



U.S. DEPARTMENT OF  
**ENERGY**

Savannah River Site

S A V A N N A H R I V E R S I T E

**Environmental Management Cleanup Program**

# Work Scope Descriptions and Glossary of Terms



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# Liquid Waste

## Work Scope Description

The U.S. Department of Energy (DOE) Environmental Management (EM) Cleanup Program is categorized by functional areas called Program Baseline Summaries (PBS) which describe the scope, schedule and cost of cleanup work to be performed.

### **PBS 14, Radioactive Liquid Tank Waste Stabilization and Disposition**

This PBS includes the removal, treatment, storage, and disposal of radioactive liquid waste stored in tanks and, ultimately, tank closure. This includes the operation of the Defense Waste Processing Facility (DWPF), waste tank farms, the Actinide Removal Process (ARP), Modular Caustic Side Solvent Extraction Unit (MCU), the Saltstone Production Facility (SPF), the Saltstone Disposal Facility (SDF), the Effluent Treatment Facility (ETF), and future waste facilities including the design, construction, and operation of the Salt Waste Processing Facility (SWPF), Saltstone Disposal Units (SDUs) and additional glass waste storage capacity. This PBS also covers the safe surveillance and maintenance of its program operational facilities through facility deactivation until the facilities are transferred to PBS 30 for decommissioning.

## Glossary of Terms

### **Canisters produced**

Canisters produced is the total number of canisters (2 feet in diameter by 10 feet tall stainless steel containers) filled at DWPF. These canisters are the final waste form for safe storage and geologic disposal of the highly radioactive waste components stored in the SRS radioactive liquid waste tank farms. The highly radioactive components of the salt and sludge wastes is mixed with glass beads that look like sand called frit and melted together in DWPF to form a glass. This molten glass is poured from the melter into the canister, where it cools and solidifies. The canisters are typically filled with about 4,000 pounds of glass.

### **Curie**

The amount of radioactivity in 1 gram of the isotope radium-226. One curie is 37 billion radioactive disintegrations per second.

## Liquid Waste *(continued)*

### **Curies stabilized**

Curies stabilized is the calculated value of curies of radioactive waste that have been immobilized within the glass structure of filled canisters, within the grouted saltstone in the Saltstone Disposal Units, and those immobilized within the grout in regulatory closed grouted waste storage tanks. This value is based on analytical sample results from individual sludge and salt batches, and emptied tanks.

### **Radioactive liquid waste**

Radioactive waste generated from dissolving used reactor fuels to recover uranium, plutonium and other isotopes. It is usually found in the form of a liquid, a saltcake or a sludge (peanut butter consistency). The liquid waste storage tanks at SRS include strontium-90, cesium-137, plutonium-238, plutonium-239, plutonium-241, various uranium isotopes, Technetium and others.

Because of the intense radiation fields, all waste storage tanks are built underground and all process work is done remotely or with proper shielding to protect workers and the public from radiation.

Treatment of the radioactive liquid waste separates high activity components from the low activity components. Sludge is washed during the preparation of sludge for vitrification in the Defense Waste Processing Facility (DWPF). The decanted liquid from sludge washing joins the salt waste. The salt waste is treated in the Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU) process or, in the future, Salt Waste Processing Facility (SWPF) to separate the low activity components into a low-level waste (LLW) stream for mixing with cementitious materials (cement, flyash and slag) in the Saltstone Production Facility (SPD) and disposition in the Saltstone Disposal Facility (SDF). The higher activity components are vitrified in DWPF. This treatment results in an approximately 10-to-one reduction in the amount of waste that must be vitrified.

### **Stabilization**

Conversion of chemically active or readily dispersible matter into an inert or less harmful form.

## Liquid Waste *(continued)*

### Salt and sludge

Radioactive liquid waste stored in tanks can generally be characterized as being either salt or sludge.

**Salt** Waste containing soluble radioactive elements (generally cesium and trace amounts of other soluble elements) that are dissolved in the waste liquid. The salt waste can be further characterized as being:

**Supernate:** liquid containing the dissolved radionuclides and sodium nitrate salts in a caustic solution with the majority of the soluble radionuclides.

