United States General Accounting Office

GAO

Report to Congressional Requesters

February 1991

NUCLEAR MATERIALS

Decreasing Tritium Requirements and Their Effect on DOE Programs

GAO/RCED-91-100

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-242839

February 8, 1991

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

The Honorable Mike Synar
Chairman, Environment, Energy
and Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

On December 16, 1990, you requested that we examine the adequacy of the Department of Energy's (DOE) tritium supplies. As subsequently agreed with your offices, this report provides information on DOE's ability to meet current and future defense tritium requirements and the effect of changes in these requirements on DOE's programs. As you know, tritium is a radioactive material used in nuclear weapons that must be periodically replenished in the weapons. DOE has not produced tritium since 1988 because its nuclear production reactors at Savannah River, South Carolina, are shut down. This report is unclassified. More detailed information will be provided to you soon in a classified version of this report.

In this report, our use of the term requirements refers to the tritium needed to service existing and new nuclear weapons. In 1990, for the first time, DOE's requirements included a substantial quantity of "reserve" tritium as a contingency against unforeseen events. We have not included these reserves in our definition of tritium requirements. We are currently reviewing DOE's tritium contingency plans and alternatives for dealing with unforeseen events and plan to issue a report on the subject in the spring of 1991.

Results in Brief

U.S. defense tritium requirements have decreased dramatically from 1988 through 1990 and may decrease further in future years, primarily as a result of actual and planned nuclear weapons retirements. DOE's analyses of tritium requirements indicate that, without starting any reactors, sufficient tritium supplies will exist to meet the anticipated

needs of the nuclear weapons stockpile for the next several years.[1] Further, DOE projects that one Savannah River nuclear reactor can meet projected tritium requirements over the remaining useful life of the reactor. Defense tritium requirements may decrease even more if the projected number of nuclear warheads is further reduced due to additional unilateral retirements or the signing of a Strategic Arms Reduction Talks (START) treaty.

The decrease in tritium requirements has important implications for DOE's programs, implications that have been considered in DOE's programmatic changes to the Savannah River reactor restart and new production reactor programs. The decreased requirements provide additional time to evaluate outstanding safety and environmental issues before restarting the Savannah River reactors and also when the reactors should be restarted. In addition, the decreased need for tritium affects DOE's decision to expand its tritium production capacity. The dramatic decrease in tritium requirements raises questions about the range of tritium production capacity needed in the long-term and what reactor technologies or other technological approaches are best for meeting these requirements.

Tritium Requirements Have Decreased Dramatically

DOE is responsible for researching, developing, testing, and building nuclear weapons as well as for developing and maintaining the capability to produce the required nuclear material. These responsibilities include producing tritium, a gaseous isotope used to enhance the power of nuclear warheads. Because tritium is a radioactive material that decays at a rate of about 5.5 percent per year, weapons containing it must be replenished periodically with the material in order to maintain their designed capability.

DOE has obtained most of its tritium from two major sources—reactors and returned tritium from the nuclear weapons stockpile. Currently DOE has three nuclear reactors capable of producing tritium. However, these reactors, located at Savannah River, South Carolina, are shut down for safety upgrades. Weapons retired by the Department of Defense (DOD) are disassembled at DOE's Pantex Plant in Texas. Tritium bottles are sent to Savannah River where the material is recovered and added to DOE's tritium inventory.

[1]The nuclear weapons stockpile consists of all nuclear weapons in the U.S. arsenal, including both active weapons and those kept by the Department of Defense in inactive reserve.

Since 1988, the actual and projected number of nuclear weapons in the stockpile has decreased significantly. Both retirements of weapons that DOD is not planning to replace and retirements resulting from the Intermediate-Range Nuclear Forces treaty contributed to this decrease. These retirements included intermediate range nuclear weapons from Germany after the country's reunification.

The actual and projected future retirement of nuclear weapons since 1988 has dramatically affected tritium supplies. This is not only because tritium in the retired weapons is returned to DOE and added to the tritium inventory, but also because the retired weapons no longer have to be periodically replenished with tritium, thus reducing future tritium requirements. Sufficient tritium supplies will exist to meet the anticipated needs of our nuclear weapons stockpile for the near-term—the next several years.

