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Nuclear Arsenal Reductions Allow Consideration of Tritium Production Options

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

The Honorable Lane Evans
House of Representatives

Bilateral agreements and unilateral decisions by the President over the past several years have resulted in plans that will generate a 75-percent reduction from the nation's 1988 nuclear weapons stockpile level. These reductions affect the future need for tritium, a gaseous radioactive isotope of hydrogen used to enhance the power of nuclear warheads. Because tritium decays at a rate of about 5.5 percent per year, it must be periodically replenished in nuclear weapons in order to maintain the designed capability of the weapons.

Your offices asked us to review the implications of these plans for reducing the nation's nuclear arsenal on the Department of Energy's (DOE) tritium strategy. Specifically, you asked us to provide information on (1) the impact of nuclear stockpile reductions on DOE's tritium supply and (2) the alternatives available to DOE for meeting tritium requirements and for providing a contingency in the event that requirements increase.

Results in Brief

In view of the plans for a significantly reduced nuclear weapons stockpile, DOE has projected that the current tritium supply, supplemented by tritium extracted from dismantled weapons, will enable DOE to service the planned nuclear arsenal through 2012 without the need for producing any additional tritium. In 2012, however, a source of new tritium must be available.

DOE's current tritium supply strategy focuses on four long-range tritium production alternatives. These include a heavy-water reactor, a modular high-temperature gas reactor, a light-water reactor, and a particle accelerator. DOE currently estimates that it will take 12 to 15 years to design, construct, and produce tritium from any of these alternatives. Preliminary design and construction cost estimates for a heavy-water and high-temperature gas reactor are $4.8 billion and $5.3 billion, respectively.

No estimates are currently available for the accelerator or the light-water reactor alternatives, although DOE has estimated light-water tritium target development costs to be about $250 million. The planned nuclear weapons arsenal reductions have allowed DOE to delay implementation of design and construction work on the chosen tritium production source until 1997 to 2000, depending on the alternative chosen and the length of the design and construction period.

DOE also had the K-reactor at the Savannah River Site (Aiken, S.C.) as a contingency source of tritium, should the need arise. However, as part of the fiscal year 1994 budget request, the K-reactor will be placed in a cold standby status, with no provision for restart. Given the closure of the K-reactor, DOE needs a well-conceived contingency plan or strategy for obtaining tritium if tritium requirements increase. DOE states that, in the event of a national emergency requiring additional tritium, a tritium-producing target could be placed in an existing light-water reactor within 5 years. DOE currently has no plan for implementing the contingency and no agreement with a utility for the use of a reactor. Furthermore, the use of a tritium-producing target in a commercial power reactor would require a resumption of funding for the program. (For fiscal year 1993, the Congress directed that no funds be used to develop a tritium target for a commercial light-water reactor.)[1]

Background

DOE is responsible for researching, developing, testing, and building nuclear weapons and for developing and maintaining the capability to produce the required nuclear material. As part of this responsibility, DOE must maintain a sufficient inventory of tritium to service the nation's arsenal of nuclear weapons. DOE has obtained most of its tritium from two major sources—reactors and tritium recycled from retired nuclear weapons and from weapons maintained in the nuclear weapons stockpile. Until 1988, three nuclear production reactors located on DOE's Savannah River Site in South Carolina were available to produce tritium for the weapons arsenal. Since 1988, these reactors have not been operating because of safety and operational problems. DOE also recovers tritium from existing nuclear weapons. When nuclear weapons are retired or tritium is replenished in active weapons, the bottles containing a mixture of tritium and helium (decayed tritium) are sent to the Savannah River

[1]We have issued several reports over the past few years that are directly related to the weapons stockpile and tritium requirements and production alternatives. For example, in our report Nuclear Materials: Decreasing Tritium Requirements and Their Effect on DOE Programs (GAO/RCED-91-100, Feb. 8, 1991), we reported that DOE should study whether other technologies may be better suited for the production of tritium in view of decreased tritium requirements.