**Concentrated Supernate:** liquid supernate that has had liquid removed by evaporation

**Salt Cake:** sodium nitrate portion of waste that has crystallized following evaporation

**Sludge** Waste containing iron, aluminum and insoluble radioactive elements (generally strontium, plutonium, and uranium as metal hydrides) that have settled to the bottom of waste tanks.

A single tank can contain sludge, supernate and salt cake, although an effort is made to segregate the sludge and salt by tank.

### Salt solution processed

The volume of salt solution from Tank 50 that are treated at the SPF to produce grout by mixing the low-level waste (LLW) liquid stream with cementitious materials (cement, flyash and slag). The LLW liquid waste stream results after the highly effective removal of the bulk of the radionuclides from the non-radioactive salts in the waste. At present, the ARP/MCU accomplishes this separation. In the future, this separation will be accomplished at a larger scale in SWPF.

## Liquid Waste *(continued)*

### **Tank closure**

Operational tank closure consists of those actions following waste removal that bring liquid radioactive waste tanks and associated facilities to a state of closure. The process involves:

- Developing and obtaining approval of tank-specific regulatory documents
- Isolating the tank from all operating systems in the surrounding Tank Farm (e.g., electrical, instruments, steam, air, water, waste transfer lines and tank ventilation systems)
- Stabilizing by grouting of the primary tank, remaining equipment, annulus and cooling coils
- Capping all tank risers

DOE plans to close 24 Type I, II, and IV tanks that are required to be removed-from-service in accordance with a formal agreement between DOE, Region IV of the Environmental Protection Agency (EPA), and the South Carolina Department of Health and Environmental Control (SCDHEC) as expressed in the SRS currently-approved Federal Facility Agreement (FFA). These tanks must be operationally closed per the currently approved FFA schedule.

### **Tanks closed**

The number of waste tanks that have been operationally closed.

### **Tanks, old style**

(Tanks 1-24) single walled

12 Type I (built 1951–1953) - tanks 5 and 6 closed in 2013

4 Type II (1955–1956)

8 Type IV (1958–1962), Tanks 17 and 20 closed in 1997

Tanks 18 and 19 closed in 2012

### **Tanks, new style**

(Tanks 25-51) double walled

Types III (built 1967–1972)

Types IIIA (1976–1981)

## Liquid Waste *(continued)*

### **Vitrification**

A process that stabilizes the high activity component of radioactive waste by mixing it with molten glass. The glass mixture is poured into cylindrical metal canisters, where it hardens.

