

November 1989

NUCLEAR MATERIALS

Information on DOE's Replacement Tritium Facility



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**Resources, Community, and
Economic Development Division**

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November 22, 1989

The Honorable Sam Nunn
Chairman, Committee on
Armed Services
United States Senate

The Honorable J. James Exon
Chairman, Subcommittee
on Strategic Forces and
Nuclear Deterrence
Committee on Armed Services
United States Senate

In response to your January 11, 1989, request for a review of Department of Energy (DOE) plans to modernize its nuclear weapons complex, and as agreed with your staff, we reviewed DOE's plans to complete and operate a replacement for the tritium loading facility at the Savannah River Site (SRS) in Aiken, South Carolina. The loading facility processes important components used in nuclear weapons. Specifically, we are providing information on (1) how the replacement tritium facility (RTF) is expected to correct the present loading facility's shortcomings and (2) why estimated costs for construction and start-up of the new facility have greatly increased since the project began in 1986.

Results in Brief

The new facility should provide substantial improvements in tritium operations, but costs have increased substantially since the program began in 1986. Inadequacies in the old facility that the RTF is designed to address include production, safety, security, and environmental shortcomings. DOE project officials told us these shortcomings could threaten continued operations in the old facility and DOE's ability to support Department of Defense requirements for new nuclear weapons and the maintenance of existing nuclear weapons.

Although construction costs increased by 20 percent from \$120 million to \$144 million, by far the greatest cost increase was for activities needed to prepare the new facility for operations once construction is completed. These start-up costs increased by more than 350 percent from an original fiscal year 1986 estimate of \$17 million, to the fiscal year 1989 estimate of \$62 million which is also the current estimate.

DOE attributes the cost increases for construction and start-up to a number of factors. For instance, nearly half of the construction cost increases resulted from stricter DOE quality assurance and security requirements, imposed at about the time the project was getting underway, while various underestimates and materials-cost increases contributed to the remainder. Most of the increased start-up costs are attributed to new, more stringent safety standards which were not in effect when original estimates were made. Other start-up cost increases are attributed to corrections of errors made in earlier estimates due to inexperience in making estimates for such a unique facility.

Background

Tritium, a radioactive isotope of hydrogen, is used to enhance the explosive power of nuclear warheads. It is produced in lithium targets in the SRS reactors. After extraction from the targets and purification, the tritium gas is loaded into stainless steel canisters called reservoirs which are then shipped for installation in nuclear weapons.

Built in the late 1950s, the SRS tritium loading facility has been expanded several times in past years to meet production needs. Continuing production, safety, security, and other limitations, however, led DOE to begin construction of a replacement for the aging facility in 1986. DOE plans to complete construction of the RTF in mid-1990 and to begin full-scale operations in mid-1992. These operations include pumping pressurized tritium gas into reservoirs (loading) and removing (unloading) tritium from old reservoirs that are returned to the site by the Department of Defense. Because tritium decays and loses its effectiveness in existing weapons, the Department of Defense replaces old reservoirs with fresh ones on scheduled dates that are calculated for each weapon. The old, depleted reservoirs are returned to SRS because some tritium remains in them which can be recovered and recycled. Rather than dismantle the old loading facility when the RTF begins operation, DOE plans to maintain it in a standby condition for potential emergency use. Also, DOE plans to continue quality control testing as well as shipping and receiving activities for tritium reservoirs in the old loading facility.

Why Improvements Are Needed in Loading Facility Operations

Project officials consider start-up of the RTF to be critical because the old facility is not reliable. They believe that operational, security, and environmental limitations at the old facility make continued operation uncertain. An interruption in operations would seriously impair DOE's ability to support maintenance of existing nuclear weapons and to manufacture new weapons.

Shortcomings in the old facility include a limited workload capacity, safety and security problems, and inadequate controls to limit tritium releases to the environment. The RTF is designed to address all of these weaknesses.

Workload Capacity Limitations

According to project officials, the RTF will increase reservoir processing capacity in a number of ways. For example, the old loading facility cannot load new reservoirs and unload returned reservoirs at the same time. This limits production capacity because DOE cannot unload tritium for recycling from returned reservoirs while also loading reservoirs to meet shipping schedules. In the future—as tritium supplies continue to decay and the reactors are not producing new supplies to replace quantities lost to decay—this recycled tritium may become the only source for loading reservoirs. The RTF, on the other hand, is designed to allow both loading and unloading operations at the same time—providing better assurance that tritium returned in old reservoirs can be removed as quickly as needed without stopping loading activities.

Similarly, the old loading facility has a limited production capacity for operating more than one type of loading production line. Because different types of nuclear weapons contain different types of tritium reservoirs, the tritium loading facility contains several different configurations of loading production lines. Some of these different loading lines can fill numerous reservoirs at once while others are more limited. When a specialized, less productive loading line that can fill only a few reservoirs at once is in operation, all the other loading lines must remain idle. By contrast, the RTF is designed to allow operation of several loading lines simultaneously—a feature that will increase operational flexibility and production capacity.

