DOE/EA--0929

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U.S. DEPARTMENT OF ENERGY

FINDING OF NO SIGNIFICANT IMPACT INTERIM STORAGE OF ENRICHED URANIUM ABOVE THE MAXIMUM HISTORICAL LEVEL AT THE Y-12 PLANT OAK RIDGE, TENNESSEE

AGENCY: Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY

The United States Department of Energy (DOE) has prepared an Environmental Assessment (EA) for the *Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September, 1994). The EA evaluates the environmental effects of transportation, prestorage processing, and interim storage of bounding quantities of enriched uranium at the Y-12 Plant over a ten-year period. The State of Tennessee and the public participated in public meetings and workshops which were held after a predecisional draft EA was released in February 1994, and after the revised pre-approval EA was issued in September 1994. Comments provided by the State and public have been carefully considered by the Department. As a result of this public process, the Department has determined that the Y-12 Plant would store no more than 500 metric tons of highly enriched uranium (HEU) and no more than 6 metric tons of low enriched uranium (LEU). The bounding storage quantities analyzed in the pre-approval EA are 500 metric tons of HEU and 7,105.9 metric tons of LEU. Based on the analyses in the EA, as revised by the attachment to the Finding of No Significant Impact (FONSI), DOE has determined that interim storage of 500 metric tons of HEU and 6 metric tons of LEU at the Y-12 Plant does not constitute a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, an Environmental Impact Statement (EIS) is not required and the Department is issuing this FONSI.

ADDRESSES AND FURTHER INFORMATION: Persons requesting additional information regarding this action or desiring a copy of the Environmental Assessment should contact:

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Copies of the Environmental Assessment are available for public review at the following Department of Energy reading rooms:

U.S. Department of Energy
Freedom of Information Reading Room
Forrestal Building, Room 1E - 190
1000 Independence Avenue, SW
Washington, D.C. 20585
(202) 586-6020

U.S. Department of Energy
Oak Ridge Public Reading Room
55 Jefferson Avenue
Oak Ridge, Tennessee 37830
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SUPPLEMENTARY INFORMATION

Background

Enriched uranium stored at the Y-12 Plant is approaching the maximum historical storage levels, primarily due to the receipt of retired weapons components containing HEU. The 506 metric tons of enriched uranium proposed to be stored at the Y-12 Plant includes up to 500 metric tons of HEU and 6 metric tons of LEU (current inventory of about 3 metric tons plus shipments of 3 metric tons over a ten year period), as shown in Table 1. (Metric tons of uranium, or MTU, is a measure of metric tons of elemental uranium in a compound). As of June 1994, as announced by the Secretary of Energy, there was 168.9 MTU HEU at the Y-12 Plant. An additional 0.58 MTU HEU was acquired from Kazakhstan for nonproliferation purposes in November 1994 and is in the process of being shipped out of the Y-12 Plant. Additional shipments have arrived from the Pantex Plant, the exact quantity of which remains classified. The historic storage level of HEU was exceeded in 1992, as explained in the EA; currently, DOE estimates that the historic level for LEU and HEU combined will be reached in about October 1995.

Retired weapons components, known as secondaries, which are removed from nuclear weapons dismantled at the Pantex Plant near Amarillo, Texas, would continue to be received for disassembly or storage at the Y-12 Plant; the exact quantity of HEU in the secondaries to be shipped from Pantex is classified. The Pantex Plant does not currently have the authorized capability for interim storage of secondaries, and historically, the secondaries have been shipped to the Y-12 Plant. Secondaries which are not needed for the strategic reserve are disassembled and processed for interim storage at the Y-12 Plant. The continued dismantlement of nuclear weapons at Pantex and disassembly of secondaries at the Y-12 Plant support the United States' goals of weapons dismantlement and nonproliferation.

Table 1: Interim Storage of Enriched Uranium at the Y-12 Plant

	Current Inventory	Enriched Uranium to be Shipped to the Y-12 Plant Over 10 Years		Interim Storage Total
		Origin	Quantity	
HEU	>169.5 MTU Includes: 168.9 MTU announced by the Secretary, 6/94; [1] HEU shipped since 6/94 and 0.58 MTU acquired from Kazakhstan	Pantex	Classified	≤ 500 MTU
		Foreign HEU Acquired by U.S. Government	up to 5.0 MTU	
		DOE-owned HEU at U.S. Sites[2]	93.4 MTU	
LEU	3.0 MTU	Universities and Commercial Users	3.0 MTU	6.0 MTU
Total	>172.5 MTU		>100.8 MTU	≤ 506.0 MTU

[1] The Secretary of Energy announced the HEU inventories at the Y-12 Plant and other sites in June 1994 as part of her Openness Initiative. Since that time, there have been additional shipments of HEU to the Y-12 Plant, primarily to support dismantlement of weapons at the Pantex. The quantities of HEU shipped since June 1994 are within the Y-12 Plant maximum historical enriched uranium storage levels.

