Savannah River Site Radionuclide Air Emissions Annual Report, WSRC-IM-94-26, 1993

by
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Savannah River Site
Aiken, South Carolina 29808

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SAVANNAH RIVER SITE
RADIONUCLIDE AIR EMISSIONS
ANNUAL REPORT
FOR
National Emission Standards for
Hazardous Air Pollutants

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Date: 12/22/93

1993 REPORT
SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H, 40 CFR 61.94)
Calendar Year 1993

Site Name
Savannah River Site

Site Location
Western Part of Central South Carolina
Near Aiken, South Carolina
Aiken, Barnwell and Allendale Counties

Field Office Information
Office: Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

Contact: A. B. Gould       Phone: (803) 725-3969

Site Information
Operator: Westinghouse Savannah River Company
P.O. Box 616
Aiken, South Carolina 29802

Contact: M. D. Dukes       Phone: (803) 725-2696
Figure 1. Savannah River Site
Section I. Facility Information

Site Description

Until 1988, the Savannah River Site (SRS) produced plutonium, tritium, and other special nuclear materials for national defense, other government programs, and some civilian purposes. While SRS still handles some nuclear material for government uses and civilian purposes, the major focus has shifted to waste management and environmental restoration.

The SRS is located in the west-central region of South Carolina and borders Georgia along the Savannah River on the eastern side. The site occupies approximately 300 square miles (one-fourth the size of Rhode Island), principally in Barnwell and Aiken Counties (Figure 1). The site is located in a rural environment where the average population density in the surrounding counties is 85 people per square mile. The largest concentration of people is in the Augusta, Georgia metropolitan area, approximately 20 miles from the site. Based on 1990 U.S. Census Bureau data, the population within a 50-mile radius (80 km) of SRS is approximately 620,100.

The countryside surrounding the site is composed of forest lands interspersed with farm lands. The principal farm crops are cotton, soybeans, corn, and small grains. Farming also includes the production of cattle and other farm animals. Essentially all site land not used for production facilities contains forests, principally pine trees, that are managed by the U.S. Forest Service.

The climate in west-central South Carolina is mild with a frost-free season of approximately 250 days. Rainfall averages approximately 50 inches per year and is distributed throughout the year. Temperatures are mild with the average daily maximum temperature ranging from 55 to 92 degrees Fahrenheit. Average daily relative humidity ranges from 36 to 98 percent and the average monthly wind speed ranges from 6.6 to 8.1 miles per hour (Hunter, 1990).

SRS is a National Environmental Research Park and serves as a refuge for five endangered species of wildlife — wood storks, bald eagles, red-cockaded woodpeckers, shortnosed sturgeons, and peregrine falcons. Other wildlife commonly found on the site include alligators, white-tailed deer, wild turkeys, and otters.

Nuclear materials production activities at the SRS were significantly curtailed in 1993 because the reactors and related processes were off-line for repairs, modifications, and upgrades. The following descriptions, which apply to normal operations, provide insight into the general categories of radionuclides handled in the facilities.

The SRS production process begins at the Reactor Materials plant. Raw materials, such as uranium, are processed to produce fuel and target assemblies for use in the SRS reactors.

At the Reactor plants, fuel and target assemblies are loaded into a reactor tank where a controlled nuclear reaction takes place. After irradiation, the assemblies are discharged to underwater storage facilities (disassembly basins) for cooling until fission products have decayed sufficiently for processing. They are then shipped to a separations or tritium plant where desired products are recovered.

Radioactive liquid wastes (principally high level fission and activation products) are stored in underground tanks for future processing in the In-Tank Precipitation (ITP) Facility and the
Defense Waste Processing Facility (DWPF) before shipment to a federal repository for permanent storage. Although the ITP Facility and DWPF are not yet operational, an associated plant (Saltstone) that stabilizes and stores low level radioactive residual waste began operation in 1990.

The Savannah River Technology Center provides research and development for site operations.

Radioactive materials used at SRS include source, by-product, and special nuclear materials as well as radioactive waste. These radioactive materials contain a variety of fission and activation products, tritium and actinides.

**Source Description**

This section contains general descriptions of SRS facilities, processes, and categories of radionuclides handled. Refer to Section II for specific radionuclide data.

Facilities which released radionuclides to the atmosphere in 1993 are grouped according to the principal function that results in the release of the radioactive materials as shown in Table 1.

**Reactor Materials**

There were no fuel and target assemblies produced in 1993 because of the change in mission of the SRS reactors. The following discussion describes the materials that the plants are designed to produce.

In Reactor Materials facilities (M-Area) enriched uranium-aluminum and lithium-aluminum alloys and aluminum-clad depleted uranium metal targets are processed. There are three major areas of production: target production, fuel production, and slug production. The slug production facilities were in a transition status in preparation for and as part of the de-inventory of materials from the facilities.

**Target Production.** Targets are made of lithium-aluminum and irradiated in the reactors for the production of tritium. In the target manufacturing process, lithium and aluminum are induction-melted and cast into cylindrical molds in the alloying process. Billets assembled from the castings are extruded into logs that are assembled into cores for extrusion into target tubes. Aluminum housings are mechanically formed around end fittings to complete the assemblies.

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**Table 1. Operational Groupings and Function**

<table>
<thead>
<tr>
<th>Group</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor Materials</td>
<td>Production of fuel and targets for irradiation in SRS reactors</td>
</tr>
<tr>
<td>Reactors</td>
<td>Irradiation of fuel and targets to produce nuclear materials</td>
</tr>
<tr>
<td>Separations</td>
<td>Separation of useful radionuclides (other than tritium)</td>
</tr>
<tr>
<td>Analytical Laboratories</td>
<td>Reactor and Separations process control laboratories</td>
</tr>
<tr>
<td>Tritium</td>
<td>Extraction, purification, and packaging of tritium</td>
</tr>
<tr>
<td>High Level Waste Management</td>
<td>Management of radioactive liquid waste</td>
</tr>
<tr>
<td>Solid Waste Management</td>
<td>Management of radioactive and mixed solid wastes</td>
</tr>
<tr>
<td>Savannah River Technology Center</td>
<td>Research and development to support SRS processes</td>
</tr>
</tbody>
</table>
Fuel Production. Enriched uranium and high-purity aluminum are melted in cylindrical graphite molds. Castings are machined into cores, then assembled into clean aluminum housings and welded to form a billet. The billets are heated and extruded through dies into tubular logs. They are then sectioned and machined into smaller cores for assembly into a second billet. Extrusion process steps are repeated to extrude these billets into fuel tubes. The tubes are cut, assembled, cleaned, and inspected before shipment to the reactors.

