



# Backgrounder

United States Nuclear Regulatory Commission

Office of Public Affairs

Washington DC 20555

Telephone: 301/415-8200 E-mail: opa@nrc.gov

## Tritium Production

### Background

Tritium is a radioactive isotope of hydrogen that typically is produced in nuclear reactors or high-energy accelerators. It decays at a rate of about five percent per year (half of it decays in about 12 years). Tritium's decay makes it necessary for routine replenishing in U.S. nuclear weapons. The United States has not produced tritium since 1988, when the Department of Energy's (DOE's) production facility site in South Carolina closed. Immediate tritium needs are being met by recycling tritium from dismantled U.S. nuclear weapons. According to DOE, resumption of tritium production is essential for maintaining the U.S. nuclear weapons stockpile.

### DOE's Strategy for the Production of Tritium

DOE is responsible for reestablishing the capability to produce tritium by the end of 2005, in accordance with a Presidential directive. As part of a dual-path strategy, DOE considered two options for producing tritium. One involved the use of a linear accelerator, which does not require Nuclear Regulatory Commission (NRC) approval. A second option, using a commercial nuclear power plant, however, does require NRC review and approval.

On May 22, 1996, the Secretary of Energy and the Chairman of the NRC signed a joint memorandum of understanding that establishes the basis for NRC review and consultation regarding DOE's use of commercial reactors for producing tritium. The memorandum supplements a 1978 agreement between DOE and NRC and relates solely to tritium production.

DOE has developed a technology for producing tritium in pressurized water reactors that uses lithium, rather than boron (which is normally used), as a neutron absorber. As a result of irradiation by neutrons in the reactor core, lithium in special rods will be converted to tritium. The rods can then be removed from the fuel assemblies and the tritium extracted by DOE.

## DOE Decision for Production of Tritium

On December 22, 1998, the DOE Secretary announced that he had chosen the light water reactor technology as the primary means for tritium production; the accelerator design will be retained as a backup. He selected the Tennessee Valley Authority's (TVA's) Watts Bar Nuclear Plant and Sequoyah Nuclear Plant, Units 1 and 2, in Tennessee as the preferred facilities for producing future supplies of tritium.

### **Commercial Light Water Reactor Production of Tritium**

In the first phase of the tritium program, NRC evaluated DOE's proposal to test irradiation of a limited number of fuel assemblies containing tritium-producing burnable absorber rods (TPBARs) in a commercial nuclear reactor. The NRC documented the results of its review in NUREG-1607, which is available to the public. This test or demonstration involved placing 32 lithium rods in a reactor core during one fuel cycle. The DOE contracted with TVA to conduct a one-time confirmatory test at the Watts Bar nuclear power plant near Spring City, Tennessee. In April 1997, TVA applied for an amendment to the Watts Bar facility operating license. NRC issued a license amendment to TVA in September 1997 that authorized a test for irradiation of the tritium-producing rods.

The lithium rods were loaded in the core during Watts Bar's first refueling outage and irradiation began the next month. The 32 tritium-producing rods were irradiated for one operating cycle (about 18 months) and were removed from the reactor during the spring 1999 refueling outage. The rods were shipped offsite by DOE and were subjected to nondestructive examination and destructive post-irradiation examination. The objective of the examinations was to confirm TPBAR design methodology and to provide information to test the analytical modeling and modeling assumptions. The results of these tests and examinations confirmed that the TPBARs had performed as expected. Because they function as normal burnable poisons, there was minimal impact on reactor operations.

The second phase focused on the production of tritium and involved NRC assisting DOE in assessing and resolving technical and licensing issues involved in using commercial reactors for tritium production. The NRC has reviewed DOE's safety assessments that were submitted in a topical report. The NRC's safety evaluation, issued as NUREG-1672 in May 1999, documents the review and identifies plant-specific interface issues that must be addressed in support of license amendment requests seeking authorization to produce tritium.

On August 20, 2001, TVA filed an application to amend the Watts Bar operating license to permit irradiation of up to 2304 TPBARs in the reactor core each fuel cycle. While the NRC issued a license amendment on September 23, 2002, approving this request, TVA subsequently filed an application reducing the boron concentration requirements which would limit the number of TPBARs that could be loaded and irradiated in the core. On October 8, 2003, the NRC issued a license amendment restricting the number of TPBARs in the Watts Bar core to

240. The first core load of production quantity lithium rods were fabricated and inserted in the Watts Bar core during the fall 2003 refueling outage. The TPBARs were irradiated for one cycle and removed from the core during the refueling cycle that ended in March 2005. The 240 TPBARs will be consolidated and shipped to DOE during the summer of 2005. An additional 240 TPBARs was loaded into the Watts Bar core for the current operating cycle.

Similar to Watts Bar, the NRC issued a license amendment on December 1, 2003, approving the irradiation of TPBARs at the Sequoyah Nuclear Plant, Units 1 and 2. The specific number of TPBARs will be dependent upon the boron concentration being maintained for accident mitigation. However, due to DOE's limited need for tritium, Sequoyah has no current plans for loading TPBARs into their reactor cores.

### Public Meetings

NRC has held numerous public meetings from 1997 through 2002 to keep the public informed of NRC activities and to allow public participation throughout the process.

- Two public meetings were held early in the evaluation process to provide an opportunity for public comments on the technical issues of the confirmatory test and to inform the public of NRC activities early in the evaluation process. An initial meeting was held at NRC Headquarters in Rockville, Maryland in February 1997. Another public meeting was held near TVA's Watts Bar plant in Tennessee in August 1997, prior to loading tritium-producing rods into the reactor core.
- Three technical meetings that were open to the public were held on March 23 and August 24, 2000, and August 20, 2001, where NRC provided updates on the status of resolution of technical issues and on proposed schedules for licensing activities.
- Two meetings with the public were held on October 2, 2001, in Evansville, Tennessee, and on October 30, 2002, in Dayton, Tennessee to provide updates on NRC activities related to the tritium production license amendments and to address public comments.

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