Further retirements of weapons, in addition to those already planned, and negotiations aimed at arms reduction treaties may reduce tritium requirements further over the next few years. According to DOE officials, ongoing negotiations with the Soviet Union for a second START treaty may result in removing more weapons from the stockpile. Finally, the Short-Range Nuclear Forces treaty, now in the early stages of negotiation, may cause a reduction in the tactical nuclear weapons stockpile in 2 or more years. DOE officials informed us that they believe any further reductions in requirements would not likely be of the same magnitude as the currently planned reduction.

Implications of Decreasing Tritium Requirements for Doe Programs

DOE has changed its plans to restart the Savannah River reactors and add new production reactor capacity. However, the decreased tritium requirements provide additional time for DOE to evaluate outstanding safety and environmental issues before restarting the Savannah River reactors and decide whether plans for future capacity are still appropriate.

Impact of Decreasing Tritium Requirements on the Savannah River Reactor Restart Project

Three Savannah River production reactors are currently the nation's only production source of tritium. These reactors have been shut down since 1988 to make hardware improvements, upgrade operator qualifications, expand staffing and training, increase management involvement, and improve oversight. In previous years DOE has made restarting

these reactors a top priority because of the perceived urgency associated with tritium requirements.[2]

DOE's recent analyses indicate that the nation's projected tritium supply in relation to defense requirements is much greater than forecasted in previous years. According to DOE's data, the decrease in the current and projected tritium demand suggests that the urgency associated with restarting the reactors to meet requirements projected in 1988 has diminished. DOE's current projections indicate that, if none of the Savannah River reactors are restarted, current tritium supplies will meet DOD's requirements for the next several years. If one reactor is restarted, DOE will be able to meet tritium requirements over the reactor's useful life. Finally, if two reactors are restarted, tritium supplies could significantly exceed projected tritium requirements.

Because the perceived urgency in restarting the reactors to meet requirements has diminished, DOE now has additional time to resolve outstanding problems associated with the reactors. These problems, which DOE is currently addressing, include a large volume of corrective maintenance requirements and a number of environmental and safety issues. We are currently developing a report on DOE's difficulties in restarting the Savannah River reactors. We expect to issue the report in March 1991.

DOE officials responsible for the Savannah River reactors informed us that they are aware of the tritium supply situation. They have announced that they will continue to operate only two reactors. The first reactor is expected to be restarted in the third quarter of 1991, while operation of the second reactor is deferred to early 1992. Operation of the third reactor will be deferred indefinitely. DOE officials told us it is important to demonstrate that the Savannah River reactors can be safely restarted in a timely manner, and it is urgent that DOE restore tritium production capability. As a result, DOE does not plan to further delay restart of the first reactor because of decreases in tritium requirements.

[2]The first Savannah River reactor was scheduled to be restarted in September 1990, but restart was subsequently delayed until December 1990. The reactor did not restart in December.

Impact of Decreasing Tritium Requirements on Doe's Plans to Build Two New Production Reactors

As part of its strategy to modernize its nuclear weapons complex, DOE developed preliminary plans to build two new production reactors. DOE based these plans, in part, on projections of future tritium needs made several years ago. Specifically, DOE selected two reactors as its preferred choices—a heavy-water reactor located at Savannah River, South Carolina, and a high-temperature, gas-cooled reactor located near Idaho Falls, Idaho. These reactors were to be completed between 1998 and 2000. The estimated cost of the two reactors is $6.8 billion.[3] In addition, to provide for contingencies, DOE began working to solve the institutional and potential legal issues associated with acquiring the Washington Nuclear Plant, Unit 1 (WNP-1), a 63-percent complete light-water reactor located on DOE's Hanford Reservation near Richland, Washington.[4] WNP-1 was designed for commercial power production on the Washington Public Power Supply System. Construction was halted in 1982 because of financial problems and uncertainties concerning future electric power demand. In fiscal year 1990, DOE spent approximately $300 million on the new production reactor program.

