DOE/EA-1393

FINAL

Programmatic Environmental Assessment for the U.S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Reusable Uranium Materials

FINDING OF NO SIGNIFICANT IMPACT

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT
FOR THE
U.S. DEPARTMENT OF ENERGY, OAK RIDGE OPERATIONS
IMPLEMENTATION OF A COMPREHENSIVE MANAGEMENT PROGRAM
FOR THE STORAGE, TRANSPORTATION, AND DISPOSITION OF
POTENTIALLY REUSABLE URANIUM MATERIALS

AGENCY: U.S. DEPARTMENT OF ENERGY (DOE)

ACTION: FINDING OF NO SIGNIFICANT IMPACT

SUMMARY: The U. S. DOE has completed a Programmatic Environmental Assessment (PEA) (DOE/EA-1393), which is incorporated herein by this reference. The purpose of the PEA is to assess potential environmental impacts of the implementation of a comprehensive management program for potentially reusable low enriched uranium (LEU), normal uranium (NU), and depleted uranium (DU). Approximately 14,200 MTU (Metric Tons of Uranium) of potentially reusable uranium is located at 158 sites. DOE has evaluated various options for interim centralized storage and interim consolidated storage at six DOE locations and two commercial sites. Ultimate disposition has also been evaluated, to the extent practicable, as part of this management program. Based on the results of the impacts analysis reported in the PEA, DOE has determined that the proposed action is not a major Federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act of 1969 (NEPA). Therefore, preparation of an Environmental Impact Statement (EIS) is not necessary, and DOE is issuing this Finding of No Significant Impact (FONSI).

PUBLIC AVAILABILITY OF PEA AND FONSI: The PEA and FONSI may be reviewed at, and copies of the document obtained from:

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BACKGROUND: The U.S. Department of Energy (DOE) proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low enriched uranium (LEU), normal uranium (NU), and depleted uranium (DU). Uranium materials, which are presently located at multiple sites, would be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition. Management would include the storage, transport, and ultimate disposition of these materials.

This action is needed because of DOE's current missions and functions; increasing budget pressures; the continuing need for good stewardship of resources, including materials in inventory; and continuing DOE attention to considerations of environment, safety, and health. Also, increased pressure on the federal budget requires that DOE take a closer look at materials management in order to ensure maximum cost effectiveness. This includes an examination of feasible uses of this material, consistent with DOE's mission, as well as an examination of management methods that are consistent with environmental requirements and budgetary constraints. DOE needs to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU.

DOE prepared a PEA to address the proposed action. The comprehensive management program addressed in this PEA looks at transportation, including preparation of uranium materials for safe shipment, long-term storage, maintenance and disposition. The PEA addresses 14,200 metric tons of uranium (MTU) materials thought to be potentially reusable; thus, uranium wastes are not part of the scope. Reusable is defined as "uranium material having an economically viable disposition path." The management plan covers uranium materials that are currently in the form of oxides, metals, and other stable compounds, and which are located at various sites around the United States. The plan does not include irradiated material, material in the form of uranium hexafluoride (UF_6), uranium that is enriched to 20% or greater in ^{235}U, or uranium enriched in ^{233}U.

Storage would occur until future sale or reuse alternatives are ready for decision-making. DOE evaluated in the PEA several proposed alternative DOE storage sites: the Portsmouth Gaseous Diffusion Plant (PORTS) in Ohio; the Paducah Gaseous Diffusion Plant (PGDP) in Kentucky; the Y-12 National Security Complex (Y-12) and East Tennessee Technology Park (ETTP) in Tennessee; the Savannah River Site (SRS) in South Carolina; and the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho. Also considered were western and eastern commercial sites. Approximately 14,200 MTU would be stored in either one (centralized) location or several (consolidated) locations based on the proximity of sites or the uranium product form. DOE now has potentially reusable uranium materials in 158 locations in the United States; however, the vast majority of these materials are located at only a few sites. These sites have additional uranium materials, which are not part of the Uranium Management Group (UMG) inventory and not addressed by the proposed action.

DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU. Uranium materials, which are presently located at multiple sites, are proposed to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition. The management plan would address the packaging and transport of potentially reusable uranium materials from DOE sites and university loan/lease returns and their receipt and storage at a site under cognizance of the UMG. This action will also cover material shipment from the UMG and disposition. A Secretarial Determination is required, under certain circumstances, for uranium in the UMG inventory to be sold. Twenty years would provide time for additional reviews required for any future related actions that may be desirable to help accomplish ultimate disposition.

Since disposition of this material is currently undefined, a "bounding" analysis was performed to estimate the potential impacts from commercial processing of this material, use of this material in research activities, provision of this material to other Government agencies, and/or the sale (international/domestic) of this material upon completion of a Secreterial Determination. Disposition is a component of each of the action alternatives and impacts would differ based only on differences in transportation. Some wastes would be produced during this disposition process.

ALTERNATIVES: In addition to the proposed action, impacts were evaluated for the no action alternative. The no action alternative would continue ongoing storage activities at all existing facilities. This alternative includes the continued storage of uranium materials in existing facilities (DOE and private). Monitoring and surveillance of the uranium materials at each site would continue, as would the handling necessary to continue proper management of these materials, including repackaging if needed. The uranium inventory would not be dispositioned.

Alternatives analyzed under the proposed action included: Interim Centralized Storage at a Single DOE Site; Interim Centralized Storage at a Single Commercial Site; Partially Consolidated Storage at Several DOE Sites; Partially Consolidated Storage at One Western and One Eastern DOE Site; Partially Consolidated Storage at One Western and One Eastern Commercial Site; and Partially Consolidated Storage by Physical Form.

DOE must be able to transfer small quantities (less than 0.1 MTU) from any one of the potential consolidated or centralized storage sites to a second location (such as a university). This option was considered as a component of each alternative under the proposed action. It was not itself a stand-alone alternative.

ENVIRONMENTAL IMPACTS:

NO ACTION

Under this alternative, the uranium currently stored at the various DOE sites, non-DOE sites, universities, and other commercial locations would remain at those sites. The uranium is currently in various container types, including 55-gallon steel drums, T-hoppers, half-high boxes, and sea-land containers.

Normal Operations. Under normal operations, land use, geology and soils, water resources, cultural resources, and the infrastructure remain unchanged. Air effluents associated with uranium inventory maintenance would be minimal and would remain the same as they are now. Because there is no new construction and there are no effluents from the stored uranium, plant and animal species would not be adversely affected and cultural resources would not be impacted. Some continued maintenance of facilities would be required, and monitoring and surveillance at the current sites would continue. The socioeconomic impact analysis assumes little or no construction activity and continued uranium monitoring by current employees. Under these assumptions, there is no change in expenditure or employment and, consequently, no impact. Even if additional workers were hired for monitoring at each potential centralized or consolidated storage site, they would represent a minimal increase to the large number (several hundred thousand) of wage and salary earners present in counties that contain the larger DOE uranium storage sites. In the absence of important impacts, environmental justice concerns do not arise.

The 3,900 MTU at the 152 locations other than the six DOE locations would remain at these sites. The amount at each individual site is very small and is typically associated with university or other types of research. No substantial environmental impacts are expected from the continued use and/or storage at these locations; however, these sites do not have a long-term mission for uranium storage and expect to ship materials back to DOE when the research work is completed.

Facility Accidents. The highest acute consequences to the public or to a co-located worker are due to a fire or earthquake at PORTS, with aerial dispersion of uranium materials, but are still negligible. This result is based on the large amount of uranium materials currently stored at PORTS (4,400 MTU or ~31% of the total of 14,200 MTU). Acute radiological and toxicological consequences are negligible at all sites.

Accidents at all facilities are expected to cause negligible to low chronic risks to humans and ecological receptors.

Transportation. There are no transportation activities associated with the no action alternative.

PROPOSED ACTION

Normal operations result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Environmental impacts associated with normal operations vary from alternative to alternative and, occasionally, by site within a given alternative. General handling accidents result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Chronic human health and ecological consequences and risk are negligible to low for all sites under all alternatives. The highest transportation consequences and risk are for alternatives that involve moving uranium materials to a western location, either to a commercial site or to INEEL.

Comparison of Alternatives

When comparing the environmental impacts of the various alternatives, the following emerge as general trends:

- There were none-to-minor impacts for all of the alternatives considered and negligible-to-low impacts from the standpoint of facility accidents (fire and seismic) for all the alternatives, while transportation effects for the alternatives generally reflected the extent of material transport associated with the alternative being analyzed.

- The greater the centralization or consolidation of the uranium inventory, the greater the potential for normal operations impacts. Greater centralization or consolidation means that new storage space has to be built, which means accompanying costs and commitment of land, and uranium materials will have to be shipped greater distances with increased risk of accidents.

- The action alternative with the fewest environmental impacts and that is the least expensive ($7.3M) is "Interim Partially Consolidated Storage at Several DOE Sites." This alternative takes advantage of the current storage of the majority of these DOE sites already. Thus, construction costs and associated environmental impacts would be less than other action alternatives.

- Similarly, the PORTS site would have the fewest environmental impacts and would be the least expensive ($8.4M) of the DOE facilities considered for interim centralized storage. It should be noted that DOE would be committed to using the existing UMG facility at PORTS; therefore other buildings would not be upgraded and the upgrade costs computed in the PEA for other buildings would not be spent. Only very minor upgrades to the existing storage facility would be needed. PDGP and commercial sites would be the most expensive centralized storage.

- Excess Latent Cancer Fatalities (LCFs) due to transportation and traffic fatalities are minimal for all alternatives but greatest for the interim storage at the single site alternatives. The increase in excess LCFs to the public from radiological exposures during transportation is less than one for all alternatives.

- Western sites would tend to have slightly higher traffic fatalities associated with them than eastern ones due to the larger volumes of uranium materials to be shipped over greater distances.

- Commercial sites would have slightly greater impacts than DOE sites (except for PGDP) when comparing similar alternatives (interim centralized storage at a single DOE site versus a single commercial site and interim partially consolidated storage at two DOE sites versus two commercial sites).

Interim Centralized Storage at a Single Commercial Site Alternative. Considering the combination of normal operations, facility accidents and transportation, the "Interim Centralized Storage at a Single Commercial Site" alternative and the PGDP site for "Interim Consolidated Storage at a Single DOE Site" alternative have the greatest potential for environmental impacts. For normal operations, the western and eastern commercial sites and PGDP have equal impact potential. Any of these sites would have 305 first-year construction workers, 14 new permanent workers, $12.2M in new construction costs, and seven acres of land commitment and habitat disturbance. Facility accidents would result in negligible to low acute and chronic risks.

Interim Centralized Storage at a Single DOE Site. Impacts are very similar to the single commercial site alternative discussed above; however, there are some differences in impacts among the DOE sites. Because PORTS has sufficient existing storage space, normal operations impacts, including socioeconomics, would be minimal at this site. Upgrading existing buildings at PORTS would not result in commitments of land or destruction of wildlife habitat that would be necessary at all other DOE sites.

Due to the very small amount of uranium storage space at PGDP, the impacts of normal operations would be almost identical to interim centralized storage at a single commercial site as noted above.

Interim Partially Consolidated Storage at Two Commercial Sites. Because none of the 14,200 MTU uranium inventory is now at these commercial sites, the normal operations impacts associated with this alternative are very similar to those for the "Interim Centralized Storage at a Single Commercial Site" alternative, except that environmental impacts would be shared by the two sites.

Interim Partially Consolidated Storage at Two DOE Sites. Environmental impacts from normal operations would tend to be less than from consolidation at two commercial sites, because some of the uranium inventory is already at INEEL and PORTS. Thus, less construction-related impacts would result. Human health and ecological risks from facility accidents would be the same as for consolidation at two commercial sites.

Interim Partially Consolidated Storage at Several DOE Sites. Because most of the uranium inventory would remain at the six prime DOE locations and only the 3,900 MTU at 152 other sites would be relocated, the normal operations impacts would be substantially less than all the other action alternatives. Additional space requirements, and the impacts associated with construction of this space, would be sharply reduced when compared to the other action alternatives. This alternative most closely resembles the No Action alternative.

CUMULATIVE IMPACTS

Cumulative impacts are impacts associated with the proposed action when combined with other past, present, or reasonably foreseeable future impacts. There are no significant impacts associated with the proposed action under normal operations. When the negligible-to-minor environmental and socioeconomic impacts associated with normal operations (construction of new storage facilities, facilities upgrades, and daily maintenance and surveillance) and any of the action alternatives are added to the baseline environment, cumulative impacts are minor.

For facility accidents, the potential for negligible to low acute consequences and risk, due to either storage area fires or seismic events, exists for the "Interim Centralized Storage at a Single DOE Site" alternative and "Interim Centralized Storage at a Single Commercial Site." Under a major seismic event scenario sufficient to mobilize uranium oxide into the environment, it is reasonable to assume that other material releases and other risks would be posed to workers at the site. Therefore, risks from uranium oxides would be one of several environmental and health risks that workers at the sites would face. For other accidents and other forms of uranium materials, the acute and chronic human health risk and ecological risk are negligible or low.

Due to a small increase in vehicular traffic to transport uranium materials, there would be a slight increase in traffic accidents and fatalities on the nation's highways. These cumulative impacts would be very minor in comparison to the baseline. Likewise, exposures of the public and workers during uranium transport would increase very slightly the risks of LCFs.

At some time in the future, the uranium inventory would be eventually dispositioned. Various disposition options including commercial processing and domestic sales of the entire inventory, disposition of limited quantities (50 MTU) at research facilities, disposition of 2,500 MTU to other government agencies, and foreign sales of 4,050 MTU may occur. Impacts associated with these options are considered as a part of each of the interim storage alternatives. In addition, potential cumulative impacts (such as temporary storage costs, new construction, and additional labor) could occur should an existing inventory of uranium materials be increased at any of these disposition option locations.

SRS. There is a large inventory (~19,000 MTU) of uranium, mostly oxides, at the SRS, which is not part of the UMG inventory. For an accident risk perspective, cumulative impacts could be important at SRS (due principally to this existing, non-UMG uranium oxide inventory). Centralized storage would add 11,300 MTU to the 2,400 MTU already included in the UMG inventory.

In addition, up to seven acres of site habitat at SRS would be devoted to new construction, removing these acres from current use. This acreage, when considered from a total site perspective, would be a minimal cumulative impact since portions of SRS are undergoing remediation or being dedicated to greater environmental uses.

PDGP. The PDGP site would need the largest amount of new construction including seven acres of permanent habitat disruption. This disruption would occur at a site undergoing ground-disturbing remediation efforts, which also affect wildlife habitat, albeit of low quality in most cases. Because of the small workforce at PDGP, direct construction-related increases in employment would be greatest at this site. Due to declining DOE employment at the site, however, the overall cumulative impact would likely be temporary but beneficial for the regional economy.

PORTS. The PORTS site has an existing inventory of uranium materials. Should the approximately 9,800 MTU of additional inventory evaluated in this EA be added to the existing inventory, then the potential for cumulative impacts due to accidental releases would increase. Since PORTS currently has sufficient existing storage space for the 14,200 MTU, the site has the lowest potential for cumulative impacts due to construction/renovation. However, as noted, DOE would be committed to using the existing UMG storage facility and upgrades to other building for uranium storage for this program would not occur.

INEEL. Like the PDGP site, INEEL would require substantial new construction with associated permanent habitat disruption. This seven acre commitment would occur at a highly developed site undergoing other ground disturbances associated with remediation. This site also has uranium inventory that is not part of the proposed action so cumulative impacts from accidental releases are possible.

Y-12 and ETTP. The two sites at Oak Ridge would also require a commitment of land for new construction. Even though there are also other uranium inventories in Oak Ridge, the physical separation of the two sites lessens the potential for cumulative impacts due to accidental releases.

DETERMINATION: Based on the findings in this PEA, DOE has determined that none of the alternatives under the proposed action to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU have potentially significant adverse environmental impacts; thus the proposed action does not constitute a major federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act. Therefore, preparation of an environmental impact statement is not required.

Issued at Oak Ridge, Tennessee, this 16 day of October 2002.

for Michael Holland
Acting Manager
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DOE/EA-1393

Final
Programmatic Environmental Assessment
for the
U.S. Department of Energy, Oak Ridge Operations
Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Reusable Uranium Materials

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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

DCG	derived concentration guideline
DOE	U.S. Department of Energy
DU	depleted uranium
EA	environmental assessment
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
FEMP	Fernald Environmental Management Project
FR	*Federal Register*
FY	fiscal year
gpd	gallons per day
HEU	highly enriched uranium
ICPP	Idaho Chemical Processing Plant
INEEL	Idaho National Engineering and Environmental Laboratory
LCF	latent cancer fatalities
LEU	low enriched uranium
MTU	metric tons of uranium
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NERP	National Environmental Research Park
NMIA	Nuclear Material Inventory Assessment
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NU	normal uranium
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PEA	programmatic environmental assessment
PEIS	programmatic environmental impact statement
PGDP	Paducah Gaseous Diffusion Plant
PORTS	Portsmouth Gaseous Diffusion Plant
PSD	prevention of significant deterioration
ROI	region of influence
SRS	Savannah River Site
TVA	Tennessee Valley Authority
UBC	Uniform Building Code
UMG	Uranium Management Group
USEC	United States Enrichment Corporation
U_3O_8	oxide ore
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
UO_3	uranium trioxide

1. INTRODUCTION

1.1 PURPOSE AND NEED FOR AGENCY ACTION

The U.S. Department of Energy (DOE) proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low enriched uranium (LEU), normal uranium (NU), and depleted uranium (DU). Uranium materials, which are presently located at multiple sites, are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition. Management would include the storage, transport, and ultimate disposition of these materials.

This action is needed because of DOE's current missions and functions; increasing budget pressures; the continuing need for good stewardship of resources, including materials in inventory; and continuing DOE attention to considerations of environment, safety, and health. Also, increased pressure on the federal budget requires that DOE take a closer look at materials management in order to ensure maximum cost effectiveness. This includes an examination of feasible uses of this material, consistent with DOE's mission, as well as an examination of management methods that are consistent with environmental requirements and budgetary constraints. DOE needs to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU.

1.2 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

DOE is preparing a programmatic environmental assessment (PEA) to address the proposed action discussed in Section 1.1. The comprehensive management program addressed in this PEA looks at transportation, including preparation of uranium materials for safe shipment, long-term storage, maintenance and disposition. The PEA addresses 14,200 metric tons of uranium (MTU) of uranium materials thought to be potentially reusable; thus, uranium wastes are not part of the scope. Reusable is defined as "uranium material having an economically viable disposition path." The management plan will cover uranium materials that are currently in the form of oxides, metals, and other stable compounds, and which are located at various sites around the United States. The plan will not include irradiated material, material in the form of uranium hexafluoride (UF_6), uranium that is enriched to 20% or greater in ^{235}U, or uranium enriched in ^{233}U.

Storage would occur until future sale or reuse alternatives are ready for decision making. DOE will evaluate several proposed alternative DOE storage sites under consideration: the Portsmouth Gaseous Diffusion Plant (PORTS) in Ohio, the Paducah Gaseous Diffusion Plant (PGDP) in Kentucky, the Y-12 National Security Complex and East Tennessee Technology Park (ETTP) in Tennessee, the Savannah River Site (SRS) in South Carolina, and the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho. Also both western and eastern commercial sites will be considered. Approximately 14,200 MTU will be stored in either one (centralized) location or several (consolidated) locations based on the proximity of sites or the uranium product form. DOE now has potentially reusable uranium materials in 158 locations in the United States; however, the vast majority of these materials are located at only a few sites. These sites have additional uranium materials, which are not part of the Uranium Management Group (UMG) inventory and not addressed by the proposed action.

Because many DOE sites have existing and potential future storage space conflicts, specific buildings and on-site locations could not be accurately determined. A midpoint location within each site is assumed unless otherwise indicated. In addition, the commercial sites to be evaluated are generic sites; that is, they are assumed to be located in the western or eastern United States, but their specific locations are not determined. Consequently, a relative comparison of alternatives is made, and the analysis is programmatic in nature.

The disposition of this surplus material is undefined at this time; however, to provide future flexibility for the disposition of this material, a "bounding" analysis is performed. The objective of this analysis is to establish a bounding scenario such that potential environmental impacts from a variety of disposition options have been considered. The scope of this analysis includes: commercial processing of the material, use of this material in research activities, provision of this material to other government agencies, and/or the sale (international/domestic) of this material. While the uranium materials covered in this PEA are potentially reusable and are not wastes, it is possible that some portion of the inventory could, in the future, be declared waste. Also, in the disposition process, some wastes could be generated. For example, product containers, once emptied, could become waste. The analysis in this PEA addresses, among other things, handling, repackaging, and transportation of the uranium product. The analysis also covers these aspects of waste production associated with the UMG Program. It is understood that a disposition option not covered by the bounding analysis may require further National Environmental Policy Act of 1969 (NEPA) activities.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 BACKGROUND

Uranium is a radioactive element that occurs naturally as an oxide ore (U_3O_8) in the Earth's crust. In order to make the uranium useful for nuclear fuel or military applications, the ore is usually concentrated and then fluorinated to yield UF_6, which is further processed to achieve an end-use product. End-use products are typically in the chemical form of uranium metal or the oxide. UF_6 is not included in this PEA.

In its natural state, uranium consists of several different isotopes, notably ^{238}U and ^{235}U, which make up ~99.3% and 0.711%, respectively, of the total uranium mass. (Man-made uranium materials have been created that achieve the same ^{235}U% as the natural uranium. In this PEA, NU refers to 0.711% ^{235}U materials created through synthetic processes as well as to natural uranium.) NU is, thus, referred to as "normal" uranium, a term widely used in the uranium industry. In most nuclear reactors, the ability to use uranium for controlled fission in nuclear chain reactions depends on increasing the proportion of ^{235}U in the material relative to ^{238}U. This isotopic separation process is called "enrichment." In this process, a stream of UF_6 containing both ^{235}U and ^{238}U is divided into separate streams. One is increased, or enriched, in its percentage of ^{235}U (typically to 3.5%) and is commonly referred to as LEU. The other is reduced, or depleted, in its percentage of ^{235}U (typically to 0.25%) and is commonly referred to as DU. (When the ^{235}U is increased by 20% or more, the material is commonly referred to as highly enriched uranium (HEU), which is not in the scope of this PEA.)

During World War II, the Manhattan Project established a system of nuclear weapons sites that came to be known as the nuclear weapons complex. During the Cold War, this complex was expanded and maintained by DOE and its predecessor agencies. The mission of many sites was the processing of uranium in different chemical forms, followed by the fabrication of weapons components. With the end of the Cold War, a number of DOE sites were left with large uranium inventories in various chemical forms that are now excess to national security needs. The mission of some of the former nuclear weapons complex sites is environmental remediation, and DOE is now dispositioning uranium from these sites in support of agreements with state and federal regulatory agencies.

In addition to defense missions, some of the DOE sites processed uranium for use in commercial nuclear power plants and for research and development programs. Under these programs, many colleges and universities and other government agencies possess DOE-owned uranium materials obtained through contractual or loan/lease agreements. Some of this loaned or leased material is now being returned to the DOE inventory.

DOE's inventories of excess LEU, NU, and DU, within the scope of this PEA, total approximately 14,200 MTU and reside at more than 150 different sites as shown in Table 2-1. Large inventories, however, are found at only a few sites. These sites have different missions and different types of uranium material. All of the approximately 14,200 MTU at the various sites is anticipated to move to an interim storage location prior to final disposition.

The data summarized in Table 2-1 and included within the scope of this PEA are taken from a 2000 DOE Nuclear Material Inventory Assessment (NMIA). It includes LEU, NU, and DU considered "excess" (i.e., no longer required for the national defense mission) but potentially reusable in the future. The data from the NMIA were increased by 10% to reflect ongoing uranium material transfer activities (i.e., amounts of uranium materials currently stored at a specific location may be higher than those indicated by these data).

Table 2.1. Uranium management inventory

Site	Amount, MTU
Potential interim storage locations	
INEEL	1,521
PGDP	1
PORTS	4,393
SRS	2,995
Oak Ridge (Y-12 Complex, ETTP, and ORNL)[a]	1,445
Total	10,355
Other DOE Sites	
Sandia National Laboratories	18
Los Alamos National Laboratory	12
Fermi National Accelerator Laboratory	287
Argonne National Laboratory, Illinois	19
Argonne National Laboratory, Idaho	228
Brookhaven National Laboratory	22
Fernald	691
Hanford	1,325
Pacific Northwest Laboratory	7
Lawrence Livermore	38
Miscellaneous (9 sites total)	~1
Total	2,648
Other locations	
Foreign (3 ports of entry)	600
Non-DOE sites (45 sites total)	51
Universities (79 sites total)	560
Total	1,211
Total for all locations (158 sites total)	**14,215**

[a]ORNL is not a potential interim storage location.
DOE = U.S. Department of Energy.
ETTP = East Tennessee Technology Park.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
ORNL = Oak Ridge National Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.
Y-12 Complex = Y-12 National Security Complex.

The mission of the Y-12 Complex has been and continues to be the refining, fabrication, and stockpiling of uranium.

The mission of ETTP, PGDP, and PORTS has historically been to enrich uranium in the chemical form of UF_6. PGDP continues this mission today, while ETTP is undergoing reindustrialization, decontamination and decommissioning, and environmental restoration. The largest inventory of uranium at each of the three sites is DU in the form of UF_6, which is not within the scope of this PEA. However, PORTS received uranium from the Fernald site in Ohio and the Hanford Site in Washington per two environmental assessments (EAs) [DOE 1999 and 2000]. The Fernald and Hanford uranium materials are discussed in the next paragraph. Neither ETTP nor Paducah has appreciable quantities of uranium that fall within the scope of this PEA. However, each site does have a continuing uranium mission or facilities.

PORTS has received and is storing almost all of the uranium materials evaluated in the two environmental assessments mentioned above. The Fernald and Hanford sites desire to disposition their remaining stored uranium, including their potentially reusable quantities of LEU, NU, and DU that fall within the scope of this PEA. Fernald's primary mission today is environmental restoration. Historically, it conducted uranium refining and fabrication operations. The largest inventories of uranium at Fernald that fall within the scope of this PEA are DU in the form of metal and uranium tetrafluoride (UF_4), NU in the form of metal, and LEU in the form of metal and oxide. Most of this uranium has already been sent to the Portsmouth Site. Hanford's primary mission today is also environmental restoration. Historically, it conducted fuel fabrication, reactor operations, and chemical separation activities. The largest inventory of uranium at Hanford that falls within the scope of this PEA is LEU in the form of metal and oxide.

SRS has historically conducted fuel fabrication, reactor operations, and chemical separation activities. In addition, DOE recently decided to locate one key plutonium disposition facility at SRS. The majority of the approximately 19,500 MTU of uranium trioxide at SRS is likely to remain there for the foreseeable future and is not considered within the scope of this PEA. These oxides are not part of the UMG inventory. The largest inventory of uranium at SRS that falls within the scope of this PEA is DU in the form of metal.

INEEL has conducted chemical separation activities for spent fuels from the U.S. Navy and research reactors. The largest inventory of uranium at INEEL that falls within the scope of this PEA is DU in the form of metal.

Table 2.2 provides a summary of the various interim storage alternatives to be considered in the PEA, the amount of uranium indicated in the 2000 NMIA data as stored at each of the major DOE sites, and the amount of uranium product potentially to be moved (including the estimated number of trucks or railcars needed for shipment). These amounts are 10% higher than the actual 2000 NMIA data. Tables 2.3, 2.4, and 2.5 show the packaging assumptions and transportation assumptions used to derive the number of containers, trucks, and railcars shown in Table 2.2. Estimates of storage space requirements at each site are shown in Table 2.7.

It should be noted that the NMIA data used for this study did not identify numbers of containers or container types for the various types of uranium material included in the PEA. This information is necessary to determine transportation impacts and storage requirements. Therefore, the number of containers shown in Table 2.2 may not reflect current storage conditions; rather, the assumptions outlined in Tables 2.3 and 2.4 and described below were used in order to evaluate all materials consistently. For example, SRS indicates the site has 3,861 wooden and cardboard boxes containing uranium metal (DU, NU and LEU) and 381 drums of LEU oxide. However, if these materials were repackaged for shipment to a different interim storage location, using the assumption in Tables 2.3 and 2.4, the number of containers would be reduced. In addition, the storage requirements shown in Table 2.6 may not reflect current storage configurations, but rather assume that all materials at a site are stored in a consistent storage array under similar conditions. The following assumptions were used to derive the number of containers either currently in storage, or anticipated to be moved, and the storage space requirements for each alternative:

- Two types of containers were considered: (1) 55-gal drums and (2) full-size (7 × 4 × 4 ft), strong, tight metal boxes (Fig. 2.1). Table 2.3 indicates the capacity of each type of container and the types of material assumed to be placed in those containers. Each line item of data in the NMIA database provided for this study was considered separately in order to determine which type of container it would be placed in (i.e., items were not combined in order to reduce the number of containers).

- Amounts of material that can be packaged in single containers are shown in Table 2.4. These values are based on container capacity for DU and NU fissile material limits for ^{235}U (10 *Code of Federal Regulations* 71.24) for Type A containers for LEU. Material types (DU, LEU, and NU) are not mixed in a single container.

Table 2.2. Uranium management PEA interim storage alternatives

Interim storage alternative	Description	Site/form	Assumed storage[a]		Additional materials to be moved				
			Amount (10^3 MTU)	Number of containers	Amount (10^3 MTU)	Number of containers	Number of sites	Number of trucks	Number of railcars
No Action	Continued storage at current sites. Total material included in the PEA is ~14,200 MTU	INEEL	1.5	639	N/A	N/A	N/A	N/A	N/A
		PGDP	<0.1	8					
		PORTS	4.4	24,765					
		SRS	3.0	2,867					
		Oak Ridge	1.4	6,431					
		All others	3.9	37,124					
Interim centralized storage at a single DOE site	All material transferred to a single, centralized DOE storage location	INEEL	1.5	639	12.7	71,195	157	5,425	4,857
		PGDP	<0.1	8	14.2	71,826	157	5,525	4,884
		PORTS	4.4	24,765	9.8	47,069	157	3,899	3,417
		SRS	3.0	2,867	11.2	68,967	157	5,195	4,693
		Oak Ridge	1.4	6,431	12.8	65,403	157	4,958	4,369
Interim centralized storage at a single commercial site	All material transferred to a single, centralized commercial storage location (east or west)	East, West	N/A	N/A	14.2	71,834	158	5,526	4,884
Interim partially consolidated storage at several DOE sites	Material moved to the closest consolidated storage location	INEEL	1.5	639	1.7	21,391	46	1,814	1,757
		PGDP	<0.1	8	0.4	400	24	49	14
		PORTS	4.4	24,765	1.4	13,458	66	995	904
		SRS	3.0	2,867	<0.1	63	7	7	0
		Oak Ridge	1.4	6,431	0.4	1,812	10	33	9
Interim partially consolidated storage at two DOE sites	Material consolidated at PORTS and INEEL	PORTS	4.4	24,765	6.6	24,940	92	1,966	1,633
		INEEL	1.5	639	1.7	21,490	64	1,832	1,757
Interim partially consolidated storage at two commercial sites	Material consolidated at one Eastern and one Western commercial site	East, West	N/A	N/A	11.0	49,705	93	3,593	3,100
			N/A	N/A	3.2	22,129	65	1,933	1,784

Table 2.2. Uranium management PEA interim storage alternatives (continued)

Interim storage alternative	Description	Site/form	Assumed storage[a]		Additional materials to be moved				
			Amount (10^3 MTU)	Number of containers	Amount (10^3 MTU)	Number of containers	Number of sites	Number of trucks	Number of railcars
Interim partially consolidated storage based on physical form	Material consolidated by physical form (i.e., the site with the largest quantity of a specific physical form is the preferred storage location for all materials of that form)	Compound (PORTS)	1.7	7,221	<0.1	1,034	12	106	78
		Metal (SRS)	2.9	1,088	6.0	32,918	21	2,903	2,676
		Misc. (PORTS)	0	0	1.2	4,998	121	220	25
		Oxide (PORTS)	0.9	15,333	0.5	7,807	17	676	648
		Reactor fuel (INEEL)	0.5	184	0.4	827	25	111	65
		Residue (INEEL)	<0.1	55	<0.1	174	7	17	5
		Source (INEEL)	<0.1	8	<0.1	187	21	42	9

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PEA = programmatic environmental assessment.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
N/A = not applicable.
SRS = Savannah River Site.

[a]It should be noted that the Nuclear Material Inventory Assessment data used for this study did not identify numbers of containers or container types for the various types of uranium material included in the programmatic environmental assessment. This information is necessary to determine transportation impacts and storage requirements. Therefore, the number of containers shown in Table 2.2 may not reflect current storage conditions; rather, the assumptions outlined in Tables 2.3 and 2.4 were used in order to evaluate all materials consistently. For example, Savannah River Site indicates the site has 3,861 wooden and cardboard boxes containing uranium metal (depleted uranium, normal uranium, and low enriched uranium) and 381 drums of LEU oxide. However, if these materials were repackaged for shipment to a different interim storage location, using the assumptions in Tables 2.3 and 2.4, the number of containers would be reduced.

Table 2.3. Packaging assumptions for uranium management PEA

Physical form(s)	Assumed container type[a]
Compound	Drum
Metal (>540 lb)	Metal box
Metal (<540 lb)	Drum
Miscellaneous	Drum
Oxide (>540 lb)	Metal box
Oxide (<540 lb)	Drum
Reactor fuel (>540 lb)	Metal box
Reactor fuel (<540 lb)	Drum
Residue	Drum
Source	Drum

[a]Assumes no mixing of material type and physical form in a single container. All low-enriched uranium (LEU) materials, regardless of amount or physical form, are packaged in drums.

PEA = programmatic environmental assessment.

Table 2.4. Container assumptions for uranium management PEA

Material type(s)	Assumed container type	Amount per container (lb)
DU, NU	Drum	540
	Metal box	5,850
LEU[a]	Drum	130

[a]Based on fissile material limits of 800 g/container at 1.35% ^{235}U (10 *Code of Federal Regulations* 71.20 for Type A containers).

DU = depleted uranium.
LEU = low-enriched uranium.
NU = normal uranium.
PEA = programmatic environmental assessment.

Table 2.5. Transportation assumptions for uranium management PEA

Transport vehicle	Material type(s)	Container type	Maximum number[a]
Truck	DU, NU	Drums	64
	LEU[b]	Drums	12
	DU, NU	Metal boxes	6
Railcar	DU, NU	Drums	240
	LEU[b]	Drums	12
	DU, NU	Metal boxes	26

[a]Maximum number based on weight and/or ^{235}U limits. Assumes no stacking for trucks or any LEU containers; railcar pallets and boxes stacked two high for DU, NU.

[b]Based on fissile material limits of 10,000 g/consignment (i.e., single truck or railcar) at 1.35% ^{235}U (10 *Code of Federal Regulations* 71.20 for Type A containers).

DU = depleted uranium.
LEU = low-enriched uranium.
NU = normal uranium.
PEA = programmatic environmental assessment.

Table 2.6. Uranium management PEA interim storage requirements

Alternative	Site	Amount (10^3 MTU)	Number of containers	Estimated storage requirement (ft^2)
No Action	INEEL	1.5	639	7,000
	PGDP	<0.1	8	100
	PORTS	4.4	24,765	75,000
	SRS	3.0	2,867	19,000
	Oak Ridge	1.4	6,431	25,000
Interim centralized storage at a single DOE or commercial site	Any	14.2	71,834	243,000
Interim partially consolidated storage at several DOE sites	INEEL	3.2	22,030	79,000
	PGDP	0.4	408	2,000
	PORTS	5.8	38,223	116,000
	SRS	3.0	2,930	19,000
	Oak Ridge	1.9	8,243	28,000
Interim partially consolidated storage at two DOE or two commercial sites	PORTS/East	11.0	49,705	165,000
	INEEL/West	3.2	22,129	79,000
Interim partially consolidated storage based on physical form	PORTS	4.4	36,393	100,000
	SRS	8.9	34,006	136,000
	INEEL	0.9	1,435	7,000

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PEA = programmatic environmental assessment.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table 2.7. Uranium management PEA disposition options

Disposition option	Description	Material type(s)	Amount (10^3 MTU)	Number of containers	Number of trucks	Number of railcars
Commercial processing/domestic sales	All material transferred from interim storage to a single commercial processing facility or single sales distribution point (east or west)	All	14.2	71,834	5,529	4,882
Transfer to research facilities	Transfer ~50 MTU from interim storage to the furthest DOE or other research location	DU, NU	0.05	204	4	1
		LEU	0.05	844	71	71
Transfer to other government agencies	Transfer ~2,500 MTU from interim storage to unspecified location (use furthest distance already evaluated)	DU, NU	2.5	10,186	160	43
		LEU	2.5	42,188	3,516	3,516
Foreign sales	All LEU/NU (~4,050 MTU) transferred to eastern or western port for overseas shipment	LEU	3.3	56,408	4,701	4,701
		NU	0.7	1.432	49	13

DOE = U.S. Department of Energy.
DU = depleted uranium.
LEU = low-enriched uranium.
MTU = metric tons of uranium.
NU = normal uranium.
PEA = programmatic environmental assessment

Fig. 2.1. Example of the 55-gallon drums and metal storage containers used at PORTS.

- Shipments were based on truck and railcar capacities as shown in Table 2.5. Storage alternatives were evaluated using both rail and truck transport, except in those instances in which the amount of material to be shipped was small enough to fit into a single truck, in which case only truck shipment was evaluated. However, containers and material types are not mixed in a single shipment (i.e., if there are not enough drums to fill an entire truck, metal boxes are not added). This assumption also tends to result in a conservative estimation of the number of trucks and railcars.

- Storage requirements (Table 2.6) are based on an assumed storage configuration that includes four drums per pallet, with pallets stacked four high and metal boxes stacked four high for DU and NU. Containers with LEU are stacked two high. Stacks of drums and boxes are arranged two deep so that access by material handling equipment is ensured. Also, aisle space is allowed every 40 ft and around the perimeter.

2.2 NO ACTION ALTERNATIVE

The No Action alternative would continue ongoing storage activities at all existing facilities. This alternative includes the continued storage of uranium materials in existing facilities (DOE and private). Monitoring and surveillance of the uranium materials at each site would continue, as would the handling necessary to continue proper management of these materials, including repackaging if needed. The uranium inventory would not be dispositioned (see Section 2.3.8).

2.3 PROPOSED ACTION

DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU. Uranium materials, which are presently located at multiple sites, are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition. The management plan will address the packaging and transport of potentially reusable uranium materials from DOE sites and university loan/lease returns and their receipt and storage at a site under cognizance of the UMG. This action will also cover material shipment from the UMG and disposition. A Secretarial Determination is required, under certain circumstances, for uranium in the UMG inventory to be sold. Twenty years will provide time for additional reviews required for any future related actions that may be desirable to help accomplish ultimate disposition. Impacts evaluated in Chapter 4 cover the 20-year period of this management plan.

The management plan will cover uranium materials that are currently in the form of oxides, metals, and other stable compounds such as UF_4. The quantity of uranium within the scope of this PEA is estimated to be 14,200 MTU and is primarily located at a few DOE locations (INEEL, PORTS, SRS, and Oak Ridge). These DOE locations have other uranium materials which are not part of the UMG inventory and not part of the 14,200 MTU addressed in the proposed action. This number is based on the 2000 NMIA data increased by approximately 10% to reflect uncertainties in material shipment. The plan will not include irradiated material, UF_6, enrichment of 20% or greater ^{235}U, or ^{233}U.

DOE must determine the safest, most effective, and most efficient approach for the consolidation and storage of this material. Consideration will be given only to those locations (DOE and commercial) within the continental United States that have a long-term mission for the handling and storage of uranium material. This material would be stored in either one (centralized) location or several (consolidated) locations. Approximately 14,200 MTU may be consolidated into one or more storage locations. This material is the primary focus of this PEA.

Since disposition of this material is currently undefined, a "bounding" analysis is performed to estimate the potential impacts from commercial processing of this material, use of this material in research activities, provision of this material to other Government agencies, and/or the sale (international/domestic) of this material upon expiration of the current moratorium. Disposition is a component of each of the action alternatives and impacts would differ based only on differences in transportation. Some wastes would be produced during this disposition process.

2.3.1 Interim Centralized Storage at a Single DOE Site

This alternative would consolidate all 14,200 MTU uranium materials at one DOE location. The potential storage sites are as follows:

- PORTS, in Pike County, Ohio;
- PGDP, near Paducah, Kentucky;
- INEEL, near Idaho Falls, Idaho;
- the Y-12 Complex and ETTP, in Oak Ridge, Tennessee; and
- SRS, near Aiken, South Carolina.

These six DOE sites have an existing inventory totaling approximately 10,300 MTU of LEU, NU, and DU in the scope of this EA. In addition, there is a relatively small amount (3,900 MTU) at 152 other sites located around the United States. The DOE preferred alternative would be to locate all these materials at the PORTS. PORTS is preferred because of its combination of characteristics:

- successful on-going receipt and storage of the uranium materials from Fernald and Hanford and universities,
- the existence of a uranium management infrastructure,
- personnel experienced in all relevant aspects of uranium operations,
- the availability of buildings with requisite floor space and nuclear safety alarm systems, and
- an ongoing uranium mission or facilities.

2.3.2 Interim Centralized Storage at a Single Commercial Site

This alternative assumes that all 14,200 MTU within the scope of this EA at existing DOE sites would be consolidated at a single commercial site. A commercial site in either the western or eastern United States would receive all the uranium materials. DOE has not identified specific commercial sites at this time. However, DOE must consider this possibility in the event that a commercial site is identified in the future. Therefore, for analysis purposes, especially transportation which requires definitive travel routes, a generic western (Utah) site and an eastern (South Carolina) site have been assumed. These sites should provide a reasonable bound for the transportation impacts.

2.3.3 Interim Partially Consolidated Storage at Several DOE Sites

Under this alternative, the six major DOE sites considered as single, consolidated storage sites will retain their existing uranium material inventory. In addition, the 3,900 MTU of uranium materials at the other 152 sites will be moved to these six sites based on proximity (closest distance).

2.3.4 Interim Partially Consolidated Storage at One Western and One Eastern DOE Site

Under this alternative two DOE sites, one in the western United States (INEEL) and one in the eastern Untied States (PORTS), will retain their existing uranium material inventories. The remaining inventory in the three major DOE sites, plus the 3,900 MTU of uranium materials at the other 157 sites, will be moved to these two sites based on proximity.

2.3.5 Interim Partially Consolidated Storage at One Western and One Eastern Commercial Site

This alternative assumes that all 14,200 MTU at existing DOE sites would be consolidated at two commercial sites, one in the western United States and one in the eastern United States. Materials would be shipped to these two sites based on closest distance. DOE has not identified specific commercial sites at this time.

2.3.6 Interim Partially Consolidated Storage by Physical Form

Under this alternative, the 14,200 MTU of uranium materials would be consolidated at three DOE sites (PORTS, SRS, and INEEL) based on physical form. It is assumed that PORTS would receive all the compounds, miscellaneous, and oxide uranium materials (about 4,400 MTU), while SRS would receive the metals (more than 8,900 MTU) and INEEL would receive the reactor fuel, residue, and sources (about 900 MTU). The sites with the largest inventory of a particular form (such as metals at SRS) would receive all of that form from every site.

2.3.7 Transfer of Small Quantities

DOE must be able to transfer small quantities (less than 0.1 MTU) from any one of the potential consolidated or centralized storage sites to a second location (such as a university). This option will be considered as a component of each alternative under the proposed action. It is not itself a stand-alone alternative. The impacts are bounded under the disposition option discussed below.

2.3.8 Disposition Options

Disposition is a component of each of the interim storage alternatives and not a separate alternative. DOE may dispose of all, or part, of the uranium materials in one of several ways. These reuse scenarios are speculative at this time, especially in regard to the quantities of uranium and timing of movement for a particular disposition path. Table 2.7 indicates the final disposition options and the amounts of uranium materials that are expected to be sent to each of these options from their respective interim storage locations. Any material not included in a specific disposition option can be included with any of the other disposition options. The disposition options are an integral constituent of each alternative, and all four options are included with each alternative when impacts are analyzed.

2.3.8.1 Commercial Processing/Domestic Sales

One option is the sale of some of the uranium materials to the domestic commercial nuclear fuel market after the sales moratorium on certain uranium materials has expired in 2008. Metals and oxides could be sold to commercial nuclear vendors for the manufacture of nuclear fuel for commercial nuclear power plants. Another scenario is the use of the uranium materials to down-blend HEU in conjunction with arms reduction treaties; the resulting LEU could be readily used in commercial nuclear power plants. The total quantity of 14,200 MTU may be reprocessed commercially or sold domestically. A generic eastern and a generic western processing site, or sales distribution point, will be assumed for analysis purposes.

2.3.8.2 Transfer to Research Facilities

Approximately 50 MTU would be potentially received by research facilities. This is based on material that is stored by the UMG that is in an acceptable form to be received by these facilities. The total 50 MTU would be transferred to a single site assumed to be the greatest distance from one of the six proposed DOE interim storage locations.

2.3.8.3 Transfer to Other Government Agencies

There would be approximately 2,500 MTU that could be provided to other government agencies. The uranium materials would be the Fernald Environmental Management Project (FEMP) DU and FEMP and Hanford uranium trioxide (UO_3). The military could use uranium metal in the armoring of military vehicles and in the manufacture of military vehicle penetrators. The total 2,500 MTU would be transferred to a single, unspecified location assumed to be the greatest distance from one of the six proposed DOE interim storage locations.

2.3.8.4 Foreign Sales

One option is the sale of some of the uranium materials to the international commercial nuclear fuel market after the sales moratorium on certain uranium materials has expired in 2008. The total LEU and NU would be approximately 4,050 MTU for international sales. This assumes that DU would not be a desired commodity internationally. The LEU and NU would be transferred from their interim storage locations to the closest international port (assumed to be Hampton Roads as an eastern port or San Diego for a western port) and shipped via cargo vessel to the farthest port in Asia or the Far East.

2.4 ALTERNATIVES CONSIDERED BUT NOT PROPOSED FOR ANALYSIS

An alternative DOE considered is to declare all of the uranium materials (14,200 MTU) included in the PEA scope as waste and dispose of them. DOE believes there is an essential need (current and ongoing) to effectively manage its existing uranium materials inventory as a government asset. Therefore, DOE believes an alternative involving the disposition of the uranium materials as waste is not reasonable. However, prior to transport and storage, the uranium material inventory addressed in this proposed action would be evaluated to ensure that none of these materials is waste. DOE has additional uranium inventories which are not reusable and might be declared waste. Also, DOE has other inventories which are not waste but, for various Department reasons, are not addressed in this EA.

3. AFFECTED ENVIRONMENT

3.1 PORTSMOUTH GASEOUS DIFFUSION PLANT

PORTS is located approximately 35 km (22 miles) northeast of Portsmouth in Pike County, Ohio, and occupies 3714 acres. Construction of the site began in late 1952 and ended in 1956, one year after the start of uranium enrichment processing at the site. On July 1, 1993, DOE leased portions of PORTS to the United States Enrichment Corporation (USEC) to manage and operate the uranium enrichment enterprise. DOE retains responsibility for the unleased portions of the site, which consist primarily of environmental restoration and waste management activities.

3.1.1 Human Health

The radiation dose from airborne radionuclides to a maximally exposed individual was 0.260 mrem, and the collective radiological dose from airborne emissions to the site region of influence (ROI) health risk population was 3.0 person-rem (DOE 1997a).

3.1.2 Climate and Air Quality

Prevailing winds at PORTS are from the south to southwest, with the south averaging the highest at just over 11% of the time. Wind speeds average 5 mph, with winds up to 75 mph on record. The average annual temperature measured at the site in 1992 was 55°F (DOE 1997a), with 112 days/year at or below 32°F in the winter with only 27 days/year at or above 90°F in the summer (MMES 1991).

Pike County is classified by the U.S. Environmental Protection Agency (EPA) as an attainment area for all six National Ambient Air Quality Standards (NAAQS) criteria air pollutants. The major sources of criteria pollutant emissions are three coal-fired boilers at the X-600 steam plant. Sources of radionuclide and fluoride emissions include purge cascade vents, cold recovery and wet evacuation vents, the X-344 evacuation vent, and six seal exhaust vents.

3.1.3 Water Resources

Surface Water

Major surface water features include the Scioto River and its on-site tributaries – Little Beaver Creek and Big Run Creek. There are no federally designated Wild and Scenic Rivers in the ROI. The Scioto River and an alluvial aquifer supply water to the site, and the on-site streams and Scioto River receive treated wastewater. The site is located outside the 500-year floodplain.

Groundwater

Major groundwater units include the Mississippian shale and sandstone bedrock aquifer and the unconsolidated sediment aquifer.

3.1.4 Geology and Soils

The site is on gently rolling land about 40 m (130 ft) above the Scioto River and 204 m (670 ft) above sea level. The predominant landform in the area is a relatively level, filled valley of the preglacial Portsmouth River, which runs north to south. Major rock units include, from oldest to youngest, the Ohio Shale, the Bedford Shale, the Berea Sandstone, the Sunbury Shale, and the Cuyahoga Shale. The site is in an abandoned river valley filled with fluvial materials. The soils in the fenced area are mostly urban land covered by roads, parking lots, buildings, and railroads. Other soils are well-drained upland soils. No major geologic faults exist in the ROI, and the potential for volcanic activity is small.

3.1.5 Ecological Resources

Vegetation consists of pastureland, old fields, oak-hickory, upland mixed hardwood, bottomland mixed hardwood, pine, second-growth hardwood, and scrub thicket. All forests and old fields are second growth. There are 45 wetlands totaling 13.9 ha (34.36 acres) at PORTS (DOE 2001a). The federally protected, endangered Indiana bat has been identified in the vicinity of the site, but no threatened or endangered species have been located on-site. Several state-listed species are known for the vicinity but none presently on-site. The sharp-shinned hawk, Carolina yellow-eyed grass, Virginia meadow beauty and rough green snake have been found on-site in the past.

3.1.6 Socioeconomics and Environmental Justice

Socioeconomics

The PORTS ROI includes both Pike County, where the facility is located, and Scioto County, which includes Portsmouth, the nearest city. Table 3.1 summarizes population, per capita income, and total person income for both counties from 1999, the last year for which figures were available. Total personal income was more than $2 billion (U.S. Bureau of Economic Analysis 2002a). Combined wage and salary employment for the region was nearly 39,817 in 2000 (U.S. Bureau of Economic Analysis 2002b). Total site employment in 1998 was 2700 (DOE 2002a).

Table 3.1. Population, income, and employment in the PORTS region of influence for Pike County and Scioto County

Region/Variable	Pike County	Scioto County
Population	27,988	80,533
Per capita personal income ($)	18,353	18,978
Total personal income (million $)	514	1,524

Environmental Justice

There are no federally recognized Native American tribes in the ROI. There are no minority populations within a 32-km (20-mile) radius of the PORTS site. However, the vast majority of a 32-km (20-mile) radius of the plant has low-income populations (based on population proportions greater than the national average of 13.1%).

3.1.7 Land Use

The site covers approximately 6.3 mile^2 (4003 acres), of which 800 acres are developed and 3203 acres are undeveloped. Of the land that is undeveloped, nearly all is available for future site development. Land use surrounding the site is predominantly rural.

3.1.8 Infrastructure

One on-site facility and 31 off-site wells provide an average of 14 million gallons of water per day. An on-site facility receives an average of 0.35 million gallons of sewage per day. The Ohio Electric Corporation supplies power via an electrical and coal-fired system; the historical load is over 1500 MW and 4500 tons of coal/month use; however, the current load is less than 100 MW/month. Transportation in the region consists of local access roads (such as Piketon Hill Road and State Route 32) and major roads (such as Interstate 70 and U.S. Highways 23, 52, and 50). The Chesapeake & Ohio Railroad and the Norfolk & Western Railroad are the primary providers of rail service to the PORTS region.

3.1.9 Cultural Resources

A 1997 archaeological survey identified 39 archaeological resources, which includes prehistoric components, isolated finds, and lithic scatters. A couple of resources contain prehistoric and historic components; another is a prehistoric, isolated find in a historic cemetery; another is a prehistoric lithic scatter and a lithic scatter in a historic farmstead (DOE 2002). Two architectural historic surveys have been completed at PORTS, and several structures have been identified that may have historical significance (DOE 2002).

3.2 PADUCAH GASEOUS DIFFUSION PLANT

The PGDP Reservation covers 3425 acres in western Kentucky, 17 km (10 miles) west of Paducah, and employs 1868 people. Paducah has been an active uranium enrichment facility since 1952. Enriched uranium is produced by the USEC for the commercial sector as fuel for nuclear power reactors in the United States and overseas. PGDP was a feed facility for PORTS.

3.2.1 Human Health

The radiation dose from airborne radionuclides to the maximally exposed individual was 0.0045 mrem, and the collective dose from radionuclide emissions to the site ROI health risk population was 0.017 person-rem. The ROI population was estimated at 500,502 based on 1990 census data.

3.2.2 Climate and Air Quality

The average prevailing wind in the area is from south to southwest at approximately 16 km/h (9.8 mph). Generally stronger winds are observed when winds are from the southwest or northwest (DOE 2000). January is the coldest month, with a daily average temperature of 35°F, while July is the warmest month with an average temperature of 79°F.

McCracken County is classified by the EPA as a marginal attainment area for ozone. The county is in attainment for the other criteria pollutants. The major sources of criteria air pollutant emissions are coal-, oil-, and gas-fired boilers. Sources of radionuclide emissions in 1997 were the cascade purge vent/stack at the C-310 purge and products building, decontamination activities at the C-400 cleaning building, and emissions from laboratory hoods in the C-710 building.

3.2.3 Water Resources

Surface Water

Major surface water features include the Ohio River, which is less than 3 km (2 miles) from PGDP, Metropolis Lake [2.4 km (1.5 miles) northeast], and two small tributaries to the Ohio River (Big Bayou Creek and Little Bayou Creek) that provide surface drainage to the site. There are no federally designated Wild and Scenic Rivers in the ROI. The site is above the probable 500-year flood level. The site receives fresh water from the Ohio River, and both the two on-site streams and the Ohio River receive treated wastewater from the site.

Groundwater

Major groundwater units include, from bottom to top, the McNairy Flow System (interbedded sand, silt and clay), the terrace gravels, the Regional Gravel Aquifer (the primary aquifer in the area, composed of sand and gravel units), and the Upper Continental Recharge System (clayey silt with interbedded sand and gravel). No aquifers are considered sole-source aquifers. Two major plumes of groundwater contamination extend off-site.

3.2.4 Geology and Soils

The topography slopes slightly from more than 137 m (450 ft) in the southern part of the site to near 91 m (300 ft) near the Ohio River. Surface sediments consist of valley fill deposits, which underlie most of the site, extending northward to the Ohio River. Major rock units include, from oldest to youngest, basement rocks, Tuscaloosa Formation basal gravels, the McNairy Formation, the Porters Creek Clay, continental deposits of gravel and clay-sand units, and a 10- to 30-ft layer of loess (windblown sediment). Soils beneath the site are nearly level and somewhat poorly drained. Geologic hazards include the potential for earthquakes. The site is near two active seismic zones, the New Madrid Fault Zone and the Wabash Valley Fault Zone. The potential for volcanic activity is small.

3.2.5 Ecological Resources

Nonforested areas consisting of mowed grass and developed area cover most of the Paducah site; forested areas are small and dominated by mature hardwood upland and riparian forests. On-site wetlands consist of forested wetlands (mature riparian hardwood forest). A wetland in the West Kentucky Wildlife Management Area (the buffer area surrounding the production facilities) has been designated an area of ecological concern.

Federally listed endangered species that have been identified, or could be identified, in the vicinity of the Paducah site include the Indiana bat, the interior least tern, and four species of pearly mussels. Another species of pearly mussel is federally listed as threatened, as is the bald eagle. No federally listed plant species are known to occur in the vicinity of Paducah.

3.2.6 Socioeconomics and Environmental Justice

Socioeconomics

The Paducah ROI includes McCracken County, Kentucky, where the facility is located. McCraken County had a population of 64,407, per capita personal income of $23,227, and a total person income of $1.8 billion in 1999 (U.S. Bureau of Economic Analysis 2002a). Wage and salary employment for the region was more than 41,859 in 2000 (US Bureau of Economic Analysis 2002b). Total site employment in 1998 was 2209 (DOE 2002b).

Environmental Justice

There are both low-income and minority populations near the plant site, with minority populations in the city of Paducah. There are no federally recognized Native American tribes in the area.

3.2.7 Land Use

The site occupies approximately 3425 acres, of which 750 acres are developed and 2675 acres are undeveloped. Land use surrounding the site is predominantly undeveloped natural area.

3.2.8 Infrastructure

The Ohio River supplies an average of 15 million gal of water per day; the water is treated on-site by chemical and physical processes. An on-site treatment plant receives an average of 0.2 million to 0.4 million gal of sewage per day. Sewage is treated on-site. Electric Energy, Inc., supplies power; the current site load is 1564 MW. The site also uses approximately 82 tons of coal per day. Transportation in the region consists of local access roads (State Routes 1154 and 358) and major roads (Interstate 24 and U.S. Highways 45, 60, and 63). The Burlington Northern Railroad, Paducah Railroad, Louisville, and the on-site U.S. Government Railroad are primary providers of rail service to the Paducah region.