Slug Production. A canning process is used to produce aluminum-clad, depleted-uranium targets for the production of plutonium. In the process, cylindrical hollow, depleted uranium cores are nickel-plated, assembled into an aluminum can, and capped with aluminum on top of the core. The cap at the open end of the can is welded to the inner and outer aluminum can walls. These slugs are bonded in a die-sizing process at elevated temperatures. When fabrication is complete, the finished slug is cleaned, visually and ultrasonically inspected, and heat-pressure-tested before shipment to the reactors.

Uranium-235 and 238 (U-235, 238) are the principal radioactive materials used in M-Area processes.

Reactors

All five production reactors originally constructed at SRS, were in non-operational standby mode. Unlike commercial reactors which produce electricity, the SRS reactors are used exclusively to irradiate target assemblies to make tritium and special nuclear materials. Because of this, they operate at low temperatures and pressures.

The SRS reactors are shielded vessels that are constructed of half-inch thick stainless steel with a one-inch thick bottom. They are 15 feet high by 16 feet wide and hold approximately 600 fuel and target assemblies. The assemblies are bombarded by neutrons during the nuclear fission reaction.

Radioactive materials used in reactors are source materials that are subsequently irradiated to produce by-product and special nuclear materials as well as fission and activation product waste. The nuclear materials are contained in cladding around the fuel and targets and, therefore, are not normally released to the environment.

When the reactors are on-line the principal radionuclides released to the environment are tritium, Argon-41 (Ar-41), and other noble gases. The tritium is contained in the heavy water moderator and is released when moderator comes in contact with air. Ar-41 is produced in the annular cavity around the reactor vessel and is vented to the atmosphere continuously. Other noble gases and small amounts of tritium are contained in a blanket gas system which must be periodically purged to the atmosphere.

When the reactors are not on-line noble gases are not present in air effluents. Tritium, the principal contributor to dose from SRS reactors and fission products released during outages result from exposure of heavy water moderator and system internals to air when openings occur for maintenance activities.

Separations

The SRS has one separation plant located in each of F- and H-Areas. The missions of these plants are to recover U-235 and Neptunium-237 (Np-237) from spent reactor fuel; recover Plutonium-239 (Pu-239) from irradiated, depleted uranium targets; and convert Pu-239 to metal. The site also has installations for separating Np-237 and Pu-238 and producing Pu-238 heat sources for use in space and other purposes.
Radioactive materials used in the Separations plants include source, by-product, and special nuclear materials as well as fission and activation product waste.

**F-Area.** The F-Area canyon (building 221-F) processes reactor targets containing Pu-239 and depleted uranium to produce plutonium and depleted uranium oxide powder. The canyon is a heavily shielded facility that is partitioned into multiple processing cells where operations and maintenance are performed remotely.

In the F-Area Canyon, aluminum-clad targets are dissolved and processed through several solvent extraction cycles to remove fission products and separate the Pu-239 from the uranium. Purified Pu-239 solution is transferred to the 221-FB-Line where it is concentrated, precipitated, and reduced to metal form.

There are several other installations within the area that support the F-Area Canyon and FB-Line. They include the Analytical Laboratories (discussed later), A-Line, where depleted uranium is processed, the 800-series of storage tanks, and other miscellaneous installations.

Two other F-Area installations, the 247-F Naval Fuel Facility and the 235-F Plutonium Fuel Forms Facility were in cold standby, but effluents from these facilities were routinely monitored.

**H-Area.** The H-Area Canyon (221-H) uses a modified solvent extraction process to recover enriched uranium. The canyon also recovers Np-237 and Pu-238 in a facility similar to F Area. Purified Pu-238 and Np-237 are transferred to 221-HB-Line where the solutions are concentrated, precipitated, and calcined to oxide products.

The Receiving Basin for Offsite Fuels (RBOF), which is also located in H-Area, receives spent fuel from offsite research reactors for storage and preparation for processing.

Atmospheric effluent air emissions from F- and H-Area Separations plants contain tritium, activation products, fission products, and actinides.

**Analytical Laboratories**

Analytical Laboratories provide support, principally process control sample analyses, for Reactor Materials, Reactors, Separations, Tritium, and Waste Management. Laboratories operated by Analytical Laboratories include the reactor support laboratory in D-Area and separations/waste management support laboratories in F-Area. Other Analytical Laboratories operations are included within operating department plants.

In the D-Area laboratory, the principal radionuclide handled is tritium. Inventories of activation and fission products are very small. The F-Area laboratories handle activation products, fission products, and actinides.

**Tritium**

The Tritium Facilities are located in H-Area adjacent to the Separations plant. Tritium is produced by heating irradiated lithium/aluminum targets, extracting the resulting gases under a vacuum, and separating the tritium from other hydrogen and helium isotopes. These plants also unload and load tritium into containers for shipment to other DOE locations.

In 1993, tritium was released in both the elemental (gas) and oxide (water vapor) forms. These emissions resulted primarily from reprocessing (loading, unloading and purification) operations with existing tritium reserves.
High Level Waste Management

The principal High Level Waste Management installations are the tank farms and associated waste handling operations (F- and H-Areas), the Effluent Treatment Facility (H-Area), and the Saltstone Facility (Z-Area). Radioactive materials used in these installations contain principally waste by-product materials with traces of source and special nuclear materials.

Tank Farms. In the tank farms, radioactive high level liquid waste, principally from the F- and H-Area Canyon separation processes, is stored and processed to reduce volume. The waste is stored in underground tanks that hold approximately one million gallons each. There are four types of tanks varying in design from a primary tank enclosed within a secondary tank to a single tank system. The tank assemblies are typically surrounded by a 30-inch-thick reinforced concrete wall. For tank systems with secondary containment, the annular space between the primary tank and the secondary tank provides a buffer zone that is monitored for leakage. In the event of a leak from the primary tank, corrective action would be taken to prevent leakage through the secondary tank to the environment. Tank systems without the secondary tank are currently scheduled to be emptied.

Waste handling operations associated with the waste tanks include diversion boxes, pump pits, and evaporators. Ventilation systems for these sources vary; some have no active ventilation, while others maintain negative pressure (approximately -0.5 in. of water) on the structure to ensure that the direction of unfiltered air flow is into the potentially contaminated structure. Effluent controls also vary, generally based on the risk from the facility. For the majority of the tank systems, the exhaust air is treated to remove moisture, heated to prevent condensation at the filters, filtered by HEPA filters, and sampled/monitored for radioactive particulates prior to release to the atmosphere. Exhaust ventilation systems for other waste handling operations include an air mover system, HEPA filtration, and sampling/monitoring for radioactive particulates prior to release to the atmosphere.

Although a supernate is present, most of the high-level radioactive waste in the storage tanks is contained in a salt solution or heavy sludge and does not volatilize. However, a continuous purge of air over the surface of the waste is required to prevent combustible elemental hydrogen from accumulating. The hydrogen is produced by radiolysis (breaking down of water molecules by radiation).