[2] Quantities, origins, and forms of HEU are shown in Table 3.1 of the EA.

The 0.58 MTU of HEU that was acquired by the United States from Kazakhstan was received at the Y-12 Plant for interim storage in November 1994. This action was taken to implement the United States nonproliferation policy of selectively acquiring fissionable material from foreign sources in order to reduce the likelihood of nuclear weapons proliferation. A classified EA was prepared on the transportation and interim storage of the HEU acquired from Kazakhstan (DOE/EA-1006, and a FONSI was issued on October 6, 1994. An unclassified version of the EA was subsequently released to the public. In May, 1995, the Department issued an EA (DOE/EA-1063) and FONSI for the disposition of the Kazakhstan-origin HEU and its removal from the Y-12 Plant. No more than 5.0 MTU of newly acquired HEU from foreign sources may be stored at the Y-12 Plant at any given time. The acquisition of any additional HEU from foreign sources that may be proposed to be received at the Y-12 Plant in the future would be subject to NEPA, and DOE would prepare appropriate environmental documentation.

In addition to the HEU from the Pantex Plant and from foreign sources, DOE-owned HEU currently stored in various forms at other sites where it is not needed would be transported over the next ten years for interim storage at the Y-12 Plant. The Department may process some of this HEU into an annular storage form[3] for material control, accountability, and maximum utilization of existing interim storage space, in accordance with good management practices. Any processing would be solely for the purposes of interim storage.

The Y-12 Plant has also historically received and stored relatively small quantities of LEU. As stated in the EA, the purpose of shipping enriched uranium materials to the Y-12 Plant is to support nonproliferation objectives, dismantlement of weapons,

[3]"Annular storage form" refers to the "annulus" which is the hollow, cylindrical shape into which enriched uranium metal is cast for storage purposes; also referred to as a right circular cylinder.

and reduce the need for interim materials management at the origin sites. Interim storage of LEU at the Y-12 Plant would be limited to 6.0 MTU, (current inventory of about 3 MTU plus shipments of 3 MTU over a ten year period), rather than the 7,105.9 MTU analyzed in the pre-approval EA . The Department has decided that the quantity of LEU shipped to the Y-12 Plant can be limited to three MTU of LEU, primarily from various universities and commercial users, to comply with existing contractual arrangements and when in the interest of health and safety requirements (e.g., a commercial or DOE facility having no alternative for storage).

The Department believes that the impacts of transporting and storing the bounding quantity of LEU analyzed in the pre-approval EA would be insignificant. However, concerns were raised by the State of Tennessee and the public about the reasons for shipping the LEU to the Y-12 Plant. One question raised was whether the LEU was being transported to the Y-12 Plant for "blending down" HEU to LEU. The proposed action in the EA did not address the blending of HEU with LEU; the EA specifically states that there would be no processing of LEU. Any processing of HEU would be for the purposes of interim storage, rather than disposition. As discussed in the EA, the Department had planned to address the long-term storage and disposition of HEU in the Programmatic Environmental Impact Statement on Long-Term Storage and Disposition of Weapons-Usable Fissile Materials (Notice of Intent published June 21, 1994 (59 FR 31935)).

On November 10, 1994, the Department met with stakeholders in Oak Ridge to discuss the possibility of preparing separate NEPA documentation for surplus, weapons-usable HEU disposition. The Department issued a Notice of Intent to prepare a separate environmental impact statement for the disposition of surplus weapons-usable HEU on April 5, 1995 (60 FR 17344). The storage and management of HEU that is not subject to surplus disposition will be addressed in the programmatic environmental impact statements concerning weapons-usable fissile material and stockpile stewardship and management. The Department will continue to involve the public in the NEPA process for storage and disposition of HEU. Interim storage of enriched uranium is independently justified because of the need to continue dismantlement of nuclear weapons at Pantex and the need to store, process, and manage on an interim basis enriched uranium that is not needed at other sites. Interim storage would not limit the alternatives for the environmental impact statements concerning disposition of surplus HEU, storage and disposition of fissile materials or stockpile stewardship and management, or prejudice the Department's decisions in this regard because, among other things, those environmental impact statements will analyze different proposals and will include additional different materials and alternatives.

Public Participation

DOE provided a Predecisional Draft *Environmental Assessment for the Storage of Highly Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* to the State of Tennessee and the public on March 2, 1994, for a 30-day comment period. A public meeting was held on March 24, 1994 and comments were transcribed for the official record. All comments received in writing during and after the comment period and all comments received at the public meeting were considered in revising the EA. In addition, a series of five Focus Area Workshops was held during April 1994 to clarify comments submitted by the public and to provide additional information requested by stakeholders. The focus areas which were selected and prioritized by members of the public participating in the process included the following: Classification and HEU Processing, Handling, and Storage; Safety Analysis Reports, Accident Analysis, and Criticality Safety; Transportation, Safeguards, and Security Issues; Environmental and Waste Management Issues; and Radiological Exposure and Worker Health and Safety Issues. Comments submitted in writing and at the