Site, where the tritium that has not yet decayed is recovered, reprocessed, and added to DOE's tritium supply.

In 1988, DOE initiated the New Production Reactors Program to design and construct, on an urgent schedule, two tritium production reactors. One reactor (a heavy-water reactor) was to be designed to produce an amount equal to DOE's 1988 tritium requirements, while the second reactor (a high-temperature gas reactor) was to be capable of producing an amount equal to about half of those requirements. However, in February 1991, when DOE's fiscal year 1992 budget request was made public, the Secretary of Energy announced that because of the high cost of building two reactors, DOE would build only one reactor and leave the option of constructing the second reactor open.

During the past 2 years, a number of events have affected the size of our nuclear stockpile and plans for future tritium production alternatives. Among these have been a series of agreements, treaties, and unilateral decisions, including the Strategic Arms Reduction Treaty (START I Treaty) that reduced our strategic nuclear stockpile of about 20,000 weapons. Dramatic reductions also occurred in June 1992, when continued discussions with the leadership of Russia resulted in an agreement to reduce our nuclear stockpile to a strategic arsenal of about 3,500 weapons by 2003.

Three months later, the Secretary of Energy announced that the New Production Reactors Program would be deferred until fiscal year 1995 and that there would be an orderly closeout of design work on the heavy-water reactor and the modular high-temperature gas reactor technologies during fiscal year 1993. Design work on a tritium-producing particle accelerator would continue so it could be on a comparable basis with the reactor technologies. DOE does not plan to make a decision on the future tritium production technologies until late 1994, when the Record of Decision for the weapons complex reconfiguration is scheduled to be announced.

Impact of Nuclear Stockpile Reductions on the Tritium Supply and Requirements

After the announced June 1992 reductions in the nuclear arsenal, DOE reevaluated the tritium supply and requirements situation and developed new projections for the time when additional tritium would be needed. DOE's analyses indicated that the current tritium supply, including the 5-year tritium reserve and the tritium recovered from dismantled weapons, would be sufficient to meet tritium requirements until 2012.[2] At that time, a new tritium source would be required to annually provide about one-quarter of the tritium thought to be needed in 1988 to service the planned arsenal. To reestablish a 5-year tritium reserve within a 5-year period after 2012, DOE would need to produce twice as much tritium.[3]

Tritium Alternatives for a Diminishing Nuclear Arsenal

DOE has been considering four tritium production alternatives, including three reactor technologies and an accelerator, and now estimates that it will take 12 to 15 years to design, construct, and produce tritium from each of these alternatives. In this regard, DOE may not have to implement design and construction work on a new tritium production source until 1997 to 2000. In addition, until recently, DOE considered the recently upgraded K-reactor as a contingency source of additional tritium until a new production source is available. DOE now plans to close the reactor and says it will use a tritium target in a commercial light-water reactor if additional tritium is needed.

Other tritium sources may be available, however. Over the past several years, DOE has studied contingency alternative sources to meet future tritium requirements for the nuclear stockpile. These alternatives have included modifying and using existing DOE facilities to produce tritium and purchasing tritium from foreign countries. Given the reduction in tritium requirements, certain of these alternatives may be capable of meeting potential contingency needs.

DOE Focus on Four Production Technologies

After reviewing the implications of the Bush-Yeltsin Agreement on the national defense requirements for tritium in late fiscal year 1992, the Secretary of Energy announced the deferral of the New Production Reactors Program and advised the Congress that DOE would focus on the following four tritium production alternatives: the construction of a downsized heavy-water reactor, a modular high-temperature gas reactor, a particle accelerator, or the use of a tritium target in a light-water reactor. The Secretary advised that these four technologies would be included in the Programmatic Environmental Impact Statement (PEIS) for the

[2]The tritium reserve was officially established in 1990 as a contingency against unforeseen events associated with the nation's tritium production capability. The reserve was created before the recent agreements and announcements on nuclear weapons reductions.