3.2.9 Cultural Resources

The site has three recorded archaeological or historic sites, and others have been identified in areas near the Paducah plant site. The site has not been subject to any systematic cultural resources surveys.

3.3 Y-12 NATIONAL SECURITY COMPLEX

The Y-12 Complex (formerly the Y-12 Plant) is one of three installations on the DOE Oak Ridge Reservation (ORR). The early missions of the site included separation of ^{235}U from normal uranium by the electromagnetic separation process and manufacturing weapons components from uranium and lithium (DOE 2001b).

During 2000, the U.S. Congress established the National Nuclear Security Administration (NNSA). Its mission is to carry out National Security responsibilities of DOE (DOE 2001).

3.3.1 Human Health

The calculated radiation doses to maximally exposed off-site individuals from airborne releases from all sources on the ORR were 0.40 mrem (ORNL 2001). The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 43 person-rem (DOE 1997a).

3.3.2 Climate and Air Quality

The climate of eastern Tennessee may be broadly classified as humid continental, although it is very near the region of temperate continental climate to the north. The Cumberland Mountains/Plateau to the northwest and the Great Smoky Mountains to the southeast influence the patterns of temperature and precipitation over the region, with cooler temperatures and greater precipitation generally occurring at the higher elevations. The average annual temperature in Oak Ridge, based on a 30-year period from 1961 to 1990, is 56.6°F, and precipitation is 136.7 cm (53.8 in.) per year. Precipitation is fairly evenly distributed most of the year. The average wind speed is approximately 4 mph (at 10 m above the ground), and the highest wind speed, 79 mph, was associated with a tornado in Bear Creek Valley during the afternoon of February 21, 1993. Prevailing wind directions are from the northeast and southwest, reflecting the channeling of winds parallel to the ridges and valleys in the area.

The air quality control region in which the Y-12 Complex is located is in attainment for NAAQS criteria pollutants. The nearest nonattainment area is Polk County, which is about 64 km (40 miles) south of the Y-12 Complex. Air quality in the region is generally good. However, the ozone standard is occasionally exceeded per monitoring data from Anderson County (DOE 2001b).

The release of radiological contaminants, primarily uranium, into the atmosphere at the Y-12 Complex occurs almost exclusively as a result of plant production, maintenance, and waste management activities (ORNL 2001). In 2000, only 9.16×10^{-3} curies of uranium (2.2 kg) were released from the Y-12 Complex (ORNL 2001). Measurements at the perimeter of the ORR indicate ambient air concentrations are less than 1% of their respective derived concentration guidelines (DCGs) given in DOE Order 5400.5 (DOE 1997a). A DCG is a concentration of a given radionuclide for one exposure pathway (e.g., inhalation) that would result in an effective dose equivalent (EDE) of 100 mrem per year to a reference individual, as defined by the International Commission on Radiological Protection.

The prevention of significant deterioration (PSD) Class I area nearest to the Y-12 Complex is the Great Smoky Mountains National Park, approximately 48 km (30 miles) south of the facility. The Joyce Kilmer Wilderness Area, which is also a Class I area, is just south of the western end of the Great Smoky Mountains National Park. The median visibility range at the park is 39 km (24 miles), with a summer median of 19 km (12 miles).

3.3.3 Water Resources

The Y-12 Complex is approximately 3 km (2 miles) from the Melton Hill Reservoir and Clinch River. On-site, two streams originate approximately in the middle of the plant. Bear Creek flows directly west from its headwaters at the Y-12 Complex, while East Fork Poplar Creek flows east before turning north and west and flowing through the residential area of Oak Ridge. These two creeks merge near ETTP, which is approximately 16 km (10 miles) west of the Y-12 Complex. The major groundwater unit for the ORR is the Knox Aquifer, composed of the Knox Group and the Maynardville Limestone. No aquifers are considered sole-source aquifers (DOE 1997b).

3.3.4 Geology and Soils

On a regional scale, the ORR, which includes the Y-12 Complex, is located on the western part of the Valley and Ridge Province (DOE 1998a). The stratigraphic section of the ORR is stacked along three major thrust faults. The eastern portion of the Y-12 Complex is located on the White Mountain thrust sheet. This fault has not been historically active (DOE 1998a).

Bear Creek Valley, to the west, is underlain by rocks of three regionally important stratigraphic units: the Rome Formation, the Conasauga Formation, and the Knox Group, which typically dip 45° to the southeast (DOE 1997b). The geology of Bear Creek Valley displays an inclined layer, cake-style stratigraphy that is observed on a variety of scales: on a regional scale, where limestone- and dolomite-dominated rock groups are interbedded with predominantly clastic shale groups, and on the scale of outcrops, where clastic beds are interlayered with carbonate beds. This layered structure exerts a strong influence on groundwater flow (DOE 1997b).

3.3.5 Ecological Resources

The ORR consists of diverse habitats and supports a rich variety of flora and fauna. Vegetation is characteristic of that found in the intermountain regions of central and southern Appalachia. The Y-12 Complex is covered in mowed grass, concrete, gravel, asphalt, and industrial structures. Thus, the site does not have unique habitats or a wide diversity of flora or fauna. Upper East Fork Poplar Creek lacks riparian vegetation because much of the stream is channelized and maintained. Lake Reality is a 2.5-acre, plastic-lined, flat-bottomed settling and spill control structure located near the east end of the facility on East Fork Poplar Creek.

There are no federally protected threatened or endangered species known on the Y-12 Complex. However, the U.S. Fish and Wildlife Service (FWS) notes that the federally listed endangered species—the gray bat (*Myotis grisescens*), the Indiana bat (*Myotis sodalis*), and the pink mucket (*Lampsilis abrupta*)—are known from, or have the potential to occur within, the project impact areas on the ORR. A Biological Assessment has been prepared covering these three species for the ORR (see Chapter 7). Although surveys for protected species are not comprehensive enough to rule out all possible federal- or state-listed vertebrates, the likelihood of finding such species seems very low (DOE 1998a).

There is a small wetland (0.45 acre) in a small, wooded area between New Hope Cemetery and Bear Creek Road.

3.3.6 Socioeconomics and Environmental Justice

The Y-12 Complex is one of three sites located on the DOE ORR, which includes portions of both Anderson and Roane counties in Tennessee. This region also includes the city of Oak Ridge, which provides a substantial portion of the work force for the three facilities. To generate the most conservative estimates of potential impact, the ROI includes only these two counties. Actual impacts are likely to be distributed over a wider area, since Anderson County is also part of the metropolitan statistical area for the much larger city of Knoxville and draws commuters from at least 12 counties in eastern Tennessee.[1]

Table 3.2 summarizes population, per capita income, and total personal income from 1999 (U.S. Bureau of Economic Analysis 2002a). Total personal income was more than $2.8 billion. Wage and salary employment for the region was 60, 311 in 2000 (U.S. Bureau of Economic Analysis 2002b). The Scarboro Community, which borders the fenceline of the plant's northern boundary, is predominantly an African-American community.

Table 3.2. Population and income in the Y-12 National Security Complex Region of Influence for Roane and Anderson Counties for 1999

Region/variable	Roane County	Anderson County
Population	50,008	71,004
Per capita personal income ($)	21,728	25,548
Total personal income (million $)	1,087	1,788

3.3.7 Land Use

The Y-12 Complex is an industrial site that has been in operation since World War II. The residential portion of Oak Ridge forms much of the northern boundary to the site, and the Tennessee Valley Authority's (TVA's) Melton Hill Reservoir and the Clinch River are located to the south and west. Recreational uses of the surrounding area include fishing, boating, hunting, swimming, and camping. Several recreational areas are within 8 km (5 miles) of the site.

3.3.8 Infrastructure

Sanitary wastewater from the Y-12 Complex is discharged to the city of Oak Ridge publicly owned treatment works under an industrial and commercial wastewater discharge permit. Sanitary sewer radiological sample results at the Y-12 Complex are routinely reviewed to determine compliance with DOE Order 500.5, "Radiological Protection of the Public and the Environment." No radiological parameter that is monitored (including uranium) has exceeded a DCG (ORNL 1998). Typically, sample results indicate the Y-12 Complex

[1]Commuting data taken from Oak Ridge Chamber of Commerce website, www.orcc.org/labor.html.

radiological discharges are three orders of magnitude below their respective DCGs (ORNL 1998). During 2000, the wastewater flow averaged about 670,000 gal/day (ORNL 2001).

3.3.9 Cultural Resources

Native American occupation of the Oak Ridge area began about 12,000 years ago. European settlement began in the 18th century. Much of the current Y-12 Complex was farmed before World War II, when the site was secured by the federal government as part of the Manhattan Project. A cultural resources survey conducted in February 1995 identified an historic district with 92 contributing structures and 53 noncontributing structures and 4 structures not contiguous with the historic district that are eligible for inclusion in the National Register of Historic Places (NRHP) (Sousa et al. 2001).

3.4 EAST TENNESSEE TECHNOLOGY PARK

ETTP, formerly known both as the Oak Ridge Gaseous Diffusion Plant and as the Oak Ridge K-25 Site, is located in Roane County, Tennessee, and is one of three large facilities on the ORR. The site is located on a level, 1500-acre tract of land near the confluence of Poplar Creek and the Clinch River. ETTP is approximately 56 km (35 miles) west of Knoxville and approximately 13 km (8 miles) southwest of the city of Oak Ridge.

3.4.1 Human Health

The calculated radiation doses to maximally exposed off-site individuals from airborne releases from all sources on the ORR were 0.40 mrem (ORNL 2001). The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 43 person-rem (DOE 1997a).

3.4.2 Climate and Air Quality

The climate of eastern Tennessee may be broadly classified as humid continental, although it is very near the region of temperate continental climate to the north. The Cumberland Mountains/Plateau to the northwest and the Great Smoky Mountains to the southeast influence the patterns of temperature and precipitation over the region, with cooler temperatures and greater precipitation generally occurring at the higher elevations. The average annual temperature in Oak Ridge, based on a 30-year period from 1961 to 1990, is 56.6°F and precipitation is 136.7 cm (53.8 in.) per year. Precipitation is fairly evenly distributed most of the year. The average wind speed is approximately 4 mph (at 10 m above the ground), and the highest wind speed, 79 mph, was associated with a tornado in Bear Creek Valley during the afternoon of February 21, 1993. Prevailing wind directions are from the northeast and southwest, reflecting the channeling of winds parallel to the ridges and valleys in the area.

Roane County and all surrounding counties are in attainment for NAAQS criteria pollutants. The nearest nonattainment area is in Polk County, about 72 km (45 miles) south of ETTP. Air quality in the region is generally good. The ozone standard is occasionally exceeded in Knoxville; however, Knox County is in attainment of the ozone standard.

The PSD Class I area nearest to ETTP is the Great Smoky Mountains National Park, 56 km (35 miles) south of the facility. The Joyce Kilmer Wilderness Area, which is also a Class I area, is just south of the western end of the Great Smoky Mountains National Park. The median visibility range at the park is 39 km (24 miles), with a summer median of 19 km (12 miles).

3.4.3 Water Resources

Surface Water

ETTP is directly adjacent to the Clinch River along the northwest boundary of the ORR. Poplar Creek is a moderately wide (30- to 70-ft) stream that enters the north side of ETTP about 0.5 km (0.3 mile) downstream of the confluence of the east and west forks of Poplar Creek. The lower reach of Poplar Creek meanders sharply along the southwest side of ETTP and enters the Clinch River.

TVA performed an analysis of floods on the Clinch River and Poplar Creek. TVA concluded that most of ETTP is above the probable maximum flood level. The only facilities identified at risk during major floods were the K-25 power plant and the pumping station for ETTP's water filtration plant. The source of flooding at ETTP would be backwater from the Clinch River near the confluence of Poplar Creek. All proposed storage locations are above the 100-year flood level.

Groundwater

Groundwater occurs at ETTP in both the unconsolidated overburden and underlying bedrock as a single, unconfined water table aquifer. With few exceptions, the water table occurs in the overburden overlying bedrock with the saturated overburden ranging up to 21 m (70 ft). In general, the water table is encountered within several feet of the surface, adjacent to major water features and in incised ravines.

Groundwater flows in bedrock are controlled by hydraulic gradients, fracture networks, and karst solution features. Typically, bedrock flowpaths tend to follow geologic strike. Karst features are present in bedrock at ETTP, but conduit-dominated flow has been confirmed only in portions underlain by Knox carbonate along Blackoak Ridge.

The nearest domestic water supply wells are located approximately 3 km (2 miles) southwest of ETTP on the opposite side of the Clinch River. It is unlikely that these wells could be affected by groundwater flowpaths from ETTP, should such a pathway exist. Additionally, there are nearly a dozen domestic wells along Blackoak Ridge, west of the DOE boundary. Four of these wells were sampled recently and found to be uncontaminated.

3.4.4 Geology and Soils

In general, ETTP is underlain by bedrock that can be broadly characterized as carbonate (Chickamauga and Knox Group) or clastic (Rome Formation). The carbonates underlie the majority of the main plant area. The eastern part of the site is underlain by clastic bedrock of the Cambrian Rome Formation. The structural geology of ETTP is complex; the principal faults in the area include the White Oak Fault, a major regional thrust fault located along the south side of the ETTP. Seismic activity in the southern Appalachian Mountains that has affected the site area has been recorded 45 times since 1800. The probability of future seismic damage is moderate.

3.4.5 Ecological Resources

The ORR consists of diverse habitats and supports a rich variety of flora and fauna. Vegetation is characteristic of that found in the intermountain regions of central and southern Appalachia. Vegetation around the buildings within the fenced area on the ETTP proper is a mixture of mowed grasses with a few shrubs and trees. Many of the shrubs and trees have been planted as landscaping, although some native species are found in unmowed areas around ponds and waterways.

Since ETTP proper is planted primarily in nonnative grasses, it has very little habitat available for native animals except along Poplar Creek. The majority of animal species found within ETTP's boundaries are species that adapt well to disturbance and the presence of humans. There are no known federally protected plant or animal species on the ETTP site, although suitable habitat exists for the endangered bald eagle on Melton Hill Reservoir and the Clinch River. Sixteen plant species and 18 animal species that are considered rare, threatened, or endangered by the state of Tennessee are found on or near ETTP. However, the FWS notes that the federally listed endangered species—the gray bat (*Myotis grisescens*), the Indiana bat (*Myotis sodalis*), and the pink mucket (*Lampsilis abrupta*)—are known from, or have the potential to occur within, the project impact areas on the ORR.

The Lower Poplar Creek Rookery is the only environmentally sensitive area within ETTP. It is approximately 6.5 acres and is located on the north bank of Poplar Creek in the middle of the plant site.

3.4.6 Socioeconomics and Environmental Justice

Like the Y-12 Complex, ETTP is located on the DOE ORR, and the region of impact is identical to the ROI for the Y-12 Complex alternative. See Section 3.3.6 for summaries of population, income, and employment within the region. ETTP is in proximity to low-income populations on Blair Road (which runs behind the park).

3.4.7 Land Use

The approximately 1500 acres of land in the ETTP site are industrial. The site formerly produced enriched uranium using a gaseous diffusion process. Portions of the site have been used for waste storage since the facility ceased enrichment operations. Efforts are under way to convert existing buildings into productive use through reindustrialization.

3.4.8 Infrastructure

Treatment of domestic wastewater is performed at the ETTP Sewage Treatment Plant, which operates within a National Pollutant Discharge Elimination System permit. The operating capacity of the treatment plant is about 600,000 gal/day with a current load of half that capacity (DOE 1997c). The ETTP water treatment plant is currently producing from 800,000 gal/day to 1.4 mgd of potable water. Capacity of the system is roughly three times the current use. Highways in the area include State Routes 95 and 58.

3.4.9 Cultural Resources

The K-25 Site was established as part of the Manhattan Project to develop and produce HEU for use in nuclear weapons. The Manhattan Project created the first industrial process for separating uranium isotopes by the gaseous diffusion method. A summer 1994 cultural resources survey of the former K-25 Site identified a Main Plant Historic District with 120 contributing structures and 37 noncontributing structures, and 11 structures that are not contiguous with the historic district, that are eligible for inclusion on the NRHP (Sousa et al. 2001).

3.5 SAVANNAH RIVER SITE

SRS is located in southwestern South Carolina adjacent to the Savannah River, which forms the boundary between South Carolina and Georgia. SRS encompasses approximately 800 km^2 (300 $mile^2$) within the Atlantic Coastal Plain physiographic province. SRS is approximately 40 km (25 miles) southeast of Augusta, Georgia, and 32 km (20 miles) south of Aiken, South Carolina. The site was constructed during the early 1950s to produce the basic materials used in the fabrication of nuclear weapons, primarily tritium and ^{239}Pu, in support of the nation's defense programs.

3.5.1 Human Health

The ROI population used in the Final Waste Management programmatic environmental impact statement (PEIS) to determine human health risk was 620,618 based on 1990 census data (DOC 1991). The radiation dose to a maximally exposed individual was 0.04 mrem for airborne radionuclides and 0.140 mrem for liquid releases (SRS 2001). In 2000, the collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 2.3 person rem (SRS 2001).

Releases of radioactivity to the environment from SRS account for less than 0.1% of the total annual average environmental radiation dose to individuals within 80 km (50 miles) of SRS (Arnett, Karapatakis, and Mamatey 1994). Standard population dose analyses for air releases are based on an 80-km (50-mile) radius, because expected dose levels beyond that distance are very small.

Worker doses at SRS have consistently been well below the DOE worker exposure limits. The all-pathway dose standard for site workers in 2000 was 100 mrem per year per DOE Order 5400.5 (SRS 2001).

3.5.2 Climate and Air Quality

SRS and surrounding counties are classified by EPA as attainment areas for all six of the NAAQS criteria air pollutants. The major sources of criteria air pollutants are nine coal-burning and four fuel oil-burning boilers, and the process facilities for fuel and target fabrication. Non-SRS sources of toxic air pollutants consist primarily of industrial installations, small manufacturing shops, and residual wood combustion.

Prevailing winds at the Bush Field Airport in 1992 are uniformly distributed, with winds from the west–southwest 7% of the time and from the west–northwest 6% of the time on a yearly basis. The highest occurrence of wind speed is 5 to 7 mph, with an annual occurrence of 35%. The annual average temperature is 66°F, with seasonal temperatures ranging from an average summertime daily maximum of 91°F to an average daily minimum in January of 38°F.

3.5.3 Water Resources

Major surface water resources include the Savannah River, which runs along the southwestern border of the site for 32 km (20 miles); on-site drainages such as Upper Three Runs, Fourmile Branch, Beaver Dam Creek, Pen Branch, Steel Creek, and Lower Three Runs; and numerous Carolina bays. No federally designated Wild and Scenic Rivers exist in the area. Groundwater wells and the Savannah River supply water for the site. On-site streams and the Savannah River receive treated wastewater. The 100-year floodplain does not encroach on existing facilities.

Major groundwater units are the interbedded sandy clays and clayey sands of the coastal plain sediments. The sandy beds generally form aquifers, and the clay rich beds act as aquitards. No sole source aquifers occur in the area.

In 2000, 24,806 radiological analyses and 125,924 non-radiological analyses were performed on groundwater samples collected from 1,188 monitoring wells. Various groundwater contaminants with estimated plumes have been identified in the A-Area and M-Area; C-Area; D-Area and TNX; the general separations and waste management areas; K-Area; L-Area and chemicals, metals, and pesticides (CMP) pits; N-Area; and P-Area (SRS 2001).

3.5.4 Geology and Soils

The topography of the area is generally flat, with some rolling hills and knolls. Elevations range from 26 to 130 m (85 to 427 ft) above mean sea level. Major rock units include, from oldest to youngest, the crystalline basement rocks, the Dunbarton Triassic Basin, and the Atlantic Coastal Plain sediments.

Soils in the area are primarily sandy loams that occur on alluvial terraces of the Savannah River and on the Aiken Plateau. Several interbasinal faults are located in the down-faulted Dunbarton Triassic Basin. However, no conclusive evidence exists of recent displacement along any fault within 300 km (186 miles) of SRS.

Two major earthquakes have occurred within 300 km (186 miles) of the site. The probability of future seismic damage is moderate.

3.5.5 Ecological Resources

Major plant communities include cypress-gum and lowland hardwood swamps, sandhills, and old agricultural fields. Ninety percent of the SRS land cover is upland pine forest and bottomland hardwood forest. Important terrestrial habitats include old fields, sandhills, upland pine forests, bottomland and upland hardwood forests, and swamp forests. Longleaf pine/wiregrass communities support sensitive species, such as the red-cockaded woodpecker. SRS was designated a National Environmental Research Park (NERP) in 1972.

SRS contains approximately 43,000 acres of wetlands (20% of SRS), consisting of emergent marsh, cypress/tupelo, bottomland hardwood, and open water. These wetlands include the Savannah River Swamp (about 10,000 acres). More than 200 Carolina bays are scattered throughout the SRS.

The site provides refuge for several federally protected endangered or threatened species of plants and animals, including the red-cockaded woodpecker, the bald eagle, the smooth coneflower, the woodstork, the short-nosed sturgeon, and the pondberry (see FWS letter dated July 16, 2002, in Chapter 7). There are another dozen species which are listed as of special concern.

The SRS is one of the most biologically diverse areas in the southeast (http://www.srs.gov/general/enviro/SRFS.htm; April 24, 2002). There are 60 mammal, 107 reptile and amphibian, 80 fish, and 174 bird species on the site. Over 1300 species of vascular plants have been collected at SRS (http://www.srs.gov/general/enviro/SRFS.htm; April 24, 2002). The National Marine Fisheries Service has listed federally protected species also (see MNFS letter to DOE dated June 28, 2002 in Chapter 7).

3.5.6 Socioeconomics and Environmental Justice

The ROI for SRS includes Aiken, Barnwell, Allendale, and Bamberg counties in South Carolina and Burke, Columbia, Richmond, and Screven counties in Georgia. At least 90% of the states' employees reside in these counties. Table 3.3 summarizes population, per capita income, and total personal income from 1999 (U.S. Bureau of Economic Analysis 2002a). Total personal income for this eight-county region was more than $11.5 billion. Total SRS site employment in 2002 is 13,800 (SRS Fact Sheet 2002).

The total population in the ROI in 1999 was 506,101. Population demographics include Native Americans at 0.2% and urban at 69.6%. Owner-occupied housing was 67.1% and renter-occupied 32.9%.

Sensitive populations include children under 15 years old – 23.7%, women of child-bearing age (15 to 44) – 24.3%, and adults over age 65 – 10.3%.

Table 3.3. Population and income in the Savannah River site region of influence for 1999

Region/variable	Population	Per capita personal income ($)	Total personal income ($ Millions)
South Carolina			
Aiken County	135,401	18,353	3,300
Allendale County	11,325	17,321	196
Bamberg County	16,289	18,606	303
Barnwell County	21,784	23,858	520
Georgia			
Burke County	23,217	16,386	232
Columbia County	93,312	22,931	2,140
Richmond County	190,310	23,980	4,564
Screven County	14,463	19,181	277

Three Native American groups, the Yuchi Tribal Organization, the Nubiunal Council of Muskogee Creek, and the Indian's People Muskogee Tribal Town Confederacy, have expressed general concerns about SRS and the Central Savannah River area regarding several plant species traditionally used in tribal ceremonies.

3.5.7 Land Use

The site occupies 198,000 acres of land, most of which serves as a forestry research center. SRS was designated a National Environmental Research Park (NERP) in 1972. Of the total area, approximately 15,840 acres are developed and 182,162 are undeveloped. Of the undeveloped land, approximately 145,400 acres are available for future site development. Land use surrounding the site is predominantly rural.

3.5.8 Infrastructure

On-site wells provide an average of 1.6 million gal of water per day. On-site treatment plants receive an average of 0.5 million gal of sewage per day. South Carolina Gas and Electric Company and on-site generation provide power. The current site load is 130 MW.

Transportation in the area consists of local access roads (such as U.S. 278 and State Route 125) and major roads (such as Interstates 20 and 95). The Seaboard Coast and Southern Railroads are the primary providers of rail service to the SRS region, including on-site rail spurs.

3.5.9 Cultural Resources

Native American population in the area began about 11,000 years ago. More than 800 prehistoric sites and about 400 historic sites have been identified at the SRS. Fifty-five sites have been determined eligible for the NRHP.

3.6 IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

INEEL is a 2305-km^2 (890-mile^2) DOE research facility located in southeastern Idaho. The physical and biological environment of INEEL and the region has been described extensively.

3.6.1 Human Health

Radiation in southeast Idaho in the vicinity of the INEEL consists of natural background radiation from cosmic, terrestrial, and internal body sources; manmade nuclear fallout; and radiation from consumer and industrial products. In 1997, INEEL activities added 0.03 mrem, 0.008% of background, to the maximally exposed individual's total EDE. These sources result in an estimated total EDE of 362 mrem/year to an average member of the public residing in southeastern Idaho (DOE 1998b).

3.6.2 Climate and Air Quality

The area surrounding INEEL is classified under the Clean Air Act of 1970 as a PSD Class II area, an area with reasonable or moderately good air quality that allows moderate industrial growth. To the west, about 19 km (12 miles), is the Craters of the Moon National Monument and Wilderness Area, classified as a PSD Class I Area.

The climate of INEEL has been studied extensively for many years. The National Oceanic and Atmospheric Administration (NOAA) operates 26 monitoring stations on or near INEEL. Detailed climatological information has been published by NOAA. Severe weather on INEEL consists of thunderstorms and funnel clouds. On average, two to three thunderstorms occur during each of the summer months. Small hail may accompany the thunderstorms, but hail damage has not occurred at INEEL. NOAA records indicate five funnel clouds and no tornadoes on INEEL since 1950.

3.6.3 Water Resources

Naturally occurring surface waters at the INEEL consist of three intermittent streams, the Big Lost River, Little Lost River, and Birch Creek. These streams drain adjacent mountain valleys and flow onto INEEL. All of the streams infiltrate, disappearing in the underlying aquifer. No surface water flows leave the INEEL.

Studies have shown that the projected 100-year flood of the Big Lost River on the INEEL would be adequately contained by the river channel with the utilization of an existing diversion area constructed near the point at which the river enters the INEEL (Bennett 1986). The flood control system was constructed on the Big Lost River in 1958. The system consists of a dam that diverts water into a series of spreading areas. In 1984, the dikes were raised so that the flood control system could contain a flood with an average return period of 300 years or more. In recent years, all of the water in the Big Lost River has been stored or diverted for irrigation upstream of the INEEL.

The Snake River Plain Aquifer is the principal groundwater feature in southeastern Idaho, underlying nearly all of the plain. Because groundwater supplies more than 50% of the drinking water consumed within the eastern Snake River Plain and an alternative drinking water source or combination of sources is not available, the EPA designated the Snake River Plain Aquifer a sole-source aquifer in 1991 (56 *FR* 50634, 1991). Aquifer depths within the INEEL range from 61 to 274 m (200 to 900 ft). This aquifer discharges approximately 8.0 billion m^3 (6.5 million acre-ft) of water annually through springs and irrigation wells. Discharges from the springs contribute substantially to the flow of the Snake River.

3.6.4 Geology and Soils

The INEEL is on the Snake River Plain and is bordered on the north and northeast by the Lost River, Lemhi, and Bitterroot mountain ranges. Elevations on the INEEL range from 1585 m (5200 ft) in the northeast, to 1448 m (4750 ft) in the southwest.

The surface of the INEEL is relatively flat and composed of basaltic lava flows interbedded with sedimentary strata. A 30-ft layer of mixed sediments covers a deeper layer of underlying basalt. A grayish-brown gravelly silt loam, derived from loess mixed with alluvium from the Big Lost River, makes up the topsoil. Gravels occupy 50% to 75% of the surface area, and the erosion hazard is slight. The soil is moderately permeable, well drained, and generally nonalkaline. However, alkalinity increases with depth, and hardpan zones may occur at depths from 50 cm (20 in.) to 7 m (20 ft).

The INEEL is in a seismic zone 2B, defined by the Uniform Building Code (UBC) as an area where destructive earthquakes may occur. Extensive seismic evaluations have been performed for the INEEL. Numerous small earthquakes have been recorded in the region. Epicenters of most earthquakes have been in the surrounding mountains. In October 1983, a large earthquake (Richter magnitude 7.3) occurred 24 km (15 miles) northwest of Mackay, Idaho.

3.6.5 Ecological Resources

Flora and fauna of the INEEL have been surveyed and studied since the late 1950s. No substantial impacts caused by operation of INEEL facilities have been identified. Biological resources at the INEEL, in general, and Idaho Chemical Processing Plant (ICPP), in particular, are extensively described in DOE/EA-0306 (DOE 1991).

No species on the federal list of threatened or endangered species are known to permanently reside on the INEEL. No unique habitats are located on the INEEL.

No known endangered or threatened species nests in or inhabits the INEEL. However, the bald eagle *(Haliaeetus leucocephalus*), a federally-protected species, has been observed wintering on or near the INEEL (Martin 1995). The FWS, in addition, lists the Canada lynx, gray wolf, bull trout, Bliss Rapids snail, and the Ute ladies-tresses as species that may occur in the area (see FWS letter to DOE dated July 1, 2002, in Chapter 7). Several additional species are on the state of Idaho watch list, including the bobcat, ferruginous hawk, long-billed curlew, and merlin. A list of the most common species of animals found at the INEEL can be found in DOE (1998b).

3.6.6 Socioeconomics and Environmental Justice

The ROI for INEEL includes seven Idaho counties (see Table 3.4). Table 3.4 summarizes population, per capita income, and total personal income from 1999 (U.S. Bureau of Economic Analysis 2002a). Total population in the ROI in 1999 was 247,224, and total personal income for this seven-county region was almost $4.9 billion. The average per capita personal income for the ROI was $19,069.

Table 3.4. Population and income in the INEEL site region of influence for 1999

Region/variable	Population	Per capita personal income ($)	Total personal income ($ Millions)
Idaho			
Bannock County	74,881	20,252	1,516
Bingham County	42,127	17,321	742
Bonnevile County	81,536	22,408	1,827
Butte County	3,012	19,376	58
Clark County	913	22,022	20
Jefferson County	19,949	16,947	338
Madison County	24,806	14,861	368

INEEL = Idaho National Engineering and Environmental Laboratory.

Employment at the INEEL rose steadily since the mid-1980s to a yearly average of approximately 12,387 [fiscal year (FY) 91]. However, employment in 1997 was 7,828 (DOE 2000) and is projected to decline to around 7,250 by 2004.

The majority of employees reside in Bonneville and Bingham counties east of INEEL. In FY 1991, an average of 8,500 employees commuted daily to INEEL facilities, primarily using the INEEL bus transit system.

The population surrounding INEEL is 7% minority and 14% low income (DOE 2000).

3.6.7 Land Use

The INEEL occupies 2305 km^2 (890 $mile^2$, 569,600 acres) in the southeastern Idaho desert. In addition to activities related to nuclear energy, the area has been designated as an NERP.

Developed facilities at the INEEL cover only a small portion (approximately 2%) of the total land area. Of the 550,000 acres of undeveloped land, approximately 330,000 acres are used for controlled grazing of cattle and sheep. The available area for future site development is approximately 22,330 acres.

3.6.8 Infrastructure

On-site wells and storage tanks provide an average of 5.242 million gal of water per day. On-site treatment facilities treat an average of 0.254 million gal of sewage per day. The Idaho Power Company supplies power, and the current load is 41.8 MW.

Transportation in the area consists of local access roads such as U.S. Routes 20 and 26. Interstate 15 passes to the east of the site and intersects Interstate 84 to the south. Rail lines, including an on-site spur connecting to the Union Pacific Railroad, also serve the region.

3.6.9 Cultural Resources

Several archeological and cultural resource surveys have been conducted in association with development (Reed et al. 1987). The only important site identified by these surveys was an historic homestead (Smithsonian Site # 10-BT-269). The site consists of a dugout shelter and associated historic debris characteristic of an occupation period between 1900 and 1930. The site is a considerable distance from any activity related to the proposed action and would not be affected by these efforts.

In the event that paleontological or cultural resources were encountered during subsurface activities, work would stop until a qualified professional assessed the significance of the resources.

4. ENVIRONMENTAL CONSEQUENCES

The first part of this chapter (Section 4.1) establishes the methodology used to calculate public and worker risk under both routine operations and various accident scenarios. Uranium source terms, assumed accident frequencies, and other parameters needed to model facility accident scenarios are defined in Appendix A. The transportation analysis is described in Appendix B. Ecological and human health methodology and detailed analysis are presented in Appendix C. Detailed results of the modeling are presented in tables showing all storage alternatives and disposition options under all credible accident scenarios. Section 4.2 addresses environmental consequences common to all alternatives and options. Sections 4.3 through 4.9 summarize the environmental consequences for each storage alternative. Section 4.10 summarizes the environmental consequences for each disposition option. Section 4.11 provides a summary comparing the impacts of each storage alternative coupled with disposition options, and Section 4.12 addresses cumulative impacts.

4.1 METHODS

This section describes environmental and socioeconomic impact methods and risk to the public, a co-located worker, and a facility worker due to continued storage of uranium materials at their current locations (No Action alternative), and receipt, interim storage, and disposition of these materials at other sites as described in Chapter 2. Risks are evaluated for routine operations and nonroutine (accident) conditions.

Routine or normal operations include construction of any new storage facilities, upgrades to existing facilities, and maintenance and surveillance. Construction costs and the number of permanent workers (maintenance and surveillance) are estimated based on the space needed for uranium materials storage and disposition. The number of construction workers is estimated assuming that half the construction costs are labor and each worker earns $20,000 per year. The permanent labor force to monitor storage in various warehousing locations is assumed to be one worker/18,000 ft^2 of storage space. Land for new building construction is assumed to be 25% greater than floor space needs, and single-story buildings are assumed to be used.

In addition, various disposition options are considered. These include commercial processing and domestic sales of the entire inventory, disposition of limited quantities (50 MTU) at research facilities, disposition of 2,500 MTU to other government agencies, and foreign sales of 4,050 MTU. Bounding analyses are provided for these options; disposition options should be considered a possible component of each interim storage alternative.

The number of parameters that could affect the off-site human health and environmental consequences of a catastrophic release is vast. For example, the assumptions regarding wind speed, wind direction, height of plume, the amount of uranium affected, the amount of dilution, and the area of deposition could vary in some cases by orders of magnitude. Because of the complexity involved with multiple varying assumptions, worst-case assumptions for off-site transport and human health dose at each potential storage location are employed according to the rationale described in this section.

For assessment of environmental consequences, the worst-case accident is assumed to be a seismic event and resulting fire that breaches a large number of containers and results in a plume that entrains a large portion of the uranium source material. It is further assumed that the plume moves directly via the shortest distance from the release point to a potential receptor at the facility boundary and that all of the uranium in the plume is respirable. Even though this scenario is considered to be extremely unlikely, it is still assumed that a resulting plume from a seismic event and fire would be the most likely worst-case accident to get the highest concentration of source material to the nearest off-site receptor (i.e., compared to a tornado). This is especially true given the form of the majority of the uranium (e.g., oxides or other physical forms that may be more readily dispersible than solid forms such as ingots or recyclable pieces of metal). The hypothetical seismic/fire scenario also results in the worst-case exposure pathway (inhalation), because uranium is predominately an alpha-particle emitter. This is addressed in greater detail in Appendix C.

Uranium released from primary containers under the accident scenario described above and modeled later in this section can be deposited on surface soils and be subject to movement with soil water through the vadose zone into groundwater. The material could also be deposited directly into water bodies or move from the surface soil overland into water bodies. As described below, any exposure pathway to human receptors via soil, groundwater, or surface water would be relatively unimportant compared to the inhalation pathway to the nearest off-site receptor.

Upon deposition of the uranium entrained in the plume, the fate and transport of uranium is a function of the environmental site characteristics and the physical/chemical properties of uranium. Such properties include uranium's solubility in water, the tendency of uranium to transform or degrade (e.g., ^{238}U has a half-life of 4.5 billion years), and chemical affinity for solids or organic matter (described as a partitioning coefficient K_d). An average K_d value for uranium is 15 L/kg, although the possible range of K_ds can vary widely (Sheppard and Thibault 1990). Contaminants with small K_ds will be leached more effectively into the groundwater (i.e., be more mobile) than those with larger K_ds. For example, uranium is much less mobile than ^{99}Tc, which has a K_d of 0.1 L/kg.

In addition, uranium can be transformed to other oxidation states in soil, further reducing its mobility. If organic matter, clay, and hydrous oxides are present in the receiving soils, adsorption of the uranium metal may occur onto these materials, also reducing the uranium's mobility and toxicity. The soils described in Chapter 3 are generally rich in clay and organic matter and would be effective in retarding the mobility of uranium. Further, even if resuspended and available to an off-site receptor via inhalation, uranium concentrations would be diluted compared to the concentrations available in the original plume.

Each of the potential storage locations described in Chapter 3 is located within water-rich environments (i.e., each site is near major rivers). Therefore, even though the previous paragraph supports minimal mobility of uranium in the soil, a fraction of the uranium could enter the water system upon any accidental release, especially by direct deposition from the plume. The mobility of uranium deposited onto water depends upon the type of complex (cationic or anionic) formed as a result of the physical processes acting on the uranium. Cationic species tend to adsorb to soil, and anionic species tend to move with water. Uranium released in a fire would be oxidized (be cationic) and would tend to adsorb to the soil particles entrained in the water. As with uranium deposited upon the soil, the doses to a receptor in contact with uranium in water or associated sediment would be less important than those of the receptor exposed to the initial plume.

Once in the off-site environment, the source material is assumed to intercept a human receptor. In general, uranium compounds are not easily absorbed across the gastrointestinal tract. Soluble uranium compounds demonstrate the best absorption, but this absorption is still low. Uranium is known to be a chemical toxicant, exposure to which leads to nephritis in the kidney. Uranium can also induce cancer when organs and tissues are exposed to alpha particles emitted from decaying uranium atoms. While other energetic emissions from radioactive decay of atoms, such as beta particles and gamma rays, also cause molecular ionization, these radiations do not produce the density of ionizations that alpha particles do when inside the human body. The ionization events cause biological damage, which is believed to be responsible for inducing cells to become cancerous. The types of uranium (e.g., natural, enriched, and depleted) under consideration are important because different types of uranium have different specific activities (the amount of radioactivity per unit mass). The difference between natural, low-enriched, and depleted uranium is defined by the percent ^{235}U mass enrichment. As the ^{235}U enrichment increases, the specific activity of the mixture increases. The different quantities of source material and their associated activities are considered in the quantitative assessment that follows.

The potential adverse effects of the uranium source material in environmental media, such as groundwater, surface water, soil, or sediment, are relatively unimportant when compared to a release of the source material into the air from various accident scenarios. Therefore, the quantitative assessment provided in this section will address the inhalation exposure pathway and the resulting calculated dose from both routine operations and various accident scenarios.

For risks due to transportation, the excess latent cancer fatalities (LCFs) were computed from Table B.4 by adding the LCFs from both incident-free and accident situations for both truck only and truck plus rail transport. This shows the total LCFs to the public from all transportation sources. The average individual consequences and traffic fatalities are also totals computed from Appendix B tables.

4.2 CONSEQUENCES COMMON TO ALL ALTERNATIVES

Regardless of the alternative, there are some actions common to all, and the resulting consequences are the same for all alternatives. For each alternative, including No Action, there will be routine handling and monitoring of the uranium inventory. In instances where packaging needs to be upgraded, the materials would be overpacked or otherwise repackaged to meet safety requirements. However, it is assumed that for both the centralized and consolidated storage alternatives that require some or all of the uranium materials to be shipped, a much more substantial repackaging effort would be required than for No Action. Both acute and chronic consequences and risk due to accidents that may occur during container handling activities are negligible under all alternatives.

During interim storage of uranium materials, workers could be exposed to direct radiation from surface contamination on the storage containers. However, the containers have been checked and would be overpacked if this is deemed necessary. Therefore, worker exposure due to routine operations associated with surveillance and maintenance of stored materials is expected to be less than detectable levels. Normal operations under any alternative are expected to cause negligible acute and chronic risks from airborne uranium.

In addition to surface contamination, non-contact radiation dose from the stored uranium materials can be expected. Dose rates from any single stored container are no more than 3 to 4 mrem/h. The dose rate at a distance of 0.3 m (1 ft) from a container is ~1 mrem/h, and the dose rate at a distance of 6 m (20 ft) is <0.05 mrem/h (approximately the same as normal background radiation doses) (DOE 1999). These dose rates are not affected by stacking the containers, because the containers and the materials themselves provide substantial shielding. For worker and collocated worker exposure, the shielding was assumed to cancel out the effect of adding additional containers. However, when calculating doses to the public, the more conservative assumption of no shielding was used. These dose rates are considered negligible to any receptor (facility worker, co-located worker, or public).

For all the action alternatives, small quantities of uranium materials would be shipped to and from university and other sites. The consequences of small quantity (less than 0.1 MTU) shipments are inconsequential, would not be a substantial cumulative impact when added to the 14,200 MTU under consideration, and would vary little from alternative to alternative. The impacts associated with the various disposition options are common to all alternatives.

Regarding Intentional Destructive Acts such as sabotage or terrorism, there are no known or reasonably anticipated scenarios that would result in human consequences greater than those already evaluated for fires, which are negligible. The types of uranium materials covered in this PEA are not considered to be reasonable targets for terrorists.

4.3 NO ACTION ALTERNATIVE

Under this alternative, the uranium currently stored at the various DOE sites, non-DOE sites, universities, and other commercial locations would remain at those sites. The uranium is currently in various container types, including 55-gal steel drums, T-hoppers, half-high boxes, and sea-land containers.

4.3.1 Normal Operations

Under normal operations, land use, geology and soils, water resources, cultural resources, and the infrastructure remain unchanged. Air effluents associated with uranium inventory maintenance would be minimal and would remain the same as they are now. Because there is no new construction and there are no effluents from the stored uranium, plant and animal species would not be adversely affected and cultural resources would not be impacted. Some continued maintenance of facilities would be required, and monitoring and surveillance at the current sites would continue. The socioeconomic impact analysis assumes little or no construction activity and continued uranium monitoring by current employees. Under these assumptions, there is no change in expenditure or employment and, consequently, no impact. Even if additional workers were hired for monitoring at each potential centralized or consolidated storage site, they would represent a minimal increase to the large number (several hundred thousand) of wage and salary earners present in counties that contain the larger DOE uranium storage sites. In the absence of important impacts, environmental justice concerns do not arise.

The 3,900 MTU at the 152 locations other than the six DOE locations would remain at these sites. The amount at each individual site is very small and is typically associated with university or other types of research. No substantial environmental impacts are expected from the continued use and/or storage at these locations; however, these sites do not have a long-term mission for uranium storage and expect to ship materials back to DOE when the research work is completed.

4.3.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and summarized in Table 4.1. The highest acute consequences to the public or to a co-located worker are due to a fire or earthquake at PORTS, with aerial dispersion of uranium materials, but is still negligible. This result is based on the large amount of uranium materials currently stored at PORTS (4,400 MTU or ~31% of the total of 14,200 MTU). Acute radiological and toxicological consequences are negligible at all other sites.

Human health and ecological risk are evaluated in Appendix C and summarized in Table 4.1. Accidents at all facilities are expected to cause negligible to low chronic risks to humans and ecological receptors.

4.3.3 Transportation

There are no transportation activities associated with the No Action alternative.

4.4 INTERIM CENTRALIZED STORAGE AT A SINGLE DOE SITE

This alternative involves moving all uranium materials to one of six DOE sites (INEEL, PGDP, PORTS, SRS, or Oak Ridge – Y-12 Complex and ETTP). The total amount to be moved depends on the amount currently stored at the site. Once all the materials have been moved, the total at any site is the same (14,200 MTU).

Table 4.1. Risks due to accidents for No Action alternative

Accident scenario	Site(s)	Maximum acute risk: Consequence level	Maximum acute risk: Overall risk	Chronic human health risk: Consequence level	Chronic human health risk: Overall risk	Chronic ecological risk: Consequence level	Chronic ecological risk: Overall risk
Facility fire	INEEL, PGDP, SRS, Oak Ridge, Max other[a]	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Seismic	INEEL, PGDP, SRS, Oak Ridge, Max other[a]	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Negligible	Negligible	Negligible	Negligible	Low	Low

[a]Max other represents the largest single amount at any site other than the DOE consolidated storage locations.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

4.4.1 Normal Operations

Under this alternative, the amount of uranium stored at one of the six DOE sites would increase from current levels to 14,200 MTU, as shown in Table 4.2. The total floor space required for storage would also increase to ~243,000 ft^2.

Table 4.2. Storage requirements for interim centralized storage at a single DOE site

Site	Assumed storage: Amount, 10^3 MTU	Assumed storage: Number of containers	Assumed storage: Storage requirement, ft^2	Materials to be moved: Amount, 10^3 MTU	Materials to be moved: Number of containers	Materials to be moved: Additional storage requirement, ft^2
INEEL	1.5	639	7,000	12.7	71,195	~236,000
PGDP	<0.1	8	100	14.1	71,821	~243,000
PORTS	4.4	24,765	75,000	9.8	47,069	~168,000[a]
SRS	3.0	2,876	19,000	11.2	68,967	~224,000
Oak Ridge	1.4	6,431	25,000	12.8	65,403	~218,000

[a]~450,000 ft^2 existing space available at PORTS.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Additional requirements, activities, and environmental impacts are summarized in Table 4.3.

Table 4.3. Impacts for interim centralized storage at a single DOE site

Site	Requirements: Initial workers	Requirements: Permanent workers	Requirements: Estimated upgrades	Activities: New construction	Activities: Availability of space	Environmental impacts: Air, water, etc.	Environmental impacts: Socioeconomics
INEEL	413	13	$16.5M	Yes	Unknown	Minor	Minor
PGDP	425	14	$17.0M	Yes	Unknown	Minor	Minor
PORTS	210	9	$8.4M	None	Yes	Minimal	Minimal
SRS	393	12	$15.7M	Yes	Unknown	Minor	Minor
Oak Ridge	383	12	$15.3M	Yes	Unknown	Minor	Minor

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

PORTS is the only DOE site with sufficient existing storage space to accommodate the entire uranium material inventory. PORTS has several large buildings with sufficient capacity to store these materials. These buildings were evaluated for uranium storage suitability (DOE 1999), and over 450,000 ft^2 of space is still available in them. Some minor work would be required to prepare the buildings, but no new construction would be anticipated. Under normal operations, land use, geology and soils, water resources, cultural resources, and the infrastructure at PORTS would remain unchanged. Air effluents associated with uranium inventory maintenance would be minimal and would remain the same as present. Because there is no new construction and there are no effluents from the stored uranium, plant and animal species would not be adversely affected, and cultural resources would not be impacted.

While existing storage space is available at this time, various potential changes at PORTS could eliminate some of this space. Therefore, it is assumed that up to 125,000 ft^2 of new space could be constructed. Under this assumption, the upgrades cost would increase from $8.4M to $10.9M, and the number of construction workers from 210 to 273. Environmental impacts and socioeconomic impacts would increase from minimal to minor. Even with some new construction, the PORTS site would still be the least expensive site for this alternative.

DOE has not identified existing buildings at INEEL, PGDP, SRS, or Oak Ridge (either the Y-12 Complex or ETTP) to accommodate these additional uranium materials at this time. Therefore, for analysis purposes, it is assumed that new storage space would have to be constructed. It is further assumed that such construction would occur in areas of the site that are already industrialized. This would minimize potential impacts to sensitive species but would permanently eliminate the habitat for existing biota on up to 7 acres committed to the project (for new buildings and associated landscaping). Infrastructure would be slightly affected, because utilities would have to be run to these new facilities. Construction would result in minor fugitive dust emissions and disturbance of soils. However, water resources and cultural resources are not expected to be affected.

The socioeconomic analysis assumes $8.4M in building upgrades at PORTS and from $15.3M at Oak Ridge to $17.0M at the PGDP for new construction (Table 4.3). The uranium materials maintenance and surveillance workers currently located at various existing storage locations are assumed to be replaced with a comparable number at the single DOE storage location. Thus, additional workers would be added to the site payroll.

Minor socioeconomic impacts include less than 1% increase in regional expenditures and approximately 1% increase in worker employment compared to the ROI during the first year (construction and transport) at the PGDP site; all other DOE sites have smaller increases. Permanent site employment would also increase less than 1%, and temporary construction-related employment would increase the site workforce during the first year by approximately 19% at PGDP, all other DOE sites have smaller increases. Such minor increases in expenditures and employment are not substantial.

4.4.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and summarized in Table 4.4. Both facility fires and seismic events result in high acute toxicological consequences due to the potential for large quantities of uranium to become airborne in a fire. This is because most of the airborne source term (~ 73%) results from compounds, oxides, and other miscellaneous forms that are relatively more dispersible than other physical forms considered in this study. The consequences are similar at all sites because the total amount of material to be stored at each site is the same (14,200 MTU).

Table 4.4. Risks due to accidents for interim centralized storage at a single DOE site

Accident scenario	Maximum acute risk		Chronic human health risk		Chronic ecological risk	
	Consequence level	Overall risk	Consequence level	Overall risk	Consequence level	Overall risk
Storage area fire	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Seismic	Low	Low	Low	Low	Negligible	Negligible

DOE = U.S. Department of Energy.

Human health and ecological risk are evaluated in Appendix C and summarized in Table 4.4. Accidents at all facilities are expected to cause negligible to low chronic risks to humans and ecological receptors. In Table 4.5 the LCFs to the public are a sum of all transportation sources (incident-free and accidents from both truck only and truck plus rail transport). The average individual consequences and traffic fatalities are also totals computed from Appendix B tables.

4.4.3 Transportation

The potential effects of transporting uranium materials for long-term centralized storage at a single DOE site are evaluated in Appendix B and summarized in Table 4.5.

Table 4.5. Transportation effects for interim centralized storage at a single DOE site

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities	Traffic fatalities
INEEL	0.0059	0.024	0.017
PGDP	0.0091	0.020	0.011
PORTS	0.0084	0.019	0.010
SRS	0.0109	0.029	0.012
Oak Ridge	0.0092	0.021	0.010

DOE = U.S. Department of Energy
INEEL = Idaho National Engineering and Environmental Laboratory
PGDP = Paducah Gaseous Diffusion Plant
PORTS = Portsmouth Gaseous Diffusion Plant
SRS = Savannah River Site

4.5 INTERIM CENTRALIZED STORAGE AT A SINGLE COMMERCIAL SITE

This alternative involves moving all uranium materials to a single commercial site in either the eastern or the western United States. The total amount to be moved and stored would be 14,200 MTU.

4.5.1 Normal Operations

Under this alternative, the amount of uranium stored at a commercial site is the same as the total of 14,200 MTU. The total floor space required for storage is ~243,000 ft^2; all would be new construction. These are the same total storage requirements discussed in Section 4.4.1.

DOE has not identified specific locations for commercial sites; however, for purposes of evaluation, a western or eastern site has been hypothesized as a potential alternative. Since the sites are generically identified, no existing buildings have been assumed to be available. This assumption produces a reasonable worst case in terms of impacts. Table 4.6 summarizes expected impacts from normal operations.

Table 4.6. Impacts for interim centralized storage at a single commercial site

	Requirements			Activities		Environmental impacts	
Site	Initial workers	Permanent workers	Estimated upgrades	New construction	Availability of space	Air, water, etc.	Socioeconomics
Western or eastern	425	14	$17.0M	Yes	Unknown	Minor	Minor

At either site, the number of initial workers for the first-year construction, the number of permanent workers, and the costs of construction would equal or exceed those for the DOE sites considered for centralized storage. Approximately 7 acres of land would be required for the storage facilities, and the biota occupying this land would be permanently displaced and their habitat lost. It is assumed that previously developed land with no known cultural resources would be used. Assuming best management practices are followed during construction (such as use of silt fences, reseeding disturbed areas, etc.), impacts to any surface waters would be minor and short-term. Socioeconomic impacts would be minor and include less than 1% increase in regional expenditures and less than 1% increase in worker employment in the region during the first-year construction phase.

4.5.2 Facility Accidents

Acute consequences associated with storage area fires and seismic events are evaluated in Appendix A. Human health and ecological risk are evaluated in Appendix C. Both acute and chronic consequences and risk are the same as for centralized storage at a DOE site (see Table 4.4) because the total amount of material to be stored at each site is the same (14,200 MTU).

4.5.3 Transportation

The potential effects of transporting uranium materials for long-term centralized storage at a single commercial site are evaluated in Appendix B and summarized in Table 4.7.

Table 4.7. Transportation effects for interim centralized storage at a commercial site

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities (total)	Traffic fatalities (total)
Western	0.0041	0.013	0.012
Eastern	0.0047	0.022	0.017

4.6 INTERIM PARTIALLY CONSOLIDATED STORAGE AT SEVERAL DOE SITES

This alternative involves moving uranium materials from their current storage location to the closest of six DOE sites (INEEL, PGDP, PORTS, SRS, Y-12 Complex, and ETTP). The total amount to be moved depends on the amount now stored at the sites. In addition, the total amounts to be stored at any given location vary depending on the number of other sites and amounts of material that are considered closest to the consolidation location. Unlike the two centralized alternatives in which the impacts at each site are independent (i.e., inputs would occur at one site), the consolidated storage alternative results in impacts at all six DOE sites.

4.6.1 Normal Operations

Under this alternative, the existing uranium materials inventory at any one of the six DOE consolidation sites would remain at its respective location, and the 3,900 MTU currently at the 152 other locations would be transported and stored at the six DOE consolidated storage sites. The materials at each of the 152 sites would be stored at the geographically closest DOE consolidation site. The amount of uranium stored at each of the six DOE sites would increase from current levels to the levels shown in Table 4.8. The total floor space required for storage would also increase.

Table 4.8. Storage requirements for interim partially consolidated storage at several DOE sites

	Assumed storage			Materials to be moved		
Site	Amount, 10^3 MTU	Number of containers	Storage requirement, ft^2	Amount, 10^3 MTU	Number of containers	Additional storage requirement, ft^2
INEEL	1.5	639	7,000	1.7	21,391	71,000
PGDP	<0.1	8	100	0.4	400	2,000
PORTS	4.4	24,765	75,000	1.4	13,458	40,000
SRS	3.0	2,867	19,000	<0.1	63	<100
Oak Ridge	1.4	6,431	25,000	0.4	1,812	2,500

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Because of the small amount of additional uranium material to be received at each consolidated storage site, the impacts are similar to the No Action alternative (see Section 4.3.1). Since INEEL would receive the most additional materials (1,700 MTU), this site serves as the worst case for normal operations impacts as shown in Table 4.9.

Table 4.9. Impacts for interim partially consolidated storage at several DOE sites

	Requirements			Activities		Environmental impacts	
Site	Initial workers	Permanent workers	Estimated upgrades	New construction	Availability of space	Air, water, etc.	Socioeconomics
INEEL	125	4	\$5.0M	Yes	Unknown	Minor	Minimal
PGDP	4	<1	\$140K	Yes	Unknown	Minor	Minimal
PORTS	50	3	\$2.0M	No	Yes	Negligible	Minimal
SRS	0	0	0	Yes	Unknown	Minimal	Minimal
Oak Ridge	4	<1	\$175K	Yes	Unknown	Minimal	Minimal

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
K = thousand dollars.
M = million dollars.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

INEEL would have the largest construction cost, most workers, and 2 acres of land permanently committed to new storage space. Environmental impacts are minor. Impacts for the other consolidation sites would be minor or minimal. The impacts at PORTS would be negligible, because there would be no new construction at this site.

For this alternative the cumulative construction/upgrades cost of ~\$7.3M for all the sites should be considered as the total construction-related cost even though the bulk (\$5.0M) would be at INEEL. Socioeconomic impacts would be minimal at all sites.

4.6.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and summarized in Table 4.10. Both storage area fires and seismic events at PORTS can result in greater than negligible toxicological consequences due to the potential for large quantities of uranium to become airborne in a fire. This result is based on the large amount of oxides currently stored at PORTS and the relatively dispersible nature of these materials compared to the other physical forms considered in this study. Acute radiological and toxicological consequences are negligible at all other sites.

Human health and ecological risk are evaluated in Appendix C and summarized in Table 4.10. Accidents at all facilities are expected to cause negligible to low chronic risks to humans and ecological receptors. Accident risk is expected to occur at all six DOE sites.

Table 4.10. Risks due to accidents for interim partially consolidated storage at several DOE sites

Accident scenario	Site(s)	Maximum acute risk		Chronic human health risk		Chronic ecological risk	
		Consequence level	Overall risk	Consequence level	Overall risk	Consequence level	Overall risk
Facility fire	INEEL, PGDP, SRS, Oak Ridge	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Low	Low	Negligible	Negligible	Negligible	Negligible
Seismic	INEEL, PGDP, Oak Ridge	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Low	Low	Negligible	Negligible	Low	Low

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

4.6.3 Transportation

The potential effects of transporting uranium materials for consolidated storage at several DOE sites are evaluated in Appendix B and summarized in Table 4.11.

