied by a ± value which represents the statistical counting error at the 95% confidence level.
c TLD measurements were taken 793 meters from the river on trail 7.
d TLD measurements were taken 823 meters from the river on trail 7.

Table 4-19 (continued)
Savannah River Swamp, Steel Creek to Little Hell Landing, TLD Radiation Measurements

River Mile	Trail Number	Distance From River (Meters)	mR/Day		
			Average Annual Results 1972-1983 ^a	Octoberb 1984	Septemberb 1985
134.4	10	0	0.36 + 0.09 0.34 + 0.04 0.23 + 0.08	0.36 + 0.03 0.22 + 0.02	0.34 + 0.03 0.18 + 0.02
West Jackson (Control)			0.23 + 0.02	0.23 + 0.02	0.23 + 0.02
Allendale Gate (Control)			0.14 + 0.01	0.14 + 0.01	0.14 + 0.01

— No analysis.

a The average values are accompanied by a plus or minus (+) limit value, which is the standard deviation of the average.

b The individual 1984 through 1985 results are accompanied by a + value which represents the statistical counting error at the 95% confidence level.

Source: Zeigler et al., 1986b

Source: Berry 1986

AERIAL RADIOLOGICAL SURVEY RESULTS ^{137}Cs DOSE

FIGURE 4-9

The DOE guideline for the maximum dose to an off-site member of the general public was reduced in 1985 from 500 mrem/yr to 100 mrem/yr (for a prolonged period of exposure) (Vaughan, 1985). Compliance is normally demonstrated at a site boundary by showing that radiation levels (above background) for continuous occupancy are lower than the guideline. The direct radiation level from the contamination is such that continuous occupancy of some areas of the swamp could result in doses exceeding the DOE guideline level of 100 mrem/yr to a member of the general public. Under current condition of occupancy and use, it is unlikely an individual would receive such a dose; however, such occupancy and use are not under control of the SRP.

4.3.4.4 Category IV

None

4.4 Quality Assurance

4.4.1 General Description of Data Handling Procedures

This section reviews the procedures for the collection and analysis of environmental data, with particular concern focused on the ability to identify the quality of the data. The quality assurance (QA) discussion is divided into two main sections: field sampling/monitoring and laboratory analysis.

The overall QA objectives of the U.S. Department of Energy (DOE) operations at the Savannah River Plant (SRP) are provided in DOE Order 5700.6A "Quality Assurance" and the Savannah River Operations Office implementing guidance (SR 5700.6B). The operating contractor at the SRP has developed a Quality Assurance Program in accordance with DOE guidance. This program is implemented through the "Savannah River Quality Assurance Policy" (DPW-76-111-1), the "Savannah River Quality Assurance Plan" (DPW-82-111-2), and the "Savannah River Quality Assurance Manual" (DPW-83-111-3). The documents cited above show the management framework that has been established by the SRP for QA of environmental data collection.

Environmental surveillance is performed by a number of organizations from SRP and by outside contractors. Table 4-20 shows the responsible organizations for both sampling and analytical work for all the SRP environmental monitoring efforts.

4.4.1.1 Environmental Monitoring

Background. The Environmental Monitoring Program for the SRP and surrounding environment is extensive. An estimated 15,000 samples were collected and 85,000 analyses performed for radioactive parameters in 1985, while another 4,000 samples and 35,000 analyses were conducted to evaluate nonradioactive parameters in the same year (Zeigler et al., 1986).

The Health Protection (HP) Department has the primary responsibility for environmental sampling, either through the Environmental Collections Group or outside contractors. The QA program for these operations is governed by "Health Protection Department: Quality Assurance Plan" (DPSOP 293, April 1979).

**TABLE 4-20. RESPONSIBILITY FOR ENVIRONMENTAL SURVEILLANCE
PROGRAM AT THE SAVANNAH RIVER PLANT**

Environmental Program	Sampling	Laboratory Analysis
Air Quality - Radioactive - Conventional	Environmental Collections Zedek Corporation*	Radiochemical Laboratory Zedek Corporation*
Drinking Water	Environmental Collections Environmental Collections	Radiochemical Laboratory (rad) 772-D Laboratory (biological)
Surface Water - Rivers and Streams - NPDES (process) - NPDES (sanitary)	Environmental Collections Environmental Collections Environmental Collections - 59 locations Power Department - 13 Locations	Water Quality Laboratory (rad) Envirodyne (chemical)* ETI* ETI* 772-D Laboratory (biological)
Radiation - TLD	Environmental Collections	Dosimetry Laboratory
Soil	Environmental Collections	Radiochemical Laboratory
Sediment	Environmental Collections	Radiochemical Laboratory
Vegetation	Environmental Collections	Radiochemical Laboratory
Milk, Food, and Wildlife	Environmental Collections	Radiochemical Laboratory
Groundwater - Radioactive - RCRA	Environmental Collections Bullard*	Radiochemical Laboratory Envirodyne*

*Indicates outside contractors

Environmental Collections. The Environmental Collections Group performs the majority of the sampling on the SRP site (as shown on Table 4-20). Environmental Collections does not have a separate QA manual but operates under the guidance of the HP Department manual (DPSOP 293).

Sampling procedures are provided in "Health Protection Department Environmental Monitoring - Collections" (DPSOP 271-1). These procedures provide extensive directions on safety precautions, equipment operation, sample collection, measurement procedures, and sample handling.

Field logbooks are maintained by the collection teams to record date and time of sample, equipment readings, repairs required, maintenance or housekeeping performed, and other notes (such as equipment failures). Data entered into the logbooks are reviewed and verified by a supervisor.

Sampling by Environmental Collections personnel for rivers and streams, ambient air (radiation), and groundwater (radiation) was observed by the Survey team. The sampling personnel were aware of the standard procedures and, for the most part, followed the procedures and currently acceptable sampling techniques.

Environmental Collections maintains maps of sample locations and monitoring routes. Sampling locations are well marked with signs, and wooden platforms are provided at most surface-water locations.

The routine environmental sampling is performed on an established monthly schedule, with different teams assigned to different monitoring routes and duties. Environmental Collections has a monitoring schedule laid out for the entire year; thus both the collection personnel and analytical staff know the projected workload and when to expect certain types of samples. On a weekly basis, a computer program prints out all the sample labels for that week. The Analytical Laboratory staff cleans and prepares the appropriate sample containers and affixes the preprinted label. The label identifies the scheduled collection date, the type of sample, the location, the collection team, and the required laboratory analysis. The sample containers with the preprinted labels are placed in the Environmental Collections sample receiving room to be picked up by the collection team. As a further aid to minimizing confusion, water sample bottles are color coded for each week of the month.

Chain of custody is observed only on those samples that require this type of tracking by regulations [i.e., National Pollutant Discharge Elimination System (NPDES) and Resource Conservation and Recovery Act (RCRA)]. Therefore, all samples that are sent to off-site laboratories or the 772-D Laboratory maintain a chain of custody. The chain-of-custody files were reviewed by the Survey team and found to be complete.

Maintenance of pumps and other sampling equipment is tracked in a maintenance logbook. Field analytical monitoring equipment (e.g., rad meters, pH meters, organic vapor analyzers) is calibrated by the Industrial Hygiene group on a predetermined schedule and equipment is marked with a tag to show the next required calibration date.

Extensive training is provided to the Environmental Collections personnel in the subject areas of SRP policies, safety requirements, Occupational Safety and Health Administration (OSHA) requirements, and sampling procedures. Each analyst is trained and approved for specific environment sampling procedures on an annual basis and these records are maintained on the "Analyst Training and Qualification Checklist" form. All training records are compiled in the "Environmental Collection Training/Cross Training Records" notebook.

Power Department. The Power Department performs the sampling of sanitary plant NPDES outfalls at approximately 13 locations. The Survey team observed the collection of NPDES samples and found the collection techniques acceptable. Signs marked the location of the sampling points and wooden platforms and walkways were available at the sample locations. Chain-of-custody procedures were observed in the collection and handling of the samples. Samples were suitably packed for shipment to Environmental Testing, Inc. (ETI) in Charlotte, North Carolina for analysis.

RCRA Groundwater Wells. The Groundwater Monitoring Program for RCRA-regulated facilities is performed by an outside contractor, the Bullards. Written sampling procedures are available and the sampling personnel are trained in the procedures. Observation of the contractor during the Survey demonstrated that RCRA-required procedures for sampling the groundwater wells were followed to prevent cross-contamination of samples and provide suitable preservation during

the shipping period. Chain of custody was maintained on the samples observed and records of chain of custody were reviewed and found to be complete. All samples were correctly labeled and packed for shipment to Envirodyne Engineers, Inc., in St. Louis, Missouri, for analysis.

Ambient Air Monitoring - Nonradioactive. The ambient air monitoring network (six stations) for nonradioactive parameters is operated by Zedek Corporation. The QA program for this operation is outlined in "Quality Control Plan, Ambient Air Quality Monitoring Program, Savannah River Plant, Aiken, South Carolina. (Northrup Environmental Sciences, SP-4160-84-33, January 15, 1985). This document provides a comprehensive approach to personnel training, equipment calibration, equipment configuration, sample collection and analysis procedures, preventive maintenance, data validation, auditing, and corrective action. The appropriate sampling procedures (DPSOL 271-1-101 through 119) are contained in this manual. During the Survey, team members accompanied the Zedek personnel on their monitoring rounds and found that sampling and calibration were carried out in accordance with the manual.

4.4.1.2 Laboratory Analysis

Background and QA Policy. The analysis of environmental samples is accomplished with a combination of SRP laboratories and off-site contractor laboratories as shown in Table 4-20. Three basic groups of laboratories are involved in the Environmental Monitoring Program: SRP Health Protection Department; SRP Laboratories Department; and off-site contractors.

The Health Protection Department has five laboratories: Radiochemical Analysis, Counting, Dosimetry, Water Quality, and Industrial Hygiene. The Industrial Hygiene Laboratory is not shown in Table 4-20 because it deals primarily with in-plant health and safety and personnel protection concerns, rather than effluent/waste streams or environmental monitoring. The laboratory is included in this discussion because it performs analyses on asbestos and toxics (metals and organics). The HP laboratories do not have separate QA manuals but operate under the "Health Protection Department Quality Assurance Plan" (DPSOL 103, April 1979).

A second group of laboratories that perform environmental sample analysis are SRP laboratories that support the process operations and are not connected with the Health Protection Department. These laboratories are organized under the Laboratories Department and perform analyses on process liquids, solids, and gases to assist in maintaining control of the manufacturing process and the quality of the finished products. These laboratories often analyze the constituents in effluent streams as a means of controlling the process and thus have developed some unique capabilities for environmental analysis on the site. The two laboratories of concern are the 320M Laboratory and the 772D Laboratory. These facilities operate under the "Laboratories Department Quality Assurance Plan" (DPSOP 81-2, July, 1980). This plan covers training, records, audits, assessments, purchasing, operations, inspection, testing, and corrective actions.

The last group of laboratories are off-site contractors, including ETI, Envirodyne Engineers, Inc., and Environmental and Chemical Sciences, Inc. (ECS). Each of the laboratories has an extensive and formal QA program which was required as part of their contract with SRP. The ETI program is defined in "Analytical Quality Assurance Program for Air and Wastewater" (ETI, July 1984). This program establishes standards for personnel qualifications and training; data management, sample acquisition and custody; instrumentation specifications, calibrations and maintenance; safety; and quality control.

Envirodyne has developed its Quality Assurance/Quality Control (QA/QC) program in accordance with its "Handbook for Quality Control" (Envirodyne, 1981). This handbook defines the following elements of its program: quality control; data handling and reporting; experiment design; calibration; reference standards; and U.S. Environmental Protection Agency (EPA) test procedures.

ECS's program for QA is developed in "Chemistry Laboratory Quality Assurance Manual" (ECS, 1986). The principal portions of this program are sample handling; laboratory materials; glassware; instrument performance; and analytical performance.

Radiochemical Analysis Laboratory. The Radiochemical Laboratory is responsible for performing analysis of environmental samples for radioactive content. Water, soil, sediment, milk, vegetation, air, and special samples are processed through this laboratory.

The QA program is derived from the HP Department QA Plan (DPSOP 293), and specific QA procedures are under preparation for incorporation into the new laboratory procedures manual (DPSOP 271-5). A monthly QA report on laboratory performance is prepared for analytical procedures performed by the Radiochemical Laboratory. These reports are computer generated and provide control charts and summaries of performance in interlaboratory comparison programs.

The laboratory procedures are currently contained in DPSOP 271, which includes both radioactive and nonradioactive laboratory procedures. Copies of existing procedures are available on the laboratory bench. The new laboratory manual, which is about 80 percent complete, is DPSOL 271-5 and will contain only radioactive procedures. Completion of the manual is expected in 1987. Procedures in the new manual will be updated and provide more detailed and explicit instructions. Laboratory data are recorded on standard forms and compared to annual ranges and monthly trends by the supervisor before approval.

Calibration and maintenance of laboratory instruments is performed on a routine basis. Training of analysts is performed and records are maintained that show the date of training, name of personnel, type of training, and approval signature.

The laboratory uses National Bureau of Standards (NBS) reference standards and participates in the DOE Environmental Measurements Laboratory (EML) and EPA Environmental Monitoring Systems Laboratory (EMSL) interlaboratory comparison programs and generally falls within the normal performance range for all the participating laboratories.

Counting Laboratory. The Counting Laboratory provides radioactive counting of prepared planchets for environmental samples.

A variety of new equipment has been installed in the laboratory to update its capabilities, and complete procedures and training requirements have not been developed for all of these instruments.

Dosimetry Laboratory. Services provided by the Dosimetry Laboratory include the analyses of all environmental thermoluminescent dosimeters (TLDs). Currently, over 2,000 TLDs are included as part of the SRP monitoring program.

Water Quality Laboratory. The Water Quality Laboratory provides analysis of environmental samples for nonradioactive analysis and conducts the analysis on low-level plutonium samples. The bulk of this laboratory's workload is attributable to nonradioactive analysis of river and stream samples. Regulatory reporting for NPDES and RCRA monitoring are performed by off-site laboratories.

The QA program is based on the HP Department QA Plan (DPSOP 293), and separate QA procedures are being developed by Water Chemistry. The analytical procedures manual (DPSOP 271) is out of date, because new procedures are used in the laboratory that have not been added to the manual. The update to the manual is on hold, pending a relocation of the laboratory to a new facility. The new manual will separate the radioactive (DPSOP 271-5) from the nonradioactive (DPSOP 271-6) procedures. The laboratory projects a 75 percent completion of the manual by the end of 1987. Laboratory results are recorded on standard forms and are reviewed and approved by a supervisor. Data are compared to annual ranges and monthly trends to detect outliers and anomalies.

Calibration and maintenance of equipment are routinely performed on laboratory instruments. Some training of personnel has been accomplished but no formal records are maintained.

Reference standards used in the laboratory are derived from NBS samples. The laboratory participates in interlaboratory comparison programs with the DOE's EML and the EPA's EMSL.

Industrial Hygiene Laboratory. The Industrial Hygiene Laboratory (IH) has extensive capabilities for organics, ions, metals, and asbestos in support of SRP's Industrial Hygiene Monitoring Program for the protection of workers. The parameter of interest in the Survey is asbestos, because the identification and proper handling of asbestos in waste materials can be a source of environmental concern.

The IH Laboratory uses the HP Department QA manual as a guide. Specific QA/QC procedures are incorporated into the analytical procedures. Procedures are available to the analyst at the laboratory bench for reference. Data are recorded on laboratory forms and reviewed and approved by the supervisor.

Laboratory instruments are calibrated and maintained on a routine basis. Training of laboratory analysts has been conducted and documented. Off-site training on the identification and classification of asbestos fibers has been provided to the staff. Currently, the IH Laboratory only identifies the presence and concentration of asbestos and uses an accredited off-site laboratory to classify the types of fibers.

The laboratory participates quarterly in the American Industrial Hygiene Association (AIHA) interlaboratory comparison program for organics (mixed), metals, and asbestos, and its performance has been very good. The laboratory has been accredited by AIHA for the period of October 1985-1988.

300M-Area Laboratory. The 300M laboratory provides analyses for polychlorinated biphenyls (PCBs) for the site. This is the only area of environmental analysis that is potentially used for regulatory purposes. This laboratory performs the analysis of volatile organics in groundwater wells and the air stripper system, and effluent analysis from the Liquid Effluent Treatment Facility (LETF). These results are used for process control purposes and are not reported as part of the regulatory monitoring requirements. The laboratory's primary responsibility is to provide analytical services for the 300M-Area for raw materials studies and QC of finished products.

This laboratory operates under the Laboratory Department QA Plan (DPSOP 81-2). Approved procedures are available for most of the analytical work, but procedures for the LETF and PCB work are in the development stage.

Laboratory data are reported on standard forms and checked by a supervisor. Extensive laboratory notebooks and records are maintained. Groundwater and NPDES results are routinely compared to similar samples analyzed by outside laboratories (i.e., Envirodyne and ETI) to check for consistency.

Calibration and maintenance are performed routinely on laboratory instruments. Analysts are trained in procedures and approved by supervisors on their proficiency in performing the procedures. EPA standards for PCBs and volatile organics are used in the laboratory. The laboratory participates in the EPA interlaboratory comparison studies once a year for volatile organics, heavy metals, oil and grease,

and total suspended solids (TSS). SCDHEC has provided Interim EPA certification to the 320M Laboratory for groundwater and NPDES samples.

772D-Area Laboratory. For environmental regulatory programs, this laboratory performs primarily total coliform and fecal coliform analyses for NPDES monthly samples (approximately 25 samples per month) and daily drinking water samples. Biological oxygen demand (BOD), TSS, and volatile organic analyses are also performed on some of these samples, but are not reported to regulatory agencies because these parameters are not required on the SRP's permits. In addition, this laboratory provides the analytical support for process control studies in the 400D-Area.

The Laboratories Department QA Plan (DPSOP 81-2) is used to guide the QA program. Control charts are maintained on the analyses for QC processes. Two analysts perform the coliform testing, using standard procedures contained in DPSOP 85. Copies of these procedures are provided on the laboratory bench for reference by the analysts.

Laboratory forms are used to record all analytical data, including time and analyst's signature. The laboratory supervisor reviews and approves all results. Chain-of-custody procedures are used in the laboratory for NPDES samples. Analysts have been trained on the procedures, and records were maintained of the training. Calibration and maintenance of thermometers are performed annually by another SRP laboratory.

National Bureau of Standards (pH, etc.) and EPA (TSS, BOD, etc.) reference standards are used. Previously, the laboratory participated in EPA NPDES and Drinking Water interlaboratory comparisons, but no longer participates because it does not report regulatory results. The laboratory has received EPA Interim Certification through the South Carolina Department of Health and Environmental Control (SCDHEC) for the NPDES program.

Off-Site Contractor Laboratories. The review of off-site laboratories was limited to an evaluation of QA procedures and a discussion with SRP personnel knowledgeable about the performance of the laboratories.

Envirodyne Engineers, Inc. is the contract laboratory for all RCRA groundwater monitoring analyses. RCRA monitoring wells are sampled once every 3 months (quarterly). ETI provides the analytical support of the NPDES monthly sampling of 72 outfalls. The analytical services of ECS are used primarily for special analytical requests.

For each of the contractors, a QA program is required by SRP to demonstrate sample handling, analytical procedures, training of personnel, calibration and maintenance of equipment, QC procedures, and data checking and management. Reviews of the QA plans submitted by Envirodyne Engineers, ETI, and ECS indicate that the policies and procedures are in place to provide the necessary QC on environmental samples submitted by SRP. Implementation of QA, however, could not be directly observed. By reviewing their performance and the data results, the effectiveness of their QA programs was evaluated. In all three cases, the performance of the laboratories in meeting quality objectives established by the SRP has been satisfactory.

SRP technical contract coordinators working within the HP Department impose QA performance goals on the outside laboratories. These performance goals include a combination of measurements of precision and accuracy on interlaboratory comparisons; EPA-provided samples; and duplicate, blanks, and spikes provided from the SRP. In the NPDES analytical contract, the QC program is defined in "Quality Control Compliance Sampling of National Pollutant Discharge Elimination System (NPDES) Outfalls" (DPSOL 271-1-334A, March 28, 1985). This procedure requires duplicates, preservatives, and blind samples to be sent to the laboratory for analysis. Twice a year, duplicate samples are sent to a second certified laboratory for analysis and comparison. Once a year, EPA-provided reference samples are sent to the laboratory for analysis.

The results of data from these laboratories for regulatory programs (i.e., NPDES and RCRA) are screened at the laboratory, then checked by SRP personnel against previous data at the same sampling points in order to detect QC problems or trends in the data.

The QA provisions imposed on these outside laboratories are comprehensive, the data are thoroughly checked, and the quality of data appears to be good.

4.4.2 Findings and Observations

4.4.2.1 Category I

None

4.4.2.2 Category II

1. Lack of Complete Laboratory Procedures. Potential errors may be introduced into the environmental laboratory analytical results because of the lack of complete and/or up-to-date laboratory procedures in certain SRP laboratories.

The status of procedures varies from laboratory to laboratory. At the 772D-Area Laboratory, the analytical procedures for environmental samples were complete and up-to-date. The 320M-Area Laboratory has completed a revision to procedures, but they have not been signed/approved and officially incorporated into the procedures manual. The interim procedures were being used by the analyst in the laboratory. The HP Water Quality and Radiochemical Analysis Laboratories had many outdated procedures, some of which were in the process of being modified. The Radiation Counting Laboratory had procedures, some of which were in the working draft stage. In the Counting Laboratory, some of the equipment was newly installed and procedures had not been developed. Procedures existed in the Dosimetry Laboratory, but the technician questioned by the Survey team did not know they existed and had not been thoroughly trained in the operation of the equipment.

The lack of complete and updated procedures does not allow standard practices to be observed by all analysts in the laboratory. These conditions provide the opportunity for variations in analytical techniques to appear in work practices and inconsistencies between analysts to develop.

This problem is partially mitigated at the SRP by an extensive analyst training program, data checking by supervisors, and the experience of the analysts.

2. Data Quality Concerns. The quality of data entered into the environmental data base may be affected by incomplete screening and verification of data points.

The SRP has a large and complex environmental data collection program that has evolved over many years and has been modified numerous times to add new types of data collection. As a result, the data handling for various data sets varies as a function of the timeframe the program was added and the use intended for the data.

The nonradioactive groundwater and NPDES data are compared to "flag" values and trends from past data to verify the results before they are entered in the data system. Much of the radioactive data, however, is not as completely checked before entering on the data management system. There is no consistent data handling, checking, and management for the environmental monitoring program.

4.4.2.3 Category III

None

4.4.2.4 Category IV

1. Stratified Water Samples. Incomplete mixing of rainwater and surface-water samples obtained from large collection bottles may produce misleading data because of stratification and settling of pollutants.

The large bottles used to collect composite samples of rainwater at the air monitoring stations and surface water at the river and stream sites are not agitated before pouring up the sample (as required in DPSOL 271-1-305, 308, and 328). The water in these large sample bottles is typically collected over a week's time and is nonhomogeneous due to settling of dense particles and floating of lighter materials. A sample taken from the upper stratified layer of these bottles may not be representative of the entire collection period.

2. Funnels for Water Collection. Soil and atmospheric deposition may be cross-contaminating several of the river and stream samples due to the unprotected storage and use of equipment at these locations.

At a number of river and stream locations, the funnels were used to assist in pouring up sample bottles. These funnels were stored adjacent to the sample locations in the grass, exposed to the environment. Thus, the funnels are potentially subject to cross-contamination from the ground or airborne deposition and may allow the introduction of contaminants to the water sample from other environmental media. If such contamination is introduced, then the sample is not representative.

3. Paddle Wheel Sampling. Stream sampling using paddlewheel samplers may not provide the most representative samples of surface-water conditions because only the upper layer of the water surface is sampled.

Paddle wheel samplers collect water from the top 1 to 2 inches of the water surface, and may not be the most representative sample for heavy metals and heavy radionuclides.

4. Paddle Wheel Maintenance. Inadequate maintenance of surface water collection equipment may introduce unknown levels of chemicals into the sample.

Paddle wheel samplers were cleaned in the field with Knights Cloud Nine and Comet with Chlorinol. Residues from these cleaners may interfere with the analysis of low-level pollutants that may be present in the river and stream samples.

5. Chain of Custody. Lack of chain-of-custody on many environmental samples affects the confidence in the data reported and defensibility to outside parties.

Chain-of-custody forms are not used for samples analyzed on the site, only for those that go to off-site laboratories. Without chain-of-custody procedures for on-site samples, it would be difficult to legally defend the data collected.

6. River and Stream Water Sample Handling. Surface-water sample handling procedures may not adequately preserve samples before delivery to the laboratory.

Water samples collected from river and stream locations are stored unprotected in the back of a pickup truck. No provisions were made to provide temperature control (i.e., ice chests).

7. HP Water Quality Laboratory Training. Training records were not maintained for the personnel in the HP Water Quality Laboratory.

Without complete records, the capability of an individual analyst to perform various procedures cannot be ascertained. In addition, there is no assurance that the analysts are familiar with the correct analytical procedures.

8. HP Rad Counting Laboratory. No documented training has been conducted for personnel in the HP Rad Counting Laboratory on certain equipment in daily use. The qualification of analysts to perform their jobs cannot be verified without records.

4.5 Inactive Waste Disposal and Contamination Sites

4.5.1 General Description and Pollution Sources and Controls

Within the boundaries of the Savannah River Plant (SRP), approximately 162 individual waste sites have been or are currently being used for the disposal of a variety of hazardous, solid, and radioactive materials. The vast majority of these waste sites are currently not active disposal locations. Approximately 66 of these waste sites have been identified by the site as inactive waste disposal sites under Section 103(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The waste sites, for the most part, can be categorized into the following general groupings: basins, pits, and piles. This section of the report will discuss these groupings and the various types of historical disposal practices at the SRP. Radiologically contaminated disposal sites are further discussed in Section 3.2, and additional information on the historical liquid discharges into seepage basins as well as liquid spills is contained in Sections 3.3 and 3.4.

These waste sites are located in over 100 separate areas around the plant site. Each waste site is identified with a unique facility number. A listing of all the waste sites is given in Table 4-21. The locations of those waste sites in the vicinity of the SRP production areas (which includes the majority of the waste sites) are shown on Figures 4-11 through 4-18. The legend for distinguishing among the basins, pits, and piles shown on these figures is given in Figure 4-10.

Of the 162 separate waste sites, some 127 contain only nonradioactive waste materials, and 20 have been used as disposal sites for only radioactive wastes. Fifteen sites have been used as disposal locations for both nonradioactive and radioactive wastes, also referred to as mixed wastes, when the nonradioactive component contains hazardous substances.

The wastes disposed of in the identified sites have come from the direct chemical processing and handling of materials for maintenance and operation of the SRP. The types of wastes disposed of at these sites span a wide range and include the following categories:

**TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS**

Site No.	Waste Site
A and M AREAS	
† 731-A	A-Area Burning/Rubble Pit
† 731-1A	A-Area Burning/Rubble Pit
† 731-2A	A-Area Rubble Pit
† 731-3A	Silverton Road Waste Site
† 731-4A	Metals Burning Pit
† 731-5A	Miscellaneous Chemical Basin
731-6A	A-Area Rubble Pile
740-G	Sanitary Landfill
788-A	A-Area Ash Pile
† 788-2A	A-Area Ash Pile
788-3A	A-Area CPRCB*
904-51G	M-Area Settling Basin
† 904-53G1, G2	Savannah River Laboratory Seepage Basin
† 904-54G	Savannah River Laboratory Seepage Basin
† 904-55G	Savannah River Laboratory Seepage Basin
904-101G	716-A Motor Shop Seepage Basin
904-110G	Metallurgical Laboratory Basin
904-112G	Lost Lake
D AREA	
Q80-20G	D-Area Asbestos Pit
† 431-D	D-Area Burning/Rubble Pit

* Coal Pile Runoff Containment Basin

† CERCLA Site

Sources: Du Pont, Technical Summary of Groundwater Quality Protection Program at Savannah River Plant, DPST-83-829, December 1983, Letter of M.B. Hughes to S.W. Wright 3/28/85 "Continuing Releases at Permitted Facilities-Addendum", Letter L. Morgan to M.L. Walker 12/9/86 "Addition to List of Potential CERCLA Sites to be Reported Under Section 103(c) of CERCLA", Letter J.S. Roberts to R.P. Whitfield 12/11/84 Waste Sites subject to State and Federal Hazardous Waste Regulations", Letter R.P. Whitfield to J.D. Spencer 11/21/84 "Waste Sites subject to Federal and State Hazardous Waste Regulations."

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE TWO

Site No.	Waste Site
D AREA (CONTINUED)	
† 431-1D	D-Area Burning/Rubble Pit
431-2D	D-Area Rubble Pit
488-D	D-Area Ash Basin
488-D	D-Area Ash Basin
488-1D	D-Area Ash Basin
488-2D	D-Area Ash Basin
489-D	D-Area CPRCB*
† 631-G	D-Area Oil Seepage Basin
† 643-5G	TNX Burying Ground
† 904-76G	TNX Seepage Basin (Old)
† 904-102G	TNX Seepage Basin (New)
C, F, H, And CS AREAS	
† 080-16G	SRP Oil Test Site
080-21G	C-Area Asbestos Pit
080-22G	C-Area Asbestos Pit
080-24G	Sanitary Sewage Sludge Disposal Pit
† 131-C	C-Area Burning/Rubble Pit
188-C	C-Area Ash Pile
188-1C	C-Area Ash Pile
188-2C	C-Area Ash Pile
189-C	C-Area CPRCB*

* Coal Pile Runoff Containment Basin

† CERCLA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE THREE

Site No.	Waste Site
C, F, H, And CS AREAS (CONTINUED)	
† 231-F	F-Area Burning/Rubble Pit
† 231-1F	F-Area Burning/Rubble Pit
† 231-2F	F-Area Rubble Pit
† 231-3F	F-Area Scrap Lumber Pile
† 231-4F	Burma Road Rubble Pit
† 281-3F	F-Area Retention Basin
† 281-3H	H-Area Retention Basin
288-F	F-Area Ash Basin
288-1F	F-Area Ash Basin
288-H	H-Area Ash Basin
289-F	F-Area CPRCB*
289-H	H-Area CPRCB*
† 63-1G	CS Burning/Rubble Pit
† 631-2G	CS Scrap Lumber Pile
† 631-3G	CS Rubble Pit
† 631-4G	Hydrofluoric Acid Spill Area
† 631-5G	CS Burning/Rubble Pit
† 631-6G	CS Burning/Rubble Pit
† 631-7G	SRL Rubble Pit
† 643-G	Radioactive Waste Burial Ground

* Coal Pile Runoff Containment Basin

† CERCLA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE FOUR

Site No.	Waste Site
C, F, H, And CS AREAS (CONTINUED)	
† 643-7G	Radioactive Waste Burial Ground
† 643-28G	Mixed Waste Burial Ground
† 643-11G	Ford Building Waste Site
904-41G	F-Area Seepage Basin
904-42G	F-Area Seepage Basin
904-43G	F-Area Seepage Basin
904-44G	H-Area Seepage Basin
904-45G	H-Area Seepage Basin
904-46G	H-Area Seepage Basin
† 904-49G	F-Area Seepage Basin (Old)
904-56G	H-Area Seepage Basin
904-66G	C-Area Seepage Basin
904-67G	C-Area Seepage Basin
904-68G	C-Area Seepage Basin
904-74G	F-Area Acid/Caustic Basin
904-75G	H-Area Acid/Caustic Basin
904-89G	C-Area Containment Basin
† 904-91G	Ford Building Seepage Basin
904-113G	Fire Department Hose Training Facility

† CERCIA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE FIVE

Site No.	Waste Site
K and L AREAS	
† 080-17G	CMP Pit
† 080-17.1G	CMP Pit
† 080-18G	CMP Pit
† 080-18.1G	CMP Pit
† 080-18.2G	CMP Pit
† 080-18.3G	CMP Pit
† 080-19G	CMP Pit
† 131-K	K-Area Burning/Rubble Pit
† 131-L	L-Area Burning/Rubble Pit
† 131-1L	L-Area Rubble Pit
131-2L	Gas Cylinder Disposal Facility
131-2L	Gas Cylinder Disposal Facility
131-3L	L-Area Rubble Pit
131-4L	L-Area Rubble Pit
188-K	K-Area Ash Basin
188-L	L-Area Ash Basin
189-K	K-Area CPRCB*
† 643-1G	K-Area Bingham Pump Outage Pit
† 643-2G	L-Area Bingham Pump Outage Pit

* Coal Pile Runoff Containment Basin

† CERCLA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE SIX

Site No.	Waste Site
K and L AREAS	
† 643-3G	L-Area Bingham Pump Outage Pit
904-64G	L-Area Seepage Basin
† 904-65G	K-Area Seepage Basin
† 904-79G	L-Area Acid/Caustic Basin
904-80G	K-Area Acid/Caustic Basin
† 904-83G	L-Area Oil And Chemical Basin
904-87G	L-Area Containment Basin
904-88G	K-Area Containment Basin
† 904-111G	Road A Chemical Basin
P and R AREAS	
080-1R	R-Area Asbestos Pit
† 131-P	P-Area Burning/Rubble Pit
† 131-R	R-Area Burning/Rubble Pit
† 131-1R	R-Area Burning/Rubble Pit
131-2R	R-Area Rubble Pit
188-P	P-Area Ash Basin
188-R	R-Area Ash Basin
189-P	P-Area CPRCB*
† 643-4G	P-Area Bingham Pump Outage Pit
† 643-8G	P-Area Bingham Pump Outage Pit
† 643-9G	R-Area Bingham Pump Outage Pit
† 643-10G	R-Area Bingham Pump Outage Pit

* Coal Pile Runoff Containment Basin
† CERCLA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE SEVEN

Site No.	Waste Site
P and R AREAS (CONTINUED)	
† 904-57G	R-Area Seepage Basin
† 904-58G	R-Area Seepage Basin
† 904-59G	R-Area Seepage Basin
† 904-60G	R-Area Seepage Basin
904-61G	P-Area Seepage Basin
904-62G	P-Area Seepage Basin
904-63G	P-Area Seepage Basin
† 904-77G	R-Area Acid/Caustic Basin
904-78G	P-Area Acid/Caustic Basin
904-86G	P-Area Containment Basin
† 904-103G	R-Area Seepage Basin
† 904-104G	R-Area Seepage Basin

† CERCLA Site

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE EIGHT

PAGE EIGHT

Site No.	Waste Site	SRP Coordinates ¹	
		North	East
GENERAL PLANT LOCATIONS			
080-15G	Central Shops Oil Storage Pad	64,000	50,800
080-25G	H-Area Erosion Control Site	70,380	61,260
080-26G	L-Area Erosion Control Site	48,200	50,000
080-27G	Substation 51 Erosion Control Site	73,500	31,000
080-28G	F-Area Erosion Control Site	79,000	49,000
080-29G	Gunsite 51 Rubble Pile	41,400	35,300
080-30G	Gunsite 102 Rubble Pile	74,697	84,965
080-31G	Gunsite 72 Rubble Pile	80,300	23,019
131-1C	C-Area Erosion Control Site	65,100	46,000
131-1P	P-Area Erosion Control Site	45,000	64,800
484-D	D-Area Waste Oil Facility	66,000	20,000
631-8G	3G Pumphouse Erosion Control Site	67,700	17,700
709-G	Hazardous Waste Storage Building	64,900	50,200
710-U	Hazardous Waste Storage Building	87,000	41,000
761-G	40 Acre Hardwood Site	53,700	28,300
761-1G	Lower Kato Road Site	83,400	39,200
761-2G	Orangeburg Site	84,500	43,700

1. Note: Coordinates are given for these waste sites since their location is not shown in figures 4-11 through 4-12.

TABLE 4-21
LISTING OF SRP WASTE SITES BY PLANT AREAS
PAGE NINE

Site No.	Waste Site	SRP Coordinates ¹	
		North	East
GENERAL PLANT LOCATIONS			
761-3G	Lucy Site	93,950	58,800
761-4G	K-Area Borrow Pit	47,000	40,500
761-5G	Par Pond Borrow Pit	36,600	76,000
761-6G	Kato Road Site	84,800	41,000
761-7G	Road F Site	92,900	65,900
761-8G	Second Par Pond Site	34,000	84,100
761-9G	Forestry Rubble Pile	101,000	68,000
761-10G	TNX Storage Area	71,000	17,000
	SREL Rubble Pile		
	Cemetery Road Rubble Pile		
	Cemetery & Brag Roads Rubble Pile		
	Gunsite 113 Rubble Pile		
	Road 781.1 Rubble Pile		
	Brag Bray Road Rubble Pile		
	Risher Road Open Metal Pit		
	Central Shops Scrap Metal Pile		

1. Note; Coordinates are given for these waste sites since their location is not shown in figures 4-11 through 4-17.

<u>Symbol</u>	<u>Designation</u>
Basin containing radioactive waste
Basin containing nonradioactive waste
Basin containing mixed waste or radioactively contaminated nonhazardous industrial waste
Pit containing nonradioactive waste
Pit containing mixed waste or radioactively contaminated solid waste
Pile consisting of nonradioactive waste

One symbol may represent more than a single waste site and is so designated on the map correlation table in each figure.