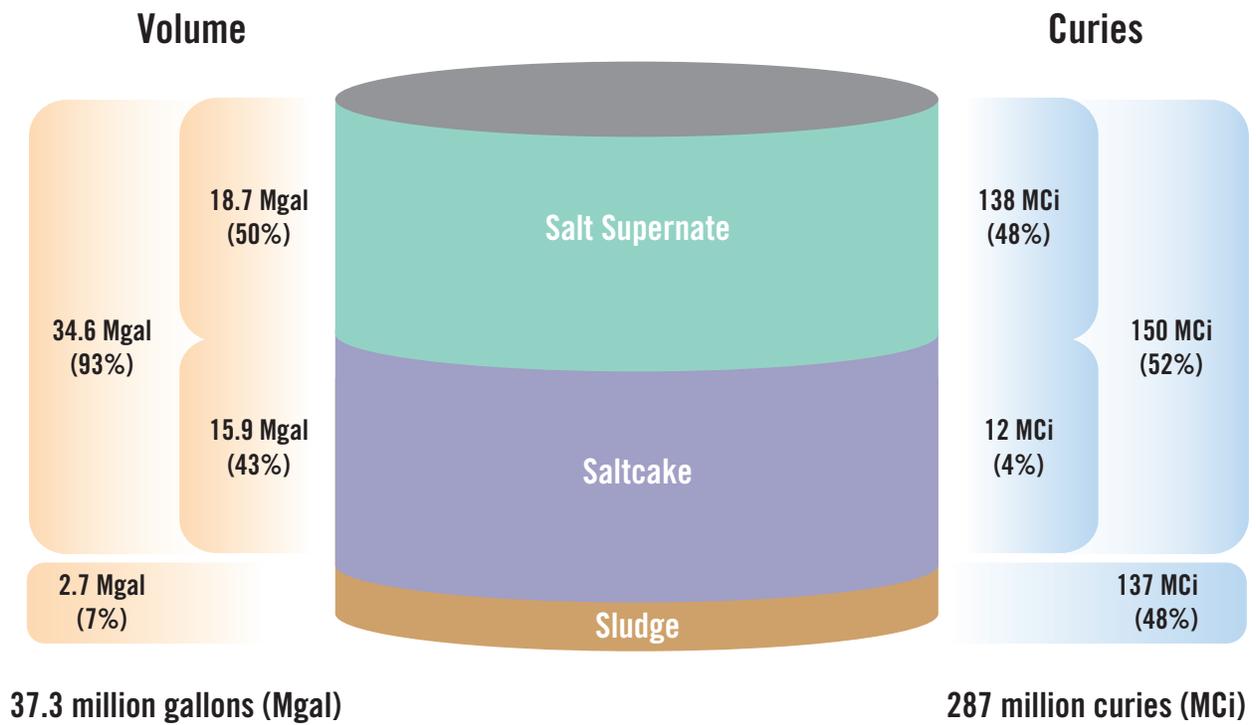
### **Waste removal and tank cleaning**

Waste removal and tank cleaning refer to:

- Transferring waste from the tanks for processing in sludge batch preparation and salt waste processing, referred to as Bulk Waste Removal Efforts (BWRE)
  - *Sludge is sent to a sludge batch feed preparation tank, and then to final treatment at DWPF*
  - *Saltcake is dissolved, removed, and blended with supernates into salt batches staged for treatment at ARP/MCU or SWPF*
- Removing the remaining material left after BWRE. The material left at the bottom of a tank after using normal transfer methods to empty a tank is referred to as the heel. Using various mechanical (e.g., water sprays, mechanical crawlers, pumps) and chemical techniques (e.g., oxalic acid washing) remaining material is removed from the floor, walls and components of the tank to the extent technically practicable from an engineering perspective. This is referred to as heel removal.
- If necessary, cleaning the tank annulus. The annulus in a waste tank is the space between the primary tank shell and the secondary containment. If material has leaked into the annulus from the main tank, annulus cleaning refers to the removal of this material.

The backlogged and currently generated HLW in SRS tanks must be removed and treated by vitrification by 2028 per the currently approved SRS Site Treatment Plan.

**Liquid Waste** *(continued)*



**SRS Liquid Waste Composite Inventory**  
 (Composite of Volumes and Characteristics of all 45 Tanks)



## Solid Waste

### Work Scope Description

The EM Cleanup Program is categorized by functional areas called Program Baseline Summaries (PBS) which describe the scope, schedule and cost of cleanup work to be performed.

#### PBS 13, Solid Waste Stabilization and Disposition

This PBS includes the storage, treatment and disposal of legacy transuranic (TRU), low-level, mixed low-level, hazardous and sanitary waste. Additionally, PBS 13 scope includes EM Historic Preservation, cultural activities and infrastructure projects such as General Plant Projects or Capital Equipment projects to support functions for the general operation of the Site. This PBS also covers the safe surveillance and maintenance of its program operational facilities through facility deactivation until the facilities are transferred to PBS 30 for decommissioning.

### Glossary of Terms

#### Low Level Waste

LLW

A catch-all term for any radioactive waste that is not classified as used (spent) fuel, high level radioactive waste, or transuranic (TRU). Included are items such as discarded clothing, equipment, tools and rags lightly contaminated by radioactive elements.

#### Mixed Low Level Waste

MLLW

Same as LLW, but also has chemical contamination at a high enough level to be considered hazardous according to Environmental Protection Agency (EPA)

#### Solid Waste disposal

Disposed waste means that the waste has been sent to Waste Isolation Pilot Plant (WIPP), buried as LLW or sent off-site for treatment and disposal as MLLW. Construction rubble is disposed at SRS in construction and demolition landfills and waste classified as ordinary garbage or refuse is buried at the Three Rivers Landfill.