Table 4.11. Transportation effects for interim partially consolidated storage at several DOE sites

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities (total)	Traffic fatalities (total)
All	0.0016	0.003	0.005

DOE = U.S. Department of Energy.

These effects represent total effects for transporting materials to all six potential DOE storage locations. The effects are less than those for the centralized storage alternatives because materials are transported to the closest site, thus minimizing transport miles.

4.7 INTERIM PARTIALLY CONSOLIDATED STORAGE AT TWO DOE SITES

This alternative involves moving uranium materials from their current storage location to the closest of two DOE sites (INEEL or PORTS). The total amount to be moved depends on the amount now stored at the sites. In addition, the total amounts to be stored at any given location vary depending on the number of other sites and amounts of materials that are considered closest to the consolidation location.

4.7.1 Normal Operations

Under this alternative, the uranium materials stored at the two DOE sites would increase from current levels to the levels shown in Table 4.12. The total floor space required for storage would also increase at both sites.

Table 4.12. Storage requirements for interim partially consolidated storage at two DOE sites

Site	Assumed storage			Materials to be moved		
	Amount, 10^3 MTU	Number of containers	Storage requirement, ft^2	Amount, 10^3 MTU	Number of containers	Additional storage requirement, ft^2
INEEL	1.5	639	7,000	1.7	21,490	72,000
PORTS	4.4	24,765	75,000	6.6	24,940	89,000

DOE = U.S. Department of Energy
INEEL = Idaho National Engineering and Environmental Laboratory
MTU = metric tons of uranium
PORTS = Portsmouth Gaseous Diffusion Plant

Additional requirements, activities, and environmental impacts are summarized in Table 4.13.

For this alternative, the cumulative construction/upgrades cost of $9.5M should be considered as the construction-related cost. At INEEL, because the amount of additional material to be stored is the same as that discussed in Section 4.6.1, the environmental impacts from normal operations would also be the same. For the PORTS site, even though there would be up to 111 workers during the first year for building upgrades, upgrade activities do not require additional land and habitat, nor do they result in large emissions to air and water. Thus, environmental impacts at PORTS would tend to be negligible. Because the regional economy and workforce at PORTS are smaller than for INEEL, socioeconomic effects are slightly larger but are still minor with approximately 2.4% increase in regional expenditures and 5% increase in construction-related employment.

Table 4.13. Impacts for interim partially consolidated storage at two DOE sites

Site	Requirements			Activities		Environmental impacts	
	Initial workers	Permanent workers	Estimated upgrades	New construction	Availability of space	Air, water, etc.	Socioeconomics
INEEL	125	4	$5.0M	Yes	Unknown	Minor	Minimal
PORTS	111	5	$4.5M	No	Yes	Negligible	Minor

DOE = U.S. Department of Energy
INEEL = Idaho National Engineering and Environmental Laboratory
PORTS = Portsmouth Gaseous Diffusion Plant

4.7.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and summarized in Table 4.14. The seismic event at PORTS can result in low toxicological consequences due to the potential for large quantities of uranium to become airborne in a fire. This is because most of the airborne source term (~ 90%) results from compounds and oxides that are relatively more dispersible than other physical forms considered in this study. Radiological and toxicological consequences are negligible at INEEL.

Table 4.14. Risks due to accidents for interim partially consolidated storage at two DOE sites

Accident scenario	Site(s)	Maximum acute risk		Chronic human health risk		Chronic ecological risk	
		Consequence level	Overall risk	Consequence level	Overall risk	Consequence level	Overall risk
Facility fire	INEEL	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Seismic	INEEL	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	PORTS	Low	Low	Negligible	Negligible	Negligible	Negligible

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PORTS = Portsmouth Gaseous Diffusion Plant.

Human health and ecological risk are evaluated in Appendix C and summarized in Table 4.14. Accidents at both facilities are expected to cause negligible to low chronic risks to humans and ecological receptors.

4.7.3 Transportation

The potential effects of transporting uranium materials for consolidated storage at two DOE sites are evaluated in Appendix B and summarized in Table 4.15.

Table 4.15. Transportation effects for interim partially consolidated storage at two DOE sites

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities (total)	Traffic fatalities (total)
All	0.0020	0.007	0.006

DOE = U.S. Department of Energy.

These effects represent total effects for transporting materials to two potential DOE storage locations. The effects are less than those for the centralized storage alternatives because materials are transported to the closest site, thus minimizing transport miles.

4.8 INTERIM PARTIALLY CONSOLIDATED STORAGE AT TWO COMMERCIAL SITES

This alternative involves moving uranium materials from their current storage locations to one of two commercial sites (one in the western one in the eastern United States). The total amount to be moved is 14,200 MTU, because these sites do not currently have any material stored. The total amounts to be stored at either location vary, depending on the number of sites and amounts of materials that are considered closest to the consolidation location.

4.8.1 Normal Operations

Under this alternative, the 14,200 MTU would be consolidated at two commercial sites, and the total floor space required would be at the levels shown in Table 4.12. It is assumed that all storage space would have to be built. Additional requirements, activities, and environmental impacts are summarized in Table 4.16. The total construction cost is $17M for this alternative, and 7 acres of land would be disturbed.

Table 4.16. Impacts for interim partially consolidated storage at two commercial sites

	Requirements			Activities		Environmental impacts	
Site	Initial workers	Permanent workers	Estimated upgrades	New construction	Availability of space	Air, water, etc.	Socioeconomics
Western	138	5	$5.5M	Yes	Unknown	Minor	Minor
Eastern	288	9	$11.5M	Yes	Unknown	Minor	Minor

4.8.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and are the same as those for storage at PORTS and INEEL. Both storage area fires and seismic events at the eastern site can result in high toxicological consequences due to the potential for large quantities of uranium to become airborne in a fire. Radiological and toxicological consequences are negligible at the western site.

Human health and ecological risk are evaluated in Appendix C and are the same as those for storage at PORTS and INEEL (see Table 4.14). Accidents at both facilities are expected to cause negligible to low chronic risks to humans and ecological receptors.

4.8.3 Transportation

The potential effects of transporting uranium materials for consolidated storage at two commercial sites are evaluated in Appendix B and summarized in Table 4.17.

Table 4.17. Transportation effects for interim partially consolidated storage at two commercial sites

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities (total)	Traffic fatalities (total)
All	0.061	0.016	0.081

These effects represent total effects for transporting materials to two potential commercial storage locations. The effects are greater than those for the consolidated storage alternative at two DOE sites, because some materials are already stored at the DOE sites, thus increasing transport miles for this alternative.

4.9 INTERIM PARTIALLY CONSOLIDATED STORAGE BASED ON PHYSICAL FORM

This alternative involves moving uranium materials from their current storage locations to a DOE site based on the physical form of the materials (i.e., the site with the largest quantity of a specific physical form is the preferred storage location for all materials of that form). The total amount to be moved depends on the amount of that physical form currently stored at the site. The storage plan for these materials is shown below:

Physical form	Preferred storage location
Compound	PORTS
Metal	SRS
Miscellaneous	PORTS
Oxide	PORTS
Reactfuel	INEEL
Residue	INEEL
Source	INEEL

4.9.1 Normal Operations

Under this alternative, ~8,200 MTU would be relocated to three DOE sites as shown in Table 4.18. This includes amounts that are moved from one of the three sites because that site is not the preferred site for that physical form. The net increase in total floor space required for storage is also shown in Table 4.18.

Table 4.18. Storage requirements for interim partially consolidated storage based on physical form

	Assumed storage[a]			Materials to be moved		
Site	Amount, 10^3 MTU	Number of containers	Storage requirement, ft^2	Amount, 10^3 MTU	Number of containers	Additional storage requirement, ft^2
PORTS	4.4	24,765	75,000	1.7	13,839	~25,000
SRS	3.0	2,867	19,000	6.0	32,918	~117,000
INEEL	1.5	639	7,000	0.4	1,188	~0

[a]Includes some materials that are moved to other sites so that like physical forms can be consolidated.
INEEL = Idaho National Engineering and Environmental Laboratory.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Additional requirements, activities, and environmental impacts are summarized in Table 4.19. The total amount is $9.5M.

Approximately 3.4 acres of land would be committed to new storage space at SRS, with accompanying loss of habitat for wildlife. At PORTS, existing storage space would be used and, absent new construction, environmental impacts would be minimal. At INEEL, there are no additional storage requirements, workers or construction costs. At SRS, only minor air and water emissions would be expected, and at both PORTS and SRS, socioeconomic impacts would be minimal in relation to the regional economy and labor base.

Table 4.19. Impacts for interim partially consolidated storage based on physical form

	Requirements			Activities		Environmental impacts	
Site	Initial workers	Permanent workers	Estimated upgrades	New construction	Availability of space	Air, water, etc.	Socioeconomics
PORTS	31	2	$1.3M	No	Yes	Minimal	Minimal
SRS	205	7	$8.2M	Yes	Unknown	Minor	Minimal
INEEL	0	0	$0K	No	NA	Negligible	Negligible

INEEL = Idaho National Engineering and Environmental Laboratory.
K = thousand dollars.
M = million dollars.
NA = not applicable.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

4.9.2 Facility Accidents

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A and summarized in Table 4.20. The seismic event at PORTS can result in low toxicological consequences due to the potential for large quantities of uranium to become airborne in a fire. This is because most of the airborne source term (~ 90%) results from compounds and oxides that are relatively more dispersible than other physical forms considered in this study. Radiological and toxicological consequences are negligible at INEEL and SRS.

Human health and ecological risk are evaluated in Appendix C and summarized in Table 4.20. Accidents at all facilities are expected to cause negligible to low chronic risks to humans and ecological receptors.

Table 4.20. Risks due to accidents for interim partially consolidated storage based on physical form

		Maximum acute risk		Chronic human health risk		Chronic ecological risk	
Accident scenario	Site(s)	Consequence level	Overall risk	Consequence level	Overall risk	Consequence level	Overall risk
Facility fire	PORTS	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	INEEL, SRS	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Seismic	PORTS	Low	Low	Negligible	Negligible	Low	Low
	INEEL, SRS	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

INEEL = Idaho National Engineering and Environmental Laboratory
PORTS = Portsmouth Gaseous Diffusion Plant
SRS = Savannah River Site

4.9.3 Transportation

The potential effects of transporting uranium materials for consolidated storage at two commercial sites are evaluated in Appendix B and summarized in Table 4.21.

Table 4.21. Transportation effects for interim partially consolidated storage based on physical form

Destination location	Average individual consequences, mrem	Excess latent cancer fatalities (total)	Traffic fatalities (total)
All	0.0022	0.003	0.005

4.10 DISPOSITION

Each of the alternatives analyzed for some type of interim storage will also potentially have impacts related to final disposition. In Section 4.10, impacts due to the various disposition options are determined. These impacts due to disposition must be added to the impacts of each action alternative considered. The impacts of disposition are presented here as bounding conditions since many details of disposition can only be assumed at this time. As discussed in Section 2.3.8, disposition could involve commercial processing and domestic sales, use in research, use by other government agencies, and foreign sales.

Depending on the disposition option(s) employed and the specific processes involved (such as downblending for example), there would be some wastes generated. In addition, the product containers, once emptied for any option, would have to be reused as is, disposed as waste, or cleaned for reuse (generating waste in the cleaning process). These wastes would be disposed in compliance with the applicable regulations governing such waste materials. Disposition would likely take place over an extended period of time and could involve several disposition options. Thus, impacts associated with waste streams are expected to be minor since they would be intermittent and part of the expected normal operations at the disposition sites.

An estimate of the uranium inventory that would be included in each disposition option is provided. It is probable that a combination of commercial processing and domestic sales, transfer to research facilities and other government agencies, and foreign sales could occur. Since all the inventory would eventually be disposed, a rough bounding of environmental impacts would be to double the environmental impacts for the alternative(s) that have the greatest impacts already identified for them. That is, one would assume a doubling of the impacts identified for the interim storage at a single site (DOE or commercial) alternative (Sects. 4.3 and 4.4) when the impacts of disposition are added. However, there are several factors, which would realistically tend to lessen these impacts, and they are discussed below.

4.10.1 Commercial Processing and Domestic Sales

The total quantity of 14,200 MTU may be reprocessed commercially. It is likely that any commercial entities that acquired the uranium inventory would already have processing facilities and would likely take possession of the uranium inventory in such a way as to minimize or eliminate the need for building new storage facilities at the processing locations. Thus no new construction is probable. However, should construction be needed, any construction-related impacts should already be approximated by the storage at a single commercial site alternative (Section 4.5.1). That is, a temporary work force of ~300 construction workers, approximately a dozen permanent staff, and >$12M in construction costs are assumed. Processing operations costs could run several million dollars per year depending on the process and the amount of inventory reprocessed. Reprocessing activities would be likely to have relatively minor environmental and socioeconomic impacts. The potential for airborne releases during reprocessing exists but should be controlled to acceptable limits by the operating permits of the facilities.

Both acute and chronic consequences and risk associated with this option are the same as that for centralized storage at a single commercial site (see Section 4.5.2) because the total amount of material to be processed is the same (14,200 MTU).

The potential effects of transporting uranium materials to a commercial reprocessing facility are also the same as transporting the materials to a single centralized storage location (see Section 4.5.3).

4.10.2 Transfer to Research Facility

Under this option, ~50 MTU would be transferred to a single research facility assumed to be the greatest distance from an interim storage location. It is possible that there would be no new construction or building upgrades required since any research facility needing these materials would already have the personnel and facilities to handle it. However, should some new construction or upgrades be required, the storage/research space would be a few thousand square feet at most and costs, environmental impacts, and socioeconomic impacts would likely be minimal.

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A. Because the total material transferred to any given site is substantially less than the amounts transferred to any of the six potential DOE storage locations evaluated for the partially consolidated storage alternative, the acute and chronic consequences and risk for human and ecological receptors are negligible or low (see Table 4.10). Transportation effects are also less than those estimated for the partially consolidated storage alternative (see Table 4.11).

4.10.3 Transfer to Other Government Agency

Under this option, ~2,500 MTU could be provided to other government agencies. The total 2,500 MTU would be transferred to a single, unspecified location assumed to be the greatest distance from one of the interim storage locations. The specific environmental impacts experienced would be related to how much of the inventory goes to any specific agency location; however, impacts can be assumed to approximate those for the interim partially consolidated storage at several DOE sites alternatives discussion (Section 4.6). That is, assuming, as a reasonable worst case, that new construction for temporary storage is required at the receiving agency, then up to 90 construction workers, $3.6M in building costs, and minor environmental impacts would occur.

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A. The total material (~2,500 MTU) is similar to amounts transferred to some of the six potential DOE storage locations evaluated for the partially consolidated storage alternative. Acute and chronic consequences and risk to human and ecological receptors are either negligible or low (see Table 4.10). Transportation effects are also less than those estimated for the partially consolidated storage alternative (see Table 4.11).

4.10.4 Foreign Sales

Under this option, ~4,050 MTU of LEU/NU could be sold to the commercial nuclear fuel market. The total 4,050 MTU would be transferred from their interim storage locations to the closest international port and shipped via cargo vessel to the farthest port in Asia or the Far East.

Impacts due to normal operations would be negligible and associated with repackaging and transport from DOE sites to U.S. ports and from there to foreign ports-of-entry.

Acute consequences associated with facility fires and seismic events are evaluated in Appendix A. The total material (~4,050 MTU) is similar to amounts transferred to PORTS as evaluated for the partially consolidated storage alternative. Acute and chronic consequences and risk are either negligible or low (see

Table 4.10). Transportation effects are also less than those estimated for the partially consolidated storage alternative (see Table 4.11).

For overseas shipment, there is no consequence to any member of the public (i.e., only the ship's crew is exposed). The average consequence to a member of a ship's crew is estimated to be approximately 1.8 mrem per person per day for each shipment of material. A dock worker loading containers could potentially receive an external dose of ~2 mrem.

There are no anticipated adverse consequences to the marine environment from overseas shipment. However, in the very unlikely event of a ship sinking or cargo loss due to some unforeseen accident, uranium product could be deposited in the sea. Impacts would vary by location and form of uranium lost. The National Marine Fisheries Service has listed federally protected species, which could conceivably be affected (see NMFS letter to DOE, dated June 28, 2002, in Chapter 7).

4.11 SUMMARY AND CONCLUSIONS

Normal operations result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Environmental impacts associated with normal operations vary from alternative to alternative and, occasionally, by site within a given alternative. General handling accidents result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Chronic human health and ecological consequences and risk are negligible to low for all sites under all alternatives. The highest transportation consequences and risk are for alternatives that involve moving uranium materials to a western location, either to a commercial site or to INEEL.

4.11.1 Comparison of Alternatives

When comparing the environmental impacts of the various alternatives, the following emerge as general trends:

- There were none-to-minor impacts for all of the alternatives considered and negligible-to-low impacts from the standpoint of facility accidents (fire and seismic) for all the alternatives, while transportation effects for the alternatives generally reflected the extent of material transport associated with the alternative being analyzed.

- The greater the centralization or consolidation of the uranium inventory, the greater the potential for normal operations impacts. Greater centralization or consolidation means that new storage space has to be built, which means accompanying costs and commitment of land, and uranium materials will have to be shipped greater distances with increased risk of accidents.

- The action alternative with the fewest environmental impacts and that is the least expensive ($7.3M) is "Interim Partially Consolidated Storage at Several DOE Sites." This alternative takes advantage of the current storage of the majority of these DOE sites already. Thus, construction costs and associated environmental impacts would be less than other action alternatives.

- Similarly, the PORTS site would have the fewest environmental impacts and would be the least expensive ($8.4M) of the DOE facilities considered for interim centralized storage. PGDP and commercial sites would be the most expensive centralized storage.

- Excess LCFs due to transportation and traffic fatalities are minimal for all alternatives but greatest for the interim storage at the single site alternatives. The increase in excess LCFs to the public from radiological exposures during transportation is less than one for all alternatives.

- Western sites would tend to have slightly higher traffic fatalities associated with them than eastern ones due to the larger volumes of uranium materials to be shipped over greater distances.

- Commercial sites would have slightly greater impacts than DOE sites (except for PGDP) when comparing similar alternatives (interim centralized storage at a single DOE site versus a single commercial site and interim partially consolidated storage at two DOE sites versus two commercial sites).

Interim Centralized Storage at a Single Commercial Site Alternative. Considering the combination of normal operations, facility accidents and transportation, the "Interim Centralized Storage at a Single Commercial Site" alternative and the PGDP site for "Interim Consolidated Storage at a Single DOE Site" alternative have the greatest potential for environmental impacts. For normal operations, the western and eastern commercial sites and PGDP have equal impact potential. Any of these sites would have 305 first-year construction workers, 14 new permanent workers, $12.2M in new construction costs, and 7 acres of land commitment and habitat disturbance. Facility accidents would result in negligible to low acute and chronic risks.

Interim Centralized Storage at a Single DOE Site. Impacts are very similar to the single commercial site alternative discussed above; however, there are some differences in impacts among the DOE sites. Because PORTS has sufficient existing storage space, normal operations impacts, including socioeconomics, would be minimal at this site. Upgrading existing buildings at PORTS would not result in commitments of land or destruction of wildlife habitat that would be necessary at all other DOE sites.

Due to the very small amount of uranium storage space at PGDP, the impacts of normal operations would be almost identical to interim centralized storage at a single commercial site as noted above.

Interim Partially Consolidated Storage at Two Commercial Sites. Because none of the 14,200 MTU uranium inventory is now at these commercial sites, the normal operations impacts associated with this alternative are very similar to those for the "Interim Centralized Storage at a Single Commercial Site" alternative, except that environmental impacts would be shared by the two sites.

Interim Partially Consolidated Storage at Two DOE Sites. Environmental impacts from normal operations would tend to be less than from consolidation at two commercial sites, because some of the uranium inventory is already at INEEL and PORTS. Thus, less construction-related impacts would result. Human health and ecological risks from facility accidents would be the same as for consolidation at two commercial sites.

Interim Partially Consolidated Storage at Several DOE Sites. Because most of the uranium inventory would remain at the six prime DOE locations and only the 3900 MTU at 152 other sites would be relocated, the normal operations impacts would be substantially less than all the other action alternatives. Additional space requirements, and the impacts associated with construction of this space, would be sharply reduced when compared to the other action alternatives. This alternative most closely resembles the No Action alternative.

No Action. Because there is no new construction at any site, this alternative has the least normal operations impacts of any alternative and no transportation impacts. Facility accidents would result in low to negligible acute and chronic risks.

4.12 CUMULATIVE IMPACTS

Cumulative impacts are impacts associated with the proposed action when combined with other past, present, or reasonably foreseeable future impacts. There are no substantial impacts associated with the proposed action under normal operations. When the negligible-to-minor environmental and socioeconomic impacts associated with normal operations (construction of new storage facilities, facilities upgrades, and daily maintenance and surveillance) and any of the action alternatives are added to the baseline environment, cumulative impacts are minor.

For facility accidents, the potential for negligible to low acute consequences and risk, due to either storage area fires or seismic events, exists for the "Interim Centralized Storage at a Single DOE Site" alternative and "Interim Centralized Storage at a Single Commercial Site." Under a major seismic event scenario sufficient to mobilize uranium oxide into the environment, it is reasonable to assume that other material releases and other risks would be posed to workers at the site. Therefore, risks from uranium oxides would be one of several environmental and health risks that workers at the sites would face. For other accidents and other forms of uranium materials, the acute and chronic human health risk and ecological risk are negligible or low.

Due to a small increase in vehicular traffic to transport uranium materials, there would be a slight increase in traffic accidents and fatalities on the nation's highways. These cumulative impacts would be very minor in comparison to the baseline. Likewise, exposures of the public and workers during uranium transport would increase very slightly the risks of LCFs.

At some time in the future, the uranium inventory would be eventually dispositioned. Various disposition options including commercial processing and domestic sales of the entire inventory, disposition of limited quantities (50 MTU) at research facilities, disposition of 2,500 MTU to other government agencies, and foreign sales of 4,050 MTU may occur. Impacts associated with these options are considered as a part of each of the interim storage alternatives. In addition, potential cumulative impacts (such as temporary storage costs, new construction, and additional labor) could occur should an existing inventory of uranium materials be increased at any of these disposition option locations.

4.12.1 SRS

There is a large inventory (~19,000 MTU) of uranium, mostly oxides, at the SRS, which is not part of the UMG inventory. For an accident risk perspective, cumulative impacts could be important at SRS (due principally to this existing, non-UMG uranium oxide inventory). Centralized storage would add 11,300 MTU to the 2400 MTU already included in the UMG inventory.

In addition, up to 7 acres of site habitat at SRS would be devoted to new construction, removing these acres from current use. This acreage, when considered from a total site perspective, would be a minimal cumulative impact since portions of SRS are undergoing remediation or being dedicated to greater environmental uses.

4.12.2 PGDP

The PGDP site would need the largest amount of new construction including 7 acres of permanent habitat disruption. This disruption would occur at a site undergoing ground-disturbing remediation efforts, which also affect wildlife habitat, albeit of low quality in most cases. Because of the small workforce at PGDP, direct construction-related increases in employment would be greatest at this site. Due to declining DOE employment at the site, however, the overall cumulative impact would likely be temporary but beneficial for the regional economy.

4.12.3 PORTS

The PORTS site has an existing inventory of uranium materials. Should the approximately 9800 MTU of additional inventory evaluated in this EA be added to the existing inventory, then the potential for cumulative impacts due to accidental releases would increase. Since PORTS currently has sufficient existing storage space for the 14,200 MTU, the site has the lowest potential for cumulative impacts due to construction/renovation. However, as noted, DOE is committed to using the existing UMG storage facility and upgrades to other buildings for uranium storage associated with the UMG program would not occur.

4.12.4 INEEL

Like the PGDP site, INEEL would require substantial new construction with associated permanent habitat disruption. This 7-acre commitment would occur at a highly developed site undergoing other ground disturbances associated with remediation. This site also has uranium inventory that is not part of the proposed action so cumulative impacts from accidental releases are possible.

4.12.5 Oak Ridge

The two sites at Oak Ridge would also require a commitment of land for new construction. Even though there are also other uranium inventories in Oak Ridge, the physical separation of the two sites lessens the potential for cumulative impacts due to accidental releases.

5. REFERENCES

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6. LIST OF PREPARERS

Name	Degree/Discipline	Professional Experience	Responsibility
Wayne Tolbert	Ph.D., Ecology	25 years experience in environmental compliance; 20 years in NEPA compliance	Project Manager; primary customer point of contact; overall responsibility for EA; affected environment and normal operations impacts
Carol Mason	M.S., Chemical Engineering	22 years experience in engineering, radiation safety, and safety analysis	Accident analysis development and calculations
Dave King	M.S., Radiation Protection Engineering	8 years experience in health physics and radiation protection; Certified Health Physicist	Human health risks
Chuck Hadden	Ph.D., Microbiology	29 years experience in environmental risk assessment, microbiology, and microbial genetics; 10 years experience in NEPA ecorisk assessment	Ecorisks
Ruth Weiner	Ph.D., Physical Chemistry	40 years experience in chemistry and environmental studies and research	Ran transportation computer models
Aparajita Morrison	B.S., Health Physics	16 years experience in health physics and 8 in NEPA analysis	Transportation accident risks; health physics
Stephen Mitz	M.S., Aquatic Toxicology	19 years experience in aquatic toxicology, chemistry, and NEPA aquatic impact assessment	Aquatic ecology and ecorisks
Diane McDaniel	B.S., Wildlife and Fisheries Science	10 years experience in wildlife biology; 8 years in NEPA compliance	Affected environment SRS and INEEL
Carolyne Thomas	M.S., Civil and Environmental Engineering	9 years experience in engineering, 5 years in Project Management	DOE Project Manager and technical reviewer

DOE = U.S. Department of Energy.
EA = Environmental Assessment.
INEEL = Idaho National Engineering and Environmental Laboratory.
NEPA = National Environmental Policy Act.
SRS = Savannah River Site.

7. LIST OF AGENCIES/INDIVIDUALS CONSULTED

This chapter contains copies of correspondence with the State Historic Preservation Officers (SHPOs) in Tennessee, Kentucky, South Carolina, Ohio, and Idaho and with the FWS, the National Marine Fisheries Service, and state conservation departments.

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 8, 2002

Those on the Attached List:

The purpose of this letter is to inform you that the U.S. Department of Energy Oak Ridge Operations (DOE ORO) is evaluating alternatives for implementation of a comprehensive management program to safely, efficiently, and effectively store, transport, and dispose of potentially reusable low-enriched uranium (LEU), natural uranium (NU), and depleted uranium (DU). The need to perform this action is based on the continuing need for good stewardship of resources, including materials in inventory, and continuing DOE attention to considerations of environment, safety, and health. Also, the increased pressure on the Federal budget requires that DOE take a closer look at materials management in order to ensure maximum cost effectiveness. We have determined, in accordance with §800.3 of the Advisory Council on Historic Preservation's (Council) revised regulations for the protection of historic properties, that DOE's proposed action for management of potentially reusable uranium materials is: (1) an undertaking, as defined in 36 CFR §800.16(y); and (2) is a type of activity that has the potential to cause effects on historic properties.

In an effort to implement an effective integration tool for the management of nuclear materials, DOE wishes to consolidate various amounts and types of uranium materials. Therefore, this proposed action advocates the packaging and transport of potentially reusable uranium materials from DOE sites and university loans/lease returns and to receive and store them at a site under the cognizance of the Uranium Management Group (UMG). This action will also cover material shipment from the UMG and disposition.

DOE's inventories of surplus LEU, NU, and DU reside at over a hundred different sites, but only a few sites that have inventories also have a continuing mission involving uranium material. Six of the sites will be considered as alternative long-term storage sites: the Y-12 Plant and the East Tennessee Technology Park, both in Oak Ridge, Tennessee; the Portsmouth Site in Ohio; the Paducah Site in Kentucky; the Savannah River Site in South Carolina; and the Idaho National Engineering and Environmental Laboratory in Idaho. The preferred alternative is centralized storage at the Portsmouth Site for surplus material that is economically feasible for relocation. The Portsmouth Site is preferred because of its combination of unique characteristics, including the existence of a uranium management infrastructure and successful on-going receipt and storage of surplus uranium materials from DOE's Fernald and Hanford Sites and from universities.

In accordance with §800.8(c) of the Council's regulations, we are notifying you, and the Council by copy of this letter, that we intend to use the process and documentation required to comply with the National Environmental Policy Act (NEPA) to comply with Section 106 of the National

5/15/02

Historic Preservation Act (NHPA) for this undertaking. In using the NEPA process in lieu of the procedures set forth in §800.3 through §800.6 of the Council's regulations (i.e., the Section 106 process), we will ensure the standards set forth in §800.8(c)(1) through §800.8(c)(5) are met.

Thank you for your attention to our notification of initiation of consultation and to use the NEPA process for Section 106 purposes. If you have any questions or need additional information on this matter, please contact me at (865) 576-0273 or by email at hartmangs@oro.doe.gov.

Sincerely,

Gary S. Hartman

Gary S. Hartman
DOE ORO Cultural Resources
Management Coordinator

cc:
Skip Gosling, MA-7, HQ/FORS
Lois Thompson, EH-232, HQ/FORS
Tom McCulloch, Advisory Council on Historic Preservation
Susan Gawarecki, Oak Ridge Local Oversight Committee
Amy Fitzgerald, City of Oak Ridge
Lloyd Stokes, Oak Ridge Heritage and Preservation Association
Annabelle Rodriguez, DOE Hanford Site
Bob Starck, DOE Idaho Operations Office
Drew Grainger, DOE Savannah River Operations Office
David R. Allen, SE-30-1, ORO
Bill Brumley, NNSA, YAO
Susan Morris, NNSA, YAO
Gerald Boyd, EM-90, ORO
Donna Perez, EM-911, ETTP Site Office
Bob Poe, SE-30, ORO
S. J. Robinson, EM-97, Portsmouth Site Office
W. D. Seaborg, EM-98, Paducah Site Office
Nancy Carnes, CC-10, ORO
Carolyne Thomas, NU-51, ORO
W. Mark Belvin, ORNL Site Office
Richard Frounfelker, EM-911, ETTP Site Office
David Tidwell, EM-98, Paducah Site Office
Kristi Wiehle, EM-97, Portsmouth Site Office
James Hall, Bldg. 6026, MS 6395, ORNL
Sheila Thornton, CDM Federal Services, Building K-1550-U, MS-7234, ETTP
Jennifer Webb, BWXT Y-12, Bldg. 9115, MS 8219
Mick Wiest, BWXT Y-12, Bldg. 9116, MS 8098
EC Document Center, Y-12, Building 9734, MS-8130

DOCS No. 60877

Dr. Joseph Garrison
Tennessee Historical Commission
Department of Environment and Conservation
2941 Lebanon Road
Nashville, Tennessee 37243-0442

David L. Morgan
Kentucky Heritage Council and State
Historic Preservation Officer
300 Washington Street
Frankfort, Kentucky 40601

David Snyder
Ohio Historic Preservation Office
567 East Hudson Street
Columbus, Ohio 43211-1030

Dr. Kenneth C. Reid, State Archaeologist and SHPO
Idaho State Historical Society
State Historic Preservation Office
210 Main Street, Suite 250
Boise, Idaho 83702-7264

Dr. Rodger E. Stroup, SHPO
Department of Archives & History
8301 Parklane Road
Columbia, South Carolina 29223-4905

Dr. Allyson Brooks, SHPO
Office of Archaeology & Historic Preservation
P.O. Box 48343
Olympia, Washington 98504-8343

James Bird, THPO
Eastern Band of Cherokee Indians
Quallah Boundary
P.O. Box 455
Cherokee, North Carolina 28719

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 20, 2002

Dr. Lee Barclay
U.S. Fish and Wildlife Service
446 Neal Street
Cookeville, TN 37501

Dear Dr. Barclay;

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE MANAGEMENT OF POTENTIALLY REUSABLE URANIUM MATERIALS

The Department of Energy Oak Ridge Operations (DOE ORO) proposes to implement a management program for potentially reusable uranium materials. DOE ORO has proposed receiving and storing these materials at one or more sites. DOE is preparing an Environmental Assessment (EA) to cover the packaging, transportation, receipt, storage, and disposition of the material at one or more sites. The preliminary alternatives include: No Action (not moving material), storage at commercial sites, and storage at one or more DOE sites.

The potential storage sites would include the two DOE sites in Oak Ridge, Tennessee (Y-12 Nuclear Security Complex and East Tennessee Technology Park), the Paducah Site in Kentucky, the Portsmouth Site in Ohio, the Savannah River Site in South Carolina, the Idaho National Engineering and Environmental Laboratory in Idaho and appropriately licensed commercial sites.

The preferred alternative is centralized storage at the Portsmouth Site for surplus material that is economically feasible for relocation. The Portsmouth Site is preferred because of its combination of unique characteristics, including the existence of a uranium management infrastructure and successful on-going receipt and storage of surplus uranium materials from DOE's Fernald and Hanford Sites and from universities.

This letter is intended to serve as Informal Consultation Under Section 7 of the Endangered Species Act. In this regard, DOE requests an updated list of protected species and habitat on or near the project site and solicits your recommendations and comments about the potential effects of this proposed action. Your input will be used in the preparation of the environmental assessment for this action pursuant to the National Environmental Policy Act.

If you need further information on this request, please do not hesitate to call me at (865) 576-0938.

Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 20, 2002

Mr. Roger Banks
Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
176 Croghan Spur Road
Suite 200
Charleston, South Carolina 29407

Dear Mr. Banks;

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE MANAGEMENT OF POTENTIALLY REUSABLE URANIUM MATERIALS

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Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 20, 2002

Ms. Allison Beck Hass
Supervisor
Snake River Basin Office
Columbia River Basin Ecoregion
1387 South Vinnell Way, Room 368
Boise, Idaho 83709

Dear Ms. Hass;

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE MANAGEMENT OF POTENTIALLY REUSABLE URANIUM MATERIALS

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If you need further information on this request, please do not hesitate to call me at (865) 576-0938.

Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 20, 2002

Mr. Ken Lammers
Field Supervisor
U.S. Fish and Wildlife Service
Reynoldsburg Ecological Services Field Office
6950 Americana Parkway, Suite H
Reynoldsburg, Ohio 43068

Dear Mr. Lammers;

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE MANAGEMENT OF POTENTIALLY REUSABLE URANIUM MATERIALS

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If you need further information on this request, please do not hesitate to call me at (865) 576-0938.

Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

May 20, 2002

Mr. David Bernhart
National Marine Fisheries Service
9721 Executive Center Drive North
St. Petersburg, Florida 33702

Dear Mr. Bernhart;

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT FOR THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE MANAGEMENT OF POTENTIALLY REUSABLE URANIUM MATERIALS

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If you need further information on this request, please do not hesitate to call me at (865) 576-0938.

Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

JLC

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

JUN 28 2002

Dear Colleague:

The National Marine Fisheries Service (NMFS) Protected Resources Division has reviewed your letter pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) concerning the programmatic environmental assessment for the management of potentially reusable uranium materials, Dept of Energy, Oak Ridge operations, letter dated May 20, 2002 to Mr. David Bernhart.

✓ We cannot determine impacts to threatened or endangered species, or designated critical habitat, under NMFS purview because the letter lacks sufficient information to evaluate the project.

✓ As requested, enclosed is a list of federally protected species under the jurisdiction of NMFS for the project area. Biological information on federally protected sea turtle species and other listed species can be found at the following website addresses: NMFS Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm); NMFS Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html); U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm); the Ocean Conservancy (http://www.cmc-ocean.org/main.php3); the Caribbean Conservation Corporation (http://www.cccturtle.org/); and http://www.turtles.org

_____ It is NMFS' opinion that the project will have **no effect** on listed species or critical habitat protected by the ESA under NMFS' purview, because there are no listed species or designated critical habitat in the project area. **No further consultation with NMFS pursuant to Section 7(a)(2) of the ESA is required.**

If you have any questions, please contact the Section 7 coordinator, Eric Hawk, at (727)570-5312, or by e-mail at eric.hawk@noaa.gov.

Sincerely,

Georgia Cranmore
Assistant Regional Administrator
for Protected Resources

✓ Enclosure

File:1514-22.b. General correspondence

OFFICIAL FILE COPY
AMESQ
Log No. 68006
Date Received JUL 08 2002
File Code ________

Endangered and Threatened Species and Critical Habitats under the Jurisdiction of the National Marine Fisheries Service

South Carolina

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
right whale	*Eubalaena glacialis*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempi*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
shortnose sturgeon	*Acipenser brevirostrum*	Endangered	03/11/67

Species Proposed for Listing
None

Designated Critical Habitat
None

Proposed Critical Habitat
None

Candidate Species[1]	Scientific Name
Fish	
dusky shark	*Carcharhinus obscurus*
sand tiger shark	*Odontaspis taurus*
night shark	*Carcharinus signatus*
Atlantic sturgeon	*Acipenser oxyrhynchus oxyrhynchus*
speckled hind	*Epinephelus drummondhayi*
Warsaw grouper	*Epinephelus nigritus*

1. Candidate species are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

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[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

EASTERN IDAHO FIELD OFFICE - ES
4425 BURLEY DR., SUITE A
CHUBBUCK, IDAHO 83202
Telephone (208) 237-6975 Fax Number (208) 237-8213

July 1, 2002

James L. Elmore, Ph.D.
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831

Subject: Informal Consultation For The Programmatic Environmental Assessment For The Management Of Potentially Reusable Uranium Materials
File # 506.0000 FWS # 1-4-02-I-0167

Dear Mr. Elmore:

The U.S. Fish and Wildlife Service (Service) is providing you with a list of endangered, threatened, proposed, and/or candidate species which may be present in the area of the Idaho National Engineering and Environmental Laboratory (INEEL) located in Bingham, Bonneville, Butte, and Jefferson Counties, Idaho. The list fulfills requirements for a Species List under Section 7(c) of the Endangered Species Act of 1973 (Act), as amended. If the project decision is not made within 180 days of this letter, regulations require that you request an updated list. Please refer to the FWS number above in all correspondence and reports.

Section 7 of the Act requires Federal agencies to assure that their actions are not likely to jeopardize the continued existence of endangered or threatened species. Federal funding, permitting, or land use management decisions are considered to be Federal actions subject to Section 7. If the proposed action may affect a listed species, consultation with the Service is required. Formal consultation must be initiated for any project that is likely to adversely affect a threatened or endangered species. If a project involves a major construction activity and may affect listed species, Federal agencies are required to prepare a Biological Assessment (BA). If a proposed species is likely to be jeopardized by a Federal action, regulations require a conference between the Federal agency and the Service.

The Service understands The Department of Energy Oak Ridge Operations (DOE ORO) proposes to implement a management program for potentially reusable uranium materials. DOE is preparing an Environmental Assessment (EA) to cover the packaging, transportation, receipt, storage, and disposition of the material at one or more sites. One of the potential storage sites includes the INEEL; however, the preferred alternative is for centralized storage at the Portsmouth Gaseous Diffusion Plant in Ohio. The EA will address 14,200 metric tons of uranium materials thought to be potentially reusable; thus, uranium waste is not part of the scope. The uranium material would either be shipped in 55 gallon drums or full size (7 x 4 x 4 ft), strong, tight metal boxes via either rail or trucks. The Service also understands that storage at the INEEL would require substantial new construction with associated permanent habitat destruction. This 7-acre commitment would occur at a highly developed site already undergoing other ground disturbances associated with remediation.

Threatened and Endangered Species

Threatened and endangered species that may occur in the proposed project area (enclosure) include: Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), bald eagle (*Haliaeetus leucocephalus*), Ute ladies'- tresses (*Spiranthes diluvialis*), bull trout (*Salvelinus confluentus*), and Bliss Rapids snail (*Taylorconcha serpenticola*). However, for your information, we also have provided you with a list of Species of Special Concern and ask that you consider them, and their habitats, during project planning and review; although they do not have legal status under the Act. Additionally, the whooping crane (*Grus americana*) appears on the species list for Bonneville County. This population of whooping cranes was an experimental/non-essential population. Furthermore, the last two known surviving whooping cranes remaining in the population have not returned this year and are thought to have not survived the winter. Therefore, they need not be considered in your EA.

Based on our knowledge of the INEEL area, sufficient habitat for Canada lynx or bull trout is not available. The proposed project area does not occur in lynx habitat (i.e., not in a Lynx Analysis Unit) and there are no linkage areas in the project area. Furthermore, there is not adequate surface water present in the area of the INEEL area for bull trout survival. The closest known bull trout habitat exists in the Little Lost River, which is located northwest of the project area. However, any available information documenting Canada lynx or bull trout presence in the project area should be noted in the project EA.

The gray wolf is listed as nonessential experimental within the central Idaho area. However, if gray wolf denning sites or rendevous areas are found near or within the project area, the Service asks that project activities be planned to minimize disturbance to wolf activities.

There are no known bald eagle nests within the project area. However, the project EA should document the most recent bald eagle survey information regarding any breeding territories in the project area and address effects of proposed project activities on any newly established breeding territories that may occur in the project area. The Guidelines for Management of Breeding Areas (Bald Eagle Management Plan for Greater Yellowstone, 1996 Final Draft) should guide the timing of any project activities with regard to potential disturbance of Nest Site Management Zones (NSMZ) from human activity, and to bald eagle foraging habitat outside NSMZs. It also should be noted that transient, wintering bald eagles may occur anywhere throughout Bingham, Bonneville, Butte, and Jefferson counties, including the project area.

Ute ladies'-tresses have the potential to occur in wetland and riparian areas including springs, wet meadows, and river meanders. The plant is known to occur at sites ranging from 1,500 to 7,000 feet in elevation. This species generally flowers from mid-July through September, and can be identified definitively only at that time. The orchid can remain dormant for several years; therefore, we suggest surveys for the orchid be scheduled for sequential years. The species may be adversely affected by modification of riparian and wetland habitats associated with livestock grazing, vegetation removal, excavation, construction for residential or commercial purposes, stream channelization, hydroelectric development and operation, and actions that alter hydrology.

The Bliss Rapids snail is part of the native mollusc fauna of the middle Snake River which characteristically require cold, fastwater or lotic habitats. The Bliss Rapids snail occurs on stable, cobble-boulder substratum only in flowing waters in unimpounded stream reaches. This species does not burrow in sediments and normally avoids surfaces with attached plants. Populations (or colonies) of the Bliss Rapids snail occur in areas associated with spring influences or rapids edge environments and tend to flank shorelines. They are found at varying depths if dissolved oxygen and temperature requirements persist. Currently, the occurrence of snails at the INEEL is unknown; therefore the project EA should document any available survey information addressing the presence or absence of snails or snail habitat in or near the project area. If survey information is not available, we recommend surveys be conducted prior to submission of the EA.

We appreciate your conscientious efforts to comply with Federal requirements and would appreciate the opportunity to be involved in further commenting on the finalized EA. If you need further information, please contact Sandi Arena of this office at (208) 237-6975 x 34. Thank you for your continued interest in endangered species conservation.

Sincerely,

Deb Mignogno
Supervisor, Eastern Idaho Sub-Office

Enclosure

BINGHAM COUNTY

LISTED SPECIES	COMMENTS
Gray wolf (XN) *(Canis lupus)*	Experimental/Non-essential population
Bald eagle (LT) *(Haliaeetus leucocephalus)*	
Bliss Rapids snail (LT) *(Taylorconcha serpenticola)*	
Ute ladies'- tresses (LT) *(Spiranthes diluvialis)*	

PROPOSED SPECIES

None

CANDIDATE SPECIES

None

The Fish and Wildlife Service is interested in the following plants and/or animals, and we are providing this list for your information. We are concerned about their population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act, therefore you are not obliged to account for them. However, in context with ecosystem-level management, we suggest that you consider these species and their habitats in project planning and review.

Mammals

Pygmy rabbit
(Brachylagus idahoensis)

Merriam's shrew
(Sorex merriami)

March 2002

Yuma myotis
(Myotis yumanensis)

Long-eared myotis
(Myotis evotis)

Western small-footed myotis
(Myotis ciliolabrum)

Townsend's big-eared bat
(Plecotus townsendii)

Fish

Snake River fine-spotted cutthroat trout
(Oncorhynchus clarki ssp.*)*

Yellowstone cutthroat trout
(Oncorhynchus clarki bouvieri)

Bonneville cutthroat trout
(Oncorhynchus clarki utah)

Birds

Columbian sharp-tailed grouse
(Tympanuchus phasianellus)

Sage grouse
(Centrocercus urophasianus)

Yellow-billed cuckoo
(Coccyzus americanus)

Ferruginous hawk
(Buteo regalis)

White-faced ibis
(Plegadis chihi)

Trumpeter swan
(Cygnus buccinator)

Black tern
(Chlidonias niger)

Long-billed curlew
(Numenius americanus)

Invertebrates
Idaho Dunes tiger beetle
(Cicindela arenicola)

Amphibians and Reptiles
Western toad
(Bufo boreas)

Northern leopard frog
(Rana pipiens)

Columbia spotted frog
(Rana luteiventris)

Ringneck snake
(Diadophis punctatus)

Common garter snake
(Thamnophis sirtalis)

Short-horned lizard
(Phrynosoma douglassi)

BONNEVILLE COUNTY

LISTED SPECIES	COMMENTS
Canada lynx (LT) *(Lynx canadensis)*	
Gray wolf (XN) *(Canis lupus)*	Experimental/Non-essential population
Bald eagle (LT) *(Haliaeetus leucocephalus)*	Wintering area/nesting area
Whooping crane (XN) *(Grus americana)*	Experimental/Non-essential population
Ute ladies'- tresses (LT) *(Spiranthes diluvialis)*	

PROPOSED SPECIES

None

CANDIDATE SPECIES

None

The Fish and Wildlife Service is interested in the following plants and/or animals, and we are providing this list for your information. We are concerned about their population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act, therefore you are not obliged to account for them. However, in context with ecosystem-level management, we suggest that you consider these species and their habitats in project planning and review.

Mammals

Western small-footed myotis
(Myotis ciliolabrum)

March 2002

Townsend's big-eared bat
(Plecotus townsendii)

Pygmy rabbit
(Brachylagus idahoensis)

Wolverine
(Gulo gulo)

Uinta chipmunk
(Tamias umbrinus)

Fish

Snake River fine-spotted cutthroat trout
(Oncorhynchus clarki ssp.*)*

Yellowstone cutthroat trout
(Oncorhynchus clarki bouvieri)

Birds

Columbian sharp-tailed grouse
(Tympanuchus phasianellus)

Sage grouse
(Centrocercus urophasianus)

White-faced ibis
(Plegadis chihi)

Trumpeter swan
(Cygnus buccinator)

Harlequin duck
(Histrionicus histrionicus)

Northern goshawk
(Accipiter gentilis)

Ferruginous hawk
(Buteo regalis)

Black tern
(Chlidonias niger)

Long-billed curlew
(Numenius americanus)

Flammulated owl
(Otus flammeolus)

Great gray owl
(Strix nebulosa)

Invertebrates

Idaho Dunes tiger beetle
(Cicindela arenicola)

Amphibians and Reptiles

Western toad
(Bufo boreas)

Northern leopard frog
(Rana pipiens)

Columbia spotted frog
(Rana luteiventris)

Ringneck snake
(Diadophis punctatus)

Common garter snake
(Thamnophis sirtalis)

Short-horned lizard
(Phrynosoma douglassi)

Plants

Payson's milkvetch
(Astragalus paysonii)

Payson's bladderpod
(Lesquerella paysonii)

Mountain twin bladderpod
(Physaria integrifolia var. *monticola)*

BUTTE COUNTY

LISTED SPECIES	COMMENTS
Gray wolf (XN) *(Canis lupus)*	Experimental/Non-essential population
Canada lynx (LT) *(Lynx canadensis)*	
Bull trout (LT) *(Salvelinus confluentus)*	
Bald eagle (LT) *(Haliaeetus leucocephalus)*	Wintering area
Ute ladies'-tresses (LT) *(Spiranthes diluvialis)*	

PROPOSED SPECIES

None

CANDIDATE SPECIES

None

The Fish and Wildlife Service is interested in the following plants and/or animals, and we are providing this list for your information. We are concerned about their population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act, therefore you are not obliged to account for them. However, in context with ecosystem-level management, we suggest that you consider these species and their habitats in project planning and review.

Mammals

Western small-footed myotis
(Myotis ciliolabrum)

Long-eared myotis
(Myotis evotis)

March 2002

Townsend's big-eared bat
(Plecotus townsendii)

Long-legged myotis
(Myotis volans)

Merriam's shrew
(Sorex merriami)

Pygmy rabbit
(Brachylagus idahoensis)

Kit fox
(Vulpes macrotis)

Birds

Sage grouse
(Centrocercus urophasianus)

Ferruginous hawk
(Buteo regalis)

Loggerhead shrike
(Lanius ludovicianus)

Long-billed curlew
(Numenius americanus)

Amphibians and Reptiles

Western toad
(Bufo boreas)

Northern leopard frog
(Rana pipiens)

Columbia spotted frog
(Rana luteiventris)

Ringneck snake
(Diadophis punctatus)

Common garter snake
(Thamnophis sirtalis)

Short-horned lizard
(Phrynosoma douglassi)

Plants

Obscure phacelia
(Phacelia inconspicua)

Slender moonwort
(Botrychium lineare)

JEFFERSON COUNTY

LISTED SPECIES	COMMENTS
Canada lynx (LT) *(Lynx canadensis)*	
Gray wolf (XN) *(Canis lupus)*	Experimental/Non-essential population
Bald eagle (LT) *(Haliaeetus leucocephalus)*	Wintering area/nesting area
Ute ladies'- tresses (LT) *(Spiranthes diluvialis)*	

PROPOSED SPECIES

None

CANDIDATE SPECIES

None

The Fish and Wildlife Service is interested in the following plants and animals, and we are providing this list for your information. We are concerned about their population status and/or threats to their long-term viability. These species have no legal status under the Endangered Species Act, therefore you are not obliged to account for them. However, in context with ecosystem-level management, we suggest that you consider these species and their habitats in project planning and review.

<u>Mammals</u>

Pygmy rabbit
(Brachylagus idahoensis)

<u>Birds</u>

Sage grouse
(Centrocercus urophasianus)

Yellow-billed cuckoo
(Coccyzus americanus)

March 2002

White-faced ibis
(Plegadis chihi)

Trumpeter swan
(Cygnus buccinator)

Ferruginous hawk
(Buteo regalis)

Black tern
(Chlidonias niger)

Long-billed curlew
(Numenius americanus)

Fish

Yellowstone cutthroat trout
(Oncorhynchus clarki lewisi)

Invertebrates

Idaho Dunes tiger beetle
(Cicindela arenicola)

Amphibians and Reptiles

Western toad
(Bufo boreas)

Northern leopard frog
(Rana pipiens)

Columbia spotted frog
(Rana luteiventris)

Common garter snake
(Thamnophis sirtalis)

Short-horned lizard
(Phrynosoma douglassi)

Plants

Slender moonwort
(Botrychium lineare)

March 2002

United States Department of the Interior

FISH AND WILDLIFE SERVICE
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

July 16, 2002

OFFICIAL FILE COPY
AMESO
Log No. 69400
Date Received JUL 19 2002
File Code

Dr. James L. Elmore
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831

Re: Preparing an Environmental Assessment to cover packaging, transportation, receipt, storage, and disposition of reusable Uranium materials potentially at the Savannah River Site, Barnwell County, South Carolina
FWS No. 4-6-02-I-298

Dr. Elmore:

We have reviewed the information received May 20, 2002 concerning the above-referenced project. The following comments are provided in accordance with the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e), and section 7 of the Endangered Species Act, as amended (16 U.S.C. 1531-1543).

We are providing a list of the federally endangered (E) and threatened (T) and candidate (C) species which potentially occur in Barnwell County, South Carolina to aid you in determining the impacts your project may have on protected species. The list also includes species of concern under review by the Service. Species of concern (SC) are not legally protected under the Endangered Species Act, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as endangered/threatened. We are including these species in our response for the purpose of giving you advance notification: These species may be listed in the future, at which time they will be protected under the Endangered Species Act. Therefore, it would be prudent for you to consider these species early in project planning to avoid any adverse effects.

County	Common Name	Scientific Name	Status	Occurrences
Barnwell				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Possible
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Pondberry	*Lindera melissifolia*	E	Possible

This is your future. Don't leave it blank. - ***Support the 2000 Census.***

Canby's dropwort	*Lobelia boykinii*	SC	Known
Piedmont bishop-weed	*Macbridea caroliniana*	SC	Known
American chaffseed	*Hypericum adpressum*	SC	Known
Dwarf burhead	*Rana capito*	SC	Known
Awned meadowbeauty	*Astragalus michauxii*	SC	Known
Bog spicebush	*Lampsilis cariosa*	SC	Known
Boykin's lobelia	*Lobelia boykinii*	SC	Known
Carolina bogmint	*Macbridea caroliniana*	SC	Known
Creeping St. John's wort	*Hypericum adpressum*	SC	Known
Gopher frog	*Rana capito*	SC	Known
Sandhills milk-vetch	*Astragalus michauxii*	SC	Known
Yellow lampmussel	*Lampsilis cariosa*	SC	Known

In-house surveys should be conducted by comparing the habitat requirements for the attached listed species with available habitat types at the project site. Field surveys for the species should be performed if habitat requirements overlap with that available at the project site. Surveys for protected plant species must be conducted by a qualified biologist during the flowering or fruiting period(s) of the species. Please notify this office with the results of any surveys for the above list of species.

We also recommend you contact the S.C. Department of Natural Resources (SCDNR), Data Manager, Wildlife Diversity Section, Columbia, SC 29202, concerning known populations of federal and/or state endangered or threatened species, and other sensitive species in the project area. Additional habitat information may also be available from SCDNR. The National Marine Fisheries Service, 9721 Executive Center Drive North, St. Petersburg, FL 33702-2449 should be contacted for consultation on species under their jurisdiction.

We reserve the right to comment on the Programmatic Environmental Assessment upon its completion. Your interest in ensuring the protection of endangered and threatened species and our nation's valuable wetland resources is appreciated. If you have further questions or require additional information, please contact Sandy Abbott of this office at (843) 727-4707 ext. 57. In future correspondence concerning the project, please reference FWS Log No 4-6-02-I-298.

Sincerely yours,

Roger L. Banks
Field Supervisor

RLB/SDA/km

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

August 6, 2002

Dr. Lee A. Barclay, Ph.D.
Field Supervisor
Fish and Wildlife Service
446 Neal Street
Cookeville, Tennessee 38501

Dear Dr. Barclay,

INFORMAL CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT, BIOLOGICAL ASSESSMENT FOR IMPLEMENTATION OF A COMPREHENSIVE MANAGEMENT PROGRAM TO STORE, TRANSPORT, AND DISPOSE OF POTENTIALLY RE-USABLE URANIUM MATERIALS

Please find enclosed a copy of a Biological Assessment (BA) for Threatened and Endangered Species under Section 7 of the Endangered Species Act for Implementation of a Comprehensive Management Program to Store, Transport, and Dispose of Potentially Re-Usable Uranium Materials. This BA was prepared in response to a request by the U. S. Fish and Wildlife Service (USFWS), (Letter from Dr. Lee A. Barclay, U. S. Fish and Wildlife Service, Cookeville, Tennessee, to Mr. David Allen, U. S. Department of Energy (DOE), Oak Ridge, Tennessee, June 10, 2002). The BA addresses three species identified by the USFWS -- the gray bat, the Indiana bat and the pink mucket -- in the aforementioned letter. Both the Y-12 National Security Complex and the East Tennessee Technology Park are being considered by the DOE as potential interim storage sites for consolidation of approximately 14,200 MTU of uranium materials in the Uranium Management Group inventory.

DOE staff conclude, based on the information presented in this BA, that implementation of the proposed action at either site on the Oak Ridge Reservation (ORR) is not likely to adversely affect any of the listed species because the proposed action involves potential warehouse construction on already developed, industrialized areas on the ORR. The ORR does not contain any proposed or designated critical habitat for the gray bat or the Indiana bat, so none would be affected. In addition, any potential adverse impacts to the Indiana bat would be expected to be negligible due to the lack of suitable summer roosting habitat at both sites. Although the ultimate use of either site may eventually require the removal of trees, any potential roosting habitat at the site is, at best, marginal. Also, there are adequate numbers of suitable and potentially suitable roost trees available immediately adjacent to the two sites. The proposed action would not affect any potentially suitable habitat for the pink mucket in the Clinch River or its tributaries. It is unlikely that the proposed action would result in any off-site releases of sediment or potential contaminants that would adversely affect this mussel. DOE requests the concurrence of the USFWS with these conclusions.

This letter is intended to serve as informal consultation under Section 7 of the Endangered Species Act. If you need further information, please call me at (865) 576-0938. Thank you in advance for your prompt reply.