Source: Christensen and Gordon, 1983

LEGEND FOR CATEGORIES OF WASTE
SITES SHOWN ON FIGURES 4-11 THROUGH 4-16

FIGURE 4-10

WASTE SITES A- & M-AREAS CONTINUED

FIGURE 4-12

Source: Christensen and Gordon, 1983

WASTE SITES C-, F-, H-, & CS-AREAS

FIGURE 4-14

WASTE SITES K- & L-AREAS

FIGURE 4-15

WASTE SITES P- & R-AREAS

FIGURE 4-16

- o Nonhazardous solids - Wood, lumber, concrete blocks and slabs, bricks, glass, fence posts, tires, rubber, trash
- o Nonvolatile organics - Fuel and motor oil and grease along with waste oil and paint
- o Anions, high and low pH waste - Coal pile runoff acids, caustics, ash sluice, liquid chemicals, hydrofluoric acid
- o Pesticides - Biocidal compounds used either in plant operation or plant maintenance
- o Heavy metals - Heavy and reactive metals, metal shavings, mercury
- o Volatile organics - Chlorinated hydrocarbons, chlorinated biphenyls, solvents, chlorocarbons, toxic organics.

Although solvent chemicals were used and continue to be used in small quantities at many locations throughout the site, the major historical usage of solvents was at Savannah River Laboratory (SRL) and the M-Area. Significant amounts of solvents were disposed of in the various burning/rubble pits located throughout the site.

A thorough discussion of waste disposal sites is contained in Ross and Green (1983) and Du Pont (1983). A brief description of the major categories of the 162 sites follows.

Rubble Pits

The use of rubble pits began in 1973 and continued until 1983 when the 10 existing rubble pits were closed. The pits were supposed to receive only inert materials such as concrete, brick, tile, asphalt, hard plastics, glass, rubber products, and nonreturnable drums.

Prior to 1973, the majority of burnable waste chemicals were disposed of in the burning/rubble pits (BRPs). When the burning/rubble pits were closed in approximately 1973-74, all burning and free liquid disposal officially stopped. The Chemicals, Metals, and Pesticides (CMP) Pits, in operation between 1971-1979, did receive solvents and organic chemicals from all over the site. Beginning in 1979, all these materials went to hazardous waste storage. It is not certain, however, that none of these materials were disposed of in the rubble pits between 1973 and 1979. Inadvertent or intentional disposal (motivated by the geographic proximity of rubble pits to generators) of drums with substantial residues or free liquid disposal potentially took place at the rubble pits. This had been the common practice at the BRPs until 1973. Table 4-22 contains a listing of the rubble pits including their dimensions and type of rubble disposed of.

No wells have been installed by the site at the rubble pits and no groundwater monitoring is planned, since it is the opinion of the SRP that no hazardous materials were ever disposed of in the rubble pits (Du Pont, 1983).

Burning/Rubble Pits

Burnable solid and liquid waste was disposed of in 15 BRPs during the period of 1951-1973. The pits were located throughout the site in close proximity to all major manufacturing and reactor areas. They consisted of a bulldozed open trench 8-12 feet deep and generally 250-400 feet in length. Paper, plastics, rubber, wood, cardboard, rags, drummed/bottled/carbuoyed/and free liquid solvents, degreasers, and oils were dumped in the trench. Burning was accomplished infrequently, perhaps monthly or less, and many of the liquid chemicals disposed of in this fashion likely soaked into the ground. Wastes were dumped starting at one end of the trench and filling to the top, then working toward the other end. Only the working face was burned.

Historic aerial and surface photographs of such sites were reviewed and they showed substantial numbers of small and large chemical containers in the pits. These ranged from small laboratory glass containers to 55-gallon drums. In approximately 1973, when the use of the pits for chemical disposal was discontinued, they were covered with a layer of soil and continued in use as "rubble only" pits until they were filled.

TABLE 4-22

RUBBLE PITS LOCATION, DIMENSIONS, AND TYPE OF RUBBLE DISPOSED OF

Site Number	Location	Size	Type of Rubble Disposed of
131-1L	L-Area	50' x 220'	Metal, lumber, poles, concrete, Transite
131-3L	L-Area	140' x 320'	Miscellaneous rubble
131-4L	L-Area	55' x 56'	Concrete and metal from powerhouse stack and silo
131-2R	R-Area	115' x 184'	Metal, concrete, lumber poles
231-2F	F-Area	261' x 509'	Concrete, lumber, cement, fence, and telephones poles, rip rap, brick, tile, wallboard, paneling, metal scrap and shavings, drums, electrical conduit, furniture, firehose
231-4F	F-Area	160' x 500'	Metal, concrete, lumber, poles, fluorescent light fixtures, glass
431-2D	D-Area	232' x 388'	Metal, concrete, lumber, poles
631-3G	Central Shops	50' x 400'	Paper, cans, lumber, barrels, metal pipe and shavings, electrical switchgear
631-7G	Central Shops	500' x 600'	Miscellaneous materials
731-2A	A-Area	179' x 328'	Paper, wooden pallets, cans, drums, glass

Source: Du Pont, 1983

Several of these burning/rubble pits were inspected such as the CS BRP; A-Area BRP (2 sites); D-Area BRP (2 sites); L-Area BRP; F-Area BRP; R-Area BRP (2 sites); P-Area BRP; and C-Area BRP. All had been fully covered and showed no visible wastes on the surface. Some had 10 to 20-foot pine trees growing on top of the trenches. The C-area BRP had 4-6 open sinkholes 6-8 feet deep and up to 10 feet in length, apparently where dumped drums or containers had rusted away. Several sites had patches and areas of little or no vegetative growth over the pit; however, it was not possible to tell if this was caused by chemical toxicity. F-Area BRP was completely covered with old railroad ties and concrete rubble.

Most of the pits visited were constructed in areas of relatively flat topography and not in the immediate proximity of surface streams or their tributaries. One notable exception to this was the P-Area BRP, which was constructed within approximately 100 feet of the bank of Steel Creek. In this area, the Steel Creek gorge is approximately 75 feet deep. About half-way down the gorge banks, there is a benched area approximately 30 feet wide. In this area, seeps and springs along the bank indicate a strong groundwater movement directly through the BRP area. A micro-R meter radiation scan of these seeps did not differentiate any radioactivity attributable to the seeps in excess of the considerable background area contamination of Steel Creek measured at 100-200 micro-R/hour. This contamination was caused by discharge of disassembly-basin water from P-Reactor during the late 1950s and 1960s when damaged fuel elements were in storage there. All sites visited in this group were scanned with the micro-R meter and Hnu photoionization organic vapor analyzer. These field measurements did not indicate any surface organic vapors or radiological contamination attributable to the BRPs.

Table 4-23 lists the estimated mass of disposal for each of the area BRPs for the most significant waste constituents. Few or no records of actual volume of disposal were kept. The estimates in Table 4-23 were computed by a computer model based on groundwater concentrations of contaminants versus background concentration. Four groundwater monitoring wells were installed in 1983-85 around each pit or group of adjacent pits. Groundwater contamination is further discussed in Section 3.4.3.

TABLE 4-23

BURNING RUBBLE PITS-ESTIMATED QUANTITIES OF WASTE DISPOSED OF

Chemical Constituent	Estimated Disposal Mass*
A-Area Trichloroethylene Depleted uranium	1.23 kg 2.1 E-03 Ci
C-Area Lead Chromium Depleted uranium Trichloroethylene	5530 kg 9500 kg 5.2 E-03 Ci 186 kg
D-Area Lead Tetrachloroethylene	204 kg 0.089 kg
F-Area Tetrachloroethylene Trichloroethylene	7.65 kg 7.43 kg
K-Area Sodium Tetrachloroethylene Trichloroethylene	210 kg 3.13 kg 1.01 kg
Central Shops Tetrachloroethylene	0.638 kg
L-Area Tetrachloroethylene	0.508 kg
R-Area Tetrachloroethylene	0.37 kg
P-Area Lead Tetrachloroethylene 1,1,1-trichloroethane Trichloroethylene Trans-1,2-dichloroethylene 1,1-dichloroethylene	3300 kg 3.48 kg 38.5 kg 3.40 kg 3.38 kg 19.1 kg

* Inventory amounts were calculated using the "PATHRAE" model, based on the downgradient well average concentration difference vs. average background concentration.

Source: Du Pont, 1986d

Silverton Road Waste Site

The Silverton Road Waste Site is located about 1-1/2 miles west of M-Area (see Figure 4-11, site 4; 731-3A). No records of waste disposal were kept and the date of startup is unknown. The site is large in area, approximately 3.24 acres with dimensions of about 200 by 700 feet (Du Pont, 1986e). Aerial and surface photographs of the site indicate that wastes disposed of include metal shavings, bricks, wood, tires, concrete, asbestos, drums, tanks, and miscellaneous chemical containers. The site was closed in 1974 and covered with soil. A walkover inspection indicated no visible wastes and no areas of vegetative distress. The site has 11 groundwater monitoring wells that show groundwater contamination by volatile organics (see Section 3.4.3) such as were used at M-Area as solvents. The major contaminants in the groundwater are trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, trichloromethane, and lead.

Estimated masses of disposal, based on the groundwater contaminant concentration versus background concentration are (Du Pont, 1986e).

<u>Waste Constituent</u>	<u>Estimated Disposal Mass (kg)</u>
Lead	14.0
Tetrachloroethylene	5.0
Trichloroethylene	4.2
Trichloromethane	3.0

Scrap Lumber Piles

It has been plant policy since startup of the SRP in the 1950s not to release scrap lumber off the site because of the expense required to monitor to ensure that the material is free of radioactive contamination. The lumber is accumulated in 2 separate areas (sites 231-3F and 631-2G) near F-Area and Central Shops. A total of approximately 200 yd³ is accumulated and burned intermittently at periods of once every several weeks. The Central Shops pile, located immediately adjacent to the Central Shops BRP, was inspected.

Old TNX-Area Seepage Basin

The old TNX-Area Seepage Basin, now closed, filled with soil, and clay-capped, is located at the southwest corner of the TNX-Area adjacent to Building 904-76G. Currently, a portion of the top of the old basin is paved over with asphalt. The Basin was operated from 1958 to 1980 to receive liquid wastes from pilot-scale experiments conducted at the TNX-Area. Other than septic tile fields, this was the only source of liquid disposal for the entire TNX-Area during that period. The basin is located at an elevation of 152 feet on a bluff overlooking the Savannah River Swamp, which is at elevations of 90 to 100 feet. The overflow of the basin flowed through a pipe over the bluff and was discharged into a gully that flowed down into the swamp.

Table 4-24 lists the chemicals that have been assumed by the plant to have been discharged into the old TNX Basin. The total quantity of wastes is not known but quantities of uranium have settled out in the basin and it has been estimated by SRP that 74 lb of mercury was discharged to the basin, mostly in the form of mercuric nitrate (Du Pont, 1983).

The area of the overflow discharge to the Savannah River Swamp was inspected. Approximately 800 to 1,000 feet west of the end of the overflow pipe, an area of stressed or dead trees exists in the swamp. Savannah River Laboratory (SRL) has obtained samples of sediment from the swamp in which mercury was detected. The samples, however, were not taken in the area of dead trees, but rather from between that area and the end of the overflow pipe outfall. The cause of the death of these trees is unknown. See Section 3.3 for additional discussion of this former overflow discharge area.

Radioactive Waste Burial Grounds

One centrally located area is used to store or dispose of all solid radioactive waste produced at the SRP, as well as occasional special shipments from off the site. This area, called the Radioactive Waste Burial Grounds (RWBG), occupies 195 acres between the F- and H-Separations Areas. The original area was 76 acres designated 643-G, which began to receive waste in 1953 and was filled in 1972.

TABLE 4-24

PROCESS CHEMICALS DISCHARGED TO THE OLD TNX SEEPAGE BASIN

Aluminum monohydrate	Neodymium
Aluminum nitrate	Nickel carbonate
Aluminum oxide	Nickel nitrate
Ammonium carbonate	Nitric acid
Ammonium hydroxide	Oxalic acid
Ammonium hydroxyisobutyrate	Potassium hydroxide
Ammonium nitrate	Potassium nitrate
Aqueous ammonia	Potassium permanganate
Calcium nitrate	Samarium
Charcoal	Silver nitrate
DPTA	Sodium aluminate
Dysprosium	Sodium carbonate
Formic acid	Sodium hydroxide
Ferric oxide	Sodium nitrate
Ferric nitrate	Sodium nitrite
Ferric sulfate	Sodium sulfate
Fluconic acid	Sulfamic acid
Hydrofluoric acid	Thorium
Hydrogen peroxide	Tributyl phosphate
Lanthanum nitrate	Ultrascene
Manganese oxide	Uranyl nitrate
Mercuric nitrate	Zinc nitrate

Source: Du Pont, 1983

Operations then shifted to a 119-acre site designated 643-7G, contiguous to the original area. Examples of the materials disposed of in these burial grounds include:

- o Contaminated equipment - obsolete or failed tanks, pipes, jumpers, and other process equipment from the fuel separations plants
- o Reactor hardware and resins - fuel components and housings not containing irradiated fuel, and spent deionizer resins
- o Spent lithium-aluminum targets - the waste target alloy after tritium has been extracted
- o Oil from gas displacement pumps in the Tritium Facilities - before 1982, oil was placed in drums containing an absorbent material prior to burial
- o Mercury from gas pumps in Tritium Facilities - before 1968, radioactively contaminated mercury was buried in 1-liter polyethylene bottles and 5-gallon steel flasks. Approximately 20,000 lb was buried between 1952 and 1968
- o Incidental waste from laboratory and production operations - small equipment, spent air filters, clothes, analytical waste, decontamination residues, plastic sheeting, and gloves
- o Occasional shipments from off-site generators - tritiated waste from Mound Laboratory and Pinellas, plutonium-238 from Los Alamos Scientific Laboratory, debris from two U.S. military aircraft accidents, and radioactive waste associated with the naval reactors program.

Degraded solvent (nominally n-dodecane containing 30 percent tributyl phosphate) from the Separations Areas has been stored or burned at the RWBG since 1956. From 1956 to 1972, part of the degraded solvent sent to the RWBG was burned by slow addition to a fire in a large open pan. Records of the waste solvent inventory at the 643G-Burial Ground are available as far back as 1955. These records include

mention of the quantities of solvents received and burned at 643G. Waste solvent not burned was stored in underground tanks. Section 4.1.1 provides more information on waste solvent storage.

For each year approximately 3,300 gallons of waste oils that are potentially radioactively contaminated are removed from equipment used in regulated areas. The oil is sent to the RWBG for disposal. The oils formerly were absorbed on an oil-dry compound and buried as solidified waste. However, since May 1982, waste oil has been stored in one of the new solvent storage tanks until an incinerator program is implemented.

Liquid scintillation solutions (LSSs) have been buried at the RWBG since 1965. A conservative estimate for plant-wide use of LSSs indicates that at least 80 gallons a month or about 10,000 gallons total have been sent to the RWBG (as of 1984). The plastic vials containing the solutions are placed in containers with a 3:1 ratio of absorbent material to liquid. In the future, all LSSs will be incinerated. LSSs are used by many plant facilities, primarily to analyze samples for tritium. These scintillation solutions consist of organic photofluoric compounds and surfactants in an aromatic organic solvent. Solvents that have been used most often include xylene, toluene, dioxane, and trimethylbenzene (pseudocumene) at 60 percent to 90 percent solvent concentrations. Products containing pseudocumene are a recent innovation to decrease the flammability of the solutions. Prior to 1978, LSSs containing naphthalene (10 percent) and dioxane (89 percent) were produced on the plant.

Experimental Sewage Sludge Application Sites

As a part of an experiment, SRL disposed of domestic sewage sludge by land-spreading at 9 borrow pit and forested sites on approximately 120 acres total area. The applications occurred between 1980 and 1981 and subsequently the growth of trees was compared against control areas. Typically, the borrow pits were hardpan soils and were planted with various trees and grasses. The forested sites contained 10 to 20-year-old softwood trees. The sewage used came from the North Augusta Sewage Treatment Plant (80 percent industrial wastewater) and the Augusta Sewage Treatment Plant (80 percent domestic wastewater). The borrow pits, covering approximately 75 acres, received roughly 800,000 gallons of sewage

sludge. The forested sites, covering 46 acres, received approximately 1,000,000 gallons of sludge. At each of the forest plots and borrow-pit sites, 3 groundwater monitoring wells were installed and groundwater and soil samples were obtained before and after the waste application. In general, these results showed no significant environmental deterioration of groundwater or soil.

SRL Oil Test Site

This former research site covers 55,000 ft² southwest of the Central Shops. The site consists of 24 plots (420 ft²) that received new automobile engine oil with a viscosity to simulate used cutting oil. The plots were arranged in strips approximately 250 feet in length. The study was designed to evaluate the biodegradation rate of waste oil. Oil was disposed of on these plots in 1975. Each plot received 220 gallons of oil for a final concentration of 5.5 gallons of oil per cubic meter of soil. Commercial fertilizers 5-10-5 (phosphorus, nitrogen, potash) and 35-0-0 were also applied to the plots at various concentrations. In 1976, two new plots (10 feet x 200 feet) were established for disposal of 825 gallons of hydraulic fluid in one plot and 1,100 gallons of paint thinner on the adjacent plot.

At least one strip of land received unknown wastes. During the Survey, several of the strips showed areas devoid of vegetation or containing stressed vegetation. A visual inspection revealed a 10-foot-diameter pile of chemical absorbent and rags that reeked of solvent chemicals and a 10-foot diameter patch of tarry residue of unknown composition. It is strongly suspected that this site received additional wastes other than oil as a part of the study.

Rubble Piles and Erosion Control Sites

The U.S. Forest Service Rubble Pile (Site 761-9G) is located off Road 2-1, about 1/2-mile southeast of the Savannah River Forest Service Headquarters. The area of this site is approximately 24,000 ft². When the SRP public deer hunts were started in the mid-1960s, hunters harvested deer on the site. The deer remains were disposed of at the rubble pile. This practice was discontinued in the mid-1970s. In addition to animal carcasses, the rubble pile received other materials, including lumber, fluorescent light fixtures, concrete, metal, metal drums, and wire.

No monitoring wells or further investigations are planned since it is the opinion of SRP that no hazardous materials were ever disposed of in these areas (Du Pont, 1983).

Waste concrete, asphalt, bricks, roofing material, stumps, and spoil have been disposed of at seven locations on the plant for the purpose of erosion control. The first site, 131-1C, is in an eroded area located near the west side of the 100C Effluent Canal. A second site, 131-1P, is in an eroded area located on the north side of the 100P-Effluent Canal to Steel Creek Road C, just northwest of P-Area, while a fourth site, 080-27G, is located north of Substation 51 near D-Area. The fifth site, 080-26G, is located near L-Area, the sixth site, 080-25G, is near H-Area, and the seventh site, 631-8G, is at the 3G Pumphouse near TNX.

The erosion control sites at C-, P-, K-, and D-Areas are all being closed out because evidently the areas have been filled to the surrounding ground surface. The sites near L-, H-, and TNX-Area will continue to be used until filled.

Miscellaneous Chemical Basin and Metals Burning Pit

The A-Area Metals Burning Pit and Miscellaneous Chemical Basin waste sites are located on either side of SRP Road C-1 between the A/M-Area and SRP Road C. The materials disposed of in the metals burning pit consisted mainly of solid lithium and aluminum waste materials generated during the metal finishing operations in M-Area. The metals deposited in the pit, which was approximately 400 x 400 ft in dimension, were burned periodically. The miscellaneous chemical basin was a small, shallow (6 meters x 6 meters wide x 3.0 meters deep) basin that received liquid chemical wastes. There are no records of what was discarded in the miscellaneous chemical basin. Soil gas analyses, however, have indicated the probability of very high levels of volatile organic solvents in the groundwater at the miscellaneous chemical basin equal to or exceeding the level of contamination at M-Area of up to tens of milligrams per meter (see Section 3.4.3). The solid materials remaining in the metals burning pit were covered with soil and the site was regraded in 1974. The miscellaneous chemical basin site has also been regraded, although the exact date is not recorded. Four groundwater monitoring wells are installed around the periphery of the metals burning pit. Five groundwater monitoring wells are planned by the site around the miscellaneous

chemical basin. No elevated levels of inorganic or metallic materials have been detected in the analyses of the groundwater from the wells around the metals burning pit. However, low levels (~45 µg/l) of a degreasing agent (trichloroethylene) have been detected in two of the wells. An analysis of the surface soils from the miscellaneous chemical basin site has detected the presence of perchloroethylene and trichloroethylene, and a decomposition product (trans-1,2-dichloroethylene).

The miscellaneous chemical basin was presumably used to dispose of waste solvents and used oil. The basin was marked with a sign that read "Chemical Waste Disposal - Keep Out". Use of the metals burning pit was discontinued in 1974 and the area was regraded. The miscellaneous chemical basin was believed to have been discontinued and regraded at the same time because it is believed that barrels were emptied at the basin and then disposed of at the burning pit, thereby linking the two sites into a unit.

Sanitary Sewage Sludge Disposal Pit

This 40-foot x 60-foot x 5-foot pit (Site 980-24G) receives all the sanitary sewage sludge from the various sewage treatment plants on the SRP. The sludge is trucked to the pit on a periodic basis. The typical loading is 100,000 gal/yr. The pit is located southeast of the SRL Oil Test Site and southwest of the Central Shops Area. There was a reported inadvertent dumping of an asphalt solution into the pit.

Chemical analysis of the sludge in May of 1980 showed the following results:

<u>Contaminant</u>	<u>mg/L</u>
Arsenic	<0.1
Barium	<1.0
Cadmium	<0.05
Chromium	<0.1
Lead	<0.2
Mercury	<0.001
Selenium	<0.1
Silver	<0.05

Endrin	<0.00003
Lindane	<0.000008
Methoxychlor	<0.0003
Toxaphene	<0.0012
2,4-D	<0.0052
2,4,5-TP Silvex	<0.0001

Currently no monitoring wells are in place at this facility to determine if groundwater quality has been affected.

Waste Oil Basins

The Motor Shop Oil Basin (Site 904-101G, see Figure 4-11), is located in A-Area at the SRP. It received waste oil, grease, kerosene, ethylene glycol, soapy water, and perhaps other unknown oils and chemical wastes from Building 716-A beginning in 1977. In 1983, all effluent discharges to the basin were terminated. The dimensions of the Motor Shop Oil Basin are approximately 200 feet x 35 feet x 6 feet deep. Two groundwater monitoring wells have been installed and analyses of groundwater have been made on a quarterly basis, beginning in 1984. (See Table J34 in Appendix J for groundwater contaminant data.)

The D-Area Oil Basin (Site 631-G; see Figure 4-13) is located near the major Coal-Fired Power Production Facility of the SRP. The basin received waste oils, beginning in 1952, which were unacceptable for incineration in the powerhouse. The D-Area Oil Basin measures approximately 380 feet x 50 feet x 6 feet deep. In 1975, the basin was decommissioned and backfilled with soil. Four groundwater monitoring wells have been installed and sampled on a quarterly basis. (See Table J35 in Appendix J for groundwater contaminant data from these wells). Both the Motor Shop Oil Basin and D-Area Oil Basin are unlined.

The source of the influent to the Motor Shop Oil Basin was the 716A Motor Shop Heavy Equipment and Motor Washing Facilities. The D-Area Waste Oil Basin, besides receiving waste oils that were not permitted to be burned at the powerhouse, received other liquids potentially contaminated with toxic chemicals. It is possible that the basin received organics including chlorinated compounds. Because of lack of records, no estimate of the quantities of wastes disposed of in either basin was made.

L-Area Oil and Chemical Basin

The L-Area Oil and Chemical Basin is 9,600 ft² in area and has a 250,000-gallon capacity (Site 904-83G; see Figure 4-15). From 1961 to 1979, the basin received low levels of radioactive oil and chemical waste from throughout the plant. Small volumes of oil and chemical wastes that were not appropriate to discharge to effluent streams, regular seepage basins, or the 200-Area waste management system were dumped here. Wastes were transported by tank truck, metal drums, etc., and radiochemically analyzed before disposal. The wastes came primarily from the Reactor Areas but the facility has been used for wastes from all production and Research Areas of the SRP. The facility received 20,000 gallons annually for a total volume of 1,040,000 gallons through 1979. The chemical composition of the waste discharged to the basin is not known. Four groundwater monitoring wells have been installed near the basins.

Former Military Sites

From 1955 to 1957, a military population of approximately 1,200 people operated three barracks and motor pool facilities with 5 associated antiaircraft gun emplacements on SRP property. Each barracks facility included multiple living quarters with buried fuel-oil tanks, offices, and a motor pool and each had its own well and septic system. The buildings were razed after they were abandoned in 1961, except Gunsite 52M where intact Building 772-8G is located. This building was locked but through the windows it could be seen that several 55-gallon drums of depleted uranium "yellow cake" were being stored in the building. The building was not marked on the outside concerning radiation materials storage and the micro-R meter showed a reading of 1,500 micro-R at the outside of the windows of the building.

At Gunsite 72, the SRP located a burial location of 3 empty, heavily rusted drums adjacent to one of the abandoned gunpads. The drums had open bungs and an Hnu photoionization organic vapor analyzer produced no reading above background inside the drums, confirming that they were empty.

The size and location of these sites are listed below:

<u>Gunsite</u>	<u>Site Number</u>	<u>Size (acres)</u>	<u>Location</u>
20	080-29G	4.1	South of Road A
72	080-31G	6.4	West end of Road A-2
121	080-30G	6.4	South of Road 2-1 and east of Road E-2

Ash Basins/Piles

Ash basins receive ash sluicewater from the powerhouses in D-, F-, K-, L-, P-, and R-Areas, and have been in service since plant startup. Currently, there are 10 ash basins on the site: 6 are active, 2 on standby, and 2 are no longer used.

By comparison, in A- and C-Areas, powerhouse ash is disposed of in dry ash piles. A total of five ash piles have been used on the site, two active and three inactive. The inactive piles have been seeded with grass to prevent erosion. The two active piles are surrounded by a containment dike.

The listing below identifies the locations and numbers of the sites:

<u>Ash Basins and Piles</u>	<u>Location-near adjacent waste sites</u>
L-Area - one basin	L-Area Oil and Chemical Basin
P-Area - one basin	P-Area CPRCB*
R-Area - one basin	R-Area Burning/Rubble Pit
C-Area - three piles	C-Area CPRCB*
F-Area - two basins	F-Area CPRCB*
H-Area - one basin	H-Area CPRCB*
D-Area - three basins	D-Area Oil Seepage Basin
A-Area - two piles	A-Area CPRCB*
K-Area - one basin	K-Area CPRCB*

* CPRCB - coal-pile runoff containment basin

No groundwater monitoring has been conducted in the vicinity of plant ash basins or piles. However, groundwater monitoring wells have been installed at the K-Area Ash Basin to fulfill commitments for L-Reactor restart. No other monitoring is planned for ash basins or piles.

A visual inspection of an area devoid of vegetation immediately north of the D-Area Ash Basins (along the road between D-area and the southern pump station along the river) indicates that leachate from the ash basin is suspected of being the cause of significant environmental damage.

Chemicals, Metals, and Pesticides Pits

The Chemicals, Metals, and Pesticides (CMP) Pits are located about 1 mile north of L-Area. At this site, seven rectangular pits were constructed, two of which received pesticides and five of which received hazardous chemicals. Much of the waste buried was containerized in drums. The site was operational between 1971 and 1979. A remediation was conducted in 1984 at a cost of approximately 1.3 million dollars. All containerized wastes were exhumed and contaminated soil was excavated. The rough contamination limit for excavation was a soil contamination level of 100 ppm total concentration for a list of 650 compounds. Approximately 45,000 ft³ of soil and 170 drums were removed from the site. A standby leachate underdrain and recharge system was installed and the site was clay-capped. The site has approximately 22 groundwater monitoring wells in the vicinity.

L-Reactor Storage Pads

There are approximately 17,000 ft³ of radiologically contaminated abandoned reactor equipment and metal scrap stored on 8 concrete pads located south of and outside the fence of L-Reactor. Some of the equipment is lying loose on the pads, such as pipes, hoses, rods, and contaminated scrap vessels, and some is containerized in B-25 boxes. The equipment for one reason or another has not been permanently disposed of at the Radioactive Waste Burial Ground (RWBG) and has been sitting in the open for several years. The pads contain no curbs and have unsealed expansion joints allowing precipitation-induced migration of contamination. Originally the equipment was all to have been "blanked" with plywood and wrapped in plastic. However, these materials have long since

disintegrated, allowing rainwater to penetrate the equipment and wash contamination off the pad and into the adjacent soil. Samples have been taken by SRP of the soil adjacent to the pads; the samples show contamination of up to 36 pCi/g cesium-137 and 19 pCi/g cobalt-60. Surface-water tributaries that carry precipitation runoff are adjacent to some of the sites. It is not believed that any of the stored equipment contains hazardous chemical wastes, but the sites have not been thoroughly examined by SRP, nor are they listed as waste disposal sites.

Areas of Radioactive Contamination

As a consequence of past operations and activities, numerous areas of radioactive contamination exist in the environs of the SRP. Stephens and Ross (1984) have compiled a listing of approximately 65 such areas. Most of these areas have resulted from accidental airborne or liquid releases and spills; some areas are inactive burial sites for low-level contaminated waste. The greatest number of these areas are in the vicinity of the 200F- and 200H-Areas. They are located both inside and outside the Areas' security fences. Contaminants include fission products (primarily Cs-137), uranium, and plutonium and activity levels range from less than 1 Ci to 1,500 Ci. Areas of contamination range from several ft² to 10⁶ft².

According to documentation and limited observations by Survey team members, efforts have been made to reduce and/or stabilize the contamination at most sites. Some of the listed areas have been cleaned completely, in preparation for new construction projects. Concrete markers (pylons) delineate the boundaries of some residual contaminated areas; some areas are designated "regulated zones"; and several areas have no special identification relative to their contaminated status. DuPont procedure DPSOL-292-417 requires documentation and annual review of all known radioactive contamination sites. The Health Protection (HP) Department and various Project Departments are responsible for documenting and controlling these areas. Cleanup and decontrol of contaminated areas are in accordance with procedure DPSOL-193-485.

The listing of sites by Stephens and Ross does not include certain contaminated areas such as active waste storage and burial sites, liquid effluent discharge and drainage pathways, seepage basins, and retention basins. Identification and control

of these sites are the responsibility of the various operating projects. Some of these sites and some of the areas from the Stephens and Ross listing are located in active drainage pathways. As such, they are potential sources of continuing water, soil, and sediment contamination. Section 3.3 ("Surface Water") discusses several of these areas in greater detail.

Waste Disposal and Contamination Site Control

Controls on waste disposal and contamination sites began in 1973 when the burning rubble pits (BRPs) were discontinued for drummed and free liquid chemical waste disposal and waste oil burning as a means of disposal was begun in 1974. The startup of the Sanitary Landfill in approximately 1977 marked a period of increased control over hazardous and toxic-waste disposal, although, as discussed in previous portions of Section 4.5.1, substantial disposal of these environmental problem-causing materials still potentially occurred.