Tritium, activation products, fission products, and traces of actinides are contained in the waste.

Effluent Treatment Facility. This installation treats and removes most chemical and radioactive contaminants from wastewater before releasing the water to Upper Three Runs Creek. Wastewater from the F- and H-Tank Farms evaporators, the F- and H-Separations plants and other SRS facilities are processed in this facility. The primary constituents of the wastewater are tritium, activation products, fission products, and traces of actinides.

Saltstone Facility. The Saltstone Facility started radioactive operations on June 12, 1990. The material being processed is principally waste from the Effluent Treatment Facility.

The waste solution is mixed with cement, fly ash, and furnace slag to form a grout. The grout is then pumped into a large concrete vault. Here it cures into stable concrete. Each vault is 600 feet long, 100 feet wide, and 25 feet tall. The vaults are divided into six sections. Each vault has a moveable steel roof that moves on railroad wheels and covers two sections as they are filled.
After filling, the vault will be capped with clean concrete to isolate it from rain and weathering. Final closure of the area will consist of covering multiple vaults with a clay cap and back filling with earth. Low concentrations of tritium, activation products, fission products, and traces of actinides are processed in this installation.

Solid Waste Management

Solid Waste Facilities. Solid radioactive wastes generated at SRS and other DOE facilities are buried in the Solid Waste Disposal Facility (SWDF) - located in E-Area between F- and H-Areas. The SWDF consists of separate trenches for wastes contaminated with intermediate-level and low-level radioactivity. Types of waste buried in the SWDF include contaminated equipment, waste from laboratory operations (e.g., gloves, beakers), and scrap and tools used in reactor areas and job control waste from various generators. Mixed waste is stored in N- and E-Areas on concrete storage pads awaiting future treatment and disposal. Transuranic waste is stored in E-Area on pads awaiting processing and eventual shipment to WIPP. Spent Canyon solvent is stored in underground storage tanks prior to transfer to new tanks to be located adjacent to the Consolidation Incineration Facility (CIF), between H- and S-Areas. The solvent will eventually be burned in CIF.

Savannah River Technology Center

The Savannah River Technology Center (SRTC), which is located in A-Area, is an applied research and development laboratory that provides technical support for the operation of the site. A brief description of SRTC activities is:

- supports radioactive waste management and tritium operations,
- performs environmental studies for the site, supports the chemical separations processes, and provides a technical library,
- supports the development, revision and/or review of safety analysis specifications and technical standards and provides risk management support to all SRS activities,
- performs a variety of research and development functions including remote operations and robotics, special equipment instrumentation development, and operational maintenance and engineering services for the laboratory,
- supports reactor operations and fuel and target manufacturing, and provides computer support, and
- provides support in the areas of university relations, technology transfer, and program integration.

Because research and development requires the use of small quantities of radioactive materials included in site processes, SRTC handles small quantities of source, by-product and special nuclear materials as well as radioactive wastes generated on the site.
SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

Section I. Air Emissions Data

Air Emission Sources

The radiological air emission sources at the SRS have been divided into three categories, Point, Grouped and Non-Point, for this report. Point sources, analyzed individually, are listed in Table 3 along with a listing of the control devices, and the control device efficiency. The sources listed in Table 4 have been grouped together either for security reasons or where individual samples are composited for analytical purposes. For grouped sources (Table 4) the listed control devices may not be on all sources within a group. Both Tables 3 and 4 contain point sources that did not have continuous effluent monitoring/sampling in 1993. The emissions from these sources, identified with a "***", was determined from Health Protection smear data, facility radionuclide content or other calculational methods, including process knowledge, utilizing existing analytical data. Table 2, provides a subset of the sources from Tables 3 & 4 which have a potential effective dose equivalent exceeding 0.1 mrem/yr (0.001 mSv/yr).

The final group of radionuclide emitting sources included in the dose calculations was the non-point sources. This group includes seepage basins, burial grounds, open pits and tanks, etc. A listing of these sources is given in Table 6.

Table 5 lists all identified radionuclides that contributed to the site dose. The table also includes a listing of the percent contribution of the radionuclide to the Total Site EDE. Although releases from the non-point sources are included in Table 5, a separate listing, Table 7, is provided for non-point sources only. When radionuclide concentrations below detection limits of specific radionuclide methods, the gross beta-gamma and the gross alpha were assumed to be Sr-90 and Pu-239, respectively. These gross values are included in the respective radionuclide quantity in both Tables 5 and 7.

Distance to Nearest Receptor

Distance to the nearest receptor is defined as the distance from each source to any member of the public at any offsite point where there is a residence, school, business, or office. The data provided for SRS installations in Tables 3 and 4 identifies the distance and the direction to the nearest residence, business, or farm. These data are provided to comply with 40 CFR 61.94 (a) and (b). The data for the center of SRS which was used to determine EDE to any member of the public at an offsite point where there is a residence, school, business or office is given in Table 8.

Because of the difficulty (inaccessibility, locked gates, closed private property, etc.) and expense in physically determining the nearest offsite receptor, U.S. Forest Service aerial photographs that were taken January 28, 1989 were used to identify the nearest offsite point where there is a residence, school, business, or office, (structure) or farm (cultivated field). It is assumed that all exposure pathways exist at the appropriate photograph features.

The adjacent offsite environment is largely rural. No significant short-term movement into or out-of these areas is expected. Therefore, aerial photographs, which are made every four to five years, should provide a sufficient degree of accuracy.

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### Table 2. Sources with PEDE > 0.1 mrem/yr (0.001 mSv/yr)

<table>
<thead>
<tr>
<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm (Direction) (Meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>773-A B Stack</td>
<td>HEPA Filters</td>
<td>&gt; 99.9</td>
<td>NNW 1360</td>
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<tr>
<td>773-A C Stack</td>
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<td>791-A Sand Filter Stack</td>
<td>Charcoal</td>
<td>99.99</td>
<td>NNW 1360</td>
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<td></td>
<td>HEPA Filters</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Sandfilter</td>
<td>&gt; 99.9</td>
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<td>NW 9350</td>
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<td></td>
<td>Fiberglass Filter</td>
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<td></td>
<td>AgNO3 Absorb</td>
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<td>772-4F</td>
<td>HEPA Filters</td>
<td>&gt; 99.9</td>
<td>NW 9350</td>
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<td>&gt; 99.9</td>
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<td></td>
<td>AgNO3 Absorb</td>
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<td>Tritium Facilities (5)</td>
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<td>321-M Machining Room</td>
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<td>&gt; 99.9</td>
<td>NNW 1320</td>
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</table>