Safety and Security Problems

In addition to production increases, the RTF is planned to provide greater resistance to natural hazards and sabotage than the old loading facility. For example, project officials assume that the old loading facility would fail completely if subjected to earthquakes or tornadoes. Workers would

be at risk from falling debris and radiation exposure from tritium releases if such an event should occur. Project officials do not believe, however, that radiation exposure at the site boundary would exceed public safety standards in such an event. By contrast, the RTF structure is designed to meet SRS earthquake and tornado standards. Also, in contrast to the loading facility, the RTF is being constructed below ground to make it more physically secure from sabotage by limiting avenues of access to the facility.

Tritium Releases

Finally, the old facility is susceptible to release of tritium to the environment, and the RTF is designed to greatly reduce such releases. Small amounts of tritium are routinely released during operations at the old loading facility and about every 5 years, larger accidental releases have occurred. Project officials told us that although these releases have not produced radiation doses in excess of safety standards for either workers or the public, the releases are still considered a serious problem to be avoided. Such releases also waste valuable tritium that is in increasingly short supply. DOE officials said that the RTF incorporates major design improvements to eliminate nearly all tritium releases.

Why Costs to Replace the Loading Facility Have Increased

Construction and other costs have increased substantially since the RTF project began in 1986. Construction, which is scheduled for completion in May 1990, has experienced a 20-percent increase in estimated cost—from \$120 million to \$144 million. Project officials, however, said the largest increases were seen in activities needed to prepare the new facility for full-scale operations in mid-1992 once construction is completed. The estimate for these start-up costs increased by more than 350 percent from an original fiscal year 1986 estimate of \$17 million to the fiscal year 1989 estimate of \$62 million, which is also the current estimate.

Project officials attributed the cost increases to, among other reasons, more stringent safety policies and under-estimates due to the unique nature of the new facility.

Construction Cost Increases

DOE project officials attribute the \$24-million construction cost increases to greater DOE quality assurance, fire protection, and security requirements; an underestimate of design and construction costs; and increases in the cost of materials such as stainless steel. For instance, they told us costs increased by about \$11 million because of stricter DOE quality assurance and security requirements which were imposed at about the

time the project was getting underway. They also said that various labor and materials cost underestimates contributed as well.

Construction is apparently on schedule and due to be completed in mid-1990. At that time, after all initial quality checks and operational tests have been completed, the RTF will be turned over to SRS tritium operations by the construction contractor.

Start-Up Cost Increases

Project officials said that most of the \$45-million increase in start-up costs—at least \$27 million—is the result of increased operational safety policies enacted at SRS since 1988. These policies were initiated to improve the safety of reactor operations but are now being applied to other types of operations as well. Project officials estimate that most of the cost increases due to safety policy changes fall into four categories:

- worker training,
- procedures documentation,
- safety analysis report, and
- engineering drawings.

Approximately \$11 million of the \$27-million increase for implementation of new safety policies is attributed to additional operator training requirements adopted by DOE. In the past, tritium facility personnel were trained on the job by senior workers who would personally determine the readiness of the trainees to assume greater responsibility. Now, however, a formal training program for operation of the RTF is being developed that will include detailed training for specific jobs and specific tasks. Project officials said that eventually the training program will probably grant formal certification to qualified employees as is now done for facilities regulated by the Nuclear Regulatory Commission.

About another \$11 million of the \$27-million increase for implementation of new safety policies is attributed to increased DOE requirements for written procedures for training, operations, and maintenance. In the past, such procedures were not documented in as much detail as is now required.

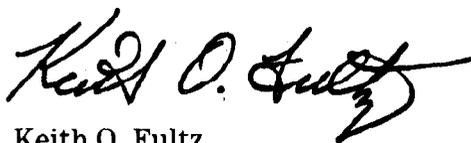
About \$3 million of the increase is attributed to a greatly expanded effort to develop a Safety Analysis Report. In the past this report would have comprised 1 volume but now will require 15 volumes to address factors that now must be included. DOE estimates that this expanded effort will increase the cost from \$1 million to \$4 million.

Another area in which DOE is instituting improved safety policies is documentation of the physical plant in engineering drawings. Project officials told us that the original estimate for the RTF did not allow for the level of detailed documentation now required and that about \$2 million more than originally estimated will be needed for adequately detailed engineering drawings.

Project officials attribute the remaining \$18 million of the total \$45-million increase to corrections of errors in original estimates that were made because of inexperience in the start-up of such a unique facility. For instance, a project engineer said that new technology and computer control systems used in the RTF require more complicated procedures documentation and worker training than was originally anticipated. In general, project officials said that earlier estimates were not accurate in some respects because the costs of starting operations and reaching full-scale capability could not be compared to costs elsewhere—the RTF is a unique facility that will not operate like any other facility.

In our review we contacted agency and contractor personnel and reviewed project files at DOE headquarters, the Albuquerque Operations Office, and the Savannah River Site. We requested officials responsible for the RTF to provide us with informal comments on a draft of this report, and incorporated their comments where appropriate. We performed our work between June and August 1989.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Secretary of Energy and other interested parties. Please call Vic Rezendes at (202) 275-1441 if you have any questions about this report. Major contributors are listed in appendix I.



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