March 24, 1994 public meeting are contained in the Response to Comments Document, along with individual responses and indications of the revisions made to the EA in response to comments. The EA was extensively revised to account for events which had occurred since the predecisional draft, and to respond to public comments regarding the level of analysis of impacts and the readability of the document. The scope of the EA was changed by adding the receipt of HEU acquired from foreign sources and low-enriched uranium to the proposed action. A public workshop was held on December 5, 1994, to allow the State and interested members of the public to informally discuss the revised EA and Response to Comments Document before final review and consideration within DOE. After the workshop, an additional comment period of two weeks was provided. A second Comment Response Document was issued to address the additional comments received and a draft FONSI was issued for public review and comment. An additional public workshop was conducted on March 13, 1995 to discuss the draft FONSI, and an additional two-week comment period was provided at the request of the State of Tennessee and stakeholders. Additional comments were received, and those comments were considered in this FONSI.

Proposed Action

The proposed action is interim storage of up to 506 metric tons of enriched uranium for up to ten years at the Y-12 Plant, located on the Oak Ridge Reservation, in Oak Ridge, Tennessee. As discussed above, the enriched uranium to be stored includes up to 500 metric tons of HEU and 6.0 MTU of LEU.

The additional 3 MTU of LEU to be received at the Y-12 Plant would not be processed and would go directly into storage. The secondaries received from the Pantex Plant that are not needed for support of the strategic reserve and stockpile would be disassembled and processed for interim storage. In addition, up to 85 percent, or 84 metric tons, of HEU received from sites other than Pantex could also require prestorage processing. This is because most of the HEU materials are not currently in forms suitable for storage or are not characterized to permit accurate quantification of the material. Future enriched uranium processing rates at the Y-12 Plant would not exceed the 1993 rate. The HEU would be received and processed in the same physical and chemical forms as during past operations; therefore no new processing activities would occur. Enriched uranium received at the Y-12 Plant would generally be in the form of enriched-uranium-bearing materials, such as alloys, oxides or nitrates, or retired weapons components known as secondaries.

No new facilities would need to be constructed to accomplish the proposed action, because the capacity of existing processing and storage facilities is sufficient. Eight facilities at the Y-12 Plant that are currently used to store enriched uranium or process it for storage would continue to be used for the interim storage of enriched uranium above the historical maximum storage level. Some minor internal modifications would be required to provide enhanced security and additional storage capacity. The primary facilities to be used for prestorage processing and interim storage are: Buildings 9204-2, 9204-2E, 9204-4, 9206, 9212, 9215, 9720-5, and 9998.

Building 9204-4 is being phased out of operation as part of the Y-12 Plant downsizing effort. Current plans are to transition the facility from the DOE Office of Defense Programs (DP) to the DOE Office of Environmental Management (EM) in the Fiscal Year 2001 time frame. Accordingly, any enriched uranium that would be stored in Building 9204-4 would be temporary and would be moved out of Building 9204-4 into the other storage locations over the next five to six years. There are no current plans to store any newly-received enriched uranium in this building as part of this proposed action.

The majority of HEU would be transported to the Y-12 Plant by DOE-owned Safe Secure Transport (SST) vehicles, which are specially designed semi-trailers pulled by armored tractors and are designed to protect the cargo from damage or release in the event of a severe accident. Less than one percent of the HEU (in small quantities), and most of the LEU, would be transported by commercial carrier in accordance with Department of Transportation regulations.

Environmental Impacts

Routine Operating Conditions at the Y-12 Plant: Storage of enriched uranium above the Y-12 Plant's maximum historical level, and related processing, would not require modification of, or application for, any regulatory permit, nor would it result in violations of any current permit conditions or noncompliance with any environmental regulations. The proposed action would not result in increased radioactive or nonradioactive airborne discharges above the 1993 baseline levels. Groundwater would not be affected by the proposed action. Since no buildings would be constructed or demolished for the proposed action, there would be no effects on land use or archaeological and cultural resources. Furthermore, as there is little natural vegetation or fauna within the Y-12 Plant, no effects on ecological resources within the plant boundaries would occur. The annual amounts of solid and liquid wastes generated as a result of the prestorage processing and storage of enriched uranium are not expected to be higher than the quantities produced in 1993, which can be managed in existing treatment and storage facilities in accordance with regulatory requirements.

Because the annual processing rates would not exceed the 1993 rate, the proposed action would not result in worker exposures higher than the 1993 levels, which were considered the bounding case for analysis in the EA. The highest annual dose estimated to be received by an individual worker would be 0.39 rem, which is less than the Y-12 Plant control limit of 1.0 rem per year. The annual collective dose for all of the workers involved in the proposed action would be 12.9 person-rem, and the ten-year collective dose would be 129 person-rem. Using the worker dose-to-risk conversion factor of 4×10^{-4} (NRC, 1991), it is estimated that the ten-year collective dose would have a probability of 0.05, one chance in twenty, of causing one excess cancer fatality among the 482 workers over a latency period of 50 years following the initial 10 year exposure.