The current major effort at identification and characterization of waste disposal and contamination sites began in the period of 1982-1983 culminating in the "Ross-Green Report Waste sites on the Savannah River Plant" (Ross and Green, 1983). The authors, who had been involved in environmental sampling at the SRP for several years, reviewed hundreds of surface photographs from the 1960s and '70s and informally interviewed many operational staff to identify the 131 waste sites listed in their report. This effort led to later publication of "Technical Summary of Groundwater Quality Protection Program at Savannah River Plant" (Du Pont, 1983). This report identified a total of 153 individual waste sites used at the SRP. Approximately 40 of these sites have groundwater wells installed and have generated 1 to 3 years' of groundwater analytical data. In proposed compliance with DOE Order 5480.14 requiring phase I installation assessments of all inactive waste sites, SRP submitted the Du Pont (1983) report, which includes its own grading system for ranking of the environmental hazard of identified waste sites. Phase II characterization has begun by the site and is being coordinated by a waste site closure task force. This task force began in 1984 and consists of members from the Central Energy and Environment Division at SRP and environmental coordinators/waste site custodians from each of the major production areas on the site. It is the site's goal to complete characterization planning by the end of 1987. The task force cites as SRP's accomplishments:

- o Completed closure plans for the M-Area Settling Basin, CMP pits, and SRL Seepage Basins
- o Completed remediation of the CMP pits and remediation in progress at the M-Area groundwater contamination plume
- o Completed waste site characterization sampling and analysis at
 - Acid/caustic basins
 - M-Area Seepage Basin
 - Old TNX Seepage Basin
 - L-Area Oil and Chemical Basin
 - Ford Building Seepage Basin
 - CMP pits
 - SRL Seepage Basins
 - F- and H-Area seepage basins
 - Silverton Road Waste Site.
- o Completion of identification of SRL waste sites
- o Commencement of a program to placard and fence all waste sites.

4.5.2 Findings and Observations

4.5.2.1 Category I

None

4.5.2.2 Category II

None

4.5.2.3 Category III

1. Previously Unidentified Waste Disposal Sites. Three waste disposal/contamination sites and a fourth group of sites exist that are not being included in the required CERCLA identification and remediation

process under DOE Order 5480.14. The sites potentially may be contaminating groundwater, soil, and surface water with migrating chemical contaminants.

(a) Gunsite on Route 1 - A former gunsite exists west of Route 1 approximately 2 miles northeast of the 700 Administration Area. It is located on property that was originally owned by the site, released as excess acreage to the U.S. Forest Service in 1972, and in 1986 re-acquired by SRP. The gunsite was reported by a U.S. Forest Service representative to have contained a barracks and gun facility similar to the other gunsites although a walkover during the Survey could not locate the reportedly razed building. The site poses a potential for groundwater contamination due to possibly buried cleaning solvents, fuel-oil tanks, and any chemical disposal that could have occurred in septic disposal systems.

(b) Old TNX Lagoon Overflow Area - The area of known dead and stressed vegetation in the Savannah River Swamp in the drainage flow of the former TNX Basin overflow potentially is an ongoing source of contaminants leading into the surface water and groundwater of the swamp and ultimately the Savannah River. The area contains unknown quantities of mercury and other unknown hazardous substances. It has never been examined for radiological contamination. See Section 3.3 for a more thorough discussion of background on this problem, and Problem #1, Section 3.3.4.3 for a parallel finding of surface water contamination.

Sampling and Analysis will be conducted in the overflow area to further define this problem.

(c) D-Area Ash Basin Dead Vegetation Area - The area of dead vegetation north of the D-Area Ash Basin is a potential ongoing source of contaminants leaching into the surface drainage resulting from the D-Area Sanitary Wastewater Plant discharge along road Riv-1. This surface water ultimately discharges into the Savannah River. The hazardous constituents causing the dead vegetation are unknown and the exact nature of the source of contaminants not fully understood, although

It is presumed to have originated from leachate from the northernmost ash basin. See Section 3.3.4.3, finding 4, for a description of this finding as a surface-water problem.

Sampling and Analysis in the area north of the Ash Basin is planned to determine the type of contamination present.

- (d) Miscellaneous Abandoned Septic Tank and Tile Field Systems. The site contains several septic tank and tile field wastewater disposal systems in process areas that were abandoned in the mid-1970s when package wastewater treatment plants with surface discharges were installed. These unused subsurface disposal systems are located at TNX Area (3 systems), F-Area, H-Area, all Reactor Areas, the Forest Service (Building 760-G), the railroad yard (Building 618-G) and the Burial Ground (Building 724-7G). Prior to their abandonment, virtually all domestic wastewater from these major process areas on the site was disposed of in them. Because of possible past unknowing disposal in sanitary drain systems of hazardous/radiological chemicals, cross-connections between process and sanitary systems, and spills to sanitary drains, the groundwater beneath these tile fields may be contaminated along with the tile field unsaturated zones and any remaining sludge in the septic tanks. No chemical or radiological testing has been done by the site of any of these septic tanks or tile fields nor are there any records of pump-out and disposal of any septic tanks.

Sampling and Analysis is planned for these abandoned septic systems to determine if any of these suspected contaminants are present in significant amounts.

2. Previous Identified Waste Disposal Sites. Most of the 162 identified non-radiological waste disposal sites and 65 radiological contamination areas at SRP demonstrate the potential for groundwater contamination and, secondarily, surface-water contamination by hazardous, toxic, or radioactive constituents of disposed waste materials.

Only eighteen of the nonradiological waste disposal sites are believed to have sufficient data to show that they present no environmental problem. Those include the nine sludge spreading sites, seven erosion control sites and rubble pits, and two lumber piles. The other 144 nonradiological sites have widely varying data available (see Section 4.5.1). Many have no groundwater monitoring wells installed although inventories of disposed materials are too incomplete to positively show that only nonhazardous materials were disposed of. In addition most sites have no analytical data available for the contents of the disposed wastes themselves (such as could be obtained by soil boring and subsurface sampling techniques). Lastly, many sites have groundwater monitoring wells that are inappropriately located or are too far away from the disposal area to yet detect contamination of groundwater (see Section 3.4.3 Hydrogeology .Environmental Monitoring Program). Sampling and Analysis is planned for one such site, the P-Area SRP, to determine whether significant contamination migrated from groundwater seeps is occurring without monitoring by SRP.

Approximately 65 areas of radioactive contamination of soil and sediment exist throughout the SRP that are potential sources of continuing surface runoff contamination and that are subject to physical contamination spread by water and wind-borne erosion of already contaminated soil/sediment particles.

As listed in Stephens and Ross, (1984), most of these 65 areas of radioactive contamination resulted from accidental liquid or airborne releases and spills. Some of the areas are inactive burial sites for low-level contaminated waste. The majority of areas are in the vicinity of the 200-F and 200-H Areas, both within and outside the area security fences. Contaminants present include cesium-137, uranium, and plutonium. Activity levels range from less than 1 curie to 1,500 curies per area. The size of these areas ranges from as small as several square feet to over 20 acres.

4.5.2.4 Category IV

1. Compliance With DOE Order 5480.14 of 4/26/85. DOE Order 5480.14 requires that a Phase I installation assessment be performed by 4/26/86 "to evaluate site history and records, and to locate and identify those inactive hazardous wastes disposal sites that may pose a risk to health, safety and the environment as a result of migration of hazardous substances". The documentation of this assessment has not been carried out in accordance with the Order.

The Phase I assessment format is spelled out in detail and includes a physical inspection and a rating of non-radioactive sites with either the CERCLA Hazard Ranking System (HRS) or DOE's modified hazard ranking system.

Although the SRP made a late submission on July 3, 1986, in compliance with this order, what was submitted was existing information from SRP reports, not in the format of that required by the order and with a hazard rating system of SRP's design and not as required. Further, a proper physical inspection has not been conducted of each site and many hundreds of available aerial photographs have not been properly reviewed for location verification, as is required by the intent and letter of the order. Very importantly, radiological sites identified by Stevens and Ross, (1984) were not included in the July 3, 1986 submission.

2. Technical Continuity and Central Control of Waste Site Investigation, Characterization and Closure. Unequal levels of attention and procedure are being devoted to waste sites at SRP.

Each process area has a staff member, generally from production staff, assigned as custodian of that area's waste sites. These custodians are supervised by waste site closure staff from the Energy and Environment Division of the SRP. Together, these groups comprise the waste site closure task force, which meets periodically to discuss and set objectives for waste site identification, characterization, and closure. Because of the large number of people involved (over 20), the regular rotation of waste site

custodians, and the geographic diversity of the site, unequal levels of attention and procedure are devoted to different waste sites. Better coordination and consistency are needed to ensure that all sites receive equally thorough assessment, characterization, and closure/remedial planning.

PRELIMINARY

REFERENCES

PRELIMINARY

REFERENCES

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PRELIMINARY

APPENDIX A - SURVEY PARTICIPANTS

PRELIMINARY

SAVANNAH RIVER PLANT
SURVEY PARTICIPANTS
JANUARY 5 - 23, 1987

DOE

Team Leader

R. Scott

Assistant Team Leader

V. Fayne

NUS and SUBCONTRACT PERSONNEL

Coordinator

K. Walter (NUS)

QA/Toxics

M. Malloy (NUS)

Surface Water

S. Gentry (NUS)

Air

T. Stewart (PNL)

Radiation

R. Lanza (ICF)

J. Connelly (NUS)

Waste Management

J. Berger (ORAU)

J. Nelson (NUS)

Inactive Waste Sites

J. English (ICF)

Hydrogeology

K. Walter (NUS)

D. Riddle (NUS)

P. Eddy (PNL)

APPENDIX B - SITE-SPECIFIC SURVEY ACTIVITIES

PRELIMINARY

B.1 Pre-Survey Preparation

The DOE Office of Environmental Audit, Assistant Secretary for Environment, Safety and Health, selected a Survey team for the Savannah River Plant (SRP) in the fall of 1986. The site is operated for the DOE by the E.I. du Pont de Nemours and Company (Du Pont). Mr. Randall Scott was designated the DOE Team Leader, and Mr. Vincent Fayne the Assistant Team Leader. The remainder of the team was composed of contractor specialists from the NUS Corporation, ICF Corporation, Battelle Pacific Northwest Laboratories, and Oak Ridge Associated Universities.

The Survey team members began reviewing SRP general environmental documents and reports in October 1986. Messrs. Scott, Fayne, Malloy, and Walter conducted a pre-Survey site visit on November 3-6, 1986 to gain familiarization with key DOE and Du Pont personnel and the site. They toured the facility and completed a cursory review of the data generated in response to an information request of September 24, 1986. The request listed environmental information of interest to the Survey team for planning purposes. The Survey team intensively reviewed the information generated during the pre-Survey visit, and on December 1-2, 1986, prepared a Survey Plan for the SRP Site. This Plan discussed the specific approach to the Survey for each of the technical disciplines and included a proposed schedule of activities for on-site activities. The Survey plan was transmitted through the Savannah River Operations Office to Du Pont during the week of December 8th, 1986.

B.2 On-Site Activities

The on-site portion of the Survey was conducted during the period of January 5-23, 1987. The opening meeting held on January 5, 1987, at the site was attended by representatives from DOE Headquarters, the Savannah River Operations Office, Du Pont, and the Survey team members. Discussions during this meeting centered on the purpose of the Survey, logistics at the SRP, and an introduction of the key personnel involved.

During the Survey, team members reviewed file materials, permits and applications, background studies, engineering drawings, accident reports, and

operating logbooks. The production process was thoroughly analyzed to identify existing and potential pollutants. Site operations and monitoring procedures were observed. Extensive interviews were conducted with plant personnel regarding environmental controls, operations, monitoring and analysis, past operations, regulatory permits, and waste management.

Daily meetings of the Survey team members were held to report observations and compare findings. A representative from the Energy and Environment Division of Du Pont met daily and often more frequently with the DOE Team Leader, Assistant Team Leader, and the NUS Coordinator to arrange for specific site personnel and facilities to be available, as needed, on the following day. Du Pont personnel accompanied Survey team members on all field reconnaissances.

The Survey team members identified further sampling and analysis (S&A) requirements necessary to complete the Survey effort. The S&A requirements were discussed by the team on January 21 and 22, 1987, and the request was transmitted to Idaho National Engineering Laboratory (INEL) representatives present at the last week of the summary. INEL was designated by DOE to provide a sampling team for SRP and to perform the laboratory analytical services.

A site closeout briefing was held on January 26, 1987, where the DOE Team Leader and Assistant Team Leader presented the preliminary observations of the Survey team. These observations were classified as preliminary, because additional research and, in some cases, additional field sampling were required to positively confirm the observations.

B.3 Sampling and Analysis

Idaho National Engineering Laboratory will perform the sampling and analysis portion of the Survey. INEL evaluated the sampling requests made by the Survey team and determined sampling and analysis logistics, costs, and schedules. The Sampling and Analysis Plan prepared by INEL includes a quality assurance plan and a health and safety plan. The Sampling and Analysis Plan will be completed during July 1987 and the Sampling and Analysis team will begin work at the site during August of 1987.

B.4 Report Preparation

A Preliminary Report for the SRP will be prepared to summarize the findings from the on-site Survey effort. This report will be provided to the Savannah River Operations Office and Du Pont for review. The findings presented in the Preliminary Report are considered draft until comments are received and S&A results are available. At that time, the comments and S&A results will be evaluated and an Interim Report will be prepared.

PRELIMINARY

B.4 Report Preparation

A Preliminary Report for the SRP will be prepared to summarize the findings from the on-site Survey effort. This report will be provided to the Savannah River Operations Office and Du Pont for review. The findings presented in the Preliminary Report are considered draft until comments are received and S&A results are available. At that time, the comments and S&A results will be evaluated and an Interim Report will be prepared.

PRELIMINARY

APPENDIX C - SURVEY PLAN

PRELIMINARY

**ENVIRONMENTAL SURVEY
SAVANNAH RIVER SITE
JANUARY 5 THROUGH 23, 1987
AIKEN, SOUTH CAROLINA**

1.0 INTRODUCTION

The Environmental Survey is a one-time baseline inventory of existing environmental information and environmental problems and risks at DOE operating facilities. The Survey will be conducted in accordance with the principles and procedures contained in the DOE Environmental Survey Manual.

The Survey is an internal management tool to aid the Secretary and Under Secretary in allocating resources for maintaining aggressive environmental programs and for mitigating environmental problems at DOE facilities.

2.0 SURVEY IMPLEMENTATION

The Environmental Survey at the Savannah River Plant will be managed by DOE Team Leader Randal Scott and Assistant Team Leader Vincent Fayne. William McMillan will serve as the Savannah River Operations Office (SR) representative on the Survey team. Technical support will be provided by contractor personnel as follows:

Air

Robert Lanza, ICF Corporation

Radiological

John Connelly, NUS Corporation

James Berger, Oak Ridge Associated
Universities

Surface Water/
Drinking Water

Terri Stewart, Pacific Northwest Laboratory
Stephen Gentry, NUS Corporation

Waste Management

James Nelson, NUS Corporation
Joseph English, ICF Corporation

Inactive Waste Sites/
Releases

Kevin Walter, NUS Corporation

Hydrogeology

Douglas Riddle, NUS Corporation
Paul Eddy, Pacific Northwest Laboratory

QA/Toxic & Chemical
Materials

Michael Malloy, NUS Corporation

2.1 Pre-Survey Activities

Survey team members began reviewing Savannah River Plant general environmental documents and reports in October 1986. Messrs. Scott, Fayne, Walter, Malloy, and Alan Crockett (Idaho National Environmental Laboratory) conducted a pre-Survey site visit on November 3-6, 1986 to gain familiarity with key DOE staff and contractor personnel from E. I. du Pont de Nemours (Du Pont). They toured the facility and completed a cursory review of documents and discussed data that were generated in response to a letter of September 20, 1986. The letter proposed the Survey dates and listed environmental information of interest to the Survey team for planning purposes.

A meeting was held with State of South Carolina, State of Georgia, and U.S. Environmental Protection Agency Region IV environmental representatives at the SR Office on November 5, 1986, to review environmental issues and explain the purpose and scope of the Survey.

This Survey Plan will be transmitted to the Savannah River Plant prior to the Survey.

2.2 On-Site Activities

The Survey will be conducted from January 5 through January 23, 1987. The

Agenda will be as shown in Table 1, with modifications as appropriate to minimize disruption of site activities and to enhance Survey efficiency and effectiveness.

At the end of Table 1, a listing of specific areas that each Survey team member will evaluate has been provided. This list is intended to assist SR in identifying the most appropriate technical contacts who should be matched with individual Survey team members.

Interviews and consultations will be conducted with environmental, safety, operations, waste management, purchasing, and warehousing personnel, among others, in the course of the Survey. Also, the Survey team will continue its review of records and other documentation during the Survey. These records are identified in the "Records Required" sections of this plan. The Survey team has already reviewed some of these documents, so copies do not have to be made. However, the originals should be readily available for reference.

2.3 Sampling and Analysis

Based on available site environmental information and the results of the Survey activities on the site, the sampling and analysis (S&A) phase of the Survey process will be implemented approximately 13 weeks after completion of the Survey. This effort will have a 6- to 8-week duration and will be conducted by the Idaho National Engineering Laboratory. Results of the S&A effort will be transmitted to the Survey Team Leader and to Savannah River if data are determined to be reportable pursuant to regulatory requirements.

2.4 Conclusions and Reporting on the Survey

A closeout briefing will be conducted during the third week of the Survey to describe the general conclusions of the on-site activities. Within 8 weeks of the on-site Survey team visit, a Preliminary Report will be developed. Within 8 weeks of the availability of the analytical results from the S&A phase of the Survey, an Interim Report will be completed.

**Table 1
Savannah River On-Site Survey Agenda ***

	Air	Radiation
Week 1 (1/5/87)		
Monday	(am) Site briefing	(am) Site briefing
	(pm) technical coordinator working group meetings	(pm) technical coordinator working group meetings
Tuesday	Site tour	Site tour
Wednesday	200F Area - 221F building; main process, 291F/292F exhaust, fume scrubber, plutonium areas	1. 200F Area - 221F building; main process, 291F/292F exhaust, fume scrubber, plutonium areas. 2. (am) 200F Area - 241F Tank farm, 242F evaporator (pm) 200H Area - 241H Tank farm/242H Evaporator, etc.
Thursday	200F Area - 211F support building, HLW/LLW processing, acid recovery, plutonium fuel form facility, solvent recovery, 221F A line (UO ₃ Plant), underground tank exhaust, 723F laundry, NFF (247F) Naval fuel facility	1. 200F Area - 211F support building, HLW/LLW processing, acid recovery, plutonium fuel form facility, solvent recovery, 221F A line (UO ₃ Plant), underground tank exhaust, 723F laundry, NFF (247F) Naval fuel facility 2. 600 Area - outfalls, Burial grounds, seepage basins.
Friday	300M Area - 313M uranium fabrication, 320M target extraction, 321M fuel fabrication	1. 300M Area - 313M uranium fabrication, 320M target extraction, 321M fuel fabrication 2. (am) 600 Area - (cont.) (pm) 722F analytical laboratory
Week 2 (1/12/87)		
Monday	(am) 300M area/700A area - 300M area air strippers, 322M metallurgy Lab, 784A power plant	1. (am) L & P reactor (cont.) (pm) 700A area labs - 773/4, 5, 6A, 735A, 779A, 794A
	(pm) 400D area - 484D power plant	2. (am) L&P reactor (cont.) (pm) 700A area labs - 773/4, 5, 6A, 735A, 779A, 794A
Tuesday	L & P reactors	1. L & P reactors 2. L & P reactors
Wednesday	H Area - 221H separations, main process, 291/292H exhaust, B/G incinerator	1. H Area - 221H separations, main process, 291/292H exhaust, B/G incinerator 2. (am) 600 TNX/CMX area- Glass plant, Pu incinerator 677T exhaust (pm) 400D area - 420D rework facility
Thursday	200H Area - 232/4/8H Tritium facilities, 244/5H receiving area, resin regeneration	1. 200H Area - 232/4/8H Tritium facilities, 244/5H receiving area, resin regeneration 2. Unusual occurrence, accidental release reports
Friday	Non rad environmental monitoring	1. Rad environmental monitoring 2. Rad environmental monitoring

Table 1
Savannah River On-Site Survey Agenda

	Air	Radiation
Week 3 (1/19/87)		
Monday	Misc. non rad sources CS, TCU areas, non rad air sample labs	1. (am) 100 Area - K reactor (pm) environmental data review 2. (am) 100 Area - K reactor (pm) environmental data review
Tuesday	Environmental data review	1. Environmental sampling-review/observation 2. Environmental sampling-review/observation
Wednesday	Follow up inspections Sampling and Analysis Planning	1. Follow up inspections 2. Sampling and Analysis Planning
Thursday	Meeting with DOE team leaders and sampling and analysis request preparation.	Meeting with DOE team leaders and sampling analysis request preparation
Friday	Close out briefing	Close out briefing

**Table 1
Savannah River On-Site Survey Agenda (Continued)**

	Surface Water/Drinking Water	Waste Management
Week 1 (1/5/87)		
Monday	(am) Site Briefing (pm) technical coordinator working group meetings	(am) Site briefing (pm) technical coordinator working group meetings
Tuesday	Site tour	Site tour
Wednesday	1. 100 Area - process sources 2. 100 Area - process sources (188-K, 189K, 904-80G)	1. 100 Area - points of generation/TSDs 2. (am) 200 Area - F/H basins (pm) 300 Area - M Basin
Thursday	1. 300 Area process sources 2. 300 Area process sources (313M, 320M, 321M)	1. 100 Area - (continued) 2. 300 Area - points of generation, TSDs
Friday	1. 200 Area process sources 2. 200 Area process sources (242H, 221H, 244/5H) 281-8H, 288-H, 284-H, 285H,	1. 200H Area - points of generation, TSDs, 221F 2. 200 F Area - points of generation
Week 2 (1/12/87)		
Monday	1. 200 Area process sources 2. 200 Area process sources (221F, 241F, 211F)	1. 200 Area - (continued) 2. 200 F Area - points of generation
Tuesday	1. 300 Area & 400 Area process sources and discharges 2. 300 Area & 400 Area process sources and discharges (420D)	1. 400 Area - points of generation, TSDs. 2. 300 Area - (continued)
Wednesday	1. 400 Area & 600 Area (CMX & TNX) process sources & discharges 2. 400 Area & 600 Area (CMX & TNX) process sources & discharges (Pu Incinerator, 690G, 607-37G, 677-G, 679-G, 607-7H, 607-H, 904-76G 904-102G	1. 400 Area (continued) 2. 600 Area (TNX) - points of generation and TSDs.
Thursday	1. NPDES sampling & surface water monitoring 2. NPDES sampling & surface water monitoring	1. Ground-water monitoring program 2. Ground-water monitoring program
Friday	1. 700 Area & CS area - process sources & discharges 2. 700 Area & CS area - process sources & discharges (723F, 8303G, 8305-G, 8307-G, 8318G, 8328G)	1. 700 Area (TCU) & CS Area - points of generation, TSDs 2. 600 Area - (continued)

Table 1
Savannah River On-Site Survey Agenda (Continued)

	Surface Water/Drinking Water	Waste Management
Week 3 (1/19/87)		
Monday	<ol style="list-style-type: none"> 1. Balance of plant process sources/discharges 2. Balance of plant process sources/discharges (905-136, 904-75G, 901-H, 905-43H, 904-80G) 	<ol style="list-style-type: none"> 1. (am) burial grounds (pm) RCRA drum storage units 2. (am) burial grounds (pm) RCRA drum storage units
Tuesday	<ol style="list-style-type: none"> 1. Environmental data review 2. Environmental data review 	<ol style="list-style-type: none"> 1. Environmental data-review 2. Environmental data-review
Wednesday	Follow up inspections Sampling and Analysis Planning	Follow up inspections Sampling and Analysis Planning
Thursday	Meeting with DOE team leaders and sampling and analysis request preparation.	Meeting with DOE team leaders and sampling and analysis request preparation
Friday	Close out briefing	Close out briefing

Table 1

Savannah River On-Site Survey Agenda (Continued))

	Inactive Waste Sites/Release (CERCLA)	Hydrogeology
Week 1 (1/5/87)		
Monday	(am) Site briefing (pm) Technical coordinator working group meetings	(am) Site briefing (pm) Technical coordinator working group meetings
Tuesday	Site tour	Site tour
Wednesday	300M Area and 700H Areas	1. 300M Area - seepage basin, pumped wells, lost lake, sludge spreading at Lucey and Road F 2. 700A Area - Misc. Chemical Basin, Metals Burning Pit, Background Well, Coal Pile Runoff Basin, 723-A Metallurgical Lab Basin, 716-A Oil & Grease Basin, Rubble Pit, SRL Seepage Basins
Thursday	400 Area (TNX) & 100K Areas	1. 400D Area (TNX) D-Area Rubble Pits, Coal Pile Runoff Basin, Oil Seepage Basin, Old TNX Seepage Basin, New TNX Seepage Basin 2. 100K Area - Containment Basin, Ash Basin, Acid/Caustic Basin, Coal Pile Runoff Basin, Rubble Pit
Friday	200 F & H Areas	1. 200F Area - F-Area Acid/caustic Basin, Rubble Pits, Burma Road Burning Pit, Scrap Lumber pile, Coal pile Runoff Basin, Old F-Area Seepage Basin, New F-Area Seepage Basins, F Canyon, Solid Waste Storage Facility, F Tank Farm 2. 200 H Area - H-Area Acid/Caustic Basin, Coal Pile Runoff Basin, Seepage Basins, Hazardous Waste Storage, Heat Exchanger Repair Basin, Tank Farms, Retention Basin, Acid Basin

Table 1

Savannah River On-Site Survey Agenda (Continued)

	Inactive Waste Sites/Release (CERCLA)	Hydrogeology
Week 2 (1/12/87)		
Monday	Data review, historical aerial and surface photographs	<ol style="list-style-type: none"> 1. Data review, well construction data, historical aerial photos 2. Data review, well construction data, historical aerial photos
Tuesday	Environmental data review	<ol style="list-style-type: none"> 1. 100 L&R Areas - L-Area Acid/Caustic Basin, Chemical & Oil Basin, Rubble Pit, Compressed Gas Cylinder Pit, Seepage Basin, Sanitary Landfill, R-Area Acid/Caustic Basin, R-Area Rubble Pits, R-Reactor Seepage Basins 2. 100 C & CS Areas - C-Area Coal Pile Runoff Basin, Chemical, Metal & Pesticide Pits, Rubble Pit, Erosion Control Pit, C-Area Seepage Basins, Central Shops Oil Basin, Central Shops Burning and Rubble Pits, C-Area Ash Piles
Wednesday	600 Area (TNX) (with waste management specialist) and follow up inspection inactive waste sites (alone)	<ol style="list-style-type: none"> 1. 100 P Area - P-Area Acid/Caustic Basin, Coal Pile Runoff Basin, Rubble Pit, Seepage Basin. 2. Misc. Site Review-SRL Oil Test Site, GVN Site, SI Rubble Pile, Seepage Faces
Thursday	Offsite reconnaissance 1. Off site reconnaissance-USFS property western site boundary, river inspection, Barnwell Industrial park.	<ol style="list-style-type: none"> 1. Off site reconnaissance-USFS property western site boundary, river inspection, Barnwell Industrial park. 2. Off site reconnaissance-USFS property western site boundary, river inspection, Barnwell Industrial park.
Friday	Follow up inspections-inactive waste sites	<ol style="list-style-type: none"> 1. Observe well sampling-background, RCRA, drinking water well/radiological parameters, offsite well
Week 3 (1/19/87)		
Monday	Burial ground (with waste management specialist)	<ol style="list-style-type: none"> 1. Environmental data review 2. Environmental data review
Tuesday	1. Environmental data review and follow up inspections and sampling and analysis planning Sampling and Analysis Planning	<ol style="list-style-type: none"> 1. Follow up inspections & sampling and analysis planning 2. Follow up inspections & sampling and analysis planning
Wednesday	Sampling and Analysis Planning	<ol style="list-style-type: none"> 1. Sampling and Analysis Planning 2. Sampling and Analysis Planning
Thursday	Meeting with DOE team leaders and sampling and analysis request preparation	<ol style="list-style-type: none"> 1. Meeting with DOE team leaders and sampling and analysis request preparation 2. Meeting with DOE team leaders and sampling and analysis request preparation
Friday	Close out briefing	Close out briefing

**Table 1
Savannah River On-Site Survey Agenda***

	QATSCA
Week 1 (1/5/86)	
Monday	(am) Site Briefing (pm) technical coordinator working group meetings
Tuesday	Site tour
Wednesday	(am) 232/4/84 building - tritium facility (pm) Health physics laboratory overview, chain of custody, sampling procedures
Thursday	(am) Industrial hygiene data review, MSD sheets toxic procedures (pm) NFF - naval fuel facility
Friday	(am) Laboratory QA & analytical procedures (pm) Offsite laboratory QA
Week 2 (1/12/87)	
Monday	Laboratory tour records-procedures
Tuesday	Chemical & Toxic materials- storage and use, warehouses/tanks
Wednesday	Asbestos procedures (am) Records review (pm) Disposal areas
Thursday	(am) PCB procedures & Storage (pm) PCB in service equipment & disposal
Friday	(am) Environmental monitoring observation, air & vegetation (pm) Surface water & ground water
Week 3 (1/19/87)	
Monday	Environmental monitoring (continued), records review
Tuesday	Pesticides (am) Records, contractors (pm) Forest Service, SRP
Wednesday	Follow up inspections and environmental data review, sampling and analyses planning
Thursday	Meet with DOE team leaders and sampling and analysis request preparation
Friday	Close out briefing

* Numbers 1 and 2 refer to activities of first and second person in each technical area.

Table 1

Savannah River On-Site Survey Agenda (Continued)

**AREAS OF INTEREST FOR
TECHNICAL COORDINATOR WORKING GROUP MEETINGS**

WASTE MANAGEMENT

J. Nelson
J. English

Hazardous Waste
Radioactive Waste
NonHazardous Waste
Underground Storage Tanks
RCRA/Solid Waste Permits

RADIOLOGICAL

J. Berger
J. Connelly

- Radioactive emissions & effluents
- Source Controls & Monitoring
Environmental Monitoring - Rad
Laboratory Analysis - Rad

AIR

R. Lanza

- Meteorology
Emission Sources, Controls & Monitoring
Environmental Monitoring - Air
Air Permits & Emission Inventory

SURFACE WATER

S. Gentry
T. Stewart

Effluent sources
NPDES Permits
Wastewater (Process & Sanitary) Treatment
Facilities
Cooling Water System
Drinking Water Supply, Treatment, &
Distribution

HYDROGEOLOGY

D. Riddle
P. Eddy

- Waste Storage & Disposal Site (Past & Active)
Spill/Accident Locations
Regional Geology & Ground Water
Well Inventory & Construcion
Ground-water Monitoring Program

INACTIVE WASTE SITES

- K. Walter - Past Waste Site Locations
Characterization Studies
Spill/Accident Locations
Remediation Work

QUALITY ASSURANCE

- M. Malloy - Environmental Sampling Program
J. Berger - Environmental Analytical Program
Data Management & Handling
QA Program Overview

TOXIC & CHEMICAL MATERIALS

- M. Malloy - Process Chemicals & Substances Inventory
T. Stewart - Asbestos Removal & Disposal
PCBs In-Service, Storage, & Disposal
Pesticide Use, Storage & Disposal
Warehousing & Tank Farms for Process
Chemicals

PRELIMINARY

3.0 AIR

3.1 Issue Identification

The radioactive and regulated/hazardous air-related Survey activities involve an assessment of the plant-wide air emissions, emissions control and monitoring equipment, and the acquisition and processing of ambient air quality data. Areas of investigation will include the process emissions of tritium, noble gases, radioactive and total particulates, nitrogen oxides, ammonia, toxic metals and volatile hydrocarbons (VOCs), and the emissions of nitrogen and sulfur oxides from fuel-burning equipment. Operational and procedural practices associated with emission control and monitoring equipment will be evaluated. Fugitive sources of radioactive and regulated/hazardous particulate and gaseous emissions including waste storage/disposal sites and solvent storage/handling areas, and any mitigative procedures will be investigated.

The general approach to the Survey will involve a review of existing air permits and impact statements, emission inventories, operating procedures, stack testing reports, radioactive effluent reports, and other relevant documents to identify significant sources of air emissions. Following the document review will be the physical inspection of significant processes, control and monitoring equipment, and potential fugitive sources. The Survey will identify air contaminants from significant processes and fugitive sources in the plant, evaluate the existing control equipment for the air contaminants, and assess the potential for environmental problems from the emissions.

The ambient air monitoring system assessment will involve inspection of the ambient air samplers and meteorological equipment; and review of data acquisition, documentation and procedures, calibration procedures, data validation, and processing. The primary emphasis will be an assessment of these procedures to characterize the environmental impact of plant operation and the defensibility of the collected data.

Several areas for specific investigation have been identified during a review of available documentation:

- o Process and fugitive airborne releases of tritium including accidental releases and evaporation from waste storage/disposal areas
- o VOC emissions from 300-Area and other areas, including process and fugitive emissions and emissions from groundwater treatment systems
- o Site-wide nitrogen oxide emission inventory
- o Ambient air concentrations of ozone (VOC) and particulates on and off the site
- o Carbon-14 and iodine-129 emissions from 100- and 200-Area facilities
- o Noble gas emissions from 100- and 200-Area facilities
- o Disposal of waste oil in facility steam boilers
- o Potential/actual emissions of regulated/hazardous pollutants from unpermitted (radiological) and/or uncharacterized sources (e.g., 241 Tank Farms)
- o Open burning (contaminated scrap wood and any other wastes)

3.2 Records Required

The following records should be available for on-site review:

- o Air permits, air permit applications, and environmental impact statements
- o Source and source emissions inventories for both radiological and regulated/hazardous process and fugitive emission sources

- o Process flow diagrams for facility production and waste treatment processes
- o Identification of process and potential fugitive/accidental release points
- o Ambient air quality calculations and dose calculations, environmental monitoring reports
- o Descriptive documentation on existing and proposed add-on emission controls and ventilation system drawings
- o Operating, testing, and maintenance procedures for control equipment
- o Correspondence between Savannah River Plant and regulatory agencies: air-related
- o Reports on accidental releases/unusual occurrences relating to radiological and regulated hazardous airborne releases
- o Ambient air monitoring program procedures/documentation (Regulated/hazardous and radiological)
 - Sample collection procedures
 - Calibration procedures and records
 - Laboratory procedures and quality assurance
 - Ambient air monitoring data
- o Stack monitoring/sampling program procedures/documentation (Regulated/hazardous and radiological)
 - Calibration procedures and records
 - Stack monitoring/sampling data
 - Laboratory procedures and quality assurance

4.0 RADIOLOGICAL

4.1 Issue Identification

The radiological aspects of the Environmental Survey will involve an assessment of the site-wide radioactive emissions, control and monitoring equipment, and the associated impact on the environment and personnel living off the site. The radiological assessment will encompass three major areas: (1) airborne radioactive emissions; (2) liquid radioactive effluents; and (3) liquid and solid radioactive waste management. Because of significant overlaps, the radiological assessment will be coordinated with, and may be partially performed by air, surface water, waste Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act, hydrogeology, and quality-assurance personnel.