[3]DOE's analysis also indicated that if the tritium reserve would not be used to service the weapons stockpile, new tritium production would be needed in 2007. In this regard, DOE determined that it would need an annualized production of about one-fourth of the tritium thought to be needed in 1988 to service the arsenal and maintain the 5-year reserve.

proposed reconfiguration of the nuclear weapons complex, which is currently scheduled for release for public comment this fall.[4]

Heavy-Water Reactor

The heavy-water technology was used in the reactors built by DOE's predecessor, the Atomic Energy Commission, at the Savannah River Site in the 1950s for the production of nuclear materials.[5] Efforts to develop a new heavy-water reactor design began in 1988 under the New Production Reactors Program. As originally planned, the New Production Reactors Program supported the development and construction of two reactors for the future production of tritium. One reactor would have been a heavy-water reactor capable of generating 100 percent of the 1988 tritium requirements. From fiscal year 1989 through fiscal year 1992, DOE spent about $421 million on the heavy-water reactor design. DOE's current efforts are focused on a smaller heavy-water reactor capable of producing one-half or less of the tritium thought to be needed in 1988. DOE's contractors estimated that it would cost about $4.8 billion for the design and construction of a half-sized heavy-water reactor. DOE now considers this estimate to be outdated and has recently taken steps to update the heavy-water reactor cost estimate. In addition, DOE now estimates that it will take about 12 to 15 years to design, construct, and produce tritium from a heavy-water reactor.[6]

Modular High-Temperature Gas Reactor

Efforts to design a modular high-temperature gas-cooled reactor for the production of tritium also began in late 1988 under the New Production Reactors Program.[7] Original plans called for the development of a four-module reactor that could produce one-half of the tritium thought to be needed in 1988. From fiscal year 1989 through fiscal year 1992, DOE spent about $471 million on a modular high-temperature gas-cooled reactor design. DOE's contractor had estimated that the design and construction of a four-module gas-cooled reactor (a half-sized reactor) would cost about $5.3 billion. As with the heavy-water reactor cost estimates, DOE now considers this cost estimate to be outdated and has

[4]The PEIS for the nuclear weapons complex will address the environmental implications of planned changes, including implications of each of the four technologies that DOE has identified. Upon the selection of a tritium production option, DOE will be required to perform an environmental impact statement for the selected technology at the selected site.

[5]A heavy-water reactor uses heavy water (i.e., water composed largely of deuterium rather than hydrogen) both as a coolant and moderator.

[6]The new 15-year schedule established by DOE in 1993 for the development and construction of a tritium production source includes 1-1/2 years for the tritium production and extraction cycle. Prior DOE estimates, not including the production and extraction cycle, have been 11 to 12 years for a reactor and about 8 years for the development and construction of an accelerator.

[7]A modular high-temperature gas reactor uses inert helium as a moderator.

recently taken steps to revise it. Also, as with the heavy-water reactor, DOE now indicates that it will take about 12 to 15 years to complete and produce tritium from a modular high-temperature gas reactor.

Light-Water Reactor Target

Light-water reactor technology is the basis for commercial nuclear power reactors in the United States. In 1988, DOE began work to develop a tritium target for a light-water power reactor as a contingency production alternative. According to DOE, the target design for this project was modeled after the reactor core designed for the construction of Washington Nuclear Power Plant, Unit-1 (WNP-1) on DOE's Hanford Reservation, near Richland, Washington.[8] While DOE had reviewed the possibility that WNP-1 could be used as a tritium production source, DOE has no current plans to acquire and finish construction of the WNP-1 reactor. DOE informed us that the light-water target it was developing could be adapted to any light-water reactor design. A DOE official also told us that the feasibility of the technology has been demonstrated and that about $71 million was spent on the project through fiscal year 1992.