The proposed action is estimated to result in a dose to the maximally-exposed member of the public of 1.3 mrem (0.0013 rem) per year, which is the 1993 dose. When added to the dose of 0.1 mrem from the Oak Ridge National Laboratory and 0.1 mrem from the K-25 Site, the total dose of 1.5 mrem to the maximally-exposed individual from the Oak Ridge Reservation is less than the EPA's National Emissions Standards for Hazardous Air Pollutants regulatory limit of 10 mrem per year. The collective dose to the public within 50 miles of the Oak Ridge Reservation from airborne releases due to Y-12 Plant operations is estimated to be 12 person-rem per year and 120 person-rem over ten years. Using the public dose-to-risk conversion factor of 5×10^{-4} (NRC, 1991), the ten-year collective dose would have a probability of 0.06, or six chances in 100, of causing one excess cancer fatality among the population within 50 miles of the Oak Ridge Reservation over a latency period of 50 years following the initial 10 year exposure.

<u>Abnormal Events/Accidents at the Y-12 Plant:</u> DOE analyzed a series of potential accidents that could occur during prestorage processing and interim storage. The postulated initiating events include earthquakes, tornadoes, an aircraft crash, and process accidents. The accidents with bounding consequences, including fires, mechanical upsets, criticality, toxic chemical release, and explosion events, were described and their impacts on workers and the public presented. The beyond-design-basis accident (a building collapse from a beyond-design-basis earthquake or airplane crash) was intentionally overestimated to cause a series of process

accidents, including a solvent fire, a fluid bed off-gas filter failure, and a criticality. According to the EA, the probability of a design-basis earthquake is 5×10^{-4} and the probability of an aircraft crash is 1×10^{-7}. The probability is lower for a beyond-design basis earthquake or aircraft crash causing the postulated series of accidents. Workers in the immediate vicinity of this accident would likely suffer fatalities in the postulated accident. The average collective dose to all of the workers on site at the Y-12 Plant would be 14,000 person-rem, which would be estimated to result in an additional five excess cancer fatalities. Under this beyond-design-basis bounding accident scenario, the collective dose to the public within a 50-mile radius of the Oak Ridge Reservation is estimated to be 190 person-rem. This collective dose to the public is estimated to have a probability of 0.1, or 1 chance in 10, of causing an excess cancer fatality in the population of approximately 880,000 people over a latency period of 50 years following the initial 10 year exposure.

In response to public comment, the EA also analyzed the extremely unlikely simultaneous collapse of five key uranium buildings, with the release of HEU from processing activities and five nuclear criticalities. Such an accident is so unlikely that it is not reasonably foreseeable. A beyond-design-basis earthquake sufficient to cause collapse of the Y-12 Plant buildings used for processing and storage of HEU has a very low likelihood of occurrence, less than .0001 per year. If such an accident were to occur, there would be 8 chances in 10 that an excess cancer fatality would occur within 50 miles of Oak Ridge, and there would likely be worker fatalities due to the combination of penetrating radiation, inhalation of radioactive uranium, acute uranium toxicity, building collapse and flying debris.

The public expressed concern regarding the potential effects if Building 9204-4 were to collapse in a Y-12 design basis earthquake as discussed above. The Safety Analysis Report Upgrade (SARUP) Phase I Report regarding the Building makes a conservative assumption (i.e., intentionally overestimates) that birdcages[4] are stored in stacked configurations during the building collapse. The current practice prohibits stacking and specifies that birdcages must be placed in a single-layer configuration within a vault-type room. Therefore, any falling debris from a building collapse that crushes both the vault-type room and the single-stacked birdcage would not compact several layers of stored material together. Furthermore, in order to form a critical array, the material would have to be removed or ejected from the birdcage's inner storage container, accumulate in the appropriate mass and shape, and have the proper amount of moderation added. These factors are part of the double-contingency principle, which means that two or more unlikely and unrelated events must occur together to allow conditions that would favor the start of a nuclear criticality. It is these reasons, when combined with the 5 x 10^{-4} probability of an earthquake, that provide the basis for determining that this accident scenario (collapse of Building 9204-4 inducing a nuclear criticality) is extremely unlikely. In addition, Building 9204-4 is being phased out of use as an enriched uranium storage building, and no newly-received enriched uranium would be stored in this building under this proposed action, as previously discussed.

Transportation: The pre-approval EA analyzes the effects of shipping the maximum bounding quantities of HEU and LEU to the Y-12 Plant. The LEU shipped to the Y-12 Plant would be limited to 3.0 MTU, rather than the 7,102.9 MTU which was analyzed in the pre-approval EA. DOE conducted an additional study to analyze the potential effects of transporting the 3 MTU LEU to the Y-12 Plant. This additional study is attached to this FONSI, and it supplements and is made part of the EA.