**Notes:**
1) Numbers in () denote number of sources in a grouped source
2) 1 meter = 3.328 feet
3) 772-4F previously listed as 772-F
<table>
<thead>
<tr>
<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm</th>
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<td>HEPA</td>
<td>&gt; 99.9</td>
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<td>WNW 10210</td>
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<tr>
<td>C Reactor Disassembly Area</td>
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<td>717-C Hot shop</td>
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<td>643-E HPS</td>
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## Table 3. Point Sources

<table>
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<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm (Meters)</th>
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<tbody>
<tr>
<td>* 643-29E</td>
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<td>* 724-7E</td>
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<td>* 724-3E</td>
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<td>6.1D Dissolver off-gas stack (F-Area)</td>
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<td>* 211-F Truck Shed</td>
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<td>* 232-F Tritium Facility</td>
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<td>* 242-16F</td>
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### Table 3. Point Sources

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<thead>
<tr>
<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm (Direction) (Meters)</th>
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## Table 3. Point Sources

<table>
<thead>
<tr>
<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm (Direction) (Meters)</th>
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<tbody>
<tr>
<td>643-E Solvent Tank 25</td>
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<td>643-E Solvent Tank 27</td>
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<td>643-E Solvent Tank 28</td>
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<td>643-E Solvent Tank 29</td>
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<td>643-E Solvent Tank 30</td>
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<td>643-E Truck Trailer</td>
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<td>645-2N (709-2G)</td>
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<td>717-G (L-Area)</td>
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<td>728-G (Central Shops)</td>
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<td>Ford Building (Central Shop)</td>
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<td>221-HB Line Soft Structure</td>
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<td>241-68H</td>
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<td>241-92H</td>
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<td>242-H</td>
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<td>242-76H</td>
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<td>291-H Stack</td>
<td>AgN03 Absorb</td>
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<td>NNW 11770</td>
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<tr>
<td>230-H Beta-Gamma Incinerator</td>
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<td>&gt; 99.9</td>
<td>NNW 11770</td>
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</table>
# SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

## Table 3. Point Sources

<table>
<thead>
<tr>
<th>Point Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm</th>
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<tr>
<td>253-H Waste Compactor</td>
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<td>NNW 11770</td>
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<td>299-H Maintenance Bldg</td>
<td>HEPA Filters</td>
<td>&gt; 99.9</td>
<td>NNW 11770</td>
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<td>241-81H ETF Process Stack</td>
<td>HEPA Filters</td>
<td>&gt; 99.9</td>
<td>NNW 11770</td>
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<tr>
<td>241-84H ETF Lab &amp; Control Bldg</td>
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<td>&gt; 99.9</td>
<td>NNW 11770</td>
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<td>K Reactor Stack</td>
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<td>WSW 10860</td>
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<td>K Reactor Stack</td>
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<td>K Reactor Disassembly Area</td>
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<td>NA</td>
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<tr>
<td>K Area HP Hood</td>
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<td>WSW 10860</td>
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<td>313-M Autoclave</td>
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<td>770-U (HWCTR)</td>
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<td>704-Z Laboratory and Offices</td>
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<td>&gt; 99.9</td>
<td>NNW 10360</td>
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<td>551-Z Low Point Drain Tank</td>
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<td>210-Z Saltstone Manufacturing</td>
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<td>NNW 10360</td>
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Notes:
1) *** Installations for which emissions were determined by calculational methods
2) 1 meter = 3.328 feet
3) Facilities renumbered: 773-A Sand Filter to 791-A
772-F to 772-4F
643-G Solvent Tanks to 643-E
241-84H ETF Process Stack to 214-81H
241-H ETF Lab & Control Building to 241-84H
# Table 4. Grouped Sources

<table>
<thead>
<tr>
<th>Grouped Source</th>
<th>Type Control</th>
<th>Control Efficiency (percent)</th>
<th>Distance To Nearest Residence, Business, or Farm (Direction) (meter)</th>
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<td>777-10A (2)</td>
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<td>421-2D Moderator Rework (3)</td>
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<td>772-D Reactor Labs (3)</td>
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<td>F Area Waste Tanks Annul (10)</td>
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<td>Tritium Facilities (5)</td>
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Notes:
1) Numbers in "()" are the total number of sources.
2) "**" installations for which emissions were determined by calculational methods.
3) 1 meter = 3.328 feet
### Table 5.
1993 Emissions
From all Sources

<table>
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<th>Radionuclide</th>
<th>Annual Quantity (Curies)</th>
<th>Percent of Total Site Dose</th>
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<td>H-3 (oxide)</td>
<td>1.33E+05</td>
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<td>Pu-238</td>
<td>1.21E-03</td>
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<tr>
<td>Pu-239</td>
<td>1.08E-03</td>
<td>0.6</td>
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<tr>
<td>U-235,238</td>
<td>1.92E-03</td>
<td>0.4</td>
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<tr>
<td>I-129</td>
<td>4.96E-03</td>
<td>0.2</td>
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<tr>
<td>Am-241,243</td>
<td>1.43E-04</td>
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<tr>
<td>Cm-242,244</td>
<td>5.64E-05</td>
<td>0.03</td>
</tr>
<tr>
<td>Cs-137 (Ba-137m)</td>
<td>6.34E-04</td>
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<td>Sr-90 (Y-90)</td>
<td>2.27E-03</td>
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<td>C-14</td>
<td>1.69E-02</td>
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<td>H-3 (elemental)</td>
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<td>1.48E-04</td>
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<td>1.96E-03</td>
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<td>Cs-134</td>
<td>1.49E-06</td>
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<td>Xe-135</td>
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<td>Co-60</td>
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<td>Ni-63</td>
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<tr>
<td>Eu-154</td>
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<tr>
<td>Ce-144 (Pr-144,144m)</td>
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<td>0.0000000000000003</td>
</tr>
<tr>
<td>Eu-155</td>
<td>1.63E-13</td>
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<tr>
<td>Sb-125</td>
<td>7.27E-15</td>
<td>0.0000000000000002</td>
</tr>
<tr>
<td>Zr-95 (Nb-95)</td>
<td>2.39E-14</td>
<td>0.0000000000000002</td>
</tr>
</tbody>
</table>