According to DOE, the use of the light-water target in an appropriate reactor could produce enough tritium to fully meet the currently projected tritium requirements. However, the light-water target project for a commercial light-water reactor may not be further developed. In Congress's fiscal year 1992 Energy and Water Development Appropriations Bill conference report, the conferees stated that DOE was to terminate the light-water target research by the end of fiscal year 1992. For fiscal year 1993, the Congress further directed that no funds be used for tritium target development for a commercial light-water reactor.

However, DOE stated that for the PEIS, it will include the light-water reactor technology along with heavy-water and high-temperature gas reactor designs and the accelerator concept. While DOE has not developed any recent cost estimates for designing and constructing a light-water production reactor, its current effort to update cost estimates for the heavy-water and high-temperature gas reactor designs will also include the development of new cost estimates for a light-water reactor design. DOE has estimated that the cost of developing a tritium target for installation in a light-water reactor would be about $250 million. In addition, during recent congressional testimony in April 1993, DOE reported that, in the event of a national emergency requiring additional tritium, an existing light-water reactor could be employed for tritium production within 5

[8]WNP-1 is a partially completed light-water reactor, whose construction was started in 1973 by the Washington Public Power Supply System. Construction was halted in 1982 because of financial problems and uncertainties concerning future electrical power demand.

years after being authorized by the Congress. DOE officials have also indicated that, in such an emergency, consideration could be given to the possible use of a Tennessee Valley Authority light-water power reactor.

Particle Accelerator

Prior to 1990, DOE dismissed the particle accelerator as a tritium production option because a tritium production source was thought to be needed on an urgent schedule and the accelerator concept was not as advanced as the heavy-water and modular high-temperature gas reactors' designs.[9] Decreasing requirements for tritium provided the basis for DOE to reconsider the accelerator as a tritium production option, and in January 1992, a special panel, commissioned by the Secretary of Energy, addressed the accelerator concept and concluded that a particle accelerator was a feasible and practical tritium production option and recommended its inclusion among the alternatives that DOE was considering for a replacement tritium production facility.[10]

In June 1992, DOE reported its intent to provide $3 million of the New Production Reactors Program's funds and reprogram $9 million from Defense Programs to provide additional resources to develop a preliminary design for the accelerator concept. DOE also included $18 million in the 1993 budget request for the accelerator design work.[11] As with the reactor technologies addressed previously, the current DOE focus is on a smaller accelerator design capable of producing one-half or less of the tritium thought to be needed in 1988. As of May 1993, DOE's contractors had not estimated the design and construction costs of an accelerator capable of producing one-half or less of the amount of tritium thought necessary in 1988. As with the reactors, DOE now indicates that it will take about 12 to 15 years to complete the design and construction of an accelerator and produce tritium.

[9]A particle accelerator is a device that uses the basic laws of electromagnetism to increase the motion energy of charged particles such as protons. The charged particles gain energy by passing through a series of electrically charged tubes.

[10]DOE's current initiative to revise and/or update the cost estimates for the reactor technologies will also include the review of the new cost estimates for the downsized accelerator design.

[11]We had previously reported in Nuclear Science: The Feasibility of Using a Particle Accelerator to Produce Tritium (GAO/RCED-90-73BR, Feb. 2, 1990) that accelerator production of tritium appeared to be technically feasible but that engineering development was needed. In our report Nuclear Science: Accelerator Technology for Tritium Production Needs Further Study (GAO/RCED-92-1, Oct. 31, 1991), we stated that using an accelerator to produce tritium is a valid technology that deserves more balanced consideration in DOE's tritium production planning.

K-Reactor Not to Be Restarted

DOE's heavy-water reactors at Savannah River, South Carolina, were placed in an outage mode in 1988 because of safety and operational problems. Subsequently, DOE made restarting the K-reactor at Savannah River a top priority because of the urgency associated with the need to have a tritium production source. When the urgency was largely eliminated in late 1991 because of the arms reduction agreements, DOE continued to plan for restarting the K-reactor, and its goal was to demonstrate the reactor's safe operation. From fiscal year 1989 into fiscal year 1993, DOE spent about $1.7 billion on various safety and operational improvements to the reactor.