## Solid Waste *(continued)*

### **Transuranic Waste**

*TRU*

Waste contaminated with transuranic radio-isotopes with an atomic number greater than 92, with a half-life of over 20 years and in concentrations of more than 1 ten-millionth of a curie of per gram of waste. Included in TRU waste are items such as discarded clothing, equipment, tools and rags lightly contaminated by radioactive elements “beyond uranium,” such as plutonium and neptunium. Although total radioactivity is no higher than LLW, the radioactivity decays slowly over thousands of years.

SRS TRU Legacy: Waste in storage prior to April 1, 2009

SRS TRU Newly Generated: Waste generated after April 1, 2009

### **Waste Isolation Pilot Plant**

*WIPP*

A government-owned deep geologic repository intended to provide permanent disposal for TRU wastes, and located 2,150 feet underground in a salt bed near Carlsbad, New Mexico



# Nuclear Materials

## Work Scope Description

*The EM Cleanup Program is categorized by functional areas called Program Baseline Summaries (PBS) which describe the scope, schedule and cost of cleanup work to be performed.*

### **PBS 11C, Nuclear Materials Stabilization and Disposition**

This PBS includes the management and disposition of nuclear materials, primarily located in H and K Areas at SRS. The H Area facilities continue to stabilize and disposition legacy nuclear materials through operation of the H Canyon and HB Line with Analytical Laboratories and Savannah River National Laboratory (SRNL) support. Continued programmatic and physical support activities related to safe receipt, inventory and management of special nuclear materials (SNM) at DOE-SR in K Area. This PBS also covers the safe surveillance and maintenance of its program operational facilities through facility deactivation until the facilities are transferred to PBS 30 for decommissioning.

### **PBS 12, Used (Spent) Nuclear Fuels Stabilization and Disposition**

This PBS covers the scope and funding for receipt and storage of used nuclear fuel originating from Atomic Energy Commission and DOE-EM activities, used nuclear fuel received at the SRS supporting the Domestic Research Reactor (DRR) and Foreign Research Reactor (FRR) programs. PBS 12 also covers safe disposition and storage of heavy water stored in C Area, K Area and L Area. This PBS covers the safe surveillance and maintenance of its program operational facilities through facility deactivation until the facilities are transferred to PBS 30 for decommissioning.

## Nuclear Materials *(continued)*

### Glossary of Terms

<b>Canyon</b>	A vernacular term for a chemical separations plant, inspired by the plant's long, high, narrow structure (e.g., H Canyon at SRS). Not all chemical separations facilities are considered "canyons."
<b>Chemical separation</b>	A process for extracting uranium, plutonium, and other radionuclides from dissolved used (spent) nuclear fuel, irradiated targets and other nuclear materials. Chemical separation is also referred to as processing and/or reprocessing.
<b>Cladding</b>	The outer layer of metal over the fissile material of a nuclear fuel element. Cladding on DOE-SR's used (spent) nuclear fuel is usually aluminum, with relatively small quantities of used fuel clad with zirconium or stainless steel cladding.
<b>Disposition</b>	Generally, when an item is placed in its permanent location (or moved off-site), then the item has been "disposed." An example of disposition is the transportation of low enriched uranium solutions by the Tennessee Valley Authority away from SRS.
<b>Disposition paths</b>	<p>A series of events that lead to the disposition of an item(s). The complete set of events may not be provided, in part because DOE has not decided to implement some of these disposition paths.</p> <p>Examples of disposition paths (specifically for plutonium):</p> <ol style="list-style-type: none"><li>1. <b>Vitrification:</b> Plutonium stored in K Area is sent to and dissolved in HB Line, sent to the H Canyon, neutralized and then sent to the DWPF for vitrification. The last step (event) of the path has not been determined which is shipment to and placement in a repository. Disposition will occur when the glass logs are shipped off-site. Because the glass logs are a very stable storage medium, some may consider the material disposed when vitrified.</li></ol>

## Nuclear Materials *(continued)*

### Disposition paths

*(continued)*

2. **Package for WIPP:** Plutonium stored in K Area is sent to and dry blended in HB Line with inert material, packaged in pipe overpack containers, and shipped to E Area for packaging in TRU pack containers. The TRU pack containers are then shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico, resulting in disposition of this material. However, shipments to and disposal at WIPP is currently suspended.
3. **MOX:** Plutonium stored in K Area and meeting the MOX plutonium specification is sent to the MOX Fuel Fabrication Facility. For EM purposes, the material is considered dispositioned at this point.