On the basis of reviews of available documents, it may be concluded that airborne releases of radionuclides from the site are larger in terms of curies than the liquid releases. Historically, radioactive air emissions have been the most significant contributors to radiation exposure from the site to the general public. However, the potential impacts to the environment and the public from the other sources will also be assessed.

The assessment will determine whether management of radioactive material released to the environment from the site, or potentially released, is creating any environmental problems. Existing environmental standards, regulations, and guidelines will be used for comparison to assess the potential magnitude of these problems. The review will also determine if appropriate actions are being taken or planned to minimize accidental releases and/or mitigate the consequences of such releases and whether there are conditions that potentially may lead to environmental problems.

Several areas for specific investigation have been identified during a review of available documentation:

- o Accidental releases (both airborne and liquid) from process facilities

- o Normal releases, both airborne and liquid, from the reactors and Fuel Separations Facilities, with specific interest in carbon-14, iodine-129, and noble gas emissions
- o Migration of activity from seepage basins
- o Emissions from radioactive waste incinerators
- o Leakage from underground waste storage tanks in the F- and H-areas, mitigation activities, and future remedial plans
- o Radioactive solid waste management practices including separation (radioactive, nonradioactive, and transuranic), storage, and disposal methods
- o Migration of contaminants from radioactive burial sites.

4.2 Records Required

The following records should be available for on-site review:

- o Radiological sampling and analysis methods and data, such as:
 - Overall effluent monitoring manual
 - Overall environmental program manual
 - Effluent sampling schedule
 - Effluent data (radionuclides, concentrations, and curies released by release point/facility)
 - Environmental sampling schedule
 - Environmental sampling data (related to facility or area if possible)
 - Radioanalytical procedures, related QA procedures and documentation.
- o Radioactive effluent reports
- o Environmental monitoring and sampling equipment calibration and maintenance records

- o Documents on the selection of sampling locations and design of monitors
- o Status reports on effluent and environmental control and monitoring upgrades
- o Radioactive waste management procedures
- o Reports on accidental releases
- o Reports on leaks from radioactive waste storage tanks
- o Reports on migration of activity from seepage basins and burial sites
- o Any classified effluent or environmental monitoring reports
- o Description of dose calculation programs

5.0 SURFACE WATER/DRINKING WATER

5.1 Issue Identification

A number of documents from the Savannah River Plant Site have been reviewed with attention being given to data and information concerning surface water (both influent and effluent waters). During the on-site Survey activities, additional information on surface water will be collected to more clearly identify current or potential environmental problems associated with either sanitary or process water.

The general approach will be to review documents requested in Section 5.2, interview personnel at selected operating facilities, and observe selected operations during facility tours. Several areas for specific investigation have been identified during a review of available documentation:

- o Outfall monitoring
- o Thermal discharges

- o Spills and leakage incidents
- o Sanitary treatment plant loading and capacity.

In addition, the Survey will include identification of potential discharges to surface water not mentioned in the National Pollutant Discharge Elimination System (NPDES) permit or other documents. Potential cross-connections between the process, sanitary, and stormwater waste treatment systems will be investigated.

An inventory of raw materials for each operation is requested to aid in identification of chemicals that have the potential for discharge to the environment. This information will provide guidance for the sampling phase of the survey.

5.2 Records Required

The following records should be available for on-site review:

- o Analytical data used for preparation of the NPDES monitoring reports
- o NPDES discharge monitoring reports for the period 1980 - present
- o Records of drinking water quality (both plant and public potable water)
- o Operator's logbooks and reports for treatment plant operations
- o Sampling logbooks
- o Treatment plant and monitoring equipment maintenance records and/or logs
- o Water balance drawings
- o Distribution and sewer drawings (process and sanitary floor drain system drawings)

- o Process flow diagrams with mass balances
- o Waste stream characterization studies
- o Analytical data on influent process water and process waste streams
- o Procedures for the operation and/or maintenance of treatment and monitoring equipment
- o Spill Prevention, Control, and Countermeasure (SPCC) plans and records of implementation
- o Individual operating facility records of the types and quantities of raw materials.

6.0 WASTE MANAGEMENT

6.1 Issue Identification

The waste management review will place emphasis on the identification of hazardous/radioactive/nonhazardous waste management activities that have potential for an adverse environmental effect. Table 2 provides a listing of all known active hazardous and radioactive mixed waste (RMW) facilities and their permit status. Of particular concern are the 10 surface impoundments, all of which are believed to be unlined, and the Radioactive Waste Burial Ground. The Burial Ground is not addressed in the Part B permit application but has received, and potentially continues to receive, a variety of radioactive and/or hazardous wastes. The Survey review will determine whether the Savannah River Plant Site hazardous/radioactive/nonhazardous waste management activities are conducted to prevent unauthorized releases to the environment. Appropriate sections of the Part B application will be reviewed for completeness. In addition, any operating and permitting deficiencies for hazardous/radioactive waste treatment, storage, and disposal (TSD) units will be defined. Solid waste management units (SWMUs) will also be identified and evaluated.

Table 2

Hazardous and Radioactive Mixed Waste Facilities

<u>Facility Name</u>	<u>Type</u>	<u>Waste Type</u>	<u>Permit Status</u>
710U Drum Storage	Container Storage	HW	I/PS
709G Drum Storage	Container Storage	HW	I/PS
709-2G Drum Storage	Container Storage	HW	PL/PS
709-4G Drum Storage	Container Storage	HW	I/PS
M-Area Basins	Surface Impoundment	RMW	I/CL
F-Area Basins	Surface Impoundment	RWM	I/PS
H-Area Basins	Surface Impoundment	RMW	I/PS
723A Metallurgical Basin	Surface Impoundment	U	U
Coal Pile Basin A	Surface Impoundment	U	U
Coal Pile Basin C	Surface Impoundment	U	U
Coal Pile Basin D	Surface Impoundment	U	U
Coal Pile Basin F	Surface Impoundment	U	U
Coal Pile Basin H	Surface Impoundment	U	U
Coal Pile Basin K	Surface Impoundment	U	U
Coal Pile Basin P	Surface Impoundment	U	U

Abbreviations

HW = Hazardous Waste

RMW = Radioactive Mixed Waste

I = Interim Status

PS = Part B Permit Application Submitted

CL = Closure/Post-Closure Plan submitted and facility no longer accepts wastes

PL = Planned Facility

U = Unknown

The waste management review will be coordinated with inactive waste sites/releases and hydrogeologic investigations to help identify possible releases. The Savannah River Plant Site will be surveyed to determine hazardous/radioactive waste generation points, and the characterization of existing and past waste disposal practices.

Several areas for specific investigation have been identified during a review of available documentation:

- o Waste and raw material storage in underground tanks
- o Waste oil management practices
- o Solid waste disposal operations, to ensure that all hazardous and radiological constituents have been identified and are properly managed
- o All radioactive waste TSD units will be included in the scope of this review

6.2 Records Required

The following records should be available for on-site review:

- o Part B permit application
- o 3016 inventory
- o Inspection documentation (State and Federal)
- o Groundwater monitoring, sampling, and analytical documentation
- o Waste inventory documentation
- o Enforcement action documentation

- o Groundwater monitoring system construction documentation
- o Internal facility inspection documentation
- o Compliance Implementation Plan, Volume II, January 31, 1986
- o Savannah River Interim Waste Management Program Plan, FY-1986, September 1985
- o Hazardous Waste Management Plan - Savannah River Plant, June 1984
- o SRP Response to DOE Order 5820.2, September 22, 1986
- o DOE - SRO SRP Candidate Mixed Hazardous Waste Streams, (draft-undated)
- o SRP Environmental Action Plan, Volume I
- o Information regarding underground storage tanks.

7.0 INACTIVE WASTE SITES/RELEASES

7.1 Issue Identification

The inactive waste sites/releases review will identify environmental problems associated with the historical handling, storage, and disposal of hazardous substances at the site. The review will evaluate information developed in response to the CERCLA regulations. The Survey will focus on current and future environmental problems related to past land disposal practices and past spills/releases.

The CERCLA portion of the Survey, since it relates to past handling, as well as disposal of hazardous and mixed chemicals/waste, will be coordinated with the waste management, toxic and chemical materials, and radiological portions of the Survey. The surface-water portion of the Survey will be included in this

coordination to check for storm and surface drainage or unknown/unpermitted subsurface disposal of water that may form a migration pathway.

Lastly, since subsurface water is the primary mode of migration for buried wastes, the CERCLA portion of the Survey will be interfaced with the groundwater review.

Several areas for specific investigation have been identified during a review of available documentation:

- o Facilities that have handled hazardous, mixed, and low-level radioactive wastes
- o Past waste disposal areas
- o Areas where past undocumented disposal may have taken place
- o Areas where leaks, spills, or inadvertent disposal may have created ongoing sources of contamination of traceable plumes of surface or subsurface contamination

7.2 Records Required

The following records should be available for on-site review:

- o Waste management plans (past and current)
- o Historical standard operating procedures (SOPs) regarding management of hazardous substances, disposal areas, and storage areas
- o Historical aerial photographs and site plans that may provide clues to undocumented disposal
- o Hazardous substances inventories

- o Listing of inactive areas used for hazardous substances use, storage, receiving and shipping, and disposal
- o Historical files on past operations and processes, substances used, and methods of handling and disposal
- o Files on past off-site waste handling and disposal
- o Records of facility expansion and building rubble disposal
- o Descriptions and notifications of inactive waste sites and potential areas of contamination
- o Descriptions and notification of spills/releases (Unusual Occurrence Reports and Minor Release Reports)
- o Descriptions of corrective actions
- o Description of all inactive waste management facilities, including buried tanks and structures
- o Ongoing CERCLA-related studies

8.0 HYDROGEOLOGY

8.1 Issue Identification

The preliminary review of documentation on the site indicates that a great deal of previous work has been conducted in the area of groundwater assessments. Site studies have shown groundwater contamination by both radioactive and nonradioactive constituents. Monitoring of groundwater for radionuclides has been ongoing since 1951. A comprehensive groundwater monitoring program for nonradiological parameters was begun in 1982. Contamination of groundwater by chlorocarbons has resulted in ongoing groundwater remediation. The issues to be dealt with during the Survey include a determination of the status of those recent and ongoing studies.

A critical concern for the Survey is the relationship between the site and the Tuscaloosa aquifer. The Tuscaloosa represents a major regional groundwater resource and is used extensively on the site for water supply. The potential sources of contamination for the Tuscaloosa include the upper (overlying) aquifers at the SRP Site which have been impacted by site activities. A general review of data-collection efforts that have taken place will be required to determine the usefulness, for purposes of the Survey, of existing information. This will include a review of sampling procedures, chain-of-custody and quality assurance/quality control (QA/QC) procedures, compatibility of data from various sources, and monitoring parameters. The reliability, construction, and placement of wells used for groundwater monitoring will be examined. To assess the potential for regional impact from groundwater contamination, principal facility users of groundwater, as well as domestic users, if any, need to be identified. Well construction data will also be evaluated for these sources.

Several areas for specific investigation have been identified during a review of available documentation:

- o Seepage and containment basins
- o Ponds
- o Underground storage tanks, and
- o Solid and liquid waste disposal operations.

8.2 Records Required

The following documents should be available for on-site review:

- o New and recent groundwater work and work plans
- o Well sampling procedures and schedules
- o Monitoring parameters, data, and results
- o General groundwater sampling and laboratory QA/QC
- o Well installation reports, boring logs, and as-built drawings
- o Air photos (historic--1940 to present)
- o Historic topography records, etc.
- o Groundwater sections of pertinent documents (for example, RCRA permits).

9.0 QUALITY ASSURANCE

9.1 Issue Identification

The QA review of the environmental program will be primarily directed at the evaluation of site sampling and analytical capabilities. The QA aspects of the environmental sampling program performed by the Health Physics Group will be evaluated. QA programs for on-site environmental laboratories and off-site laboratories (e.g., Envirodyne Engineers, Environmental Testing) will be reviewed.

The intent of this review will be to verify the QA procedures for obtaining process effluent and environmental samples, performing the analytical work to identify pollutants, and the handling and reporting of data. All aspects of the QA program relating to environmental monitoring and analysis of the Savannah River Plant Site will be reviewed.

The environmental sampling performed by the Health Physics Group will be evaluated by reviewing procedures, data handling, records, and logbooks. Field techniques will be observed to determine actual sampling practices.

The analytical laboratories will be reviewed through an evaluation of procedures and records, and through observation of laboratory operations. Off-site laboratories will be evaluated by using documents at the Savannah River Plant Site. No visits to off-site laboratories are anticipated for these operations.

Several areas for specific investigation have been identified during a review of available documentation:

- o Operator training
- o Equipment and instrument calibration/maintenance
- o Precision and accuracy studies
- o Blank, split, and spiked sample analyses
- o Sample handling and chain-of-custody procedures
- o Data reduction and validation

- o Data reporting and documentation
- o Calculation and logbook reviews.

9.2 Records Required

The following records should be available for on-site review:

- o Analytical laboratory and environmental sampling QA plans and manuals
- o QA audits of laboratory and sampling program
- o Reports for precision and accuracy
- o External performance standard results (e.g., EPA or DOE Environmental Measurements Laboratory)
- o Laboratory and sampling procedures manuals
- o Operator training records (laboratory and sampling)
- o Instrument maintenance and calibration records (laboratory and sampling)
- o Laboratory and sampling calculations, workbooks, and standard data reporting forms.

10.0 TOXIC AND CHEMICAL MATERIALS

10.1 Issue Identification

The toxic and chemical materials review will address the raw materials and process-related chemicals used at the Savannah River Plant Site. The use, handling, and disposal of polychlorinated biphenyls (PCBs), asbestos, pesticides, and herbicides will also be within the scope of this effort.

Several areas for specific investigation have been identified during a review of available documentation:

- o All toxic materials purchased, used, or manufactured by Du Pont and the other site contractors (e.g., Forest Service, Ecology Laboratory) will be surveyed. Tracking, control, and management of these substances will be reviewed. Records of usage will be examined to assess the potential for toxic materials to enter effluent streams.

- o An inventory of PCB-contaminated electrical equipment in use at the facility areas will be obtained. The condition of this equipment, its potential for leakage, and the quantity of contaminated fluids will be assessed.
- o Obsolete or used PCB items and contaminated items in storage will be inspected for proper packaging, adequate storage protection requirements, and inventory controls.
- o Disposal practices for current and past inventories will be reviewed to determine the method(s) of disposal and location(s) of disposal sites.
- o Procedures for PCB analysis, removal, handling, and disposal will be reviewed.
- o The presence of asbestos building materials and insulation at the site will be identified. Specifications or plans for modification/removal projects will be reviewed with the site construction/operation contractor and subcontractors.
- o Procedures for asbestos modification/removal, handling, and disposal will be investigated.
- o Training and certification of asbestos workers will be reviewed. Practices will be reviewed to determine disposal methods and locations.
- o The usage of pesticides and herbicides on the site will be reviewed, as well as personnel training, application records, and storage and disposal practices.

10.2 Records Required

The following records should be available for on-site review:

- o Inventory of toxic materials and purchasing records
- o Toxic materials labeling and tracking system
- o Procedures for handling, control, and management of toxic materials
- o Annual PCB status reports
- o Inventory of in-service PCB-contaminated equipment and fluids
- o PCB handling, storage, and disposal procedures
- o Storage records of PCB items
- o Disposal records for PCB items
- o Asbestos handling, removal, and disposal procedures
- o Locations of buildings containing asbestos
- o Asbestos disposal records, including method and location of disposal
- o Inventory of pesticides/herbicides
- o Pesticide/herbicide training, handling, storage, and disposal records
- o Standard operating procedures for pesticides/herbicides.

APPENDIX D - CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

PRELIMINARY

LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS

α -	Alpha particles (radiation)
AIHA -	American Industrial Hygiene Association
ARU -	Acid recovery unit
ATD -	Actinide Technology Division
β -	Beta particles (radiation)
BDC -	Beaver Dam Creek
BGI -	Beta/Gamma Incinerator
BOD -	Biological Oxygen Demand
BRP -	Burning/Rubble Pit
C -	Degrees centigrade
cc -	Cubic centimeters
CERCLA -	Comprehensive Environmental Response, Compensation, and Liability Act
CIF -	Consolidated Incineration Facility
CMP -	Chemicals, Metals, and Pesticides Pits
cpm -	Counts per minute
CTF -	Chemical Transfer Facility
Ci -	Curie
DETF -	Dilute Effluent Treatment Facility
DOE -	U.S. Department of Energy
DOE-SR -	U.S. Department of Energy Savannah River (Operations Office)
dpm -	Disintegrations per minute
DWPF -	Defense Waste Processing Facility
ECS -	Environmental and Chemical Sciences, Inc.
ED -	Enriched/depleted (uranium)
E&E -	Du Pont Energy and Environment Department
EID -	Environmental Information Document
ELLT -	Engineered low-level trench
EML -	(DOE) Environmental Measurements Laboratory

LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS (continued)

EMSC - Environmental Monitoring Systems Laboratory
EP - Extraction procedure
EPA - U.S. Environmental Protection Agency
ETI - Environmental Testing, Inc.

F - Degrees fahrenheit
FMC - Four Mile Creek
FMF - Fuel Material Facility
ft² - Square feet
ft³/yr - cubic feet per year

g - Gram
GAO - U.S. Government Accounting Office
GCD - Greater Confinement Disposal

ha - Hectare
HAW - High-activity waste
HEPA - High-Efficiency Particulate Air (filter)
HLW - High-level (hazardous waste)
HP - Health Protection
HW - Hazardous waste

IH - Industrial Hygiene
IGB - Indian Grave Branch
ILW - Intermediate-level waste
INEL - Idaho National Engineering Laboratory

K - Kilo (1000)
Kg - Kilogram
Km - Kilometer

l - Liter
LAW - Low-activity waste

LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS (continued)

LETF -	Liquid Effluent Treatment Facility
LLW -	Low-level waste
LSS -	Liquid scintillation solutions
LTRC -	Lower Three Runs Creek
m -	Milli (1/1000)
μ -	Micro (10^{-6})
MB -	Meyers Branch
mCi -	Millicurie (1/1000 curie)
μ Ci -	Microcurie (10^{-6} curie)
mg -	Milligram (1/1000 gram)
mgd -	Million gallons per day
ml -	Milliliter
μ g -	Micrograms (10^{-6} gram)
mR -	Milliroentgen (1/1000 roentgen)
mrem -	Millirem (1/1000 rem)
μ R -	Microroentgen (10^{-6} roentgen)
mCi/l -	Millicurie per liter
MCL -	Maximum contaminant level
MSDS -	Material Safety Data Sheet
MW -	Mixed waste
MWMF -	Mixed Waste Management Facility
MWSF -	Mixed Waste Storage Facility
NBS -	U.S. National Bureau of Standards
NEPA -	National Environmental Policy Act
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NPDES -	National Pollutant Discharge Elimination System
NPH -	Normal paraffin hydrocarbon
NRDC -	Natural Resources Defense Council
NSPS -	New source performance standards
O&G -	Oil and grease

LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS (continued)

ORDP -	Organic Removal Demonstration Plant
OSHA -	U.S. Occupational Safety and Health Administration
p -	Pico (10^{-12})
pCi-	Picocuries (10^{-12} curies)
pCi/l -	Picocuries per liter
PCB -	Polychlorinated biphenyls
PHEF -	Precipitate Hydrolysis Experimental Facility
PP -	Par Pond
ppb -	Parts per billion
ppm -	Parts per million
PSD -	prevention of significant deterioration
PUFF -	Plutonium Fuel Forms Facility
PVC -	Polyvinyl chloride
QA -	Quality assurance
QC -	Quality control
R -	Röntgen
R&D -	Research and development
RBOF -	Receiving basin for off-site fuels
RCF -	Refractory ceramic fibers
RCRA -	Resource Conservation and Recovery Act of 1976
RTF -	Replacement Tritium Facility
RWBG -	Radioactive Waste Burial Ground
SC -	Steel Creek
SCDHEC -	South Carolina Department of Health and Environmental Control
SCEGC -	South Carolina Electric and Gas Company
SLB -	Shallow land burial
SME -	slurry mix evaporator
SPCC -	Spill Prevention, Control and Countermeasure Plan
SRAT -	Surry Receipt Adjustment Tank

LIST OF SYMBOLS, ABBREVIATIONS, ACRONYMS (continued)

SRC - Savannah River Construction
SREL - Savannah River Ecology Laboratory
SRL - Savannah River Laboratory
SRP - Savannah River Plant

T - Temperature
TB - Tims Branch
TBP - Tributyl phosphate
TCA - Trichloroethane
TCE - Trichloroethylene
TLD - Thermoluminescent dosimeter
TOC - Total organic carbon
TOH - Total organic halogens
TNX - Trinitroxyene
TRU - Transuranic
TSCA - Toxic Substances Control Act
TSD - Treatment, storage, and disposal
TSP - Total suspended particulates
TSS - Total suspended solids

USGS - United States Geological Survey
UST - Underground storage tank
UTRC - Upper Three Runs Creek

VOC - Volatile organic compound

WIPP - Waste Isolation Pilot Plant
WSI - Wackenhut Services, Incorporated

APPENDIX E - AMENDED COMPLAINT NRDC VS. HERRINGTON

PRELIMINARY

U.S. Department of Justice

United States Attorney
District of South Carolina

October 18, 1985

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U.S. Department of Energy
Office of the Chief Counsel
Attn: James Bauer, Esquire
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

Re: Natural Resources Defense Council, Inc., et al.
v. Herrington, et al.

Dear Jim:

Enclosed please find a copy of the Amended Complaint and cover letter which was received by certified mail by this office on October 18, 1985.

With kind regards, we remain

Sincerely,

VINTON D. LIDE
United States Attorney

BY:

JOHN B. GRIMBALL
Assistant United States Attorney

JBG:gg
Enclosure

cc: Robert Steinberg, Esquire
Special Litigation Counsel
Land & Natural Resources Division
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P.O. Box 8296
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(803) 771-7223

October 17, 1985

Honorable John W. Williams
Clerk, U.S. District Court
P.O. Box 867
Columbia, SC 29202

Re: Natural Resources Defense Council, Inc.,
Energy Research Foundation, League of
Women Voters, Inc. and the Georgia
Conservancy vs. John S. Herrington,
William A. Vaughan and U.S. Department
of Energy
C/A No. 1:85-2583-6

Dear Mr. Williams:

Enclosed for filing please find the original and one copy of the Amended Complaint in the above-referenced action. None of the Defendants have yet answered, and the amendment merely deletes the word "underground" on pages 3 and 17 of the Complaint, and corrects a statutory reference on page 4. As noted in the attached Certificate of Service, I am serving copies of this Amended Complaint on the Defendants by certified mail.

Please return a clocked-in copy of this pleading to me in the enclosed envelope.

Thank you very much for your kind cooperation and assistance.

Yours very truly,

James S. Chandler, Jr.

JSC/plb

cc: Honorable John S. Herrington
Honorable Willaim A. Vaughan
Honorable Edwin Meese
✓ Honorable Vinton D. Lide

UNITED STATES DISTRICT COURT
DISTRICT OF SOUTH CAROLINA
AIKEN DIVISION

NATURAL RESOURCES DEFENSE COUNCIL, INC.)
1350 New York Avenue, N.W., Suite 300)
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(202) 783-7800)

ENERGY RESEARCH FOUNDATION)
2530 Devine Street, Suite 201)
Columbia, S.C. 29205)
(803) 256-7298)

LEAGUE OF WOMEN VOTERS OF SOUTH)
CAROLINA, INC.)
2838 Devine Street)
Columbia, S.C. 29205)
(803) 771-0063)

and)

THE GEORGIA CONSERVANCY)
3110 Maple Drive)
Atlanta, GA 30305)
(404) 262-1967)

Plaintiffs,)

vs.)

JOHN S. HERRINGTON)
Secretary of Energy)
1000 Independence Ave., S.W.)
Washington, D.C. 20585)
(202) 252-6210)

WILLIAM A. VAUGHAN)
Assistant Secretary for)
Environment, Safety, and Health)
U.S. Department of Energy)
1000 Independence Avenue, S.W.)
Washington, D.C. 20585)
(202) 252-4700)

and)

U.S. DEPARTMENT OF ENERGY)
1000 Independence Avenue, S.W.)
Washington, D.C. 20585)
(202) 252-5000)

Defendants.)

AMENDED
COMPLAINT
CIVIL ACTION
NO. 1:85-2583-6

INTRODUCTION

Plaintiffs bring this action against the U.S. Department of Energy ("DOE") and against the named officials of that agency, to require compliance with the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"), the South Carolina Hazardous Waste Management Act, §§44-56-10 to 44-56-140 and applicable federal and state regulations in connection with the treatment, storage and disposal of hazardous wastes at DOE's Savannah River Plant ("SRP") in Aiken, South Carolina. This action challenges Defendants': (1) failure to identify and include in Notifications and Permit Applications, hazardous waste management activities at a number of waste sites at SRP; (2) failure to implement adequate groundwater monitoring; (3) failure to develop adequate closure and post-closure plans; and (4) unauthorized disposal of hazardous wastes from chemical storage tanks.

At least 153 waste management units have been identified at SRP. Many of these units are pits, basins, landfills, and storage areas which contain and continue to receive vast quantities of hazardous wastes regulated under RCRA, including mercury, chromium, lead and numerous chlorinated organic compounds.

RCRA requires, inter alia, that an owner or operator of an existing or proposed facility for the treatment, storage or disposal of hazardous waste notify the Environmental Protection Agency ("EPA") or an authorized state agency of such activities and apply for a permit. As part of the required Notification and

Permit Application, the owner or operator must identify units where wastes subject to RCRA have been or will be treated, stored, or disposed.

Defendants have included in their Notification and Permit Application only seven such units. Defendants have failed to provide proper notice and apply for a permit in regard to numerous other units, despite formal requests to do so by EPA, the South Carolina Department of Health and Environmental Control ("DHEC") and the Plaintiffs. Defendants have also failed to comply with interim status standards regarding groundwater monitoring and closure and post-closure care at a number of SRP units. Finally, Defendants have engaged in unauthorized disposal of hazardous wastes from chemical storage tanks. Defendants' violations frustrate the implementation of RCRA's important substantive requirements and endanger human health and the environment.

Plaintiffs are seeking, inter alia, a declaratory judgment that Defendants have failed to comply with RCRA and applicable regulations, an order requiring immediate compliance, and an order requiring cleanup of hazardous wastes disposed of from tanks.

JURISDICTION AND VENUE

1. This Court has subject matter jurisdiction over the claims set forth in this Complaint, by virtue of RCRA Section 7002(a), 42 U.S.C. §6982(a). Jurisdiction is also founded on provisions conferring jurisdiction in cases raising a federal question, 28

U.S.C. §1331, seeking to compel any officer of the United States to perform a duty owed to Plaintiff, 28 U.S.C. §1361, and requesting a declaratory judgment, 28 U.S.C. §2201.

2. On June 26, 1985, Plaintiffs notified Defendant, John S. Herrington, of the violations of RCRA set out in this Complaint and stated their intent to file suit, as required by RCRA Section 7002(b), 42 U.S.C. §6972(b). The notice was also sent to the Administrator of the United States Environmental Protection Agency ("EPA") and to the South Carolina Department of Health and Environmental Control ("DHEC"), as required by §7002(b). A copy of the notice is attached to this Complaint as Exhibit A.

3. The RCRA violations complained of in the notice have not ceased. Neither EPA nor DHEC has commenced and prosecuted a civil or criminal action to redress the violations.

4. Venue is appropriate in the District of South Carolina pursuant to RCRA Section 7002(a), 42 U.S.C. §6972(a), because the sources of the violations complained of are located within this District.

PARTIES

5. Plaintiff Natural Resources Defense Council, Inc. ("NRDC") is a national non-profit membership organization incorporated under the laws of the State of New York with offices in Washington, D.C., New York City, and San Francisco, California. NRDC is dedicated to preserving, protecting, and defending the environment, its natural resources and wildlife, and has actively worked to promote the implementation and enforcement of RCRA.

NRDC has a long-standing interest in federal facility compliance with RCRA, especially with regard to DOE facilities. See e.g., Legal Environmental Assistance Foundation, NRDC et al. v. Hodel et al., 506 F. Supp. 1163 (E.D. Tenn. 1984). Plaintiff NRDC has over 50,000 individual members nationwide. More than 600 NRDC members live in South Carolina and Georgia. Many members have joined NRDC so they may obtain adequate representation and protection of the environmental interests they share with Plaintiff NRDC.

6. Plaintiff Energy Research Foundation ("ERF") is a private operating foundation incorporated under the laws of the State of South Carolina with offices in Columbia, South Carolina. ERF engages in research and public education on nuclear and other energy issues in South Carolina. ERF has a particular interest in the effects of SRP operations upon the environment, public health, and economy of South Carolina.

7. Plaintiff League of Women Voters of South Carolina, Inc. ("LWV-S.C.") is a non-partisan, non-profit membership organization incorporated in 1967 under the laws of the State of South Carolina, with offices in Columbia, S.C. The purpose of the LWV-S.C. is to promote open and accountable government and to foster citizen involvement in governmental decision-making affecting South Carolina. THE LWV-S.C. has had a particular and long-standing interest in the environmental hazards posed by SRP. Plaintiff LWV-S.C. has some 800 members statewide.

8. Plaintiff Georgia Conservancy is a non-profit membership organization founded in 1967, incorporated under the laws of the

State of Georgia, with offices in Atlanta and Savannah, Ga. The purpose of Plaintiff Georgia Conservancy is to maintain and improve the quality of the environment in Georgia. The Georgia Conservancy engages in public education and advocacy in pursuit of its objectives. The Georgia Conservancy has a standing committee which has been actively concerned about the hazards which nuclear facilities, including SRP, pose to the environment. The Georgia Conservancy has a state-wide membership of 3000 individuals, families, organizations, and businesses. Many members join The Georgia Conservancy in order to obtain representation of the environmental interests which they share with Plaintiff Georgia Conservancy.

9. Members of the plaintiff organizations use the Savannah River and its environs for many purposes, including domestic consumption, boating, swimming, fishing, crabbing, wildlife viewing, nature photography, environmental education and research, hiking, and general aesthetic and spiritual enjoyment. Hazardous wastes from SRP have contaminated and continue to contaminate the Savannah River and its environs. Additionally, members of the plaintiff organizations use groundwater for domestic purposes which is threatened by or already contaminated with SRP hazardous wastes.

10. If the Defendants fail to comply with RCRA at SRP, the health, safety, property, aesthetic, and environmental interests of members of Plaintiff organizations will be directly and adversely affected by the risks of accidental and routine releases of hazardous wastes from the Savannah River Plant into

the environment, including the waters of the Savannah River and underground sources of domestic water.

11. Defendant John S. Herrington is sued in his official capacity as Secretary of the United States Department of Energy, and is charged under 42 U.S.C. §7131 with administration of the Department of Energy. Defendant Herrington's office is at the Department of Energy's headquarters in Washington, D.C.

12. Defendant William A. Vaughan is sued in his official capacity as Assistant Secretary for Environment, Safety and Health. He is charged under 42 U.S.C. §7133(3) with responsibility for DOE's compliance with environmental laws, including RCRA. Defendant Vaughan's office is at the Department of Energy's headquarters in Washington, D.C.

13. Defendant U.S. Department of Energy is an executive department under 42 U.S.C. §7131, and is charged with responsibility for all operations at the Savannah River Plant.

STATEMENT OF CLAIMS

14. The Savannah River Plant ("SRP") is a nuclear weapons production facility operated by the Department of Energy. It is located near the center of one of the fastest-growing regions of the United States. The SRP is about 160 miles east of Atlanta, Ga.; about 90 miles southwest of Columbia, S.C.; about 140 miles southwest of Charlotte, N.C.; and about 20 miles southeast of Augusta, Ga. and south of Aiken, S.C.

15. The SRP is located on the northeast bank of the Savannah River, one of the major rivers of the southeastern United

States. The Savannah River downstream from SRP is a source of water for drinking and other domestic purposes for some 51,000 people in Beaufort and Jasper Counties in South Carolina. The Savannah River also provides water for a business-industrial complex near Savannah, Georgia that has an estimated consumer population of over 20,000. The fish in the river provide recreation for sport fishermen. The river is also used for boating and, near its mouth, for swimming and bathing.

16. The water table at SRP ranges from zero to 33 meters beneath the surface. The SRP sits atop the McBean, Congaree, and Tuscaloosa Aquifers, which are all sources of drinking water. The Tuscaloosa Aquifer is one of the largest and most relied upon freshwater reserves in the South Carolina-Georgia region.

17. The operation and maintenance of SRP produces vast quantities of hazardous chemical and radioactive wastes. These wastes include mercury, lead, sodium cyanide and a variety of solvents and pesticides. The Radioactive Waste Burial Grounds, for example, have received over ten tons of radioactive mercury and thousands of gallons of solvents.

18. At least 153 waste management units have been identified within the boundaries of SRP. The waste sites are located in over 100 separate areas around the plant and consist generally of basins, pits, and piles. Of the 153 separate waste management units, 118 contain only nonradioactive waste materials, and 20 have been used as disposal sites for only radioactive wastes. The nonradioactive waste units contain materials classified as solid waste, hazardous waste (as defined by state or federal

law), or a combination of both. Fifteen units have been used as disposal locations for both nonradioactive and radioactive wastes, referred to as "mixed" wastes when the wastes are both hazardous as defined by RCRA and also radioactive.

19. On December 19, 1979 DOE submitted a Notification of Hazardous Waste Activity to the South Carolina Department of Health and Environmental Control ("DHEC"). The Notification failed to include numerous SRP solid waste management units containing hazardous waste covered by RCRA and applicable regulations.

20. On September 29, 1980 DOE submitted a Hazardous Waste Facility Permit Application ("Part A Application") to DHEC. The Part A Application included as RCRA units the Intermediate Storage Facility for Hazardous Waste, the temporary hazardous waste storage facility at Building 710-U, and the seepage basins at 200-F and H Areas and 300-M Area. No other waste management units containing hazardous waste covered by RCRA were included.

21. On April 11, 1984 DHEC wrote to DOE noting the potential for serious groundwater contamination problems at the Radioactive Waste Burial Grounds (described as the "low-level burial grounds"). DHEC requested that the unit be treated as a hazardous waste facility.

22. In an October 26, 1984 letter, EPA (Region IV) requested DOE to provide information regarding waste sites at SRP to determine whether additional sites should be included as RCRA units in the Permit Applications and therefore be subject to RCRA groundwater monitoring requirements. In an Attachment to the

October 26 letter, EPA identified numerous waste management units which were required to be included in Permit Applications based on information supplied by DOE.