In fiscal year 1992, DOE essentially completed safety and operational improvements to the reactor, except for connecting the newly constructed cooling tower, and successfully completed a power ascension test program. Following DOE's efforts to connect the new cooling tower to the reactor, DOE's plan was to operate the reactor at 30-percent power and produce a fraction of the tritium thought to be needed in 1988. This 5-month demonstration was to show that the K-reactor is a viable contingency production source of tritium. After the test, which was scheduled for the spring of 1993, DOE was planning to place the reactor in a 5-year standby mode. According to DOE officials, the K-reactor could produce enough tritium to satisfy currently projected tritium requirements. DOE also estimated that the remaining life expectancy of the upgraded K-reactor was in excess of 20 years.

On April 8, 1993, with the announcement of the fiscal year 1994 budget request, DOE canceled the demonstration production run and restart plan for the K-reactor and said the reactor would be placed in a "cold standby" status, without further testing. In its budget request, DOE stated that

> Planning for K-reactor has been changed from demonstrating and then maintaining tritium production viability to placing K-reactor and its directly associated support facilities in cold standby condition starting in fiscal year 1993 with no planned provision for restart. Preparations are to be started to transition K-reactor to the Office of Environmental Restoration and Waste Management for eventual decontamination and decommissioning.

DOE said that it took this action because a sufficient tritium supply exists to meet all tritium needs for national defense beyond the next decade and that budgetary constraints no longer permit maintenance of the K-reactor as a tritium production contingency. DOE has estimated that the K-reactor will be placed in cold standby by the end of 1994 at a cost of about $96 million. DOE has estimated that if a new decision is made to restart the

K-reactor at the end of fiscal year 1994, producing tritium at the reactor will take about 4 years and cost about $1.3 billion.[12]

The K-reactor was DOE's contingency in case world events or other factors resulted in the need for additional tritium. As discussed previously, DOE has stated that in the event of a national emergency, an existing light-water reactor could be used to produce tritium. While the light-water reactor has become DOE's contingency tritium source, DOE has no agreement with a utility to use its reactor, and the Congress has declined to provide further funding for light-water target research and development.

Other Tritium Supply Alternatives

Since 1988, DOE has conducted two studies to identify alternatives for obtaining the tritium needed to service our nation's nuclear weapons. In 1988, DOE prepared a report on potential contingency options for the production of tritium in the event that production reactors at the Savannah River Site became inoperable. After the Savannah River reactors were shut down in 1988, DOE prepared a second report, which identified four tritium sources as options but did not discuss their relative feasibility. That report was updated in 1989 and identified six types of tritium sources: (1) tritium produced in DOE's N-reactor;[13] (2) tritium produced in commercial-type light-water reactors; (3) tritium produced in selected DOE test and research reactors (considered one option); (4) tritium purchased from Canada; (5) tritium obtained from detritiated heavy water; and (6) tritium produced in naval reactors.[14] After the report was issued, DOE pursued the development of a tritium target for a light-water reactor (addressed in a preceding section of this letter).

Producing Tritium in Test and Research Reactors

DOE's studies have included analyzing the possibility of producing tritium in DOE's Fast Flux Test Facility (FFTF), in Hanford, Washington, and Advanced Test Reactor (ATR), in Idaho Falls, Idaho. FFTF is a liquid metal reactor that was built in 1980 to support DOE's advanced liquid metal-cooled breeder reactor development program. FFTF was also utilized in a 1989 mission to produce plutonium-238. The utilization of FFTF to produce tritium would require the successful development of a new

[12]According to DOE, if a decision were made to restart the K-reactor in October 1993, the cost of restart would be between $600 million and $700 million over a 2-year period.