Additional examples of disposition paths (specifically for used nuclear fuel):

1. **Aluminum Clad Fuel:** Dissolve in H Canyon, recover the highly enriched uranium, blend with natural uranium to make low enriched uranium and provide to the Tennessee Valley Authority to make commercial fuel; or
2. **Non-Aluminum Clad Fuel:** Ship offsite to either Idaho National Laboratory or to another federal facility (interim storage site or federal repository). The fuel may or may not be placed in a dry storage cask. (Note H Canyon cannot process non-aluminum clad fuel without extensive modifications.)

### Dry cask storage

The storage of used (spent) nuclear fuel without keeping it immersed in water. This storage method has been implemented at a number of commercial nuclear stations, but not yet at SRS due to the different cladding, enrichments, sizes and shapes of the SNF stored in L Basin.

### Fissile material

Fissile materials are a subset of nuclear materials that are capable of undergoing fission. Fission is the splitting of an atom that results in the release of a large amount of energy.

### Fission

Fission is the process in which the nucleus of an atom splits into smaller parts (lighter nuclei). The fission process often produces free neutrons (in the form of gamma rays), and releases a very large amount of energy. Fission can be spontaneous (radioactive decay) or initiated by bombardment of a heavy nucleus with subatomic particle, e.g. a neutron.

## Nuclear Materials *(continued)*

<b>Half-life</b>	The amount of time needed for half of the atoms of a radioactive material to disintegrate or decay
<b>Heavy Water</b>	Water with a heavy isotope of hydrogen called deuterium. Heavy water exists in all water in low concentrations, and is not radioactive. Heavy water was used as the primary coolant in SRS reactors during the Cold War.
<b>Highly Enriched Uranium</b> <i>HEU</i>	A uranium mixture containing 20 percent or more by weight of uranium-235. When uranium-235 makes up 20 percent or more of all the weight of the uranium (all uranium isotopes added together), then it is highly enriched.
<b>Low Enriched Uranium</b> <i>LEU</i>	Uranium having an assay greater than 0.711 but less than 20 percent by weight in the fissile isotope 235. Naturally occurring uranium is approximately 99.3 percent U-238 and 0.7 percent the fissile isotope U-235, by weight. Enrichment is the process of increasing the amount of U-235 in a mass of uranium. Note: Fuel typically used in commercial reactors is enriched to approximately 3 to 5 percent.
<b>Mixed oxide</b> <i>MOX</i>	Mixed-oxide fuel fabricated from a mixture of plutonium and uranium oxides
<b>Nuclear materials</b>	A collective term for accountable materials designated in DOE Order 410.2, Management of Nuclear Materials. These materials are americium, californium, curium, deuterium, enriched lithium, neptunium, thorium, plutonium and uranium.
<b>Nonproliferation</b>	Efforts to prevent or slow the spread of nuclear weapons and the materials and technologies used to produce them
<b>Plutonium</b> <i>Pu</i>	An artificially produced radioactive element having 94 protons. Plutonium is generally created by the bombardment of uranium with neutrons. Different isotopes are used in weapons and space missions, and can be used for electric power generation. Examples include:

## Nuclear Materials *(continued)*

### **Plutonium** *(continued)*

**Plutonium-239:** Radioactive isotope of plutonium used in weapons, usually as a metal (but can be in other forms like oxide).

**Plutonium-238:** Radioactive isotope of plutonium used in nuclear batteries, primarily in deep space missions such as Cassini, Galileo and Voyager. Exists as an oxide.

### **Spent Nuclear Fuel** *SNF*

See **Used Nuclear Fuel**

### **Stabilization**

The conversion of a material to a more stable or safer condition. An example of Stabilization is the dissolution of SNF that is at-risk which after dissolution is sent to DWPF for vitrification in glass. Another example of stabilization is the placement of material into a robust storage container (like a DOE Standard 3013 container).