23. On January 4, 1985 DOE responded to EPA's October 26, 1984 RCRA compliance letter. DOE refused to add any other hazardous waste units to the Permit Application, as requested by EPA. DOE also refused to provide information about mixed waste units until regulations were promulgated regarding such wastes.

24. On February 6, 1985 DOE submitted a Revised Part A Application and a Draft Hazardous Waste Part B Permit Application ("Draft Part B Application"). The Revised Part A Application and Draft Part B Applications included as RCRA units the Container Storage Facilities at Buildings 710-D, 709-G, 709-2G, and 709-4G and the seepage basins at 200-F and H Areas and 300-M Area. No other waste management units containing hazardous waste covered by RCRA were included.

25. There are numerous tanks at SRP containing toxic chemicals used in SRP operations. Some of these tanks are located adjacent to the M-Area solid waste management unit. Since at least November 19, 1980, Defendants have allowed the leakage of toxic chemical products from such storage tanks. These hazardous wastes have contaminated or threaten to contaminate groundwater and surface water in the vicinity of SRP.

26. On June 26, 1985 the Natural Resources Defense Council, the Energy Research Foundation, the League of Women Voters of South Carolina and the Georgia Conservancy wrote to Defendant Herrington outlining DOE's unauthorized treatment, storage and

disposal of hazardous waste at SRP, and also the agency's inadequate groundwater monitoring and planning for closure and post-closure care. DOE responded to the letter on August 13, 1985 but did not specifically address the environmental organizations' allegations.

COUNT I

27. Plaintiffs reallege and incorporate by reference herein the allegations of paragraphs 1 through 26.

28. The Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §§6901, et seq., governs the generation, transportation, treatment, storage, and disposal of hazardous wastes. Regulations promulgated by EPA pursuant to RCRA establish standards for identification and listing of hazardous wastes, notification and recordkeeping by generators of hazardous wastes, transporter standards, standards for permitting hazardous waste facilities, and interim status standards to govern facility operation until final facility permits are issued. 40 C.F.R. Parts 260-267. South Carolina has promulgated almost identical regulations pursuant to the South Carolina Hazardous Waste Management Act, South Carolina Code of Laws, §§44-56-10 -- 44-56-140. South Carolina Hazardous Waste Management Regulations ("S.C.") R.61-79.124 -- 270. DHEC and EPA jointly administer the hazardous waste regulatory program applicable to SRP.

29. RCRA Section 6001, 42 U.S.C. §6961, makes each department, agency and instrumentality of the executive branch of the Federal Government subject to all of the requirements of RCRA, the So in

Carolina Hazardous Waste Management Act, and applicable regulations in the same manner, and to the same extent, as any person is subject to such requirements.

30. RCRA Section 3005, 42 U.S.C. §6925, requires that every owner or operator of an existing or proposed facility for the treatment, storage or disposal of hazardous waste which has received hazardous waste since November 19, 1980 have a permit issued pursuant to RCRA. RCRA Section 3005(e), 42 U.S.C. §6925(e), allows existing facilities to operate under "interim status" while its Permit Application is under review if the facility has complied with the requirements of Section 3010(a), 42 U.S.C. §6930(a), infra, and has made an application for a permit under Section 3005(b), 42 U.S.C. §6925(b), infra.

31. RCRA Section 3010(a), 42 U.S.C. §6930(a), requires that any person owning or operating a facility for the treatment, storage or disposal of hazardous waste as defined in 40 C.F.R. §§260.10 and 261.3, must file a Notification with the Administrator stating the location and general description of such activity and the identified or listed wastes handled by such person.

32. RCRA Section 3005(b), 42 U.S.C. §6925(b), requires that an application for a hazardous waste treatment, storage or disposal facility contain, at a minimum, information regarding:

(a) estimates with respect to the composition, quantities, and concentrations of any hazardous waste identified or listed under subtitle C of RCRA, or combinations of any such hazardous waste and any other solid waste, proposed to be

disposed of, treated, transported, or stored, and the time, frequency, or rate at which such waste is proposed to be disposed of, treated, or stored; and

(b) the site at which such hazardous waste or the products of treatment of such hazardous waste will be disposed of, treated, transported to, or stored.

Pursuant to 40 C.F.R §270.13 and S.C. R.61-79.270.13, the above information is to be included in the owner or operator's "Part A" Permit Application as required by 40 C.F.R. §270.10(e), (g) and S.C. R.61-79.270.10(e), (g).

33. Defendants have violated and continue to violate Section 3005(a), 42 U.S.C. Sections 6925(a), and 3010(a), 42 U.S.C. 6930(a), and the regulations implementing them, including, but not limited to, 40 C.F.R., Parts 124, 265, and 270, and S.C. R.61-79.124, 265, and 270 (1984 Cum. Supp.), by failing to identify and include in the Section 3005(a) Permit Application and/or the Section 3010(a) Notice, hazardous waste management activities as defined by RCRA and applicable regulations at the solid waste management units referred to by Defendants as:

- a. The Radioactive Waste Burial Grounds;
- b. The pipelines running from the M-area process buildings to the M-area natural seepage area, the overflow from the M-basin to the seepage area, the overflow from the seepage area to Lost Lake, and Lost Lake;
- c. New TNX Basin
- d. Savannah River Laboratory Seepage Basins
- e. Metallurgical Laboratory Basin

f. Acid/Caustic Basins

g. Other SRP solid waste management units.

COUNT II

34. Plaintiffs reallege and incorporate by reference herein the allegations of paragraphs 1 through 33.

35. An interim status facility which treats, stores, or disposes of hazardous waste after November 19, 1980 must do so in accordance with 40 C.F.R. Part 265 and applicable state regulations until there is a final administrative disposition of the facility's permit application. 40 C.F.R. 265.1, 270.73. 40 C.F.R. Part 265 and S.C. R.61-79.265 establish minimum standards for management of hazardous waste during interim status as provided for under RCRA Section 3005(e), 42 U.S.C. 6925(e).

36. 40 C.F.R. 265, Subpart F requires that by November 19, 1981 the owner or operator of a surface impoundment, landfill, or land treatment facility which is used to manage hazardous waste must implement a groundwater monitoring program in compliance with the requirements of Subpart F.

37. 40 C.F.R. 265, Subpart F requires, inter alia, that an owner or operator correctly locate and install a sufficient number of monitoring wells at a unit so as to detect immediately hazardous wastes which migrate to the uppermost aquifer. 40 C.F.R. 265.91. The owner or operator must collect and analyze samples from the monitoring wells in accordance with a groundwater sampling and analysis plan. 40 C.F.R. 265.92. If contamination of groundwater is found the owner or operator must

develop and implement a comprehensive groundwater quality assessment program. 40 C.F.R. 265.93.

38. Defendants have violated and continue to violate the groundwater monitoring requirements of 40 C.F.R. 265, Subpart F by failing, inter alia, to install monitoring wells, and develop and follow groundwater sampling and analysis plans and groundwater quality assessment programs at the solid waste management units referred to by Defendants as:

- a. The Radioactive Waste Burial Grounds;
- b. M-Area Settling Basin and the pipelines running from the M-area process buildings to the M-area natural seepage area, the overflow from the M-basin to the seepage area, the overflow from the seepage area to Lost Lake, and Lost Lake;
- c. New TNX Basin
- d. Savannah River Laboratory Seepage Basins
- e. Metallurgical Laboratory Basin
- f. Acid/Caustic Basins
- g. Other SRP solid waste management units.

COUNT III

39. Plaintiffs reallege and incorporate by reference herein the allegations of paragraphs 1 through 38.

40. 40 C.F.R. 265, Subpart G requires that owners and operators of all hazardous waste treatment, storage, and disposal facilities must have written closure plans which meet the requirements of Subpart G for each RCRA unit by May 19, 1981. In addition, disposal facilities must have written post-closure

plans which meet the requirements of Subpart G by the same date for each RCRA unit .

41. 40 C.F.R. 265, Subpart G requires, inter alia, that an owner or operator of a treatment, storage, or disposal facility develop a written closure plan that describes, inter alia, how a facility will be partially or finally closed. 40 C.F.R. 265.112. Subpart G also requires that the owner or operator of a disposal facility develop a written post-closure plan that describes, inter alia, the monitoring and maintenance activities which will be carried on after closure. 40 C.F.R. 265.118.

42. Defendants have violated and continue to violate the closure and post-closure requirements of 40 C.F.R. 265, Subpart G by failing to develop and/or developing inadequate closure and post-closure plans at the solid waste management units referred to by Defendants as:

- a. The Radioactive Waste Burial Grounds;
- b. M-Area Settling Basin and the pipelines running from the M-area process buildings to the M-area natural seepage area, the overflow from the M-basin to the seepage area, the overflow from the seepage area to Lost Lake, and Lost Lake;
- c. New TNX Basin
- d. Savannah River Laboratory Seepage Basins
- e. Metallurgical Laboratory Basin
- f. Acid/Caustic Basins
- g. Other SRP solid waste management units.

COUNT IV

43. Plaintiffs reallege and incorporate by reference herein the allegations of paragraphs 1 through 42.

44. 40 C.F.R. 261.33 provides that certain unused chemicals when "discarded" become RCRA hazardous wastes. The discarding of such chemicals includes leakage into the environment. 40 C.F.R. 261.2(c). Such leakage constitutes unauthorized disposal of hazardous wastes under RCRA Section 3005, 42 U.S.C. §6925, requires notification under RCRA Section 3010, 42 U.S.C. §6930, and requires installation of adequate groundwater monitoring under 40 C.F.R. 265, Subpart F.

45. Defendants have stored chemical products listed in 40 C.F.R. 261.33 in tanks adjacent to the M-Area and in other locations at SRP. Since at least November 19, 1980, such chemical products have leaked from one or more tanks into the environment, including groundwaters beneath SRP. Pursuant to RCRA Section 3005, 42 U.S.C. §6925, Defendants have engaged in unauthorized disposal of hazardous waste. Defendants have also failed to include information about such disposal activity in the Section 3010(a) Preliminary Notification. Defendants have also failed to install adequate groundwater monitoring as required by 40 C.F.R. 265, Subpart F.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs respectfully request that this Court:

A. Adjudge and declare that the Defendants have violated RCRA, the RCRA Regulations, and the S.C. Hazardous Waste Management Regulations as follows:

(1) By failing to identify and include in Notifications and Permit Applications, hazardous waste management activities at SRP waste management units specified in Count I and to be later identified,

(2) By failing to implement adequate groundwater monitoring at SRP waste management units specified in Count II and to be later identified,

(3) By failing to develop adequate closure and post-closure plans at SRP waste management units specified in Count III and to be later identified,

(4) By engaging in unauthorized disposal of hazardous wastes from chemical storage tanks.

B. Order the Defendants to comply immediately with all requirements of RCRA and applicable state and federal regulations;

C. For hazardous waste activities conducted since November 19, 1980 for which interim status is not obtained, order DOE to halt all such unauthorized disposal and remove contaminants resulting from such activity from the affected environment.

D. Assess penalties against the Defendants of up to \$25,000 for each day of each of the aforesaid violations as provided for under RCRA Section 3008(g), 42 U.S.C. Section 6928(g);

E. Award Plaintiffs their costs, disbursements, and reasonable attorney and expert witness fees pursuant to RCRA Section 7002(e), 42 U.S.C. §6972(e);

F. Grant Plaintiffs such other relief as this Court may deem just and proper.

Dan W. Reicher
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Attorneys for Plaintiffs

October 17, 1985.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing AMENDED COMPLAINT on opposing counsel by depositing a copy of same in the U.S. Mail, by using Certified Mail, Return Receipt Requested, in a properly addressed envelope with sufficient postage affixed thereto, as follows:

Honorable John S. Herrington

Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Honorable William A. Vaughan
Assistant Secretary for Environmental
Protection, Safety and
Environmental Preparedness
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Honorable Edwin Meese
U.S. Department of Energy
U.S. Attorney General
Tenth and Constitution Avenue
Washington, D.C. 20530

Honorable Vinton P. Lide
U.S. Department of Energy
United States Attorney
P.O. Box 2266
Columbia, SC 29202

this 17 day of October, 1985.

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APPENDIX F - SRP PROCESS DESCRIPTIONS

PRELIMINARY

APPENDIX F

PROCESS DESCRIPTIONS

The primary purpose of the Savannah River Plant (SRP) is to produce plutonium, tritium, and other special nuclear materials for use in the U.S. defense program. This objective is accomplished by several primary production facilities and numerous support facilities, laboratories, utilities, and waste management facilities. The primary production facilities include:

- o Fuel and Target Fabrication Facilities that supply materials to the site reactors
- o Five nuclear production reactors, two of which are shut down, that supply irradiated target and fuel assemblies to the Separations Plants and Tritium Production Facility
- o Two Chemical Separations Plants which recover plutonium -238 and 239, enriched and depleted uranium, neptunium and fission products from irradiated fuel and targets
- o The Tritium Production Facility which recovers tritium from irradiated target material.

Other production facilities include the Naval Reactor Fuel Material Facility (FMF), which produces material for naval reactor fuel elements from enriched uranium. Many of the process steps and some of the raw materials used in this process are classified, and the process will not be discussed in detail for this reason. Also located at SRP is the Plutonium Fuel Forms Facility (PUFF) which manufactures plutonium-heat sources for the space program. This facility is now on standby.

The site produced deuterium oxide (heavy water) from natural water by the hydrogen sulfide extraction process until 1981. The heavy-water plant has been permanently shut down and partially dismantled.

Each primary production facility and the major support facilities, laboratories, and waste management facilities are described in detail in this section. Operation of support facilities such as water supply systems, and steam plants and other fuel-burning equipment, with the exception of waste management facilities, is not discussed.

Fuel and Target Fabrication Facilities (300M-Area)

The Fuel and Target Fabrication Facilities consist of three process buildings and the Metallurgical Laboratory. Enriched uranium/aluminum alloy reactor fuel elements are produced in Building 321M. Aluminum-clad depleted uranium target elements are produced in Building 313M and lithium/aluminum alloy reactor control rods and targets are produced in Building 320M. This section was adapted from several documents, including Processes and Products of the Raw Materials Department (Du Pont, 1986b), the Operational Compliance Implementation Plan (Du Pont, 1985), and other documents provided by Du Pont.

321M - Reactor Fuel Fabrication

Enriched uranium from off-site suppliers and aluminum are melted in a furnace and cast into ingots. These ingots are machined into cores, which are assembled with aluminum components into billets. The aluminum components are cleaned in a vapor degreaser using trichloroethane, and cleaned with caustic (aluminux) and nitric acid prior to assembly. The use of phosphoric acid in this cleaning process has been discontinued. The assembled billets are extruded in an extrusion press into core logs, which are machined and inspected. The extruded and machined core logs and cleaned aluminum components are assembled into billets. The billets are preheated and lubricated with leaded oil before being extruded into tubes. The tubes are cut and then cleaned with trichloroethane, caustic, and nitric acid prior to cold drawing and final machining. After final inspection, the tubes are again cleaned with trichloroethane, caustic, and nitric acid prior to final assembly and shipment to the Reactor Areas.

313M - Slug (Depleted Uranium Target) Fabrication

Depleted uranium cores from off-site suppliers and aluminum components are prepared for assembly into slugs. The uranium cores are cleaned with caustic and nitric acid, and are plated with nickel. Aluminum components are etched and cleaned with caustic and nitric acid. The cores and aluminum components are assembled into slugs by inserting the core into an aluminum can and applying a cap. The slugs are then lubricated and preheated prior to sizing and aluminum/uranium bonding in the press die. The sized slugs are quenched in water and deflashed using a cutoff saw. The ends of the slugs are then bonded to the uranium with heat and pressure, after which the slugs are cleaned in a shell-blaster using crushed walnut shells. The slugs are then machined and inspected before a final etching with nitric acid. The finished slugs are placed in an autoclave for final testing. Defective slugs may be destroyed in this test by reaction of the uranium and high-pressure steam. Finished slugs are shipped to the Reactor Areas.

Another 313M-Building activity is uranium recovery. Reject slugs are taken to the recovery room for processing. Caustic, nitric acid, and rinse tanks are used in the recovery of uranium cores from slugs. Another recovery room process is recovery of dissolved uranium from process solutions. The recovery includes a reaction of the acid solution in a tank with caustic to precipitate the uranium, pumping from the tank to the rotary filter, and separation of the uranium by the rotary filter. Uranium is also recovered from uranium oxide produced when slugs fail in the autoclave. This recovery is accomplished by use of a filter press.

320 - Control Rod/Target Tube Fabrication

Lithium/aluminum alloy is produced in an air-melt furnace. The alloy is cast into billets, which are machined and extruded in a high-temperature extrusion press into either alloy bars or logs. These are cut into sections prior to further processing. Alloy bars are made into control rods; logs are fabricated into target tubes. Alloy bars are straightened and cut into pins that are placed in an aluminum sheath. This assembly is machined to form a control rod. After the ends of the control rod are welded and tested, the rods are inspected prior to shipment to the Reactor Areas.

Alloy logs are cut into sections and machined. These are assembled into billets and further fabricated into target tubes in the 321M-Building. The tubes are returned to the 320M-Building for end-welding, final machining, and inspection prior to shipment.

The fabrication of aluminum control rod housings begins with preparation for extrusion. Aluminum ingots are purchased, and as with the prepared alloy billets, they are cut and machined. Then the preheated aluminum billets are extruded into housing tubes. This extrusion is performed with the same extrusion press as was used for alloy bars and logs, but the press is fitted with different dies. The extruded housings are cut to length and sent to the 321M-Building for further processing. After processing, the housings are returned to 320M to undergo final machining. They are then subjected to hydrostatic testing. After this testing, end fittings are attached the housings receive a final inspection prior to shipping.

Acceptable scrap from the fabrication processes is reclaimed by melting in the open-air furnace and casting into billets. Resultant aluminum billets are cut and machined to specification and delivered to the 321M-Building. Resultant lithium-aluminum billets are extruded into bars, cut, tested for lithium content, and recycled within the 320M Building.

There is a cleaning room similar to that found in 313M consisting of a trichloroethane vapor degreaser and nitric acid and caustic tanks. However, the 320M tanks are considerably longer than those in 313M to accommodate the length of the tubes and housings.

322M Waste Filtration System

Wastewater Treatment Facilities treat process rinsewaters and concentrated chemicals used in the fabrication of reactor components in M-Area. Filtration of a portion of the 322M Metallurgical Laboratory effluent ensures removal of uranium metal particles from wastewater. Depleted uranium slurry generated by cutting and grinding operations is filtered in a filter press housed in the 340M-Building. A sintered metal filter in 322M ensures removal of metal enriched in fissile uranium-235.

On a monthly basis, about 300 gallons of uranium slurry consisting of uranium and aluminum fines, water, and an organic colloid is pumped to the filtrate feed tank in 340-M and through the filter to the filtrate collection tank. Filtered water and coolant are pumped to the Chemical Transfer Facility (CTF) in Building 313M. Fifty gallons of filtrate without colloid from Building 322M enriched uranium processing facilities is routed to the Dilute Effluent Treatment Facility (DETF) each month. A turbidity meter monitors the effluent to stop flow and alarm on filter breakthrough.

313M - Chemical Transfer Facility (CTF)

The CTF is a collection/treatment system for chemical wastes from the 300M-Area Fuel and Target Fabrication Facilities, and is located in the 313M - (slug fabrication) Building.

Rinsewater from the first pre-etch rinse, post-etch rinse, core recovery caustic and nitric rinses, and the autoclave basket and final slug cleaning rinses are fed to an equalization tank. This solution is then pumped to the rinsewater evaporator. The evaporator overheads are condensed and pumped to the DETF. The evaporator concentrates the rinse streams to produce a bottoms stream, which is pumped to the nitric acid storage tank for subsequent neutralization.

The condensate and flushing streams from the autoclave slug-testing operation contain low amounts of insoluble uranium dioxide (UO_2) which forms when an aluminum-jacketed slug fails. The steam condensate, cooling water flushes, and occasional slug failure flushwater are pumped to a flow equalization tank. The tank is agitated to maintain the UO_2 in suspension. The UO_2 suspension is pumped from the flow-equalization tank through an in-line mixer into which the diatomaceous earth mixed with process water is injected at a ratio of approximately 1 g/g UO_2 . Diatomaceous earth assists in filtering the UO_2 .

The mixed UO_2 /filter aid stream is then pumped to an automatic pressure filter (APF). On-line turbidity meters are used for detection of filter breakthrough. Two automatic air backwash polishing filters using sintered metal media are used to remove trace uranium in the filtrate. The polishing filters are sized to retain UO_2 .

during a breakthrough of the automatic filter press filter media. The sludge cake from the APF, as well as the backwash from the polishing filters, is transferred to the nitric acid waste receipt tank for subsequent neutralization. Filtrate from the filters is pumped to the Filtrate Hold Tank in the DETF.

Spent caustic, nitric acid, and nickel solutions are discharged to the neutralization system. The waste streams are segregated, with the exception of the nickel solution and nitric acid. Also, the evaporator bottoms, autoclave pressure filter sludge, and polishing filter backwash are transferred to the nitric acid storage tank. The waste solutions in the nitric acid storage tank contain uranyl nitrate.

Batch caustic solutions are transferred to the Neutralization Tank; then acid is slowly added until pH 11 is reached. After reaching pH 11, the slurry is transferred to the CTF Slurry Storage Tank, where it is combined with the sludge from the DETF.

341M Dilute Effluent Treatment Facility (DETF)

The DETF treats liquid wastes from 300M-Area Fuel and Target Fabrication and Chemical Waste Treatment processes. The DETF receives influent flows from 313M, 320M, 321M, 322M-Laboratory, and from the 313M nitric acid fume scrubbers, and receives the CTF dilute uranium rinsewater evaporator overheads. Influent wastewater concentration variations to the DETF are equalized in two agitated tanks each with 24-hour storage capacity. While dilute wastewater is accumulating in one tank, a batch in the other tank is treated for metals precipitation, then flocculated and filtered.

The solution pH is adjusted with caustic or sulfuric acid to optimize the precipitation of metal hydroxides. After pH adjustment, the treated wastewater is fed to a flocculation tank where polyelectrolyte may be added to aid filtration. Following flocculation, the wastewater is pumped from the tank through an automated pressure filter. The filter feed is mixed with diatomaceous earth at approximately 2-to-1 weight ratio with precipitated solids. On-line analyzers monitor turbidity and pH of the filtrate and automatically recycle or stop flow if limits are exceeded. Dewatered filter cake is transferred to the Slurry Storage

Tank in the CTF.

Filtrate from the pressure filter will be pumped to one of three Filtrate Hold Tanks. Each tank is capable of holding 24 hours of discharge and is provided as hold or diversion tanks where the DETF effluent and CTF autoclave filtrate may be held and analyzed for NPDES permit compliance prior to discharge. Piping is provided to recirculate the contents to the DETF for reprocessing if necessary.

Reactor Facilities (100K, 100L, and 100P)

The Savannah River Plant has three operating reactors, located in 100K-, 100L-, and 100P-Areas. Two other reactors, in 100C- and 100R-Areas, are shut down. R-Reactor has been partially disassembled, and will probably never be restarted. C-Reactor is shut down for an indefinite period.

The reactors irradiate depleted uranium and lithium/aluminum target assemblies to produce plutonium-239 and tritium, respectively. Reactor fuel rods, target assemblies, and control rods are manufactured in 300M-Area. Major reactor systems and components are described in the following sections, adapted from the L-Reactor Environmental Impact Statement (DOE, 1984).

Reactor Vessel and Reactor Lattice

The L-Reactor vessel is a cylinder about 4.5 meters high and 5 meters in diameter made of 1/2-inch Type 304 stainless steel plate. Primary coolant enters through six nozzles at the top of the reactor into a plenum, flows down coolant channels in the fuel and target assemblies, and discharges into the bulk moderator. The coolant leaves through six nozzles at the bottom of the reactor vessel. A gas plenum and top radiation shield are located under the inlet water plenum. Under the reactor vessel, a radiation shield containing 600 monitor pins provides flow and temperature monitoring for each fuel and target position.

The reactor contains positions for 600 fuel and target assemblies; other principal positions in the reactor lattice are used for control rod housings, spargers, and gas port pressure-relief tubes. In addition to the downflow coolant for the fuel and

target, upflow coolant is provided for the control assemblies and for the bulk moderator. Neutron flux in the reactor is controlled by neutron-absorbing rods in 61 positions; each position contains seven individually motor-driven control rods.

Primary Coolant System

Heavy water (D_2O) serves as both a neutron moderator and primary coolant to remove heat from the nuclear fission process. The heavy water is circulated through the reactor by six parallel pumping systems. In each system, about 1,600 L/sec are pumped from one of six outlet nozzles at the bottom of the reactor, through two parallel heat exchangers, and into one of six inlet nozzles in the water plenum above the reactor. The L-Reactor produces no electric power, which allows it to operate without the high temperatures and pressures needed in power reactors.

Limits on pD (the heavy-water equivalent of pH), conductivity, and impurity levels of the heavy water are maintained to control the corrosion of aluminum and stainless steel and to reduce the decomposition of the heavy water. Nitric acid is added to the heavy water through a pump suction line to maintain a heavy-water pD of about 5.2. Because some of the acid is neutralized as the process water flows through the purification deionizers (causing the pD to increase), periodic injections of nitric acid are necessary.

Secondary Coolant System

Each of the six heavy-water pumping systems contains two parallel, single-pass heat exchangers to transfer heat from the heavy water (primary coolant) to secondary cooling water. The secondary water is either drawn from the Savannah River (K- and L-Reactors) and Par Pond (P-Reactor) and discharged to L-Lake (L-Reactor), Steel Creek (K-Reactor), or Par Pond (P-Reactor), from which it flows back to the Savannah River. Water is taken from the Savannah River at two pumphouses and delivered to the K- and L-Area cooling-water reservoirs (186-Basins) with flows at approximately $11 \text{ }^3/\text{sec}$. An alternate tie-line provides an emergency supply of cooling water from the river to the reservoir if the primary line from the river fails. Some activity is transferred to the secondary coolant and

subsequently to surface water discharges (L-Lake, Par Pond, and Steel Creek).

Core Reloading

New fuel is received and stored in the reactor assembly area. Racks and hangers maintain adequate spacing for criticality control; an additional safety margin for assemblies containing fuel is provided by storage in racks constructed of material that contains boron, a neutron absorber. The equipment for core reloading includes an inlet conveyor, a charge machine, a discharge machine, and a deposit-and-exit conveyor. The charge and discharge machines are similar, and each can perform most of the functions of the other; however, only the discharge machine can provide heavy- or light-water cooling to an irradiated assembly. Both machines travel on tracks on two parallel ledges that are part of the reactor-room wall; power for their operation is provided through cables along the ledges. Reloading operations are conducted from a control room adjacent to the reactor control room. The charge and discharge machines can be operated manually or automatically.

Fuel Discharge and Storage

Fuel and target assemblies are discharged from the reactor by the discharge machine. Four sources of water are available on the discharge machine to cool an assembly during the discharge operation--primary D_2O , primary H_2O , secondary D_2O , and secondary H_2O . The primary and secondary sources supply water through different paths to the assembly. Cooling starts automatically when an irradiated assembly is completely withdrawn from the reactor; it can also be maintained if an assembly sticks during withdrawal.

The deposit-and-exit conveyor, located in a water-filled canal connecting the reactor room and the disassembly basin, receives an assembly from the discharge machine and carries it under the reactor room wall to a water-filled disassembly basin for temporary storage.

Irradiated assemblies are stored in the disassembly basin to allow radionuclides and heat to decay to a level low enough for shipment to the Separations Facilities. The

assemblies are cooled by natural convection; hangers allow this cooling while maintaining adequate spacing for criticality control. The basin water also provides shielding of radiation from the assemblies.

Blanket-Gas System

The blanket-gas system, which uses helium (an inert gas), is the initial barrier to the release of radioactive gases from the reactor. This system has three primary functions: (1) to dilute deuterium and oxygen evolved from the moderator (due to radiolysis) to a nonflammable concentration; (2) to recombine the deuterium and oxygen constituents of the gases evolved to heavy water; and (3) to maintain the pressure in the moderator (pressurize the gas plenum of the reactor to about 5 psig). Helium is used as the blanket gas because it neither reacts with moderator decomposition products nor absorbs neutrons to produce radioactive gases.

During operation, gases evolve from the reactor and enter the gas plenum. From the plenum, the gases are routed to catalytic recombiners and spray separators where the deuterium and oxygen are recombined and most of the entrained heavy water is removed from the helium and returned to the reactor. The helium is then returned to the gas plenum.

Activity-Confinement System

During reactor operation, the process areas are maintained at a pressure lower than the pressure of the external atmosphere to ensure that all air from the process areas is exhausted through the activity-confinement system. The air from these areas is exhausted through a set of confinement filters before it is released to the 200-foot stack.

Three large centrifugal fans exhaust the air from the process areas. Two of these fans normally are online, but only one is necessary to maintain the negative pressure. Exhaust filters remove moisture, particulates, and halogens. The filter banks are enclosed in five separate compartments, three to five of which are online during operation. Each compartment can be isolated for maintenance and/or testing; each contains filter banks, in the following order of air-flow treatment:

1. Moisture separators -- designed to remove about 99 percent of entrained water (spherical particles measuring 1 to 5 microns) to protect against significant blinding of the particulate filters.
2. Particulate filters -- designed to retain more than 99 percent of all particulates with diameters of 0.3 micron or larger.
3. Activated carbon beds -- impregnated carbon designed to retain halogen activity.

Liquid Radwaste System

The chemical purity of the moderator is maintained to minimize heavy-water radiolysis, to minimize the corrosion rate of aluminum and stainless steel in the reactor, and to maintain the efficiency of the moderator. The neutron activation of moderator impurities and corrosion products, along with any fission products released by fuel failures, contributes to the overall activity level in the moderator.

The moderator is continuously purified by circulation of a sidestream to a purification area to be deionized and filtered. Most of this sidestream is returned to the reactor; a small amount is distilled to remove light water (H_2O). The purification system circulates the moderator through a pre-filter, a deionizer, and an after-filter. The deionizer contains deuterized cation and anion exchange resin. The filters retain particles larger than 10 microns in diameter.

Radioactive impurities are concentrated in disposable filter and deionizer units. Vessels containing spent deionizer are processed to recover deuterium oxide. After processing, these vessels are sent to the Burial Ground for disposal.

An evaporator system removes particulate matter from the deuterium oxide from the distillation column reboiler purge. No facilities are currently available to remove tritium from the reactor moderator. When the deuterium oxide distillation columns are emptied for maintenance or repair, the water is either collected in a tank to be reused or drummed to be reworked at the Heavy-Water Rework Facility (420D).

Target and spent-fuel assemblies removed from the reactor are rinsed in the discharge machine. The rinsewater is collected by the discharge machine-water pan and sent to the rinse collection tank. Rinsewater is drummed and reworked.

Some radioactivity is transferred from the irradiated assemblies to the water in the disassembly basin, even after rinsing of the assemblies. Basin water is purged periodically to reduce the radiation exposure to operation personnel from the accumulation of tritium. During the purging operation, water from the basin is passed through two deionizer beds in series, and monitored before it is discharged to a seepage basin. The deionizers reduce the release of any radioactivity other than tritium to the seepage basin. The spent resin from the deionizer beds is regenerated at the Receiving Basin for Off-Site Fuels (244H) facility, and the spent regenerant is concentrated and stored in the High-Level Radioactive Waste Tanks (241F and 241H).

Two sand filters maintain the clarity of the disassembly-basin water. Particulate matter in the basin water tends to agglomerate and adsorb radioisotopes. When the basin water passes through the sand filters, the particulate burden is reduced. The filtration rate can vary depending on the initial fluid clarity and the demand for treatment. When the differential pressure across the filter beds indicates the need, a filter can be isolated and backflushed. Backflushed radioactive material is transferred to the Chemical Separations Area for concentration and storage in the High-Level Radioactive Waste Tanks.

Separations Facilities (200F-Area and 200H-Area)

The chemical processes in the 200F- and 200H-Areas (Buildings 221F and 221H and associated facilities) involve dissolving irradiated reactor fuel and target assemblies in nitric acid, and subsequently separating uranium, plutonium, and neptunium isotopes from fission products and waste materials through a multistep organic/aqueous extraction process. The F- and H-Area processes are similar with respect to the process equipment used, but have important differences in the isotopes processed. The F-Area process handles depleted uranium target elements while the H-Area process separates enriched uranium fuel elements into isotopes. Mercuric nitrate is used in the H-Area dissolution process as a catalyst for the

dissolution reaction. No catalyst is required in the F-Area two-step dissolution process. F-Area has an additional process step to recover depleted uranium as uranium oxide (UO_3). This process is referred to as denitration and takes place in A-Line, outside the 221F-Building. The Purex Separations Process is described in detail in The Purex Process (Starks, 1977), and much of the following discussion was adapted from that document. Additional information on H-Area operations and waste management/disposal facilities was adapted from the Operational Compliance Implementation Plan (Du Pont, 1985).

F-Area

The F-Area separations process feed rate is on the order of 10 metric tons per day of depleted uranium target elements. This material is dissolved in a two-step batch process. The first step, using caustic, dissolves the aluminum cladding, and the second step, using nitric acid, dissolves the irradiated uranium. The cladding waste solution is piped to the 241F Tank Farm, and the fumes from the first dissolution step (containing ammonia) are vented to a 200-foot vent pipe. Nitric acid fumes from the second dissolution step are vented to a silver nitrate reactor to remove radioiodines, and to an acid recovery unit (ARU) that produces 50 percent nitric acid, which is recycled back into the process. The product of the dissolution process is an aqueous uranyl nitrate solution, which is further processed in the 221F-Building.

Uranium-238 and plutonium-239 in the aqueous uranyl nitrate solution are separated from fission products and other isotopes by a multi-step extraction process. A mixture of 30 percent tributyl phosphate and 70 percent normal paraffin hydrocarbon (similar to kerosene) is used as the organic extractant. The first solvent extraction cycle produces an aqueous waste stream containing fission products, an aqueous stream containing plutonium-239, an aqueous stream containing uranium-238, and a contaminated organic stream. The aqueous fission product stream is piped to the 241F Tank Farm, and the organic stream is recycled to the solvent-washing process. The aqueous plutonium-239 and uranium-238 solutions are further processed in the second plutonium and second uranium extraction cycles, respectively.

The second plutonium extraction cycle further purifies the aqueous plutonium solution, and produces an aqueous waste stream and an organic stream. The aqueous stream is concentrated in the low-activity waste evaporator, and the organic stream is recycled to the solvent washing process. The plutonium solution is piped to the plutonium finishing process (FB-Line) which produces plutonium metal or plutonium oxide (PuO_2) in a glove-box operation.