Note: † Curie = 3.7E10 Bq
### Table 6. Non-point Sources

<table>
<thead>
<tr>
<th>Non-point Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Seepage Basin</td>
</tr>
<tr>
<td>D Drum Wash Tank A</td>
</tr>
<tr>
<td>D Drum Wash Tank B</td>
</tr>
<tr>
<td>K Contaminated Water Tank</td>
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<tr>
<td>K Contaminated Basin</td>
</tr>
<tr>
<td>K Sand Filter</td>
</tr>
<tr>
<td>K Settler Tank</td>
</tr>
<tr>
<td>L Sand Filter</td>
</tr>
<tr>
<td>L Seepage Basin</td>
</tr>
<tr>
<td>L Settler Tank</td>
</tr>
<tr>
<td>P Sand Filter</td>
</tr>
<tr>
<td>P Seepage Basin</td>
</tr>
<tr>
<td>P Settler Tank</td>
</tr>
<tr>
<td>SRL Seepage Basin</td>
</tr>
<tr>
<td>828-29E</td>
</tr>
<tr>
<td>849-E</td>
</tr>
<tr>
<td>849-7E</td>
</tr>
<tr>
<td>241-F Tanks 1-8 Annuli (6)</td>
</tr>
<tr>
<td>241-F DB1</td>
</tr>
<tr>
<td>241-F DB3</td>
</tr>
<tr>
<td>241-23F</td>
</tr>
<tr>
<td>241-97F</td>
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<td>607-1F</td>
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<tr>
<td>004-47G *</td>
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</tr>
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<td>607-24H</td>
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<td>316-M</td>
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<td>451-Z</td>
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* Previously listed as 904-49G

### Table 7. Non-point Sources Emissions

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Annual Quantity (Ci)</th>
</tr>
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<tbody>
<tr>
<td>H-3 (oxide)</td>
<td>4.31E+01</td>
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<tr>
<td>Sr-90</td>
<td>1.07E-04</td>
</tr>
<tr>
<td>Pu-239</td>
<td>3.22E-07</td>
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</tbody>
</table>

Note: 1 Curie = 3.7 E+0 Bq
Section III. Dose Assessment

Description of Dose Model

The software referred to as the Clean Air Act Assessment Package - 1988 (CAP-88) was used to determine the Effective Dose Equivalent (EDE) to the maximally exposed offsite individual (Beres, 1990). The computer program that models environmental transport in CAP-88 is AIRDOS-EPA. This program uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six co-located sources. AIRDOS-EPA computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from inhalation of air and ingestion of food produced in the assessment area.

The computer program PREPAR is used to prepare the input data for AIRDOS-EPA. Input data includes the agricultural productivity data, population distributions, and meteorological data. PREPAR also passes on information concerning the fraction of food assumed to be home-grown, taken from production within the 80-kilometer assessment area, and imported from outside the assessment area.

Dose and risk are estimated by the program DARTAB which uses the EPA supplied library of dose and risk factors. DARTAB combines the inhalation and ingestion intake rates, and the air and ground surface concentration output from AIRDOS-EPA with the dose and risk factors from the RADRISK database. DARTAB lists the dose and risk to the maximally exposed individual, the average exposed individual, and the dose to the collective population. Doses and risks are further tabulated as a function of radionuclide, pathway, location, and organ.

Summary of Input Parameters

To determine the location of the maximally exposed individual using CAP-88, all sources are modeled as if they were co-located at the same point, the center of the site.

The distance to the nearest members of the public for each of the sixteen 22.5 degree sectors used in CAP-88 and a description of the nearest offsite residence, school, business, or office (structure) or farm (cultivated field) is shown in Table 8. The location of the sixteen sectors is shown in Figure 2.

SRS input parameters (Hamby, 1991) developed for the site and used in all dose assessment codes, including CAP-88, are provided in Table 9. All other input parameters not listed in Table 9 or not discussed in this section are those supplied as default values with CAP-88.

The H-Area meteorological joint frequency data from 1987 to 1991, which is the most recent 5 year average, was used in the SRS dose assessment model because the H tower data are quality assured data from a meteorological tower near the center of the site with wind rose characteristics typical for other site towers. The joint frequency data is provided in Table 10. The method of collection and analysis of joint frequency data is given in Weber, 1993. Copies of appropriate data contained in the CAP-88 printout are provided in Appendix A.

Beef, milk, vegetable and leafy-vegetable production data (Hamby, 1991) utilized as input is provided in Appendix A. The population data used as input is taken from 1990 census data and is reproduced in Appendix A.
Compliance Assessment

Total Site Effective Dose Equivalent (all sources): 0.18 mrem, * (1.8E-03 mSv)

Location of Maximally Exposed Individual: Structure in N Sector (16100 meters)

* Note: The Effective Dose Equivalent from Non-point sources, which is included in the Total Site EDE, was 8.0E-5 mrem (8.0E-7 mSv).

Table 8. Location of Nearest Individual to the Center of SRS (a)

<table>
<thead>
<tr>
<th>Description</th>
<th>Sector</th>
<th>Distance (meters)</th>
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<tr>
<td>Cultivated field</td>
<td>S</td>
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<td>Cultivated field</td>
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<td>17,230</td>
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<tr>
<td>Structure/field</td>
<td>SW</td>
<td>16,420</td>
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<tr>
<td>Cultivated field</td>
<td>W</td>
<td>14,170</td>
</tr>
<tr>
<td>Cultivated field</td>
<td>WNW</td>
<td>13,850</td>
</tr>
<tr>
<td>Structure</td>
<td>NW</td>
<td>14,650</td>
</tr>
<tr>
<td>Structure</td>
<td>NNW</td>
<td>15,300</td>
</tr>
<tr>
<td>Structure</td>
<td>N</td>
<td>16,100</td>
</tr>
<tr>
<td>Cultivated field</td>
<td>NNE</td>
<td>16,260</td>
</tr>
<tr>
<td>Structure</td>
<td>NE</td>
<td>17,550</td>
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<tr>
<td>Structure</td>
<td>ENE</td>
<td>16,580</td>
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<tr>
<td>Allied Nuclear Plant</td>
<td>E</td>
<td>13,200</td>
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<tr>
<td>Cultivated field</td>
<td>ESE</td>
<td>15,300</td>
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<tr>
<td>Cultivated field</td>
<td>SE</td>
<td>15,300</td>
</tr>
<tr>
<td>Cultivated field</td>
<td>SSE</td>
<td>15,300</td>
</tr>
</tbody>
</table>

(a) Distance from the geographic center of the SRS to the nearest offsite point where there is a residence, school, business, office or farm.
Figure 2. Sector Map of SRS and Vicinity (50 Mile Radius)
### Table 9. SRS-Specific Usage Values *