### **Storage**

The preserving of an item in a protected environment for future stabilization, disposition or use

### **Tritium**

A radioactive isotope of hydrogen used in nuclear weapons, exit signs and watch dials. Tritium gas is used to boost the explosive power of most modern nuclear weapons. Tritium has a half-life of approximately 12 years.

### **Uranium**

The basic material for nuclear technology. This element is naturally slightly radioactive and can be refined from its ore to a heavy metal more dense than lead. Uranium is a radioactive element having 92 protons. Uranium has 14 known isotopes, the most abundant being uranium-238 (92 protons, 146 neutrons, 92 electrons).

### **Used Nuclear Fuel** *UNF*

*Also called*

*Spent Nuclear Fuel (SNF)*

Fuel withdrawn from a nuclear reactor following irradiation, the constituent elements of which having not been separated by reprocessing.



# Soil and Water Remediation and Facility D&D

## Work Scope Description

The EM Cleanup Program is categorized by functional areas called Program Baseline Summaries (PBS) which describe the scope, schedule and cost of cleanup work to be performed.

### PBS 30, Soil and Water Remediation and Facility D&D

This PBS includes the investigation and, if necessary, remediation of contaminated waste sites, surface water and groundwater in accordance with applicable State and Federal regulatory requirements. Where possible, an Area Completion approach is being used for greater efficiency in lieu of individual waste site investigation/remediation and general facility deactivation and decommissioning (D&D).

## Glossary of Terms

### Area Completion

An approach to clean up multiple waste units (contaminated soils) and facilities in a discrete geographic area of SRS (where site missions took place), conducted as one integrated action. Typically, Area Completion employs Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) removal and remedial-type actions, to perform waste unit cleanup in combination with D&D activities. Area Completion at SRS provides for cleanup of these areas so as to allow future industrial reuse. Some of these areas are located near the Site boundary, while others are located within the interior of SRS. The Area Completion activities may address contamination in surface soil or deeper soil, as well as buildings which have released (or could potentially release) contaminants to the environment.

## Soil and Water Remediation, and Facility D&D *(continued)*

### **Deactivation**

The process of placing a shutdown facility into a safe and stable condition by the elimination or reduction of residual hazards. Deactivation protects the health and safety of workers, the public, and the environment, and minimizes the long-term cost of surveillance and maintenance.

### **Decommissioning**

Typically the final stage for a facility. This is when the residual hazards are eliminated permanently. A range of possible alternative end states is evaluated, and the best one chosen. The available alternatives at SRS are in-situ disposal or demolition:

**In-Situ Disposal:** A term describing a facility end state after decommissioning in which some residual contamination remains, but has been permanently sealed in place. For example, P and R Reactors.

**Demolition:** Demolishing and removal of the entire facility, to grade, including necessary decontamination to meet established release criteria. For example, the Heavy Water Components Test Reactor.

### **Groundwater cleanup**

Groundwater contamination plumes at SRS cover approximately 5,000 acres. Cleanup activities addressing the plumes are ongoing and are typically addressed separately from the associated surface contamination waste unit, due in part to the longer time periods required to perform cleanup.

### **Waste site**

An area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located. 515 waste sites have been identified at SRS.

### **Waste site remediation**

An action taken to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment. Remediation is necessary if investigation of the waste site shows that the contaminants pose an unacceptable risk to human health and/or the environment.



# Site Support Functions

## Work Scope Description

*The EM Cleanup Program is categorized by functional areas called Program Baseline Summaries (PBS) which describe the scope, schedule and cost of cleanup work to be performed.*

### **PBS 20, Safeguards and Security**

This PBS provides the protection of DOE-SR nuclear materials, production facilities and classified matter from theft, sabotage or unauthorized control. The program provides for uniformed protective force personnel, law enforcement and general site security, aviation operations and special response teams, as well as special nuclear materials control and accountability.

### **PBS 100, Non-Closure Mission Support**

This PBS provides support to enable DOE-SR to perform its missions and cleanup activities and provides funding to support: community outreach, environmental compliance and regulatory integration, including the State of Georgia for emergency management activities, the State of South Carolina for emergency management activities, grants for independent environmental monitoring, the Department of Natural Resources comprehensive program to sustain the health, productivity and diversity of the SRS natural resources, South Carolina Department of Health and Environmental Control for oversight and implementation of the FFA and validation of cleanup credits under the Site Treatment Plan (STP), Payment-in-Lieu-of-Taxes for Aiken, Allendale and Barnwell counties, DOE lease agreements and support for the SRS Citizens Advisory Board are also provided.