The second uranium extraction cycle further purifies the aqueous uranyl nitrate solution, and also produces an aqueous waste stream and an organic stream. The uranium solution is piped to A-Line, where it is converted to uranium oxide by denitration. The aqueous waste stream is piped to the 241F Tank Farm, and the organic stream is recycled.

In the A-Line denitration process, the uranyl nitrate solution is concentrated by evaporation. Calciners are used to convert the solution into a molten salt with a specific gravity of approximately 3.0. This material is denitrified by further heating and agitation, and then degassed to drive off the resulting NO^x , which is vented to the acid recovery unit. Finally, the molten material is allowed to solidify, followed by crushing to a powder and packaging in drums. Fifteen to eighteen drums/day of UO_3 are generated.

H-Area

The 221-H Canyon Building is structurally very similar to the 221-F Canyon Building and originally was operated as a Purex solvent extraction facility. It was modified in 1959, and since then it has been devoted primarily to recovery of enriched uranium from SRP reactor fuel. Further modifications to the canyon added a small dissolver and ion exchange equipment for the recovery of plutonium-238 from irradiated neptunium. An electrolytic dissolver was installed for the handling of fuels clad with stainless steel or zirconium. Special processing programs have included recovery of thorium, uranium-233, and various mixtures of plutonium isotopes.

The solvent extraction operations are similar to those of the Purex system, with modifications in the chemical processes required by differences in the fuels. The

standard enriched uranium fuel element is a uranium-aluminum alloy, clad in aluminum, and the whole fuel piece is dissolved in nitric acid catalyzed by mercuric nitrate, without a separate decladding step. As in F-Area, the off-gases go through a silver nitrate reactor to reduce iodine emissions and then through an ARU. Recovered acid is not used in the H-Area process. The dissolved fuel is clarified, and the adjusted solution is fed to the solvent extraction system. Uranium and neptunium are extracted from the fission products and separated from each other in the first cycle; then each goes through two separate cycles of solvent extraction for further purification. The uranium product solution is not concentrated further, but is transferred out of the building, loaded into tank trucks, and sent off the site for further processing. The neptunium product solution is transferred to a separate area in the building for subsequent purification.

F- and H-Area Waste Treatment/Disposal

High-activity cladding waste streams from the F-Area-separations process are piped to the F- and H-Area tank farms for storage and treatment by evaporation. High-activity wastes other than cladding waste and low-activity wastes from both the areas are evaporated in Separation Area process units. The concentrates from these evaporators are piped to the F-and H-Area Tank Farms. The overheads (condensate) are piped to acid recovery evaporator units. Recovered concentrated acid is reused in the F-Area process. Overheads from the acid recovery evaporator units are disposed of in seepage basins. Spent solvent from both processes is incinerated.

Nitric acid is also recovered in the fume scrubbers (ARU) in F- and H-Areas. The ARUs recirculate concentrated nitric acid countercurrently to the dissolver and denitrator offgases to remove nitric acid fumes. The exhaust gases from the fume scrubbers are vented through sand filters that remove particulates, and to the process stacks. The waste tank farms and evaporators are separately described in this section.

Tritium Facility (232H/234H)

The information in this section was compiled primarily from the Tritium Facility Summary (Havron, 1983). Tritium is produced in the reactors by irradiation of targets containing lithium-6, which absorbs a neutron and decays to tritium (^3H) and helium (^4He). Irradiated targets are melted in an inert-gas shrouded electric furnace in the 232H-Building, which releases the tritium and other hydrogen isotopes, along with inert gases (helium, argon, nitrogen), into the process. Hydrogen isotopes are separated from the inert gases in a palladium-coil diffuser. Hot palladium is a catalyst for hydrogen, and all hydrogen isotopes which contact the coil wall dissociate from the combined form, a molecule composed of two atoms, to the individual atom (nascent) form; for example, H_2 becomes $\text{H}+\text{H}$; HD becomes $\text{H}+\text{D}$. In the individual atomic form, the hydrogen diffuses through the walls of the palladium coil into the outer shell of the diffuser. Other gases' structures are heavier and larger and will not diffuse through the palladium.

The hydrogen gases, which diffuse through the coil into the shell, are pumped to collection tanks and processed through thermal diffusion columns or the cryogenic distillation systems, depending on isotopic composition.

The thermal diffusion column is encased in a 3-inch-diameter cooling water jacket. There is a molybdenum rod from top to bottom, exactly centered inside the column. A mixture of isotopes of hydrogen gases are continuously fed to the column at a point just above center. Thermal diffusion causes the lighter molecules to collect near the hot wire, while the heavier ones stay near the cold wall. Thermal siphoning causes the hotter gas in the center to rise while the cold gas at the wall sinks. This continuous streaming of the gas, together with the influence of thermal diffusion, results in a concentration of the heavier isotopic species at the bottom of the column, while the lighter isotopes concentrate at the top. Separation factors of the order of 10^3 are achieved.

There are two cryogenic distillation systems at the Tritium Production Facility, each consisting of a double-vacuum enclosed column, two helium compressors, a helium refrigerator, a feed preparation system, and pumps and hold tanks for feeding and removing gases. The two systems operate independently, but have piping connections that permit use of either pump system with any tanks.

The purpose of the cryogenic systems is to fractionally distill the various isotopes of hydrogen which are homogeneously condensed during a feed cycle. Each isotope has a different condensation point and, therefore, a different boiling point. The higher masses condense at lower (colder) temperatures, and conversely the heavier isotopes at higher.

Heat is applied to the reboiler section at the bottom of the distillation column. The heat boils the hydrogen isotopes, which rise into the column. The heavier isotopes condense in the column and fall back into the reboiler section. The lighter isotopes rise to the top of the column where they are condensed and removed. The light hydrogen is separated from the tritium by this process.

Zeolite (Z)-beds are used in the process to trap waters. In the stripper system the Z-beds are downstream of catalyst beds that help in the intentional formation of waters. In other process locations, the Z-beds adsorb waters that may be present in the gases being processed.

Water molecules adsorb upon the surface of the zeolite. When heated in the recovery system furnace, the zeolite swells and the waters release. Gases flow through a Z-bed from top to bottom while it is in the process sites and is adsorbing. During the regeneration cycle in the recovery system, the flow is reversed; regenerant gas enters the bottom of the bed and exits above the zeolite charge. The regenerant gas is a dry gas; either argon or dried, desorbed Z-bed gas.

Magnesium beds are used to decompose water to hydrogen and oxygen. The magnesium bed is operated at about 500°C. Water contacting the magnesium is decomposed by releasing its oxygen molecule to magnesium, forming MgO^2 , and liberating the hydrogen isotope as a dry gas. As water is decomposed the metallic magnesium is consumed and the bed becomes depleted. Each bed can reduce (react) about 3-1/2 liters of liquid (about 4200 liters of gas). Depleted beds are expendable. They are used once and buried, unlike Z-beds, which may be regenerated.

Uranium (U)-beds, are also used to decompose water. They are located in the furnace extraction line before the in-line Z-bed and the diffuser. The primary

difference in the magnesium and uranium bed is that each magnesium atom can combine with only two oxygen atoms, while uranium can combine with up to eight. U-beds are also buried when depleted.

Catalyst (CA) beds are used in the stripper system. Free oxygen is available in abundance within the cupric oxide with which the bed is charged. As waste gases flow through the CA bed any hydrogen isotope that may be present in the waste gas combines with the free oxygen to form water, which is then sorbed upon zeolite in beds located downstream of the CA bed.

CA beds are regenerated by passing air through them in a metered flow. Normally enough air is present in routine furnace evacuations to keep the oxygen supply adequate without special air treatment.

Z-beds that have been used in the process have waters sorbed upon the zeolite. There are two furnaces and a magnesium bed for desorbing the beds and returning them to process service. The furnaces have electrically heated calrods around a space into which the Z-bed is inserted. When heated, the zeolite will swell and the sorbed molecules of water are released. The vapor pressure of water is much higher at increased temperatures, so both these characteristics contribute to the desorption process.

When the water is released from the zeolite, it must be moved out of the Z-bed through piping to the magnesium bed. The movement is accomplished with dry gas from the outlet of the magnesium bed. A pump takes suction from the magnesium bed outlet and discharges the dry gas into the bottom of the heated Z-bed. The dry gas flows upward through the zeolite and exits the top of the Z-bed.

234H

Tritium and deuterium are mixed to specified concentrations and then compressed into small containers called reservoirs. After a number of years, the reservoirs are returned and unloaded. The helium resulting from tritium decay is separated from the tritium by processing through a diffuser.

The process is described under five headings as follows:

- o Receiving and Mixing
- o Loading
- o Finishing
- o Reservoir Unloading
- o Waste Gas Handling.

Receiving and Mixing

T-2 and D-2 are received from the tritium extraction facilities and put into hold tanks. T-2/D-2 mixtures are supplied through jacketed product transfer lines or from product containers that are unloaded into hold tanks. The receiving and transferring pumping system is used to transfer T-2 to a tank where pressure, volume, temperature measurements, and analysis of the gas in the mix tank are recorded.

D-2 from hold tanks or recycled from returned reservoirs is transferred to a mix tank for the desired mixture of D-2/T-2. The mixture of D-2/T-2 is then opened to a process compressor which transfers it to the loading manifolds.

Loading

The loading operation involves compression of D-2/T-2 mixtures, pure D-2, or pure inert gas into reservoirs.

Reservoirs are connected to a loading manifold. The connection is leak-tested with a trace of tritium in argon. Following the argon leak test, the system is evacuated. The D-2/T-2 mixture in the mix tank is then passed through a Z-bed to remove moisture before it is passed through a compressor.

During this loading operation, a sample of the compressed gas is taken from the manifold for mass spectrometer analysis. Each filled reservoir is then valved off and sealed by pinch welding.

Each manifold is let down to the unloading and reprocessing system or to a mix tank and then evacuated. The rate of pressure rise is measured to detect any leakage through pinch welds. The vacuum is then broken with argon, and the reservoirs are disconnected.

Finishing

Sealed reservoirs are sent by conveyor from the loading cabinets to the finishing line. These reservoirs are then transported through the finishing line where they are surveyed and inspected.

Reservoir Unloading

Reservoir unloading stations discharge reservoir contents into the process for gas reprocessing. The reservoir opening mechanism consists of a pneumatically or electrically operated cutter rod. The rod shears off the fill tube pinch weld. The escaping reservoir gas is expanded into a hold tank for reprocessing. This operation is performed in a bell jar for secondary containment. If, for some reason, the reservoir opening mechanism fails, a pneumatically actuated drill can be used to drill into the reservoir.

Gas from the unloaded reservoir is passed through a hot palladium diffuser. Hydrogen isotopes diffuse through the palladium and are then transferred to the mix tanks for reuse in receiving and mixing or reprocessed for enrichment of the tritium.

Waste Gas Handling

Process waste gas is passed through a hot catalyst bed, which oxidizes hydrogen isotopes to water vapor. The water vapor formed is then adsorbed on a zeolite bed downstream. Z-beds are periodically desorbed.

When the catalyst beds lose their oxidizing capacity, as indicated by increased stack losses through the stripping system, the beds are replaced or regenerated by purging them with atmospheric air at specified temperatures, pressures, and flow

rates.

Waste gas is sent to one of the stack tanks from:

- o Flush gas used before lines are broken for maintenance
- o Argon leak-check gas
- o Evacuated air before loading or unloading.

The stack tanks are normally operated at 1 atmosphere. The intent is to stack only the minimum quantities of tritium to the atmosphere. SR and Du Pont management are notified when the amount of tritium released in one day exceeds 10,000 curies.

238-H

Some reservoirs returned to SRP from the field and some reservoirs rejected in the loading process are reclaimed in Building 238H. The process includes removing the used tube from the fill end of reservoirs previously unloaded, machining a counterbore in the reservoir tops, and welding new fill tubes into the counterbores. The reservoirs are then pressure-tested, leak-checked, internally purged with nitrogen, externally decontaminated, weighed, inspected, and returned to Building 234H for reuse.

Waste Management Tank Farms and Evaporators (241/2F and 241/2H)

The storage and treatment of high-level wastes (HLW) from the process facilities occurs in the waste management areas of the 200F- and 200H-Areas. These areas contain a total of 51 underground waste storage tanks (USTs) in two farms (241F and 241H), located in F- and H-Areas, respectively. Each tank farm area contains two evaporators (242F, 241-16F and 242H, 242-16H, respectively). There are four basic types (I, II, III, IV) of HLW storage tanks. All tanks except eight uncooled type IV tanks have an annular area between the steel tank and concrete vault which is ventilated. There are 22 tanks in F-Area and 29 tanks in H-Area, all of which are used to receive and/or process HLW.

HLW is placed into double-walled tanks equipped with cooling coils, and is aged for 1 to 2 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 is transferred to continuous evaporators. There are two evaporators in each area, which concentrate the liquid waste by evaporation of water using heat which is supplied by low-pressure steam. The liquid is pumped into the evaporator vessel from a feed tank, and is recirculated through a reboiler where heat is applied. The water vapor generated is drawn from the evaporator vessel and recovered by a series of mist de-entrainers and water-cooled condensers. The condenser exhausts to the main vessel vent and through high-efficiency particulate air (HEPA) filters to the atmosphere. The evaporator building ventilation system is exhausted through a separate HEPA filter unit to a stack.

The condensate from the evaporator is passed through an ion exchange column to remove the entrained cesium, and is then discharged to the seepage basins. The concentrate from the evaporator is transferred to a cooled waste tank where the suspended salts settle. The supernate remaining after crystallization is then returned to the evaporator. This process continues until essentially all the liquid has been converted to a crystallized salt cake.

The tank farm system also includes interarea waste transfer lines, which enable the transfer of wastes between F- and H-Areas. The lines are constructed of 3-inch 304L stainless steel, each of which is encased in a 4-inch carbon steel jacket. The lines are approximately 2 miles long and slope downward toward each area from a high point approximately midway between the two areas.

The contents of the HLW tanks will eventually be processed in both the proposed Defense Waste Processing Facility (DWPF), which will generate a vitrified-waste form for disposal at an off-site Federal repository; and the proposed Saltstone Facility, which will generate a solid-waste form for on-site disposal.

Beta/Gamma Radioactive Waste Incinerator (230H)

The Beta/Gamma Incinerator (BGI) is a dual-chamber controlled air incinerator that burns low-level liquid and solid radioactive waste. The solid waste burned includes paper, plastic, wood, and other box-type wastes. Liquid wastes include spent solvent from the separations process (kerosene/tributyl phosphate) and waste oil, which is used as an auxiliary fuel when solid wastes are being burned. Most of the stockpiled spent solvent from the separation processes (about 140,000 gallons) has been incinerated. Diesel fuel is used as an auxiliary fuel and for start-up. There is an auxiliary fuel burner in each of the two incinerator combustion chambers. Liquids are fed into the incinerator through atomizers, and solids are fed through a ram-feeder.

The BGI is controlled by temperature monitors and automatic burner controls to maintain the desired air/fuel ratio and temperature in each chamber. The normal operating temperature range is 850°F to 1100°F. The rated capacity of the incinerator is 300 lb/hr of liquid waste or 400 lb/hr of solid waste. The State operating permit for the BGI limits the feed rate to 400 lb/hr of boxed solid waste, which may contain up to 10 percent plastics, and also allows the burning of polyvinyl chlorides (PVCs), rubber, and spent solvent. Burning of PVCs is generally avoided to minimize corrosion. Waste oil containing less than 0.05 mCi/ml of tritium is also burned in the incinerator. Oil with higher tritium content is not presently burned, but may be burned after the installation of a tritium monitor. No alpha-type wastes are allowed to be incinerated.

The radioactive nature of the waste burned requires extensive particulate controls. Controlled air incinerators, by design, generate relatively small quantities of flyash when burning solid waste; most of the ash is removed from the incinerator bottom. Combustion of liquids generates more flyash and less bottom ash, as the particulates are of finer size and therefore more easily entrained in the flue gas. The hot flue gas (about 1000°F) passes through a quench tower, where the temperature of the gas is reduced to about 400°F using a water spray. The water

evaporates to steam by cooling the gas, and no liquid effluent is generated.* The cooled gas then enters a baghouse, which removes entrained particulates. The gas then passes through banks of HEPA filters as a final particulate-removal step before exiting the stack. Particulate emissions from the incinerator are minimal.

The BGI generates low-level solid wastes in the form of ash, and spent fabric filter bags and HEPA filters. The amount of ash generated depends on the waste incinerated. Canyon solvent generates a relatively high volume of ash because tetrabutyl titanate must be added to the solvent to fix phosphate. The resultant volume reduction (volume of waste to volume of ash) is only 3.5 to 1. The volume reduction with boxed solid wastes is up to 100 to 1. Presently, approximately 80 drums of ash are generated monthly, and disposed of at the Burial Ground.

The F-Area Analytical Lab (772F)

The F-Area Analytical Lab (772F) performs various process analyses to support the F- and H-Separations Areas. The ventilation systems on high-level plutonium laboratories and the exhaust from all five glove boxes go through the F-Canyon and then to the 291F stack via the sand filter. The remaining ventilation air goes through filters and is exhausted through the 772F stack which is monitored for particulates and radioiodines.

Savannah River Laboratory (700A-Area)

The Savannah River Laboratory (SRL) performs research and development work related to plant changes, upgrades, improvements, and waste management. The main SRL building contains laboratories, shielded high-level cells, and a fabrication laboratory.

* Note that as no liquid effluent is generated by the quench process, no acid gases are removed from the flue gas in the quench tower. Acid gases remain entrained in the gas with the vaporized quench water, and the quench tower cannot therefore be considered a scrubber.

Fuel element prototypes of both natural and enriched uranium are fabricated in Building 773A. Oxides of americium and curium separated from previous reactor campaigns are refabricated into targets for further irradiation to produce californium-252 and other higher isotopes. Gases from the offgas system pass through three stages of HEPA filters before discharging to a stack.

Research and development on separations processes involve both laboratory and pilot-scale work; process operations range from the handling of irradiated fuel and targets to the packaging of the final product. Venting of containment systems, regeneration of cold traps in inert atmosphere purification systems, and replacement of pump oil in vacuum systems are potential avenues for release of tritium. Nonvolatile fission products and actinides are controlled by handling them in containment systems from which all effluent streams (gaseous, liquid, and solid) are monitored.

The Environmental Sciences Laboratories (Buildings 735A and 736A) contain facilities for geology, hydrology, meteorology, radiochemistry, radiobiology, radiation dosimetry, radiation instrumentation, soils, ecology, and limnology. The cobalt-60 Irradiation Facility (Building 774A) consists of three cobalt-60 sources (totaling more than 1,000,000 curies) in a water-filled basin. The Heat Transfer Laboratory (Building 786A) is designed to study cooling of reactor fuel elements under various flow conditions. The Reactor Hydraulic Test facility (Building 786A) is designed to study steam injection, transport, and quenching in a reactor mockup. Heat is vented to the atmosphere as steam or is transferred to cooling water released to a drainage ditch. The Experimental Physics Laboratory (Building 777A) houses three low-power test reactors and a subcritical test facility for evaluating fuel assemblies and lattice arrangement in heavy-water reactors. Under normal operation, this facility produces no detectable radioactive releases.

The liquid waste disposal facility (Building 776A) contains large tanks for short-term storage of both high- and low-level wastes. Tank trucks remove this waste on a regular basis to the High-Level Storage Tanks in the Separations Areas (241F and 241H).

The Manipulator Repair Facility (Building 779A) receives and repairs contaminated master/slave manipulators from the shielded facilities in the main laboratory building and from the production areas of the plant. Contaminated liquid wastes are transferred to the liquid waste disposal facility (Building 776A).

Ventilation air is exhausted from the laboratories through a single-stage HEPA filter to a 100-foot stack. The air is monitored continuously for radioactive contaminants; when contaminants are detected, the air is diverted to a sand filter. In areas where high levels of radioactive contamination are handled, the inlet air flows through a HEPA filter into process enclosures and then through at least two stages of HEPA filters to the sand filters and 160-foot stack. The effluents from the three principal stacks in the Technical Area are monitored continuously for gross alpha and beta-gamma particulates and for radioiodine. Other stacks are sampled continuously.

PRELIMINARY

APPENDIX G - DEDICATED SCRUBBING SYSTEMS

AT NAVAL FUEL MATERIALS FACILITY

PRELIMINARY

Appendix G

Dedicated Scrubbing Systems at Naval Fuel

UF₆ Conversion OffGas Scrubber - This scrubbing system is dedicated to the removal of uranium aerosols, uranium vapors, and hydrogen fluoride (HF) vapors which are generated in the UF₆ conversion process. Gases containing these contaminants are vented from process vessels and cabinets through a scrubber system that utilizes a "high energy scrubber." Aluminum nitrate is used as a scrubbing solution. Liquid-gas separation occurs in a cyclone separator and the scrubbed gas is vented to the building ventilation system. The scrubber solution can be sent to wastewater treatment or to scrap recovery.

Ammonium Scrubber - A venturi scrubber, with water as the scrubbing liquid, cleans the offgases from the process with the potential for containing HF and NH₄F fumes and NH₃ vapors. The cleaned gas is vented to the building ventilation system and the scrubber solution is transferred to wastewater treatment.

HNO₃, HCl Scrubbers - HNO₃ and HCl vapors are minimized by vapor coolers upstream of the vessel vent header which condense the HNO₃ or HCl and allow them to fall back into the vessel. Some vessels contain packed beds which utilize air to strip out the acids before the offgases are vented to the vessel vent system. Caustic scrubbers which vent the scrubbed gases to the vessel vent system are also utilized.

Sulfate Scrubber - Sulfuric acid fumes pass through a sintered metal filter and a condenser/scrubber which utilizes concentrated H₂SO₄ as a scrubbing medium. The scrubbed offgas is sent to the vessel vent scrubber.

Process Vessel Vent Scrubber - Most vessels in the process are vented to the vessel vent scrubber. The scrubber consists of a venturi scrubber, separator, and collection tank. A caustic solution is the recirculating liquid used to remove vapors from the offgases. Dual process vessel vent scrubbers are provided, one for use and one as a spare. The spent scrubbing solution is discharged to wastewater treatment.

APPENDIX H - STACK RADIOLOGICAL EFFLUENT MONITORING PROGRAM

PRELIMINARY

REACTOR AIR EFFLUENTS

Emission Point: Building 105 200" Stack
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper for fission products) and Charcoal Canisters for radiiodines. Samples are removed and initial calculations are made by area HP. The samples are forwarded to 735-A for final analysis and release calculations.

Continous online monitoring for noble gasses (noble gas monitor) and Kanne Chambers for tritium. Noble gas releases are calculated daily by area HP. Tritium releases are calculated daily by the Reactor Department per DPSOL 105-1878.

Emission Point: Building 105 Stack Area HX repair
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling for fission products (Gelman, Type AE filter paper).

Emission Point: Disassembly Transfer Area
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling for fission products (Gelman, Type AE filter paper).

Emission Point: Disassembly Area
Type of Release: Fission Products, Tritium, and Iodine-131 (I-131)
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for fission products and Charcoal Canisters for radiiodines. Samples are removed and initial release calculations are made by area HP. Samples are forwarded to 735-A for final analysis.

Silica gel grab samples are collected weekly and are forwarded to 772-D for tritium analysis.

Emission Point: O' Level Process Room Exhaust to Stack
Type of Release: Fission Products, I-131, and Tritium (H-3)
Sampling/Monitoring: Continuous online sampling (Gelman Type AE filter paper) for fission products and Charcoal Canisters for radiiodines. Kanne Chambers for tritium monitoring. Samples are forwarded to 735-A for analysis.

Emission Point: -40' Level Process Room Exhaust to Stack
Type of Release: Fission Products, I-131, and Tritium
Sampling/Monitoring: Continuous online sampling (Gelman Type AE filter paper) for fission products and Charcoal Canisters for radiiodines. Kanne Chambers for tritium monitoring. Samples are forwarded to 735-A for analysis.

Emission Point: Purification Exhaust to Stack
Type of Release: Fission Products, I-131, and Tritium
Sampling/Monitoring: Continuous online sampling (Gelman Type AE filter paper) for fission products and Charcoal Canisters for radiiodines. Kanne Chambers for tritium monitoring. Samples are forwarded to 735-A for analysis.

Emission Point: NURE Trailer Detector Module (C Area only)
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling for fission products.

Emission Point: NURE Trailer Storage Module (C Area only)
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling for fission products.

Emission Point: 200' Stack
Type of Release: Tritium and Fission Products
Sampling/Monitoring: Continuous online monitoring of stack effluents for tritium and fission products (Stack Total Activity Monitor and Stack Tritium Monitor).

PRELIMINARY

REACTOR SAMPLING MEDIA AND FREQUENCIES

<u>Emission Point</u>	<u>Media</u>	<u>Frequency</u>
200' Stack (Sampling Point +148' Level)	Gelman, Type AE filter paper Charcoal Canister Noble Gas Monitor Kanne Chamber	Weekly Weekly Continuous Continuous
HX Repair (C Area only)	Gelman, Type AE filter paper	Weekly
Disassembly Area	Gelman, Type AE filter paper Charcoal Canister Silica Gel (HTO grab sample)	Weekly Weekly Weekly
Disassembly Area Transfer Area	Gelman, Type AE	Weekly
O' Level Process Room Exhaust to Stack	Gelman, Type AE Charcoal Canister Kanne Chamber	Weekly Weekly Continuous
-40' Level Pump Room Exhaust to	Gelman, Type AE Charcoal Canister Kanne Chamber	Weekly Weekly Continuous
Purification Exhaust to Stack	Gelman, Type AE Charcoal Canister	Weekly Weekly
NURE Trailer Detector Module	Gelman, Type AE	Weekly
NURE Trailer Storage Module	Gelman, Type AE	Weekly
200' Stack Effluents	Stack Tritium Monitor	Continuous

M-AREA AIR EFFLUENTS

1. Building 313-M

Emission Point: 100' Recovery Scrubber Stack
Type of Release: Uranium-235, (U-235), Uranium-238 (U-238)
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: 100' Plating Line Stack - HNO_3 Exhaust
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: 100' Plating Line Stack Exhaust - HCl , H_3PO_4 , HNO_3
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: 30' Recovery Stack (caustic)
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Autoclave Room Exhaust A & B
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

2. Building 320-M

Emission Point: Room 128 Enriched Uranium Hood Exhaust
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Room 129 Depleted Uranium Hood Exhaust
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

3. Building 321-M

Emission Point: Casting Room "A, B, & C" Furnace Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Casting Area Cooling Hood Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Metal Prep. Weighing Hood Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Lathe Room Building Air Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Machine Room "A & B" Lathe Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Outgassing Oven Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

Emission Point: Component Cleaning Room Exhaust Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE, filter paper) for particulates.

4. Building 322-M

Emission Point: Rm. 125, Contam. Metal Prep. Hood 50' Stack
Type of Release: Fission Products
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for particulates.

Emission Point: Rm. 125, Contam. Metal Prep. Hood Exhaust - Kanne
Type of Release: Fission Products and Tritium
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.

Emission Point: Rm. 109, Metal Prep. Lathe Hood Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.

Emission Point: Rm. 109, Metal Prep. Hood Exhaust to Stack
Type of Release: U-235, U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.

Emission Point: Rm. 109, Metal Prep. Saw Hood Exhaust
Type of Release: U-238
Sampling/Monitoring: Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.

Emission Point:	Rm. 107 & 108, Caustic & Sludge Fume Hoods Exhaust
Type of Release:	U-235, U-238
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.
Emission Point:	Rm. 112, Acid Hood Exhaust
Type of Release:	U-238
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.
Emission Point:	Rm. 113, Acid Hood Exhaust
Type of Release:	U-238
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.
Emission Point:	Etch Tank Exhaust
Type of Release:	U-235, U-238
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.
Emission Point:	Rm. 123, Acid Fume Hood Exhaust
Type of Release:	Fission Products
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates. Kanne Chamber for tritium.
Emission Point:	Rm. 131, Sample Prep.
Type of Release:	Fission Products
Sampling/Monitoring:	Ion Chambers and continuous online sampling (Gelman, Type AE filter paper) for particulates.
Emission Point:	Rm. 136, Grinding Laboratory
Type of Release:	Fission Products, U-235, U-238
Sampling/Monitoring:	Ion Chambers and continuous online sampling (Gelman, Type AE filter paper) for particulates.
Emission Point:	322-M, Laboratory Addition Exhaust to 50' Stack
Type of Release:	Fission Products, U-235, U-238
Sampling/Monitoring:	Continuous online sampling (Gelman, Type AE filter paper) for particulates.

M-AREA SAMPLING MEDIA AND FREQUENCIES

<u>Emission Point</u>	<u>Media</u>	<u>Frequency</u>
<u>1. Building 313-M</u>		
100' Recovery Scrubber Stack	Gelman, Type AE filter paper	Bimonthly
100' Plating Line Stack - HNO_3	Gelman, Type AE filter paper	Bimonthly
100' Plating Line Stack Exhaust HCl , H_2 , PO_4 , HNO_3	Gelman, Type AE filter paper	Bimonthly
30' Recovery Stack (caustic)	Gelman, Type AE filter paper	Bimonthly
Autoclave Room Exhaust A & B	Gelman, Type AE filter paper	Bimonthly
<u>2. Building 320-M</u>		
Rm 128, Enriched Uranium Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 129, Depleted Uranium Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
<u>3. Building 321-M</u>		
Casting Rm, "A, B, & C" Furnace Exhausts	Gelman, Type AE filter paper	Bimonthly
Casting Rm, Building Air Exhaust	Gelman, Type AE filter paper	Bimonthly
Casting Area Cooling Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Metal Prep. Weighing Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Lathe Rm Building Air Exhaust	Gelman, Type AE filter paper	Bimonthly

Machine Rm "A & B" Lathe Exhausts	Gelman, Type AE filter paper	Bimonthly
Outgassing Oven Exhaust	Gelman, Type AE filter paper	Bimonthly
Component Cleaning Room Exhaust	Gelman, Type AE filter paper	Bimonthly

4. Building 322-M

Rm 125, Contam. Metal Prep. Hood - 50' Stack	Gelman, Type AE filter paper	Bimonthly
Rm 109, Metal Prep. Lathe Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 109, Metal Prep. Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 109, Metal Prep. Saw	Gelman, Type AE filter paper	Bimonthly
Rm 107 and 108 Caustic & Sludge Fume Hood Exhausts	Gelman, Type AE filter paper	Bimonthly
Rm 112, Acid Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 113, Acid Fume Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 123, Acid Fume Hood Exhaust	Gelman, Type AE filter paper	Bimonthly
Rm 125, Contam. Metal Prep. Hood Exhaust - Kanne	Gelman, Type AE filter paper Kanne Chamber	Bimonthly Continuous
Etch Tank Hood Exhaust -	Gelman, Type AE filter paper	Bimonthly
Room 131, Sample	Gelman, Type AE filter paper	Bimonthly
Room 136, Grinding Laboratory	Gelman, Type AE filter paper	Bimonthly
322-M, Laboratory Addition Exhaust to Stack	Gelman, Type AE filter paper	Bimonthly

F-AREA AIR EFFLUENTS

Emission Point No. and Location	Type of Release	Monitoring
1) Building 291-F (200 ft)	Strontium-89 (Sr-89), Strontium-90 (Sr-90), Zirconium-95 (Zr-95), Niobium-95 (Nb-95), Ruthenium-103 (Ru-103), Ruthenium-106 (Ru-106), I-131, Cesium-134 (Cs-134), Cesium-137 (Cs-137), Cerium-141 (Ce-141), Cerium-144 (Ce-144), other $\beta\gamma$, U-235, U-238, Plutonium-238 (Pu-238), Plutonium-239 (Pu-239), other α , Carbon-14 (C-14), Iodine-124 (I-124), Xenon-131m (Xe-131m), Xenon-133 (Xe-133)	Continuous online monitoring filter paper for alpha, filter paper for beta-gamma, and charcoal for I-131. The samples are removed and initial release calculations made by area HP. The samples are forwarded to Building 735-A HP for final analysis and release calculations.
2) Dissolver Stack (200 ft)	Krypton-85 (Kr-85) Alpha beta-gamma Ru-103, Ru-106, I-131	Continuous online monitoring. Continuous filter paper sampling during coating removal. Filter paper and molecular sieve sampling during dissolution. Filter paper counted and release calculated by area HP and sent to Building 735-A for calculation. PHA and release calculations of molecular sieve sample by Building 735-A HP.
3) Building 772-F (75 ft)	Alpha and beta-gamma	Continuous sampling with filter paper. Initial release calculation by area HP. Final analysis and release calculations by Building 735-A HP. Continuous sampling with filter paper. Filter paper counted and stack releases calculated by area HP.
4) Underground Waste Tanks Cell at Building 211-F	Alpha and beta-gamma	Continuous sampling with filter paper. Filter paper counted and stack releases calculated by area HP.

5) Building 723-F
(Laundry - 12')	Alpha and beta-gamma	Continuous sampling with filter paper. Filter paper counted and stack releases calculated by area HP.
6) A-line
Building 221-1F	Alpha and beta-gamma
(uranium)	Continuous sampling with filter paper. Filter paper counted and releases calculated by area HP.
7) Building 242-F
CTS exhaust
and Building
241-F Waste Tanks
exhaust (15 ft)	Alpha and beta-gamma	Continuous sampling with filter paper. Filter paper counted and releases calculated by area HP. For a release above 10 μ Ci alpha or beta-gamma, the sample forwarded to Building 735-A HP for analysis and release calculations.