This production strategy was developed in 1988, when tritium requirements were much higher than they are now. Production capacity, efficiency, and safety features of the preferred reactors can change with lower tritium requirements. Further, other production alternatives that DOE dismissed in 1988 may be worthy of further consideration. For example, in a February 1990 report (Nuclear Science: The Feasibility of Using a Particle Accelerator to Produce Tritium, GAO/RCED-90-73BR) we found that a particle accelerator,[5] which DOE rejected partly on the grounds that it would require excessive power to produce necessary amounts of tritium, has certain safety and environmental advantages over nuclear reactors. The smaller particle accelerator needed to meet the lower tritium requirements would use less power than the type previously reviewed by DOE. This feature could make its safety and environmental advantages more attractive. Due to its modular nature, the particle accelerator may also be more flexible in terms of capacity. We are currently preparing a report, expected to be issued in the spring of

[3]The $6.8 billion includes $3.2 billion for the heavy-water reactor and $3.6 billion for the modular high-temperature, gas-cooled reactor. These are capital and preoperational costs in 1988 dollars. DOE plans to provide an updated cost estimate in March 1991.

[4]Issues that could hamper DOE in acquiring and converting WNP-1 are potential legal challenges resulting from local political opposition and concerns over the policy question of using a commercial reactor to generate defense nuclear materials.

[5]A particle accelerator is a device that uses basic laws of electromagnetism to increase the motion energy of charged particles.

1991, that discusses the cost estimate and criteria used in DOE's evaluation of the accelerator for tritium production.

In the fiscal year 1992 budget, released February 4, 1991, DOE announced that because of the high cost of building two reactors, it would build only one reactor now while leaving the option of constructing the second reactor open. DOE officials told us that they were not reconsidering the capacity of the reactors or changing the technologies under consideration for the first reactor because of the need to (1) quickly build a replacement for the Savannah River reactors and (2) provide additional reactor capacity in the event that tritium requirements dramatically increase.

Conclusions

The dramatic decrease in tritium requirements and the prospect of further decreases provide additional time to evaluate outstanding issues before restarting the Savannah River reactors. In addition, decreasing tritium requirements raise issues about the best approach to building adequate capacity to produce tritium. DOE has recently made changes to its Savannah River reactor restart and new production reactor programs. However, even with these programmatic changes, we believe it is clear that additional time is available to evaluate (1) outstanding safety and environmental issues before restarting the Savannah River reactors and (2) when the reactors should be restarted. DOE also has additional time to reconsider the capacity and choice of technology to meet the lower tritium requirements.

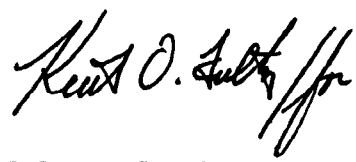
Matter for Consideration by the Congress

The future of DOE's nuclear weapons complex has significant implications not only for our national defense, but also for the national budget. For these reasons, it is important that decisions concerning the future of the weapons complex take into account all potential technologies and the best available information on the size of the facilities needed to produce the required nuclear materials. Accordingly, the Congress should consider carefully the appropriate level of funding for further development of new reactor technologies with a view toward minimizing outlays while asking DOE to study whether other technologies may be better suited for the production of tritium in view of the decreased tritium requirements.

We discussed the information in this report with DOE officials, and we incorporated their views where appropriate. As requested, however, we

did not obtain official agency comments on a draft of this report. As arranged with your offices, 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 of this report to the appropriate congressional committees, the Secretary of Energy, and the Director, Office of Management and Budget. Copies will also be made available to other interested parties who request them. Our work was performed between October 1990 and January 1991 in accordance with generally accepted government auditing standards. (Appendix I provides a discussion of our objectives, scope, and methodology.)

This work was performed under the direction of Victor S. Rezendes, Director of Energy Issues, who can be reached at (202) 275-1441. Major contributors to this report are listed in appendix II.



J. Dexter Peach
Assistant Comptroller General

Objectives, Scope, and Methodology

Our objectives were to provide information on current and future defense tritium requirements and the impact of changes in tritium requirements on DOE's (1) Savannah River reactor restart project and (2) plans to add new production capacity.

In conducting our work, we obtained and reviewed DOE's information regarding current and projected tritium requirements and inventory. We obtained information on tritium requirements and inventory issues from DOE officials in the Production Planning Division. We obtained additional information on weapons retirements from the Office of Deputy Assistant Secretary for Military Applications. We also obtained information on new production reactor development issues from officials in the Office of New Production Reactors and information on possible future treaty-driven weapons retirements from officials in DOE's Office of Arms Control.

We discussed the information in this report with DOE officials, and we incorporated their views where appropriate. However, we did not ask for official DOE comments on the report.

We conducted our review between October 1990 and January 1991 in accordance with generally accepted government auditing standards.

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