## Site Support Functions *(continued)*

### Glossary of Terms *(not specific to any particular area of cleanup)*

#### **Hazardous waste**

Any chemically toxic, corrosive, reactive or ignitable material that could damage the environment or negatively affect human health

#### **Hazardous waste characteristics**

A waste that has not been specifically listed by the EPA may still be considered a hazardous waste if it exhibits one of four characteristics defined in EPA regulations:

- **Ignitable:** Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents.
- **Corrosive:** Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels.
- **Reactive:** Reactive wastes are unstable under “normal” conditions. They can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and explosives.
- **Toxic:** Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water. Toxicity is determined through a laboratory procedure called the *Toxicity Characteristic Leaching Procedure (TCLP)*. The TCLP helps identify wastes likely to leach concentrations of contaminants that may be harmful to human health or the environment.

#### **Legacy waste**

Wastes that are a legacy of the Cold War, which have been placed in storage until technologies and facilities are developed to safely and effectively dispose of them.

## Site Support Functions *(continued)*

### **National Environmental Policy Act**

NEPA

An Act that established a broad national framework for protection of the human environment. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that could significantly affect the environment. NEPA set up procedural requirements for all federal government agencies to prepare Environmental Assessments (EAs) and Environmental Impact Statements (EISs). EAs and EISs contain statements of the environmental effects of proposed federal agency actions. NEPA's procedural requirements apply to all federal agencies in the executive branch. At Savannah River, DOE has prepared EISs on construction and operation of DWPF, management of spent nuclear fuel, closure of waste tanks, and other projects. DOE has prepared EAs on military training at SRS, construction of the biomass cogeneration facility, and other projects.

### **Radiation**

A form of energy produced from the radioactive decay of atoms. It may be emitted as particles, such as alpha, beta, neutrons or pure energy such as gamma rays or x-rays.

- **Alpha particles:** Alpha particles are the heaviest particles and have very little penetrating ability. They can travel only a few inches in the air, and can't get through a sheet of paper or the outer layer of a person's skin. Alpha particles are only hazardous if inhaled, swallowed absorbed or injected.
- **Beta particles:** Beta particles are more penetrating than alpha particles and can travel a few feet in the air. Beta particles can pass through a sheet of paper or thin clothing but are stopped by a thin sheet of aluminum foil or glass. Beta particles can penetrate into and damage skin but pose the greatest risk if swallowed, inhaled, absorbed or injected.
- **Neutrons** – Particles emitted from the splitting or fissioning of certain atoms like plutonium. Neutrons are very penetrating and are an external hazard. They are usually shielded using concrete, water or thick sheets of plastic.

## Site Support Functions *(continued)*

### **Radiation**

*(continued)*

- **Gamma rays** – Gamma rays are pure energy, typically emitted simultaneously with beta particles and occasionally with alpha particles or neutrons. Gamma rays are extremely penetrating and are also an external hazard. Thick layers of concrete, lead steel or water can be used to stop penetration of gamma rays.
- **X-rays** – X-rays are essentially identical to gamma rays, but generally have less energy. Therefore, x-rays are less penetrating than gamma rays and require less shielding.

### **Sanitary waste**

Waste classified as ordinary garbage or refuse



# SRS Disposition Paths for Environmental Cleanup

## Definition

A cleanup element is considered disposed when it is in a final physical state as well as final location.