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[4]Birdcages are small metal cages used to ensure criticality safety while enriched uranium material is staged for processing or storage.

The ten-year collective dose to all transport workers under incident-free conditions was estimated to be 246 person-rem, based on the bounding quantities of enriched uranium which were analyzed in the pre-approval EA. Of that total dose, 63 person-rem would result from transport of 500 MTU of HEU. If 7,102.9 MTU of LEU were to be shipped, the collective dose to workers from those shipments would be 183 person-rem. However, the shipments of LEU will be limited to 3 MTU, which is 0.04 percent of the quantity analyzed in the EA. Thus, the 246 person-rem collective dose to workers is a bounding estimate, and the actual dose would be substantially lower. The collective dose to workers from the shipment of 3 MTU LEU is estimated to be 0.31 person-rem. Using the worker dose-to-risk conversion factor of 4×10^{-4} cancer fatalities per person-rem (NRC 1991), the total 246 person-rem collective dose, estimated as the bounding case, would have a probability of 0.1, or 1 chance in 10, of causing one excess cancer fatality among the workers over a latency period of 50 years following the initial 10 year exposure. Based on the reduced shipment of 3 MTU LEU and the 500 MTU HEU, the collective dose to all workers would be reduced to 63.31 person-rem rather than the 246 person-rem as analyzed in the EA. Using the dose-to-risk conversion factor for workers of 4×10^{-4} cancer fatalities per person-rem (NRC 1991), this lower dose would result in a probability of 0.025 (0.03), or 3 chances in 100, or 1 chance in 33 of causing one excess cancer fatality among the workers over a latency period of 50 years following the initial 10 year exposure.

The ten-year collective dose to the public from incident-free transportation was estimated to be 486 person-rem, based on the bounding quantities analyzed in the pre-approval EA. Of that total dose, 33 person-rem would result from transport of 500 MTU of HEU. If 7,102.9 MTU of LEU were to be shipped, the collective dose to the public from those shipments would be 453 person-rem. Limiting the receipt of LEU to 3 MTU shipments would result in a substantially lower dose to the public, as well as the workers. The collective dose to the public from the shipment of 3

MTU LEU is estimated to be 0.49 person-rem. Using the general population dose-to-risk conversion factor of 5 x 10^{-4} cancer fatalities per person-rem (NRC 1991), the collective dose to the public of 486 person-rem, estimated as the bounding case, would have a probability of 0.2, or 1 chance in 5, of causing one excess cancer fatality in the affected population of approximately 8.9 million over a latency period of 50 years following the initial 10 year exposure. Based on the reduced shipments of 3 MTU LEU combined with the 500 MTU HEU, the collective dose to the public would be reduced to 33.49 person-rem rather than the bounding case of 453 person-rem as analyzed in the pre-approval EA. Using the general population dose-to-risk conversion factor of 5 x 10^{-4} cancer fatalities per person-rem (NRC 1991), this lower dose would be expected to result in a probability of 0.017 (0.02), or 2 chances in 100, or 1 chance in 50, of causing one excess latent cancer fatality among the affected population of approximately 8.9 million people over a latency period of 50 years following the initial 10 year exposure.

The bounding transportation accident would be an SST accident involving the transport of HEU from a site other than Pantex. The collective dose due to this accident was conservatively estimated to be 60,500 person-rem to a population of 5,210,000. The probability of this bounding SST accident occurring in an urban area was estimated to be 1 x 10^{-7}, or 1 chance in 10,000,000. Workers and the public are considered as one population for the purposes of determining accident consequences, and the general population dose-to-risk conversion factor of 5 x 10^{-4} cancer fatalities per person-rem (NRC 1991) is used. Using this dose-to-risk conversion factor, the collective dose of 60,500 person-rem was estimated in the EA to result in 30 latent cancer fatalities if this extremely unlikely accident occurred. The Department has conducted more than 119 million km (74 million miles) of SST operations without accidents that resulted in any release of radioactive materials.

Alternatives Considered

DOE considered the following alternatives to the proposed action of interim storage of enriched uranium above historic levels at the Y-12 Plant: no action, restricted receipt of HEU, and enriched uranium storage at sites(s) other than the Y-12 Plant.

Under the no-action alternative, the Y-12 Plant would continue to receive enriched uranium for interim storage until historical storage levels of enriched uranium are reached. Shipments would be suspended, including shipments of components from weapons dismantlement from the Pantex Plant. This alternative would not meet DOE's purposes of supporting the United States goals of nonproliferation and reduction of global nuclear danger. In addition, the no-action alternative would have programmatic and funding effects on the Pantex Plant, the Portsmouth Site, Savannah River Site, the Rocky Flats Plant and Idaho National Engineering Laboratory, which would have to continue to store enriched uranium for which the sites have no further need.

Under the alternative of restricted storage of HEU, the Y-12 Plant would receive HEU from the Pantex Plant and might receive fissionable material from foreign sources. No enriched uranium would be received from any other domestic sites. This alternative would support dismantlement activities at the Pantex Plant and disassembly of secondaries at the Y-12 Plant, but the effects on sites other than Pantex would be the same as those under the no action alternative.

