

# facts

A B O U T T H E S A V A N N A H R I V E R S I T E

## SRS Tritium Facilities

### Mission

The Savannah River Site's (SRS) Tritium Facilities are designed and operated to supply and process tritium, a radioactive form of hydrogen gas that is a vital component of nuclear weapons. These facilities are part of the National Nuclear Security Administration's (NNSA) Defense Programs operations at SRS.

### Background

Tritium processing involves a number of key operations, including reclamation of previously used tritium reservoirs (stainless steel containers); receipt, packaging and shipping of reservoirs; recycling, extraction, and enrichment of tritium gas; and laboratory operations. The SRS Tritium Facilities consist of four main active process buildings:

- The H Area Old Manufacturing (HAOM) Facility was built in the late 1950s
- The 238-H Reclamation Facility began operations in the late 1960s.
- A third building, called the H Area New Manufacturing (HANM) Facility, began operations in 1994 and received an upgrade in 2004, which served to consolidate tritium processing and handling activities, improve safety, and reduce both cost and environmental releases.



*The Tritium Extraction Facility (TEF), which began operating in 2007.*



*Employees perform work in TEF and the H Area New Manufacturing Facility.*



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- The fourth and newest process building — the Tritium Extraction Facility (TEF), which incorporates new tritium extraction technology — became fully operational in early 2007.

### *Reestablishment of Tritium Supply*

The nation's tritium production capability was lost when the last heavy water reactor at SRS shut down in 1988. Interim stockpile requirements were met through recycling, which involved recovering and purifying the gas from dismantled nuclear weapons and from routine tritium reservoir exchanges from the existing nuclear stockpile. In December 1998, the Department of Energy (DOE) announced that commercial reactors would be the source for new tritium production. The Tennessee Valley Authority's Watts Bar Unit 1, Sequoyah Unit 1, and/or Sequoyah Unit 2 reactors were selected for irradiation of DOE-supplied Tritium Producing Burnable Absorber Rods (TPBARs). The TPBARs are irradiated in the Watts Bar reactor and then transported to SRS, where the tritium is safely and efficiently extracted in the Tritium Extraction Facility (TEF). The tritium is then piped to the HANM facility for further purification prior to loading into reservoirs for shipment to the Department of Defense (DOD).

In October 2003, the first TPBARs were inserted into TVA's Watts Bar reactor for irradiation. The first shipment of irradiated TPBARs arrived at SRS in August 2005 and was stored, awaiting completion of the TEF.

The TEF project earned numerous awards for successful execution. A celebration of the safe, successful completion of non-radioactive startup testing in TEF was held on Feb. 28, 2006. Over 700 different systems and components were successfully tested. Included among the startup accomplishments were hydrogen tests, shielding surveys, and the startup tests of individual components and remote handling features. The startup testing program was accomplished six months ahead of the baseline schedule.

In November 2006, the NNSA approved radioactive startup of the TEF and the first tritium was introduced into the building. The first tritium was extracted from TPBARs in January 2007 and transferred via underground piping to the Tritium Loading Facility in February 2007.

## **Facility Descriptions**

### *Tritium Extraction Facility (TEF)*

The TEF provides the means to extract tritium from tritium-bearing targets irradiated in commercial light water reactors, and is located in SRS's H Area. Approximately 600 workers were employed during peak construction, and the facility has an operations staff of approximately 100 permanent employees.

There are three major structures: the Remote Handling Building (RHB), Tritium Processing Building (TPB) and Tritium Support Building (TSB).

- In the RHB, the TPBARs are unloaded and the tritium gas extracted. The RHB is approximately 60 feet high, 86 feet high and 215 feet long. It has a truck receiving area, cask decontamination area, TPBAR and waste preparation area, furnaces, and hot maintenance area, along with the associated gloveboxes for extraction pumps and tanks. It also includes an overhead crane and remote handling equipment.



- The TPB provides preliminary purification of the extracted gases. It is a single-story facility, approximately 125 feet wide by 155 feet long, and is built above ground. The TPB houses the main control room, crane control room, and miscellaneous rooms for gas analysis and radiation control activities.
- The TSB houses management and support staff as well as change rooms, maintenance support areas, and a loading dock.

The second extraction run in TEF was successfully completed in December 2007. Irradiation of TPBARs is continuing in the Watts Bar Unit #1 reactor and the design of the TPBAR is undergoing minor revision to improve its performance. Shipments of irradiated TPBARs are being received at TEF, and additional extractions are planned for 2009 and beyond. In addition, NNSA is currently evaluating the optimum mode of operations for the TEF, based on most efficient use of SRS resources and the changing demands for new tritium to support the nuclear weapons stockpile.

### *H Area New Manufacturing Facility (HANM)*

The HANM facility, which became operational in 1994, consolidated tritium processing capabilities into a more centralized location, while improving safety and greatly reducing releases to the environment. HANM provides the following capabilities:

#### 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, and 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 the DOD contain three gases: the remaining tritium, non-radioactive deuterium and helium-3 (the gas that forms 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 recycled gas. The gas is cycled through a TCAP column using specific operating parameters, and the two isotopes are drawn off separate ends of the column and fed into separate storage beds. Thus, enrichment of both isotopes is accomplished.



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### 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 an oil-free 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, and the seal weld is inspected using 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 SRS 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 to 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.

### *H Area Old Manufacturing Facility (HAOM)*

The HAOM facility is used for three main operations:

#### Reservoir Finishing

Reservoir finishing consists of all operations necessary to ensure the loaded reservoirs are safe and meet Design Agency specifications. These include pinch weld evaluation; gas fill validation; fill stem trimming, polishing, deburring, and gauging; tritium leak rate measurement; laser marking; surface defect inspection; and in some cases assembly of the reservoirs to squib valves (designed to release the gas in the weapon).

#### Inert Reservoir Processing

Some reservoirs require filling with gases other than tritium (e.g., argon). Because these “inert” gases are non-radioactive, they are processed separately from tritium reservoirs in clean areas.

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### Packaging

After reservoirs have been formally certified as acceptable for use in the weapon, they are packaged for shipping. The shipping packages used for tritium reservoirs are specifically designed to contain tritium in the event of a worst-case accident, and are periodically recertified as acceptable for transportation in the HAOM facility.

### *Reclamation Facility*

Some types of tritium reservoirs can be reclaimed and reused after being from the field, thereby reducing cost. Following unloading in the HANM facility, these reservoirs are sent to the Reclamation Facility, where their old pinch-welded fill stems are removed and new fill stems are welded in place to make the reservoirs suitable for reloading.

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