Cleanup Element	Disposition Path	
<b>High Level Radioactive Liquid Waste</b>		
<b>Tank Waste after removal of High Radionuclides</b>	Final Physical State:	Saltstone
	Final Location:	Saltstone Disposal Units - On Site
<b>Highly Radioactive Components in Tank Sludge and Salt Waste</b>	Final Physical State:	Mixed with molten glass and solidified in Canisters
	Interim Location:	Glass Waste Storage Buildings and above ground pad storage - On Site
	Final Location:	Federal Repository - Off Site
<b>Tanks</b>	Final Physical State:	Waste removed and cleaned to maximum extent practical (MEP), Grouted
	Final Location:	In Place - On Site
<b>Solid Waste</b>		
<b>Transuranic (TRU) Waste</b>	Final Location:	Waste Isolation Pilot Plant (WIPP) - Off Site
<b>Mixed Low Level Waste</b>	Final Location:	Commercial RCRA Permitted Facilities - Off Site
<b>Low Level Waste</b>	Final Location:	Primarily Buried - On Site
<b>Hazardous Waste</b>	Final Location:	Commercial RCRA Permitted Facilities - Off Site
<b>Construction Waste</b>	Final Location:	Permitted Construction and Debris Landfill - On Site
<b>Sanitary Waste</b>	Final Location:	Permitted Three Rivers Landfill - Off Site
<b>Nuclear Materials</b>		
<b>Highly Enriched Uranium (HEU)</b> Reactor Fuel from SRS & DOE Complex	Final Physical State:	Recovered HEU blended down to Low Enriched Uranium
	Final Location:	Tennessee Valley Authority (TVA) - Off Site (Complete)
<b>Used Nuclear Fuel (UNF)</b> Sodium Reactor Experiment (SRE) Approved - 148 Bundles	Final Physical State:	Canisters of solidified radioactive waste in molten glass
	Interim Location:	Canister Storage Facility - On Site
	Final Location:	Federal Repository - Off Site
<b>Used Nuclear Fuel (UNF)</b> Foreign & Domestic Research Reactor Fuel Approved -1,000 Bundles, 200 HFIR Cores	Final Physical State:	Recovered HEU from UNF blended down to Low Enriched Uranium
	Final Location:	Tennessee Valley Authority - Off Site
<b>Used Nuclear Fuel (UNF)</b> Foreign & Domestic Research Reactor Fuel Balance, Pending Approval - 2,000+ Bundles	To Be Determined	Option 1: Recovered HEU from UNF blended down to Low Enriched Uranium Option 2: Interim Dry Storage of UNF on site with final disposition to Federal Repository - Off Site

Cleanup Element	Disposition Path	
<b>Nuclear Materials - continued</b>		
<b>Plutonium (Pu) - Path 1</b>	Final Physical State: Interim Location: Final Location:	Pu Prepared for MOX Processing K Area / MOX Facility - On Site Commercial Nuclear Fuel Manufacturers - Off Site
<b>Plutonium (Pu) - Path 2</b>	Final Physical State: Final Location:	Pu Packaged for Shipment Waste Isolation Pilot Plant (WIPP) - Off Site
<b>Heavy Water</b>	Final Physical State: Final Location:	Convert to Solidified State Commercial / Govt Facilities- Off site
<b>Soil, Water, Facilities</b>		
<b>Contaminated Soil - Path 1</b> (Treated in place)	Final Physical State: Final Location:	Treated In Situ (Capped, monitored) In Place - On Site
<b>Contaminated Soil - Path 2</b> (Removed)	Final Physical State: Final Location:	Excavated Disposed On Site in the Slit Trenches, Disposed Off Site at Three Rivers, or Other Location Consolidated into Other Waste Unit On Site
<b>Contaminated Water - Path 1 (Plumes)</b> (Treated in place)	Final Physical State: Final Location:	Treated In Situ through Active or Passive Means In Place - On Site
<b>Contaminated Water - Path 2 (Samples/Purge Water)</b> (Collected)	Final Physical State: Final Location:	Treated at Effluent Treatment Facility (ETF) and Discharged "National Pollutant Discharge Elimination System (NPDES) Outfall H-16 "
<b>Facilities - Path 1</b> (Operational and Administrative Buildings)	Final Physical State: Final Location:	Demolished and Segregated Disposed On Site in the Slit Trenches, Disposed Off Site at Three Rivers, or Other Location Reclaimed/Recycled
<b>Facilities - Path 2</b> (Selected Operational Buildings)	Final Physical State: Final Location:	In Situ (Grouted) In Place - On Site



U.S. DEPARTMENT OF  
**ENERGY**

Savannah River Site

SAVANNAH RIVER SITE

## **Environmental Management Cleanup Program**

### Work Scope Descriptions and Glossary of Terms

**September 2014**

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