Fact Sheets

SRS

SRS Tritium Facilities

The Savannah River Site Tritium Facilities are designed and operated to process tritium, a radioactive form of hydrogen gas that is a vital component of nuclear weapons. In the Tritium Facilities, tritium is loaded into stainless steel containers called reservoirs. Tritium reservoirs are then shipped to the Department of Defense (DOD), where they are installed in nuclear weapons. Tritium in the weapons stockpile must be replenished continually because it has a half-life of only 12.3 years. To accomplish this, tritium is recycled from existing weapons reservoirs. All tritium recycling work, that supports the nation's nuclear weapons stockpile, is conducted within these facilities at SRS.

The Tritium Facilities consist of four main process buildings. Three of these, buildings 232-H, 234-H and 238-H, are part of the original facility construction. These buildings still house a number of key operations, including reclamation of previously used tritium reservoirs, receipt, packaging and shipping of reservoirs, recycling and enrichment of tritium gas and several important laboratories and maintenance shops.

Construction began on the newest building, 233-H, in the fall of 1986. This one-acre underground facility became fully operational in 1994, when gas processing in building 234-H was terminated. The facility operations conducted in building 233-H include unloading gases from stockpile return reservoirs, separating the useful hydrogen isotopes (tritium and deuterium), purifying these hydrogen isotopes and mixing these gases to exact specifications for loading into reservoirs.

Safety, Security and Environmental Protection

Building 233-H is designed to meet the highest standards of safety, security and environmental protection while continuing to meet national defense needs. The new building incorporates several technological improvements:

- It is located underground to enhance safety and security. The building's thick concrete shell offers protection against natural disasters, such as earthquakes and tornadoes.

- To ensure that tritium releases to the environment are minimal, the building is designed for total confinement. All tritium work is performed within gloveboxes which are filled with nitrogen gas and maintained at a pressure slightly less than that in the surrounding room so that any minute leak from a process component

- would be contained inside the glovebox rather than released into a room. This nitrogen atmosphere greatly reduces the potential for formation of tritiated water, the most difficult form of tritium to handle.

- Operational releases at this building are approximately 100 times less than in the original facility buildings. In addition, because of the facility design, process rooms are operated as virtually "clean" radiologically controlled areas, further reducing the already low worker radiation exposure.

- Four glovebox cleanup systems, called stripper systems, remove residual tritium from the gloveboxes. The nitrogen atmosphere continually recirculates between the gloveboxes and the stripper systems. To maintain a safe operating pressure, small amounts of cleaned nitrogen must be discharged to the atmosphere. This nitrogen, which already has been through a primary stripper, is processed through a purge stripper to remove any traces of tritium before the clean nitrogen gas is discharged to the environment. The tritium stripped from the nitrogen is stored for later processing.

- Metal hydride beds are used for storage, pumping, separating and purifying tritium and deuterium. These beds — metal containers filled with metal particles — absorb hydrogen isotopes (such as tritium) when the particles are cold and release the gases when heated. This allows the isotopes to be stored in an easily contained and safe solid form, with storage capacities many times greater than conventional tanks.

- A laser system replaces a mechanical shearing system used in 234-H for unloading reservoirs. The laser system allows for more rapid unloading, reduces maintenance time and eliminates the need for time-consuming mechanical drilling operations. Drilling, which carried a higher potential for leaks, was necessary when the shear system in 234-H failed to operate.

- Much of the new facility is computer controlled, eliminating the need for employees to manually operate switches and valves, thus reducing employee radiological exposure and also reducing the chance for human error.

- The building's dry pumping systems eliminates the use of oils and mercury, a contaminant from older processes. The dry systems reduce the generation of mixed (hazardous and radioactive) waste.

Unloading

Gases are removed from returned reservoirs using a 400-watt laser. The laser is mounted on a mobile base and housed in its own secure enclosure. Operators use an alignment laser in back of the cutting laser, in conjunction with a video monitor, to ensure the cutting beam's alignment.

The cutting laser beam is directed through a prism, then passes through a series of containment windows before striking the stem of the reservoir. A series of pinpoint firings cut a hole in stem of the reservoir, allowing gas to expand into the receiving tank.

Separation and Enrichment

Reservoirs returned from DOD contain three gases: the remaining tritium, non-radioactive deuterium and helium-3 (the gas that results when tritium decays). The three component gas is pumped through a hydride bed to separate the helium from the hydrogen isotopes. The separated tritium/deuterium gas is transferred to storage beds to await enrichment. The beds occupy about 1/300th of the space required by conventional gas storage tanks.

To be useful, the tritium and deuterium must also be separated — a process called enrichment — so they can be mixed in exact proportions. A Thermal Cycling Absorption Process (TCAP) accomplishes this enrichment of the recycled gas. The gas is cycled through a TCAP column using specific operating parameters. The two isotopes are then drawn off separate ends of the column and fed into separate storage beds. Thus, enrichment of both isotopes is accomplished.

Mixing, Loading and Welding

Before loading into the reservoirs, tritium and deuterium are mixed to an exact ratio. Several different types of reservoirs, all requiring different gas proportions, are processed at SRS.

Laboratory analysis, using a mass spectrometer (an instrument that measures the mass of atoms and molecules), verifies that each tank contains the exact mix for its intended reservoir. The blended isotopes are fed into a mechanical compressor system that compresses the gas mixture to achieve the proper loading pressure.

When each reservoir is loaded to the correct pressure, its fill stem is pinched closed using electrodes, and the stem is resistance-welded. This completely seals the gas into the reservoir. The seal weld is inspected using and other non-destructive methods.

Reservoir Surveillance

As part of the nuclear weapons stockpile surveillance program, selected gas transfer systems (including reservoirs) are removed from the active stockpile and sent to the Savannah River Site for testing. The tests ensure that the tritium gas delivery system will function properly should the weapon be used. In addition to function testing, the reservoirs are subjected to one or more conditioning steps that simulate forces that could be experienced during use. These tests which include vibration, acceleration, and dynamic shock are important to ensure reliability of the weapons systems.

Construction for the Future

Construction activities are underway that will reconfigure the Tritium Facilities to support the nuclear weapons stockpile for the next 30 years. Two line item projects—Tritium Facility Modernization & Consolidation (TFM&C) and the Tritium Extraction Facility (TEF)—will modernize processing capability and provide the means for extracting virgin tritium in support of the nuclear weapons stockpile.

The TFM&C project will consolidate tritium gas processing operations in state-of-the-art facilities in the 233-H building and enable the deactivation of the 50-year-old 232-H building. This project is on schedule for startup in fiscal year 2004. Deactivation of the 232-H building is scheduled for completion at the end of fiscal year 2005.

The TEF will provide the means to extract tritium from tritium bearing targets irradiated in commercial light water reactors. The TEF is scheduled for startup in fiscal year 2007.