Sincerely,

James L. Elmore, Ph.D.
Alternate NEPA Compliance Officer

Enclosure

cc:
David Allen, SE-30-1
Carolyne Thomas, NU-51
Wayne Tolbert, SAIC, Oak Ridge

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

September 18, 2002

Mr. James L. Elmore, Ph.D.
U.S. Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831

Dear Dr. Elmore:

Thank you for your letter and enclosure of August 6, 2002, transmitting the Biological Assessment (BA) for the Implementation of a Comprehensive Management Program to Store, Transport, and Dispose of Potentially Re-Usable Uranium Materials at the Y-12 National Security Complex and the East Tennessee Technology Park in Oak Ridge, Roane and Anderson Counties, Tennessee. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

The BA is adequate and supports the conclusion of not likely to adversely affect, with which we concur. In view of this, we believe that the requirements of Section 7 of the Endangered Species Act (Act) have been fulfilled and that no further consultation is needed at this time. However, obligations under Section 7 of the Act must be reconsidered if: (1) new information reveals that the proposed action may affect listed species in a manner or to an extent not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered in this biological assessment, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

Our previous comments of June 10, 2002, regarding the Programmatic Environmental Assessment (PEA) remain valid. We would appreciate further consideration of the issues presented therein.

These constitute the comments of the U.S. Department of the Interior in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.), the Migratory Bird Treaty Act (16 U.S.C. 703-711), the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), and the National Environmental Policy Act (42 U.S.C. 4321-4347; 83 Stat. 852). We appreciate the opportunity to comment. Should you have any questions or need further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

xc: John Owsley, TDEC, Oak Ridge
Dave McKinney, TWRA, Nashville

Endangered Species Act

BIOLOGICAL ASSESSMENT

for

Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Reusable Uranium Materials at the Oak Ridge Reservation, Oak Ridge, Tennessee

Prepared by
Science Applications International Corporation
151 Lafayette Drive
Oak Ridge, Tennessee 37831

Prepared for
U.S. Department of Energy
Oak Ridge Operations Office
Oak Ridge, Tennessee 37831

July 2002

01-217(doc)/093002

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Contributed to the preparation of this document and should not be considered an eligible contractor for its review.

CONTENTS

FIGURES

ACRONYMS

BA	biological assessment
DOE	U.S. Department of Energy
DU	depleted uranium
EFPC	East Fork Poplar Creek
ETTP	East Tennessee Technology Park
FWS	U.S. Fish and Wildlife Service
LEFPC	Lower East Fork Poplar Creek
LEU	low enriched uranium
MTU	metric tons of uranium
NU	normal uranium
ORR	Oak Ridge Reservation
PEA	programmatic environmental assessment
TVA	Tennessee Valley Authority
UEFPC	Upper East Fork Poplar Creek
UMG	Uranium Management Group
Y-12 Complex	Y-12 National Security Complex

EXECUTIVE SUMMARY

This biological assessment (BA) assesses potential impacts on three federally listed animal species that could result from the implementation of a comprehensive management program to store, transport, and dispose of potentially reusable uranium materials by the U.S. Department of Energy (DOE) at one of two sites the Y-12 National Security Complex (hereafter referred to as the Y-12 Complex) or East Tennessee Technology Park (ETTP) on the Oak Ridge Reservation (ORR). The species discussed in this BA are those mentioned in comments received from the U.S. Fish and Wildlife Service (FWS) to DOE, dated June 10, 2002.[2] The FWS comments were specifically directed toward potential impacts resulting from implementing the proposed uranium management program on the ORR.

The three species include two listed endangered mammals, the gray bat (*Myotis grisescens*) and the Indiana bat (*Myotis sodalis*), and a listed endangered freshwater mussel, the pink mucket (*Lampsilis abrupta*). None of these species is likely to be present on either of the proposed sites, and proposed or designated critical habitats for the species are not present on or near either of the proposed sites. However, caves that could provide potential roosting habitat for the gray bat are present within 6.4 km (4 miles) of the ORR. Suitable roosting habitat for the Indiana bat is also present within the vicinity of the proposed project. In addition, the Clinch River (Melton Hill Reservoir), an impoundment on the Clinch River that forms the southern boundary of the ORR, and Poplar Creek, which flows through ETTP, provide suitable foraging habitat for the gray bat and Indiana bat. The pink mucket is known to occur in the Clinch River (Melton Hill Lake). All surface water from Y-12 Complex drainage eventually enters the Clinch River near ETTP. Both Bear Creek, a tributary to East Fork Poplar Creek (EFPC), and EFPC rise at the Y-12 Complex. EFPC flows into Poplar Creek, which flows through ETTP before entering the Clinch River.

DOE staff conclude, based on the information presented in this BA, that implementation of the proposed action at either site on the ORR is not likely to adversely affect any of the listed species because the proposed action involves potential warehouse construction on already developed, industrialized areas on the ORR. The ORR does not contain any proposed or designated critical habitat for the gray bat or the Indiana bat, so none would be affected. In addition, any potential adverse impacts to the Indiana bat would be expected to be negligible due to the lack of suitable summer roosting habitat at both sites. Although the ultimate use of either site may eventually require the removal of trees, any potential roosting habitat at the site is, at best, marginal. Also, there are adequate numbers of suitable and potentially suitable roost trees available immediately adjacent to the two sites. The proposed action would not affect any potentially suitable habitat for the pink mucket in the Clinch River or its tributaries. It is unlikely that the proposed action would result in any off-site releases of sediment or potential contaminants that would adversely affect this mussel. DOE requests the concurrence of the FWS with these conclusions.

---

[2]Letter from Dr. Lee A. Barclay, U.S. Fish and Wildlife Service, Cookeville, Tennessee, to Mr. David Allen, U.S. Department of Energy, Oak Ridge, Tennessee, June 10, 2002.

1. INTRODUCTION

This biological assessment (BA) only evaluates the effect of the proposed action on threatened and endangered species for two sites in Oak Ridge, the Y-12 National Security Complex (hereafter referred to as the Y-12 Complex) and East Tennessee Technology Park (ETTP) [Figure 1].

1.1 PURPOSE AND NEED FOR AGENCY ACTION

The U.S. Department of Energy (DOE) proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low enriched uranium (LEU), normal uranium (NU), and depleted uranium (DU). Uranium materials, which are presently located at multiple sites, are to be consolidated by transporting the materials to one, or several, storage locations to facilitate ultimate disposition. Management would include the storage, transport, and ultimate disposition of these materials.

This action is needed because of DOE's current missions and functions; increasing budget pressures; the continuing need for good stewardship of resources, including materials in inventory; and continuing DOE attention to considerations of environment, safety, and health. Also, increased pressure on the federal budget requires that DOE take a closer look at materials management in order to ensure maximum cost effectiveness. This includes an examination of feasible uses of this material, consistent with DOE's mission, as well as an examination of management methods that are consistent with environmental requirements and budgetary constraints. DOE needs to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU.

1.2 PROPOSED ACTION

DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU. Uranium materials, which are presently located at multiple sites, are to be consolidated by transporting the materials to one, or several, storage locations to facilitate ultimate disposition. The management plan will address the packaging and transport of potentially reusable uranium materials from DOE sites and university loan/lease returns and their receipt and storage at a site under cognizance of the Uranium Management Group (UMG). This action will also cover material shipment from the UMG and disposition. A Secretarial Determination is required, under certain conditions, for uranium in the UMG inventory to be sold. Twenty years will provide time for additional reviews required for any future related actions that may be desirable to help accomplish ultimate disposition. Impacts evaluated in Chapter 4 of the Draft Programmatic Environmental Assessment (PEA) prepared for this project (DOE 2002) cover the 20-year period of this management plan.

The management plan will cover uranium materials that are currently in the form of oxides, metals, and other stable compounds such as UF_4. The quantity of uranium within the scope of this PEA is estimated to be 14,200 metric tons of uranium (MTU) and is primarily located at a few DOE locations (Idaho National Engineering and Environmental Laboratory, Portsmouth Gaseous Diffusion Plant, Savannah River Site, and Oak Ridge). These DOE locations have other uranium materials, which are not part of the UMG inventory and not part of the 14,200 MTU addressed in the proposed action. This number is based on the 2000 Nuclear Material Inventory Assessment data increased by approximately 10% to reflect uncertainties in material shipment. The plan will not include irradiated material, UF_6, enrichment of 20% or greater ^{235}U, or ^{233}U.

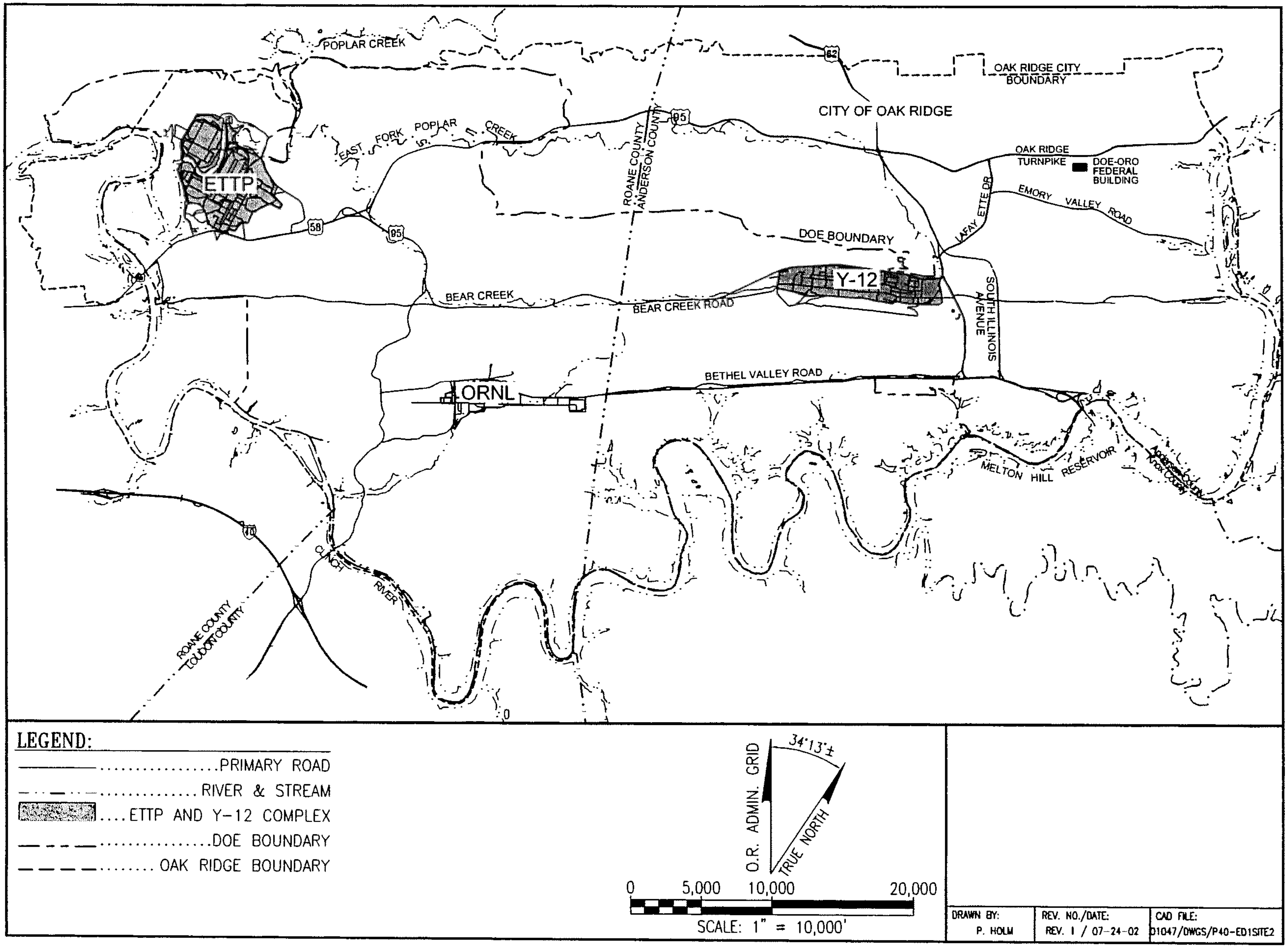

Fig. 1. Location of Y-12 Complex and ETTP on the DOE's Oak Ridge Reservation.

DOE must determine the safest, most effective, and most efficient approach for the consolidation and storage of this material. Consideration will be given only to those locations (DOE and commercial) within the continental United States that have a long-term mission for the handling and storage of uranium material. This material would be stored in either one (centralized) location or several (consolidated) locations. Approximately 14,200 MTU may be consolidated into one or more storage locations. This material is the primary focus of this PEA. Several alternatives were evaluated in detail for the Draft PEA prepared for this project (DOE 2002).

1.3 ECOLOGICAL DESCRIPTION OF THE SITES

1.3.1 Y-12 Complex

The Y-12 Complex (formerly the Y-12 Plant) is one of three installations on the DOE ORR. The early missions of the site included separation of ^{235}U from normal uranium by the electromagnetic separation process and manufacturing weapons components from uranium and lithium (DOE 2001a).

During 2000, the U.S. Congress established the National Nuclear Security Administration. Its mission is to carry out National Security responsibilities of DOE (DOE 2001b).

1.3.1.1 Water resources

The Y-12 Complex is approximately 3 km (2 miles) from the Melton Hill Reservoir and Clinch River. On-site, two streams originate approximately in the middle of the complex. Bear Creek flows directly west from its headwaters at the Y-12 Complex, while EFPC flows east before turning north and west and flowing through the residential area of Oak Ridge. These two creeks merge near ETTP, which is approximately 16 km (10 miles) west of the Y-12 Complex. The major groundwater unit for the ORR is the Knox Aquifer, composed of the Knox Group and the Maynardville Limestone. No aquifers are considered sole-source aquifers (DOE 1997a).

1.3.1.2 Ecological resources

The ORR consists of diverse habitats and supports a rich variety of flora and fauna. Vegetation is characteristic of that found in the inter-mountain regions of central and southern Appalachia. The Y-12 Complex is covered in mowed grass, concrete, gravel, asphalt, and industrial structures. Thus, the site does not have unique habitats or a wide diversity of flora or fauna. Upper East Fork Poplar Creek (UEFPC) lacks riparian vegetation because much of the stream is channelized and maintained. Lake Reality is a 1.0-hectare (2.5-acre), plastic-lined, flat-bottomed settling and spill control structure located near the east end of the facility on EFPC. Upper Bear Creek is also channelized, but, generally, it has somewhat better habitat quality and a better-defined riparian zone than UEFPC. There are mature hardwood forests in upper Bear Creek valley within 1.6 km (1.0 mile) of the Y-12 Complex. There is a small wetland [0.18 hectare (0.45 acre)] in a small, wooded area between New Hope Cemetery and Bear Creek Road. Bear Creek valley contains several wetlands that cover a total area of several hectares.

There are no federally protected threatened or endangered species known on the Y-12 Complex. However, the FWS notes that the federally listed endangered species—the gray bat (*Myotis grisescens*), the Indiana bat (*Myotis sodalis*), and the pink mucket (*Lampsilis abrupta*)—are known from, or have the potential to occur within, the project impact areas on the ORR. Although surveys for protected species are not comprehensive enough to rule out all possible federal- or state-listed vertebrates, the likelihood of finding such species seems very low (DOE 1998a).

1.3.2 East Tennessee Technology Park

ETTP, formerly known both as the Oak Ridge Gaseous Diffusion Plant and as the Oak Ridge K-25 Site, is located in Roane County, Tennessee, and is one of three large facilities on the ORR. The site is located on a level, 607-hectare (1500-acre) tract of land near the confluence of Poplar Creek and the Clinch River. ETTP is approximately 56 km (35 miles) west of Knoxville and approximately 13 km (8 miles) southwest of the city of Oak Ridge.

1.3.2.1 Surface water

ETTP is directly adjacent to the Clinch River along the northwest boundary of the ORR. Poplar Creek is a moderately wide [9- to 21-m (30- to 70-ft)] stream that enters the north side of ETTP about 0.5 km (0.3 mile) downstream of the confluence of the east and west forks of Poplar Creek (DOE 1997b). The lower reach of Poplar Creek meanders sharply along the southwest side of ETTP and enters the Clinch River.

The Tennessee Valley Authority (TVA) performed an analysis of floods on the Clinch River and Poplar Creek. TVA concluded that most of ETTP is above the probable maximum flood level. The only facilities identified at risk during major floods were the K-25 power plant and the pumping station for ETTP's water filtration plant. The source of flooding at ETTP would be backwater from the Clinch River near the confluence of Poplar Creek. All proposed storage locations are above the 100-year flood level.

1.3.2.2 Ecological resources

The ORR consists of diverse habitats and supports a rich variety of flora and fauna. Vegetation is characteristic of that found in the intermountain regions of central and southern Appalachia. Vegetation around the buildings within the fenced area on the ETTP proper is a mixture of mowed grasses with a few shrubs and trees. Many of the shrubs and trees have been planted as landscaping, although some native species are found in unmowed areas around ponds and waterways. There are several hectares of wetlands in and around ETTP. The Lower Poplar Creek Rookery is the only environmentally sensitive area within ETTP. It is approximately 2.6 hectares (6.5 acres) and is located on the north bank of Poplar Creek in the middle of the plant site.

Since ETTP proper is planted primarily in non-native grasses, it has very little habitat available for native animals except along Poplar Creek. The majority of animal species found within ETTP's boundaries are species that adapt well to disturbance and the presence of humans. There are no known federally protected plant or animal species on the ETTP site, although suitable habitat exists for the endangered bald eagle on Melton Hill Reservoir and the Clinch River. Sixteen plant species and 18 animal species that are considered rare, threatened, or endangered by the state of Tennessee are found on or near ETTP. However, the FWS notes that the federally listed endangered species—the gray bat (*Myotis grisescens*), the Indiana bat (*Myotis sodalis*), and the pink mucket (*Lampsilis abrupta*)—are known from, or have the potential to occur within, the project impact areas on the ORR.

2. ECOLOGICAL DESCRIPTION AND POTENTIAL IMPACTS OF THE PROPOSED PROJECT ON LISTED SPECIES

The general ecology of federally listed species that are known to occur near the site and the expected potential impacts on them from the project are summarized below. Unless otherwise noted, general biological information on the species is derived from the published literature, reports, and Internet resources listed under each species heading.

2.1 GRAY BAT (*Myotis grisescens*)

Unless otherwise noted or referenced, the following general biological information on the gray bat is derived from FWS (1991), Harvey (1992), and Kentucky Bat Working Group (KBWG) [2000]. The core range of the endangered gray bat encompasses the cave regions of Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee, but a few occur in northwestern Florida, western Georgia, southwestern Kansas, south Indiana, south and southwestern Illinois, northeastern Oklahoma, northeastern Mississippi, western Virginia, and possibly western North Carolina. Gray bats are restricted to caves or cave-like habitats, and few caves meet their specific roost requirements. These restrictions result in about 95% of the populations hibernating in only eight or nine caves. For hibernation, the roost site must have an average temperature of 5.6°C to 11.1°C (42°F to 52°F). Most of the caves used by gray bats for hibernation have deep vertical passages with large rooms that function as cold air traps. Summer caves must be warm, between 13.9°C to 25.0°C (57°F and 77°F), or have small rooms or domes that can trap the body heat of roosting bats. Summer caves are normally located close to rivers or lakes where the bats feed. Gray bats have been known to fly as far as 12 miles or more from their colony to feed.

Gray bats roost, breed, rear young, and hibernate in caves year-round. They migrate between summer and winter caves and will use transient or stopover caves along the way. One-way migrating distance between winter and summer caves may vary from as little as 16 km (10 miles) to well over 322 km (200 miles). Mating occurs as bats return to winter caves in September and October. By November most gray bats are hibernating. Adult females begin to emerge in late March, followed by juveniles and adult males. Females store sperm over the winter and become pregnant the following spring. A few hundred to many thousands of pregnant females congregate to form maternity colonies. Males and nonreproductive females gather in smaller groups to form what are known as bachelor colonies. A single pup is born in late May or early June. The young begin to fly 20 to 25 days after birth. Gray bats primarily feed on flying insects over lakes, rivers, and streams. Aquatic insects, particularly mayflies, make up most of their diet.

Information about the occurrence of gray bats on the ORR is limited. In November 1994, a single, dead gray bat was found in a display cabinet in a building at the Oak Ridge Y-12 Plant. The bat was probably an isolated, individual juvenile that became lost, disoriented, and trapped. Mist netting for bats was conducted on the Lower East Fork Poplar Creek (LEFPC) and its tributaries in May 1992 and again in May–June 1997 (Harvey 1997). The 1997 survey included portions of lower Bear Creek near its confluence with LEFPC. The creeks in this area provided good gray bat foraging habitat at the time of the surveys. No gray bats were recorded among the six species captured. More than 20 caves have been identified on the ORR. Seven of the caves (Copper Ridge, Flashlight Heaven, Walker Branch, Big Turtle, Little Turtle, Pinnacle, and Bull Bluff) were surveyed by Mitchell et al. (1996), but no gray bats were found. There is an unverified report of ten gray bats roosting in Little Turtle Cave in September 1996. These bats were observed roosting and were not further disturbed; therefore, a definite, in-the-hand identification was not made (Webb 1996). Examination of photographs taken of the roosting bats indicate that they appeared to be *Myotis* and more than likely were gray bats, but the species could not be positively determined [Major (2000) and Henry (2000)].

Although no caves are present within the area of the proposed project, several caves are located within 6.4 km (4 miles) of the proposed site location, and two of the caves are located within 2.4 km (1.5 miles). None of the caves has been completely and systematically surveyed for bats, except for the limited surveys reported in Mitchell et al. (1996) and the 1996 report of *Myotis* roosting in Little Turtle Cave. The caves within the vicinity of the project area may not provide adequate hibernacula for gray bats, but they could provide transient or stopover roosting habitat for migrating gray bats. Suitable foraging habitat for gray bats within the vicinity of the proposed facility includes the Clinch River (Melton Hill Lake), which is located about mile south of the Y-12 complex. Both Bear Creek and East Fork Poplar Creek are narrow, small streams and are considered suboptimal for frequent foraging for gray bats.

Both the Y-12 Complex and ETTP are highly industrialized areas with little natural habitat that remains immediately surrounding the complex. No caves would be disturbed by the proposed action, and activities would also not directly impact any of the potential foraging habitat that exists in the vicinity. If construction of new facilities were required, it would occur only during the day, so any foraging by gray bats would not be disrupted. Activities associated with the operation of the proposed facility would also primarily occur during the day and would not disrupt any gray bats that might forage near the site. In addition, no significant emissions or effluents would be produced by the facility that could directly impact foraging gray bats or indirectly affect aquatic insect fauna on which the gray bats would prey. Thus, the proposed project is unlikely to adversely affect the gray bat or its habitat.

2.2 INDIANA BAT (*Myotis sodalis*)

Unless otherwise noted or referenced, the following general biological information on the Indiana bat is derived from FWS (1991, 1999a, 1999b, 2000), Harvey (1992), and KBWG (1997, 2000). The Indiana bat is a migratory species found throughout much of the eastern half of the United States from Oklahoma, Iowa, and Wisconsin east to Vermont and south to northwestern Florida. For hibernation, Indiana bats prefer limestone caves with stable temperatures of 3.3°C to 6.1°C (38°F to 43°F) and high relative humidity. As with the gray bat, few caves meet the specific roost requirements of the species. Subsequently, more than 85% of the population hibernates in only nine sites. However, Indiana bats have been found hibernating in a few abandoned mines, a tunnel, and a hydroelectric dam. The bats hibernate from October to April, depending on climatic conditions. Density in tightly packed clusters is usually estimated at 3228 bats per square meter (300 bats per square foot), although as many as 5165 bats per square meter (480 per square foot) have been reported.

Female Indiana bats depart hibernation caves before males and arrive at summer maternity roosts in mid-May. A single offspring is born between late June and early July. The young bats can fly within a month of birth. Early researchers considered floodplain and riparian forest to be the primary roosting and foraging habitats used during the summer by the Indiana bat, and these forest types unquestionably are important. More recently, upland forest has been shown to be used by Indiana bats for roosting. Within the range of the species, the existence of Indiana bats in a particular area may be governed by the availability of natural roost structures, primarily standing dead trees with loose bark. The suitability of any tree as a roost site is determined by (1) its condition (dead or alive), (2) the quantity of loose bark, (3) the tree's solar exposure and location in relation to other trees, and (4) the tree's spatial relationship to water sources and foraging areas. The most important characteristic of roost trees is probably not species but structure (i.e., exfoliating bark with space for bats to roost between the bark and the bole of the tree). To a limited extent, tree cavities and crevices are also used for roosting. Maternity colonies use multiple primary roost trees, which are used by a majority of the bats most of the summer, and a number of "secondary" roosts, which are used intermittently and by fewer bats, especially during periods of precipitation or extreme temperatures. The summer roost of adult males is often near maternity roosts, but where most spend the day is unknown. Others remain near the hibernaculum, and a few males are found in other caves during summer. Researchers have found that primary roosts are generally in openings or at the edge of forest stands, while alternate roosts can be either in the open or in the interior of the forest stands. Indiana bats use roosts in the spring and fall similar to those selected during the summer. During the fall, when Indiana bats swarm and mate at their hibernacula, male bats roost in trees nearby during the day and fly to the cave during the night.

Indiana bats forage in and around the tree canopy of floodplain, riparian, and upland forest. In riparian areas, Indiana bats primarily forage around and near riparian and floodplain trees (e.g., sycamore, cottonwood, black walnut, black willow, and oaks), and solitary trees and forest edge on the floodplain. Streams, associated floodplain forests, and impounded bodies of water (e.g., ponds, wetlands, and reservoirs) are preferred foraging habitat for pregnant and lactating Indiana bats, some of which may fly up to 1.5 miles from upland roosts. Indiana bats also forage within the canopy of upland forests, over clearings with early successional vegetation (e.g., old fields), along the borders of croplands, along wooded fencerows, and over farm ponds in pastures. Indiana bats return nightly to their foraging areas. Indiana bats feed strictly on flying insects, and their selection of prey items reflects the environment in which they forage. Both aquatic and terrestrial insects are consumed. Moths, caddisflies, flies, mosquitoes, and midges are major prey items. Other prey include bees, wasps, flying ants, beetles, leafhoppers, and treehoppers. During September, the bats depart for hibernation caves.

Information about the occurrence of Indiana bats on the ORR is limited. Mist netting for bats was conducted on LEFPC and its tributaries in May 1992 and again in May–June 1997 (Harvey 1997). The 1997 survey included portions of lower Bear Creek near its confluence with LEFPC. The creeks in this area provided Indiana bat summer roosting and foraging habitat at the time of the surveys. No Indiana bats were recorded among the six species captured.

In Tennessee, the nearest hibernating population of Indiana bats exists in White Oak Blowhole Cave, located in Blount County in the western end of the Great Smoky Mountains National Park. This cave has been designated as critical habitat for this species. A few Indiana bats also hibernate in Bull Cave, also located in Blount County. No maternity roosts have been located on the ORR, or as yet in Tennessee. However, in July 1999, a small colony of Indiana bats was discovered roosting in a dead hemlock tree on the Cheoah Ranger District of the Nantahala National Forest in Graham County, North Carolina. This discovery represents the first record of a reproductive female Indiana bat being found south of Kentucky. Recent collections of individual Indiana bats have also been recorded from the Cherokee National Forest near Tellico Lake in Monroe County, Tennessee. These reports indicate that summer colonies of the species may be present in east Tennessee. The habitat from which these individuals were collected is similar to suitable habitat found on the ORR.

Although there is no suitable summer roosting habitat for the Indiana bat on the ORR, there is probably suitable habitat along forested portions of Chestnut Ridge and Pine Ridge, which border the Y-12 complex to the south and north, respectively, in upper Bear Creek Valley. Suitable foraging habitat for Indiana bats within the vicinity of the proposed facility includes the Clinch River (Melton Hill Lake) and Poplar Creek at ETTP. Upper Bear Creek and EFPC are narrow, small streams and are considered suboptimal for frequent foraging for Indiana bats. Although unlikely, a maternity colony, an adult male colony, or individual Indiana bats could use roosting habitat located in the vicinity of the proposed project in upper Bear Creek Valley. Any potential adverse impacts to the Indiana bat would be eliminated by not cutting down any trees during the Indiana bat's summer roosting season from May through September. Such actions should prevent the loss of any bats that otherwise might be using the trees for rearing young and should also eliminate the need for mist netting or detailed surveys.

Both the Y-12 Complex and ETTP are highly industrialized areas with little natural habitat that remains immediately surrounding the complex. Additional clearing of the woodland at either site should not affect bats because of the poor quality habitat. If new construction was required, these activities would also not directly impact any of the potential foraging habitat that exists in the vicinity. Any construction activities would occur only during the day, so any foraging by Indiana bats would not be disrupted. Activities associated with the operation of the proposed facility would also primarily occur during the day and would not disrupt any foraging Indiana bats near the site. In addition, no significant emissions or effluents would be produced by the facility that could directly impact foraging Indiana bats or indirectly affect aquatic insect fauna that the Indiana bats would prey on.

2.3 PINK MUCKET (*Lampsilis abrupta*)

The endangered pink mucket (also called pink mucket pearlymussel, *L. orbiculata*) is a freshwater mussel in the Unionidae family (CMI–FWIE 2002; EPA 2000). The pink mucket is found in medium to large rivers. It seems to prefer larger rivers with moderate to fast-flowing water, at depths from 0.5 to 8.0 m (1.6 to 26.2 ft). The species has been found in substrates including gravel, cobble, sand, or boulders. Silt clogs the species' siphon so silty substrates and water columns are not conducive to the species being present. Habitat of the glochidia is initially within the gills of the female, then in the water column, and finally attached to a suitable fish host. Habitat requirements for the juvenile stage are unknown. Any alteration of the life-stage-specific habitats during the pink mucket's lifecycle would likely affect the long-term success of a population. In addition, impoundments and surface water contaminants are known to adversely affect this species and contribute to its decline in numbers.

The species has an elliptical-shaped shell and is generally about 10.2 cm (4 in.) long, 6.1 cm (2.4 in.) wide, and 7.6 cm (3 in.) high (CMI–FWIE 2002; EPA 2000). The valves are heavy and thick. The species is sexually dimorphic, with both males and females having rounded anterior margins, but with males having a pointed posterior margins and females a truncated, expanded posterior to accommodate the gravid condition. Young mussels have a yellow to brown shell that is smooth and glossy with green rays, while older specimens are dull brown. The nacre color varies from white to pink, with the posterior margin iridescent. The early life stage of the mussel, glochidia, is an obligate parasite on the gills or fins of fish, but the required fish host species are unknown. The adult mussels are filter feeders and consume particulate matter that is suspended in the water column. Identifiable stomach contents from mussels invariably include mud, desmids, diatoms, protozoa, and zooplankton. However, studies on the food habits for this species have not been conducted, so its specific food requirements are not known. The species has no known commercial value. The reproductive cycle of the pink mucket is presumed to be similar to that of other freshwater mussels. Males release sperm into the water column, which is then taken up by the females during siphoning and results in the eggs being fertilized. The embryos develop into the glochidia inside the female and are then released into the water column. The glochidia must then attach to a suitable fish host for metamorphosis to the free-living juvenile stage. There is no information on the population biology for this species.

Currently, the pink mucket is known in 16 rivers and tributaries from 7 states, with the greatest concentrations in the Tennessee (Tennessee, Alabama) and Cumberland (Tennessee, Kentucky) rivers and in the Osage and Meramec rivers in Missouri. Smaller populations have been found in the Clinch River (Tennessee); Green River (Kentucky); Kanawha River (West Virginia); Big, Black, and Little Black and Gasconde rivers (Missouri); and Current and Spring rivers (Arkansas). The FWS indicated that the pink mucket is known to occur near the project area (FWS 2002). Pink muckets have been found in the Clinch River adjacent to the ORR. However, pink muckets have not been observed at the Y-12 Complex or ETTP. Furthermore, the aquatic habitat in the streams closest to the proposed facility (Bear Creek, and EFPC) is not appropriate to support the pink mucket. Both are small streams with low flow. Both streams also receive low levels of various contaminant inputs from several sources. Appropriate engineering controls, administrative procedures, and emergency management protocols would prevent any releases and off-site migration of potential contaminants from either site. Therefore, the combination of unsuitable stream sizes, improper habitat, and presence of contaminants leads DOE to conclude that the presence of pink mucket pearlymussel on or near the Y-12 Complex or ETTP is extremely unlikely. Likewise, implementation of the uranium management program at the Y-12 Complex would not have any adverse impacts on this species.

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APPENDIX A

HAZARD AND ACCIDENT ANALYSIS FOR URANIUM MANAGEMENT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

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ACRONYMS

ARF	airborne release fraction
DOE	U.S. Department of Energy
DR	damage ratio
ERPG	Emergency Response Planning Guideline
HC-2	Hazard Category 2
IDLH	Immediately Dangerous to Life and Health
INEEL	Idaho National Engineering and Environmental Laboratory
LEU	low-enriched uranium
MAR	material-at-risk
mph	miles per hour
MTU	metric tons of uranium
N/A	not applicable
NU	normal uranium
PC-3	Performance Category 3
PEA	programmatic environmental assessment
PGDP	Paducah Gaseous Diffusion Plant
PORTS	Portsmouth Gaseous Diffusion Plant
RF	respirable fraction
SRS	Savannah River Site

APPENDIX A

HAZARD AND ACCIDENT ANALYSIS FOR URANIUM MANAGEMENT PROGAMMATIC ENVIRONMENTAL ASSESSMENT

A.1 INTRODUCTION

This appendix discusses the systematic identification and assessment of hazards associated with uranium management activities for the U.S. Department of Energy (DOE). This analysis includes a semiquantitative evaluation of the potential internal hazards, natural phenomena hazards, and other external events that could cause the identified hazards to develop into accidents. This appendix presents the potential consequences and risks to workers (immediate and co-located) and members of the public. Risks are evaluated for routine operations and nonroutine (accident) conditions.

Hazards and accidents are considered for a number of interim storage alternatives and disposition options, as described in Chap. 2 of the programmatic environmental assessment and summarized in Tables A.1 and A.2. Inventories for each interim storage alternative and disposition option are shown in Tables A.3 and A.4.

Table A.1. Uranium management interim storage alternatives

Alternative	Discussion
No Action	Continued storage at current sites. Total material included in the PEA is 14,200 MTU
Centralized storage at a single DOE site	All material transferred to a single, centralized DOE storage location
Centralized storage at a single commercial site	All material transferred to a single, centralized commercial storage location (east or west)
Partially consolidated storage at several DOE sites	Material is moved to the closest consolidated storage location
Partially consolidated storage at two DOE sites	Consolidate at one eastern DOE site (PORTS) and one western DOE site (INEEL)
Partially consolidated storage at two commercial sites	Consolidate at one eastern commercial site and one western commercial site
Partially consolidated storage based on physical form	Consolidate by physical form (i.e., the site with the largest quantity of a specific physical form is the preferred storage location for all materials of that form)

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
PEA = programmatic environmental assessment.
PORTS = Portsmouth Gaseous Diffusion Plant.

Table A.2. Uranium management disposition options

Option	Discussion
Commercial processing/domestic sales	All material transferred from interim storage to a single commercial processing facility or single sales distribution point (east or west). Total material included is 14,200 MTU
Transfer to research facilities	Transfer ~50 MTU from interim storage to the furthest DOE or other research location
Transfer to other government agencies	Transfer ~2,500 MTU from interim storage to unspecified location (use furthest distance already evaluated)
Foreign sales	All LEU/NU (~4,050 MTU) transferred to eastern or western port for overseas shipment

DOE = U.S. Department of Energy.
LEU = low enriched uranium.
MTU = metric tons of uranium.
NU = normal uranium.
PEA = programmatic environmental assessment.

Table A.3. Uranium management interim storage inventories

		Current storage		Additional materials to be moved	
Alternative	Site/form	Amount, 10^3 MTU	Number of containers	Amount, 10^3 MTU	Number of containers
No Action	INEEL	1.5	639	N/A	N/A
	PGDP	<0.1	8		
	PORTS	4.4	24,765		
	SRS	3.0	2,867		
	Oak Ridge	1.4	6,431		
	All others	3.9	37,124		
Centralized storage at single DOE site	INEEL	1.5	639	12.7	71,195
	PGDP	<0.1	8	14.2	71,826
	PORTS	4.4	24,765	9.8	47,069
	SRS	3.0	2,867	11.2	68,967
	Oak Ridge	1.4	6,431	12.8	65,403
Centralized storage at single commercial site	East, West	N/A	N/A	14.2	71,834
Partially consolidated storage at several DOE sites	INEEL	1.5	639	1.7	21,391
	PGDP	<0.1	8	0.4	400
	PORTS	4.4	24,765	1.4	13,458
	SRS	3.0	2,867	<0.1	63
	Oak Ridge	1.4	6,431	0.4	1,812
Partially consolidated storage at two DOE sites	PORTS	4.4	24,765	6.6	49,705
	INEEL	1.5	639	1.7	22,129
Partially consolidated storage at two commercial sites	East	N/A	N/A	11.0	49,705
	West	N/A	N/A	3.2	22,129

Table A.3. Uranium management interim storage inventories (continued)

Alternative	Site/form	Current storage		Additional materials to be moved	
		Amount, 10^3 MTU	Number of containers	Amount, 10^3 MTU	Number of containers
Partially consolidated storage based on physical form	Compound (PORTS)	1.7	7,221	<0.1	1,034
	Metal (SRS)	2.9	1,088	6.0	32,918
	Misc (PORTS)	0	0	1.2	4,998
	Oxide (PORTS)	0.9	15,333	0.5	7,807
	Reactfuel (INEEL)	0.5	184	0.4	827
	Residue (INEEL)	<0.1	55	<0.1	174
	Source (INEEL)	<0.1	8	<0.1	187

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
MTU = metric tons of uranium.
N/A = not applicable.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table A.4. Uranium management disposition option inventories

Disposition option	Description	Material type(s)	Amount (10^3 MTU)	Number of containers
Commercial processing/domestic sales	All material transferred from interim storage to a single commercial processing facility or single sales distribution point (east or west)	All	14.2	71,834
Transfer to research facilities	Transfer ~50 MTU from interim storage to the furthest DOE or other research location	DU, NU LEU	0.05 0.05	204 844
Transfer to other government agencies	Transfer ~2,500 MTU from interim storage to unspecified location (use furthest distance already evaluated)	DU, NU LEU	2.5 2.5	10,186 42,188
Foreign sales	All LEU/NU (~4,050 MTU) transferred to eastern or western port for overseas shipment	LEU NU	3.3 0.7	56,408 1,432

DOE = U.S. Department of Energy.
DU = depleted uranium.
LEU = low-enriched uranium.
MTU = metric tons of uranium.
N/A = not applicable.
NU = normal uranium.

An additional activity to be evaluated for each alternative is the potential to ship small quantities [<0.01 metric tons of uranium (MTU)] from any storage location, either centralized or consolidated, to a second location such as a university or commercial facility.

A.2 ROUTINE OPERATIONS

During storage or disposition of uranium materials at any of the proposed sites, workers could be exposed to direct radiation from surface contamination on storage containers. However, all containers will have been checked, overpacked if necessary, and certified for transport before storage. Therefore, worker exposure due to routine operations associated with surveillance and maintenance of uranium materials is expected to be less than detectable levels.

In addition to surface contamination, radiation dose from the uranium materials can be expected. Dose rates from any single container are no more than 3 to 4 mrem/h. The dose rate at a distance of 0.3 m (1 ft) from a container is ~1 mrem/h, and the rate at a distance of 6 m (20 ft) is <0.05 mrem/h (approximately the same as normal background radiation doses). These dose rates are not affected by stacking the containers, because the containers and the materials themselves provide significant shielding. These dose rates are considered negligible to any receptor (e.g., facility worker, co-located worker, or public).

A.3 ACCIDENTS

Accidents that could occur under the proposed storage alternatives and disposition options are analyzed in this section. Potential accidents could be initiated during initial packaging, transportation of materials to one or more centralized or consolidated storage locations, storage, and transportation to one or more disposition options. Accidents can also be caused by natural phenomena (earthquake and wind). Reasonably foreseeable accidents have been screened, and the accidents with the greatest consequences to co-located workers and the public have been identified. These are the "bounding" accidents that provide an envelope for the consequences of other accidents with less impact.

Each consolidated or centralized storage location or disposition site is assumed to consist of one or more areas dedicated to the storage (either interim or until further processing or disposition occurs) of uranium materials. Fire-suppression systems may be available for storage or disposition in existing buildings. On-site fire department response, however, is assumed for all storage alternatives and disposition options.

A.3.1 Postulated Accident Scenarios

A hazard survey of the activities involved in packaging, transporting, and storing various forms and quantities of uranium was conducted for six potential storage locations and two generic commercial locations. The hazards identified for the storage alternatives are considered bounding for any accidents that might occur during the disposition options. The primary focus of the hazard survey was to identify those specific hazards that exist for each identified alternative and to evaluate the potential for that hazard to develop into an accident.

Accidents that could occur during implementation of the proposed action(s) can be grouped into two classes. As shown in Table A.5, these classes are fire and container breach. The accidents shown in Table A.5 are determined to be "credible," a term that is used in safety analysis to mean that the accident has an annual probability of 1E-6 or greater. Evaluation of accident frequency is largely qualitative and results in an estimate of the postulated accident scenarios' frequencies of occurrence. These are then assigned to high, moderate, low, or negligible categories of frequency, such as in the example shown in Table A.6. This table is adapted from CCPS (1992) and is similar to a table given in DOE (1994a).

The accidents shown in Table A.5 were selected to represent the range of postulated accidents that could occur under the proposed alternatives. Accidents are shown for general handling and storage operations and are applicable for all alternatives except as noted. Bounding accidents are selected for each major type of event in order to establish maximum consequences and risks for each alternative. These bounding accidents are discussed below.

Table A.5. Postulated accidents identified for uranium management activities

Activity	Operational events: Fire	Operational events: Container breach	External events: Natural phenomena
Packaging, handling, loading, and unloading (not applicable for No Action alternative)	Forklift fire affecting small number of containers	Forklift impact with stored containers Container(s) dropped during handling	Not applicable Containers handled for short period of time
Transportation (not applicable for No Action alternative)	Transport vehicle fire	Transport vehicle accident	Not applicable Containers handled for short period of time
General handling in storage or disposition facility	Forklift fire affecting small number of containers	Forklift impact with stored containers Container(s) dropped during handling	Not applicable Containers handled for short period of time
Storage or processing (includes surveillance and maintenance)	Large fire affecting multiple containers in single area	Forklift impact with containers	Direct release, small fires in storage or processing area
	Small fire affecting limited number of containers	Corrosion, degradation of containers	

Table A.6. Frequency classes considered in accident analysis

Frequency category	Estimated annual frequency of occurrence	Description
Anticipated	f > 1E-2	Incidents that may occur several times during the lifetime of the facility (incidents that occur commonly).
Unlikely	1E-2 ≥ f > 1E-4	Accidents that are not anticipated to occur during the lifetime of the facility. Natural phenomena of this probability class include design basis earthquake, 100-year flood, maximum wind gust, etc.
Extremely unlikely	1E-4 ≥ f > 1E-6	Accidents that will probably not occur during the life cycle of the facility. This class includes most design basis accidents.
Beyond extremely unlikely	f < 1E-6	Accidents that are not credible.

A.3.1.1 Fires

Fires resulting in releases of uranium are postulated for handling, transportation, storage, and disposition operations. The types of fire include gasoline/diesel fuel fires caused by forklift accidents, transport vehicle fires, and building fires that spread to involve multiple containers. Due to activation of the fire-suppression system and/or fire department response, a building fire would be limited to a relatively small area. This is an extremely unlikely event due to minimal ignition sources and combustible loading. Forklift fires, involving limited numbers of containers, are more likely but result in substantially smaller releases to the atmosphere.

A.3.1.2 Container breach

Container breach includes events such as releases from leaking (primarily due to long-term corrosion); forklift puncture during movement of other containers; dropping during packaging, loading, placement into interim storage, or movement in a disposition facility; and damage as the result of a transport vehicle accident.

Single-container handling accidents are considered "bounding"; these events dominate the risk to workers because of their relatively high frequency and the proximity of the workers to any such release. Such events include overpacking containers prior to shipment, and moving containers to/from loading docks during shipment/receipt. These activities are prone to mechanical stresses in industrial accidents such as drops or punctures by a forklift; however, airborne releases resulting from breaches in a single container are relatively insignificant compared with releases involving fires. As a result, these events usually constitute little hazard to the general public.

A.3.1.3 Natural phenomena

Natural phenomena events, such as high wind and earthquake, have the potential to cause damage to buildings and structures leading to consequences that equal or exceed the consequences of operational events. With respect to natural phenomena, each potential storage or disposition location can be considered Performance Category 3 (PC-3) in accordance with DOE guidelines (DOE 1993). In accordance with DOE criteria (DOE 1994b), PC-2 facilities are required to withstand the earthquake, tornado, and high wind intensities shown in Table A.7. Although not explicitly determined, it is assumed that the uranium storage and disposition facilities are Hazard Category 2 (HC-2) facilities based on DOE criteria (DOE 1992). The frequencies shown in Table A.7 represent the frequencies of facility failure under challenge from natural phenomena.

Table A.7. Natural phenomena intensities

Event	Site	Intensity	Frequency/year
Earthquake	INEEL	0.17g	5E-4
	PGDP	0.35g	
	PORTS	0.19g	
	SRS	0.18g	
	Oak Ridge	0.19g	
	Generic eastern (assumed same as PORTS)	0.19g	
	Generic western (assumed same as INEEL)	0.17g	
Tornado	INEEL	N/A	2E-5
	PGDP	144 mph	
	PORTS	110 mph	
	SRS	137 mph	
	Oak Ridge	113 mph	
	Generic eastern	110 mph	
	Generic western	N/A	
Straight wind	All	70 mph	1E-3

INEEL = Idaho National Engineering and Environmental Laboratory.
mph = miles per hour.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

During the seismic event defined above, all facility structures are assumed to be destroyed, and nothing but rubble remains. All utilities, including fire suppression, are lost. All releases are at ground level. Hazardous materials that can be suspended in air in respirable form and be available for transport are considered to be released from direct seismic accelerations.

Following the direct seismic event, a number of small fires may occur due to electrical shorts or downed power lines. Any fires would be scattered throughout the rubble and would be exposed to the outside elements, since no building structure remains. The top layer of rubble would consist primarily of noncombustible materials such as reinforced concrete and structural steel from buildings, or structural supports from tension-support structures. The fire is assumed to be slow-burning amid rubble and fallen/breached containers. All fire mitigation facilities are assumed destroyed, and all roadways are blocked by debris. Therefore, there is no fire mitigation by either the on-site fire department or other outside agencies.

Seismic events are used as the surrogate initiator for straight winds or tornadoes, because standard atmospheric dispersion modeling predicts greater dispersion (and, therefore, greatly reduced airborne concentration) for high wind conditions than for the stable wind conditions assumed to be present during earthquakes (Hanna et al. 1982). Existing analyses in DOE safety analysis reports suggest that seismic events generally bound the risks of winds or tornadoes, including the risks from wind-driven projectiles. With respect to such projectiles, unpublished preliminary analyses for waste drums stored on outdoor pads show that damage from projectiles could exceed damage caused by seismic events primarily because of the stability of the drum-stacking arrangement and the lack of protection against projectiles. The same phenomenon is assumed to apply to the containers proposed for uranium storage and disposition. To appropriately bound potential damage by projectiles to unprotected areas, the damage assumed for seismic events is conservatively defined to have higher damage ratios than those that might otherwise be used to bound the damage caused by high winds or wind-driven projectiles.

A.3.2 Development of Source Terms for Accident Sequences

The approach taken in this assessment is to convert material-at-risk (MAR) quantities to atmospheric source terms using conservative release factors (Hanna et al. 1982). These source term factors, based on DOE (1994c), take into account the physical mechanism through which material becomes airborne as well as the fraction of airborne materials in the respirable particle size range (<10 microns). The source term associated with each accident is the product of four factors that vary for type of materials affected by the accident:

$$\text{Source term} = MAR \times DR \times ARF \times RF \ ,$$

where

MAR = material at risk,
DR = damage ratio,
ARF = airborne release fraction,
RF = respirable fraction.

A.3.3 Evaluation of Source Term Parameters and Frequencies

This section describes the development of frequency and source term data for handling, transportation, storage, and disposition accidents.

A.3.3.1 Container breach accidents

The dominant contributor to worker risk from hazardous material releases is expected to result from mechanical breaches of containers during handling accidents. This expectation stems from the relatively high frequency of such occurrences and the proximity of the worker to the point of release in such events. Handling accidents include container breaches caused by drops or by impact from forklifts or other vehicles. Although one container would generally be breached in an accident, rupture of multiple containers could occur in instances when several containers are being handled at a time.

Source Term Parameters. The MAR for handling activities generally varies from one to four drums, depending on the method of stacking and the arrangement of the array. The maximum MAR for each physical form of material and container type is shown in Table A.8. The damage ratio (DR) for the MAR depends on several factors, including the physical form of the MAR and the severity of the accident stress. In general, breached containers with solid uranium forms (i.e., metal, reactfuel, source) are assumed to have DRs no greater than 0.10 (i.e., no more than 10% of the material is directly impacted or damaged by the event). For other containers with oxides or other unspecified forms, the single-container DR is assumed to be 0.25. The combined airborne release fraction (ARF) × respirable fraction (RF) for oxides and other forms subjected to free-fall spill and impaction stress is ~1E-5. The combined ARF × RF for solid materials is essentially negligible but is estimated to be 1E-6 as a conservative assumption.

Table A.8. Source term parameters for container breach accidents

Physical form	Type of container	DR	ARF × RF
Compound	Drum	0.25	1E-5
Metal	Metal box	0.10	1E-6
	Drum		
Miscellaneous	Drum	0.25	1E-5
Oxide	Metal box	0.25	1E-5
	Drum		
Reactfuel	Metal box	0.10	1E-6
	Drum		
Residue	Drum	0.25	1E-5
Source	Drum	0.25	1E-5

ARF = airborne release fraction.
DR = damage ratio.
RF = respirable fraction.

Frequency. On the basis of numerous studies evaluated for other environmental impact statements, a probability of one handling error per 10,000 containers handled is used in this analysis (WSRC 1994). It is assumed that two severe breaches of confinement occur for each inventory of 10,000 containers handled. All containers will be packaged, loaded for transport, and moved into an interim storage location within a relatively short period of time (assumed to be no more than 6 months). All containers will be handled again for transport to a disposition option. Based on the estimated total number of containers handled at any given location (see Tables A.3 and A.4), the frequency of container breach due to handling accidents is >1E-2/year (anticipated).

A.3.3.2 Facility fires

For the purposes of this assessment, fire in a storage or disposition facility is assumed to bound the risk to workers and the public from fires involving smaller numbers of containers due to forklift or other vehicle accidents. This event is a facility fire mitigated by the fire-suppression system and/or fire department response, and involves a limited area at a storage or disposition location.

Source Term Parameters. The MAR is assumed to be no more than 10% of the inventory at a storage or disposition location under any alternative (see Tables A.2 and A.3). The DR for materials in metal containers exposed to fires is 0.1. In addition, no more than 10% of the surface area of the solid forms (i.e., metal, reactfuel, and source) are exposed to the fire and subject to oxidation (overall DR of 0.01 for these materials). The ARF and RF for airborne release of particulates during relatively low-temperature (<900°C) oxidation are 1E-4 and 1.0, respectively. For composite solids (all other physical forms), the ARF and RF are 6E-3 and 1E-2, respectively.

Frequency. Although fire data from DOE sites indicate that facility fires are credible, fires of this magnitude in storage or disposition facilities with low combustible loading and limited ignition sources are considered unlikely.

A.3.3.3 Seismic event

The dominant contributor to risk from uranium releases is expected to result from breaches of containers in an earthquake followed by a number of small fires. The event would impact all containers in a facility.

Source Term Parameters. The MAR is shown in Tables A.3 and A.4. The DR for the direct release is based on an evaluation of waste container storage in a DOE facility similar to those that might be used for storing these materials (Hand 1998). Overall DRs for stacked storage containers include the following:

- Five percent of the containers on the lowest level fall, as do 10% from the middle layer(s) and 15% from the top layer, for an overall fraction of 10% for containers falling from stacked storage arrays. This fraction applies to DU and NU materials that are stacked four high, and is conservative for LEU materials that are only stacked two high.

- Of the containers that fall, ~25% are breached.

- Of the containers that are breached, ~25% of the material is spilled outside the container for solid materials and 100% for composite materials.

Therefore, the DRs for materials initially released during a seismic event are:

- Solids: $DR = 0.10 \times 0.25 \times 0.25 = 0.00625$.

- Composites: $DR = 0.10 \times 0.25 \times 1.0 = 0.025$.

The combined ARF × RFs for solids and composite forms are the same as those for container handling events. Release factors for subsequent fires are the same as those described for facility fires; however, the MAR is 10% of the actual inventory because the fires are small, distributed throughout the facility, and impact only the outside layers of the rubble and fallen/breached containers.

Frequency. The annual frequencies of seismic events exceeding the design basis for HC-2 facilities were shown in Table A.7. Conditional probabilities are estimated to be 0.10 for inducing a number of unmitigated fires. The overall frequency for each site is, therefore, 5E-5/year (extremely unlikely).

A.3.4 Results

Radiological and toxicological source terms and consequences for the bounding accident scenarios are discussed in this section.

A.3.4.1 Source terms for bounding accident scenarios

Radiological airborne source terms are estimated based on MARs and release parameters identified in Sect. A.3.3 and are expressed in units of grams. The activity (Ci/g) for each type of material released is based on an assumed 20% ^{235}U for low-enriched uranium with a specific activity of 7.0E-7 Ci/g. This activity is considered bounding for all types of uranium considered in this evaluation because the actual distribution of material is ~71% depleted uranium, which has a specific activity of ~3.4E-7 Ci/g. The higher activity is used to estimate all radiological airborne source terms in units of curies. These source term estimates are shown in Table A.9 for the interim storage alternatives and disposition options. For the disposition options, it is assumed that the maximum amount for each option (shown in Table A.4) is moved to a single disposition location. The distribution of physical form of the materials included in the transfer to research facility and transfer to other government agency is assumed to be the same as the overall distribution of physical forms shown in Table A.1. The distribution of physical form for the foreign sales option is the same as that for the entire inventory of 4050 MTU of LEU/NU included in that option.

Toxicological airborne release rates are estimated based on an assumed release duration of 1 h for the total amount released and are expressed in units of mg/sec. These release rate estimates are also shown in Table A.9.

Table A.9. Source terms due to bounding accident scenarios

Alternative/ Option	Accident scenario	Site	Airborne source term, Ci	Airborne release rate, mg/sec
All	General container handling	All	1.71E-06	1.84E+00
No Action	Facility fire	INEEL	1.08E-04	4.28E+01
		PGDP	4.38E-07	1.74E-01
		PORTS	1.25E-03	4.94E+02
		SRS	2.46E-04	9.78E+01
		Oak Ridge	1.18E-04	4.69E+01
		Max other[a]	1.46E-04	5.79E+01
	Seismic (direct release)	INEEL	7.32E-06	2.90E+00
		PGDP	1.83E-07	7.25E-02
		PORTS	4.77E-04	1.89E+02
		SRS	3.11E-05	1.23E+01
		Oak Ridge	1.46E-05	5.80E+00
		Max other[a]	6.08E-05	2.41E+01
No Action (continued)	Seismic (fire)	INEEL	7.05E-06	2.80E+00
		PGDP	1.10E-07	4.35E-02
		PORTS	2.89E-04	1.15E+02
		SRS	2.37E-05	9.40E+00
		Oak Ridge	1.12E-05	4.45E+00
		Max other[a]	3.65E-05	1.45E+01

Table A.9. Source terms due to bounding accident scenarios (continued)

Alternative/ Option	Accident scenario	Site	Airborne source term, Ci	Airborne release rate, mg/sec
Centralized storage at a single site (includes commercial processing/domestic sales disposition option)	Facility fire	All	2.56E-03	1.01E+03
	Seismic (direct release)	All	8.24E-04	3.27E+02
	Seismic (fire)	All	5.11E-04	2.03E+02
Partially consolidated storage at several DOE sites	Facility fire	INEEL	2.49E-04	9.89E+01
		PGDP	3.73E-05	1.48E+01
		PORTS	1.73E-03	6.80E+02
		SRS	2.52E-04	1.00E+02
		Oak Ridge	3.04E-04	1.21E+02
	Seismic (direct release)	INEEL	2.67E-05	1.06E+01
		PGDP	7.50E-06	2.98E+00
		PORTS	6.64E-04	2.63E+02
		SRS	3.35E-05	1.33E+01
		Oak Ridge	9.21E-05	3.66E+01
	Seismic (fire)	INEEL	2.15E-05	8.52E+00
		PGDP	5.07E-06	2.01E+00
		PORTS	4.02E-04	1.59E+02
		SRS	2.51E-05	9.97E+00
		Oak Ridge	5.77E-05	2.29E+01
Partially consolidated storage at two sites	Facility fire	East	2.30E-03	9.13E+02
		West	2.57E-04	1.02E+02
	Seismic (direct release)	East	7.94E-04	3.15E+02
		West	2.99E-05	1.19E+01
	Seismic (fire)	East	4.88E-04	1.94E+02
		West	2.34E-05	9.29E+00
Partially consolidated storage based on physical form	Facility fire	PORTS	1.86E-03	4.38E+02
		SRS	6.22E-04	2.47E+02
		INEEL	7.60E-05	3.01E+01
	Seismic (direct release)	PORTS	7.75E-04	3.07E+02
		SRS	3.89E-05	1.54E+01
		INEEL	1.01E-05	4.01E+00
	Seismic (fire)	PORTS	4.65E-04	1.84E+02
		SRS	3.89E-05	1.54E+01
		INEEL	7.58E-06	3.01E+00
Transfer to research facility	Facility fire	Generic	8.98E-06	3.56E+00
	Seismic (direct release)	Generic	2.89E-06	1.15E+00
	Seismic (fire)	Generic	1.80E-06	7.13E-01
Transfer to other government agency	Facility fire	Generic	4.49E-04	1.78E+02
	Seismic (direct release)	Generic	1.45E-04	5.74E+01
	Seismic (fire)	Generic	8.98E-05	3.56E+01

Table A.9. Source terms due to bounding accident scenarios (continued)

Alternative/ Option	Accident scenario	Site	Airborne source term, Ci	Airborne release rate, mg/sec
Foreign sales	Facility fire	Generic	8.88E-04	3.52E+02
	Seismic (direct release)	Generic	3.12E-04	1.24E+02
	Seismic (fire)	Generic	1.91E-04	7.60E+01

[a]Max other represents the largest single amount at any site other than the DOE consolidated storage locations.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

A.3.4.2 Consequences for bounding accident scenarios

Consequences to facility workers, co-located workers (assumed to be 100 m from the release point), and the public are estimated for each bounding accident scenario for each storage or disposition location. For the facility worker and co-located worker, the consequences are the same regardless of site. For the public, consequences vary depending on distances to the site boundaries. Distances and associated dispersion parameters for each site are shown in Table A.10 for ground-level releases (container breach events and direct seismic event).