<table>
<thead>
<tr>
<th>Land Usage Statistics</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
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<tr>
<td>Beef-cow forage consumption (dry)</td>
<td>kg/day</td>
<td>11 (a)</td>
</tr>
<tr>
<td>Agricultural productivity (pasture grass)</td>
<td>kg/sq m</td>
<td>1.8</td>
</tr>
<tr>
<td>Transport time (feed-milk-man)</td>
<td>days</td>
<td>4</td>
</tr>
<tr>
<td>Fraction of time cattle on pasture</td>
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<td>0.67</td>
</tr>
<tr>
<td>Fraction of intake from pasture</td>
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<td>0.66</td>
</tr>
<tr>
<td>Time from slaughter to consumption</td>
<td>days</td>
<td>6</td>
</tr>
<tr>
<td>Fraction of leafy vegetables from garden</td>
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</tr>
<tr>
<td>Fraction of other vegetables from garden</td>
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<td>0.76</td>
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<tr>
<td>Agricultural productivity (produce/veg.)</td>
<td>kg/sq m</td>
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<tr>
<td>Crop exposure time</td>
<td>days</td>
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<tr>
<td>Human consumption of produce</td>
<td>kg/yr</td>
<td>160</td>
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<tr>
<td>Human consumption of milk</td>
<td>L/yr</td>
<td>126</td>
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<tr>
<td>Human consumption of meat</td>
<td>kg/yr</td>
<td>43</td>
</tr>
<tr>
<td>Human consumption of leafy-Veg.</td>
<td>kg/yr</td>
<td>21</td>
</tr>
<tr>
<td>Soil surface density</td>
<td>kg/sq m</td>
<td>240 (b)</td>
</tr>
<tr>
<td>Annual rainfall rate</td>
<td>cm/yr</td>
<td>121 (c)</td>
</tr>
<tr>
<td>Average Absolute Relative Humidity</td>
<td>g/cc/ cm.</td>
<td>11.4 (d)</td>
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<tr>
<td>Mean annual temperature</td>
<td>°C</td>
<td>18</td>
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</tbody>
</table>

(a) Estimated assuming forage is 75% water
(b) Assuming a soil density of 1.6 g/cm³
(c) From historical meteorological records
(d) Hamby, 1990b
* Hamby, 1991
### Table 10. Meteorological Data

#### FOR EACH STABILITY CLASS

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DATE:</strong> TUE 19 APRIL, 1994 10:41:51 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>CATEG.</strong></td>
<td><strong>NORTH WIND SPEEDS (M/W.)</strong></td>
<td><strong>WIND FREQ.</strong></td>
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<td></td>
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<tr>
<td><strong>HDG</strong></td>
<td>2.457</td>
<td>3.082</td>
<td>4.697</td>
<td>4.935</td>
<td>1.160</td>
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<td><strong>HDG</strong></td>
<td>1.311</td>
<td>1.880</td>
<td>2.449</td>
<td>3.235</td>
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<tr>
<td><strong>HDG</strong></td>
<td>1.750</td>
<td>2.370</td>
<td>3.000</td>
<td>3.650</td>
<td>2.645</td>
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<td><strong>HDG</strong></td>
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<td>2.760</td>
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<td>2.965</td>
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<td><strong>HDG</strong></td>
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<td>2.365</td>
<td>2.985</td>
<td>3.565</td>
<td>2.565</td>
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<td><strong>HDG</strong></td>
<td>2.140</td>
<td>2.750</td>
<td>3.360</td>
<td>3.950</td>
<td>2.950</td>
<td>2.950</td>
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<tr>
<td><strong>HDG</strong></td>
<td>1.735</td>
<td>2.345</td>
<td>2.955</td>
<td>3.545</td>
<td>2.545</td>
<td>2.545</td>
</tr>
<tr>
<td><strong>HDG</strong></td>
<td>2.135</td>
<td>2.745</td>
<td>3.355</td>
<td>3.945</td>
<td>2.945</td>
<td>2.945</td>
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<tr>
<td><strong>HEIGHT OF LID</strong></td>
<td>1.000 (M)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>RAINFALL RATE</strong></td>
<td>1.322 (CM/HR)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>AVERAGE AIR TEMPERATURE</strong></td>
<td>1.730 (DEG C)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>SURFACE ROUGHNESS LENGTH</strong></td>
<td>2.00 (CM)</td>
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<td><strong>HEIGHT OF WIND MEASUREMENTS</strong></td>
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<td><strong>AVERAGE WIND SPEED</strong></td>
<td>3.02 (M/S)</td>
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</tbody>
</table>

**Comments:**
- The table provides a detailed analysis of meteorological data for each stability class, including wind speeds and frequencies.
- The data is grouped by categories, with each category having specific wind speeds and corresponding frequencies.
- The table also includes additional meteorological parameters such as rainfall rate, average air temperature, surface roughness length, and height of wind measurements.

**1993 Report**
References


Hamby, D. 1990a. Sector-Specific Distances to the Nearest Housing Structure, Business, or Cultivated Field for NESHAP Compliance Reports, SRL-ETS-900115. March 1990. Savannah River Laboratory, Aiken, SC.

Hamby, D. and C.E. Jumper 1990b. Average Absolute Humidity at the Savannah River Site, SRL-ETS-900141, March 1990, Savannah River Laboratory, Aiken, SC.


Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. The SRS monitoring systems from which the data in this report is collected predate the regulatory scheme and are currently being upgraded to meet the EPA requirements. These upgrades are proceeding according to the schedules contained in the Federal Facility Compliance Agreement for Radionuclide NESHAP.

Name  J. F. Jordan
Title  Vice President & General Manager ESH&QA Division
Signature  
Company Official, Authorized Representative of Owner  Date  6/14/94

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Section IV. Additional Information

Construct-Modify Waivers

In 1993, the SRS did not complete any construction projects for which approval to construct or modify was waived under 40 CFR 61.96.

Unplanned Releases

All unplanned releases were included in the Total Site EDE and the Collective Effective Dose Equivalent dose presented in Attachment I.

On March 9, 1993, during routine compaction of Low Level radioactive waste, a small unplanned release occurred. A maximum of 1.67 Ci (6.18 E10 Bq) of elemental tritium was released.

On December 22, 1993, during a routine loading operation in the Tritium Facilities, approximately 8 Ci (2.96E11 Bq) of elemental tritium was released to the atmosphere.

Between December 27 and 28, 1993, during a routine transfer between F-Areas underground tanks approximately 188 μCi (6.96 E06 Bq) of Pu-238 and 24 μCi (8.88 E05 Bq) of Pu-239 was released via the air pathway.

Unmonitored Point Sources and Diffuse Sources

All sources without emissions sampling/monitoring, both point and diffuse sources, at the SRS were evaluated for potential emissions by 40 CFR 61 Appendix D methodology. There were no point sources that exceeded 0.1 mrem/yr (0.001 mSv/yr) by these conservative methods. All calculations were based on actual field data, such as Health Protection smear data, physical analysis of tank contents, or known radionuclide inventory through the installation. As a result of these evaluations, the SRS was informed by the EPA-TV that all sources should now be considered monitored.

The realistic releases from sources without continuous sampling/monitoring were determined based on either the Hazard Index methodology (NRC, 1991) or known radionuclide release rates from similar facilities (i.e. a seepage basins release approximately 30% of the tritium inventory in the basin). The calculated radionuclide releases were included in the CAP-88 input data set.