PRELIMINARY

F-AREA SAMPLING MEDIA AND FREQUENCIES

<u>Emission Point</u>	<u>Media</u>	<u>Frequency</u>
1) Building 291-F stack	Gelman, Type AE Charcoal canister	Daily Weekly
2) Dissolver stacks	Gelman, Type AE Molecular sieve	Daily (Mon-Fri) Weekly
3) Building 772-F	Gelman, Type AE	Daily
4) Building 211-F, truck shed	Gelman, Type AE	Daily (Mon-Fri)
5) Building 723-F(laundry)	Gelman Fiberglass	Daily (Mon-Fri)
6) A-Line, Building 221-1F	Gelman, Type AE	Daily (Mon-Fri)
7) Building 242-F CTS exhaust and Building 241-F waste tanks exhaust	Gelman, Type AE	Weekly

H-AREA AIR EFFLUENTS

<u>Emission Point No. and Location</u>	<u>Type of Release</u>	<u>Monitoring</u>
1) Building 291-H (200 ft)	Sr-89, Sr-90, ZrNb-95, Ru-103, Ru-106, I-131, Cs-134, Cs-137, Ce-141, other $\beta\gamma$, U-235, U-238, Pu-238, Pu-239, other α	Continuous online monitoring filter paper for alpha, filter paper for beta-gamma, and charcoal for I-131. The samples are removed and initial release calculations made by area HP. The samples are forwarded to Building 735-A HP for final analysis and release calculations.
	C-14, Kr-85, I-124 Xe-131m, Xe-133	Calculated
2) Building 232-H (200 ft) Lines 1 and 2	H-3	Continuous online monitoring of stack with Kanne chamber and recorder. Release calculated by area HP per DPSOL 193-3-310.
3) Building 232-H (200 ft) Line 3	H-3	Same as 2) above.
4) Building 234-H	H-3	Same as 2) above.
5) Building 237- and 238-H (75 ft)	H-3	Same as 2) above.
6) Building 244-H (53 ft) Two stacks 1) Building exhaust 2) PVV exhaust	H-3, I-131 Alpha and beta-gamma	Continuous online monitoring of stack with Kanne chamber and recorder for H-3. Continuous sampling with filter paper for alpha and beta-gamma and charcoal cartridge for I-131. H-3 release calculated by area HP. Filter paper counted and initial release calculation by area HP. Charcoal cartridge forwarded to Building 735-A HP for analysis and final release calculations.

7) Building 242-H
CTS exhaust and
Building 241-H
Waste Tanks
exhaust
(15 ft) | Alpha and beta-gamma | Continuous sampling with filter
paper. Filter paper counted and
releases calculated by area HP.
For a release above 10 μ Ci alpha
or beta-gamma, the sample is
forwarded to Building 735-A HP
for analysis and release
calculations |
|---|----------------------|--|

PRELIMINARY

**APPENDIX I - SURFACE-WATER QUALITY
FOR SRP STREAMS**

PRELIMINARY

TABLE I-1
SURFACE WATER QUALITY 1985

Parameter, Average	Savannah River			On-Site Streams								
	Savannah River 2 Above Plant	Savannah River 3B Below Plant Vogtle	Savannah River 1D Below Plant	Upper Three Runs HY 278	Upper Three Runs Thermal Effects Lab	Upper Three Runs Road A	Tims Branch 5	Steel Creek at Road A	Four Mile Creek Rd A-7	Beaver Dam Creek at Swamp	Lower 3 Runs Patterson Mill	SC at Hatvie Bridge
Temperature, Degrees C	18	21	19	17	17	17	16	19	18	25	19	19
pH, max/min	7.6/6.2	7.7/6.6	7.6/6.1	6.9/5.2	7.3/5.2	6.6/5.0	7.6/6.0	7.4/6.3	7.4/6.1	7.6/6.2	7.9/6.5	7.6/5.7
Dissolved O ₂ mg/l	9.6	7.2	9.6	8.6	8.7	8.1	8.6	7.7	7.9	7.9	8.2	8.0
Alkalinity, mg/l	19	20	20	18	4.4	4.5	9.2	20	12	18	39	19
Hardness, mg/l	5.9	5.1	6.0	0.99	3.6	3.1	2.5	6.7	4.7	5.5	16	8.1
Conductivity, µmho/cm	82	88	69	15	20	22	24	63	88	97	96	68
Total Org. Carbon, mg/l	---	---	---	---	---	53	3.1	5.5	3.7	---	---	---
Turbidity, NTU	5.4	4.0	5.0	13	15	1.9	3.5	4.3	1.9	5.2	13	4.1
Susp. Solids, mg/l	9.3	6.3	12	4.0	4.9	5.1	5.1	7.2	5.4	5.5	5.2	7.2
Volatile Solids, mg/l	2.9	2.1	2.9	2.1	2.5	2.7	1.9	3.1	2.2	4.1	2.9	<3.0
Total Dissolved Solids, mg/l	55	61	59	15	24	26	24	59	62	63	63	54

Source: Zeigler et al., 1986b

TABLE I-1
SURFACE WATER QUALITY 1985
PAGE TWO

Parameter, Average	Savannah River				On-Site Streams							
	Savannah River 2 Above Plant	Savannah River R-38 Below Plant Vogtle	Savannah River 10 Below Plant	Upper 3 Runs HY 278	Upper 3 Runs Thermal Effects Lab	Upper 3 Runs Road A	Tims Branch 5	Steel Creek at Road A	Four Mile Creek Rd A-7	Beaver Dam Creek at Swamp	Lower Three Runs Patterson Mill	SC at Hatvie Bridge
Total Solids, mg/l	64	67	71	19	30	31	29	66	67	62	68	61
Fixed Residue, mg/l	6.6	4.3	9.2	<2.5	<2.8	2.7	3.3	4.5	3.2	4.5	<2.8	<4.2
COD, mg/l	15	13	13	12	12	12	8.4	13	7.7	13	16	13
Original Nitrogen, mg/l	—	—	—	—	—	<0.16	<0.16	0.28	<0.19	—	—	—
Chloride (Cl), mg/l	6.6	5.8	6.6	2.5	2.8	3.1	2.3	5.2	4.3	7.2	4.2	5.0
NO ₂ + NO ₃ (N) mg/l	0.5	0.69	0.53	68	56	0.19	0.52	150	3.8	0.55	68	60
Sulfate (SO ₄), mg/l	6.5	6.9	6.5	<2.1	<2.2	2.1	2.3	4.3	8.4	12	<2.2	3.6
Total Phosph. (P), mg/l	0.1	0.08	0.09	<0.02	0.03	0.04	0.04	0.06	<0.03	0.08	0.04	0.04
Aluminum (Al), mg/l	0.16	0.09	0.17	0.07	0.12	0.13	0.09	0.14	0.09	0.29	0.06	0.10
Ammonia (NH ₃), mg/l	0.13	0.09	0.10	0.02	<0.01	<0.02	0.01	0.02	0.02	0.15	0.02	0.03
Calcium (Ca), mg/l	4.6	3.9	4.7	0.67	2.1	2.8	2.0	5.7	4.0	4.2	15	7.1
Copper (Cu), mg/l	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01

Source: Zeigler et al., 1986b

TABLE I-1
SURFACE WATER QUALITY 1985
PAGE THREE

Parameter, Average	Savannah River				On-Site Streams							
	Savannah River 2 Above Plant	Savannah River 3 Below Plant Vogtle	Savannah River 10 Below Plant	Upper Three Runs HY 278	Upper Three Runs Thermal Effects Lab	Upper Three Runs Road A	Tims Branch 5	Steel Creek at Road A	Four Mile Creek Rd A-7	Beaver Dam Creek at Swamp	Lower Three Runs Patterson Mill	SC at Hatvle Bridge
Cadmium (Cd), mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium (Mg), mg/l	1.3	1.2	1.3	0.32	0.34	0.36	0.44	0.99	0.70	1.3	0.87	0.97
Manganese (Mn), mg/l	0.10	0.07	0.07	0.02	0.02	0.03	0.08	0.09	0.08	0.07	0.09	0.13
Mercury (Hg), µg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.17
Nickel (Ni), mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.02	<0.1	<0.1	<0.1	<0.1	<0.10
Sodium (Na), mg/l	10	9.3	8.6	1.2	1.5	1.4	3.2	8.8	12	11	3.9	5.8
Total Iron (Fe), mg/l	0.34	0.35	0.52	0.25	0.32	0.37	0.76	0.53	0.36	0.47	0.33	1.1
Lead (Pb), mg/l	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (Cr), mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn), mg/l	0.04	0.04	0.03	0.03	0.06	0.08	0.05	0.06	0.07	0.05	0.04	0.06

Source: Ziegler et al., 1986b

**TABLE I-2
RADIOACTIVITY IN SAVANNAH RIVER**

Location (a)	Alpha	Average Nonvolatile Beta	Concentration, pCi/l			
			H-3	Cr-51	Mn-54	Co-60
Above plant (2R)(a)	0.07(b) 0.11(c)	1.3(b) 0.02(c)	460	1.3	0.03	0.59
Below plant (10R at Highway 301)(a)	0.03(b) 0.11(c)	1.3(b) 0.03(c)	3,700	0.93	0.03	0.43

* Source: Zelgler et al., 1986b

a See Figure 3-9 to locate upriver sampling point 2R and downriver sampling point 10R.

b Dissolved

c Suspended

APPENDIX J - GROUNDWATER QUALITY DATA

PRELIMINARY

CONTENTS - APPENDIX J

<u>NUMBER</u>		<u>PAGE</u>
J-1	Met Lab Seepage Basin Groundwater Contaminant Data	J-1
J-2	A-Area Seepage Basin Groundwater Contaminant Data	J-2
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TABLE J-1

**METALLURGICAL LAB SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	AMB-1A	AMB-2	AMB-3		
Gross Alpha	3-128	-	4-19	pCi/L	15
Nonvol Beta	3-146	-	-	pCi/L	
Lead	-	16-26	-	µg/L	50
Radium	< 1-16	-	-	pCi/L	5
TOH	< 5-72.6	85.0-311.6	-	µg/L	N/A
Trichloroethylene	6.36-29.0	92.9-152	4.57-5.0	µg/L	2.7
Carbon Tetrachloride	-	< 5.0-381		µg/L	0.4

* Based on Dose

Flag I Constituents:

Ag, Na, pH, TOC
As, B, Fe, Hg, Ra

TABLE J-2

**A-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.						Units	Applicable Standard
	ASB-1A	ASB-2A	ASB-3A	ASB-4	ASB-5A	ASB-6A		
Manganese	20-120	45-74	-	-	-	-	µg/L	50
Lead	<4-35	<4-26	-	-	-	<4-36	µg/L	50
Gross α	-	4-20	<2-18	-	-	-	pCi/L	15
Total Radium	-	4-6	<1-11	4-6	-	<1-7	pCi/L	5
TOH	-	-	<5-25	10-71	47-356.4	9-44	µg/L	N/A
Chromium	-	-	-	<4-32	-	-	µg/L	50
Iron	-	-	-	366-1,690	-	-	µg/L	300

Flag I Constituents:

Phenol, Nonvol. β, SO₄, TOC, Hg, Zn, Spec. Cond, Ni, Cl, Na, pH

TABLE J-3

C-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.						Units	Applicable Standard
	CSB-1A	CSB-2A	CSB-3A	CSB-4A	CSB-5A	CSB-6A		
Chloroform	15	11	-	32	34	-	µg/L	0.19
Chromium	30-61	-	-	-	-	30-50	µg/L	50
Lead	78-193	-	-	-	-	<5-45	µg/L	50
pH	11.1-11.53	-	-	-	7.5-10.77	11.31-11.49	pH	N/A
TOH	48-150	38	21-182	22-150	44-219	38-81	µg/L	N/A
TCE	6	-	-	6	-	30	µg/L	2.7
Manganese	-	8-62	-	-	-	-	µg/L	50
Tritium	-	31,750	97,212,000	39,529,000	446,000	147,000,000	pCi/L	20,000

Flag | Constituents:

Ag, Spec. Cond., Na, Phenol, SO₄, TOC

TABLE J-4

**F-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.										Units	Applicable Standards
	FSB-76	FSB-76C	FSB-77	FSB-78	FSB-78B	FSB-78C	FSB-79	FSB-79C	FSB-87D			
Gross alpha	<2-83	-	184-717	279-1,614	-	61-87	<2-588	1,182	1,652	pCi/L	15	
Nonvol Beta	7-59	-	237-991	1,507-1,923	-	1,050-1,084	<3-1150	2,537	1,799	pCi/L	*	
Lead	9-47	<5-1,050	17-164	63-299	-	13-293	<5-82	<5-55	168-310	µg/L	50	
Radium	<1-5	-	56	67	-	-	<1-42	-	-	pCi/L	5	
Zinc	1,700-6,940	-	51-3,880	202-4,230	-	-	-	-	-	µg/L	5,000	
Cadmium	-	-	<2-60	1-22	-	3-22	0.006-6	14-21	14-29	µg/L	10	
Chromium	-	-	<4-51	-	-	-	-	-	-	µg/L	50	
Iron	-	-	31-321	148-1,800	-	553	-	-	1,160-1,200	µg/L	300	
Manganese	-	-	114-479	1,070-1,340	-	3,880	2,660-3,840	4,160	1,430-1,460	µg/L	50	
No ₃ -N Nitrate	-	-	23,100-81,000	300,000-354,300	-	239,000-250,000	34,500-188,000	216,000-245,000	280,000-325,000	µg/L	10,000	
TOC	-	-	330-83,000	-	-	-	-	-	-	µg/L	N/A	
pH	-	-	-	2.21-3.51	6.54-8.04	-	2,60-3.65	-	2.14-3.66	pCi/L	N/A	
TOH	-	-	-	<5-54	-	-	<5-38	10-29	-	µg/L	N/A	
Barium	-	-	-	-	-	-	326-552	606	-	µg/L	1,000	
Mercury	-	-	-	-	-	-	0.28-2.31	-	-	µg/L	2	

* Based on Dose

Flag 1 Constituents Spec. Cond., Na, Phenol, SO₄

TABLE J-5

**F-AREA "OLD" SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.					Units	Applicable Standard
	FNB-1	FNB-2	FNB-3	FNB-3B	FNB-4		
Gross α	2.0-16.0	3-274	12.2-118.0	-	-	pCi/L	15
Chromium	<4-73	-	<4-153	-	-	μ g/L	50
Iron	18-327	-	32-3,520	-	19-592	μ g/L	300
Radium	<1.0-9.0	2-51	10-56	-	-	pCi/L	5
TOH	<5-33	6-37.7	<5-26	-	-	μ g/L	N/A
Nonvol. Beta	-	5-1,906	136-365	-	-	pCi/L	*
Copper	-	13-570	-	-	-	μ g/L	50
Manganese	-	405-686	410-1,324	-	-	μ g/L	50
Nitrate-N	-	58,800-92,000	11,500-34,000	19,200	-	μ g/L	10,000
Lead	-	<5-309	29-82	-	8-31	μ g/L	50
pH	-	2.84-3.53	-	-	-	μ g/L	N/A
Zinc	-	101-3,310	-	-	-	μ g/L	5,000
Barium	-	-	128-1,100	-	-	μ g/L	1,000
Cadmium	-	-	<2-6	-	-	μ g/L	10

* Based on Dose

Flag I Constituents:

Spec. Cond., Na, Phenol, NI, TOC, Be, F

TABLE J-6

**H-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

GROUNDWATER CONTAMINANT DATA (TABLE LEVEL 2)													
Well No.	Contaminant												
	Lead (µg/L)	TOH (µg/L)	Tritium pCi/L	Cadmium (µg/L)	Gross alpha pCi/L	Nonvol. Beta pCi/L	Mercury (µg/L)	Manganese (µg/L)	Nitrate-N (µg/L)	Radium pCi/L	pH (pH)	Zinc (µg/L)	Iron (µg/L)
Units	(µg/L)	(µg/L)	pCi/L	(µg/L)	pCi/L	pCi/L	(µg/L)	(µg/L)	(µg/L)	pCi/L	(pH)	(µg/L)	(µg/L)
HSB-65	22-67	<5-36	69,000	-	-	-	-	-	-	-	-	-	-
HSB-65B	-	<5-30	-	-	-	-	-	-	-	-	-	-	-
HSB-65C	10-26	-	35,000	2-6	-	-	-	-	-	-	-	-	-
HSB-66	-	<5-32	61,000	-	-	-	-	-	-	-	-	-	-
HSB-67	19-100	10.3-30	-	-	24	956	1.6- 5.12	12.5-214	12,900- 23,000	17	-	-	-
HSB-68	<5-118	<5-33.6	-	4-13	84	7,785	0.82- 2.00	1,600-3,580	42,400- 69,000	35	-	-	-
HSB-68A	-	-	115,000	-	-	-	-	-	-	-	8.8-9.4	-	-
HSB-68B	-	-	49,000	-	-	-	-	-	-	-	7.3-9.4	-	-
HSB-68C	-	-	1,633,000	3-8	-	-	-	65	9,750- 11,100	-	-	-	-
HSB-69	10-79	<5-433	-	-	2-39	3-4,774	<0.2- 2.04	931-1,480	49,600- 62,000	<1-28	-	-	-
HSB-70	12-46	<5-41.2	-	-	-	-	-	-	<500- 18,200	-	-	-	-
HSB-71	<5-51	<5-66	-	-	-	-	-	-	1,650- 58,000	-	-	250- 2840	-
HSB-83B	-	-	31,800	-	-	-	-	-	-	-	-	-	-
HSB-83D	12-48	-	-	-	-	-	1.14- 1.97	133	65,000- 97,200	-	-	-	-
Applicable Standard	50	N/A	20	10	15	*	2	50	<10,000	5	N/A	5,000	300

H-AREA SEEPAGE BASIN

PAGE TWO

Well No.	Contaminant												
	Lead (µg/L)	TQH (µg/L)	Tritium pCi/L	Cadmium (µg/L)	Gross alpha pCi/L	Nonvol. Beta pCi/L	Mercury (µg/L)	Manganese (µg/L)	Nitrate-N (µg/L)	Radium pCi/L	pH (pH)	Zinc (µg/L)	Iron (µg/L)
HSB-84A	-	-	-	-	-	-	-	561	38,500- 54,000	-	-	-	-
HSB-84B	-	-	899,000	-	-	-	-	-	-	-	9.2- 9.72	-	-
HSB-84C	-	<5-174	285,000	-	-	-	-	-	-	-	9.85- 10.0	-	-
HSB-84D	12-30	-	-	-	-	-	-	247-251	11,800- 15,800	-	-	-	-
HSB-85B	-	-	-	-	-	-	-	-	-	-	7.8- 9.85	-	-
HSB-86B	-	-	-	-	-	-	-	-	-	-	-	-	467
HSB-86C	26-30	-	-	-	-	-	-	616	49,000- 71,200	-	-	-	-
HSB-86D	<5-36	-	-	-	-	-	-	1,230	36,000- 82,400	-	-	-	-
Applicable Standard	50	N/A	20	10	15	*	2	50	10,000	5	N/A	5,000	300

* Based on Dose

Flag I Constituents:

Ag, Spec. Cond., Na, Phenol, TOC, Ba, Cr, SO₄

TABLE J-7

**H-AREA "OLD" RETENTION BASINS
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

281-3H

Contaminant	Well No.		Units	Applicable Standard
	HR3-11	HR3-13		
Gross Alpha	1.4-238	-	pCi/L	15
Gross Beta	2.3-96	-	pCi/L	*
Mercury	0.31-1.01	-	µg/L	2
Radium	<1.0-8	-	pCi/L	5
TOH	12-32	<5-1,150	µg/L	N/A
Tritium	26,300	52,000	pCi/L	20,000
pH	-	7.79-10.15	pH	N/A

Flag I Constituents:

Cl, Na, Phenol, As, Spec. Cond., Cr, NO₃-N**281-8H**

Contaminant	Well No.				Units	Applicable Standard
	HR8-11	HR8-12	HR8-13	HR8-14		
Lead	25-58	42-90	38-235	41-65	µg/L	50
H ³	67.8	38.4	38.0	-	pCi/L	20,000
Gross Alpha	-	1.0-36	3.2-44	10.2-26	pCi/L	15
Total Ra	-	1.8-8	2.3-13	8.0-21	pCi/L	5
Mn	-	-	-	100-109	µg/L	50
NO ₃ -N	-	-	-	38,500-50,000	µg/L	10,000

Flag I Constituents:

Nonvol. β, TOH, Fe, Phenol, Cl, Na, Ba, Spec. Cond.

* Based on Dose

TABLE J-8

**K-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	KSB-1	KSB-2	KSB-3	KSB-4		
Tritium	1,013,000	52,800	69,100	169	pCi/L	20,000

Flag I Constituents:

Nonvol. B, Pb, Phenol

PRELIMINARY

TABLE J-9

**L-AREA DISASSEMBLY BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.		Units	Applicable Standard
	LDB-1	LDB-2		
Gross Alpha	28	-	pCi/L	15
Iron	466	833	µg/L	300
Manganese	100	92	µg/L	50
Radium	6.0	6.0	pCi/L	5
TOH	171	40	µg/L	N/A

Flag I Constituents:

α, β, TOC

TABLE J-10

**L-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	LSB-1	LSB-2	LSB-3	LSB-4		
Lead	20-50	42-192	25-48	42-202	µg/L	50
Tritium	111,000	-	-	116,000	pCi/L	20,000
TOH	-	-	< 5-120	-	µg/L	N/A

Flag I Constituents:

Cr, Cu, pH, Fe, Nonvol. 8

TABLE J-11

P-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.							Units	Applicable Standard
	PSB-1A	PSB-2A	PSB-3A	PSB-4A	PSB-5A	PSB-6A	PSB-7A		
pH	8.3-8.6			-	-	-	7.8-8.13	pH	N/A
TOH	<5-73	<5-53	-	6-110	-	<5-88	<5-116	µg/L	N/A
Lead	-	-	<5-75	<5-96	7-129	<5-54	-	µg/L	50
Nitrate-N	-	-	-	-	-	7,200-15,000	-	µg/L	10,000

Flag I Constituents:

Spec. Cond., TOC, Ba, Mn, Na

TABLE J-12

**OLD TNX SEEPAGE BASIN - XSB
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	XSB-1	XSB-2	XSB-3A	XSB-4		
Gross Alpha	9.0-15	235-391	13-47	278-344	pCi/L	15
Cadmium	<2.0-7.0	<2.0-17	<2.0-38	10-27	µg/L	10
Nitrate-Ni	12,500-16,000	140,000-200,000	2,900-34,000	59,000-138,000	µg/L	10,000
Radium	4.0-7.0	128-154	3.0-13	58-64	pCi/L	5
TOH	206-442	554-1131	13-190	204-414	µg/L	N/A
Trichloroethylene	344-491	826	25-27	342	µg/L	2.7
Barium	-	429-510		532-538	µg/L	1000
Nonvol. Beta	-	141-160		192-195	pCi/L	*
Chloroform	-	12		-	µg/L	.19
Mercury	-	8.0-15.27	<2-1.82	5.26-15.63	µg/L	2
Manganese	-	1720-2270	44-299	634-803	µg/L	50
Lead	-	22-138	-	21-108	µg/L	50
TOC		4000-35,000	-	-	µg/L	N/A

* Based on Dose

Flag I Constituents:

As, Ba, B, sp.con., Na, Ni, pH, phenol, SO₄, Zn, Fe, Ag, Cl, Cn, Cr, TOC

TABLE J-13

**NEW TNX SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	YSB-1A	YSB-2	YSB-3	YSB-4		
Gross Alpha	<2.0-17	-	-	-	pCi/L	15
Iron	18-1040	-	-	56-661	µg/L	300
pH	2.65-5.94	-	-	-	pH	N/A
Radium	<1.0-5.0	-	-	2.0-14	pCi/L	5
TOH	-	<5.0-39.9	<5.0-30.7	-	µg/L	N/A
Nitrate-N	-	-	350-22,100	-	µg/L	10,000

Flag I Constituents:

α, β, sp.con., Na, NO₃, phenol, SO₄, TOC, TOH, Cl, Fe, pH

TABLE J-14

**K-AREA RETENTION BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.					Units	Applicable Standard
	KRB-1	KRB-8	KRB-13	KRB-14	KRB-15		
Tritium	109,000	289,000,000	23,546,000	18,804,000	98,934,000	pCi/L	20,000
Lead	-	5-69		-	-	µg/L	50
TOH	-	74-178	96-121	96-121	15-45	µg/L	N/A
Manganese	-	-	-	-	-	µg/L	50

Flag I Constituents:

TOC, Na, Cd, Cl, Spec. Cond., Nonvol. B, pH, SO₄

TABLE J-15

**M-AREA SEEPAGE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No								Units	Applicable Standard
	MSB-1A	MSB-2A	MSB-3A	MSB-4A	MSB-5A	MSB-7A	MSB-8A	MSB-29D		
Lead	8.77	-	<5-34	<4-30	-	-	-	30-34	µg/L	50
Tetrachloroethylene	78.1-85.1	42.7-68	220,615	4,785-5,195	39.7	37.3-44.9	155.2	-	µg/L	0.8
Radium	2-6	2-6	8-92	19-23	-	2-6	4-10	8.5	pCi/L	5
TOH	160-600	91-970	222-176,100	876-5,281	<5-65	<5-63	111-302	-	µg/L	N/A
Trichloroethylene	193-202	158.3-399	57,075	3,207-3,437	11.2	13.5-17.1	38.8	-	µg/L	2.7
Gross alpha	-	4-15	9-92	16-27	-	4-26	-	-	pCi/L	15
Nitrate-N	-	1,830-19,750	21,330-143,000	116,000-330,000	1,700-14,300	-	11,900-36,400	-	µg/L	10,000
Nonvol. Beta	-	-	44-128	24-73	-	-	3-76	-	pCi/L	*
Endrin	-	-	0.07-0.22	<0.04-0.22	-	-	-	-	µg/L	0.20
Manganese	-	-	315-385	-	-	-	-	-	µg/L	50
Sulfate	-	-	<5,000-145,000	20,000-266,000	-	-	-	-	µg/L	250,000
Iron	-	-	-	-	-	60-805	-	-	µg/L	300

* Based on Dose

Flag I Constituents:

Spec. Cond., Na, Ni, Cr, Ba, Cl, Cn, pH, Phenol, TOC, Al

TABLE J-16
CMP PIT5
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant*	Well No.										Units	Applicable Standard
	CMP-9B	CMP-10	CMP-8	CMP-11	CMP-12	CMP-12A	CMP-13	CMP-15A	CMP-15B	CMP-15C		
Tetrachloroethylene	8.0	-	-	-	-	-	4.0-6.0	-	-	-	µg/L	0.8
TOH	38.0	-	-	-	<5.0-93.1	-	-	-	-	-	µg/L	N/A
Manganese	-	14.54	-	-	-	128	-	-	-	-	µg/L	50
Zinc	-	19.3, 106	895 4,070	-	437-2,960	-	29.5, 940	-	-	-	µg/L	5,000
Gross Alpha	-	-	-	<2-182	-	-	<2-362	-	-	-	pCi/L	15
Gross Beta	-	-	-	<3-77	-	-	<3-86	-	-	-	pCi/L	*
Iron	-	-	-	36-1,740	-	-	-	-	-	-	µg/L	300
Radium	-	-	-	<1-41	-	-	<1-8	-	-	-	pCi/L	5
Lead	-	-	-	-	<10-157	-	-	-	-	-	µg/L	50
Trichloroethylene	-	-	-	-	-	-	3.0-5.0	-	-	290	µg/L	2.7
pH	-	-	-	-	-	-	-	8.5-9.44	10.2-10.95	-	pH	N/A

* Based on Dose

Flag I Constituents:

Cd, Mn, phenol, TOC, TOH, Cl, Zn, Ni, As, Na, Ba, F, Fe, pH, SO₄, Spec. Cond., Pb, Total a

TABLE J-17

**F-AREA ACID/CAUSTIC BASIN
GROUND-WATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	FAC-1	FAC-2	FAC-3	FAC-4		
Manganese	88-138	31-52	-	401-499	µg/L	50
Lead	6-27	-	-	-	µg/L	50
TOH	<5-38.9	-	-	-	µg/L	N/A
Mercury	-	<0.2-4.19	-	-	µg/L	2
Gross Alpha	-	-	<2-391	12-56	pCi/L	15
Nonvol. Beta	-	-	4-1,076	10-58	pCi/L	*
pH	-	-	8.63-9.7	-	pH	N/A
Radium	-	-	<1-40	12-24	pCi/L	5

* Based on Dose

Flag I Constituents:

Na, Phenol, SO₄, Zn, Spec. Cond., Cr, TOC

TABLE J-18

**K-AREA ACID/CAUSTIC BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	KAC-1	KAC-2	KAC-3	KAC-4		
Nonvol. Beta	<3-460	-	-	2.7-59	pCi/L	*
Iron	43-593	9-1,370	-	-	µg/L	300
Selenium	<2-18	-	<2-54	<2-6	µg/L	10
Sulfate	165,000-840,000	44,000-500,000	116,000-765,000	58,000-165,000	µg/L	200,000
TOC	880-43,500	-	-	-	µg/L	N/A
Manganese	-	2-526	-	-	µg/L	50
pH	-	-	6.2-8.46	-	pH	N/A
TOH	-	-	7-41.3	-	µg/L	N/A
Gross Alpha	-	-	-	<2-28	pCi/L	15
Radium	-	-	-	<1-5	pCi/L	5

* Based on Dose

Flag I Constituents:

Cl, Spec. Cond., Na, F, Phenol, Ag

TABLE J-19

**L-AREA ACID/CAUSTIC RETENTION BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	LAC-1	LAC-2	LAC-3	LAC-4		
Iron	68-1,390	-	-	-	µg/L	300
Lead	15-38	< 10-35	-	-	µg/L	50
TOH	-	< 5-88	6-38	19-36	µg/L	N/A
pH	-	-	6.4-9.4	-	pH	N/A
Selenium	-	-	-	< 2-8	µg/L	10

Flag I Constituents:

Cu, Phenol, Zn, Gross α, Na, SO₄, Spec. Cond.

TABLE J-20

**P-AREA ACID/CAUSTIC RETENTION BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	PAC-1	PAC-2	PAC-4		
Iron	52-365	42-1,640	-	µg/L	300
TOH	-	6-46	-	µg/L	N/A
Silver	-	-	0.65-460	µg/L	50
Selenium	-	-	< 1-6	µg/L	10

Flag 1 Constituents:

As, Cr, Mn, Ni, pH, Phenol, Spec. Cond., Na, SO₄, TOC, Ba, Cl, Gross α;
Nonvol. β

TABLE J-21

SILVERTON ROAD WASTE SITE
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.												Units	Applicable Standard
	SRW-1	SRW-2	SRW-4	SRW-5	SRW-6	SRW-7	SRW-8	SRW-9	SRW-9A	SRW-10	SRW-11	SRW-12A	SRW-16C	
Iron	24-707	-	48-372	19-1,430	-	-	-	-	-	-	35-1,530	-	-	µg/L 300
TOH	<5.0-65	-	7.9-33	8.3-26	30-148.5	19-31	<5.0-33.8	-	-	-	18-35	-	-	µg/L N/A
Lead	-	30-39	-	-	-	-	-	-	26	<10-26	-	38	25-28	µg/L 50
Radium	-	1.0-5.0	-	-	-	-	-	-	-	-	-	-	-	pCi/L 5
Trichloroethylene	-	-	-	2.0-7.0	3.0-6.0	6.0-12	6.0-11	6.0-7.0	-	2.0-4.0	15-16	-	-	µg/L 2.7
Tetrachloroethylene	-	-	-	-	-	4.0-5.0	3.0-5.0	-	-	-	7.0-8.0	-	-	µg/L 0.8
Zinc	-	-	-	-	-	59-12,100	-	26-3,070	-	-	42-7,050	-	-	µg/L 5,000
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	57-70	µg/L 50

Flag I Constituents:

As, Zn, Spec. Cond., TCE, Fe,
Ag, a, Na, SO₄, TOC, TOH, Zn, Pb, Fe, Mn, NO₃, pH, Ra, B, tetrachloroethylene

TABLE J-22

**SANITARY LANDFILL
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.							Units	Applicable Standard
	LFW-6	LFW-7	LFW-8	LFW-9	LFW-17	LFW-18	LFW-23		
TOC	1,874-144,000	8,000-171,000	6,500-29,520	-	30,000-858,000	50,850-160,000	6,500-29,520	µg/L	N/A
TOH	150	264	205	193	186	197	25	µg/L	N/A
Cadmium	-	<1.0-19	-	-	<1.0-48	<1.0-19	-	µg/L	10
Chromium	-	<4.0-37	-	-	<4.0-95	<4.0-38	-	µg/L	50
Chloride	-	-	-	-	3,280-147,250	-	-	µg/L	250,000
Lead	-	-	-	-	<10-91	-	-	µg/L	50

Flag I Constituents:

Cl, SPEC. COND., CR, BA, HG, CD,
Ag, As, Pb, SO₄, TOC, NO₃, Cr

TABLE J-23

**A-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	ARP-1A	ARP-2	ARP-3	ARP-4		
TOH	<5.0-35	<5.0-35	13.0-44.4	-	µg/L	N/A
Trichloroethylene	4.15-<5.0	-	14.0-29.5	2.68-2.81	µg/L	2.7
Lead	-	<5.0-346	-	-	µg/L	50
TOC	-	-	290-25,000	-	µg/L	N/A
Radium	-	-	-	<1.0-6.0	pCi/L	5

Flag I Constituents:

α, Ni, pH, SO₄, TOC, Cu, Mn, Ra, Zn, Trichloroethylene

TABLE J-24

**METALS BURNING PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	ARP-1A	ARP-2	ARP-3	ARP-4		
Iron	30-892	-	68-182	-	µg/L	300
Trichloroethylene	2.5- < 5.0	25-30	45-49.8	3.55- < 5.0	µg/L	2.7
TOH	-	15-43	33-42	-	µg/L	N/A
Lead	-	-	-	< 5.0-39	µg/L	50

Flag I Constituents:

α, β, Hg, Mn, TOC, Ra

TABLE J-25

**C-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	CRP-1A	CRP-2	CRP-3	CRP-4		
pH	4.4-8.4	-	3.8-12.0	5.2-9.3	pH	N/A
TOC	345-41,300	350-35,100	1000-40,500	280-47,900	µg/L	N/A
TOH	711-3700	-	1000-3500	-	µg/L	N/A
Trichloroethylene	1250-3280	4.0-6.0	2410-3670	-	µg/L	2.7
Chromium	-	-	32.0-57.0	-	µg/L	50
Lead	-	-	31.0-106.0	-	µg/L	50

Flag I Constituents:

α, β, Cr, Ag, Spec. Cond., Na, Phenol, F, pH, TOH

TABLE J-26

**CENTRAL SHOPS RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	CSR-1A	CSR-2	CSR-3	CSR-4		
Lead	15.0-41.0	11.0-58.0	-	-	µg/L	50
TOH	<5.0-31.5	<5.0-64.1	<5.0-44.0	-	µg/L	N/A
Chromium	<4.0-232	-	-	-	µg/L	50
Iron	-	84-902	-	-	µg/L	300

Flag | Constituents:

CCd, Fe, pH, phenol, Pb, F, α , No₃, Ra, Cu, Mn, Ni

TABLE J-27

**D-AREA BURNING RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	DBP-1A	DBP-2	DBP-3	DBP-4		
Lead	7.0-27.0	-	-	<10-66	µg/L	50
Iron	-	120-458	-	26-317	µg/L	300
Manganese	-	59-164	-	859-2260	µg/L	30
TOH	-	19-42	-	-	µg/L	N/A

Flag I Constituents:

Mn, Na, NO₃, TOH, Spec. Cond., Ba, Cl, pH, phenol, SO₄, TOC, Zn

TABLE J-28

**F-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	FBP-1A	FBP-2A	FBP-3A	FBP-4		
Gross Alpha	<2.0-16	-	-	<2.0-41	pCi/L	15
Nonvol. Beta	8.0-188	-	-	-	pCi/L	*
Manganese	19-83	-	-	-	µg/L	50
Nitrate-Nitrogen	1850-22,000	-	-	-	µg/L	10,000
Lead	<4.0-38	<4.0-26	-	-	µg/L	50
Radium	<1.0-8.0	-	-	<1.0-7.0	pCi/L	5
TOH	11-68	65-330	11-62	<5.0-840	µg/L	N/A
Trichloroethylene	20-23	98-105	-	-	µg/L	2.7
Carbon Tetrachloride	-	17	-	-	µg/L	0.4
Tetrachloroethylene	-	98-104	11-12	-	µg/L	0.8
Cadmium	-	-	<1.0-48	-	µg/L	10
Iron	-	-	19-323	-	µg/L	300

* Based on Dose

Flag I Constituents:

Ba, Na, Ni, Spec. Cond., %, Nonvol. B
Pb, SO₄, TOC

TABLE J-29

**K-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	KRP-1	KRP-2	KRP-3	KRP-4		
Lead	13-60	12-34	< 10-27	-	µg/L	50
TOC	300-55,900	-	-	-	µg/L	N/A
TOH	< 5.0- 35,950(?)	-	< 5-63	39-198.7	µg/L	N/A
Gross Alpha	-	< 2.0-20	-	-	pCi/L	15
Iron	-	-	25-434	-	µg/L	300
Manganese	-	-	-	126-167	µg/L	50
Tetrachloroethylene	-	-	-	79-140	µg/L	0.8

Flag I Constituents:

Cu, Fe, Mn, pH, tetrachloroethylene, TCE, Na, Pb, 50₄, B, Cl,
TOH, phenol, Ba, Cl, Spec. Cond., Nonvol., 8

TABLE J-30

**L-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	LRP-1	LRP-2	LRP-3	LRP-4		
Nitrate-N	600-163,900	-	-	-	µg/L	10,000
Lead	20-36	14-80	-	8-39	µg/L	50
Iron	-	-	52-312	-	µg/L	300

Flag I Constituents:

Fe, Ni, TOC, Ra, Mn, pH, Ag, TOH

TABLE J-31

**P-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	PRP-1A	PRP-2	PRP-3		
Iron	55-362	-	92-660	µg/L	300
Lead	27-74	< 10-31	35-52	µg/L	50
TOH	-	< 5.0-41	161-917	µg/L	N/A
Manganese	-	-	37-73	µg/L	50
Tetrachloroethylene	-	-	58-65	µg/L	0.8

Flag I Constituents:

Ba, Cu, Mn, Ni, TOC, α , , Cl, Spec. Cond., Na, Ra, Pb

TABLE J-32

**R-AREA RUBBLE PIT
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	RRP-1A	RRP-2	RRP-3	RRP-4		
Lead	13-46	18-35	< 10-26	-	µg/L	50
TOH	-	< 5.0-25	-	-	µg/L	N/A
Gross Alpha	-	-	-	< 2.0-18	pCi/L	15

Flag I Constituents:

Hg, TOC, TOH, B, CL, Fe, Mn, SO₄

TABLE J-33

ROAD A CHEMICAL BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.		Units	Applicable Standard
	BRD-1	BRD-3		
Manganese	46.0-98.0	32.0-135.0	µg/L	50
Lead	32.0-120.0	<4.0-28.0	µg/L	50

Flag I Constituents:

Fe, Mn, pH, SO₄, Ra, α, Ag

TABLE J-34

**716A OIL AND GREASE BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL2)**

Contaminant	Well No.		Units	Applicable Standard
	AOB-1	AOB-2		
Chromium	<4.0-55	-	µg/L	50
Endrin	.11-<1.45	-	µg/L	0.2
Tetrachlorethylene	36.11-52.0	-	µg/L	0.8
TOH	72-260	<5.0-27	µg/L	N/A
Trichloroethylene	6.0-38.55	-	µg/L	2.7

Flag I Constituents:

Fe, Ni, Phenol, TOC, Ra, Hg, Cr, Endrin, Mn, tetrachloroethylene.