Table A.10. Distances and dispersion parameters for ground-level releases

Storage location	Distance to site boundary, m	Dispersion parameter χ/Q, sec/m^3
INEEL	526	1.56E-03
PGDP	511	1.56E-03
PORTS	715	8.47E-04
SRS	727	8.47E-04
Oak Ridge	537	1.56E-03
Generic eastern (assumed same as PORTS)	N/A	8.47E-04
Generic western (assumed same as INEEL)	N/A	1.56E-03
Max other; disposition options (worst-case)	N/A	1.56E-03

INEEL = Idaho National Engineering and Environmental Laboratory.
N/A = not applicable.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

For fires, the release point is elevated due to hot air buoyancy effects from fires. Although not specifically evaluated, the release height is estimated based on the model described in U.S. Army (1981). The maximum dispersion parameter occurs at a distance of 270 m from the release point for an elevated release. This value (3.51E-04 sec/m^3) is used for releases due to fires for all sites regardless of distance to the site boundary and is, therefore, conservative (i.e., dispersion parameters due to elevated releases for receptors located at other distances are lower).

Dispersion parameters are based on a point-source Gaussian dispersion model described by Hand et al. (1982) and are evaluated for F-Class wind stability with wind speed of 1.5 m/sec. All receptors are considered to be at ground level.

Consequences are shown in Tables A.11 and A.12 for all receptors. Other parameters used in estimating consequences include the following:

- Breathing rate of 3.3E-4 m^3/sec based on recommendations from the International Commission on Radiological Protection.

- Inhalation 50-year committed effective dose equivalent dose conversion factor for uranium of 1.2E+8 rem/Ci (DOE 1988).

- Consequences to facility workers based on instantaneous dispersion into a hemisphere 10 m in diameter. The worker walks through the hemisphere at a rate of 1 m/sec for a maximum exposure time of 10 sec. Consequences to facility workers during fires or natural phenomena events are considered to be negligible because these workers are assumed to evacuate the area before significant exposure can occur. This assumption is based on standard DOE site emergency response procedures that require facility worker evacuation in the event of accidents.

For fires, it is assumed that the co-located worker and the public are both exposed to the maximum downwind consequences. This is a conservative assumption because, in most cases, the location of maximum consequence occurs at a distance beyond the location of the co-located worker (i.e., 270 m vs. 100 m for the co-located worker). If actual dispersion parameters for elevated releases and receptors at 100 m were used, the estimated consequences would be significantly less.

Exposure duration is assumed to be the same as release duration for all events. This is a conservative assumption for fires, because downwind receptors are not likely to remain in a smoke plume once a fire is detected, and fire duration is several hours. For container handling events or direct release from a seismic event, it is also a conservative assumption because the material forms are such that no hazardous materials must become dislodged before they become airborne, and the overall release rate is slow relative to the rate of uptake by the receptor.

Table A.11. Radiological consequences due to bounding accident scenarios

Alternative/ Option	Accident scenario	Site	Radiological consequences, rem: Facility worker	Co-located worker	Public	Maximum consequence category
All	General container handling	INEEL, PGDP, Oak Ridge	7.08E-03	6.36E-03	2.89E-04	Negligible
		PORTS, SRS	7.08E-03	6.36E-03	1.57E-04	Negligible
No Action	Facility fire	INEEL	Negligible	1.51E-03	1.51E-03	Negligible
		PGDP	Negligible	6.15E-06	6.15E-06	Negligible
		PORTS	Negligible	1.75E-02	1.75E-02	Negligible
		SRS	Negligible	3.46E-03	3.46E-03	Negligible
		Oak Ridge	Negligible	1.66E-03	1.66E-03	Negligible
		Max other[a]	Negligible	2.05E-03	2.05E-03	Negligible
	Seismic	INEEL	Negligible	1.01E-02	5.55E-04	Negligible
		PGDP	Negligible	2.52E-04	1.29E-05	Negligible
		PORTS	Negligible	6.57E-01	2.02E-02	Negligible
		SRS	Negligible	4.29E-02	1.38E-03	Negligible
		Oak Ridge	Negligible	2.02E-02	1.07E-03	Negligible
		Max other[a]	Negligible	8.39E-02	4.30E-03	Negligible
Centralized storage at a single site (includes commercial processing/ domestic sales disposition option)	Facility fire	All	Negligible	3.59E-02	3.59E-02	Negligible
	Seismic	INEEL, PGDP, Oak Ridge	Negligible	1.14E+00	5.85E-02	Low
		PORTS, SRS	Negligible	1.14E+00	3.50E-02	Low
Partially consolidated storage at several DOE sites	Facility fire	INEEL	Negligible	3.50E-03	3.50E-03	Negligible
		PGDP	Negligible	5.23E-04	5.23E-04	Negligible
		PORTS	Negligible	2.40E-02	2.40E-02	Negligible
		SRS	Negligible	3.53E-03	3.53E-03	Negligible
		Oak Ridge	Negligible	4.27E-03	4.27E-03	Negligible
	Seismic	INEEL	Negligible	3.69E-02	1.97E-03	Negligible
		PGDP	Negligible	1.03E-02	5.39E-04	Negligible
		PORTS	Negligible	9.15E-01	2.81E-02	Negligible
		SRS	Negligible	4.67E-02	1.49E-03	Negligible
		Oak Ridge	Negligible	1.27E-01	6.55E-03	Negligible
Partially consolidated storage at two sites	Facility fire	East	Negligible	3.23E-02	3.23E-02	Negligible
		West	Negligible	3.61E-03	3.61E-03	Negligible
	Seismic	East	Negligible	1.09E+00	3.37E-02	Low
		West	Negligible	4.14E-02	2.19E-03	Negligible

Table A.11. Radiological consequences due to bounding accident scenarios

Alternative/ Option	Accident scenario	Site	Radiological consequences, rem: Facility worker	Radiological consequences, rem: Co-located worker	Radiological consequences, rem: Public	Maximum consequence category
Partially consolidated storage based on physical form	Facility fire	PORTS	Negligible	1.07E+00	3.27E-02	Low
		SRS	Negligible	5.38E-02	1.86E-03	Negligible
		INEEL	Negligible	1.40E-02	7.36E-04	Negligible
	Seismic	PORTS	Negligible	6.51E-01	2.00E-02	Negligible
		SRS	Negligible	4.96E+00	1.52E-01	Low
		INEEL	Negligible	5.43E-03	2.99E-04	Negligible
Transfer to research facility	Facility fire	Generic	Negligible	1.26E-04	1.26E-04	Negligible
	Seismic	Generic	Negligible	3.99E-03	2.06E-04	Negligible
Transfer to other government agency	Facility fire	Generic	Negligible	6.30E-03	6.30E-03	Negligible
	Seismic	Generic	Negligible	2.00E-01	1.03E-02	Negligible
Foreign sales	Facility fire	Generic	Negligible	1.25E-02	1.25E-02	Negligible
	Seismic	Generic	Negligible	4.31E-01	2.22E-02	Negligible

[a]Max other represents the largest single amount at any site other than the DOE consolidated storage locations.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table A.12. Toxicological consequences due to bounding accident scenarios

Alternative/ Option	Accident scenario	Site	Toxicological consequences, mg/m^3 Facility worker	Co-located worker	Public	Maximum consequence category
All	General container handling	INEEL, PGDP, Oak Ridge	7.03E-02	6.32E-02	2.87E-03	Negligible
		PORTS, SRS	7.03E-02	6.32E-02	1.56E-03	Negligible
No Action	Facility fire	INEEL	Negligible	1.50E-02	1.50E-02	Negligible
		PGDP	Negligible	6.11E-05	6.11E-05	Negligible
		PORTS	Negligible	1.74E-01	1.74E-01	Low
		SRS	Negligible	3.43E-02	3.43E-02	Negligible
		Oak Ridge	Negligible	1.65E-02	1.65E-02	Negligible
		Max other[a]	Negligible	2.03E-02	2.03E-02	Negligible
	Seismic	INEEL	Negligible	1.01E-01	5.51E-03	Negligible
		PGDP	Negligible	2.50E-03	1.28E-04	Negligible
		PORTS	Negligible	6.53E+00	2.00E-01	Low
		SRS	Negligible	4.26E-01	1.37E-02	Negligible
		Oak Ridge	Negligible	2.00E-01	1.06E-02	Negligible
		Max other[a]	Negligible	8.33E-01	4.27E-02	Negligible
Centralized storage at a single site (includes commercial processing/domestic sales disposition option)	Facility fire	All	Negligible	3.56E-01	3.56E-01	Low
	Seismic	INEEL, PGDP, Oak Ridge	Negligible	1.13E+01	5.81E-01	High
		PORTS, SRS	Negligible	1.13E+01	3.48E-01	High
Partially consolidated storage at several DOE sites	Facility fire	INEEL	Negligible	3.47E-02	3.47E-02	Negligible
		PGDP	Negligible	5.19E-03	5.19E-03	Negligible
		PORTS	Negligible	2.39E-01	2.39E-01	Low
		SRS	Negligible	3.51E-02	3.51E-02	Negligible
		Oak Ridge	Negligible	4.24E-02	4.24E-02	Negligible
	Seismic	INEEL	Negligible	3.66E-01	1.95E-02	Negligible
		PGDP	Negligible	1.03E-01	5.35E-03	Negligible
		PORTS	Negligible	9.09E+00	2.79E-01	Low
		SRS	Negligible	4.59E-01	1.47E-02	Negligible
		Oak Ridge	Negligible	1.26E+00	6.51E-02	Low

Table A.12. Toxicological consequences due to bounding accident scenarios

Alternative/ Option	Accident scenario	Site	Toxicological consequences, mg/m^3: Facility worker	Toxicological consequences, mg/m^3: Co-located worker	Toxicological consequences, mg/m^3: Public	Maximum consequence category
Partially consolidated storage at two sites	Facility fire	East	Negligible	1.09E+01	3.35E-01	High
		West	Negligible	4.11E-02	2.18E-02	Negligible
	Seismic	East	Negligible	5.53E+01	1.70E+00	High
		West	Negligible	4.31E-01	2.29E-02	Negligible
Partially consolidated storage based on physical form	Facility fire	PORTS	Negligible	2.59E-01	2.59E-01	Low
		SRS	Negligible	8.66E-02	8.66E-02	Negligible
		INEEL	Negligible	1.06E-02	1.06E-02	Negligible
	Seismic	PORTS	Negligible	1.06E+01	3.25E-01	High
		SRS	Negligible	5.34E-01	1.85E-02	Negligible
		INEEL	Negligible	1.39E-01	7.31E-03	Negligible
Transfer to research facility	Facility fire	Generic	Negligible	1.25E-03	1.25E-03	Negligible
	Seismic	Generic	Negligible	3.96E-02	2.04E-03	Negligible
Transfer to other government agency	Facility fire	Generic	Negligible	6.26E-02	6.26E-02	Negligible
	Seismic	Generic	Negligible	1.98E+00	1.02E-01	Negligible
Foreign sales	Facility fire	Generic	Negligible	1.24E-01	1.24E-01	Low
	Seismic	Generic	Negligible	4.28E+00	2.20E-01	Low

[a]Max other represents the largest single amount at any site other than the DOE consolidated storage locations.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Tables A.11 and A.12 also indicate the maximum consequence level for each scenario for each alternative. These levels are based on consequence categories shown in Tables A.13 and A.14. These are based on prevailing regulations, DOE Orders, and other DOE standards such as "DOE 1994d."

Table A.13. Consequence categories for public exposure

		Consequence level	
Consequence category	**Description**	**Radiological**	**Toxicological**
Negligible	Less than low off-site impact	≤0.1 rem	<0.1 × ERPG-2
Low	Negligible off-site impact	>0.1 to ≤5 rem	≤ERPG-2
Moderate	Minor off-site impact	>5 to ≤25 rem	Not defined (subjective)
High	Considerable off-site impact	>25 rem	>ERPG-2

ERPG = Emergency Response Planning Guideline.

Table A.14. Consequence categories for worker exposure

		Consequence level	
Consequence category	**Description**	**Radiological**	**Toxicological**
Negligible	Negligible on-site impact	≤1 rem	<0.1 x IDLH
Low	Minor on-site impact	>1 to ≤5 rem	≤IDLH
Moderate	Moderate on-site impact	>5 to ≤100 rem	Not defined (subjective)
High	Considerable on-site impact	>100 rem	>IDLH

IDLH = Immediately Dangerous to Life and Health.

The toxicological consequence levels are expressed in terms of Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association. ERPG-2 is defined as a threshold concentration that, for exposures of up to 1 h, will not produce irreversible health effects in the large majority of the general population. This value (1 mg/m^3 for uranium) is applied for public exposure. However, for workers, the Immediately Dangerous to Life and Health (IDLH) value is more appropriate. This value (10 mg/m^3 for uranium) is based on effects that might occur to unprotected workers as a consequence of a 30-min exposure. Therefore, IDLH values as defined by the National Institute for Occupational Safety and Health (NIOSH 1997) are used to define high consequences to facility and co-located workers.

A.4 PUBLIC AND WORKER RISK SUMMARY

Public and worker risks due to normal operations and accidents are shown in Table A.15. The risk categories are based on the accident frequency and maximum radiological or toxicological consequence level as shown in Fig. A.1. These accident scenarios that fall within Regions 7, 8, and 9 of the matrix are considered high risk, and those that fall within Regions 4, 5, and 6 are considered moderate risk. Those accident scenarios that fall within Regions 1 through 3 of the matrix are considered low risk and represent less than a marginal concern.

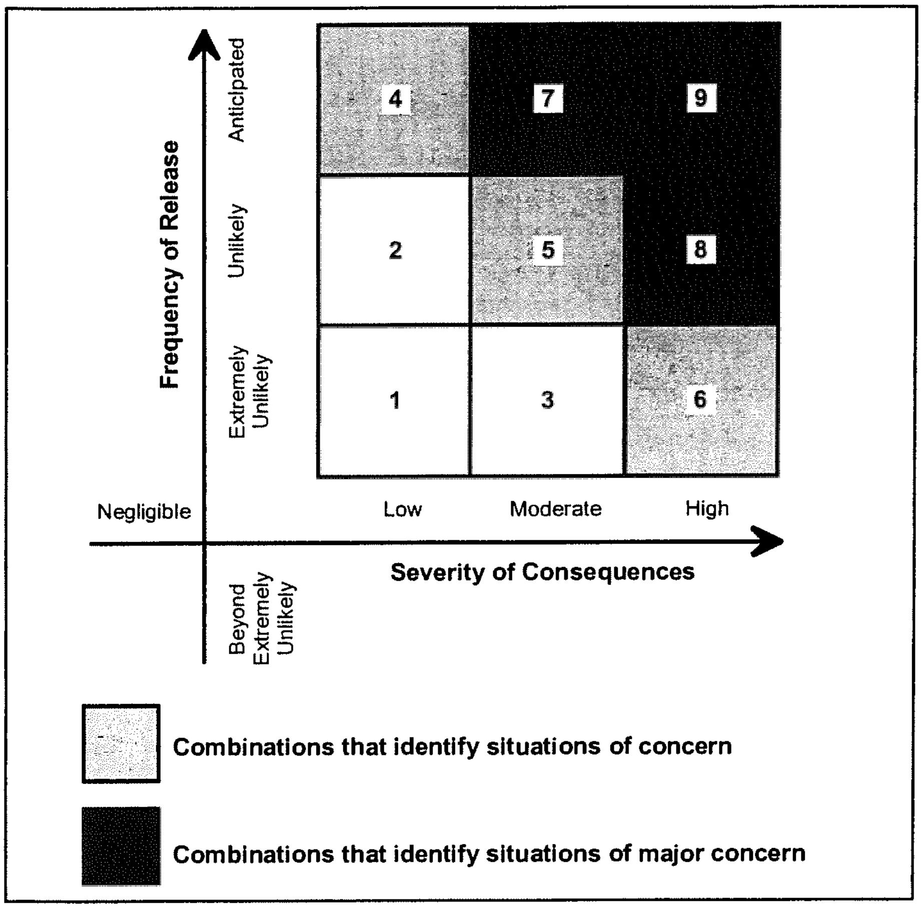

Fig. A.1. Frequency and consequence ranking matrix.

Table A.15. Risks due to normal operations and accidents

Alternative/Option	Accident scenario	Site	Frequency	Maximum radiological consequence	Maximum toxicological consequence	Risk
All	Normal operations	All	Anticipated	Negligible	Negligible	Negligible
All	General handling events	All	Anticipated	Negligible	Negligible	Negligible
No Action	Facility fire	INEEL, PGDP, SRS, Oak Ridge, Max other[a]	Unlikely	Negligible	Negligible	Negligible
		PORTS		Negligible	Low	Low
	Seismic	INEEL, PGDP, SRS, Oak Ridge, Max other[a]	Extremely unlikely	Negligible	Negligible	Negligible
		PORTS		Negligible	Low	Low
Centralized storage at a single site (includes commercial processing/domestic sales disposition option)	Facility fire	All	Unlikely	Negligible	Low	Low
	Seismic	All	Extremely unlikely	Low	High	Moderate
Partially consolidated storage at several DOE sites	Facility fire	INEEL, PGDP, SRS, Oak Ridge	Unlikely	Negligible	Negligible	Negligible
		PORTS		Negligible	Low	Low
	Seismic	INEEL, PGDP, SRS, Oak Ridge	Extremely unlikely	Negligible	Negligible	Negligible
		PORTS		Negligible	Low	Low
Partially consolidated storage at two sites	Facility fire	East	Unlikely	Negligible	Low	Low
		West		Negligible	Negligible	Negligible
	Seismic	East	Extremely unlikely	Low	High	Moderate
		West		Negligible	Negligible	Negligible
Partially consolidated storage based on physical form	Facility fire	PORTS	Unlikely	Negligible	Low	Low
		INEEL, SRS		Negligible	Negligible	Negligible
	Seismic	PORTS	Extremely unlikely	Low	High	Moderate
		SRS, INEEL		Negligible	Negligible	Negligible
Transfer to research facility	Facility fire	All	Unlikely	Negligible	Negligible	Negligible
	Seismic	All	Extremely unlikely	Negligible	Negligible	Negligible
Transfer to other government agency	Facility fire	All	Unlikely	Negligible	Negligible	Negligible
	Seismic	All	Extremely unlikely	Negligible	Low	Low

Table A.15. Risks due to normal operations and accidents

Alternative/Option	Accident scenario	Site	Frequency	Maximum radiological consequence	Maximum toxicological consequence	Risk
Foreign sales	Facility fire	All	Unlikely	Negligible	Low	Low
	Seismic	All	Extremely unlikely	Negligible	Low	Low

[a]Max other represents the largest single amount at any site other than the DOE consolidated storage locations.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

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APPENDIX B

APPENDIX B

TRANSPORTATION ANALYSIS FOR URANIUM MANAGEMENT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

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ACRONYMS

DOE	U.S. Department of Energy
DU	depleted uranium
ICRP	International Commission on Radiological Protection
INEEL	Idaho National Engineering and Environmental Laboratory
LCF	latent cancer fatality
LEU	low-enriched uranium
NU	normal uranium
PGDP	Paducah Gaseous Diffusion Plant
PORTS	Portsmouth Gaseous Diffusion Plant
SRS	Savannah River Site
TRAGIS	Transportation Routing Analysis Geographic Information System
vph	vehicles per hour

APPENDIX B
TRANSPORTATION ANALYSIS FOR URANIUM MANAGEMENT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

B.1 PURPOSE

The purpose of this calculation package is to provide details of the risk analysis of transporting normal uranium (NU), depleted uranium (DU), and low-enriched uranium (LEU) to and from a number of sites.

B.2 METHOD

Routes were calculated for highway from the 155 origin sites to 11 alternate destinations in the United States:

1. the nearest U.S. Department of Energy (DOE) consolidation site;
2. Savannah River Site (SRS);
3. Portsmouth Gaseous Diffusion Plant (PORTS);
4. Paducah Gaseous Diffusion Plant (PGDP);
5. Idaho National Engineering and Environmental Laboratory (INEEL);
6. Oak Ridge National Laboratory and other Oak Ridge facilities;
7. a "western commercial site," for which Envirocare in Utah was selected;
8. an "eastern commercial site," for which Barnwell in South Carolina was selected;
9. the nearest DOE consolidation site when consolidating by material form;
10. PORTS or INEEL, whichever is closer to the origin site; and
11. Envirocare or Barnwell, whichever is closer to the origin site.

Rail routes were calculated where appropriate. Route distances and population densities for rural, suburban, and urban route segments were calculated using the Transportation Routing Analysis Geographic Information System (TRAGIS).[1]

Two modal options were analyzed:

1. all shipment by truck, and

2. shipment by rail where rail was appropriate, and all other shipment by truck (this is called the "truck/rail" option).

Public and occupational doses for incident-free transportation and dose risks for transportation accidents were estimated by calculating unit risk factors using RADTRAN 5[2] (a transportation risk

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[1]TRAGIS is a routing analysis tool combining graphical interfaces with an extensive highway, rail, and waterway database. TRAGIS can be used to calculate detailed routes based on user-specified parameters, and replaces the legacy HIGHWAY and INTERLINE routing models.

[2]RADTRAN is the world standard for transportation risk assessment. The code was developed at Sandia National Laboratories. RADTRAN combines user-determined meteorological, demographic, transportation, packaging, and material data with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive materials.

assessment computer code) [Neuhauser, Kanipe, and Weiner 2000; Chap. 3, 4, and 5] and multiplying the unit risk factors by the appropriate route distances and population densities.

Collective accident dose risks were calculated using the national average truck and rail accident rates from Saricks and Tompkins (1999; Tables 4 and 6). Accident dose risks were calculated by calculating a unit risk factor (that includes severity and release fractions) using RADTRAN 5, and multiplying by the accident rates, distances, and population densities. Traffic fatalities were also taken from Saricks and Tompkins (1999; Tables 4 and 6).

Per-shipment and per-container occupational doses for trans-Atlantic and trans-Pacific shipping were calculated using RADTRAN 5 and using data from Appendix J of the Yucca Mountain Environmental Impact Statement (DOE 2002).

B.3 ASSUMPTIONS

For the incident-free transportation analyses:

- Trucks were assumed to travel only on interstate or U.S. primary highways, and the speed was taken to be 88 km/hour, except during rush hour. Ten percent of urban and suburban truck travel was assumed to be during rush hour. Rush hour speed was assumed to be half of the non-rush hour speed.
- Vehicle densities were assumed to be the standard RADTRAN values: (1) rural: 470 vehicles per hour (vph), (2) suburban: 780 vph, and (3) urban: 2800 vph. Rush hour vehicle densities were assumed to be twice the non-rush hour vehicle density.
- Per the truck stop model of Griego, Smith, and Neuhauser (1996), trucks with onboard restroom facilities were assumed to stop every 525 miles for rest and refueling for an average time of 20 minutes. Two drivers per truck were assumed.
- Truck crew members were assumed to be 3 m from the cargo and their dose regulated at 2 mrem/hr. At stops, one crew member was assumed to stay in the truck at all times.
- Rail speeds were the standard RADTRAN speeds: (1) rural: 64 kph, (2) suburban: 40 kph, and (3) urban: 24 kph.
- External dose rate (TI) at one meter from the surface is assumed to be 1 mrem/hr from a drum or standard waste box, so that adjacent drums would have a total TI of 2 mrem/hr and two layers of adjacent drums, 4 mrem/hr. These are conservative assumptions.
- Crew members aboard transoceanic freighters were assumed to spend two hours per day at a distance between one and 16 m from the containers, and half of the time 30 m from the containers. No credit was taken for shielding.
- The maximum transoceanic distance assumed was 14,400 km, port to port.

For the transportation accident analysis:

- All radioactive material released is assumed to be particulate matter with a settling velocity or 0.01 m/sec.

- The cargo was assumed to include containers containing DU, NU, and LEU. Accident unit risk factors were calculated for DU, NU, and LEU using RADTRAN and using fractions of uranium isotopes shown in Table B.1.

Table B.1. Fractions of uranium isotopes in DU, NU, and LEU

Radionuclide	Fraction in DU	Fraction in NU	Fraction in LEU
^{238}U	0.007	0.992	0.969
^{235}U	0.0025	0.00711	0.03
^{234}U	0.001	0.0009	0.001

DU = depleted uranium.
LEU = low-enriched uranium.
NU = normal uranium.
U = uranium.

- Accident rates were the national average truck and rail accident rates from Saricks and Tompkins (1999; Tables 4 and 6).

- Conditional accident probabilities (severity fractions) and release and aerosol fractions are the same as given in Appendix A.

- It as assumed that 1% of the accidents would result in release of radioactive material, and 99% would not result in any damage to cargo.

- National average meteorological conditions were assumed. Dispersion was calculated using RADTRAN, which incorporates a Gaussian dispersion model. The same model and assumptions were used to calculate airborne concentrations of uranium.

- Fatality rates for truck and rail accidents are from Saricks and Tompkins (1999; Tables 4 and 6).

For transoceanic transportation:

- The longest distance that would be traveled would be 14,400 km, from either the west or east coasts of the United States.

- While the ship is at sea, there is no dose to any member of the public. Only the ship's crew is exposed. An average crew member spends 2 hours per day within 16 m of the cargo, and 22 hours per day at 30 m from the cargo. No shielding is assumed.

B.4 COMPUTER SOFTWARE/MODELS

Unit risk factors were calculated using RADTRAN 5 (Neuhauser, Kanipe, and Weiner 2000). Route segment lengths and population densities were calculated using WebTRAGIS (Johnson and Michelhaugh 2000). Other calculations were done with a Microsoft™ Excel spreadsheet.

B.5 RESULTS

Table B.2 shows the collective dose to the public for the two modal options. As is evident from Table B.2, collective dose is directly proportional to the total distance traveled; the two consolidation options yield the smallest collective dose, and the two east/west options yield collective doses that are not much larger. When rail transportation is used, the collective dose is decreased still further, for two reasons: (1) rural population densities along rail routes are about 50% to 60% of rural population densities along highway routes, and 45% to 75% of any route is rural; and (2) the origin sites that can use rail transportation are those that ship the largest number of containers, thus emphasizing the smaller results for rail shipment. It should be noted that one railcar is one shipment, so the number of cars in a single train that carry uranium does not affect the analysis.

Accident dose risks are several orders of magnitude smaller than incident-free doses. Even if 10% of the accidents were assumed to result in release of radioactive material, the accident dose risks would increase by a factor of ten but would still be negligible compared to the incident-free doses. Accident dose risks for the truck/rail option are somewhat larger than for the truck-only option, because rail accident rates are somewhat larger than heavy truck accident rates.

Table B.2. Public collective dose for uranium transportation

		Public dose and dose risk (person rem)			
		Truck only		Truck and rail	
Interim storage alternative	**Destination**	**Incident-free**	**Accident**	**Incident-free**	**Accident**
Centralized storage at a single DOE site	SRS	34.9	0.0036	23.3	0.0137
	Oak Ridge	23.1	0.00198	18.7	0.00775
	PGDP	22.3	0.00165	18.5	0.0154
	PORTS	18.5	0.00123	18.5	0.00477
	INEEL	38.1	0.00379	9.44	0.0233
Centralized storage at a single commercial site	Eastern (Barnwell)	34.6	0.00206	22.1	0.013
	Western (Envirocare)	38.9	0.00414	36.2	0.00341
Partially consolidated storage at two DOE sites	INEEL/PORTS	6.28	8.74E-04	6.85	0.0037
Partially consolidated storage at two commercial sites	Eastern/western	21	0.003	10.1	0.0117
Partially consolidated	By physical form	4.36	7.10E-04	2.15	2.94E-03
	By closest site	4.37	7.07E-04	2.15	2.94E-03

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

The average dose to an individual member of the public was calculated by dividing the doses (and dose risks) shown in Table B.2 by the populations in a mile-wide band along each route. The results are shown in Table B.3.

Table B.3. Average individual public dose (mrem)

Destination	Truck only		Truck and rail	
	Incident-free	Accident	Incident-free	Accident
SRS	6.51E-03	5.41E-06	4.41E-03	2.30E-05
Oak Ridge	5.02E-03	3.13E-06	4.12E-03	1.34E-05
PGDP	4.89E-03	2.51E-06	4.14E-03	2.61E-05
PORTS	4.16E-03	1.86E-06	4.25E-03	7.95E-06
INEEL	5.83E-03	5.65E-06	0.00E+00	3.86E-05
Eastern (Barnwell)	6.58E-03	3.16E-06	4.22E-06	1.99E-05
Western (Envirocare)	5.93E-03	5.99E-06	5.46E-03	5.56E-05
INEEL/PORTS	2.03E-03	1.31E-06	2.28E-03	6.14E-06
Eastern/western	5.87E-02	4.44E-06	2.45E-03	1.60E-05
By physical form	1.59E-03	1.12E-06	8.04E-04	5.03E-06
By closest site	1.63E-03	1.12E-06	8.22E-04	5.04E-06

INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

The average background radiation dose for a person living in the United States is 360 mrem/year. Thus the dose from the proposed shipments of uranium is less than 1/10,000 of the average background dose.

Another comparison that may be made is to calculate possible health effects from these exposures. International Commission on Radiological Protection (ICRP) Publication 60 (ICRP 1991) projects 0.0005 latent cancer fatalities (LCFs) per rem of exposure. The results of applying this factor to the data in Table B.2 are shown in Table B.4.

These projected LCFs are in excess of the potentially fatal cancers projected to occur in the populations along the routes. As Table B.4 shows, less than 1/50 LCF is projected for any alternative.

Table B.5 shows the collective occupational (crew) doses for the various alternatives. These collective doses appear to be quite large, especially since trucks carry a crew of two people. However, truck crew members are considered radiation workers, and both the dose rate and the cumulative dose are limited by regulation. One cannot say at this time how many truck crew members would be involved in these shipping campaigns.

Rail crew members on a train that is in transit (in motion) have no exposure because they are too far from the radioactive material and too well shielded. The collective doses cited in Table B.5 for the truck/rail option include doses to rail classification yard workers.

Table B.4. Potential excess latent cancer fatalities (LCFs)

Interim storage alternative	Destination	Potential excess latent cancer fatalities (total)			
		Truck only		Truck and rail	
		Incident-free	Accident	Incident-free	Accident
Centralized storage at a single DOE site	SRS	0.0175	1.80E-06	0.0117	6.85E-06
	Oak Ridge	0.0116	9.90E-07	0.0094	3.88E-06
	PGDP	0.0112	8.25E-07	0.0093	7.70E-06
	PORTS	0.0093	6.15E-07	0.0093	2.39E-06
	INEEL	0.0191	1.90E-06	0.0047	1.17E-05
Centralized storage at a single commercial site	Eastern (Barnwell)	0.0173	1.03E-06	0.0111	6.50E-06
	Western (Envirocare)	0.0195	2.07E-06	0.0181	1.71E-06
Partially consolidated storage at two DOE sites	INEEL/PORTS	0.0031	4.37E-07	0.0034	1.85E-06
Partially consolidated storage at two commercial sites	Eastern/western	0.0105	1.50E-06	0.0051	5.85E-06
Partially consolidated	By physical form	0.0022	3.55E-07	0.0011	1.47E-06
	By closest site	0.0022	3.54E-07	0.0011	1.47E-06

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table B.5. Collective crew dose

Interim storage alternative	Destination	Collective crew dose (person-rem)	
		Truck only	Truck and rail
Centralized storage at a single DOE site	SRS	245	11.1
	Oak Ridge	188	9.73
	PGDP	192	8.71
	PORTS	157	9.38
	INEEL	342	5.33
Centralized storage at a single commercial site	Eastern (Barnwell)	246	11.1
	Western (Envirocare)	346	6.25
Partially consolidated storage at two DOE sites	INEEL/PORTS	48.8	2.07
Partially consolidated storage at two commercial sites	Eastern/western	220	3.34
Partially consolidated	By physical form	36.7	1.84
	By closest site	36.7	1.77

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table B.6 shows projected potential traffic fatalities from truck and rail accidents, which are comparable to projected LCFs. The table also includes airborne concentrations of uranium and uranium compounds. The toxicity threshold for airborne uranium and uranium compound particles is 2 mg/m^3 (Lewis 1993).

Table B.6. Potential traffic fatalities and airborne uranium concentrations

	Traffic fatalities (total)		Airborne concentration of uranium (μg/m^3)
Destination	Truck only	Truck and rail	
SRS	0.00427	0.0078	0.0771
Oak Ridge	0.00374	0.00676	0.0714
PGDP	0.00374	0.0069	0.081
PORTS	0.00357	0.00635	0.0319
INEEL	0.00595	0.0106	0.0797
Eastern (Barnwell)	0.00426	0.0077	0.081
Western (Envirocare)	0.00591	0.0109	0.081
INEEL/PORTS	0.00215	0.0037	0.0306
Eastern/western	0.00256	0.00447	0.081
By physical form	0.0019	0.00309	0.0172
By closest site	0.00183	0.00301	0.017

DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Radiological impacts of transoceanic transportation were also calculated. While the freighter carrying the uranium is at sea, there is no dose to the public. Projected impacts, based on assumptions in Section B.3, would be:

- the average dose to a crew member would be approximately 1.8 mrem per person per day for each shipment of material, and
- a dock worker loading containers could potentially receive an external dose of 2 mrem.

The total number of shipments needed could not be estimated because this cargo would probably be carried with other cargo, and the amount in each shipment would depend on the rate of arrival at the debarcation port.

B.6 REFERENCES

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APPENDIX C

APPENDIX C

ANALYSIS OF CHRONIC RISK TO HUMANS AND ECOLOGICAL RECEPTORS FROM URANIUM DEPOSITED ON SOIL AND SURFACE WATER FOR URANIUM MANAGEMENT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

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ACRONYMS

AF	adherence factor
AT	averaging time
BW	body weight
CASRN	Chemical Abstract Services Registry Number
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CF	conversion factor
Ci/g	curies per gram
CSFx	cancer slope factor (pathway x)
DCFx	dose conversion factor (pathway x)
DNA	deoxyribonucleic acid
DOE	U.S. Department of Energy
ED	exposure duration
EF	exposure frequency
EFetx	exposure frequency (gamma)
EM	emergency management
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ET	exposure time
GI	gastrointestinal
HQ	hazard quotient
ICRP	International Commission on Radiological Protection
INEEL	Idaho National Engineering and Environmental Laboratory
IRair	inhalation rate (dust)
IRsoil	ingestion rate (soil)
NOAEL	No observed adverse effect level
PEA	programmatic environmental assessment
PEF	particulate emission factors
PGDP	Paducah Gaseous Diffusion Plant
PORTS	Portsmouth Gaseous Diffusion Plant
RAGS	Risk Assessment Guidance
RfD	reference dose
SA	surface area
Se	gamma shielding factor
SRS	Savannah River Site
Te	gamma exposure time
TRV	toxicity reference value
U_T	total uranium

C.1 INTRODUCTION

This appendix presents an assessment of chronic risks to humans and ecological receptors of airborne uranium deposited on soil and surface water and from water to sediment. It does the following:

- describes methods to calculate deposition rates of particulate and particulate-bound airborne uranium under conditions described in Appendix A;
- presents methods to determine the concentrations of uranium in surface soil, surface water, and sediment and the calculated concentrations after releases resulting from accidents described in Appendix A;
- assesses exposure of nearby human receptors to the chronic chemical, radiological, and carcinogenic effects of uranium in soil; and
- assesses exposure of terrestrial and aquatic ecological receptors and consumers of aquatic and benthic (sediment-dwelling) biota to the chemical and radiological effects of uranium in soil, surface water, and sediment.

The resulting hazards and risks are organized into categories according to the severity of the consequences (negligible, low, moderate, and high). These consequence categories are combined with the expected frequencies of the associated accidents to predict the overall risk from each proposed alternative at each location.

C.2 DEVELOPMENT OF SOURCE TERMS FOR CONTAMINATED SOIL, SURFACE WATER, AND SEDIMENT

An accident that releases airborne uranium will result in deposition of uranium on soil and water and from water to sediment in a downwind direction from the release. Humans and ecological receptors located in the area of deposition will be chronically exposed to the contaminated soil, surface water, and sediment. This section describes the calculation of concentrations in those media as a result of deposition.

C.2.1 DEPOSITION RATES

Deposition rates in the downwind direction were modeled for dry air. It was assumed that all of the airborne uranium is particulate or becomes associated with particles and is deposited as the particles settle. Deposition of particles was modeled with a simple Gaussian plume model in which the horizontal axis of the plume descends with distance from the source as particles settle out (Pasquill 1974). The accident scenarios result in release to the atmosphere of uranium in amounts that vary with the scenario and the location. In all cases, it was assumed that all of the uranium that is released is released in 1 hour (Appendix A, Sect. A.3.4.1). Although that is not likely to be true in any given case, the entire released source term is accounted for, so the assumption is acceptable.

The equation for deposition rate was adapted from Pasquill (1974) by omitting the term Q for release rate, which is different for different scenarios. The result of the equation is equivalent to the rate of deposition when the release rate is 1 g/s. The equation is as follows:

$$Ds = \frac{v_s}{2 \pi U \sigma_y \sigma_z} \exp\left[\frac{-y^2}{2(\sigma_y)^2}\right] \exp\left[\frac{-\left((h-z) - {v_s x}/{U}\right)^2}{2(\sigma_z)^2}\right]$$

where

- Ds = relative deposition rate per unit area (m^{-2}),
- v_s = deposition velocity (m/s),
- U = average wind velocity (m/s),
- σ_y = crosswind dispersion coefficient (m),
- σ_z = vertical dispersion coefficient (m),
- y = lateral distance of the deposition point from the plume centerline at the downwind location (m),
- h = elevation of the initial centerline of the plume above the release point (m) ,
- z = elevation of the deposition point above the release point (m),
- x = distance downwind from the release point (m).

C.2.1.1 Parameters

The deposition velocity was assumed to be 2 cm/s (2×10^{-2} m/s), a typical velocity for particles of approximately 10 μm in diameter (Hanna, Briggs, and Hosker 1982). The average wind velocity (1.5 m/s) and crosswind dispersion coefficient (calculated for atmospheric stability class F, which is the most stable, thus providing the least mixing and, as a result, the most conservative class) were discussed in Appendix A, Sect. A.3.4.2. Releases to the environment from a fire were assumed to occur at a height of 15 m, and releases from a seismic event were assumed to begin at a height of 5 m.

C.2.1.2 Deposition model results

The deposition model predicts that the concentrations are highest along the centerline of the plume (directly downwind from the release), decreasing with lateral distance from the centerline. The maximum deposition rates occurred about 550 m from the release point in the case of fires and at 175 m in the case of seismic events.

As a conservative estimate of exposure, the habitats in which biota are exposed were assumed to be located directly downwind of the release point. The deposition rate was the maximum deposition rate for the condition (fire or seismic event), regardless of the size of the habitat. Deposition rates and total uranium deposited per unit area are shown in Table C.1. Concentrations of uranium in soil, surface water, and sediment were calculated from the amount of uranium deposited per unit area.

Table C.1. Rates and amounts of deposition of uranium resulting from bounding accident scenarios[a]

Alternative	Accident scenario	Site	Airborne release rate (mg/s)	Maximum deposition rate[b] ($mg/m^2/s$)	Total deposition[c] (mg/m^2)
All	General container handling	All	1.84E+00	1.28E-04	4.61E-01
No Action	Storage area fire	INEEL	4.28E+01	3.35E-04	1.21E+00
		PGDP	1.74E-01	1.36E-06	4.91E-03
		PORTS	4.94E+02	3.87E-03	1.39E+01
		SRS	9.78E+01	7.66E-04	2.76E+00
		Oak Ridge	4.69E+01	3.68E-04	1.32E+00
		Max other	5.79E+01	4.54E-04	1.63E+00
	Seismic (direct release)	INEEL	2.90E+00	2.02E-04	7.26E-01
		PGDP	7.25E-02	5.04E-06	1.82E-02
		PORTS	1.89E+02	1.31E-02	4.73E+01
		SRS	1.23E+01	8.55E-04	3.08E+00
		Oak Ridge	5.80E+00	4.03E-04	1.45E+00
		Max other	2.41E+01	1.68E-03	6.03E+00
	Seismic (fire)	INEEL	2.80E+00	2.19E-05	7.90E-02
		PGDP	4.35E-02	3.41E-07	1.23E-03
		PORTS	1.15E+02	9.01E-04	3.24E+00
		SRS	9.40E+00	7.37E-05	2.65E-01
		Oak Ridge	4.45E+00	3.49E-05	1.26E-01
		Max other	1.45E+01	1.14E-04	4.09E-01
Centralized storage at a single site	Storage area fire	All	1.01E+03	7.91E-03	2.85E+01
	Seismic (direct release)	All	3.27E+02	2.27E-02	8.19E+01
	Seismic (fire)	All	2.03E+02	1.59E-03	5.73E+00
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	9.89E+01	7.75E-04	2.79E+00
		PGDP	1.48E+01	1.16E-04	4.18E-01
		PORTS	6.80E+02	5.33E-03	1.92E+01
		SRS	1.00E+02	7.84E-04	2.82E+00
		Oak Ridge	1.21E+02	9.48E-04	3.41E+00
	Seismic (direct release)	INEEL	1.06E+01	7.37E-04	2.65E+00
		PGDP	2.98E+00	2.07E-04	7.46E-01
		PORTS	2.63E+02	1.83E-02	6.59E+01
		SRS	1.33E+01	9.25E-04	3.33E+00
		Oak Ridge	3.66E+01	2.55E-03	9.16E+00
	Seismic (fire)	INEEL	8.52E+00	6.68E-05	2.40E-01
		PGDP	2.01E+00	1.58E-05	5.67E-02
		PORTS	1.59E+02	1.25E-03	4.49E+00
		SRS	9.97E+00	7.81E-05	2.81E-01
		Oak Ridge	2.29E+01	1.79E-04	6.46E-01
Partially consolidated storage at two sites	Storage area fire	East	9.13E+02	7.15E-03	2.58E+01
		West	1.02E+02	7.99E-04	2.88E+00
	Seismic (direct release)	East	3.15E+02	2.19E-02	7.89E+01
		West	1.19E+01	8.28E-04	2.98E+00
	Seismic (fire)	East	1.94E+02	1.52E-03	5.47E+00
		West	9.29E+00	7.28E-05	2.62E-01

Table C.1. Rates and amounts of deposition of uranium resulting from bounding accident scenarios[a] (continued)

Alternative	Accident scenario	Site	Airborne release rate (mg/s)	Maximum deposition rate[b] ($mg/m^2/s$)	Total deposition[c] (mg/m^2)
Partially consolidated storage based on physical form	Storage area fire	PORTS	4.38E+02	3.43E-03	1.24E+01
		SRS	2.47E+02	1.94E-03	6.97E+00
		INEEL	3.01E+01	2.36E-04	8.49E-01
	Seismic (direct release)	PORTS	3.07E+02	2.14E-02	7.69E+01
		SRS	1.54E+01	1.07E-03	3.86E+00
		INEEL	4.01E+00	2.79E-04	1.00E+00
	Seismic (fire)	PORTS	1.84E+02	1.44E-03	5.19E+00
		SRS	1.54E+01	1.21E-04	4.34E-01
		INEEL	3.01E+00	2.36E-05	8.49E-02
Transfer to research facility	Facility fire	Generic	3.56E+00	2.79E-05	1.00E-01
	Seismic (direct release)	Generic	1.15E+00	9.01E-06	3.24E-02
	Seismic (fire)	Generic	7.13E-01	5.59E-06	2.01E-02
Transfer to other government agencies	Facility fire	Generic	1.78E+02	1.39E-03	5.02E+00
	Seismic (direct release)	Generic	5.74E+01	4.50E-04	1.62E+00
	Seismic (fire)	Generic	3.56E+01	2.79E-04	1.00E+00
Foreign sales	Facility fire	Generic	3.52E+02	2.76E-03	9.93E+00
	Seismic (direct release)	Generic	1.24E+02	9.72E-04	3.50E+00
	Seismic (fire)	Generic	7.60E+01	5.96E-04	2.14E+00

[a]Airborne release rates from Appendix A, Table A-7.
[b]Q (mg/s) × max unit deposition (m^{-2}).
[c]Max rate × 3600 sec.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

C.2.2 Media Concentrations

Concentrations of uranium in soil, surface water, and sediment as a consequence of accidental releases were calculated as described below.

C.2.2.1 Soil

Uranium concentrations in the upper 5 cm (2 in.) of dry soil were calculated using a U.S. Environmental Protection Agency (EPA) model (EPA 1999). The calculation was done with the following equation:

$$Cs = Q \times Ds \times t \times 1000 / (0.05 \times 1600) ,$$

where

- Cs = concentration in the soil (mg/kg),
- Q = release rate (g/s) [Appendix A, Table A-7],
- Ds = relative deposition rate per unit area (m^{-2}),
- t = duration of release (s),
- 1000 = conversion factor (mg/g),
- 0.05 = volume conversion factor (m^{-3} per m^{-2}),
- 1600 = density of soil (kg/m^3).

To illustrate the distribution of uranium concentrations in soil downwind from a release, a fractional release rate was calculated, with Q equal to 1 g/s. As previously described, the release was assumed to occur over a period of 1 hour and to include the entire airborne source term in that time period. The resulting soil concentrations per unit area (mg/kg) in soil are shown in Table C.2.

C.2.2.2 Surface water

Uranium was assumed to be deposited in a pond with an average depth of 2 m. Concentrations of uranium in the surface water were assumed to be determined by the ratios of dissolved-to-sediment-bound uranium as well as the deposition rate. The fraction of uranium in the water column (F_w) was calculated by using an equation presented by EPA (Eq. B-2-10, EPA 1999):

$$F_{wc} = [(1 + Kd_{sw} \times TSS \times 10^{-6}) \times d_{wc}/d_z] / [(1 + Kd_{sw} \times TSS \times 10^{-6}) \times d_{wc}/d_z) + (q_{bs} + Kd_{bs} \times BS) \times d_{bs}/d_z] ,$$

where

- F_{wc} = fraction of deposited uranium concentration in the water column,
- Kd_{sw} = suspended sediment/water partitioning coefficient (450 L/kg),
- TSS = total suspended solids (assumed to be 10 mg/L),
- 10^{-6} = conversion factor (kg/mg),
- d_{wc} = depth of the water column (assumed to be 2 m),
- d_{bs} = depth of the upper sediment layer [0.03 m, default value (EPA 1999)],
- d_z = combined depth of water column and sediment layer (2.03 m),
- Kd_{bs} = bed sediment/water partitioning coefficient (450 L/kg),
- q_{bs} = bed sediment porosity (0.6 L water/L sediment, EPA default [EPA 1999]),
- BS = benthic solids concentration (1 kg/L).

Using these parameters, the value of F_{wc} was calculated as 0.13.

Table C.2. Concentrations of uranium in soil, surface water, and sediment resulting from deposition of uranium after accidents[a]

			Untilled soil (5-cm depth)		Tilled soil		Surface water (2-m depth)		Sediment (3-cm depth)	
Alternative	**Accident scenario**	**Site**	**Concentration[b] (mg/kg)**	**Activity[c] (pCi/g)**	**Concentration[e] (mg/kg)**	**Activity[d] (pCi/g)**	**Concentration[d] (mg/L)**	**Activity[e] (pCi/L)**	**Concentration[f] (mg/kg)**	**Activity[c] (pCi/g)**
All	General container handling	All	5.76E-03	4.03E-03	1.44E-03	1.01E-03	2.94E-05	2.06E-02	8.36E-03	5.85E-03
No Action	Storage area fire	INEEL	1.51E-02	1.06E-02	3.77E-03	2.64E-03	7.81E-05	5.47E-02	2.19E-02	1.53E-02
		PGDP	6.14E-05	4.30E-05	1.53E-05	1.07E-05	3.18E-07	2.22E-04	8.90E-05	6.23E-05
		PORTS	1.74E-01	1.22E-01	4.36E-02	3.05E-02	9.02E-04	6.31E-01	2.53E-01	1.77E-01
		SRS	3.45E-02	2.41E-02	8.62E-03	6.04E-03	1.78E-04	1.25E-01	5.00E-02	3.50E-02
		Oak Ridge	1.65E-02	1.16E-02	4.13E-03	2.89E-03	8.56E-05	5.99E-02	2.40E-02	1.68E-02
		Max other	2.04E-02	1.43E-02	5.10E-03	3.57E-03	1.06E-04	7.40E-02	2.96E-02	2.07E-02
	Seismic (direct release)	INEEL	9.08E-03	6.35E-03	2.27E-03	1.59E-03	4.70E-05	3.29E-02	1.32E-02	9.22E-03
		PGDP	2.27E-04	1.59E-04	5.67E-05	3.97E-05	1.17E-06	8.22E-04	3.29E-04	2.30E-04
		PORTS	5.92E-01	4.14E-01	1.48E-01	1.04E-01	3.06E-03	2.14E+00	8.58E-01	6.01E-01
		SRS	3.85E-02	2.69E-02	9.62E-03	6.74E-03	1.99E-04	1.39E-01	5.59E-02	3.91E-02
		Oak Ridge	1.82E-02	1.27E-02	4.54E-03	3.18E-03	9.40E-05	6.58E-02	2.63E-02	1.84E-02
		Max other	7.54E-02	5.28E-02	1.89E-02	1.32E-02	3.90E-04	2.73E-01	1.09E-01	7.66E-02
	Seismic (fire)	INEEL	9.87E-04	6.91E-04	2.47E-04	1.73E-04	5.11E-06	3.58E-03	1.43E-03	1.00E-03
		PGDP	1.53E-05	1.07E-05	3.83E-06	2.68E-06	7.94E-08	5.56E-05	2.23E-05	1.56E-05
		PORTS	4.06E-02	2.84E-02	1.01E-02	7.10E-03	2.10E-04	1.47E-01	5.88E-02	4.12E-02
		SRS	3.31E-03	2.32E-03	8.29E-04	5.80E-04	1.72E-05	1.20E-02	4.81E-03	3.37E-03
		Oak Ridge	1.57E-03	1.10E-03	3.92E-04	2.75E-04	8.12E-06	5.69E-03	2.28E-03	1.59E-03
		Max other	5.11E-03	3.58E-03	1.28E-03	8.95E-04	2.65E-05	1.85E-02	7.42E-03	5.19E-03
Centralized storage at a single site	Storage area fire	All	3.56E-01	2.49E-01	8.90E-02	6.23E-02	1.84E-03	1.29E+00	5.17E-01	3.62E-01
	Seismic (direct release)	All	1.02E+00	7.16E-01	2.56E-01	1.79E-01	5.30E-03	3.71E+00	1.49E+00	1.04E+00
	Seismic (fire)	All	7.16E-02	5.01E-02	1.79E-02	1.25E-02	3.70E-04	2.59E-01	1.04E-01	7.27E-02
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	3.49E-02	2.44E-02	8.72E-03	6.10E-03	1.80E-04	1.26E-01	5.06E-02	3.54E-02
		PGDP	5.22E-03	3.65E-03	1.30E-03	9.13E-04	2.70E-05	1.89E-02	7.57E-03	5.30E-03
		PORTS	2.40E-01	1.68E-01	5.99E-02	4.20E-02	1.24E-03	8.69E-01	3.48E-01	2.44E-01
		SRS	3.53E-02	2.47E-02	8.82E-03	6.17E-03	1.83E-04	1.28E-01	5.12E-02	3.58E-02
		Oak Ridge	4.27E-02	2.99E-02	1.07E-02	7.47E-03	2.21E-04	1.55E-01	6.19E-02	4.33E-02

Table C.2. Concentrations of uranium in soil, surface water, and sediment resulting from deposition of uranium after accidents[a] (continued)

			Untilled soil (5-cm depth)		Tilled soil		Surface water (2-m depth)		Sediment (3-cm depth)	
Alternative	Accident scenario	Site	Concentration[b] (mg/kg)	Activity[c] (pCi/g)	Concentration[e] (mg/kg)	Activity[d] (pCi/g)	Concentration[d] (mg/L)	Activity[e] (pCi/L)	Concentration[f] (mg/kg)	Activity[c] (pCi/g)
	Seismic (direct release)	INEEL	3.32E-02	2.32E-02	8.29E-03	5.81E-03	1.72E-04	1.20E-01	4.81E-02	3.37E-02
		PGDP	9.33E-03	6.53E-03	2.33E-03	1.63E-03	4.83E-05	3.38E-02	1.35E-02	9.47E-03
		PORTS	8.23E-01	5.76E-01	2.06E-01	1.44E-01	4.26E-03	2.98E+00	1.19E+00	8.36E-01
		SRS	4.16E-02	2.91E-02	1.04E-02	7.28E-03	2.15E-04	1.51E-01	6.04E-02	4.23E-02
		Oak Ridge	1.15E-01	8.02E-02	2.86E-02	2.00E-02	5.93E-04	4.15E-01	1.66E-01	1.16E-01
	Seismic (fire)	INEEL	3.00E-03	2.10E-03	7.51E-04	5.26E-04	1.55E-05	1.09E-02	4.36E-03	3.05E-03
		PGDP	7.09E-04	4.96E-04	1.77E-04	1.24E-04	3.67E-06	2.57E-03	1.03E-03	7.20E-04
		PORTS	5.61E-02	3.92E-02	1.40E-02	9.81E-03	2.90E-04	2.03E-01	8.14E-02	5.69E-02
		SRS	3.52E-03	2.46E-03	8.79E-04	6.15E-04	1.82E-05	1.27E-02	5.10E-03	3.57E-03
		Oak Ridge	8.08E-03	5.65E-03	2.02E-03	1.41E-03	4.18E-05	2.93E-02	1.17E-02	8.20E-03
Partially consolidated storage at two sites	Storage area fire	East	3.22E-01	2.25E-01	8.05E-02	5.63E-02	1.67E-03	1.17E+00	4.67E-01	3.27E-01
		West	3.60E-02	2.52E-02	8.99E-03	6.29E-03	1.86E-04	1.30E-01	5.22E-02	3.65E-02
	Seismic (direct release)	East	9.86E-01	6.90E-01	2.46E-01	1.73E-01	5.10E-03	3.57E+00	1.43E+00	1.00E+00
		West	3.72E-02	2.61E-02	9.31E-03	6.52E-03	1.93E-04	1.35E-01	5.40E-02	3.78E-02
	Seismic (fire)	East	6.84E-02	4.79E-02	1.71E-02	1.20E-02	3.54E-04	2.48E-01	9.93E-02	6.95E-02
		West	3.28E-03	2.29E-03	8.19E-04	5.73E-04	1.70E-05	1.19E-02	4.75E-03	3.33E-03
Partially consolidated storage based on physical form	Storage area fire	PORTS	1.54E-01	1.08E-01	3.86E-02	2.70E-02	7.99E-04	5.60E-01	2.24E-01	1.57E-01
		SRS	8.71E-02	6.10E-02	2.18E-02	1.52E-02	4.51E-04	3.16E-01	1.26E-01	8.85E-02
		INEEL	1.06E-02	7.43E-03	2.65E-03	1.86E-03	5.49E-05	3.85E-02	1.54E-02	1.08E-02
	Seismic (direct release)	PORTS	9.61E-01	6.73E-01	2.40E-01	1.68E-01	4.97E-03	3.48E+00	1.39E+00	9.76E-01
		SRS	4.82E-02	3.37E-02	1.20E-02	8.43E-03	2.49E-04	1.75E-01	6.99E-02	4.90E-02
		INEEL	1.26E-02	8.79E-03	3.14E-03	2.20E-03	6.50E-05	4.55E-02	1.82E-02	1.27E-02
	Seismic (fire)	PORTS	6.49E-02	4.54E-02	1.62E-02	1.14E-02	3.36E-04	2.35E-01	9.41E-02	6.59E-02
		SRS	5.43E-03	3.80E-03	1.36E-03	9.50E-04	2.81E-05	1.97E-02	7.88E-03	5.52E-03
		INEEL	1.06E-03	7.43E-04	2.65E-04	1.86E-04	5.49E-06	3.85E-03	1.54E-03	1.08E-03
Transfer to research facility	Facility fire	Generic	1.26E-03	8.79E-04	3.14E-04	2.20E-04	6.50E-06	4.55E-03	1.82E-03	1.28E-03
	Seismic (direct release)	Generic	4.06E-04	2.84E-04	1.01E-04	7.10E-05	2.10E-06	1.47E-03	5.88E-04	4.12E-04
	Seismic (fire)	Generic	2.51E-04	1.76E-04	6.29E-05	4.40E-05	1.30E-06	9.11E-04	3.65E-04	2.55E-04

Table C.2. Concentrations of uranium in soil, surface water, and sediment resulting from deposition of uranium after accidents[a] (continued)

Transfer to other government agencies	Facility fire	Generic	6.28E-02	4.39E-02	1.57E-02	1.10E-02	3.25E-04	2.27E-01	9.11E-02	6.38E-02
	Seismic (direct release)	Generic	2.02E-02	1.42E-02	5.06E-03	3.54E-03	1.05E-04	7.33E-02	2.94E-02	2.06E-02
	Seismic (fire)	Generic	1.26E-02	8.79E-03	3.14E-03	2.20E-03	6.50E-05	4.55E-02	1.82E-02	1.28E-02
Foreign sales	Facility fire	Generic	1.24E-01	8.69E-02	3.10E-02	2.17E-02	6.42E-04	4.50E-01	1.80E-01	1.26E-01
	Seismic (direct release)	Generic	4.37E-02	3.06E-02	1.09E-02	7.65E-03	2.26E-04	1.58E-01	6.34E-02	4.44E-02
	Seismic (fire)	Generic	2.68E-02	1.88E-02	6.70E-03	4.69E-03	1.39E-04	9.71E-02	3.89E-02	2.72E-02

[a]Calculated from data in Table C.1 using methods discussed in Sect. 5.
[b]Deposition (mg/m^2) / (0.05 m^3/m^2 at 5 cm depth * 1600 kg/m^3 density of soil).
[c]Concentration (mg U/kg soil) * 1E-3 kg soil/g soil * 1E-3 g U/mg U * 7E-7 Ci/g U * 1E12 pCi/Ci = 7E-1 pCi/g per mg/kg.
[d]Calculated as described in Sect. 2.2.2.
[e]C mg U/L * 1E-3 g U/mg U * 7E-7 Ci/g U * 1E12 pCi/Ci = 7E2 pCi/L per mg/L.
[f]Calculated as described in Sect. 2.2.3.
DOE = U.S. Department of Energy.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

The concentration of uranium in the surface water is given (Eq. B-2-17, EPA 1999) by:

$$C_{wctot} = F_{wc} \times C_{wtot} \times d_z/d_{wc} \ ,$$

where

C_{wctot} = total uranium concentration in the water column (mg/L),
F_{wc} = fraction of uranium in the water column (0.13 from equation above),
C_{wtot} = total uranium concentration including water and bed sediment (total deposited per m^2/2.03 m),
d_z = combined depth of water column and sediment layer (2.03 m),
d_{wc} = depth of water column (2 m).