References

Subparts Q and T of 40 CFR 61

Subpart Q applies to DOE facilities that store or dispose of waste radium-containing materials in sufficient concentration to exceed the standard and Subpart T to the disposal of uranium mill tailings. There are no known applications of these subparts at SRS.

Emission of Rn-220 from Sources Containing U-232 and Th-232

At SRS, there are no known release of Ra-220 from sources containing U-232 and/or Th-232 where emissions could potentially exceed 0.1 mrem/yr (0.001 mSv/yr) or 10% of the non-radon dose to the public.

Emission of Rn-222 from non-disposal/non-storage Sources

At SRS, there are no known release of Rn-222 from non-disposal/non-storage sources where emissions could potentially exceed 0.1 mrem/yr (0.001 mSv/yr) or 10% of the non-radon dose to the public.

Status of Compliance With Subpart H

An evaluation of all known radionuclide sources was initially completed in 1991 at SRS. A subsequent evaluation was performed in 1992 using the sources physical location for modelling purposes. As a result of these evaluations thirteen point sources with potential emissions greater than 0.1 mrem/yr (0.001 mSv/yr) were identified. Of those point sources exceeding the 0.1 mrem/yr (0.001 mSv/yr) threshold for potential emissions, seven where identified as needing monitoring upgrades. The Department of Energy and the Environmental Protection Agency entered into an Interim Federal Facility Compliance Agreement (June 28, 1991) which was subsequently replaced by a Federal Facility Compliance Agreement (FFCA) on October 30, 1991. This agreement, amended on August 16, 1993, contains schedules to achieve compliance for the seven facilities. The SRS has completed all required actions contained in the FFCA as scheduled and is in compliance with the agreement.

The elements of the QA program are in place at SRS. A Final Draft QA Project Plan (QAPP) was in place in 1992. The final QAPP was issued in March 1993.

The site is currently bound by the QAPP to continue periodic confirmatory measurements as outlined in the Appendices to that document. This program is based on information submitted in Spreadsheet 3, *SRS Air Effluent Sampling Data*, (ESH, 1991), which was prepared for and submitted to EPA-IV in 1991. A phased approach to periodic confirmatory measurements, based on potential EDE has been developed and approved by the EPA-IV as part of the QAPP.
Facility Operational Status

As requested by EPA-IV, Table 11 has been prepared to tabulate SRS facility operational status. Since the mission of the DOE has changed and will continue to change based on world events, the FY 95 projected facility status is also subject to change.

References

## Table 11. Source Operational Status

<table>
<thead>
<tr>
<th>Effluent Identification</th>
<th>Custodian</th>
<th>1993 * Operational Status</th>
<th>Projected FY 95 * Operational Status</th>
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(1) The Plutonium Storage Facility (221-F) did not operate. Currently, 221-F is physically incomplete; plans are to complete facility post FY94.

(2) Facility is out of service. Plans are to close the facility as part of Environmental Restoration Projects.

(3) Stack is valved out.

(4) All contamination in the facility is fixed.

(5) Old burial ground. Covered and not in use.

(6) These tanks are not in use. A plan for permanent close is under development. The tanks do contain contaminated solvents.

(7) Future operation of this facility is under review.

* CODES FOR TABLE

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<td>2</td>
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Note: Facility number changes are listed with Tables 3, 4 and 6.
## SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

### Appendix A
Computer Printouts

**ID CODE:**

**DATE/TIME:** TUE 19 APRIL, 1994 10:49:50 AM

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**SITE INFORMATION**

- **TEMPERATURE:** 10°C
- **RAINFALL:** 122 CM/yr
- **MIXING HEIGHT:** 1000 METERS

**EMISSION INFORMATION**

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**EMISSIONS**

**FOOD SUPPLY FRACTIONS**

| VEGETABLE | 0.700 | 0.000 | 0.558 |
| MEAT      | 0.442 | 0.000 | 0.360 |
| MILK      | 0.399 | 0.000 | 0.601 |

**FOOD ARRAYS WERE NOT GENERATED OR SUPPLIED FOR THIS RUN. DEFAULT VALUES USED.**

**DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT**

16100

**REFERENCE FILE NAMES FOR ASSESSMENT**

- **JCL FILE:** `TENVT.IMECA.JCL(CAP&BIND)`
- **INPUT FILE:** `TENVT.DATA.CAP85(INPUTIND)`
- **ALLRAD FILE:** `TENVT.DATA.CAP85(ALLRAD86)`
- **STARRFILE:** `TENVT.DATA.CAP85(TH88286)`
- **PREDI FILE:** `TENVT.DATA.CAP85(PRDIND)`
- **RISK FILE:** `TENVT.RADRISK.DATA`
### SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

**Appendix A**

Computer Printouts, Con'd

---

**DATE** TUE 19 APRIL, 1994 10:49:50 AM

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**NUMBER OF NUCLIDES** NNUCS=29

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## Appendix A
Computer Printouts, Con'd

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**NOTE:** VG SET TO ZERO FOR AIRDOS UNLESS GREATER THAN 1.000E-02

**NOTE:** ANLAM SET TO ZERO FOR AIRDOS UNLESS GREATER THAN 1.000E-02
### SRS Radionuclide Air Emissions Annual Report

**Appendix A**

Computer Printouts, Con'd

**DATE** TUE 19 APRIL, 1994 10:49:50 AM

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36 1993 Report
### SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

Appendix A
Computer Printouts, Con’d

#### Beef Production Grid (kg/sq meter)

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# SRS RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

## Appendix A

Computer Printouts, Con'd

### Vegetable Production Grid (kg/sq meter)

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**1993 Report**
Appendix A
Computer Printouts, Con’d

DATE TUE 19 APRIL, 1994 10:49:50 AM
THE LOCATION USED FOR THE SELECTED INDIVIDUAL EXPOSURE IS
16100 METERS N FROM THE SOURCE.
The LIFETIME FATAL CANCER RISK IS 4.88E-06.