TABLE J-35

**D - AREA OIL DISPOSAL BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	DOB-1A	DOB-2	DOB-3		
Iron	17-554	76-982	17-848	µg/L	300
TOH	<5.0-30	6.0-41	<5.0-29	µg/L	N/A
Manganese	-	9.0-53	-	µg/L	50

Flag I Constituents:

DpH, SO₄, TOC, Spec. Cond., phenol

TABLE J-36

**100L OIL AND CHEMICAL BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	LCO-1	LCO-3	LCO-4		
Nonvol. Beta	120	-	-	pCi/L	*
Chromium	<4.0-520	-	<4.0-100.5	µg/L	50
TOH	10-45	-	53-118.5	µg/L	N/A
Iron	-	56-410	-	µg/L	300
pH	-	6.8-10.1	-	pH	N/A
Tetrachloroethylene	-	6-7	-	µg/L	0.8
Mercury	-	-	<0.2-3.32	µg/L	2
Manganese	-	-	2.0-118	µg/L	50
Sulfate	-	-	143,000-620,000	µg/L	250,000
Radium	-	-	4.4-6.0	pCi/L	5
Tritium	-	-	390,000	pCi/L	20,000

* Based on Dose

Flag I Constituents:

Fe, Hg, Na, pH, SO₄, TOC, Spec. Cond., F, Fe, Se, CL
Cr, Pb, tetrachloroethylene, TOH, As, α, CL

TABLE J-37

**COAL PILE RUNOFF CONTAINMENT BASIN - A - AREA
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.			Units	Applicable Standard
	ACB-2A	ACB-3A	ACB-4A		
TOC	614-37,000	-	-	µg/L	N/A
Radium	<1-5	-	4-6	pCi/L	5
TOH	<5-25	-	-	µg/L	N/A
Mercury	-	<0.2-1.16	-	µg/L	2

Flag I Constituents:

Gross α Na, Phenol, SO₄, Fe, Mn, pH

TABLE J-38

**C-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.		Units	Applicable Standard
	CCB-1	CCB-3		
TOH	<5-34	-	µg/L	N/A
TOC	-	243-40,500	µg/L	N/A

Flag I Constituents:

Fe

TABLE J-39

**D-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.					Units	Applicable Standard
	DCB-1A	DCB-2A	DCB-3A	DCB-4A	DCB-5A		
Silver	10-39	-	-	-	-	µg/L	50
Gross Alpha	12-95	-	-	-	-	pCi/L	15
Beryllium	30-94	-	-	-	-	µg/L	20
Cadmium	20-26	-	-	-	-	µg/L	10
Chromium	124-176	-	-	-	-	µg/L	50
Copper	674-1,566	-	-	-	-	µg/L	1,000
Fluoride	1,050-2,450	-	-	-	-	µg/L	4,000
Iron (Fe)	101,000-986,000	<4-426	-	49-460	416-3,830	µg/L	300
Manganese	22,600-40,200	-	72-178	141-1,090	221-653	µg/L	50
Nickel	1,420-4,560	-	-	-	-	µg/L	350
Lead	50-196	-	-	-	-	µg/L	50
pH	2.4-2.65	-	-	-	-	pH	N/A
Selenium	<1-21	-	-	-	-	µg/L	10
Sulfate	470,000-748,600	-	-	177,000-290,000	95,000-215,000	µg/L	250,000
Radium	7-39	-	-	4-8	-	pCi/L	5
TOH	34-260	-	-	12-33	21-41	µg/L	N/A
Zinc	5,860-12,100	-	-	-	-	µg/L	5,000
Mercury	-	-	-	<0.2-1.04	-	µg/L	2

Flag | Constituents:

Nonvol. β, Cl, Spec. Cond., Na, Phenol, TOC, NO₃-N, Ba

TABLE J-40

**F-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	FCB-1	FCB-2	FCB-3	FCB-4		
Lead	49-276	-	-	-	µg/L	50
pH	11.6-12.4	-	-	-	pH	N/A
TOH	<5-139	<5-42.2	-	6-50.1	µg/L	N/A
Gross Alpha	-	-	25-37	-	pCi/L	15
Radium	-	-	10-22	-	pCi/L	5
Iron	-	-	-	60-1,050	µg/L	300

Flag | Constituents:

Ag, Ba, Spec. Cond. Cr, Cu, Na, Phenol, Zn, Nonvol. B, Mn

TABLE J-41

**H-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	HCB-1	HCB-2	HCB-3	HCB-4		
Iron	53-542	139-436	-	-	µg/L	300
Manganese	263-361	4,770-5,910	-	122-202	µg/L	50
TOH	<5-27	8-32	-	-	µg/L	N/A
Gross Alpha	-	35-158	-	-	pCi/L	15
Nonvol. Beta	-	80-116	-	-	pCi/L	*
Sulfate	-	78,000-112,500	-	-	µg/L	250,000
Radium	-	50-61	-	-	pCi/L	5
Lead	-	-	22-29	-	µg/L	50
TOC	-	-	-	410-30,670	µg/L	N/A

* Based on Dose

Flag I Constituents:

Ba, Cl, Spec. Cond., Cd, Cu, F, Na, pH, Zn

TABLE J-42

**K-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	KCB-1	KCB-2	KCB-3	KCB-4		
Gross Alpha	3-26	-	-	-	pCi/L	15
Radium	1-9	< 1-5	-	8-11	pCi/L	5
TOH	< 5-50.2	< 5-54.4	-	< 5-63.9	mg/L	N/A
Manganese	-	-	-	252-855	µg/L	50
Sulfate	-	-	-	30,000-172,000	µg/L	250,000

Flag I Constituents:

Nonvol. B, Spec. Cond., Na, Fe, Ba, Cu, F, Se, TOC, Cl

TABLE J-43

**K-AREA ASH BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	KAB-1	KAB-2	KAB-3	KAB-4		
Iron	13-562	-	12-535	349-1,250	µg/L	300
Manganese	5-268	197-411	-	17-54	µg/L	50
Sulfate	-	5,000-215,000	-	-	µg/L	250,000
TOH	-	<5-51	-	<5-34.6	µg/L	N/A
Radium	-	-	4-9	8-16	pCi/L	5
Gross Alpha	-	-	-	12-19	pCi/L	15

Flag I Constituents:

Nonvol. β, Cl, Spec. Cond., Cr, Na, pH, Phenol, Zn, Ni, Ba

TABLE J-44

**P-AREA COAL PILE RUNOFF CONTAINMENT BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	PCB-1A	PCB-2A	PCB-3A	PCB-4A		
Iron	160-7,390	40-482	120-25,900	31-626	µg/L	300
Manganese	451-7,150	32-96	1,060-5,790	71-81	µg/L	50
Sulfate	< 5,000-260,000	-	410,000-3,400,000	-	µg/L	250,000
TOH	< 5-29	-	-	6-37.6	µg/L	N/A
Lead	-	12-26	40-151	14-48	µg/L	50
Gross Alpha	-	-	< 2-45	-	pCi/L	15
Cadmium	-	-	< 2-15	-	µg/L	10
Nickel	-	-	435-450	-	µg/L	350
Selenium	-	-	4-8	-	µg/L	10
Radium	-	-	2-6	-	pCi/L	5

Flag I Constituents:

Ba, Spec. Cond., Hg, Na, TOC, Zn, Phenol, Ag, Be, Nonvol. B, Cr, Cu, F, pH

TABLE J-45

**F-AREA CANYON BUILDING
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.						Units	Applicable Standard
	FCA-2D	FCA-9D	FCA-10A	FCA-10D	FCA-16A	FCA-16D		
Manganese	1,630	382-392	360	-	-	56	µg/L	50
Nitrate-N	650,000	-	-	-	-	-	µg/L	10,000
Lead	367	202-205	34	162	-	37	µg/L	50
pH	2.57-2.58	-	-	2.32	-	-	pH	N/A
TOH	306	49	321	42	56	139	µg/L	N/A
Cadmium	-	-	8.0	-	-	-	µg/L	10
TOC	-	-	43,000	-	-	-	µg/L	N/A

Flag I Constituents:

Ag, Ba, Cd, sp. con., F, Na, Mn, pH, SO₄, Fe, NO₃, TOC

Note: There are additional elevated radioactive constituents.

TABLE J-46

A-AREA BACKGROUND WELL
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.	Units	Applicable Standard
	ABW-1		
Tetrachloroethylene	9.21-10	µg/L	0.8
TOH	< 5-100	µg/L	N/A
Trichloroethylene	10.75-14	µg/L	2.7

Flag I Constituents:

Gross α , Ci, Spec. Cond., Cr

TABLE J-47

HAWTHORNE FIRE TOWER BACKGROUND WELL
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.	Units	Applicable Standard
	GBW-1		
Lead	17-114	µg/L	50

Flag I Constituents:

Gross α, Cr, TOH

PRELIMINARY

TABLE J-48

**NAVAL FUELS BACKGROUND WELLS
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.					Units	Applicable Standard
	NBG-1	NBG-2	NBG-3	NBG-4	NBG-5		
Lead	76	-	69	49		µg/L	50
TOH	60	28			26	µg/L	N/A
Tritium	240,000	155,000				pCi/L	20,000
Manganese	-	151				µg/L	50
Nitrate-Nitrogen	-	15,250				µg/L	10,000
pH	-	-			9.35	pH	N/A

Flag I Constituents:

Nonvol. β, Mn, Na, NO₃, pH, α, As, Ba, Fe, TOH, H₃SO₄, Spec. Cond.

TABLE J-49

**S-AREA BACKGROUND WELLS
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No. 4	Units	Applicable Standard
	SBG-4		
TOH	32	µg/L	N/A

Flag I Constituents:

Hg, Pb, TOH

PRELIMINARY

TABLE J-50

HEAT EXCHANGER REPAIR FACILITY BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.	Units	Applicable Standard
	HXB-1		
TOH	< 5-28	µg/L	N/A

Flag I Constituents:

Cr, Ni, Phenol, pH

PRELIMINARY

TABLE J-51

**HAZARDOUS WASTE STORAGE AT CENTRAL SHOPS
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.		Units	Applicable Standard
	HWS-1A	HWS-2		
TOH	< 5.0-35.3	-	µg/L	N/A
Gross Alpha	-	< 2.0-19	pCi/L	15
Lead	-	< 5.0-34	µg/L	50

Flag I Constituents:

sp.con. B, Pb

TABLE J-52

**CENTRAL SHOPS HYDROFLUORIC ACID BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.				Units	Applicable Standard
	CSA-1A	CSA-2	CSA-3	CSA-4		
Lead	<4.0-35	-	-	-	µg/L	50
TOH	-	<5.0-40	<5.0-195.4	-	µg/L	N/A

Flag I Constituents:

Cr, F, NO₃, TOH, α, Pb, phenol, Se, TOC, Nonvol.

TABLE J-53

**CENTRAL SHOPS BURNABLE OIL BASIN
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)**

Contaminant	Well No.		Units	Applicable Standard
	CSO-1	CSO-2		
TOH	< 5-45		µg/L	N/A
Lead		9-28	µg/L	50

Flag I Constituents:

Cr, Phenol, TOC

PRELIMINARY

TABLE J-54

F-AREA "A"-LINE
GROUNDWATER CONTAMINANT DATA (FLAG LEVEL 2)

Contaminant	Well No.		Units	Applicable Standard
	FAL-1	FAL-2		
Iron	545	335	µg/L	300
Manganese	28750	201N/A	µg/L	
Lead	43	153	µg/L	
TOH	26	44	µg/L	

Flag I Constituents:

As, Spec. Cond., Na, pH, Phenol, SO₄, Ra

APPENDIX K

RADIOLOGICAL CRITERIA

PRELIMINARY

APPENDIX K

RADIOLOGICAL CRITERIA

This section discusses radiological criteria, dose calculation and related topics. To operate the Savannah River Plant (SRP), specific criteria must be met. These criteria stem from Federal and State laws and regulations, Executive Orders, and Department of Energy (DOE) Orders. Guidelines that address radiological criteria and, more specifically, dose to the members of the public are discussed below. Recent changes in DOE guidance warrant particular attention. The section on regulatory criteria is followed by a discussion of dosimetric terms used in the radiological protection regulations. A discussion on as-low-as-reasonably-achievable (ALARA) and guide values as well as dose calculations is also provided.

1.0 REGULATORY CRITERIA

The DOE has the responsibility under the Atomic Energy Act (AEA) to establish the necessary standards to protect members of the public from radiation exposures resulting from departmental activities. In addition, Presidential Order 12088, "Federal Compliance with Pollution Control Standards," requires that all Federal facilities comply with the legislative acts and regulations relating to the prevention, control, and abatement of environmental pollution.

1.1 DOE Criteria

This section presents those DOE regulations that establish dose standards for the general public.

1.1.1 DOE Order 5481.A

Until recently, DOE radiation protection standards were established in DOE 5480.1A, Chapter XI "Environmental Protection, Safety and Health Protection Program for DOE Operations" (revision 8/13/81). The exposure limits for individuals and population groups in uncontrolled areas (i.e., off-site) were:

<u>Type of Exposure</u>	<u>Annual Dose Equivalent or Dose Commitment (mrem)</u>	
	Based on dose to individuals at points of maximum probable exposure	Based on average dose to a suitable sample of the exposed population
Whole body, gonads, or bone marrow	500	170
Other organs	1,500	500

The limiting concentrations for specific radionuclides released to the environment in air and water were termed Concentration Guides (CG). The CGs, based upon the 500 mrem per year whole body exposure limits, were nearly identical to those used by the Nuclear Regulatory Commission (as promulgated in 10 CFR 20) and are based upon National Council on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP) recommendations originally set forth in ICRP 2.

1.1.2 Vaughan Memorandum

In 1984 in a paper providing guidance to the U.S. Environmental Protection Agency (EPA), the NCRP endorsed the recommendations of the ICRP to limit the continuous exposure of any member of the public from other than medical sources and natural background to 100 mrem per year whole body dose-equivalent. The previously recommended limit of 500 mrem per year was retained for non-continuous exposure. By memorandum, W. A. Vaughan, Assistant Secretary for Environment, Safety and Health (Vaughan, 85) put into effect these interim radiation protection standards, until they could be codified in a revision to DOE Order 5481.A. This reduction of the dose limit to 100 mrem per year for all pathways also reduced the discharge concentrations. Those new discharge concentrations, derived from the 100 mrem per year limit, were called Derived Concentration Guides (DCG).

The EPA limits from 40 CFR 61, Subpart H, which are 25 mrem per year to the whole body or 75 mrem per year to any organ, from air pathways only, were also included in the memorandum.

1.1.3 DOE Draft Order 5480.xx

A new draft DOE Order, DOE 5480.xx, "Radiation Protection of the Public and the Environment," was developed to integrate, consolidate, and update DOE public and environmental radiation protection standards and control practices. This draft order is discussed since it reflects the current policy regarding radiation protection and compliance with other Federal regulations. Specifically, DOE 5480.xx (revision 3/31/87): updates DOE 5480.1A, Chapter 11 (revision 8/13/81); adopts current guidance and standards issued by national and international authoritative bodies on radiation protection; incorporates current regulatory requirements applicable to DOE operations; and, consolidates and upgrades DOE monitoring, surveillance, and control practices. The following paragraphs provide additional background on specific aspects of the Order which are of most interest.

DOE 5480.xx adopts and implements dose standards consistent with the recommendations of the ICRP. In 1977, ICRP recommended a system of dose limitations which has been adopted and implemented by essentially all countries with nuclear programs. The ICRP system of dose limitations provides a scientific basis for health protection and selection of dose limits. The system also reflects current information on health risks, dosimetry, and radiation practices, and promotes a more uniform and consistent application of radiation protection among diverse activities. The ICRP system is based on sophisticated analytical models, and requires computer capabilities for evaluations or use of conversion tables produced from such evaluations. Although the ICRP system is precise, the terminology is complex. This terminology is discussed in Section 2.0.

In addition to adopting radiation standards for its own operations, DOE is also required to implement applicable rules and regulations of other Federal agencies, most of which have not adopted the ICRP system. The result is a mixture of dose standards, terminology, and units which DOE cannot alter. Therefore, some dose limits in DOE 5480.xx are expressed in terms of effective dose equivalent consistent with current ICRP recommendations, while others are expressed in terms of dose

equivalent to specific organs as used by other Federal agencies consistent with pre-1977 recommendations of ICRP.

The primary DOE dose limit for members of the public which is based on ICRP recommendations, includes consideration of exposure modes to all man-made sources except those used for medical purposes. The primary dose limit is expressed as an effective dose equivalent, which is a term developed by the ICRP for their risk-based system that requires the weighted summation of non-uniform doses to various organs of the body. Additional dose limits are established by EPA regulations for exposures to several selected sources or exposure modes (pathways or conditions). Dose limits promulgated by EPA for selected exposure modes are generally expressed as dose equivalent, which does not include risk-based weighting and summation of doses to various organs. DOE activities are to be conducted, to the extent practicable, in accordance with the contemporary risk-based system for protection against radiation. DOE must also comply with applicable EPA regulations and guidelines (e.g., 40 CFR 61, and 40 CFR 191) including administrative and procedural requirements.

The EPA regulations included in 5480 xx are discussed in Section 1.2. It should be noted that these limits, although numerically lower than DOE values discussed below, are for doses from limited specific pathways whereas the higher DOE limit is for the total dose from all pathways.

The DOE dose limit for members of the public from all exposure modes from all DOE sources of radiation is as follows:

The exposure of members of the public to radiation sources as a consequence of routine DOE activities and remedial actions shall not cause any individual to receive, in a year, an effective dose equivalent greater than 100 mrem. In addition, the exposure shall not cause a dose equivalent for any tissue (including the skin and the lens of the eye) greater than 5 rem, in a year, for members of the public.

The 100-mrem dose limit specified above is the sum of the effective dose equivalent (or deep dose equivalent, if dosimeter data are used) from exposures to radiation sources external to the body during the year plus the committed effective dose equivalent from radionuclides taken into the body during the year.

Doses from all exposure modes which could contribute significantly to the total dose shall be evaluated. The limits apply to the doses to individuals who are exposed to radiation or contamination by radionuclides: (1) at sites where public access is permitted; and, (2) at sites subsequent to "remedial action" and as a consequence of the release of surplus equipment and material for unrestricted use.

Note that DOE operators are required to report DOE dose contributions of 25 mrem or more, in a year.

1.2 EPA Criteria

This section presents EPA regulations that establish dose standards which affect DOE facilities. These standards are also included in DOE 5480.xx (August 15, 1986 and March 31, 1987 versions).

1.2.1 40 CFR 61

The National Emission Standards for Hazardous Air Pollutants (NESHAPS) include a standard for radionuclides released in air from DOE facilities (Subpart H, "National Emission Standard for Radionuclide Emissions from DOE Facilities"). The regulation states that airborne emissions of radionuclides from DOE facilities shall not exceed those amounts that cause a dose equivalent rate of 25 mrem/yr to the whole body and 75 mrem/yr to a critical organ of any member of the public. Doses due to radon-222, and their respective decay products are excluded from these limits. To determine compliance with the standard, the regulation states that the dose equivalent to members of the public shall be determined using EPA codes AIRDOS-EPA and RADRISK or other procedures, including those based on environmental measurements, that EPA has determined to be suitable. In most cases, compliance is determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public resides or abides.

1.2.2 40 CFR 141

The National Interim Primary Drinking Water Regulations implement the Public Health Service Act as amended, and establish standards applicable to public water systems. They promulgate maximum contaminant levels for radioactivity in community water systems, which are defined as public water systems that serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. The regulations specify that the average annual concentration of man-made radionuclides in drinking water as delivered to the user by such a system shall not result in an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr.

Specific annual average concentration limits are established for certain radionuclides and are as follows:

Tritium	$2 \times 10^{-5} \mu\text{Ci/ml}$	(20 pCi/ml = 20,000 pCi/l)
Sr-90	$8 \times 10^{-9} \mu\text{Ci/ml}$	(0.008 pCi/ml = 8 pCi/l)
Ra-226,228	$5 \times 10^{-9} \mu\text{Ci/ml}$	(0.005 pCi/ml = 5 pCi/l)
Total alpha (excluding Rn-222 & U)	$1.5 \times 10^{-8} \mu\text{Ci/ml}$	(0.015 pCi/ml = 15 pCi/l)

1.2.3 40 CFR 91

The Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes establish radiation protection standards for protection of the general public from disposal facilities regulated by the Nuclear Regulatory Commission (NRC) or Agreement States in part 191.03(a) and Department of Energy (DOE) facilities in part 191.03(b).

Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities for the disposal of such fuel or waste that are operated by the DOE and that are not regulated by the NRC or Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation

from such management and storage shall not exceed 25 millirems to the whole body and 75 millirems to any critical organ.

This regulation does not apply to most DOE facilities. However, DOE does consider the Waste Isolation Pilot Plant (WIPP) a disposal facility subject to 40 CFR 191.

2.0 DOSIMETRIC TERMINOLOGY

The purpose of this section is to clarify the dosimetric terminology used in the regulatory guidance and identify definitions that have been used in the report. Specific methodology for calculating the types of doses discussed is presented in Section 3.0.

The following definitions have been taken from DOE Order 5480.xx (revision 3/31/87):

As Low as Reasonably Achievable (ALARA) is a phrase (acronym) used to describe an approach to radiation exposure control or management whereby the exposures and resulting doses are maintained as far below the limits specified for the appropriate circumstances as social, economic, technical, and practical considerations permit.

Derived Concentration Guide (DCG) is the concentration of a radionuclide in air or water which, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water or submersion or inhalation of air), for one year, a "reference man" would receive the most restrictive of: (1) an effective dose equivalent of 100 mrem; or, (2) a dose equivalent of 5 rem to any tissue, including skin and lens of the eye. (DCG values are presented in Attachment-1 of 5480.xx).

Dose Terms

- (1) Absorbed Dose is the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad.
- (2) Deep Dose Equivalent, as used in this Order, means the dose equivalent at a depth of 1 centimeter in tissue from external (penetrating) radiation.

- (3) Dose Equivalent is the product of absorbed dose in rad in tissue, a quality factor, and other modifying factors. Dose equivalent is expressed in units of rem.
- (4) Effective Dose Equivalent is the summation of the products of the dose equivalent and weighting factor for each tissue. The weighting factor is the decimal fraction of the risk arising from irradiation of a selected tissue to the total risk when the whole body is irradiated uniformly to the same dose equivalent. These factors permit dose equivalents from non-uniform exposure of the body to be expressed in terms of an effective dose equivalent that is numerically equal to the dose from a uniform exposure of the whole body that entails the same risk as the internal exposure. The weighting factors recommended by the ICRP are used. For purposes of this Order, the effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent due to penetrating radiation from sources external to the body and is expressed in units of rem.
- (5) Committed Dose Equivalent is the predicted total dose equivalent to a tissue or organ, over a 50-year period after an intake of a radionuclide into the body. It does not include contributions from external dose. Committed dose equivalent is expressed in units of rem.
- (6) Committed Effective Dose Equivalent is the sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem.
- (7) Collective Dose Equivalent and Collective Effective Dose Equivalent are the sums of the dose equivalents or effective dose equivalents of all individuals in an exposed population within 50 miles, for the purposes of this Order, and are expressed in units of person-rem. (This is often called the population dose).

- (8) Quality Factor is the principal modifying factor used to calculate the dose equivalent from the absorbed dose. For the purposes of this Order, quality factors, which are consistent with ICRP Publication 30, are to be used.

3.0 ALARA AND GUIDE VALUES

ALARA is an acronym for a radiation protection concept (defined in Section 2.0) which means keeping the radiation dose as low as reasonably achievable. To ensure compliance with applicable regulations and to maintain and/or reduce off-site radiation doses consistent with the ALARA principle, the SRP assigns to each major facility that releases radioactive effluents an annual release guide. These annual guide values are internal plant administrative guides, not regulatory limits, and are well below any values derived from regulatory limits. These plant guides should not be confused with DOE Concentration Guides (CGs) or their replacement, the new Derived Concentration Guides (DCGs) that are based upon limiting the off-site annual dose to 100 mrem. The latter values are regulatory limits.

Annual (plant) guides are target values used to keep releases ALARA. They are total quantities of specific radionuclides, rather than concentrations, that can be released from a facility annually. The guide values are determined each year by management based upon the control equipment available, the capacity of the facility, and/or its expected annual production (all of which affect releases). These annual guides are then divided by 12 to obtain monthly guide values. Guide values are sufficiently restrictive that 10 to 20 percent of the facilities may exceed one or more of the guides (target values) during the year. When this occurs, the offending parameter is flagged, investigated, and tracked with both Dupont and Savannah River Operations Office (SR) management being notified via a monthly effluent report.

4.0 RADIATION DOSE TO THE PUBLIC

Various regulations, such as DOE Orders and the EPA regulations previously discussed in Section 1.0, limit the annual radiation dose to personnel on-site (occupational workers) and to personnel off-site (general public). Because of these regulations, it is necessary for each site to calculate annual doses.

To comply with the differing regulations regarding radiation dose to members of the general public, different methods must be used to determine their dose. There are three general methods of determining the doses, which correspond roughly to the pathways (or exposure mode) of receiving the dose. The dose can be received by:

- 1) Direct radiation from an on-site facility or radioactive material stored there.
- 2) Radiation from the airborne effluents (radioactive materials released from the facility) while airborne or on the soil, and dose resulting from uptake through the food chain.
- 3) Radiation from liquid effluents (radioactive materials released from the facility), including uptake through the food chain, uptake through drinking water and radiation received from recreational activities.

For most civilian nuclear power plants and for most DOE sites, the predominant radiation dose delivered to the public is through the airborne effluent pathway. The second largest dose is usually delivered through the liquid pathway. Direct radiation from on-site facilities is usually minimal.

Because of reduction of direct radiation levels with distance and the dilution of airborne and liquid effluents that usually occur over distance, the highest dose rate is usually located closest to a site (i.e., at the perimeter). The dose to the maximally exposed person (usually a hypothetical person) is determined based upon the person receiving the highest dose from all pathways and it is assumed the person resides at the site boundary.

TLDs are placed at the SRP site boundary to determine the direct radiation component of the dose. SRP normally obtains liquid and airborne samples at the release point (effluent samples), near the site boundary, and outside the site (environmental samples). In the environmental samples, some radionuclides are near or below the limits of detection using standard analytical methods. Therefore, mathematical models must be used together with effluent data to calculate the

concentration and resulting dose at the site boundary and at other off-site locations.

For a number of years, SRP has been using standard models (such as GASPAR and LADTAP) for calculating maximum and average doses to off-site individuals from atmospheric and liquid releases. These models were developed for the nuclear industry and approved by the Nuclear Regulatory Commission (NRC). GASPAR was modified to meet the requirements for input of specific SRP physical and biological data, but the basic calculational methods were not modified. The SRP version of GASPAR (MAXIGASP and POPGASP) was verified by comparing calculated to measured concentrations in the environment for measurable radionuclides. EPA did some comparisons during a study in December 1982 and compared its model against the modified NRC model used by SRP.

In 1985 SRP updated its dose calculation methodology to comply with Secretary Vaughan's memo. Basically, SRP changed from ICRP 2 data and methodology to that of the newer ICRP 30. A comparison of the different annual doses that resulted by using the old and new dose factors is shown below. In general, the dose to the maximally exposed individual and to the population was reduced to approximately 70 percent and 60 percent, respectively, of the value calculated with the old dose factors.

Comparison of 1985 Off-Site Doses

<u>Atmospheric Releases</u>	<u>ICRP 2</u>	<u>ICRP 30</u>
Maximum individual (mrem)	1.22	0.90
Population (person-rem)	68.3	42.3
<u>Liquid Releases</u>		
Maximum individual (mrem)	0.68	0.46
Population (person-rem)	10.0	5.6

To comply with NESHAPS (40 CFR 61, 1985), SRP must calculate the dose from airborne radioactive emissions using the EPA code (AIRDOS-EPA), since the EPA has not yet officially approved the codes SRP is using. The EPA does not take into consideration local topography and has some very conservative default values that must be used. As a result, higher doses are calculated with this code than with the NRC codes SRP is using. As a comparison, the atmospheric values calculated for 1985 by SRP are:

Comparison of 1985 Airborne Doses

<u>Atmospheric Releases</u>	<u>SRP Code</u>	<u>AIRDOS-EPA</u>
Maximum individual (mrem)	0.90	1.36
Population (person-rem)	42	125

No matter which code is used, SRP can demonstrate compliance and is only a few percent (6 percent or less) of the 25 mrem/yr EPA limit.

The above atmospheric codes take into account the effect of eating contaminated food products since location of crops and domestic animals, and average consumption rates are relatively well known in the 50-mile (80-km) radius around SRP. However, they do not take into account eating contaminated wildlife (such as deer, hogs, ducks, and turtles) since parameters (such as quantity of animals, average consumption rates, average radioactivity, etc.) are small or vary widely. The number of successful hunters on the SRP site (approximately 1,200 annually) is small (0.2 percent) relative to the 80 km population (555,000). Approximately 90 percent of the game taken is deer and for the last 18 years the average cesium-137 concentration in deer on-site has been approximately the same as deer in the South Carolina Coastal Plains (SCCP). However, the maximum cesium-137 concentration of deer taken at SRP is about 3 times that of an SCCP deer (DuPont 86).

For 1985, if the hunter who killed the most-contaminated deer (30 pCi/kg of cesium-137) ate all the meat, he would receive a 50 year dose commitment of 18 mrem. If there were 4 people in the family and the meat were shared equally, this

value would drop to 4.5 mrem, and if friends were invited to share the meat, the maximum dose to an individual might drop to 1 mrem. Likewise, a turtle captured on-site in 1986 had 3,600 pCi/g of strontium-90 in the flesh. If one pound of flesh were consumed by an individual, the 50-year committed dose to this individual would be 80 mrem (see Section 3.2.3.5 for discussion on wildlife). The consumption rate for wildlife in these cases is not known well enough to calculate the correct dose to an individual, but the maximum hypothetical doses for deer and turtle (18 and 80 mrem) are sufficiently large in comparison with the calculated dose to the theoretical maximally exposed individual (approximately 1 mrem), that it might be more appropriate for the doses to be reported in the annual environmental monitoring report off-site dose section (with appropriate explanations and caveats), in addition to the animal monitoring section (where it is reported).

5.0 REFERENCES

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