C_{wctot} was calculated to be 6.37×10^{-5} mg/L per mg/m^2 deposited. The resulting concentrations in surface water are shown in Table C.2.

C.2.2.3 Sediment

Concentrations in pond sediment were estimated by assuming that the uranium is deposited on a pond. It was assumed that in the long-term, the total mass of uranium comes to equilibrium between sediment and surface water. The uranium was assumed to become adsorbed to sediment particles in the upper 2 cm of bottom sediment.

The fraction of uranium in bed sediment (F_{bs}) is 1-F_{wc} = 0.87, and the concentration of uranium in the sediment is given (Eq. B-2-19, EPA 1999) by:

$$C_{sed} = F_{bs} \times C_{wtot} \times [Kd_{bs}/(q_{bs} + Kd_{bs} \times BS)] \times [(d_{wc} + d_{bs})/d_{bs}] \ ,$$

where

C_{sed} = concentration in bed sediment (mg/kg),
F_{bs} = fraction of uranium in bed sediment (0.87),
C_{wtot} = total uranium concentration including water and bed sediment (total deposited per m^2/2.03 m),
Kd_{bs} = bed sediment/water partitioning coefficient (450 L/kg),
q_{bs} = bed sediment porosity [0.6 L water/L sediment, EPA default (EPA 1999)],
BS = benthic solids concentration (1 kg/L),
d_{wc} = depth of water column (2 m),
d_{bs} = depth of bed sediment (0.03 m).

C_{sed} was calculated to be 1.81×10^{-2} mg/kg per mg/m^2 deposited on the water surface. The resulting concentrations in sediment are shown in Table C.2.

C.3 ASSESSMENT OF CHRONIC HUMAN EXPOSURE TO URANIUM

The purpose of this assessment is to evaluate chronic exposure to uranium potentially released from the U.S. Department of Energy's uranium management activities. This assessment considered three exposure scenarios, including an emergency management (EM) cleanup worker, a standard industrial worker, and a standard resident. The standard resident was presented as a worst-case scenario for comparison, although residential exposure is considered implausible under current site conditions. All receptors were assumed to be exposed to uranium deposited over surface soils. Exposure pathways include soil ingestion, dust inhalation, dermal contact, and external gamma exposure. Carcinogenic risks, non-carcinogenic hazards, and radiological doses were estimated for these pathway and receptor combinations.

This assessment was performed with the initial assumption that all chronic exposures would be within or below tolerable limits where tolerable limits are defined as follows:

1. radiological dose less than 1 mrem/year was considered *de minimus*;
2. noncarcinogenic risk (hazard) less than 0.1 was considered *de minimus*;
3. carcinogenic risk less than 10^{-6} was considered *de minimus*; and
4. carcinogenic risk within the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) target risk range of 10^{-4} to 10^{-6} was considered tolerable.

Using this approach, dose and risk calculations were performed using the highest modeled soil concentrations. If risk or dose estimates were above tolerable limits, additional calculations were performed to identify those areas that pose the highest dose and risk under chronic exposure conditions. If risk and dose estimates using the highest modeled soil concentrations were below tolerable limits, no additional evaluation was performed.

The following sections provide a more detailed description of methods used to estimate receptor risk and dose estimates. This description is supplemented by the information tabulated in Tables C.3 through C.8. In general, the methods follow those described in Risk Assessment Guidance (RAGS) Part A (EPA 1989).

C.3.1 EXPOSURE POINT CONCENTRATIONS

Based on the data presented in the programmatic environmental assessment (PEA), the maximum uranium concentration is 1.02 mg/kg, which is associated with a direct release during a seismic incident at a central storage facility at a single site (Table C.2). While concentrations in mg/kg are sufficient for noncarcinogenic risk estimates, concentrations must be expressed per radioisotope in pCi/g units in order to complete carcinogenic risk and radiological dose estimates. This conversion was completed in two steps beginning with the conversion from mg/kg uranium to total uranium (U_T) activity:

$$U_T\ (\text{pCi/g}) = U_T\ (\text{mg/kg}) * 1'10^{-6}\ \text{kg soil/mg soil} * 7'10^{-7}\ \text{Ci/g U} * 1'10^{12}\ \text{pCi/Ci}$$
$$U_T = 3.55\ \text{pCi/g}$$

The value 7×10^{-7} curies per gram of uranium (Ci/g) represents the specific activity of normal uranium. Normal uranium was assumed, although the PEA indicates that the uranium distribution would be 85% depleted, with a specific activity of ~3.5E-7 Ci/g. The more conservative conversion factor is used to provide an upper-bound estimate of carcinogenic risk and radiological dose (there is no impact to noncarcinogenic risk).

Table C.3. Human health exposure parameters for the uranium accident and hazard analysis

Receptor	EF (d/y)	ED (y)	BW (kg)	AT (d)	CF[a] (g/kg)	IR_{soil} (kg/d)	ET (hr/hr)	IR_{air} (m^3/d)	SA (m^2/d)	AF (mg/cm^2)	Se (unitless)	Te (hr/hr)	EF_{ext} (d/d)	PEF (m^3/kg)
EM worker[b]	5	1	70	365	1000	5.E-05	1.0	20	0.53	1.0	0.2	0.333	0.014	5.38E+09
Industrial[c]	250	25	70	9125	1000	5.E-05	1.0	20	0.53	1.0	0.2	0.333	0.685	5.38E+09
Resident[d]	350	30	70	10950	1000	1E-04	1.0	20	0.53	1.0	0.2	1.0	0.959	5.38E+09

[a]For dermal: 0.01 = CFd = (kg-cm^2)/(mg-m^2).
Also w/ dermal: 0.01 = ABS = absorption fraction.
1.0 = FI = fraction ingested.
AT for dermal pathway only.
SA for average surface area for head, hands, forearm, and lower legs for an adult.
AF for soil.
[b]EM (emergency management) worker assumed to be present for cleanup activities only–40-h total.
[c]Assumed to be standard default industrial worker–8 h/day for 250 days/year.
[d]Assumed to be standard adult resident–24 h/day for 350 days/year.

Radiological risk equations
Ingestion risk = EPC * IRsoil * EF * ED * CF * CSFing
Inhalation risk = EPC *IRair * (1/PEF) * ET * EF * ED * CF * CSFinh
External exposure risk = EPC * (1-Se) * Te * EFext * ED * CSFext

Non-carcinogenic risk equations
Dermal hazard = EPC * CFd * AF * ABS * SA * ED * EF * (1/RfD) / (AT * BW)
Oral hazard = EPC * FI * IRsoil * ED * EF * (1/RfD) / (AT * BW)

Radiological dose equations
Ingestion dose = EPC * IRsoil * EF * CF * DCFing
Inhalation dose = EPC *IRair * (1/PEF) * ET * EF * CF * DCFinh
External dose = EPC * (1-Se) * Te * EFext * DCFext

Variable	Description
AF	adherence factor
AT	averaging time
BW	body weight
CF	conversion factor
CSFx	cancer slope factor (pathway x)
DCFx	dose conversion factor (pathway x)
ED	exposure duration
EF	exposure frequency
EFetx	exposure frequency (gamma)
EPC	exposure point concentration
ET	exposure time
IRair	inhalation rate (dust)
IRsoil	ingestion rate (soil)
PEF	particulate emission factors
RfD	reference dose
SA	surface area
Se	gamma shielding factor
Te	gamma exposure time

Table C.4. Summary of cancer risks

Analyte	EPC[a] (pCi/g)	Cancer intakes (pCi)[b]			Cancer risks			
		Ingestion	Inhalation	External	Ingestion	Inhalation	External[c]	Total
Short-term Emergency Worker								
Uranium-234	3.50E-01	8.8E-02	6.5E-06	1.3E-03	1.4E-11	7.4E-14	3.2E-13	1.4E-11
Uranium-235+D	1.61E-02	4.0E-03	3.0E-07	5.9E-05	6.6E-13	3.0E-15	3.2E-11	3.3E-11
Uranium-238+D	3.50E-01	8.8E-02	6.5E-06	1.3E-03	1.8E-11	6.1E-14	1.5E-10	1.6E-10
Pathway total					3.3E-11	1.4E-13	1.8E-10	2.1E-10
Standard Industrial Worker								
Uranium-234	3.50E-01	1.1E+02	8.1E-03	1.6E+00	1.7E-08	9.3E-11	4.0E-10	1.8E-08
Uranium-235+D	1.61E-02	5.0E+00	3.7E-04	7.4E-02	8.2E-10	3.8E-12	4.0E-08	4.1E-08
Uranium-238+D	3.50E-01	1.1E+02	8.1E-03	1.6E+00	2.3E-08	7.6E-11	1.8E-07	2.1E-07
Pathway total					4.1E-08	1.7E-10	2.2E-07	2.6E-07
Standard Adult Resident								
Uranium-234	3.50E-01	3.7E+02	1.4E-02	8.1E+00	5.8E-08	1.6E-10	2.0E-09	6.0E-08
Uranium-235+D	1.61E-02	1.7E+01	6.3E-04	3.7E-01	2.8E-09	6.4E-12	2.0E-07	2.0E-07
Uranium-238+D	3.50E-01	3.7E+02	1.4E-02	8.1E+00	7.7E-08	1.3E-10	9.2E-07	1.0E-06
Pathway total					1.4E-07	2.9E-10	1.1E-06	1.3E-06

[a]EPC = Exposure point concentration; maximum values used to provide conservative exposure estimate.
[b]Or pCi*yr/g for external gamma.
[c]Using slope factors for infinite depth.

Table C.5. Summary of radiological dose

Analyte	EPC[a] (pCi/g)	Intakes (pCi/yr)[b]			Dose (mrem/yr)			
		Ingestion	Inhalation	External	Ingestion	Inhalation	External[c]	Total
				Short-term Emergency Worker				
Uranium-234	3.50E-01	8.8E-02	6.5E-06	1.3E-03	2.5E-05	5.1E-08	5.1E-07	2.5E-05
Uranium-235+D	1.61E-02	4.0E-03	3.0E-07	5.9E-05	1.1E-06	2.2E-09	4.5E-05	4.6E-05
Uranium-238+D	3.50E-01	8.8E-02	6.5E-06	1.3E-03	2.4E-05	4.6E-08	1.6E-04	1.9E-04
Pathway total					4.9E-05	1.0E-07	2.1E-04	2.6E-04
				Standard Industrial Worker				
Uranium-234	3.50E-01	4.4E+00	3.3E-04	6.4E-02	1.2E-03	2.6E-06	2.6E-05	1.3E-03
Uranium-235+D	1.61E-02	2.0E-01	1.5E-05	2.9E-03	5.4E-05	1.1E-07	2.2E-03	2.3E-03
Uranium-238+D	3.50E-01	4.4E+00	3.3E-04	6.4E-02	1.2E-03	2.3E-06	8.2E-03	9.4E-03
Pathway total					2.5E-03	5.0E-06	1.1E-02	1.3E-02
				Standard Adult Resident				
Uranium-234	3.50E-01	1.2E+01	4.6E-04	2.7E-01	3.5E-03	3.6E-06	1.1E-04	3.6E-03
Uranium-235+D	1.61E-02	5.6E-01	2.1E-05	1.2E-02	1.5E-04	1.5E-07	9.4E-03	9.5E-03
Uranium-238+D	3.50E-01	1.2E+01	4.6E-04	2.7E-01	3.3E-03	3.2E-06	3.5E-02	3.8E-02
Pathway total					6.9E-03	7.0E-06	4.4E-02	5.1E-02

[a]EPC = Exposure point concentration; maximum values used to provide conservative exposure estimate.
[b]Or pCi*yr/g for external gamma.
[c]Using slope factors for infinite depth.

Table C.6. Summary of non-carcinogenic hazard

Analyte	EPC[a] (mg/kg)	Intakes (mg/kg-day) Ingestion	Intakes (mg/kg-day) Dermal	Hazard Ingestion	Hazard Dermal	Hazard Total
		Short-term Emergency Worker				
Uranium	1.02E+00	1.0E-08	1.1E-08	6.0E-12	5.4E-12	1.1E-11
Pathway total				6.0E-12	5.4E-12	1.1E-11
		Standard Industrial Worker				
Uranium	1.02E+00	5.0E-07	5.3E-07	3.0E-10	2.7E-10	5.7E-10
Pathway total				3.0E-10	2.7E-10	5.7E-10
		Standard Adult Resident				
Uranium	1.02E+00	1.4E-06	7.4E-07	8.4E-10	3.8E-10	1.2E-09
Pathway total				8.4E-10	3.8E-10	1.2E-09

[a]EPC = Exposure point concentration; maximum values used to provide conservative exposure estimate.

Table C.7. Toxicity values for human health risk and dose calculations

Radionuclide	CASRN	ICRP lung type	Soil ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External exposure (Risk/yr/pCi/g)	Oral chronic RfD (mg/kg-day)	Dermal chronic RfD (mg/kg-day)	GI absorption factor	Dermal absorption factor	Soil ingestion (mrem/pCi)	Inhalation (mrem/pCi)	External exposure (mrem/yr/pCi/g)
Uranium-234	013966-29-5	M	1.58E-10	1.14E-08	2.52E-10					2.84E-04	7.89E-03	4.02E-04
Uranium-235+D	015117-96-1(+D)	M	1.63E-10	1.01E-08	5.43E-07					2.68E-04	7.30E-03	7.58E-01
Uranium-238+D	007440-61-1(+D)	M	2.10E-10	9.35E-09	1.14E-07					2.68E-04	7.07E-03	1.29E-01
Uranium	NA					6.00E-04	5.10E-04	0.8500	0.001			

Dose factors from Federal Guidance Reports 11 and 12

Isotopes	Ingestion dose conversion factor			Inhalation dose conversion factor			External infinite		
	Sv/Bq Effective	mrem/pCi Effective	basis	Sv/Bq Effective	mrem/pCi Effective	basis	Sv per Bq s m-3	mrem/s per pCi/m3	mrem/yr per pCi/g
Uranium-234	7.66E-08	2.8E-04	0.05	2.13E-06	7.89E-03	W	2.15E-21	7.96E-18	4.02E-04
Uranium-235+D	7.23E-08	2.68E-04		1.97E-06	7.30E-03		4.06E-18	1.50E-14	7.58E-01
U-235	7.19E-08	2.66E-04	0.05	1.97E-06	7.30E-03	W	3.86E-18	1.43E-14	7.21E-01
Th-231	3.65E-10	1.35E-06		2.33E-10	8.63E-07	W	1.95E-19	7.22E-16	3.64E-02
Uranium-238+D	7.25E-08	2.68E-04		1.91E-06	7.07E-03		6.90E-19	2.56E-15	1.29E-01
U-238	6.88E-08	2.55E-04	0.05	1.90E-06	7.04E-03	W	5.52E-22	2.04E-18	1.03E-04
Th-234	3.69E-09	1.37E-05		8.04E-09	2.98E-05	W	1.29E-19	4.78E-16	2.41E-02
Pa-234m							4.80E-19	1.78E-15	8.97E-02
Pa-234	5.84E-10	2.16E-06		1.98E-10	7.33E-07	W	6.18E-17	2.29E-13	1.15E+01

For lung class, W = M.

CASRN = Chemical Abstract Services Registry Number.
GI = gastrointestinal.
ICRP = International Commission on Radiological Protection.
RfD = reference dose.

Table C.8. Uranium source term

				Normal uranium			
Accident scenario	Site	Material	Concentration (mg/kg)	U-total activity[a] (pCi/g)	U-234 activity[b] (pCi/g)	U-235 activity[b] (pCi/g)	U-238 activity[b] (pCi/g)
All	General container handling	Composite/T Hopper	5.76E-03	4.03E-03	1.97E-03	9.06E-05	1.97E-03
No Action	Storage area fire	INEEL	1.51E-02	1.06E-02	5.16E-03	2.38E-04	5.16E-03
		PGDP	6.14E-05	4.30E-05	2.10E-05	9.66E-07	2.10E-05
		PORTS	1.74E-01	1.22E-01	5.96E-02	2.74E-03	5.96E-02
		SRS	3.45E-02	2.41E-02	1.18E-02	5.43E-04	1.18E-02
		Oak Ridge	1.65E-02	1.16E-02	5.66E-03	2.60E-04	5.66E-03
		Max other	2.04E-02	1.43E-02	6.99E-03	3.21E-04	6.99E-03
	Seismic (direct release)	INEEL	9.08E-03	6.35E-03	3.11E-03	1.43E-04	3.11E-03
		PGDP	2.27E-04	1.59E-04	7.76E-05	3.57E-06	7.76E-05
		PORTS	5.92E-01	4.14E-01	2.02E-01	9.31E-03	2.02E-01
		SRS	3.85E-02	2.69E-02	1.32E-02	6.06E-04	1.32E-02
		Oak Ridge	1.82E-02	1.27E-02	6.21E-03	2.86E-04	6.21E-03
		Max other	7.54E-02	5.28E-02	2.58E-02	1.19E-03	2.58E-02
	Seismic (fire)	INEEL	9.87E-04	6.91E-04	3.38E-04	1.55E-05	3.38E-04
		PGDP	1.53E-05	1.07E-05	5.25E-06	2.41E-07	5.25E-06
		PORTS	4.06E-02	2.84E-02	1.39E-02	6.38E-04	1.39E-02
		SRS	3.31E-03	2.32E-03	1.13E-03	5.22E-05	1.13E-03
		Oak Ridge	1.57E-03	1.10E-03	5.37E-04	2.47E-05	5.37E-04
		Max other	5.11E-03	3.58E-03	1.75E-03	8.05E-05	1.75E-03
Long-term centralized storage	Storage area fire	All	3.56E-01	2.49E-01	1.22E-01	5.61E-03	1.22E-01
	Seismic (direct release)	All	1.02E+00	7.16E-01	3.50E-01	1.61E-02	3.50E-01
	Seismic (fire)	All	7.16E-02	5.01E-02	2.45E-02	1.13E-03	2.45E-02
Consolidate at several sites	Storage area fire	INEEL	3.49E-02	2.44E-02	1.19E-02	5.49E-04	1.19E-02
		PGDP	5.22E-03	3.65E-03	1.79E-03	8.21E-05	1.79E-03
		PORTS	2.40E-01	1.68E-01	8.20E-02	3.77E-03	8.20E-02
		SRS	3.53E-02	2.47E-02	1.21E-02	5.55E-04	1.21E-02
		Oak Ridge	4.27E-02	2.99E-02	1.46E-02	6.72E-04	1.46E-02

Table C.8. Uranium source term (continued)

Accident scenario	Site	Material	Concentration (mg/kg)	Normal uranium U-total activity[a] (pCi/g)	U-234 activity[b] (pCi/g)	U-235 activity[b] (pCi/g)	U-238 activity[b] (pCi/g)
	Seismic (direct release)	INEEL	3.32E-02	2.32E-02	1.14E-02	5.22E-04	1.14E-02
		PGDP	9.33E-03	6.53E-03	3.19E-03	1.47E-04	3.19E-03
		PORTS	8.23E-01	5.76E-01	2.82E-01	1.30E-02	2.82E-01
		SRS	4.16E-02	2.91E-02	1.42E-02	6.55E-04	1.42E-02
		Oak Ridge	1.15E-01	8.02E-02	3.92E-02	1.80E-03	3.92E-02
	Seismic (fire)	INEEL	3.00E-03	2.10E-03	1.03E-03	4.73E-05	1.03E-03
		PGDP	7.09E-04	4.96E-04	2.43E-04	1.12E-05	2.43E-04
		PORTS	5.61E-02	3.92E-02	1.92E-02	8.82E-04	1.92E-02
		SRS	3.52E-03	2.46E-03	1.20E-03	5.53E-05	1.20E-03
		Oak Ridge	8.08E-03	5.65E-03	2.76E-03	1.27E-04	2.76E-03
Consolidate at one western site and one eastern site	Storage area fire	East	3.22E-01	2.25E-01	1.10E-01	5.07E-03	1.10E-01
		West	3.60E-02	2.52E-02	1.23E-02	5.66E-04	1.23E-02
	Seismic (direct release)	East	9.86E-01	6.90E-01	3.37E-01	1.55E-02	3.37E-01
		West	3.72E-02	2.61E-02	1.27E-02	5.86E-04	1.27E-02
	Seismic (fire)	East	6.84E-02	4.79E-02	2.34E-02	1.08E-03	2.34E-02
		West	3.28E-03	2.29E-03	1.12E-03	5.16E-05	1.12E-03
Consolidate by physical form	Storage area fire	PORTS/compound, misc., oxide	1.54E-01	1.08E-01	5.28E-02	2.43E-03	5.28E-02
		SRS/metal	8.71E-02	6.10E-02	2.98E-02	1.37E-03	2.98E-02
		INEEL/reactfuel, source	1.06E-02	7.43E-03	3.63E-03	1.67E-04	3.63E-03
	Seismic (direct release)	PORTS/compound, misc., oxide	9.61E-01	6.73E-01	3.29E-01	1.51E-02	3.29E-01
		SRS/metal	4.82E-02	3.37E-02	1.65E-02	7.59E-04	1.65E-02
		INEEL/reactfuel, source	1.26E-02	8.79E-03	4.29E-03	1.98E-04	4.29E-03
	Seismic (fire)	PORTS/compound, misc., oxide	6.49E-02	4.54E-02	2.22E-02	1.02E-03	2.22E-02
		SRS/metal	5.43E-03	3.80E-03	1.86E-03	8.55E-05	1.86E-03
		INEEL/reactfuel, source	1.06E-03	7.43E-04	3.63E-04	1.67E-05	3.63E-04
Transfer to research facility	Storage area fire	Generic	1.26E-03	8.79E-04	4.30E-04	1.98E-05	4.30E-04
	Seismic (direct release)	Generic	4.06E-04	2.84E-04	1.39E-04	6.38E-06	1.39E-04
	Seismic (fire)	Generic	2.51E-04	1.76E-04	8.60E-05	3.96E-06	8.60E-05

Table C.8. Uranium source term (continued)

				Normal uranium			
Accident scenario	**Site**	**Material**	**Concentration (mg/kg)**	**U-total activity[a] (pCi/g)**	**U-234 activity[b] (pCi/g)**	**U-235 activity[b] (pCi/g)**	**U-238 activity[b] (pCi/g)**
Transfer to other government agencies	Storage area fire	Generic	6.28E-02	4.39E-02	2.15E-02	9.88E-04	2.15E-02
	Seismic (direct release)	Generic	2.02E-02	1.42E-02	6.93E-03	3.19E-04	6.93E-03
	Seismic (fire)	Generic	1.26E-02	8.79E-03	4.30E-03	1.98E-04	4.30E-03
Foreign sales	Storage area fire	Generic	1.24E-01	8.69E-02	4.25E-02	1.95E-03	4.25E-02
	Seismic (direct release)	Generic	4.37E-02	3.06E-02	1.50E-02	6.88E-04	1.50E-02
	Seismic (fire)	Generic	2.68E-02	1.88E-02	9.17E-03	4.22E-04	9.17E-03
			1.02E+00	7.16E-01	3.50E-01	1.61E-02	3.50E-01

[a]mg U/kg soil * 1E-3 kg soil/g soil * 1E-3 g U/mg U * 7E-7 Ci/g U * 1E12 pCi/Ci = 7E-1 pCi/g per mg/kg.
[b]Total-U (pCi/g)/2.046 for U-234 and U-238 or Total-U (pCi/g)*0.046/2.046 for U-235.

U-235 = (21.6 * %enrichment * 0.01 * U-238) / {3.35*[1-(%enrichment*0.01)]}.

U-234 = U-235 × {27.18 - 0.3004(U-238/U-235) + [0.00143(U-238/U-235)]^2}.

Estimated based on a best-fit curve from Fig. 2-2 of the *Health Physics Manual of Good Practices for Uranium Facilities*.

INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

The second step of unit conversions was to partition the total activity among uranium isotopes. This was accomplished using guidance from the *Health Physics Manual of Good Practices for Uranium Facilities* (DOE 1988). Concentrations of individual uranium isotopes were calculated based on the following equations:

$$\text{U-234 (pCi/g)} = \text{U-238 (pCi/g)} = U_T \text{ (pCi/g)} / 2.046 = 3.55 / 2.046 = 1.73 \text{ pCi/g}$$

$$\text{U-235 (pCi/g)} = U_T \text{ (pCi/g)} * 0.046 / 2.046 = (3.55*0.046) / 2.046 = 0.080 \text{ pCi/g}$$

This approach assumes a concentration ratio of 1.0-to-0.046-to-1.0 for ^{234}U, ^{235}U, and ^{238}U, respectively. For this assessment it was also assumed that short-lived decay products (i.e., with half-life less than 6 months) of ^{235}U and ^{238}U were present at equilibrium concentrations. Modeled soil concentrations are tabulated in Table C.8.

C.3.2 EXPOSURE PATHWAYS

The complete exposure pathway is dependent on the following four conditions:

- a source of contamination,
- a route of transport to an exposure point,
- a receptor at the exposure point, and
- a route of exposure to the receptor.

For the accident condition considered, the soil is the source of contamination, and it is assumed that the identified receptors will be exposed to the contaminated soil. Routes of exposure are inhalation, ingestion, dermal contact, and external exposure to radiation.

Three receptors were evaluated in this assessment: an EM worker, an industrial worker, and a resident. The EM worker is assumed to be exposed to contaminants for 40 hours while conducting cleanup activities. The industrial worker is assumed to work in the area and is exposed for 8 hours/day, 250 days/year, for 25 years. The resident is assumed to live on-site and is exposed for 24 hours/day, 350 days/year, for 30 years. The receptors have been chosen to represent a range of hypothetical exposures and provide an upper-bound estimate on potential health risks, although the residential receptor is not considered plausible under current site conditions The exposure parameters used in the evaluation are presented in Table C.3 and are used along with toxicity data presented in the following section to calculate risks and hazards.

C.3.3 TOXICITY ASSESSMENT

Table C.7 presents toxicity data, including cancer slope factors, reference doses (RfDs), and dose conversion factors. Slope factors were taken from EPA's Health Effects Assessment Summary Table, and RfDs were taken from EPA's Integrated Risk Information System. The dose conversion factors were derived from Federal Guidance Report No. 11 (EPA 1988) and Federal Guidance Report No. 12 (EPA 1993a).

C.3.4 CHARACTERIZATION OF CONSEQUENCES

The exposure parameters and toxicity data are used to calculate the overall risks, doses, and hazards to the exposed receptors.

C.3.4.1 Method

Risks from the uranium isotopes were evaluated using the following equations per RAGS, Part A (see Table C.3 for details):

- Ingestion risk = EPC * IR_{soil} * EF * ED * CF * CSF_{ing}
- Inhalation risk = EPC *IR_{air} * (1/PEF) * ET * EF * ED * CF * CSF_{inh}
- External exposure risk = EPC * (1-S_e) * Te * EF_{ext} * ED * CSF_{ext}

Hazards associated with total uranium were calculated with the following equations:

- Oral hazard = EPC * FI * IR_{soil} * ED * EF * (1/RfD) / (AT * BW)
- Dermal hazard = EPC * CF_d * AF * ABS * SA * ED * EF * (1/RfD) / (AT * BW)

Doses were estimated for the uranium isotopes, with the following equations using modified RAGS, Part A, equations for dose versus risk estimates:

- Ingestion dose = EPC * IR_{soil} * EF * CF * DCF_{ing}
- Inhalation dose = EPC *IR_{air} * (1/PEF) * ET * EF * CF * DCF_{inh}
- External dose = EPC * (1-S_e) * T_e * EF_{ext} * DCF_{ext}

Total risk, hazard, and dose calculations were performed for each receptor and were calculated by summing across exposure pathways. The results of the carcinogenic risk, radiological dose, and noncarcinogenic hazard are presented in Tables C-4, C-5, and C-6, respectively.

C.3.4.2 Results

The maximum total risks for all isotopes are 2.1×10^{-10} for the EM worker, 2.6×10^{-7} for the standard industrial worker, and 1.3×10^{-6} for the standard resident. While only the EM worker risk is *de minimus*, all carcinogenic risk estimates are within or below the CERCLA target range of 10^{-4} to 10^{-6}. The maximum calculated dose is 0.051 mrem/year for the implausible standard resident; thus, all doses are considered *de minimus*. The maximum calculated hazard is 1.2×10^{-9} for the implausible standard resident; thus, all hazards are considered *de minimus*. Overall the risks, doses, and hazards are within, or below, tolerable limits even using the conservative residential scenario and using the maximum modeled concentrations. These results indicate a low probability of adverse health effects from chronic exposure associated with the most serious accident scenario.

C.3.5 OVERALL RISK EVALUATION

Overall risks were evaluated by combining the consequences of an alternative-specific accident and the likelihood of the accident, as shown in Appendix A, Fig. A.1. Following are cancer risk categories: $<10^{-6}$, negligible; between 10^{-6} and 10^{-5}, low; between 10^{-5} and 10^{-4}, moderate; and $>10^{-4}$, high. Radiological consequence categories are shown in Appendix A, Tables A.11 and A.12. Following are toxicological consequence categories: hazard quotient (HQ) <0.1, negligible; HQ between 0.1 and 1, low; and HQ >1, high (the moderate consequence category is not defined). The accident frequency and consequence categories for the proposed alternatives are shown in Tables C-9 and C-10, along with the resulting overall risks.

C.4 ALTERNATIVE-SPECIFIC EVALUATION OF IMPACTS TO ECOLOGICAL RECEPTORS

C.4.1 GENERAL APPROACH

Potential ecological exposures were evaluated for each alternative. It was assumed that airborne uranium will be deposited on soil and surface water. From surface water it will accumulate in sediment. Plants and terrestrial invertebrates are exposed to uranium by direct uptake from soil. Terrestrial vertebrates are exposed by direct uptake from soil and by ingestion of contaminated food. Aquatic biota and benthic invertebrates are exposed directly to uranium in surface water and sediment, respectively. Also evaluated are carnivores that prey on aquatic and benthic biota. All indicator receptors are exposed to the chemical effects of incorporated uranium as well as both external radiation from contaminated media and internal radiation from incorporated uranium.

C.4.2 HAZARD IDENTIFICATION

The indicator terrestrial vertebrates used in this evaluation are short-tailed shrews and American robins, which are highly exposed to soil contaminants because they ingest relatively large quantities of soil along with a diet of plants and terrestrial invertebrates. The indicator vertebrate exposed to contaminants in water is the great blue heron, which is highly exposed because it ingests water and sediment as well as fish and sediment-dwelling benthic invertebrates. Because uranium does not bioaccumulate up the food chain, these receptors are expected to be more exposed than carnivores at a higher trophic level. For simplicity, it is assumed that the habitats of all of the indicator receptors occur within the path of the airborne uranium.

C.4.3 EXPOSURE ASSESSMENT

The following three subsections describe the assessment of exposure of the ecological receptors, evaluation of the environmental toxicity of uranium, and an evaluation of the risks resulting from deposition of uranium after the hypothetical accidents described in the description of alternatives.

The exposure assessment includes an estimate of exposure concentrations at the locations where biota are expected to be maximally exposed under each alternative at each site. Concentrations of uranium in soil and water were based on estimates of the rate of deposition of airborne uranium released by accidents under each alternative. Estimates of media concentrations were made as described in Chap. 5.

Terrestrial biota are assumed to be exposed to uranium by uptake or ingestion and by direct exposure to contaminated soil. Aquatic biota and predators of aquatic biota are assumed to be exposed by uptake or ingestion and by direct exposure to contaminated surface water and sediment. It was assumed that the uranium in soil had the isotopic distribution of normal uranium (i.e., 48.8% of total U activity as ^{234}U, 2.4% as ^{235}U, and 48.8% as ^{238}U).

Table C.9. Summary of chronic radiation risks to human receptors due to deposition of uranium on soil under bounding accident scenarios

Alternative	Accident scenario	Site	Frequency	Radiation risk: Maximum risk	Radiation risk: Consequence level	Radiation risk: Risk	Radiation exposure: Maximum dose	Radiation exposure: Consequence level	Radiation exposure: Risk
All	General container handling	All	Anticipated	7.6E-09	Negligible	Negligible	3.1E-04	Negligible	Negligible
No Action	Storage area fire	INEEL	Extremely unlikely	2.0E-08	Negligible	Negligible	8.0E-04	Negligible	Negligible
		PGDP		8.1E-11	Negligible	Negligible	3.3E-06	Negligible	Negligible
		PORTS		2.3E-07	Negligible	Negligible	9.3E-03	Negligible	Negligible
		SRS		4.6E-08	Negligible	Negligible	1.8E-03	Negligible	Negligible
		Oak Ridge		2.2E-08	Negligible	Negligible	8.8E-04	Negligible	Negligible
		Max other		2.7E-08	Negligible	Negligible	1.1E-03	Negligible	Negligible
	Seismic (direct release)	INEEL	Extremely unlikely	1.2E-08	Negligible	Negligible	4.8E-04	Negligible	Negligible
		PGDP		3.0E-10	Negligible	Negligible	1.2E-05	Negligible	Negligible
		PORTS		7.8E-07	Negligible	Negligible	3.2E-02	Negligible	Negligible
		SRS		5.1E-08	Negligible	Negligible	2.1E-03	Negligible	Negligible
		Oak Ridge		2.4E-08	Negligible	Negligible	9.7E-04	Negligible	Negligible
		Max other		1.0E-07	Negligible	Negligible	4.0E-03	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	1.3E-09	Negligible	Negligible	5.3E-05	Negligible	Negligible
		PGDP		2.0E-11	Negligible	Negligible	8.2E-07	Negligible	Negligible
		PORTS		5.4E-08	Negligible	Negligible	2.2E-03	Negligible	Negligible
		SRS		4.4E-09	Negligible	Negligible	1.8E-04	Negligible	Negligible
		Oak Ridge		2.1E-09	Negligible	Negligible	8.4E-05	Negligible	Negligible
		Max other		6.8E-09	Negligible	Negligible	2.7E-04	Negligible	Negligible
Centralized storage at a single site	Storage area fire	All	Extremely unlikely	4.7E-07	Negligible	Negligible	1.9E-02	Negligible	Negligible
	Seismic (direct release)	All	Extremely unlikely	1.4E-06	Low	Low	5.5E-02	Negligible	Negligible
	Seismic (fire)	All	Extremely unlikely	9.5E-08	Negligible	Negligible	3.8E-03	Negligible	Negligible
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	Extremely unlikely	4.6E-08	Negligible	Negligible	1.9E-03	Negligible	Negligible
		PGDP		6.9E-09	Negligible	Negligible	2.8E-04	Negligible	Negligible
		PORTS		3.2E-07	Negligible	Negligible	1.3E-02	Negligible	Negligible
		SRS		4.7E-08	Negligible	Negligible	1.9E-03	Negligible	Negligible
		Oak Ridge		5.6E-08	Negligible	Negligible	2.3E-03	Negligible	Negligible

Table C.9. Summary of chronic radiation risks to human receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Frequency	Radiation risk: Maximum risk	Radiation risk: Consequence level	Radiation risk: Risk	Radiation exposure: Maximum dose	Radiation exposure: Consequence level	Radiation exposure: Risk
	Seismic (direct release)	INEEL	Extremely unlikely	4.4E-08	Negligible	Negligible	1.8E-03	Negligible	Negligible
		PGDP		1.2E-08	Negligible	Negligible	5.0E-04	Negligible	Negligible
		PORTS		1.1E-06	Low	Low	4.4E-02	Negligible	Negligible
		SRS		5.5E-08	Negligible	Negligible	2.2E-03	Negligible	Negligible
		Oak Ridge		1.5E-07	Negligible	Negligible	6.1E-03	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	4.0E-09	Negligible	Negligible	1.6E-04	Negligible	Negligible
		PGDP		9.4E-10	Negligible	Negligible	3.8E-05	Negligible	Negligible
		PORTS		7.4E-08	Negligible	Negligible	3.0E-03	Negligible	Negligible
		SRS		4.6E-09	Negligible	Negligible	1.9E-04	Negligible	Negligible
		Oak Ridge		1.1E-08	Negligible	Negligible	4.3E-04	Negligible	Negligible
Partially consolidated storage at two sites	Storage area fire	East	Extremely unlikely	4.3E-07	Negligible	Negligible	1.7E-02	Negligible	Negligible
		West		4.8E-08	Negligible	Negligible	1.9E-03	Negligible	Negligible
	Seismic (direct release)	East	Extremely unlikely	1.3E-06	Low	Low	5.3E-02	Negligible	Negligible
		West		4.9E-08	Negligible	Negligible	2.0E-03	Negligible	Negligible
	Seismic (fire)	East	Extremely unlikely	9.0E-08	Negligible	Negligible	3.6E-03	Negligible	Negligible
		West		4.3E-09	Negligible	Negligible	1.7E-04	Negligible	Negligible
Partially consolidated storage based on physical form	Storage area fire	PORTS	Extremely unlikely	2.0E-07	Negligible	Negligible	8.2E-03	Negligible	Negligible
		SRS		1.2E-07	Negligible	Negligible	4.6E-03	Negligible	Negligible
		INEEL		1.4E-08	Negligible	Negligible	5.7E-04	Negligible	Negligible
	Seismic (direct release)	PORTS	Extremely unlikely	1.3E-06	Low	Low	5.1E-02	Negligible	Negligible
		SRS		6.4E-08	Negligible	Negligible	2.6E-03	Negligible	Negligible
		INEEL		1.7E-08	Negligible	Negligible	6.7E-04	Negligible	Negligible
	Seismic (fire)	PORTS	Extremely unlikely	8.6E-08	Negligible	Negligible	3.5E-03	Negligible	Negligible
		SRS		7.2E-09	Negligible	Negligible	2.9E-04	Negligible	Negligible
		INEEL		1.4E-09	Negligible	Negligible	5.7E-05	Negligible	Negligible
Transfer to research facility	Facility fire	Generic	Extremely unlikely	1.7E-09	Negligible	Negligible	6.7E-05	Negligible	Negligible
	Seismic (direct release)	Generic		5.4E-10	Negligible	Negligible	2.2E-05	Negligible	Negligible
	Seismic (fire)	Generic		3.3E-10	Negligible	Negligible	1.3E-05	Negligible	Negligible

Table C.9. Summary of chronic radiation risks to human receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

				Radiation risk			Radiation exposure		
Alternative	Accident scenario	Site	Frequency	Maximum risk	Consequence level	Risk	Maximum dose	Consequence level	Risk
Transfer to other government agencies	Facility fire	Generic	Extremely unlikely	8.3E-08	Negligible	Negligible	3.3E-03	Negligible	Negligible
	Seismic (direct release)	Generic		2.7E-08	Negligible	Negligible	1.1E-03	Negligible	Negligible
	Seismic (fire)	Generic		1.7E-08	Negligible	Negligible	6.7E-04	Negligible	Negligible
Foreign sales	Facility fire	Generic	Extremely unlikely	1.6E-07	Negligible	Negligible	6.6E-03	Negligible	Negligible
	Seismic (direct release)	Generic		5.8E-08	Negligible	Negligible	2.3E-03	Negligible	Negligible
	Seismic (fire)	Generic		3.5E-08	Negligible	Negligible	1.4E-03	Negligible	Negligible

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

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Table C.10. Summary of chronic chemical risks to human receptors due to deposition of uranium on soil under bounding accident scenarios

Alternative	Accident scenario	Site	Frequency	Chemical exposure: Maximum HQ	Chemical exposure: Consequence level	Chemical exposure: Risk
All	General container handling	All	Anticipated	4.8E-12	Negligible	Negligible
No Action	Storage area fire	INEEL	Extremely unlikely	1.3E-11	Negligible	Negligible
		PGDP		5.1E-14	Negligible	Negligible
		PORTS		1.4E-10	Negligible	Negligible
		SRS		2.9E-11	Negligible	Negligible
		Oak Ridge		1.4E-11	Negligible	Negligible
		Max other		1.7E-11	Negligible	Negligible
	Seismic (direct release)	INEEL	Extremely unlikely	7.5E-12	Negligible	Negligible
		PGDP		1.9E-13	Negligible	Negligible
		PORTS		4.9E-10	Negligible	Negligible
		SRS		3.2E-11	Negligible	Negligible
		Oak Ridge		1.5E-11	Negligible	Negligible
		Max other		6.2E-11	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	8.2E-13	Negligible	Negligible
		PGDP		1.3E-14	Negligible	Negligible
		PORTS		3.4E-11	Negligible	Negligible
		SRS		2.7E-12	Negligible	Negligible
		Oak Ridge		1.3E-12	Negligible	Negligible
		Max other		4.2E-12	Negligible	Negligible
Centralized storage at a single site	Storage area fire	All	Extremely unlikely	3.0E-10	Negligible	Negligible
	Seismic (direct release)	All	Extremely unlikely	8.5E-10	Negligible	Negligible
	Seismic (fire)	All	Extremely unlikely	5.9E-11	Negligible	Negligible
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	Extremely unlikely	2.9E-11	Negligible	Negligible
		PGDP		4.3E-12	Negligible	Negligible
		PORTS		2.0E-10	Negligible	Negligible
		SRS		2.9E-11	Negligible	Negligible
		Oak Ridge		3.5E-11	Negligible	Negligible
	Seismic (direct release)	INEEL	Extremely unlikely	2.7E-11	Negligible	Negligible
		PGDP		7.7E-12	Negligible	Negligible
		PORTS		6.8E-10	Negligible	Negligible
		SRS		3.4E-11	Negligible	Negligible
		Oak Ridge		9.5E-11	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	2.5E-12	Negligible	Negligible
		PGDP		5.9E-13	Negligible	Negligible
		PORTS		4.6E-11	Negligible	Negligible
		SRS		2.9E-12	Negligible	Negligible
		Oak Ridge		6.7E-12	Negligible	Negligible

Table C.10. Summary of chronic chemical risks to human receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Frequency	Chemical exposure: Maximum HQ	Chemical exposure: Consequence level	Chemical exposure: Risk
Partially consolidated storage at two sites	Storage area fire	East	Extremely unlikely	2.7E-10	Negligible	Negligible
		West		3.0E-11	Negligible	Negligible
	Seismic (direct release)	East	Extremely unlikely	8.2E-10	Negligible	Negligible
		West		3.1E-11	Negligible	Negligible
	Seismic (fire)	East	Extremely unlikely	5.7E-11	Negligible	Negligible
		West		2.7E-12	Negligible	Negligible
Partially consolidated storage based on physical form	Storage area fire	PORTS	Extremely unlikely	1.3E-10	Negligible	Negligible
		SRS		7.2E-11	Negligible	Negligible
		INEEL		8.8E-12	Negligible	Negligible
	Seismic (direct release)	PORTS	Extremely unlikely	8.0E-10	Negligible	Negligible
		SRS		4.0E-11	Negligible	Negligible
		INEEL		1.0E-11	Negligible	Negligible
	Seismic (fire)	PORTS	Extremely unlikely	5.4E-11	Negligible	Negligible
		SRS		4.5E-12	Negligible	Negligible
		INEEL		8.8E-13	Negligible	Negligible
Transfer to research facility	Facility fire	Generic	Extremely unlikely	1.0E-12	Negligible	Negligible
	Seismic (direct release)	Generic		3.4E-13	Negligible	Negligible
	Seismic (fire)	Generic		2.1E-13	Negligible	Negligible
Transfer to other government agencies	Facility fire	Generic	Extremely unlikely	5.2E-11	Negligible	Negligible
	Seismic (direct release)	Generic		1.7E-11	Negligible	Negligible
	Seismic (fire)	Generic		1.0E-11	Negligible	Negligible
Foreign sales	Facility fire	Generic	Extremely unlikely	1.0E-10	Negligible	Negligible
	Seismic (direct release)	Generic		3.6E-11	Negligible	Negligible
	Seismic (fire)	Generic		2.2E-11	Negligible	Negligible

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

C.4.3.1 Terrestrial biota exposed to chemical toxicity of uranium

Plants and earthworms are exposed by direct contact and uptake of uranium from the surrounding soil. The concentration of uranium in plant and earthworm tissues is calculated by multiplying the soil concentration by a soil-to-tissue bioconcentration factor (Table C.11). Exposure of shrews and robins, the indicator receptors, is calculated by multiplying their rates of ingestion of plants, earthworms, and soil by the concentration of uranium in each of those ingested materials. Ingestion rates were published by EPA (1993b). The dose per unit body weight was calculated using body weights published by EPA (1993b). Daily doses in mg/kg body weight/day per mg U/kg soil were calculated as shown in Table C.11.

C.4.3.2 Terrestrial biota exposed to radiological effects of uranium

The terrestrial receptors are exposed to external radiation from the surrounding soil and to internal radiation from incorporated uranium. External radiation doses were calculated for both surface exposure and subsurface exposure.

Table C.11. Chemical toxicity rates to ecological receptors from uranium in soil[a]

Receptor	Fraction of time below ground surface[b] (F_{below})	Fraction of time above ground surface[b] (F_{above})	BCF[c] (soil to tissue) (g soil/ g tissue)	Ba[c] (food to tissue) (d/kg)	IR[d] (kg/d)	BAF[e] (food to tissue) (g food/ g tissue)	Tissue concen-tration[f] (mg/kg)	Dose[g] (mg/kg or mg/kg/day)	TRV[h] (mg/kg or mg/kg/day)	HQ per mg/kg soil (dose/TRV)
Plant	0	1	1.70E-03	NA	NA		1.70E-03	1	5	0.2
Earthworm	0.9	0.1	3.30E-03	NA	NA		3.30E-03	1	No TRV	None
Shrew	0.25	0.75	NA	2.00E-04						
Plant					1.24E-03	2.47E-07	NA	4.20E-10		
Earthworm					8.27E-03	1.65E-06	NA	5.45E-09		
Soil					1.24E-03	2.47E-07	NA	2.47E-07		
Total								2.53E-07	3.07E+00	8.24E-08
Robin	0	0.5	NA	2.00E-04						
Plant					6.08E-02	1.22E-05	NA	2.07E-08		
Earthworm					6.08E-02	1.22E-05	NA	4.01E-08		
Soil					1.26E-02	2.53E-06	NA	2.53E-06		
Total								2.59E-06	1.60E+01	1.62E-07

[a]Doses were calculated for a concentration of 1 mg/kg in soil.
[b]Assumed values.
[c]Bioconcentration factors:
For plants, taken from Baes et al. (1984), adjusted to wet-weight basis by multiplying by 0.2, assuming earthworm is 80% water.
For earthworms, taken from DOE (1997), Appendix G, Table G.39, mean uptake value.
For mammals and birds, Ba is the biotransfer factor taken from Baes et al. (1984).
[d]Ingestion rate (EPA 1993b).
[e]Ba × IR.
[f]Soil concentration (1 mg/kg) × BCF.
[g]For plants and earthworms, soil concentration; for shrews and robins, BAF × ingested soil and tissue concentration.
[h]See Table C.15.
HQ = hazard quotient.
NA = not applicable.
TRV = toxicity reference value.

External subsurface exposure. The equation for subsurface exposure by immersion in soil is modified (Sample et al. 1997) from an equation for immersion in water (Blaylock, Frank, and O'Neal 1993):

$$D_{sub}\ (rad/d) = 1.05 \times F_{below} \times CFa \times C_{soil} \times (F_b \times E_b n_b + F_g \times E_g n_g)\ ,$$

where

D_{sub} = dose (rad/d) from uranium in soil by immersion in soil,
1.05 = conversion factor to account for immersion in soil rather than water,
F_{below} = fraction of time spent below ground surface (unitless; Table C.12),
CFa = conversion factor to convert MeV/event to rad/d per pCi/g = 5.12×10^{-5},
C_{soil} = activity of uranium in soil (pCi/g),
$F_{b\_}$ = absorbed fraction of energy E_ = 1 (Blaylock, Frank, and O'Neal 1993; Table C.12),
$E_b n_b$ = beta energy of the radionuclide (MeV) × proportion of disintegrations producing a g-particle (Table A.1, EPA 1993a; Table C.12),
$F_{g\_}$ = absorbed fraction of energy E_ (Blaylock, Frank, and O'Neal 1993 and DOE 1997; Table C.12),
$E_g n_g$ = photon energy emitted during transition from a higher to a lower energy state (MeV) × proportion of disintegrations producing a g-particle (Table A.1, EPA 1993a; Table C.12).

The external subsurface dose rates per pCi/g of total uranium in soil were calculated to be 0 for plants, 6.47×10^{-7} for earthworms, 1.83×10^{-7} for shrews, and 0 for robins (Table C.12).

External surface exposure. The equation for external radiation from surface exposure to uranium in soil (Sample et al. 1977) is:

$$D_{sur} = C_{soil} \times F_{ruf} \times CFb \times DCF_{soil} \times ECF\ ,$$

where

D_{sur} = dose from surface soil (rad/d),
C_{soil} = activity of uranium in soil (pCi/g),
F_{above} = fraction of time spent above ground (unitless, Table C.12),
F_{ruf} = dose rate reduction factor accounting for ground roughness (unitless) = 0.7 (Sample et al. 1997),
CFb = conversion factor to convert Sv/s per Bq/m^3 to rad/d per pCi/g = 5.12×10^{11},
DCF_{soil} = external dose conversion factor for soil contaminated to a depth of 5 cm for ^{234}U (1.82×10^{-21}), ^{235}U (2.65×10^{-18}), or ^{238}U (5.45×10^{-22}) [Table III.5 EPA 1993a; Table C.12],
ECF = elevation correction factor to adjust dose coefficients to value representative of effective height of receptor above ground (Sample et al. 1997; Table C.12).

The external surface dose rates per pCi/g of total uranium in soil were calculated to be 4.72×10^{-8} for plants, 4.72×10^{-9} for earthworms, 3.54×10^{-8} for shrews, and 2.36×10^{-8} for robins (Table C.12).

Table C.12. Radiation dose rates to ecological receptors from uranium in soil[a]

Receptor	Fraction of time below ground Surface[b] (F_{below})	Fraction of time above ground Surface[b] (F_{above})	BCF[c] (soil to tissue) (g soil/ g tissue)	Ba[c] (food to tissue) (d/kg)	IR[d] (kg/d)	BAF[e] (food to tissue) (g food/ g tissue)	Tissue activity[f] (pCi/ g tissue)	Radiation dose (rad/d) per pCi/g soil[g] Subsurface	Surface	Internal	Total
Plant	0	1	1.70E-03	NA	NA		1.70E-03	0.00E+00	4.72E-08	1.88E-06	1.93E-06
Earthworm	0.9	0.1	3.30E-03	NA	NA		3.30E-03	6.47E-07	4.72E-09	3.65E-06	4.30E-06
Shrew	0.25	0.75	NA	2.00E-04							
Plant					1.24E-03	2.47E-07	4.20E-10				
Earthworm					8.27E-03	1.65E-06	5.45E-09				
Soil					1.24E-03	2.47E-07	2.47E-07				
Total							2.53E-07	1.83E-07	3.54E-08	2.80E-10	2.19E-07
Robin	0	0.5	NA	2.00E-04							
Plant					6.08E-02	1.22E-05	2.07E-08				
Earthworm					6.08E-02	1.22E-05	4.01E-08				
Soil					1.26E-02	2.53E-06	2.53E-06				
Total							2.59E-06	0.00E+00	2.36E-08	2.87E-09	2.64E-08

[a]Doses were calculated for an activity of 1 pCi/g in soil.
[b]Assumed values.
[c]Bioconcentration factors (EPA 1999).
[d]Ingestion rate (EPA 1993b).
[e]Ba × IR.
[f]Soil concentration (1 mg/kg) × BCF.
[g]Calculated by equipments found in Sect. C.4.3.2. Radiation dose parameters are as follows:

Isotope	U-234	U-235	U-238
DCF	1.82E-21	2.65E-18	5.45E-22
E n	4.46	4.4	4.19
E n	0.013	0.049	0.01
E n	0.002	0.156	0.001

F_g for:	U-234	U-235	U-238
Plants	0.63	0.008	0.63
Earthworms	0.63	0.008	0.63
Shrew	0.79	0.0115	0.79
Robin	0.79	0.0115	0.79

Internal exposure. Internal exposures were calculated by multiplying the tissue activity by decay energy and absorption factors and conversion factors (Blaylock, Frank, and O'Neal 1993; Sample et al. 1997):

$$D_{int} = C_{tiss} \times CFa \times (QF \times F_a \times E_a n_a + F_b \times E_b n_b + F_g E_g n_g) ,$$

where

D_{int} = internal radiation dose from incorporated uranium (rad/d),
C_{tiss} = uranium activity in receptor tissues (pCi/g tissue),
CFa = conversion factor to convert MeV/event to rad/d per pCi/g = 5.12×10^{-5},
QF = quality factor to account for greater biological effectiveness of alpha particles = 5,
F_a = absorbed fraction of energy E_ = 1 (Blaylock, Frank, and O'Neal 1993),
$E_a n_a$ = alpha energy of the radionuclide (MeV) × proportion of disintegrations producing an a-particle (Table A.1, EPA 1993a; Table C.12),
F_b = absorbed fraction of energy E_ = 1 (Blaylock, Frank, and O'Neal 1993),
$E_b n_b$ = beta energy of the radionuclide (MeV) × proportion of disintegrations producing a b-particle (Table A.1, EPA 1993a; Table C.12),
F_g = absorbed fraction of energy E_ (Blaylock, Frank, and O'Neal 1993 and DOE 1997; Table C.12),
$E_g n_g$ = photon energy emitted during transition from a higher to a lower energy state (MeV) × proportion of disintegrations producing a g-particle (Table A.1, EPA 1993a; Table C.12).