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*** SELECTED INDIVIDUAL ***

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<td>2.08E-01</td>
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PATHWAY DOSE/EXPOSURE SUMMARY

*** SELECTED INDIVIDUAL ***

DOSE RATES:

| WEIGHTED SUMS OF ORGAN DOSE RATES |
| PATHWAYS: INGESTION INHALATION AIR GROUND IMMERSION SURFACE |
| DOSE EQUIVALENT (mrem/y) | 1.29E-01 | 5.34E-02 | 2.08E-08 | 8.71E-05 |

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<th>INTERNAL</th>
<th>EXTERNAL</th>
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### NUCLIDE DOSE/EXPOSURE SUMMARY

#### SELECTED INDIVIDUAL

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<tr>
<th>Nuclides</th>
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<th>Zr-95</th>
<th>Nb-95</th>
<th>Ru-106</th>
<th>PR-144M</th>
<th>PR-144</th>
<th>Eu-154</th>
<th>Eu-155</th>
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<tr>
<td>Dose Rates</td>
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<td>1.71E-17</td>
<td>1.71E-17</td>
<td>8.68E-09</td>
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<td>8.68E-09</td>
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<th>Co-60</th>
<th>Mo-99</th>
<th>Ru-106</th>
<th>Ru-147</th>
<th>Cs-131</th>
<th>Cs-134</th>
<th>Cs-137</th>
<th>Ba-137M</th>
<th>Ce-144</th>
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<td>Dose Rates</td>
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**DATE** TUE 19 APRIL, 1994 10:49:50 AM

**1993 Report** 41
### MVALUES FOR RADIONUCLIDE-INDEPENDENT VARIABLES

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<tr>
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<tr>
<td>NUMBER OF NUCLIDES CONSIDERED</td>
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<tr>
<td>TIME DELAY--INGESTION OF PASTURE GRASS BY ANIMALS (HR)</td>
<td>0.09E+00</td>
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<tr>
<td>TIME DELAY--INGESTION OF STORED FEED BY ANIMALS (HR)</td>
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<tr>
<td>TIME DELAY--INGESTION OF LEAFY VEGETABLES BY MAN (HR)</td>
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<tr>
<td>TIME DELAY--INGESTION OF PRODUCE BY MAN (HR)</td>
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<td>REMOVAL RATE CONSTANT FOR PHYSICAL LOSS BY WEATHERING (PER HOUR)</td>
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<tr>
<td>PERIOD OF EXPOSURE DURING GROWING SEASON--PASTURE GRASS (HR)</td>
<td>0.72E+03</td>
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<td>PERIOD OF EXPOSURE DURING GROWING SEASON--CROPS OR LEAFY VEGETABLES (HR)</td>
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<td>AGRICULTURAL PRODUCTIVITY BY UNIT AREA (GRASS-COW-MILK-MAN PATHWAY (KG/SQ. METER))</td>
<td>0.15E+01</td>
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<td>AGRICULTURAL PRODUCTIVITY BY UNIT AREA (PRODUCE OR LEAFY VEGETABLES (HR))</td>
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<tr>
<td>FRACTION OF YEAR ANIMALS GRAZE ON PASTURE</td>
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<td>FRACTION OF DAILY FEED THAT IS PASTURE GRASS WHEN ANIMAL GRAZES ON PASTURE</td>
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<tr>
<td>CONSUMPTION RATE OF CONTAMINATED FEED OR FORAGE BY ANIMAL IN KG/DAY (DRY WEIGHT)</td>
<td>0.11E+02</td>
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<tr>
<td>TRANSPORT TIME FROM ANIMAL FEED-MILK-MAN (DAY)</td>
<td>0.30E+01</td>
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<tr>
<td>RATE OF INGESTION OF PRODUCE BY MAN (KG/YR)</td>
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</tr>
<tr>
<td>RATE OF INGESTION OF MILK BY MAN (LITERS/YR)</td>
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<tr>
<td>RATE OF INGESTION OF MEAT BY MAN (KG/YR)</td>
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<tr>
<td>RATE OF INGESTION OF LEAFY VEGETABLES BY MAN (KG/YR)</td>
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<td>AVERAGE TIME FROM SLAUGHTER OF MEAT ANIMAL TO CONSUMPTION (DAY)</td>
<td>0.60E+01</td>
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<td>FRACTION OF PRODUCE INGESTED GROWN IN GARDEN OF INTEREST</td>
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<tr>
<td>FRACTION OF LEAFY VEGETABLES GROWN IN GARDEN OF INTEREST</td>
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<td>PERIOD OF LONG-TERM AVOIDP FOR ACTIVITY IN SOIL (YEARS)</td>
<td>0.36E+02</td>
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<tr>
<td>EFFECTIVE SURFACE DENSITY OF SOIL KG/SQ. M. DRY WEIGHT. (ASSUMES 15 CM PLOW LAYER)</td>
<td>0.24E+03</td>
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<td>VEGETABLE INGESTION RATIO--IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA</td>
<td>0.16E+01</td>
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<td>Description</td>
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<td>MEAT INGESTION RATIO-IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA</td>
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<td>MINIMUM FRACTIONS OF FOOD TYPES FROM OUTSIDE AREA</td>
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<td>MINIMUM FRACTION MEAT INGESTED FROM OUTSIDE AREA</td>
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<td>MINIMUM FRACTION MILK INGESTED FROM OUTSIDE AREA</td>
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<td>INHALATION RATE OF MAN (CUBIC CENTIMETERS/HR)</td>
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<td>BUILDUP TIME FOR RADIOACTIVITY DEPOSITED ON GROUND AND WATER (DAYS)</td>
<td>0.16E+05</td>
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<tr>
<td>DILUTION FACTOR FOR WATER FOR SWIMMING (CM)</td>
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<td>FRACTION OF TIME SPENT SWIMMING</td>
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<td>MUSCLE MASS OF ANIMAL AT SLAUGHTER (KG)</td>
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<td>FRACTION OF ANIMAL HERD SLAUGHTERED PER DAY</td>
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<td>MILK PRODUCTION OF COW (LITERS/DAY)</td>
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<td>FALLOUT INTERCEPTION FRACTION-VEGETABLES</td>
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<td>FALLOUT INTERCEPTION FRACTION-PASTURE</td>
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<td>FRACTION OF RADIOACTIVITY RETAINED ON LEAFY VEGETABLES AND PRODUCE AFTER WASHING</td>
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<td>TOTAL AREA OF VEGETABLE FOOD CROPS (SQUARE METERS)</td>
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<td>TOTAL MEAT CONSUMPTION (KG PER YEAR)</td>
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<td>TOTAL MEAT PRODUCTION (KG PER YEAR)</td>
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<td>TOTAL MILK CONSUMPTION (LITERS/YEAR)</td>
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SYNOPSIS REPORT - CAP-68 (1.00)

ID CODE: WWWW-12345678
DATE/TIME: TUE 19 APRIL, 1994 10:49:50 AM

FACTORITY: WESTINGHOUSE SAVANNAH RIVER COMPANY
ADDRESS: SAVANNAH RIVER SITE
CITY: AIKEN
STATE: SC
ZIPCODE: 29801

SOURCE CATEGORY: DOE FACILITIES

COMMENTS:
1993 SRS OPERATING RELEASES TO ATMOSPHERE (INDIVIDUAL RUN)
1987-91 MET DATA FROM ONSITE TOWERS

INDIVIDUAL AT MAXIMUM RISK ASSESSMENT
(RN-222 RISKS EXCLUDED)

LOCATION TO THE INDIVIDUAL: 16100 METERS NORTH

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<th>ORGAN</th>
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<th>LUNGS</th>
<th>THYROID</th>
<th>ENDOST</th>
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