Alternative storage sites could include one of the sites where HEU is currently located, a Department of Defense (DoD) facility, or a non-DOE or non-DoD facility. None of these sites have the existing facilities to process enriched uranium for storage or the existing authorized capability to store the Pantex Plant HEU. Only the Y-12 Plant currently has the processing capabilities necessary for disassembly of secondaries received from the Pantex Plant. Prestorage processing capability could not be added at other sites in the immediate near-term, and secondaries could not be disassembled. Therefore, this alternative could not meet DOE's purposes of supporting the United States goals of nonproliferation and reduction of global nuclear danger.

DETERMINATION: Based on the analyses in the EA, and after careful consideration of all comments received, DOE has determined that the transportation, prestorage processing, and interim storage of 506 MTU of enriched uranium, including up to 500 MTU of HEU and 6 MTU of LEU, does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an EIS is not required.

Issued at Washington, D.C., this 14 day of SEPT, 1995.

Victor H. Reis
Assistant Secretary
for Defense Programs

Attachment: "Analysis of the Transportation of Three Metric Tons of Low Enriched Uranium to the Oak Ridge Y-12 Plant," DOE/EA-0929-S, August 1995.

DOE/EA-0929-S

Analysis of the Transportation of Three Metric Tons of Low Enriched Uranium to the Oak Ridge Y-12 Plant

August 1995

U.S. Department of Energy

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INTRODUCTION

The United States Department of Energy (DOE) prepared a preapproval Environmental Assessment (EA) for the *Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994). The EA evaluates the potential environmental effects of the transportation, prestorage processing, and interim storage of bounding quantities of 7,105.9 metric tons of low enriched uranium (LEU) and 500 metric tons of highly enriched uranium (HEU). Through the public participation process associated with the EA, DOE decided that no more than three metric tons of LEU and 500 metric tons HEU would be transported to the Y-12 Plant for interim storage. To support the decision- making process associated with the EA, DOE prepared a supplemental analysis regarding the potential environmental effects of the transportation of only three metric tons of LEU to the Y-12 Plant. This report summarizes the results of the supplemental transportation analysis, *"Transportation Environmental Safety Analysis of the Commercial Movement of Low Enriched Uranium (LEU) from DOE Sites to the Oak Ridge Y-12 Plant," UCRL-ID-121434*, and modifies the EA.

Analysis of the Transportation of Three Metric Tons of Low Enriched Uranium to the Oak Ridge Y-12 Plant

1.0 Basis for Analysis

For the purpose of this analysis, conservative assumptions were used to bound the potential risk. This bounding case analyzed three metric tons of low enriched uranium (LEU) shipped from the Lawrence Livermore National Laboratory (LLNL) in Livermore, California (the most distant location) to the Y-12 Plant in Oak Ridge, Tennessee. Potential quantities and origin locations are shown in Table 1.

Table 1: LEU Potential Origin Sites and Quantities

Potential Origin Site	Quantity (kilograms)
Rocky Flats Plant, Colorado	800
Lawrence Livermore National Laboratory (LLNL), California	1,000
Los Alamos National Laboratory (LANL), New Mexico	200
Other[1]	1,000
Total	**3,000** (3 metric tons)

The method of shipment would be a commercial carrier using a Type A, 6J shipping container shipped in accordance with the U.S. Nuclear Regulatory Commission (NRC) Regulations at 10 Code of Federal Regulations (CFR) Part 71, and U.S. Department of Transportation (DOT) regulations at 49 CFR Part 173. The analysis used a bounding case of 350 grams of ^{235}U per package and 3 metric tons of 4.5% enriched LEU, resulting in 341 containers using 15 commercial trucks to complete the transfer of the three metric tons LEU. On-site transportation at the Y-12 Plant is addressed in the preapproval EA (DOE/EA-0929) and was therefore not addressed in this analysis.

The analysis of the three metric tons of LEU was conducted using the RADTRAN and HIGHWAY computer codes. RADTRAN is a risk/consequence analysis model developed by Sandia National Laboratories to calculate potential effects associated with transportation of

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1 Other potential sources of LEU include the K-25 Site, Tennessee; Argonne National Laboratory West, Idaho; Sandia National Laboratory, New Mexico; and various other commercial and university sources.

radiological materials in accident and incident-free scenarios. The HIGHWAY database is a computerized road atlas of the U.S. Interstate system and most highways. HIGHWAY calculates routes and population densities along those routes for use by the RADTRAN model. (Specific computer code input parameters are documented in *"Transportation Environmental Safety Analysis of the Commercial Movement of Low Enriched Uranium (LEU) from DOE Sites to the Oak Ridge Y-12 Plant,"* (LLNL, 1995).)