Alpha radiation has a higher biological effect on biological tissue than beta and gamma radiation because of the momentum carried by the large mass of the alpha particle. To account for the higher effect of alpha radiation, the alpha radiation dose is multiplied by a quality factor of 5.

The internal dose rates per pCi/g of total uranium in soil were calculated to be 1.88×10^{-6} for plants, 4.30×10^{-6} for earthworms, 2.19×10^{-7} for shrews, and 2.64×10^{-8} for robins (Table C.12).

C.4.3.3 Aquatic biota exposed to chemical toxicity of uranium

Aquatic biota (represented by fish) and benthic invertebrates are exposed by direct contact and uptake of uranium from the surrounding surface water and sediment. The concentration of uranium in fish tissues is calculated by multiplying the surface water concentration by a water-to-tissue bioconcentration factor [50 L/kg tissue (NRC 1992); Table C.13]. The concentration of uranium in benthic invertebrate tissues was calculated by multiplying the sediment concentration by a sediment-to-tissue bioconcentration factor [0.9 kg sediment/kg tissue (EPA 1999); Table C.13]. Exposure of great blue herons, the indicator receptors, was calculated by multiplying their rates of ingestion of fish, benthic invertebrates, surface water, and sediment by the concentration of uranium in each of those ingested materials. Ingestion rates were published by EPA (1993b). The dose per unit body weight was calculated using body weights published by EPA (1993b). Daily doses in mg/kg body weight/day per mg U/L water were calculated as shown in Table C.13. The daily dose for herons was calculated to be 6.40×10^{-3} mg/kg/d per mg/L (Table C.13).

Table C.13. Chemical toxicity rates to ecological receptors from uranium in surface water and sediment[a]

Receptor	Fraction of time exposed to sediment[b] (F_{sed})	Fraction of time exposed to water[b] (F_{water})	BCF[c] (medium to tissue) (kg sed or L water/ kg tissue)	Ba[c] (food to tissue) (d/kg)	IR[d] (kg/d or L/d))	BAF[e] (food to tissue) (g food/ g tissue)	Tissue concen-tration[f] (mg/kg)	Dose[g] (mg/kg or mg/L or mg/kg/day)	TRV[h] (mg/kg or mg/L or mg/kg/day)	HQ dose/TRV
Aquatic biota	0	1	5.00E+01	NA	NA		5.00E+01	1.00E+00	2.60E+00	3.85E-01
Sed. Inverts	0.9	0.1	9.00E-01	NA	NA		2.52E+02	2.80E+02	No TRV	None
Heron	0	0.5								
Fish			NA	2.00E-04	4.09E-01	8.17E-05	NA	4.09E-03		
Inverts			NA	2.00E-04	2.15E-02	4.30E-06	NA	1.08E-03		
Water			NA	2.00E-04	1.08E-01	2.15E-05	NA	2.15E-05		
Sediment			NA	2.00E-04	2.15E-02	4.30E-06	NA	1.20E-03		
Total								6.40E-03	1.60E+01	4.00E-04

[a]Doses were calculated for a concentration of 1 mg/L in surface water.
[b]Assumed values.
[c]Bioconcentration factors (EPA 1999).
For aquatic biota, taken from NRC (1992).
For benthic invertebrates, taken from EPA (1999).
For great blue herons, Ba is the biotransfer factor taken from Baes et al. (1984).
[d]Ingestion rate (EPA 1993b).
[e]Ba × IR.
[f]Surface water concentration (1 mg/L) × BCF; also multiplied by 280 to account for binding of uranium to sediment.
[g]For aquatic biota, surface water concentration; for benthic invertebrates, sediment concentration.
[h]See Table C.15.
HQ = hazard quotient.
NA = not applicable.
TRV = toxicity reference value.

C.4.3.4 Aquatic biota exposed to radiological effects of uranium

The aquatic receptors are exposed to external radiation from the surrounding water and sediment and to internal radiation from incorporated uranium. External radiation doses were calculated for both immersion in surface water and immersion in sediment.

External exposure to surface water. The equation for external exposure by immersion in surface water is given by Blaylock, Frank, and O'Neal (1993):

$$D_{sw} = F_{below} \times CFa \times C_{sw} \times 0.001 \times E_g n_g \times (1 - F_g) \ ,$$

where

D_{sw} = dose from uranium by immersion in surface water (rad/d),
F_{below} = fraction of time spent immersed in water or, for the heron, close enough to the water surface to receive external radiation (unitless, Table C.14),
CFa = conversion factor to convert MeV/event to rad/d per pCi/g water = 5.12×10^{-5},
C_{sw} = activity of uranium in surface water (pCi/L),
0.001 = L water/g water,
$E_g n_g$ = photon energy emitted during transition from a higher to a lower energy state (MeV) × proportion of disintegrations producing a g-particle (Table A.1, EPA 1993a; Table C.14),
F_g = absorbed fraction of energy E_g (Blaylock, Frank, and O'Neal 1993 and DOE 1997; Table C.14).

The external water dose rates per pCi/L of total uranium in surface water were calculated to be 1.81×10^{-10} for fish, 2.21×10^{-11} for benthic invertebrates, and 9.38×10^{-11} for great blue herons (Table C.14).

External exposure to surface water. The equation for external exposure by immersion in sediment is given by Blaylock, Frank, and O'Neal (1993):

$$D_{sw} = F_{below} \times CFa \times C_{sw} \times 280 \times E_g n_g \times (1 - F_g) \ ,$$

where

D_{sw} = dose from uranium by immersion in sediment (rad/d),
F_{below} = fraction of time spent immersed in sediment (unitless, Table C.14),
CFa = conversion factor to convert MeV/event to rad/d per pCi/g sediment = 5.12×10^{-5},
C_{sw} = activity of uranium in surface water (pCi/L),
280 = mg U/kg sediment per mg U/L water,
$E_g n_g$ = photon energy emitted during transition from a higher to a lower energy state (MeV) × proportion of disintegrations producing a g-particle (Table A.1, EPA 1993a; Table C.14),
F_g = absorbed fraction of energy E_g (Blaylock, Frank, and O'Neal 1993 and DOE 1997; Table C.14).

The external sediment dose rates per pCi/L of total uranium in surface water were calculated to be 0 for fish, 9.80×10^{-5} for benthic invertebrates, and 0 for great blue herons (Table C.14).

Internal exposure to incorporated uranium. Internal exposures of fish, benthic invertebrates, and herons were calculated as described for terrestrial receptors and are shown in Table C.14. The internal dose rates per pCi/L total uranium in surface water were calculated to be 4.05×10^{-6} for fish, 1.18×10^{-4} for benthic invertebrates, and 9.97×10^{-8} for great blue herons (Table C.14).

Table C.14. Radiation dose rates to ecological receptors from uranium in surface water and sediment[a]

Receptor	Fraction of time exposed to sediment[b] (F_{sed})	Fraction of time exposed to water[b] (F_{water})	BCF[c] (medium to tissue) (kg sed or L water/ kg tissue)	Ba[c] (food to tissue) (d/kg)	IR[d] (kg/d or L/d)	BAF[e] (food to tissue) (g food/ g tissue)	Tissue activity (pCi/ g tissue)	Radiation dose (rad/d per pCi/L)			
								Sediment	Water	Internal	Total
Aquatic biota	0	1	5.00E+01	NA	NA		5.00E-02	0.00E+00	1.81E-10	4.05E-06	4.05E-06
Sed. Inverts	0.9	0.1	9.00E-01	NA	NA		2.52E-01	9.80E-05	2.21E-11	2.04E-05	1.18E-04
Heron	0	0.5									
Fish			NA	2.00E-04	4.09E-01	8.17E-05	4.09E-06				
Inverts			NA	2.00E-04	2.15E-02	4.30E-06	1.08E-06				
Water			NA	2.00E-04	1.08E-01	2.15E-05	2.15E-05				
Sediment			NA	2.00E-04	2.15E-02	4.30E-06	1.20E-03				
Total							1.23E-03	0.00E+00	9.38E-11	9.96E-08	9.97E-08

[a]Doses were calculated for a concentration of 1 mg/L in surface water.
[b]Assumed values.
[c]Bioconcentration factors (EPA 1999).
[d]Ingestion rate (EPA 1993b).
[e]Ba × IR.
[f]Surface water concentration (1 mg/L) × BCF; also multiplied by 280 to account for binding of uranium to sediment.
[g]For aquatic biota, surface water concentration; for benthic invertebrates, sediment concentration; for herons, BAF × ingested water, sediment, and tissue concentration.
[h]Calculated by equations found in Section C.4.3.2. Radiation dose parameters are as follows:

Isotope	U-234	U-235	U-238
DCF	1.82E-21	2.65E-18	5.45E-22
$E_a n_a$	4.46	4.4	4.19
$E_b n_b$	0.013	0.049	0.01
$E_g n_g$	0.002	0.156	0.001

F_g for:	U-234	U-235	U-238
Aquatic biota	0.94	0.0949	0.94
Benthic invertebrates	0.63	0.008	0.63
Heron	0.94	0.06	0.94

NA = not applicable.

C.4.4 EFFECTS ASSESSMENT

C.4.4.1 Chemical effects

The toxic effects of uranium were evaluated for all receptors. Effects evaluated were toxicity of uranium in soil to plants (Efroymson et al. 1997) and earthworms (Efroymson, Will, and Suter 1997); toxicity of ingested uranium to shrews, robins, and herons (Sample, Opresko, and Suter 1996); toxicity of uranium in water to fish (Suter and Tsao 1996); and toxicity of uranium in sediment to benthic invertebrates (Jones, Suter, and Hull 1997). The toxicity endpoints, benchmarks used, and their sources are described in Table C.15.

C.4.4.2 Irradiation

Ionizing radiation (alpha, beta, and gamma radiation) interacts with biological molecules to produce free radicals and ions. High doses can cause death from radiation sickness induced by high levels of damage. However, at low doses, the major concern is damage to deoxyribonucleic acid (DNA). DNA damage that is not repaired by the organism can cause cancerous tumors, leukemia, and heritable genetic damage. The endpoint for radiation toxicity to ecological receptors is maintenance of populations. The benchmark values given by the International Atomic Energy Agency (IAEA 1992) are 0.1 rad/day for terrestrial mammals and birds and 1 rad/day for plants, invertebrates, and aquatic biota. These values were used as benchmarks in this assessment.

C.4.5 CONSEQUENCE EVALUATION

Hypothetical accident scenarios, identified in Sect. 1.2 and evaluated for acute risk to humans in Sect. 1.3, are evaluated in this section for chronic risk to the environment. Accident scenarios are described in detail in Sect. 1.3 and are referred to only by alternative in this section. For each alternative, each location, and each receptor, the daily dose was divided by the benchmark dose to calculate the HQ. If the HQ is above 1, exposure above the benchmark is indicated and further evaluation is required to determine whether unacceptable ecological risks are indicated. Consequences of exposure to uranium in soil were evaluated by comparing the modeled chemical and radiological doses to benchmarks for toxicity to plants and soil invertebrates (earthworms), which are exposed directly to soil contaminants, and to small mammals (shrews) and songbirds (robins), which are exposed by eating soil and prey that have accumulated uranium from the soil (Tables C.16 and C.17). Consequences of exposure to uranium in surface water were evaluated by comparing concentrations in water or chemical and radiological doses to benchmarks for aquatic biota (fish), which are exposed directly to waterborne contaminants; to benthic invertebrates, which are exposed directly to sediment contaminants; and to herons, which are exposed by ingesting prey that have accumulated uranium from the water, surface water, and sediment and by direct exposure to surface water (Tables C.18 and C.19).

C.4.5.1 Soil

Tables C.16 and C.17 show that no alternative resulted in unacceptable risks to terrestrial receptors. The highest chemical risk, with an HQ of 0.205 (Table C.16), was to plants exposed to uranium in soil after a direct seismic release under centralized storage at a single site. This HQ is rather uncertain for a large population of plants for a number of reasons. First, it assumes that all plants are exposed at the maximum soil concentration, whereas the deposition model shows that the concentrations fall off rapidly with both lateral and longitudinal distance from the maximum point. Second, the model assumes that the wind blows in only one direction, whereas variable wind directions will realistically result in a variety of downwind directions, so deposition will be dispersed rather than along a single centerline of the plume. Third, exceeding the toxicity benchmark by 1% may inhibit growth of plants but is not likely to be detrimental to the plant population. The highest chemical HQ for other terrestrial animal receptors is 1.7×10^{-7} for exposure of robins to soil uranium.

Table C.15. Uranium toxicity benchmarks for ecological receptors

Receptor	Concentration or dose	Justification	Reference
Terrestrial plants	5 mg/kg	Inhibition of root growth	Efroymson et al. 1997
Earthworms	No data	Not applicable	Not applicable
Short-tailed shrew	3.07 mg/kg BW/day	Chronic NOAEL for decreased reproduction	
American robin	16.0 mg/kg BW/day	No observed effect from subchronic exposure at 160 mg/kg; uncertainty factor of 10 used to estimate chronic NOAEL	Sample, Opresko, and Suter 1996
Aquatic biota	2.6 mg/L	Tier II Secondary chronic value	Suter and Tsao 1996
Benthic invertebrates	No data	Not applicable	Not applicable
Great blue heron	16.0 mg/kg BW/day	No observed effect from subchronic exposure at 160 mg/kg; uncertainty factor of 10 used to estimate chronic NOAEL	Sample, Opresko, and Suter 1996

BW = body weight.
NOAEL = No observed adverse effect level.

Table C.16. Chemical toxicity consequences to ecological receptors due to deposition of uranium on soil under bounding accident scenarios

Alternative	Accident scenario	Site	Untilled soil concentration (mg/kg)	HQ for ecological receptors		
				Plants	Shrews	Robins
All	General container handling	All	5.76E-03	1.15E-03	4.75E-10	9.33E-10
No Action	Storage area fire	INEEL	1.51E-02	3.02E-03	1.24E-09	2.45E-09
		PGDP	6.14E-05	1.23E-05	5.06E-12	9.94E-12
		PORTS	1.74E-01	3.48E-02	1.44E-08	2.82E-08
		SRS	3.45E-02	6.90E-03	2.84E-09	5.59E-09
		Oak Ridge	1.65E-02	3.31E-03	1.36E-09	2.68E-09
		Max other	2.04E-02	4.08E-03	1.68E-09	3.31E-09
	Seismic (direct release)	INEEL	9.08E-03	1.82E-03	7.48E-10	1.47E-09
		PGDP	2.27E-04	4.54E-05	1.87E-11	3.68E-11
		PORTS	5.92E-01	1.18E-01	4.87E-08	9.58E-08
		SRS	3.85E-02	7.70E-03	3.17E-09	6.24E-09
		Oak Ridge	1.82E-02	3.63E-03	1.50E-09	2.94E-09
		Max other	7.54E-02	1.51E-02	6.22E-09	1.22E-08
	Seismic (fire)	INEEL	9.87E-04	1.97E-04	8.14E-11	1.60E-10
		PGDP	1.53E-05	3.07E-06	1.26E-12	2.49E-12
		PORTS	4.06E-02	8.11E-03	3.34E-09	6.57E-09
		SRS	3.31E-03	6.63E-04	2.73E-10	5.37E-10
		Oak Ridge	1.57E-03	3.14E-04	1.29E-10	2.54E-10
		Max other	5.11E-03	1.02E-03	4.21E-10	8.28E-10
Centralized storage at a single site	Storage area fire	All	3.56E-01	7.12E-02	2.93E-08	5.77E-08
	Seismic (direct release)	All	1.02E+00	2.05E-01	8.43E-08	1.66E-07
	Seismic (fire)	All	7.16E-02	1.43E-02	5.90E-09	1.16E-08
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	3.49E-02	6.98E-03	2.87E-09	5.65E-09
		PGDP	5.22E-03	1.04E-03	4.30E-10	8.45E-10
		PORTS	2.40E-01	4.80E-02	1.98E-08	3.88E-08
		SRS	3.53E-02	7.05E-03	2.91E-09	5.71E-09
		Oak Ridge	4.27E-02	8.53E-03	3.52E-09	6.91E-09
	Seismic (direct release)	INEEL	3.32E-02	6.64E-03	2.73E-09	5.37E-09
		PGDP	9.33E-03	1.87E-03	7.69E-10	1.51E-09
		PORTS	8.23E-01	1.65E-01	6.78E-08	1.33E-07
		SRS	4.16E-02	8.33E-03	3.43E-09	6.74E-09
		Oak Ridge	1.15E-01	2.29E-02	9.44E-09	1.86E-08
	Seismic (fire)	INEEL	3.00E-03	6.01E-04	2.48E-10	4.87E-10
		PGDP	7.09E-04	1.42E-04	5.84E-11	1.15E-10
		PORTS	5.61E-02	1.12E-02	4.62E-09	9.08E-09
		SRS	3.52E-03	7.03E-04	2.90E-10	5.70E-10
		Oak Ridge	8.08E-03	1.62E-03	6.65E-10	1.31E-09
Partially consolidated storage at two sites	Storage area fire	East	3.22E-01	6.44E-02	2.65E-08	5.22E-08
		West	3.60E-02	7.19E-03	2.96E-09	5.83E-09
	Seismic (direct release)	East	9.86E-01	1.97E-01	8.12E-08	1.60E-07
		West	3.72E-02	7.45E-03	3.07E-09	6.03E-09
	Seismic (fire)	East	6.84E-02	1.37E-02	5.64E-09	1.11E-08
		West	3.28E-03	6.55E-04	2.70E-10	5.31E-10

Table C.16. Chemical toxicity consequences to ecological receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Untilled soil concentration (mg/kg)	HQ for ecological receptors		
				Plants	Shrews	Robins
Partially consolidated storage based on physical form	Storage area fire	PORTS	1.54E-01	3.09E-02	1.27E-08	2.50E-08
		SRS	8.71E-02	1.74E-02	7.18E-09	1.41E-08
		INEEL	1.06E-02	2.12E-03	8.75E-10	1.72E-09
	Seismic (direct release)	PORTS	9.61E-01	1.92E-01	7.92E-08	1.56E-07
		SRS	4.82E-02	9.64E-03	3.97E-09	7.81E-09
		INEEL	1.26E-02	2.51E-03	1.03E-09	2.03E-09
	Seismic (fire)	PORTS	6.49E-02	1.30E-02	5.35E-09	1.05E-08
		SRS	5.43E-03	1.09E-03	4.47E-10	8.80E-10
		INEEL	1.06E-03	2.12E-04	8.75E-11	1.72E-10
Transfer to research facility	Facility fire	Generic	1.26E-03	2.51E-04	1.03E-10	2.03E-10
	Seismic (direct release)	Generic	4.06E-04	8.11E-05	3.34E-11	6.57E-11
	Seismic (fire)	Generic	2.51E-04	5.03E-05	2.07E-11	4.07E-11
Transfer to other government agencies	Facility fire	Generic	6.28E-02	1.26E-02	5.17E-09	1.02E-08
	Seismic (direct release)	Generic	2.02E-02	4.05E-03	1.67E-09	3.28E-09
	Seismic (fire)	Generic	1.26E-02	2.51E-03	1.03E-09	2.03E-09
Foreign sales	Facility fire	Generic	1.24E-01	2.48E-02	1.02E-08	2.01E-08
	Seismic (direct release)	Generic	4.37E-02	8.75E-03	3.60E-09	7.08E-09
	Seismic (fire)	Generic	2.68E-02	5.36E-03	2.21E-09	4.34E-09
				2.05E-01	8.43E-08	1.66E-07

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table C.17. Radiological consequences to ecological receptors due to deposition of uranium on soil under bounding accident scenarios

Alternative	Accident scenario	Site	Untilled soil activity (pCi/g)	HQ for ecological receptors			
				Plants	Soil invertebrates	Shrews	Robins
All	General container handling	All	4.03E-03	7.78E-09	1.73E-08	8.83E-10	1.06E-10
No Action	Storage area fire	INEEL	1.06E-02	2.04E-08	4.54E-08	2.31E-09	2.79E-10
		PGDP	4.30E-05	8.29E-11	1.85E-10	9.41E-12	1.13E-12
		PORTS	1.22E-01	2.35E-07	5.24E-07	2.67E-08	3.22E-09
		SRS	2.41E-02	4.66E-08	1.04E-07	5.29E-09	6.37E-10
		Oak Ridge	1.16E-02	2.23E-08	4.98E-08	2.54E-09	3.06E-10
		Max other	1.43E-02	2.76E-08	6.15E-08	3.13E-09	3.77E-10
	Seismic (direct release)	INEEL	6.35E-03	1.23E-08	2.73E-08	1.39E-09	1.68E-10
		PGDP	1.59E-04	3.07E-10	6.83E-10	3.48E-11	4.19E-12
		PORTS	4.14E-01	7.99E-07	1.78E-06	9.07E-08	1.09E-08
		SRS	2.69E-02	5.20E-08	1.16E-07	5.90E-09	7.11E-10
		Oak Ridge	1.27E-02	2.45E-08	5.46E-08	2.78E-09	3.35E-10
		Max other	5.28E-02	1.02E-07	2.27E-07	1.16E-08	1.39E-09
	Seismic (fire)	INEEL	6.91E-04	1.33E-09	2.97E-09	1.51E-10	1.82E-11
		PGDP	1.07E-05	2.07E-11	4.62E-11	2.35E-12	2.83E-13
		PORTS	2.84E-02	5.48E-08	1.22E-07	6.22E-09	7.49E-10
		SRS	2.32E-03	4.48E-09	9.98E-09	5.08E-10	6.13E-11
		Oak Ridge	1.10E-03	2.12E-09	4.72E-09	2.41E-10	2.90E-11
		Max other	3.58E-03	6.91E-09	1.54E-08	7.84E-10	9.45E-11
Centralized storage at a single site	Storage area fire	All	2.49E-01	4.81E-07	1.07E-06	5.46E-08	6.58E-09
	Seismic (direct release)	All	7.16E-01	1.38E-06	3.08E-06	1.57E-07	1.89E-08
	Seismic (fire)	All	5.01E-02	9.67E-08	2.15E-07	1.10E-08	1.32E-09
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	2.44E-02	4.71E-08	1.05E-07	5.35E-09	6.44E-10
		PGDP	3.65E-03	7.05E-09	1.57E-08	8.00E-10	9.64E-11
		PORTS	1.68E-01	3.24E-07	7.22E-07	3.68E-08	4.43E-09
		SRS	2.47E-02	4.76E-08	1.06E-07	5.41E-09	6.52E-10
		Oak Ridge	2.99E-02	5.76E-08	1.28E-07	6.54E-09	7.89E-10
	Seismic (direct release)	INEEL	2.32E-02	4.48E-08	9.99E-08	5.09E-09	6.13E-10
		PGDP	6.53E-03	1.26E-08	2.81E-08	1.43E-09	1.72E-10
		PORTS	5.76E-01	1.11E-06	2.48E-06	1.26E-07	1.52E-08
		SRS	2.91E-02	5.62E-08	1.25E-07	6.38E-09	7.69E-10
		Oak Ridge	8.02E-02	1.55E-07	3.45E-07	1.76E-08	2.12E-09
	Seismic (fire)	INEEL	2.10E-03	4.06E-09	9.04E-09	4.61E-10	5.55E-11
		PGDP	4.96E-04	9.58E-10	2.13E-09	1.09E-10	1.31E-11
		PORTS	3.92E-02	7.57E-08	1.69E-07	8.60E-09	1.04E-09
		SRS	2.46E-03	4.75E-09	1.06E-08	5.39E-10	6.50E-11
		Oak Ridge	5.65E-03	1.09E-08	2.43E-08	1.24E-09	1.49E-10
Partially consolidated storage at two sites	Storage area fire	East	2.25E-01	4.35E-07	9.69E-07	4.94E-08	5.95E-09
		West	2.52E-02	4.86E-08	1.08E-07	5.51E-09	6.65E-10
	Seismic (direct release)	East	6.90E-01	1.33E-06	2.97E-06	1.51E-07	1.82E-08
		West	2.61E-02	5.03E-08	1.12E-07	5.71E-09	6.88E-10
	Seismic (fire)	East	4.79E-02	9.24E-08	2.06E-07	1.05E-08	1.26E-09
		West	2.29E-03	4.43E-09	9.86E-09	5.02E-10	6.05E-11

Table C.17. Radiological consequences to ecological receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Untilled soil activity (pCi/g)	HQ for ecological receptors			
				Plants	Soil invertebrates	Shrews	Robins
Partially consolidated storage based on physical form	Storage area fire	PORTS	1.08E-01	2.09E-07	4.65E-07	2.37E-08	2.85E-09
		SRS	6.10E-02	1.18E-07	2.62E-07	1.34E-08	1.61E-09
		INEEL	7.43E-03	1.43E-08	3.19E-08	1.63E-09	1.96E-10
	Seismic (direct release)	PORTS	6.73E-01	1.30E-06	2.89E-06	1.47E-07	1.78E-08
		SRS	3.37E-02	6.51E-08	1.45E-07	7.39E-09	8.91E-10
		INEEL	8.79E-03	1.70E-08	3.78E-08	1.92E-09	2.32E-10
	Seismic (fire)	PORTS	4.54E-02	8.77E-08	1.95E-07	9.95E-09	1.20E-09
		SRS	3.80E-03	7.34E-09	1.63E-08	8.33E-10	1.00E-10
		INEEL	7.43E-04	1.43E-09	3.19E-09	1.63E-10	1.96E-11
Transfer to research facility	Facility fire	Generic	8.79E-04	1.70E-09	3.78E-09	1.92E-10	2.32E-11
	Seismic (direct release)	Generic	2.84E-04	5.48E-10	1.22E-09	6.22E-11	7.49E-12
	Seismic (fire)	Generic	1.76E-04	3.40E-10	7.57E-10	3.85E-11	4.65E-12
Transfer to other government agencies	Facility fire	Generic	4.39E-02	8.48E-08	1.89E-07	9.62E-09	1.16E-09
	Seismic (direct release)	Generic	1.42E-02	2.73E-08	6.09E-08	3.10E-09	3.74E-10
	Seismic (fire)	Generic	8.79E-03	1.70E-08	3.78E-08	1.92E-09	2.32E-10
Foreign sales	Facility fire	Generic	8.69E-02	1.68E-07	3.74E-07	1.90E-08	2.29E-09
	Seismic (direct release)	Generic	3.06E-02	5.91E-08	1.32E-07	6.70E-09	8.08E-10
	Seismic (fire)	Generic	1.88E-02	3.62E-08	8.07E-08	4.11E-09	4.95E-10
			Max	1.38E-06	3.08E-06	1.57E-07	1.89E-08

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table C.18. Chemical toxicity consequences to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios

Alternative	Accident scenario	Site	Surface water concentration (mg/L)	HQ for ecological receptors	
				Aquatic biota	Herons
All	General container handling	All	2.94E-05	1.13E-05	1.17E-08
No Action	Storage area fire	INEEL	7.81E-05	3.01E-05	3.12E-08
		PGDP	3.18E-07	1.22E-07	1.27E-10
		PORTS	9.02E-04	3.47E-04	3.61E-07
		SRS	1.78E-04	6.87E-05	7.14E-08
		Oak Ridge	8.56E-05	3.30E-05	3.42E-08
		Max other	1.06E-04	4.07E-05	4.23E-08
	Seismic (direct release)	INEEL	4.70E-05	1.81E-05	1.88E-08
		PGDP	1.17E-06	4.52E-07	4.70E-10
		PORTS	3.06E-03	1.18E-03	1.22E-06
		SRS	1.99E-04	7.67E-05	7.97E-08
		Oak Ridge	9.40E-05	3.62E-05	3.76E-08
		Max other	3.90E-04	1.50E-04	1.56E-07
	Seismic (fire)	INEEL	5.11E-06	1.97E-06	2.04E-09
		PGDP	7.94E-08	3.06E-08	3.18E-11
		PORTS	2.10E-04	8.08E-05	8.40E-08
		SRS	1.72E-05	6.60E-06	6.86E-09
		Oak Ridge	8.12E-06	3.13E-06	3.25E-09
		Max other	2.65E-05	1.02E-05	1.06E-08
Centralized storage at a single site	Storage area fire	All	1.84E-03	7.10E-04	7.37E-07
	Seismic (direct release)	All	5.30E-03	2.04E-03	2.12E-06
	Seismic (fire)	All	3.70E-04	1.43E-04	1.48E-07
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	1.80E-04	6.95E-05	7.22E-08
		PGDP	2.70E-05	1.04E-05	1.08E-08
		PORTS	1.24E-03	4.78E-04	4.96E-07
		SRS	1.83E-04	7.03E-05	7.30E-08
		Oak Ridge	2.21E-04	8.50E-05	8.83E-08
	Seismic (direct release)	INEEL	1.72E-04	6.61E-05	6.87E-08
		PGDP	4.83E-05	1.86E-05	1.93E-08
		PORTS	4.26E-03	1.64E-03	1.70E-06
		SRS	2.15E-04	8.29E-05	8.62E-08
		Oak Ridge	5.93E-04	2.28E-04	2.37E-07
	Seismic (fire)	INEEL	1.55E-05	5.99E-06	6.22E-09
		PGDP	3.67E-06	1.41E-06	1.47E-09
		PORTS	2.90E-04	1.12E-04	1.16E-07
		SRS	1.82E-05	7.01E-06	7.28E-09
		Oak Ridge	4.18E-05	1.61E-05	1.67E-08
Partially consolidated storage at two sites	Storage area fire	East	1.67E-03	6.42E-04	6.67E-07
		West	1.86E-04	7.17E-05	7.45E-08
	Seismic (direct release)	East	5.10E-03	1.96E-03	2.04E-06
		West	1.93E-04	7.42E-05	7.71E-08
	Seismic (fire)	East	3.54E-04	1.36E-04	1.42E-07
		West	1.70E-05	6.53E-06	6.78E-09

Table C.18. Chemical toxicity consequences to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Surface water concentration (mg/L)	HQ for ecological receptors	
				Aquatic biota	Herons
Partially consolidated storage based on physical form	Storage area fire	PORTS	7.99E-04	3.08E-04	3.20E-07
		SRS	4.51E-04	1.74E-04	1.80E-07
		INEEL	5.49E-05	2.11E-05	2.20E-08
	Seismic (direct release)	PORTS	4.97E-03	1.91E-03	1.99E-06
		SRS	2.49E-04	9.60E-05	9.98E-08
		INEEL	6.50E-05	2.50E-05	2.60E-08
	Seismic (fire)	PORTS	3.36E-04	1.29E-04	1.34E-07
		SRS	2.81E-05	1.08E-05	1.12E-08
		INEEL	5.49E-06	2.11E-06	2.20E-09
Transfer to research facility	Facility fire	Generic	6.50E-06	2.50E-06	2.60E-09
	Seismic (direct release)	Generic	2.10E-06	8.08E-07	8.40E-10
	Seismic (fire)	Generic	1.30E-06	5.01E-07	5.21E-10
Transfer to other govemment agencies	Facility fire	Generic	3.25E-04	1.25E-04	1.30E-07
	Seismic (direct release)	Generic	1.05E-04	4.03E-05	4.19E-08
	Seismic (fire)	Generic	6.50E-05	2.50E-05	2.60E-08
Foreign sales	Facility fire	Generic	6.42E-04	2.47E-04	2.57E-07
	Seismic (direct release)	Generic	2.26E-04	8.71E-05	9.05E-08
	Seismic (fire)	Generic	1.39E-04	5.34E-05	5.55E-08
				2.04E-03	2.12E-06

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table C.19. Radiological consequences to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios

Alternative	Accident scenario	Site	Surface water activity (pCi/L)	HQ for ecological receptors: Aquatic biota	Sediment invertebrates	Herons
All	General container handling	All	2.06E-02	8.32E-08	2.43E-06	2.05E-09
No Action	Storage area fire	INEEL	5.47E-02	2.21E-07	6.45E-06	5.45E-09
		PGDP	2.22E-04	9.00E-10	2.62E-08	2.22E-11
		PORTS	6.31E-01	2.56E-06	7.45E-05	6.29E-08
		SRS	1.25E-01	5.06E-07	1.47E-05	1.25E-08
		Oak Ridge	5.99E-02	2.43E-07	7.07E-06	5.97E-09
		Max other	7.40E-02	3.00E-07	8.73E-06	7.37E-09
	Seismic (direct release)	INEEL	3.29E-02	1.33E-07	3.88E-06	3.28E-09
		PGDP	8.22E-04	3.33E-09	9.70E-08	8.20E-11
		PORTS	2.14E+00	8.68E-06	2.53E-04	2.14E-07
		SRS	1.39E-01	5.65E-07	1.65E-05	1.39E-08
		Oak Ridge	6.58E-02	2.66E-07	7.76E-06	6.56E-09
		Max other	2.73E-01	1.11E-06	3.22E-05	2.72E-08
	Seismic (fire)	INEEL	3.58E-03	1.45E-08	4.22E-07	3.57E-10
		PGDP	5.56E-05	2.25E-10	6.56E-09	5.54E-12
		PORTS	1.47E-01	5.95E-07	1.73E-05	1.46E-08
		SRS	1.20E-02	4.86E-08	1.42E-06	1.20E-09
		Oak Ridge	5.69E-03	2.30E-08	6.71E-07	5.67E-10
		Max other	1.85E-02	7.50E-08	2.19E-06	1.85E-09
Centralized storage at a single site	Storage area fire	All	1.29E+00	5.23E-06	1.52E-04	1.29E-07
	Seismic (direct release)	All	3.71E+00	1.50E-05	4.38E-04	3.70E-07
	Seismic (fire)	All	2.59E-01	1.05E-06	3.06E-05	2.59E-08
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	1.26E-01	5.12E-07	1.49E-05	1.26E-08
		PGDP	1.89E-02	7.66E-08	2.23E-06	1.89E-09
		PORTS	8.69E-01	3.52E-06	1.03E-04	8.66E-08
		SRS	1.28E-01	5.17E-07	1.51E-05	1.27E-08
		Oak Ridge	1.55E-01	6.26E-07	1.82E-05	1.54E-08
	Seismic (direct release)	INEEL	1.20E-01	4.87E-07	1.42E-05	1.20E-08
		PGDP	3.38E-02	1.37E-07	3.99E-06	3.37E-09
		PORTS	2.98E+00	1.21E-05	3.52E-04	2.97E-07
		SRS	1.51E-01	6.11E-07	1.78E-05	1.50E-08
		Oak Ridge	4.15E-01	1.68E-06	4.90E-05	4.14E-08
	Seismic (fire)	INEEL	1.09E-02	4.41E-08	1.28E-06	1.09E-09
		PGDP	2.57E-03	1.04E-08	3.03E-07	2.56E-10
		PORTS	2.03E-01	8.23E-07	2.40E-05	2.03E-08
		SRS	1.27E-02	5.16E-08	1.50E-06	1.27E-09
		Oak Ridge	2.93E-02	1.18E-07	3.45E-06	2.92E-09
Partially consolidated storage at two sites	Storage area fire	East	1.17E+00	4.72E-06	1.38E-04	1.16E-07
		West	1.30E-01	5.28E-07	1.54E-05	1.30E-08
	Seismic (direct release)	East	3.57E+00	1.45E-05	4.21E-04	3.56E-07
		West	1.35E-01	5.46E-07	1.59E-05	1.35E-08
	Seismic (fire)	East	2.48E-01	1.00E-06	2.92E-05	2.47E-08
		West	1.19E-02	4.81E-08	1.40E-06	1.18E-09

Table C.19. Radiological consequences to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Surface water activity (pCi/L)	HQ for ecological receptors		
				Aquatic biota	Sediment invertebrates	Herons
Partially consolidated storage based on physical form	Storage area fire	PORTS	5.60E-01	2.27E-06	6.60E-05	5.58E-08
		SRS	3.16E-01	1.28E-06	3.72E-05	3.15E-08
		INEEL	3.85E-02	1.56E-07	4.54E-06	3.83E-09
	Seismic (direct release)	PORTS	3.48E+00	1.41E-05	4.11E-04	3.47E-07
		SRS	1.75E-01	7.07E-07	2.06E-05	1.74E-08
		INEEL	4.55E-02	1.84E-07	5.37E-06	4.53E-09
	Seismic (fire)	PORTS	2.35E-01	9.52E-07	2.77E-05	2.34E-08
		SRS	1.97E-02	7.97E-08	2.32E-06	1.96E-09
		INEEL	3.85E-03	1.56E-08	4.54E-07	3.83E-10
Transfer to research facility	Facility fire	Generic	4.55E-03	1.84E-08	5.37E-07	4.53E-10
	Seismic (direct release)	Generic	1.47E-03	5.95E-09	1.73E-07	1.46E-10
	Seismic (fire)	Generic	9.11E-04	3.69E-09	1.07E-07	9.08E-11
Transfer to other government agencies	Facility fire	Generic	2.27E-01	9.21E-07	2.68E-05	2.27E-08
	Seismic (direct release)	Generic	7.33E-02	2.97E-07	8.65E-06	7.31E-09
	Seismic (fire)	Generic	4.55E-02	1.84E-07	5.37E-06	4.53E-09
Foreign sales	Facility fire	Generic	4.50E-01	1.82E-06	5.31E-05	4.48E-08
	Seismic (direct release)	Generic	1.58E-01	6.42E-07	1.87E-05	1.58E-08
	Seismic (fire)	Generic	9.71E-02	3.93E-07	1.15E-05	9.68E-09
				1.50E-05	4.38E-04	3.70E-07

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

The highest risk from radiation exposure in soil (Table C.17) is an HQ of 3.1×10^{-6} for exposure of earthworms as a result of a direct seismic release under centralized storage at a single site. Because all other risks are below this level, there is no unacceptable risk from radiation exposure of terrestrial receptors.

C.4.5.2 Surface water and sediment

Tables C.18 and C.19 show that no alternative resulted in unacceptable risks to aquatic biota, benthic invertebrates, and predators of aquatic biota and benthic invertebrates. The highest chemical risk was an HQ of 2.0×10^{-3} for exposure of aquatic biota as a result of a direct seismic release under centralized storage at a single site (Table C.18). Because all other risks are below this level, there is no unacceptable risk from chemical exposure of receptors of uranium deposited in surface water.

The highest risk of radiation exposure from uranium deposited in surface water is an HQ of 3.0×10^{-3} for exposure of great blue herons as a result of a direct seismic release under centralized storage at a single site (Table C.19). Because all other risks are below this level, there is no unacceptable risk from radiation exposure of receptors of uranium deposited in surface water.

C.4.6 OVERALL RISK EVALUATION

The overall risk from each alternative was evaluated by combining the predicted frequency of accidents with the consequences of those accidents as shown in Appendix A, Fig. A.1. The predicted frequency of each accident is shown in Appendix A, Table A.13. Ecological consequences were assigned categories as follows: HQ <0.1, negligible; HQ between 0.1 and 1, low; HQ between 1 and 10, moderate; and HQ greater than 10, high. Overall risks are shown in Tables C.20 (terrestrial receptors) and C.21 (receptors of uranium deposited in surface water). These tables show that overall risks under all alternatives are negligible.

C.5 SUMMARY

Airborne uranium released after potential accidents would be deposited downwind onto soil and surface water. Humans and ecological receptors would be exposed to the chemical toxicity of uranium and to the effects of radiation from contact, inhalation, and ingestion of contaminated soil, water, sediment, and food. This analysis calculates the concentrations of uranium in soil, surface water, and sediment that would result from each of the accident scenarios described in Appendix A.

Risks to EM workers, industrial workers, and residents who live on, and are surrounded by, contaminated soil were evaluated. Cancer risk, chronic radiation dose, and chronic chemical toxicity were assessed. Under all alternatives, all three types of consequences were negligible or low.

Table C.20. Summary of chronic risks to ecological receptors due to deposition of uranium on soil under bounding accident scenarios

Alternative	Accident scenario	Site	Frequency	Chemical exposure: Maximum HQ	Chemical exposure: Consequence level	Chemical exposure: Risk	Radiation exposure: Maximum HQ	Radiation exposure: Consequence level	Radiation exposure: Risk
All	General container handling	All	Anticipated	1.2E-03	Negligible	Negligible	1.7E-08	Negligible	Negligible
No Action	Storage area fire	INEEL	Extremely unlikely	3.0E-03	Negligible	Negligible	4.5E-08	Negligible	Negligible
		PGDP		1.2E-05	Negligible	Negligible	1.8E-10	Negligible	Negligible
		PORTS		3.5E-02	Negligible	Negligible	5.2E-07	Negligible	Negligible
		SRS		6.9E-03	Negligible	Negligible	1.0E-07	Negligible	Negligible
		Oak Ridge		3.3E-03	Negligible	Negligible	5.0E-08	Negligible	Negligible
		Max other		4.1E-03	Negligible	Negligible	6.1E-08	Negligible	Negligible
	Seismic (direct release)	INEEL	Extremely unlikely	1.8E-03	Negligible	Negligible	2.7E-08	Negligible	Negligible
		PGDP		4.5E-05	Negligible	Negligible	6.8E-10	Negligible	Negligible
		PORTS		1.2E-01	Low	Low	1.8E-06	Negligible	Negligible
		SRS		7.7E-03	Negligible	Negligible	1.2E-07	Negligible	Negligible
		Oak Ridge		3.6E-03	Negligible	Negligible	5.5E-08	Negligible	Negligible
		Max other		1.5E-02	Negligible	Negligible	2.3E-07	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	2.0E-04	Negligible	Negligible	3.0E-09	Negligible	Negligible
		PGDP		3.1E-06	Negligible	Negligible	4.6E-11	Negligible	Negligible
		PORTS		8.1E-03	Negligible	Negligible	1.2E-07	Negligible	Negligible
		SRS		6.6E-04	Negligible	Negligible	1.0E-08	Negligible	Negligible
		Oak Ridge		3.1E-04	Negligible	Negligible	4.7E-09	Negligible	Negligible
		Max other		1.0E-03	Negligible	Negligible	1.5E-08	Negligible	Negligible
Centralized storage at a single site	Storage area fire	All	Extremely unlikely	7.1E-02	Negligible	Negligible	1.1E-06	Negligible	Negligible
	Seismic (direct release)	All	Extremely unlikely	2.0E-01	Low	Low	3.1E-06	Negligible	Negligible
	Seismic (fire)	All	Extremely unlikely	1.4E-02	Negligible	Negligible	2.2E-07	Negligible	Negligible
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	Extremely unlikely	7.0E-03	Negligible	Negligible	1.0E-07	Negligible	Negligible
		PGDP		1.0E-03	Negligible	Negligible	1.6E-08	Negligible	Negligible
		PORTS		4.8E-02	Negligible	Negligible	7.2E-07	Negligible	Negligible
		SRS		7.1E-03	Negligible	Negligible	1.1E-07	Negligible	Negligible
		Oak Ridge		8.5E-03	Negligible	Negligible	1.3E-07	Negligible	Negligible

Table C.20. Summary of chronic risks to ecological receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Frequency	Chemical exposure			Radiation exposure		
				Maximum HQ	Consequence level	Risk	Maximum HQ	Consequence level	Risk
	Seismic (direct release)	INEEL	Extremely unlikely	6.6E-03	Negligible	Negligible	1.0E-07	Negligible	Negligible
		PGDP		1.9E-03	Negligible	Negligible	2.8E-08	Negligible	Negligible
		PORTS		1.6E-01	Low	Low	2.5E-06	Negligible	Negligible
		SRS		8.3E-03	Negligible	Negligible	1.3E-07	Negligible	Negligible
		Oak Ridge		2.3E-02	Negligible	Negligible	3.4E-07	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	6.0E-04	Negligible	Negligible	9.0E-09	Negligible	Negligible
		PGDP		1.4E-04	Negligible	Negligible	2.1E-09	Negligible	Negligible
		PORTS		1.1E-02	Negligible	Negligible	1.7E-07	Negligible	Negligible
		SRS		7.0E-04	Negligible	Negligible	1.1E-08	Negligible	Negligible
		Oak Ridge		1.6E-03	Negligible	Negligible	2.4E-08	Negligible	Negligible
Partially consolidated storage at two sites	Storage area fire	East	Extremely unlikely	6.4E-02	Negligible	Negligible	9.7E-07	Negligible	Negligible
		West		7.2E-03	Negligible	Negligible	1.1E-07	Negligible	Negligible
	Seismic (direct release)	East	Extremely unlikely	2.0E-01	Low	Low	3.0E-06	Negligible	Negligible
		West		7.4E-03	Negligible	Negligible	1.1E-07	Negligible	Negligible
	Seismic (fire)	East	Extremely unlikely	1.4E-02	Negligible	Negligible	2.1E-07	Negligible	Negligible
		West		6.6E-04	Negligible	Negligible	9.9E-09	Negligible	Negligible
Partially consolidated storage based on physical form	Storage area fire	PORTS	Extremely unlikely	3.1E-02	Negligible	Negligible	4.6E-07	Negligible	Negligible
		SRS		1.7E-02	Negligible	Negligible	2.6E-07	Negligible	Negligible
		INEEL		2.1E-03	Negligible	Negligible	3.2E-08	Negligible	Negligible
	Seismic (direct release)	PORTS	Extremely unlikely	1.9E-01	Low	Low	2.9E-06	Negligible	Negligible
		SRS		9.6E-03	Negligible	Negligible	1.5E-07	Negligible	Negligible
		INEEL		2.5E-03	Negligible	Negligible	3.8E-08	Negligible	Negligible
	Seismic (fire)	PORTS	Extremely unlikely	1.3E-02	Negligible	Negligible	2.0E-07	Negligible	Negligible
		SRS		1.1E-03	Negligible	Negligible	1.6E-08	Negligible	Negligible
		INEEL		2.1E-04	Negligible	Negligible	3.2E-09	Negligible	Negligible
Transfer to research facility	Facility fire	Generic	Extremely unlikely	2.5E-04	Negligible	Negligible	3.8E-09	Negligible	Negligible
	Seismic (direct release)	Generic		8.1E-05	Negligible	Negligible	1.2E-09	Negligible	Negligible
	Seismic (fire)	Generic		5.0E-05	Negligible	Negligible	7.6E-10	Negligible	Negligible

Table C.20. Summary of chronic risks to ecological receptors due to deposition of uranium on soil under bounding accident scenarios (continued)

				Chemical exposure			Radiation exposure		
Alternative	**Accident scenario**	**Site**	**Frequency**	**Maximum HQ**	**Consequence level**	**Risk**	**Maximum HQ**	**Consequence level**	**Risk**
Transfer to other government Agencies	Facility fire	Generic	Extremely unlikely	1.3E-02	Negligible	Negligible	1.9E-07	Negligible	Negligible
	Seismic (direct release)	Generic		4.0E-03	Negligible	Negligible	6.1E-08	Negligible	Negligible
	Seismic (fire)	Generic		2.5E-03	Negligible	Negligible	3.8E-08	Negligible	Negligible
Foreign sales	Facility fire	Generic	Extremely unlikely	2.5E-02	Negligible	Negligible	3.7E-07	Negligible	Negligible
	Seismic (direct release)	Generic		8.7E-03	Negligible	Negligible	1.3E-07	Negligible	Negligible
	Seismic (fire)	Generic		5.4E-03	Negligible	Negligible	8.1E-08	Negligible	Negligible

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Table C.21. Summary of chronic risks to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios

Alternative	Accident scenario	Site	Frequency	Chemical exposure: Maximum HQ	Chemical exposure: Consequence level	Chemical exposure: Risk	Radiation exposure: Maximum HQ	Radiation exposure: Consequence level	Radiation exposure: Risk
All	General container handling	All	Anticipated	1.1E-05	Negligible	Negligible	2.4E-06	Negligible	Negligible
No Action	Storage area fire	INEEL	Extremely unlikely	3.0E-05	Negligible	Negligible	6.5E-06	Negligible	Negligible
		PGDP		1.2E-07	Negligible	Negligible	2.6E-08	Negligible	Negligible
		PORTS		3.5E-04	Negligible	Negligible	7.4E-05	Negligible	Negligible
		SRS		6.9E-05	Negligible	Negligible	1.5E-05	Negligible	Negligible
		Oak Ridge		3.3E-05	Negligible	Negligible	7.1E-06	Negligible	Negligible
		Max other		4.1E-05	Negligible	Negligible	8.7E-06	Negligible	Negligible
	Seismic (direct release)	INEEL	Extremely unlikely	1.8E-05	Negligible	Negligible	3.9E-06	Negligible	Negligible
		PGDP		4.5E-07	Negligible	Negligible	9.7E-08	Negligible	Negligible
		PORTS		1.2E-03	Negligible	Negligible	2.5E-04	Negligible	Negligible
		SRS		7.7E-05	Negligible	Negligible	1.6E-05	Negligible	Negligible
		Oak Ridge		3.6E-05	Negligible	Negligible	7.8E-06	Negligible	Negligible
		Max other		1.5E-04	Negligible	Negligible	3.2E-05	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	2.0E-06	Negligible	Negligible	4.2E-07	Negligible	Negligible
		PGDP		3.1E-08	Negligible	Negligible	6.6E-09	Negligible	Negligible
		PORTS		8.1E-05	Negligible	Negligible	1.7E-05	Negligible	Negligible
		SRS		6.6E-06	Negligible	Negligible	1.4E-06	Negligible	Negligible
		Oak Ridge		3.1E-06	Negligible	Negligible	6.7E-07	Negligible	Negligible
		Max other		1.0E-05	Negligible	Negligible	2.2E-06	Negligible	Negligible
Centralized storage at a single site	Storage area fire	All	Extremely unlikely	7.1E-04	Negligible	Negligible	1.5E-04	Negligible	Negligible
	Seismic (direct release)	All	Extremely unlikely	2.0E-03	Negligible	Negligible	4.4E-04	Negligible	Negligible
	Seismic (fire)	All	Extremely unlikely	1.4E-04	Negligible	Negligible	3.1E-05	Negligible	Negligible
Partially consolidated storage at several DOE sites	Storage area fire	INEEL	Extremely unlikely	6.9E-05	Negligible	Negligible	1.5E-05	Negligible	Negligible
		PGDP		1.0E-05	Negligible	Negligible	2.2E-06	Negligible	Negligible
		PORTS		4.8E-04	Negligible	Negligible	1.0E-04	Negligible	Negligible
		SRS		7.0E-05	Negligible	Negligible	1.5E-05	Negligible	Negligible
		Oak Ridge		8.5E-05	Negligible	Negligible	1.8E-05	Negligible	Negligible

Table C.21. Summary of chronic risks to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Frequency	Chemical exposure: Maximum HQ	Chemical exposure: Consequence level	Chemical exposure: Risk	Radiation exposure: Maximum HQ	Radiation exposure: Consequence level	Radiation exposure: Risk
	Seismic (direct release)	INEEL	Extremely unlikely	6.6E-05	Negligible	Negligible	1.4E-05	Negligible	Negligible
		PGDP		1.9E-05	Negligible	Negligible	4.0E-06	Negligible	Negligible
		PORTS		1.6E-03	Negligible	Negligible	3.5E-04	Negligible	Negligible
		SRS		8.3E-05	Negligible	Negligible	1.8E-05	Negligible	Negligible
		Oak Ridge		2.3E-04	Negligible	Negligible	4.9E-05	Negligible	Negligible
	Seismic (fire)	INEEL	Extremely unlikely	6.0E-06	Negligible	Negligible	1.3E-06	Negligible	Negligible
		PGDP		1.4E-06	Negligible	Negligible	3.0E-07	Negligible	Negligible
		PORTS		1.1E-04	Negligible	Negligible	2.4E-05	Negligible	Negligible
		SRS		7.0E-06	Negligible	Negligible	1.5E-06	Negligible	Negligible
		Oak Ridge		1.6E-05	Negligible	Negligible	3.5E-06	Negligible	Negligible
Partially consolidated storage at two sites	Storage area fire	East	Extremely unlikely	6.4E-04	Negligible	Negligible	1.4E-04	Negligible	Negligible
		West		7.2E-05	Negligible	Negligible	1.5E-05	Negligible	Negligible
	Seismic (direct release)	East	Extremely unlikely	2.0E-03	Negligible	Negligible	4.2E-04	Negligible	Negligible
		West		7.4E-05	Negligible	Negligible	1.6E-05	Negligible	Negligible
	Seismic (fire)	East	Extremely unlikely	1.4E-04	Negligible	Negligible	2.9E-05	Negligible	Negligible
		West		6.5E-06	Negligible	Negligible	1.4E-06	Negligible	Negligible
Partially consolidated storage based on physical form	Storage area fire	PORTS	Extremely unlikely	3.1E-04	Negligible	Negligible	6.6E-05	Negligible	Negligible
		SRS		1.7E-04	Negligible	Negligible	3.7E-05	Negligible	Negligible
		INEEL		2.1E-05	Negligible	Negligible	4.5E-06	Negligible	Negligible
	Seismic (direct release)	PORTS	Extremely unlikely	1.9E-03	Negligible	Negligible	4.1E-04	Negligible	Negligible
		SRS		9.6E-05	Negligible	Negligible	2.1E-05	Negligible	Negligible
		INEEL		2.5E-05	Negligible	Negligible	5.4E-06	Negligible	Negligible
	Seismic (fire)	PORTS	Extremely unlikely	1.3E-04	Negligible	Negligible	2.8E-05	Negligible	Negligible
		SRS		1.1E-05	Negligible	Negligible	2.3E-06	Negligible	Negligible
		INEEL		2.1E-06	Negligible	Negligible	4.5E-07	Negligible	Negligible
Transfer to research facility	Facility fire	Generic	Extremely unlikely	2.5E-06	Negligible	Negligible	5.4E-07	Negligible	Negligible
	Seismic (direct release)	Generic		8.1E-07	Negligible	Negligible	1.7E-07	Negligible	Negligible
	Seismic (fire)	Generic		5.0E-07	Negligible	Negligible	1.1E-07	Negligible	Negligible
Transfer to other government agencies	Facility fire	Generic	Extremely unlikely	1.3E-04	Negligible	Negligible	2.7E-05	Negligible	Negligible
	Seismic (direct release)	Generic		4.0E-05	Negligible	Negligible	8.7E-06	Negligible	Negligible
	Seismic (fire)	Generic		2.5E-05	Negligible	Negligible	5.4E-06	Negligible	Negligible

Table C.21. Summary of chronic risks to ecological receptors due to deposition of uranium on surface water under bounding accident scenarios (continued)

Alternative	Accident scenario	Site	Frequency	Chemical exposure			Radiation exposure		
				Maximum HQ	Consequence level	Risk	Maximum HQ	Consequence level	Risk
Foreign sales	Facility fire	Generic	Extremely unlikely	2.5E-04	Negligible	Negligible	5.3E-05	Negligible	Negligible
	Seismic (direct release)	Generic		8.7E-05	Negligible	Negligible	1.9E-05	Negligible	Negligible
	Seismic (fire)	Generic		5.3E-05	Negligible	Negligible	1.1E-05	Negligible	Negligible

DOE = U.S. Department of Energy.
HQ = hazard quotient.
INEEL = Idaho National Engineering and Environmental Laboratory.
PGDP = Paducah Gaseous Diffusion Plant.
PORTS = Portsmouth Gaseous Diffusion Plant.
SRS = Savannah River Site.

Risks to terrestrial plants, soil invertebrates, and consumers of contaminated soil, plants, and invertebrates were evaluated. The indicator receptors for these groups were plants, earthworms, and short-tailed shrews and American robins, respectively. Chronic chemical toxicity and radiation dose were assessed. The consequences of chemical toxicity to plants were negligible or low; consequences of chemical toxicity to other receptors and of radiation dose to all receptors were negligible.

Risks to terrestrial aquatic biota, benthic invertebrates, and animal consumers of contaminated surface water, sediment, aquatic biota, and benthic invertebrates were evaluated. The indicator receptor animal was the great blue heron. Chronic chemical toxicity and radiation dose were assessed. Under all alternatives, all types of consequences were negligible for all receptors.

Consequence levels were combined with the expected frequency of occurrence of the associated accidents to determine the overall risk to ecological receptors from each alternative. Overall risks were negligible or low for all alternatives.

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APPENDIX D

APPENDIX D

COMMENTS AND RESPONSE TO COMMENTS

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APPENDIX D.1. COMMENTS RECEIVED

DRAFT URANIUM MANAGEMENT PROGAMMATIC ENVIRONMENTAL ASSESSMENT

SOUTHERN
OHIO
DIVERSIFICATION
INITIATIVE

1864 Shyville Road
Piketon, Ohio 45661
P: 740 - 289 - 3654
F: 740 - 289 - 4591

reindustrializing south central ohio

June 20, 2002

David Allen
US Dept of Energy
SE-30-N, PO Box 2001
Oak Ridge, TN 37831

Dear Mr. Allen:

I am writing on behalf of the Board of Directors of the Southern Ohio Diversification Initiative (SODI) in response to the Draft Programmatic Environmental Assessment (DOE/EA-1393). As the designated DOE Community Reuse Organization, SODI is working with many organizations to bring new projects to the Portsmouth Site (PORTS). The action proposed in the Environmental Assessment will have many adverse impacts on our collective efforts to implement a productive reuse strategy.