[13]The N-reactor, a graphite-moderated reactor located at DOE's Hanford, Washington site, operated from 1963 to 1987 and primarily produced plutonium for DOE's weapons program. This alternative is no longer viable because in August 1991, DOE announced its decision to initiate decontamination and decommissioning of the N-reactor.

[14]Naval reactors were discounted as a tritium source because of their small tritium contribution and several institutional and technical problems.

tritium target. If such a target were developed, DOE estimated that FFTF could annually produce about one-eighth of the tritium thought to be needed in 1988. While this quantity of tritium would not be sufficient to meet DOE's 1988 requirements, it could contribute to meeting currently projected requirements and could delay the need for constructing a new tritium production source. DOE estimated that FFTF could be operated for at least 20 more years without major maintenance or modification.

In fiscal year 1992, because of budgetary constraints, DOE examined the need for the continued operation of FFTF. DOE estimated that it would cost about $70 million annually to maintain the reactor in operational status. As a result, in April 1992, FFTF was placed in standby status because of the continued uncertainty about its long-term mission. In January 1993, the former Secretary of Energy directed that FFTF be closed. At the present time, FFTF is being maintained in a hot standby status pending a study on the potential for funding from outside sources for multiagency or international use to defray operational and maintenance costs.[15]

The ATR is a water-cooled test reactor that began operations in 1967 at the Idaho National Engineering Laboratory to provide a facility for the irradiation of fuels and materials primarily for DOE's Naval Reactor Program. DOE estimated that, as a tritium production option, ATR could annually produce about one-sixteenth of the tritium thought to be needed in 1988. DOE estimated that ATR could be operated about 20 more years without major maintenance or modification. Like FFTF, ATR did not have sufficient estimated tritium production capacity to individually meet 1988 requirements; however, it could contribute to meeting the currently projected smaller tritium requirements, possibly in conjunction with other tritium sources.

Purchasing Tritium From Foreign Countries

In addition to several potential production options, DOE had also considered the potential for purchasing tritium from several foreign governments. DOE had estimated that significant quantities of the tritium thought to be needed in 1988 might be collectively available from these countries on an annual basis. While this quantity would not have been sufficient to meet 1988 requirements, it could have contributed to meeting or possibly have met the smaller requirements now projected. However, DOE concluded that purchasing tritium from abroad could not be relied on to meet tritium requirements. Each potential source, according to DOE, had its own set of potential problems and obstacles, including policies against

[15]Hot standby status of a reactor means that the reactor is operating at a power level that will maintain the minimum reactor operating temperature only.

tritium sales for weapons production and the high purchase price of the tritium. In this regard, DOE concluded that relying on purchases of tritium from abroad to meet our arsenal's requirements posed too many uncertainties. However, because of the changes taking place in the former Soviet Union, DOE officials have recently commented that there may be the potential to make a one-time purchase from Russia to further extend the time before new production is needed.

Producing Tritium From Detritiated Heavy Water

The detritiation of heavy water was also considered by DOE as a potential source of new tritium. Under this process, tritium is extracted from the heavy water that was used in the heavy-water reactors at Savannah River. At the time that this process was being considered, DOE estimated that a small fraction of the tritium thought to be needed in 1988 could be obtained. While the available quantity of tritium was insufficient to meet the requirements at that time, it could make a contribution to meeting DOE's currently projected tritium requirements and could delay the need for a new production source of tritium or, in conjunction with other existing sources of tritium, could provide the required amounts. However, this option would require the construction of a detritiation facility.

Conclusions

If the currently projected nuclear weapons stockpile configuration is considered, DOE's tritium supply is sufficient to service the planned nuclear weapons stockpile until 2012. As a result, DOE does not have to implement design and construction of the chosen tritium alternative until 1997 to 2000, given the estimated 12 to 15 years that DOE now reports as the time needed to design, construct, and produce new tritium from a new production source. Until recently, DOE relied on the K-reactor at Savannah River as the contingency tritium production source until a replacement production source became available. DOE has decided to place the K-reactor in a cold standby status without provision for restarting the reactor and then move to decontaminating and decommissioning the reactor.