2.0 Results

The supplemental analysis provided conservative estimates for potential radiological and non-radiological impacts as a result of the shipment of three metric tons of LEU from LLNL to the Y-12 Plant. The RADTRAN assessment consisted of two separate analyses: incident-free analysis and accident analysis. The incident-free assessment is comprised of transportation activities in which radiological doses from normal transport are modeled. The accident analysis evaluates probabilities and consequences which could result in the event of an accident. A third analysis was conducted to evaluate the potential non-radiological impacts.

2.1 Potential Radiological Impacts

RADTRAN was used to calculate the incident-free radiological dose consequences for the public and workers. Potential dose to the public was modeled at three specific locations: (1) persons within 800 meters of the transport link center line; (2) persons at stops; and, (3) persons sharing the transportation route. Included in these calculations to the public is a dose to the maximally exposed member of the public. This calculation models a person 30 meters from the highway subject to the dose from every shipment in the campaign. Potential dose to the workers considered both the transportation crew and transportation handlers.

2.1.1 Incident-Free Transportation

Table 2 shows the average annual radiological consequences of incident-free transport of LEU to the transportation crew and the public. The average annual collective dose to the exposed public during incident-free transportation was estimated to be 0.49 person-rem per year. The average annual collective dose to the maximally-exposed worker would be 0.31 person-rem per year. The maximally-exposed member of the public in transit would receive a dose of 2.81×10^{-7} rem per year or 2.81×10^{-4} (0.000281) mrem per year. The U.S. Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants (NESHAP) regulatory limit is 10 mrem/year to the maximally-exposed member of the public (40 CFR 61, Subpart H). In addition, DOE Order 5400.5, "Radiation Protection of the Public and the Environment," limits the radiological exposure that any individual can receive from all pathways (excluding natural background radiation) to an Effective Dose Equivalent of 100 mrem.

Table 2: Average Annual Incident-Free Radiological Exposure for LEU Shipments

Population Affected		Population Size (number of people)	Dose (person-rem)
Transportation Crew	Collective Dose	2	0.31
	Average Exposed Individual	1	0.16
Transportation Handlers	Collective Dose	4	0.22
	Average Exposed Individual	4	0.06
Public	Collective Dose	709,000	0.49
	Maximum Individual In-Transit Dose	1	2.81×10^{-7} (0.000000281)

These potential impacts were then considered over a ten-year time frame consistent with the analysis in the preapproval EA (DOE/EA-0929). The potential doses are converted to an estimate of latent cancer fatalities using the NRC recommended conversion factors of 4×10^{-4} (0.0004) latent cancer fatalities pers person-rem for workers and 5×10^{-4} (0.0005) latent cancer fatalities per person-rem for members of the general public. These data are presented in Table 3.

Table 3: Total Radiological Impacts of Incident-Free Transportation (Over the Course of Ten Years)

Population	Collective Dose (person-rem)	Latent Cancer Fatalities
Transportation Crew	3.08	1.23×10^{-3} (0.00123)
Transportation Handlers	2.17	8.68×10^{-4} (0.00086)
Public	4.87	2.44×10^{-3} (0.00244)

Workers - The ten-year collective dose to transportation crews during 10 years of incident-free operations is estimated to be 3.08 person-rem. Using the worker dose-to-risk conversion factor of 4×10^{-4} cancer fatalities per person-rem, the collective dose to workers of 3.08 person-rem would be estimated to result in 1.23×10^{-3} latent cancer fatalities (3.08 person-rem x 0.0004 [risk factor] = 0.00123). This means that there would be a probability of 0.00123, or one chance in 1000, that these shipments should cause any additional cancer fatalities among the workers.

Public - The ten-year collective dose to the public during incident-free transportation for the shipment of 3 metric tons LEU is estimated to be 4.87 person-rem. Using the general population dose-to-risk conversion factor of 5×10^{-4} cancer fatalities per person-rem, the collective dose to the public of 4.87 person-rem would be estimated to result in 2.4×10^{-3} (0.0024) latent cancer fatalities (4.87 person-rem x 0.0005 [risk factor] = 2.44×10^{-3}). This means that there would be a probability of 0.0024, or two chances in 1,000, or one chance in 500, that any excess cancer fatalities would occur among the affected population of approximately 709,000.

Based on these doses and the estimated latent cancer fatalities, it is expected that not a single worker or member of the public would die from cancer as a result of exposure to radiation from the proposed transportation of three metric tons of LEU under normal (incident-free) operations.

2.1.2 Accident Conditions

RADTRAN was also used to calculate potential radiological impacts under accident conditions. Both the probability of an accident occurring and its associated radiological consequences were evaluated to determine the accident risk. Since numerous types of accident sequences exist, they can be grouped by severity categories. This analysis used eight such accident severity categories to delineate the extent of credible accident conditions expected to occur in the event of a transportation accident. The severity categories depict the magnitudes of mechanical (crush, impact, and puncture) and thermal (duration and temperature) forces, expressed as a conditional probability, extending from the least severe (category 1) to the most severe (category 8). The bounding accident used in this analysis is the highest severity category accident having a release fraction of one (1.0) associated with a probability of occurrence for the urban population density area. The bounding accident probability of occurrence is acquired through the summation of the individual severity category probabilities having a release fraction equal to one (1.0). In accordance with NUREG-0170, *The Transportation of Radioactive Material by Air and Other Modes* (Nuclear Regulatory Commission, 1977) Type A package release fractions of one (1.0) begin with severity category four (4).

Using the above assumptions, parameters, and input values, RADTRAN estimated a population size of 3.32×10^{6} (public and workers included together) would be subject to a total population dose of 116 person-rem for the bounding accident in urban areas. These results are displayed in Table 4 below. Radiological consequences from a transportation accident would occur primarily from the release of respirable radioactive particulates and the subsequent inhalation by persons downwind of the accident. RADTRAN also included ingestion (rural areas only), resuspension, groundshine, and cloudshine exposure pathways in its calculations. Using the

5.0×10^{-4} risk factor, the expected number of latent cancer fatalities would be 5.80×10^{-2} or almost 6 chances in 100 that any excess cancer fatalities would occur among the affected population. The frequency of such an accident occurring is shown in Table 5.

Table 4: Radiological Exposure form Bounding Accident in Urban Areas

Affected Population Size	Population Collective Dose (person-rem)	Latent Cancer Fatalities
3,320,000	116	5.8×10^{-2}

Table 5: Accident Frequencies

Perspective (per)	Frequency
10-year campaign	1.77×10^{-4}
Annual	1.77×10^{-5}
Shipment	1.26×10^{-5}
Kilometer	4.4×10^{-7}

2.2 Potential Non-Radiological Impacts

Potential non-radiological effects ere calculated using guidance developed by R.K. Rao, E.L. Wilmot, and R.E. Luna, *"Non-Radiological Impacts of Transporting Radioactive Material,"* SAND81-1703, TTC-0236, Sandia National Laboratories, Albuquerque, NM, January 1982. Non-radiological transportation impacts consider two areas of effects: latent cancer fatalities and deaths due to accidents. The non-radiological latent cancer fatalities occur through the release of hazardous exhaust fumes from the transport carriers whereas the non-radiological deaths are a ramification of accident fatalities transpiring from travel between LLNL and Y-12. Two sets of results for non-radiological impacts are provided in Table 5. The first set of numbers reflect the estimated impacts due to a non-exclusive shipment. This is a shipment where the conveyances are used to transport the LEU from LLNL to the Y-12 Plant and then are used for different purposes afterwards, thus not requiring a return trip to LLNL. In other words, the impacts are calculated for a one-way trip only. The second set of numbers represent the estimated impacts from an exclusive use shipment where the conveyances make a round trip between LLNL and the Y-12 Plant.

Table 6: Total Non-Radiological Transportation Impacts

Type Shipment	Pollution Health Effects (Latent Cancer Fatalities)	Accident Fatalities
Non-Exclusive (one-way trip)	2.85×10^{-4}	1.71×10^{-3}
Exclusive (round-trip)	5.70×10^{-4}	3.42×10^{-3}

From a round-trip shipment, the expected number of latent cancer fatalities from pollution health effects would be 5.7×10^{-4} or 0.00057 or almost 6 chances in 10,000 that any excess latent cancer fatalities would occur among the affected population. It is also expected that the number of accident fatalities would be 3.42×10^{-3} or 0.00342 or about 3 chances in 1,000 that any person would suffer a traffic fatality as a result of the shipments.

3.0 CONCLUSION

This report summarizes the results of *"Transportation Environmental Safety Analysis of the Commercial Movement of Low Enriched Uranium (LEU) from DOE Sites to the Oak Ridge Y-12 Plant," UCRL-ID-121434,* which is the technical basis for evaluating the potential environmental impacts of transporting three metric tons of LEU by commercial carrier from DOE sites to the Oak Ridge Y-12 Plant. Based on analyses performed, it is expected that there would be no latent cancer fatalities (induced by radiological or non-radiological causes) as a result of this shipping campaign.

4.0 REFERENCES

10 CFR 71 — *"Packaging and Transportation of Radioactive Material,"* Title 10 Energy, Code of Federal Regulations, Part 71 (10 CFR 71), National Archives and Record Administration, Washington DC, January 1, 1994.

49 CFR 173 — *"Shippers-General Requirements for Shipments and Packagings,"* Title 49 Transportation, Code of Federal Regulations, Subchapter C-Hazardous Materials Regulations, Part 173 (49 CFR 173), National Archives and Record Administration, Washington DC, December 31, 1991.

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NCRP 91 — *"Recommendations on Limits for Exposure to Ionizing Radiation,"* National Council on Radiation Protection and Measurements, NCRP Report No. 91, Bethesda, MD, 1987.

NUREG-0170 — *"Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes,"* NUREG-0170, Vol. 1, Docket No. PR-71, 73 (40 FR 23768), Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington DC, December, 1977.

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