While the tritium supply may provide DOE with time for its long-term plan for a new production source, the decision not to restart the K-reactor will leave DOE without a potential contingency production source if additional tritium is needed. If the world situation changes and the need for nuclear weapons increases, a viable contingency alternative(s) may be necessary to meet an increased tritium need. DOE says it will use a light-water reactor to meet such an emergency. However, DOE has no plan for how or when this will be done, and the Congress has declined to fund further light-water target research and development.

In our view, this situation indicates the need for DOE to develop a comprehensive tritium strategy that not only provides for the long-term development of a new tritium production source but also addresses the need for and implementation of a contingency tritium source. This strategy should also address the role and need for a tritium reserve. Certain alternatives considered in DOE's previous contingency studies may be capable of serving as a contingency source of tritium if there is an increased demand for tritium before a new production source is available and can be considered in the development of the strategy.

Recommendation

We recommend that the Secretary of Energy reexamine DOE's tritium strategy with emphasis on contingency planning until a new production source is available. DOE should examine all potential tritium source alternatives, and its goal should be to utilize the most economic and appropriate means for providing a tritium contingency in the short term and midterm if tritium demand increases. In view of its implications for the size of and timing for a new tritium production source, the Secretary may also want to examine the role and need for the tritium reserve.

Agency Comments

We discussed the facts contained in this report with DOE Defense Program officials in the Offices of the Deputy Assistant Secretaries for Military Application, Weapons Complex Reconfiguration, and Facilities. These officials generally agreed with the facts presented and offered suggested clarity changes and updated information, which we incorporated where appropriate. As requested, however, we did not obtain written DOE comments on a draft of this report.

Scope and Methodology

To determine DOE's assessment for future tritium requirements and future production alternatives, we reviewed various DOE documents on tritium supply and requirements projections and the various tritium production options. To obtain current information on tritium supply and future requirements, we interviewed key DOE Defense Programs representatives involved in tritium requirements development. Regarding tritium production and source alternatives, we interviewed DOE officials in Defense Programs offices and the former Office of New Production Reactors. We also considered our previously issued reports on DOE's efforts to (1) project tritium requirements and (2) consider potential production alternatives. Our work was performed between August 1992 and April 1993 in accordance with generally accepted government auditing standards.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretary of Energy and the Director, Office of Management and Budget. We will make copies available to others on request.

This work was performed under the direction of Victor S. Rezendes, Director of Energy and Science Issues, who can be reached at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix I.

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Related GAO Products

Nuclear Science: Consideration of Accelerator Production of Tritium Requires R&D (GAO/RCED-92-154, June 15, 1992).

Nuclear Science: Accelerator Technology for Tritium Production Needs Further Study (GAO/RCED-92-1, Oct. 31, 1991).

Nuclear Safety: Status of Reactor Restart Efforts and Safety Culture Change (GAO/RCED-91-95, Mar. 13, 1991).

Nuclear Materials: Decreasing Tritium Requirements and Their Effect on DOE Programs (GAO/RCED-91-100, Feb. 8, 1991).

Nuclear Science: The Feasibility of Using a Particle Accelerator to Produce Tritium (GAO/RCED-90-73BR, Feb. 2, 1990).

Nuclear Science: Better Information Needed for Selection of New Production Reactor (GAO/RCED-89-206, Sept. 21, 1989).

Nuclear Science: DOE Richland Role in the Proposal to Convert Washington Nuclear Power Plant No.1 (GAO/RCED-89-134BR, June 6, 1989).

Nuclear Science: Effect of Conversion of Washington Nuclear Plant No.1 on Debt and Electric Rates (GAO/RCED-89-88FS, Mar. 9, 1989).

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