The following are provided as initial questions and comments requiring your response:

- Please identify any other potentially reusable uranium material/uranium feed currently located at PORTS.
- What buildings would be used at PORTS for this project?
- What building(s) are included in the 450,000 square feet of available building space cited in the Draft Environmental Assessment (DOE/EA 1393)?
- What other facilities would be required to support the DOE preferred option to consolidate all of the material at PORTS?
- Why is the material considered "valuable" and "reusable"?
- If more potentially reusable material is shipped to PORTS, please identify the impacts/restrictions on other building and facilities at the site (in the context of production reuse).
- Please identify the method of shipment, mode of transportation, and route(s).
- What guarantees will the local community receive regarding the ultimate disposition date?
- Please provide the proposed schedule of re-classification to ensure the material is reusable, marketable, and not deemed a waste.
- What happens to the material if it is subsequently determined to be a waste?
- Please identify the markets for this material.
- When did the DOE preferred option first receive consideration?

- How would the importation of the material affect current clean up projects? Future D&D activities?
- How many permanent jobs are associated with this project? Newly created full-time permanent positions with the DOE preferred option?
- Please identify the community benefits associated with the importation of this material to PORTS.
- Will the full proceeds, including applicable taxes, of the sale of this material be returned to the community?
- Will the DOE utilize the designated CRO for disposal/sale of this material?
- Define temporary storage.
- Assuming there is a market for this material, is there a prohibition or moratorium that would prevent or affect its sale?
- Does USEC have any need for any of this material?
- Has the DOE considered transferring ownership of any of the material to USEC?
- Will additional security be needed at PORTS if any of the material is imported?
- Has DOE consulted with and sought the input of the Ohio Congressional Delegation regarding the importation of nuclear material to PORTS? If so, what was the outcome?
- Of the 158 sites currently storing the material, is there any more "reusable" or "potentially marketable" material being generated? If yes, will it automatically be transferred to the storage site chosen during this action?
- Has any of this material ever been classified as a waste?
- Please identify all of the sites currently storing this material and provide a brief description of the material at those sites.
- Please explain the relationship (on page 3-2/Environmental Justice Section) between race, income and the decisions to store this material at any location.
- Please provide brief details on the nature of retrofitting/upgrade required at PORTS for the DOE preferred alternative.
- Who will be used to complete retrofitting required at PORTS?
- Who regulates the safe storage of the material at PORTS?

On behalf of the southern Ohio region, and before any decision on this matter is made, we respectfully request a meeting with the Secretary of Energy or his designee with authority to make decisions regarding this issue.

We believe this proposed action is contrary to our efforts, the stated DOE mission to reindustrialize, and the tireless efforts of our elected representatives in Columbus and Washington for productive, job intensive reuse of the PORTS facility in Piketon. Therefore, the SODI Board of Directors opposes the subject material being stored at the Piketon site. The residents of Southern Ohio desire projects that have recognizable value and benefit for the community. We want input into our future, the goals for the site, and new missions.

Thank you for the opportunity to provide these questions and comments. Your responses are greatly anticipated and may lead to more questions. We look forward to an open dialogue and honest discussion with DOE on this and other matters. If you have any questions or need clarifications do not hesitate to contact me at the above.

Sincerely,

Gregory L. Simonton
Executive Director
Southern Ohio Diversification Initiative

Cc: file
SODI Board of Directors

State of Ohio Environmental Protection Agency

Southwest District Office

401 East Fifth Street
Dayton, Ohio 45402-2911

TELE: (937) 285-6357 FAX: (937) 285-6249

Bob Taft, Governor
Maureen O'Connor, Lt. Governor
Christopher Jones, Director

June 22, 2002

Mr. David R. Allen
United States Department of Energy
Oak Ridge Operations Office
200 Administration Road
Oak Ridge, Tennessee 237830

Re: **Ohio EPA Comments on Draft Programmatic Environmental Assessment for Uranium Management Group**

Dear Mr. Allen:

Enclosed are Ohio EPA's Comments on the Draft Programmatic Environmental Assessment for the Uranium Management Group. Ohio EPA is concerned about several issues regarding US DOE's intent to store uranium material at the Portsmouth site without any plan or budget in place to properly evaluate the economic value of this material. We believe continued discussion with all stakeholders is a necessary component to the future of uranium management at Portsmouth as well as other facilities within the US DOE complex.

If you have any questions regarding the enclosed comments, please do not hesitate to contact me at (740) 380-5289.

Sincerely,

Graham E. Mitchell, Chief
Office of Federal Facilities Oversight

MG/mg

cc: Ken Dewey, Ohio EPA, SEDO
Tony Takacs, US DOE-PORTS
Melody Stewart, Ohio EPA
Maria Galanti

Ohio EPA Comments on the Draft Programmatic Environmental Assessment for the Uranium Management Group.

1) During the meeting on June 4, it was noted that funding just became available to help with proper disposition of the uranium material currently stored at the Portsmouth facility and that additional funding would be needed to continue to find a new use for this material. Please state how US DOE intends to continue funding this program so that material will not be stored in perpetuity but rather shipped to other entities for re-use. US DOE must make funding this program a priority within each budget in order to continue disposition of the uranium material. Without proper funding, the necessary research to determine potential uses for this material can not be accomplished. The cost for management and research for re-use of this material should not come from the budget for the clean-up and remediation of the Portsmouth facility.

2) Portions of the revenues generated from the Uranium Management Group should be maintained in Portsmouth to off set the cost of storing the material as well as cleanup activities.

3) Ohio EPA understands US DOE's goal to consolidate uranium materials to reduce costs and promote more efficient management of these materials. However, to really develop credibility, US DOE is going to have to prove that this material does have economic value and other companies or government agencies are interested in it. Uranium materials need to be leaving the site rather than just arriving for storage. US DOE should establish goals and commitments to stakeholders to remove a certain percentage of material per year. These commitments could be in the form of a letter of intent or other type of agreement with the State of Ohio.

4) The draft EA noted that US DOE considers 20 years or greater to be interim storage. At what point within the 20 years will US DOE determine that this material is no longer of value and deem that it should no longer be stored but treated as a waste? What plan(s) does US DOE have to evaluate this material over the next 20 years to determine if it is of value? Because of past problems with storage of materials that later became waste, US DOE must make a commitment in the EA to establish a

process where the inventory is reevaluated on a regular basis (3-5 years) to ensure that it still has economic value. Please refer to the comment above in regard to establishing an agreement with the State of Ohio to continually evaluate the material and remove a percentage of this material from the site each year. US DOE can not continually accept material at the Portsmouth facility without establishing that the material is of economic value.

5) US DOE mentions that disposition is a major function of this uranium management effort. US DOE must also include disposition as waste as an additional component of this effort. Over time, as US DOE reevaluates this material, some of it may no longer have economic value and US DOE should be able to disposition it as waste under this EA. US DOE must ensure that funding is available to remove the material that is no longer of economic value as a waste.

6) The material currently at Portsmouth was moved there in order for US DOE to meet its regulatory requirements at several other sites. US DOE-Portsmouth has a regulatory requirement to address contamination at the site per the requirements of the Ohio Consent Decree. Currently, the material stored on site is in a building which sits upon and is adjacent to a groundwater plume which is to be addressed during the next fiscal year. The storage of the uranium material may interfere with the overall site clean-up. Please state how US DOE will ensure that storage of the additional material will not interfere with the requirements of the Ohio Consent Decree to clean-up the site. US DOE should conduct environmental characterization of buildings to be upgraded to meet the potential storage needs for incoming material. This effort could avoid future disruption of uranium management efforts.

7) Please state how storage of this material will not interfere with the other potential missions at the US DOE-Portsmouth site? For example, if Portsmouth were to become a D&D site, would it still be a good location for this facility? How does the storage of this material fit in with the current mission of Portsmouth to clean-up the current contamination at the site and potential re-use of the site for future industrial purposes?

8) US DOE should evaluate the long term storage of the uranium material at a facility such as the Nevada Test Site. The material could be easily obtained if it is determined to be of economic value and should US DOE determine that it is a waste the material may not have to be moved again for final disposition. Storing the uranium material in this manner may save the US DOE valuable economic resources.

9) Please state if the material will be tested for evaluation of RCRA characteristics including TCLP prior to shipping and storing the material to ensure that it meets regulatory requirements? Prior to shipping US DOE should make this evaluation to avoid potential regulatory issues at the site. As you are aware this site is not permitted to accept any hazardous waste from other facilities, to do so would be a violation of the permit.

10) If additional buildings/space will be needed for this effort, US DOE should coordinate with SODI in an effort to make the best future use of buildings.

11) US DOE should evaluate who the likely users of the material may be prior to shipment to Portsmouth. US DOE should avoid shipment of material over long distances for storage only to have the material re-locate to a user near its origin (i.g. shipping the material from the Hanford Facility to Portsmouth then back to a western user) . Conducting this type of evaluation up front will save US DOE economic resources as well as avoid potential risks associated with transportation of this material over long distances.

June 21, 2002

Mr. David Allen
US Department of Energy
SE-30-N, PO Box 2001
Oak Ridge, TN 37831

Dear Mr. Allen,

I am writing on behalf of the Seal Township, Pike County, Ohio, Trustees to oppose the DOE bringing in wastes from other sites to store at Piketon. The Piketon Gaseous Diffusion Plant is partially located in Seal Township. I am also a Board Member of the Southern Ohio Diversification Initiative.

DOE has called this waste a valuable material, but cannot explain how or why it is valuable. Futhermore, by bringing this waste to Piketon, 157 other sites will be cleaned up. We want to know why 157 other communities are more important than Piketon. This past weekend our community held a Relay for Life to raise money for the American Cancer Society. My wife is a cancer survivor. I cannot in good conscience support any more cancer-causing wastes, or material as DOE claims, coming to the Piketon site for storage.

I do support projects that accelerate the cleanup of the Piketon site and provide a safe environment for our residents. The DOE should build and operate the DUF6 plant and accelerate cleanup of the lands and buildings, such as the 340 acres SODI tried to get for economic development. These projects benefit the community by creating jobs and cleaning up our environment. Storing waste here for 20 years does not.

Thank you,

Larry E. Scaggs
Larry Scaggs

June 21, 2002

Mr. David Allen
US DOE
SE-30-N, PO Box 2001
Oak Ridge, TN 37831

Dear Mr. Allen,

I am a Scioto Township Trustee elected by the residents surrounding the Piketon gaseous diffusion plant, a member of the Southern Ohio Diversification Initiative Board of Directors, and owner of property adjoining the Piketon gaseous diffusion plant. I am opposed to the storage of uranium waste that is described as "reusable material" in the draft programmatic environmental assessment DOE/EA-1393. As a neighbor of the plant and representative of the people surrounding the plant, I do not want our community to become DOE's dumping ground. How can you tell our community that the waste is valuable material, yet you can tell the other communities that the material is a waste and they are now cleaned up?

As a SODI Board member and Scioto Township Trustee, I support projects that will benefit our community by providing jobs and a safe environment for our people. We want DOE to accelerate cleanup, build the DUF6 plant, transfer land to SODI, and bring new enrichment technology to Piketon.

Thank you,

Teddy L. West
Teddy L. West
Scioto Township Trustee

DOE Contract No. DE-AC05-98OR22700
Job No. 23900
June 14, 2002

U.S. Department of Energy
Portsmouth Site Office
Post Office Box 700
Piketon, Ohio 45661

Attention: Ms. Sharon J. Robinson, Site Manager

Subject: Programmatic Environmental Assessment (PEA) for the Storage, Transportation and Disposition of Potentially Reusable Uranium (EM-97-0376)

Dear Ms. Robinson:

As requested in the referenced letter, we have reviewed the subject PEA and submit the following comments.

1. Sec. 1.1 ("Purpose and Need for Agency Action", pg. 1-1). We suggest that the paragraph be revised by adding a new sentence (shown in italics), so that the paragraph reads as follows:

   "The U.S. Department of Energy (DOE) proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low enriched uranium (LEU), normal uranium (NU) and depleted uranium (DU). *Uranium materials which are presently located at multiple sites are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition.* Management would include the storage, transport, and ultimate disposition of these materials."

2. Sec. 2.2 ("No Action Alternative", pg. 2-9). In the last sentence in the paragraph, suggest changing "disposed" to "dispositioned".

3. Sec. 2.3 ("Proposed Action", pg. 2-9).

   In the first paragraph, we suggest that the 1st sentence be revised to create two sentences, to read, "DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU. Uranium materials which are presently located at multiple sites are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition.

   "In the third paragraph, suggest revising the first sentence to read, "DOE must determine the safest, most effective, and most efficient approach for the consolidation and storage of this material."

4. Sec. 4.11, "Summary and Conclusions", pg. 4-19. The 1st paragraph currently reads as follows:

   "Normal operations result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Environmental impacts associated with normal operations vary substantially from alternative to alternative and, occasionally, by site within a given alternative. General handling accidents result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Chronic human health and ecological consequences and risk are negligible to low for all sites under all alternatives. The highest transportation consequences are for alternatives that involve moving uranium materials to a western location, either to a commercial site or to INEEL."

Comments:

- We suggest that this summary paragraph be reworded to more broadly discuss the PEA's conclusions. The conclusion/summary as we see the overall PEA analysis is that there were none-to-minor impacts for all of the alternatives from the standpoint of environmental impact; negligible-to-low impacts from the standpoint of facility accidents (fire and seismic) for all the alternatives; while transportation effects for the alternatives generally reflected the extent of material transport associated with the alternative being analyzed. The overall conclusion is that potential impacts appear not to be significant for any of the material consolidation alternatives which were analyzed.

- We also suggest that discussion be added to the paragraph to summarize the reasons for proposing the PORTS option, given that at least one other option (i.e., the partial consolidated storage at several DOE sites) is forecast to have a less expensive construction cost. The reasons for proposing the PORTS option, are that a single consolidated storage location affords greater flexibility and ease of future disposition of the material, and reduces the overall expected future cost for facility surveillance & maintenance (S&M) and material accountability/material S&M, than if the material was at several locations. These benefits outweigh the potentially greater up-front renovation/construction costs.

- Consideration should be given to adding an overall summary table (example attached).

- Additional specific comments on the paragraph as written include the following:

  - The statement that "environmental impacts ...vary substantially from alternative to alternative" appears inconsistent with the analysis, which indicated that for all the alternatives, the environmental impacts were negligible, minimal, or at most minor. "Vary substantially" seems to imply that there are significant impacts, when the analysis says there were none or minimal.

- The statement that "General handling accidents result in no more than negligible acute or chronic consequences.... appears correct, based on the analysis. However, "general handling" is part of "normal operations" – which from the 1st sentence have no impacts. It is unclear as to why the extra emphasis is being given to the impacts from "Normal operations".

- The paragraph omits discussion of the negligible-to-low risk associated with facility accidents (fire and seismic).

5. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. The 3rd paragraph currently reads as follows:

"In addition to surface contamination, radiation dose from the stored uranium materials can be expected. Dose rates from any single stored container are no more than 3 to 4 mrem/h. The dose rate at a distance of 0.3 m (f t.) from a container is about 1 mrem/h, and the dose rate at a distance of 6 m (20 ft.) is < 0.5 mrem/hr (approximately the same as normal background radiation doses). These dose rates are not affected by stacking the containers, because the containers and the materials themselves provide substantial shielding. These dose rates are considered negligible to any receptor (facility worker, co-located worker, or public)."

Comments

- Suggest specifying whether the "3 to 4 mrem/h" dose rate is "on contact". Also, we suggest to citing the basis for indicating the dose is 3 – 4 mrem/h maximum.

- Based on calculations, a dose at 6 m (20 ft.) would be < 0.05 mrem/hr. Suggest using "<0.05 mrem/hr" – rather than "<0.5 mrem/hr."

- It is unclear as to what the information in the parenthesis – "(approximately the same as normal background radiation doses)" refers to. If what is being referred to is 0.5 mrem/hr, this would not seem to be "approximately background", as 0.5 mrem/hr at 2000 hrs/year would result in 1 rem/yr., which exceeds background. On the other hand, if what is being referred to is 0.05 mrem/yr, then this does more closely approximate background.

- The phrase "dose rates not affected by stacking the containers" is somewhat unclear. "Stacking" typically refers to one container on top of another. We would think that dose rate would be affected if there were multiple containers stacked on top of each other, or containers side by side. The next statement regarding containers providing shielding seems to be referring to the containers behind one another – not container "stacking". Suggest clarifying whether we're referring to "stacking" containers on top of one another, or those behind each other. Overall, while there may be mitigation of dose from shielding, it would also seem that there could be dose contribution from adjacent or stacked containers.

- The conclusion that "these dose rates are considered negligible to any receptor" may be correct, but it is not clear from this paragraph how this is so, given the above comments.

6. Sec. 4, "Consequences" - General

   Consideration should be given in Sec. 4 ("Consequences") to adding specific Appendix references so that the reader can easily trace the amounts given in Sec. 4 back to where the amounts were calculated and appear in the appendices. As an example, for the "transportation effects" amounts shown in table 4.17, add a reference or footnote to indicate where these amounts are shown in Appendix B ("Transportation Analysis").

   In Sec. 4 ("Environmental Consequences"), in the "Impacts" tables – tables 4.3, 4.6, 4.9, 4.13, 4.16, and 4.19 – the cost of upgrades appears in each table. This is referred to in each table as "construction/upgrades cost". From the methodology (Sec. 4.1, "Methods", 2nd paragraph, pg. 4-1), it appears that the intent of these cost figures is that they include not only the cost of construction/upgrades but also the cost of surveillance & maintenance (S&M). However, it is not clear that S&M costs – either facility S&M or material S&M (which would also include maintaining nuclear material control & accountability) - are fully included by this approach.

   It may be more appropriate to base facility and material S&M costs on the total square footage of storage space for the material – not just on the upgraded space. The conclusion that would likely emerge is that there would be a significant cost component associated with S&M, at each facility where material would be stored. Eliminating this duplicative S&M cost at multiple storage facilities would appear to be a strong supporting rationale for the proposed approach – consolidating material at a single DOE site. Consideration should be given to discussing these S&M costs and/or including S&M costs in the affected "impact" tables.

If you have any questions, please contact Buck Sheward at extension 2266.

Sincerely,

Gilbert D. Drexel
Manager of Projects

GDD/CWS/BG/rd
LTR-INFS-RD-02-093

cc: Beth Keener
Rosemary Richmond
Tony Takacs, DOE-PORTS
File - INFS
File - PORTS DMC - RC

Pike County Board of Commissioners
Courthouse • 100 East Second Street • Waverly, Ohio 45690 • (740) 947-4817 • Fax (740) 947-5065

June 13, 2002

Mr. David Allen
United States Department of Energy
SE-30-N P.O. Box 2001
Oak Ridge, TN 37831

Mr. Allen:

I am submitting my comments to the United States D.O.E. on the proposed use of the "Piketon" Gaseous Diffusion Plant situated in Pike County.

I am presently serving Pike County as Vice-Chairman of the Board of Commissioners.

Over the years our community has done everything we can to support the nations needs. In fact we have gone above and beyond the call of duty. In the past the D.O.E. has ignored our input in work to minimize our concerns.

This proposed action raises numerous concerns. Specifically, safe transportation concerns and security of all material at the Piketon Plant is in question. Health of workers, residents and environmental safety issues are also of major concern.

The perception of Pike County, our home, being a national dump site for the governments excess waste is appalling, to say the least.

This project has no financial, environmental, educational or social benefits to Pike County and its people. For these reasons, I am very much opposed to bringing any material to Piketon for storage.

Sincerely,

Harry Rider
Vice Chairman
Pike County Board of Commissioners
Waverly, OH

Resolution

Distribution

Economic Development Office

SCIOTO COUNTY COMMISSIONERS

COMMISSIONERS
Tom Reiser
Vern Riffe, III
Opal M. Spears

Clerk
INEZ BLOOMFIELD

Adopted JUNE 13, 2002

Subject IN THE MATTER OF RESOLUTION OPPOSING THE STORAGE OF FERNALD AND HANFORD EXCESS URANIUM AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT.

It was moved by Mr. Riffe and seconded by Ms. Spears that the following resolution be adopted:

RESOLUTION

WHEREAS, the Scioto County Board of Commissioners have supported the U.S. Department of Energy's Uranium Enrichment Operation at the Portsmouth Gaseous Diffusion Plant (PGDP) in Piketon, Ohio for the past half-century; and

WHEREAS, the Scioto County Board of Commissioners have been supportive of local, regional, and State of Ohio efforts to encourage DOE and the U.S. Enrichment Corporation to bring new enrichment technologies to the PGDP, to continue environmental remediation efforts, to maintain the PGDP for possible future production, and to support decommissioning and decontamination work, for the national and economic security of our nation; and

WHEREAS, the PGDP's mission and employees have been an integral part in the success of our nation's cold war victory over the former Soviet Union of Socialistic Republics; and

WHEREAS, the Board of Scioto County Commissioners have been appreciative of the cooperative relationship among local governments and the DOE, in DOE's support and leadership in economic development diversification initiatives in Scioto, Pike, Jackson, and Ross counties; and

WHEREAS, the DOE is currently seeking public input into a Programmatic Environmental Assessment at the PGDP to store 14,200 metric tons of low level excess uranium from the Fernald Weapons Plant in Cincinnati, Ohio and the Hanford Plant in Washington State; and

WHEREAS, the Scioto County Board of Commissioners believe the storage of this excess uranium and the marketing of these materials over a 20+ year time frame will have a negative effect on our current and future marketing of the PGDP and GCEP sites for re-use and on the marketing of industrial sites for new business development in south central Ohio; and

WHEREAS, the Scioto County Board of Commissioners also have a matter of concern over the downgrading of security forces at the PGDP in recent years;

CERTIFICATION

I, Inez Bloomfield, the duly appointed and acting Clerk of the Bo of County Commissioners, Scioto County, Ohio, do hereby certify t the above is a true and correct copy of a resolution adopted on June 13, 2002, Journal 75, and Page 47.

By: Inez Bloomfield
Inez Bloomfield, Clerk

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

RECEIVED
OFFICE OF THE MANAGER
6-13-02

June 10, 2002

Mr. David Allen
U.S. Department of Energy
Oak Ridge Operations Office
200 Administration Road
Oak Ridge, Tennessee 37831

Dear Mr. Allen:

Thank you for your May 17, 2002, letter and enclosure regarding the National Environmental Policy Act (NEPA) Programmatic Environmental Assessment (EA) for the U.S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Re-usable Uranium Materials (DOE/EA-1393). We received your request for informal consultation under Section 7 of the Endangered Species Act for this proposal on May 28, 2002. The draft PEA was submitted for review prior to consideration and incorporation of our comments on the request for informal consultation. The PEA evaluates potential storage, transportation, accidental release, and the ultimate disposition of re-useable uranium at the following Department of Energy (DOE) facilities: Portsmouth Gaseous Diffusion Plant in Ohio; Paducah Gaseous Diffusion Plant in Kentucky; Y-12 National Security Complex and East Tennessee Technology Park in Tennessee; Savannah River Site in South Carolina; and the Idaho National Engineering and Environmental Laboratory in Idaho. The PEA evaluates the ultimate disposition of approximately 14,200 metric tons of uranium (MTU). Based on existing storage space and the lowest potential for cumulative impacts due to construction/renovation, the preferred location for storage of this material is the Portsmouth Gaseous Diffusion Plant in Ohio.

The draft PEA does not include copies of correspondence requesting informal Section 7 consultation with U.S. Fish and Wildlife Service (Service) Ecological Services Field Offices in Ohio, South Carolina, or Idaho. Service personnel have reviewed the information submitted and offer the following comments relative to the PGDP in McCracken County, Kentucky and the Oak Ridge Reservation (ORR) in Roane and Anderson Counties, Tennessee, for consideration.

The description of Federally endangered and threatened species present in the vicinity of PGDP (Section 3.2.5) generally reflects information provided by this office to DOE on February 23, 2001. The evening bat (*Nycticeius humeralis*) does not currently have Federal protection pursuant to the Endangered Species Act. Based on our review of the Tennessee Natural Heritage database, Tennessee Valley Authority biological collection records on and adjacent to the ORR, Tennessee Wildlife Resource Agency collection records on the ORR, Oak Ridge National Laboratory observations and habitat evaluations, DOE ORR Environmental Management program ecological

FILE COPY

risk assessment evaluations, and internal Tennessee/Kentucky Field Office records, the descriptions of ecological resources, including Federally threatened and endangered species, at the Y-12 National Security Complex (Section 3.3.5) and the East Tennessee Technology Park (Section 3.4.5) are not comprehensive and do not reflect the current knowledge of ecological resources present on the ORR. They also do not reflect past Service informal consultations for a number of previous DOE proposals.

According to our records, the following federally listed endangered species are known from or have the potential to occur within the project impact areas on the ORR:

gray bat	*Myotis grisescens*
Indiana bat	*Myotis sodalis*
pink mucket	*Lampsilis abrupta*

We recommend that qualified biologists assess potential impacts and determine if the proposed ORR alternative may affect the species. We recommend that you submit a copy of your assessment and finding to this office for review and concurrence. A finding of "may affect" could require the initiation of formal consultation procedures.

Since the Portsmouth Gaseous Diffusion Plant has been tentatively selected as the preferred alternative storage location, we recommend that the ecological resources sections of this draft PEA referenced above be modified to accurately reflect the current extent of knowledge regarding biological/ecological resources of the Y-12 and ETTP areas, including East Fork Poplar Creek, Poplar Creek, and the Clinch River. Since the American robin (*Turdus migratorius*) was modeled in the risk assessment in Appendix C of this draft PEA and given the responsibilities placed on Federal agencies by Executive Order 13186, we believe it would also be prudent to include discussions regarding migratory birds.

These constitute the comments of the U.S. Department of the Interior in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.), the Migratory Bird Treaty Act (16 U.S.C. 703-711), the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), and the National Environmental Policy Act (42 U.S.C. 4321-4347; 83 Stat. 852). We appreciate the opportunity to comment. Should you have any questions or need further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

xc: Michael Holland, DOE, Oak Ridge
Reggie Reeves, TDEC, Nashville
Gary Myers, TWRA, Nashville
Dave McKinney, TWRA, Nashville
Field Supervisor, FWS-ES, Ohio
Field Supervisor, FWS-ES, South Carolina
Field Supervisor, FWS-ES, Idaho

Pike County Board of Commissioners

Courthouse • 100 East Second Street • Waverly, Ohio 45690 • (740) 947-4817 • Fax (740) 947-5065

June 12, 2002

Mr. David Allen
United States Department of Energy
SE-30-N, P.O. Box 2001
Oak Ridge, Tennessee 37831

Mr. Allen:

My name is Jim Brushart and I am presently serving as Chairman of the Board of Commissioners in Pike County, Ohio.

I have lived all of my 64 years in Pike County. I was here when the "Atomic Plant" was built and I have witnessed all of the changes in lifestyles of our people up to and including the present operator U.S.E.C.

I have seen our county suffer as a result of this property being tax exempt from 1952 until 1999 and also the many health problems attributed to the operation of this plant throughout the years.

After all of the wrong the federal government has heaped upon our people in Southern Ohio, one would think that they would at least try to assist us in rebuilding what they have torn down.

This is just not the case though. The Department of Energy is now planning to store excess uranium material at the Piketon plant. Pike County has been dumped on for the past 50 years by the D.O.E. and I think its time to stop.

In Pike County, we are trying to pick up the pieces and make economic development attractive. If we are made a dumping ground for the governments waste to be stored, this will severely hamper any possibilities of economic development in the future. Pike County would be recognized as a national dumping site for waste, thus creating a more negative image of Southern Ohio.

In closing, I ask you on behalf of thousands of Pike County Constituents, to please take your waste elsewhere. I challenge the Department of Energy to do something good for Pike County and its people. We certainly deserve much better treatment than what we have received in the past.

Sincerely,

James A. Brushart
Chairman
Pike County Board of Commissioners
Waverly, Ohio

cc: U.S. Senator Mike DeWine
U.S. Senator George Voinovich
Congressman Ted Strickland
Congressman Rob Portman
Governor Bob Taft
Senator Mike Shoemaker
Senator Doug White
State Representative Dennis Stapleton
Waverly News Watchman
Portsmouth Daily Times
Chillicothe Gazette

6/8/2002

David Allen:
U.S. Dept of Energy:

Dear Sir:

Please Please don't let Washington and Cincinnati dump spent uranium at the Portsmouth Diffusion Plant in Pike County.

Southern Ohio has a rate of more cancer here than any place of the U.S.

We have fought for years to have it cleaned up. EPA says its safe one month and unsafe the next month.

It is densely populated in this area. There are many other places to take it like Idaho Falls and Hanford, Wash and others more safe.

We do not want it here and pray you don't dump it on us. Respectfully

H. E. King
8339 SR 139
Minford, Oh 45653

P.S.
We have grand children we want to [illegible] Ohio

6-15-02

Cindy Newsom
2315 Grandview Ave.
Portsmouth, Oh 45662

David Allen
US Dept of Energy
SE-30-1, PO Box 2001
Oak Ridge, Tenn. 37831

Dear David,

I am writing in response to the June 7, 2002 article in the Portsmouth Daily Times. I would like to strongly suggest that you find somewhere else to store your material [other than at the Portsmouth Gaseous Diffusion Plant]. I support Rep. Ted Strickland when he said, "you can't trust them (DOE) on anything they've said to us. They've lied to us before." I do not think that using PGD plant is in the best interest of our area - we have enough problems without needing dumped on with nuclear waste. I don't believe the DOE will "re-use" or re-sale the material. A dump site is a dump site. Thank you,

Cindy Newsom

June 15, 02

NO! NO! NO! No More Excess Uranium or any Uranium at Portsmouth Gaseous Diffusion Plant. We've had this killer here since the 50's. No More. The fish in Scioto River are covered with sores. The bottom feeders are already dead. The wells are contaminated. The trees are dying. People are dying - go to hospital in Columbus nurses ask "Where are you from?" you reply "Portsmouth" Their response "oh the Cancer Capitol of The State."

(2) You clean this killer up at Fernald and Hanford and ship it someplace else to contaminate another place. How stupid can you get? For years you've talked "Jobs" well you know what you can do with your "Jobs"

([illegible]) If Mr Jackson is so enamored with "properties for solar collectors" then let him store it near him at Oak Ridge TN. The last time I was thru there the lake and trees didn't look too healthy - so give it to Mr Jackson or ship it to D.C. if it's so good. I will actively campaign against anyone who does not fight this.

D.E. Culver
878 Shawnee Rd
W. Portsmouth O. [illegible]

Oak Ridge Reservation
Local Oversight Committee, Inc.
136 S. Illinois Avenue, Suite 208
Oak Ridge, Tennessee 37830

Fax Cover Sheet

DATE:	June 21, 2002	**TIME:**	3:10 PM
TO:	David Allen DOE ORO	**PHONE:** **FAX:**	576-0411 576-0746
FROM:	Susan L. Gawarecki Executive Director, LOC	**PHONE:** **FAX:**	(865) 483-1333 (865) 482-6572
RE:	Transmittal of Letter with comments regarding DOE/EA-1393		

Number of pages including cover sheet: 4

Message

Transmitted with this FAX is the document listed below:

> Letter to David Allen from Norman A. Mulvenon, Chair, LOC Citizens' Advisory Panel; Subject - Programmatic Environmental Assessment (PEA) for the U.S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Re-Usable Uranium Materials (DOE/EA-1393)

The original comment letter will also be sent to you in hard copy.

LOC INC
Oak Ridge Reservation Local Oversight Committee

June 21, 2002

David R. Allen
U.S. Department of Energy
Oak Ridge Operations Office
SE-30-1
PO Box 2001
Oak Ridge, Tennessee 37831

<u>Subject</u>: *Programmatic Environmental Assessment (PEA) for the U.S. Department of Energy. Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Re-Usable Uranium Materials (DOE/EA-1393)*

Dear Mr. Allen:

The Oak Ridge Reservation (ORR) Local Oversight Committee (LOC) Citizens' Advisory Panel (CAP) submits the following comments on the subject PEA. These comments should be attributed to the CAP only, as the LOC Board has not had the opportunity to address the issue.

The CAP reviewers find the document poorly written and the alternatives presented in an unclear and confusing manner, such that the average reader cannot make an intelligent evaluation. It appears that no quality assurance was performed on this document prior to release for public comment. At the very minimum, the subcontractor, Science Applications International Corporation, should have read their own material for content and used the appropriate annotated outline to guarantee that all text material was included and properly organized to allow proper evaluation. At the maximum, all involved parties as listed on page 6-1 should have properly reviewed and vetted this document. The CAP's primary recommendation is that DOE retract the document and have it internally reviewed, rewritten, corrected, amended, and then re-issued for public comment.

Comments that support revision and re-issuance of the PEA are listed below:

1. The PEA lacks an Executive Summary.
2. The preferred alternative—Portsmouth—is not stated until page 2-10. Even then, it is unclear whether this is the preferred alternative of all alternatives or only of the DOE sites under consideration. The PEA should present the compelling rationale for the preference. The reasons listed are not "unique" as most are applicable to the Y-12 National Security Complex also.
3. The various alternatives are not numbered or consistently named in such a way as to easily identify them for comparison. The various alternatives also appear in random order throughout the document causing additional confusion for the reader. An example of this is the final interim storage alternative listed in Table 2.2 "interim partially consolidate storage based on physical form" which is apparently the same as "Interim

Partially Consolidated Storage at Several DOE Sites" in Section 4.11.1 Comparison of Alternatives.

4. There are errors or unexplained inconsistencies between the final interim storage alternative listed in Table 2.2 "interim partially consolidate storage based on physical form" and the unnumbered, unnamed table in section 4.9 that shows the storage plan for materials based on physical form.

5. NU in the acronym list is defined as normal uranium. The definition used in Appendix A, page A-iv is natural uranium. The terms "natural uranium" and "normal uranium" are interchangeably and randomly used throughout the EA text and appendices. This is confusing to the reader and technically inaccurate, as "natural uranium" is the proper term.

6. The missions of the various sites for storage were not properly considered.

   - Portsmouth is no longer in use as a gaseous diffusion facility and its future role may be limited to being one of the two sites for a conversion plant for depleted uranium hexafluoride (Paducah being the other site).
   - The three sites at Oak Ridge are lumped together in Table 2.1 and Oak Ridge is the only designator listed in later tables. In reality, the three major DOE sites in Oak Ridge have separate missions and two of the sites are not suitable for the proposed storage mission. ETTP is a closure site, and DOE has stated an intention to transfer the site to other ownership by 2008. ETTP should not even be on the list of alternatives, in that there is no future DOE mission contemplated once the site is cleaned up and closed. ORNL is listed in Table 2.1, but then is not included in any of the analyses. As a national laboratory, it is a poor candidate for a storage site.

7. Information is scattered and difficult to find in the PEA. For example, on page 2-3 it is stated that the uranium trioxide at SRS is not considered within the scope of this PEA. We don't learn why (that these oxides are not part of the UMG inventory) until page 4-21.

8. The option of transportation by barge is not evaluated.

The PEA doesn't seem to focus on the most logical analysis of alternatives for interim storage. This would be the consolidation of uranium at sites with compatible enrichment forms or with potential future uses. Some examples:

1. Portsmouth and Paducah will both have facilities for conversion of depleted uranium hexafluoride to oxide or metallic forms. Either of these locations would be a logical choice for the national stockpile of DU.

2. Paducah has a continuing mission of gaseous diffusion enrichment of uranium for commercial nuclear fuel. It would be a logical location for the storage of LEU.

3. Y-12 has exceptional capabilities for handling and storing HEU, and could act as a repository for any of the forms, particularly those that are more reactive such as metallic uranium. Because proposals for future disposition of HEU include down-blending to a

lower enrichment, Y-12 might be a logical place to store compatible forms that could be used for this purpose at a later date.

The transportation analysis relies too heavily on computer modeling without actual analysis of the existing roads. Portsmouth is not accessible by interstate and for this reason would be a poor choice for storage of all forms/enrichments, making it a hub for a major shipping campaign involving sensitive cargos. It is more logical to minimize transportation on secondary roads and express a preference for sites close to interstate highways or other major bulk transportation options (rail or barge). In particular, if multiple shipments of a particular form or enrichment to a variety of end users are likely, the preferred storage location should weight access to good transportation routes more heavily.

With so much uncertainty about end states, one wonders why DOE has undertaken an assessment at this time. It also makes little sense that DOE's huge stock of depleted uranium hexafluoride in cylinders—soon to be converted to a more stable chemical form—is outside the scope of the PEA.

The LOC is a non-profit regional organization funded by the State of Tennessee and established to provide local government and citizen input into the environmental management, decision-making and operation of the DOE's Oak Ridge Reservation. The Board of Directors of the LOC is composed of elected and appointed officials from the City of Oak Ridge and the seven counties surrounding and downstream of the ORR, and the chair of the Citizens' Advisory Panel. The CAP is a stakeholder organization with up to 20 members with diverse backgrounds who represent the greater ORR region; the CAP supports Board interests by reviewing and providing recommendations on DOE decisions and policies.

The CAP appreciates the opportunity to comment on the PEA. We look forward to seeing a revised draft with a more user-friendly and logical analysis of alternatives.

Sincerely,

Norman A. Mulvenon

Norman A. Mulvenon
Chair, LOC Citizens' Advisory Panel

cc: LOC Document Register
LOC CAP
LOC Board
John Owsley, Director, TDEC DOE-O
Justin Wilson, Special Deputy to the Governor on Policy
Joe Sanders, General Counsel, TDEC
Michael Holland, Acting Manager, DOE ORO
William Brumley, Manager, Y-12 Area Office
Pat Halsey, FFA Administrative Coordinator, DOE ORO
Luther Gibson, Chair, ORSSAB
Carol M. Borgstrom, Director, NEPA Oversight, DOE HQ

Hart, Melissa

From: Allen, David R
Sent: Monday, June 24, 2002 8:05 AM
To: Hart, Melissa
Subject: FW: Reusable Uranium PEA

Comments on the PEA

-----Original Message-----
From: Norman A Mulvenon [mailto:mulvenon@juno.com]
Sent: Saturday, June 22, 2002 8:02 PM
To: Allen, David R
Cc: mulvenon@juno.com
Subject: Reusable Uranium PEA

David,

Just a note to tell you that one of the LOC/CAP members put it best and I do not think it was included in our remarks. To wit:

"I also find the document exasperating, in that information is either

not there or hard to find. I haven't found the form the uranium is at the various sites. With so much uncertainty about end states, one wonders why DOE is bothering with an assessment at this time. Particularly when the gorilla of depleted uranium hexafluoride in cylinders appears to be outside the scope."

A lot of people, not just one or two, read and analyzed this PEA and the LOC/CAP comments are a true aggregate.

Have a nice day.

Norman

==
Norman Mulvenon, 118 Concord Rd, Oak Ridge TN 37830-7126 USA
Tel: 865.482.3153 FAX: 865.483.9234 Mobile: 865.607.0131
E-mail: mulvenon@juno.com [TEXT & ATTACHMENTS]
==

Hart, Melissa

From: Thomas, Carolyne F
Sent: Friday, June 21, 2002 4:22 PM
To: Hart, Melissa
Subject: UMG PEA

More comments.

-----Original Message-----
From: Hurley, Larry R.
Sent: Wednesday, May 29, 2002 10:49 AM
To: Thomas, Carolynne F. (V6C)
Subject: DOE/EA-1393

Feedback: I'd like to see this material stored at the Yucca Mountain site (along with all the rest of the nation's nuclear materials).

Thanks,

Larry

Hart, Melissa

From: Thomas, Carolyne F
Sent: Friday, June 21, 2002 4:40 PM
To: Hart, Melissa
Subject: UMG PEA

Comment on Uranium PEA.

-----Original Message-----
From: Lee Poe [mailto:leepoe@mindspring.com]
Sent: Thursday, May 23, 2002 6:45 AM
To: Thomas, Carolyne F
Cc: Drew Granger; Lyddie Broussard
Subject: RE: UMG PEA

Carolyne: I am reading the PEA on uranium and I find that it doesn't include most of the uranium at SRS. (There is 24,500 MTU as oxide and ~250 MYU of depleted uranium in F-Area as a nitrate solution.) Please provide me with the rational on why the uranium selected was selected and why other uranium at DOE sites was not included? On the surface it sounds like the PEA should consider all of DOE's U.

Why was UF6 not covered in the EA?

Was scoping performed on this NEPA document? If so please send me the scoping document summary. Thanks

> -----Original Message-----
> From: Thomas, Carolyne F [mailto:ThomasCF@oro.doe.gov]
> Sent: Wednesday, May 22, 2002 3:05 PM
> To: 'Lee Poe'
> Subject: RE: UMG PEA
>
>
> Mr. Poe,
>
> On our stakeholder mailing list, it was noted that you wanted a hard copy
> and a paper copy. A hard copy was mailed out to you in the mail
> at the end
> of last week. You should receive this in the mail today or at the latest
> tomorrow. If you do not receive it, please let me know and I
> will send you
> another copy.
>
> Thank You,
> Carolyne Thomas
>
> -----Original Message-----
> From: Lee Poe [mailto:leepoe@mindspring.com]
> Sent: Wednesday, May 22, 2002 6:58 AM
> To: Thomas, Carolyne F
> Subject: RE: UMG PEA
>
>
> I would like a paper copy of this EA. I find looking at 167 page
> documents
> on the computer to be quite difficult and time consuming. Since we only
> have a short reply period, please send me the copy by overnight mail.
> Thanks Lee Poe

>
> > -----Original Message-----
> > From: Thomas, Carolyne F [mailto:ThomasCF@oro.doe.gov]
> > Sent: Wednesday, May 22, 2002 1:05 PM
> > To: 'mueller.heinz@epa.gov'; 'holroyd.david@epa.gov';
> > 'laurie.tyler@srs.gov'; 'gail.jernigan@srs.gov'; 'oliverj@ttnus.com';
> > 'sbooher@aol.com'; 'leepoe@mindspring.com'; 'john.cook@srs.gov';
> > 'lwaishwe@eohsi.rutgers.edu'; Rothrock, Amy L;
> > 'fjhahne@nuclearfuelservices.com'; 'kpatterson@home.ifx.net';
> > 'pattersonk@ttnus.com'
> > Cc: Thomas, Carolyne F
> > Subject: UMG PEA
> >
> >
> > Dear Stakeholder,
> >
> > Please find attached a copy of the Programmatic
> > Environmental Assessment for the U.S. Department of Energy, Oak Ridge
> > Operations Implementation of a Comprehensive Management Program for the
> > Storage Transportation, and Disposition of Potentially Re-Usable Uranium
> > Materials. All public comments are due no later than June 21, 2002.
> >
> > A public meeting with be held on June 4, 2002 at 5:00 p.m.
> > at the Veme Riffe Career Technology Center Cafeteria, 175 Beaver Creek
> > Road, in Piketon, Ohio.
> >
> > If you have questions or need to receive a hard copy of this
> > document, please contact me at the information below.
> >
> >
> > <<NEPA LETTER TO STAKEHOLDERS.wpd>>
> >
> >
> >
> > > <<Revised Preliminary Draft 051602.pdf>>
> > >
> > > Carolyne Thomas
> > > Senior Project Manager
> > > Uranium Management Division
> > > (865) 576-2690 (Phone)
> > > (865) 576-8577 (Fax)
> > > (865) 222-1916 (Pager)
> > thomascf@oro.doe.gov
> >
> >
> >
> >
>

INEEL Oversight
Idaho's eyes on the INEEL

Dirk Kempthorne, Governor
Kathleen E. Trever, Coordinator

900 North Skyline, Suite C • Idaho Falls, Idaho 834(
1410 North Hilton • Boise, Idaho 83706

June 21, 2002

David Allen
U.S. Department of Energy, SE-30-1,
P.O. Box 2001
Oak Ridge, TN 37831

Re: Draft Programmatic Environmental Assessment (PEA) *Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Reusable Uranium Materials* (DOE/EA-1393)

Dear Mr. Allen:

In stating a need for this EA, DOE emphasizes increasing budget pressures, good stewardship of resources, and ensuring maximum cost-effectiveness. DOE does not, however, provide a clear explanation of how its alternatives for moving materials around before deciding on their disposition addresses these goals. This explanation is essential to supporting a sound policy decision.

Although DOE may be able to "bound" impacts based on hypothetical disposition paths, the geographical locations for disposition of the various physical forms could form a discriminator among alternatives that require transport, facility upgrade or construction. If, for example, there may be future activities using materials at their current or nearby location, it probably does not make sense to "consolidate" them elsewhere.

To support a sound decision, DOE should also provide information as to whether other activities at the storage facilities in question would still require similar monitoring or upkeep regardless of whether the reusable uranium materials remain. To enable fair evaluation of the alternative for consolidation by physical form versus solely geographical approaches, DOE should also provide information as to how physical form can relate to ultimate disposition, as well as identifying any differences in interim storage needs.

The document's simplified assumptions prevent much quantitative analysis, but do allow some qualitative comparisons.

The fundamental, outstanding question left by the EA, however, is to what extent the alternatives can achieve DOE's stated purpose of achieving management efficiencies.

Sincerely,

Kathleen E. Trever
Coordinator-Manager

cc: Roger Twitchell, DOE-Idaho NEPA Coordinator

an Idaho state program that independently monitors activities at the INEEL on behalf of the citizens of Idaho

IF: (208) 528-2600 Boise: (208) 373-0498
IF: (208) 528-2605 Boise: (208) 373-0429
www2.state.id.us/deqinel/main_op.htm

Hart, Melissa

From: Day, Katatra C
Sent: Monday, June 24, 2002 1:18 PM
To: Hart, Melissa
Subject: Comments to be added for the Uranium PEA

Below is another Comment from Richard Demming that should be included in the file of comments for the Uranium PEA.

Katatra Day

-----Original Message-----
From: Thomas, Carolyne F
Sent: Monday, June 24, 2002 8:17 AM
To: Day, Katatra C
Subject:

Please make sure Melissa send you the comments so you can get them to Wayne Tolbert. Also we need to add the Richard Demming comment:

1) All references to aircraft impact as shown on page 4-1, last paragraph, last sentence. This suggestion is made after the 9/11 attack. Replace references with external events.

Also here is a comment from me:

Table 2.2, page 2-5 contradicts with page 2-11, section 2.3.6. Please correct the Table to reflect the information in section 2.3.6, which is consistent with Appendix A.

Thanks

Carolyne Thomas
Senior Project Manager
Uranium Management Division
(865) 576-2690 (Phone)
(865) 576-8577 (Fax)
(865) 222-1916 (Pager)

SCIOTO COUNTY ECONOMIC DEVELOPMENT OFFICE

602 Seventh Street
Room 301, Courthouse
Portsmouth, Ohio 45662
www.sciotocountyohio.com

Steven T. Carter, Ex. Director
Telephone: (740) 354-5395
Fax: (740) 353-7358

June 10, 2002

Mr. David Allen
U.S. Department of Energy, SE-30-1
P.O. Box 2001
Oak Ridge, TN 37831

Re: Programmatic Environmental Assessment PGD / Storage of 14,200 metric tons of excess uranium from the Fernald Weapons Plant in Cincinnati and the Hanford plant in Washington State

Dear Mr. Allen:

The Scioto County Economic Development Office and the Scioto County Commissioners, along with U.S. Congressman Ted Strickland, are opposed to the siting of the 14,200 metric tons of re-usable excess uranium from other DOE sites that are proposed to be stored at DOE's Portsmouth Gaseous Diffusion Plant. Even though we are a rural / small city community, our region is densely populated. We believe there are other DOE sites that are much larger than our 3,700 acre site where these materials can be stored and marketed over time. We also believe the storage of these materials over a 20+ year time frame will have a negative effect on our current marketing efforts of the site for re-use and on the marketing of industrial sites for new business development in South Central Ohio.

Another major concern has been the downgrading of security forces in both manpower and armaments of PGD's security forces over the last several years.

Sincerely,

Steven T. Carter
Executive Director

Hart, Melissa

From: Perry, Walter N
Sent: Friday, June 21, 2002 4:03 PM
To: Hart, Melissa; Allen, David R
Subject: FW: Ohio EPA comments on Draft PEA for Uranium Materials

OEPA comments of drat EA.2wpd....

-----Original Message-----
From: Graham Mitchell [mailto:Graham.Mitchell@epa.state.oh.us]
Sent: Friday, June 21, 2002 2:47 PM
To: NEPA (Stakeholders comments mailbox)
Cc: tjustice@bright.net; Brian Blair; Chris Jones; Ken Dewey; Maria Galanti; szeigler@sso.org
Subject: Ohio EPA comments on Draft PEA for Uranium Materials

David R. Allen:
Attached are Ohio EPA comments on the Draft PEA for Uranium Materials. Please contact me if you have any questions.
Graham Mitchell
Ohio EPA
937-285-6018

June 24, 2002
807 E. Rollingwood Rd.
Aiken, SC 29801

Mr. David R. Allen
United States Department of Energy
Oak Ridge Operations Office
200 Administration Road
Oak Ridge, Tennessee 37830

Specific Comments on PEA for Potentially Reusable Uranium Materials (EA-1393)

This memorandum is a continuation of the letter I sent you on May 29, 2002 that contained my General Comments on the above PEA. This letter provides my Specific Comments on the PEA. I hope you will accept these comments even though the comment period closed several days ago.

Specific Comments

- P2-1, 1st Paragraph. Broaden this paragraph to cover UO_3 and state why UF_6 is not included. This sets the stage for the NEPA document.
- Table 2.1 on P 2-2 should be expanded to include other uranium materials stored for reuse or disposition.
- P 2-3 states most of the uranium is in the form of uranium metal. Where is this covered in the EA? How much of the 14,200 MTU is metal. EA should provide a table that provides the breakdown of the inventory into it associated form.
- In the fourth paragraph on P 2-3 the SRS inventory is described as contained in wooden boxes, cardboard boxes for metal and drums for LEU Oxide. I was never able to determine if the EA contained environmental consequences from repackaging of that inventory. Later the EA discusses storage of drums and steel boxes.
- Figure 2.1 shows example storage of metal boxes and drum storage. This figure is unclear in the printed version of the EA. It is basically a black photo with a large white box in the center. When I looked at the electronic version, it was legible. Should be legible in all forms of the EA. The title of the figure should specify the multi-stack storage being discussed when the figure was called out.
- The No Action alternative described in Section 2.2 on P 2-9 should provide clarify the small site storage. How many sites are assumed to store this uranium and for how long? The last sentence says the uranium would not be dispositioned. In my mind this means very long term consequences and none were discussed in the EA.
- As already pointed out the scope of the EA needs be expanded to discuss the other uranium being stored and discusses in fifth paragraph on P 2-9.

- The last paragraph on P 2-9 says the analysis associated with the action alternatives discusses the bounding assumption associated with disposition. There is very little additional information in the EA on the bounding assumptions.
- P 2-10 in Section 2.3.2 says that DOE has not selected a commercial site for uranium consolidation in this alternative but for analysis purposes, a western and an eastern site were selected for the transportation analysis. Does the selection of Utah and South Carolina maximize transportation consequences? The justification for this selection should be given a few more sentences of description to convince the reader that this assumption is reasonable.
- The alternative for interim partially consolidated storage by physical form described on P 2-11 in paragraph 2.3.6 calls for SRS to be the metal storage site. I could find no information to support metal storage at SRS. In my technical judgment, metal storage has much larger consequence that does storage of oxides. As I indicated in my earlier letter, metal has a unique hazard, not analyses in this EA, of metal fire potential which is exaggerated in long time storage.
- Paragraph 2.4 discusses DOE's belief that uranium storage is a government asset. Two sentences later it says DOE might declare other inventory a waste. This seems to be a two-forked statement. This paragraph should be rewritten to eliminate this apparently inconsistency. I would really like to know what it is saying. What makes some uranium a national asset and other uranium a waste product?
- Section 3 discusses the affected environment at Portsmouth, Paducah, Y-12, K-25 (both in Oak Ridge), and Savannah River Site. There is no mention of the other sites that currently store some of the uranium or those planned as alternatives for possible storing and managing uranium within this EA. These sites should be discussed in this section, but probably not in the detail of the five major sites.
- The Method's section (P 4-1 in Section 4.1) says that 14 people are required for managing the uranium inventory. This seems like a low staffing level to manage 243,000 square foot of storage space with ~71,900 containers in storage. I could find no further information on what these personnel were assumed to do. If this uranium is a true national asset, it probably has the lowest surveillance staff of any of our national treasurers. The uranium management staffing should be reexamined.
- In the fourth paragraph of Section 4.1, I find the statement "worst case assumptions ..... are employed". As I have said, I do not think this statement is correct. One such statement is that 14 people can manage this uranium. I will point out other assumptions I do not think appropriate as I proceed with these comments.
- The EA should analyze and present sabotage scenarios. These might range from theft of uranium (remember it is a national asset) for its value to those that would blow it up to disperse the radionuclides and cause bad publicity. Those 14 people would not be able to prevent either.
- The third paragraph on P 4-2 lists K_d units as L/kg. Please correct the units on this term.
- P 4-6 Table 4-3 lists PORT upgrade cost as $8.4M and the second paragraph says it is considered to be $10.9M. Please correct all tables listing the earlier value. The other values in the table for PORT should also be corrected.

- P 4-6. It is obvious that DOE from major sites other than PORTS and also at the minor site have not been consulted on this EA. I make this judgment based upon the many tables in this section have say space availability is unknown. This lack of communication with other DOE site personnel should be eliminated and the same level of knowledge applied for each site. The lead statement in the third paragraph on this page confirms the lack of communication.
- Table 4.5 (P 4-7), Table 4.7 and Appendix B need units added for the two columns giving transportation fatalities. Are these fatalities per year or per activity?
- Section 4.7 on P 4-17 is a very weak analysis for disposition. As I indicated earlier in this set of comments and in my General Comments, the section talks about bounding conditions and impacts then makes an arbitrary statement that all they did was double the impacts of storage. If these are bounding, please explain how you know since no analysis was performed.
- Third bullet on P 4-19 gives the $8.4M that was later changed to $10.5M. (See P4-6 comment.)
- Combine the fourth and fifth bullets on P 4-19. They seem to be saying the same thing.
- Expand the sixth bullet. It is not clear where the judgment came from. It says that commercial sites are less efficient than DOE sites. I continually hear from DOE that they want to do things using commercial approaches since it is more efficient than the DOE system. At best what does this add?
- Section A.2 describes overpacking all containers prior to shipping. Where are the environmental impacts of this action included in the EA. If they are not included, why not?
- The last sentence on P A-2 says worker dose commitment from surveillance and maintenance of this uranium is expected to be less than detectable. I doubt this is a correct statement. The top paragraph on P A-4 goes on to describe the expected radiation dose from containers. These doses were detectable. The last sentence of this top paragraph goes on to make an unsupported conclusion. It says "these dose rates are considered negligible to any receptor". What about doses to workers who purified this uranium and developed illnesses that DOE (or the government) is now paying for?
- Second paragraph in Section A.3.1 on P A-4 uses a slang approach (1E-6) with no description of what is meant by that notation. Use the proper scientific notation then describe what it means.
- As I read Section A.3.1.1 on P A-5 particularly the last couple of sentences, I do not know what conclusion you are trying to make.
- Section A.3.1.2 on PA-6 describes a single container breach as being a bounding accident. This same event could breach multiple containers on adjacent pallets. Why then is a single breach bounding?
- The next to last sentence in Section A.3.1.2 says that container breach is insignificant compares with a fire. Multiple drum ruptures are speculated above. The logic that shows fire is more significant than rupture should be clearly made or both analysis given.
- The basis for the frequencies given in Table A.7 should be given.

- How can the frequencies for tornadoes at all sites be the same as shown on Table A.7? I likewise have the same comment for earthquakes.
- P A-7. Describe your judgment of how long seismically damaged facilities will be left in the damaged condition while personnel repair other higher risk damaged facilities. This duration of exposure to the elements should be included in the analysis for these facilities.
- P A-7 second paragraph references reinforced concrete and structural steel debris as fire mitigation. All storage facilities will not be constructed of concrete thus the concrete and steel should not be relied upon as a fire mitigator. It is unclear from the text of that paragraph how much reliance is afforded by this building material.
- The second paragraph on page A-8 seems to use the MAR yet MAR is not given on Table A.8.
- The DR's in Table A.8 seem to be totally subjective. Support for the values used should be provided in this appendix.
- The ARF x RF values given in Table A.8 should be referenced.
- Add a section describing storage facilities (similar to that given in Section 2 of the EA) to this appendix on page A-9 to support the analysis given in Section A.3.3.2.
- U metal is pyrophoric and when ignited, I would expect that all of the metal would be at risk. U fires are not easily extinguished.
- The source terms discussed in the second paragraph are very subjective. Add information so your reader will understand why the values were picked. References, showing why values were picked, are always beneficial.
- The frequency of facility fires is stated to be unlikely. Be more quantitative. Is this one chance in 10 years or a frequency of 0.1/year. My judgment says it is a frequency of 10^{-4} to 10^{-6} is unlikely. DOE experience of fires is probably in the range of 10^{-2} to 10^{-3} and with the number of facilities described in this EA fires can be expected to occur during the time interval for this uranium storage.
- In section A.3.3.3 include the long-term consequences as well as short term consequences. Material lost from containment during a seismic event will probably remain in an exposed condition (to the environment) for weeks and some of it will be transported to surface streams before the low priority uranium cleanup can be accomplished.
- Identify the basis for the 10% and 15% of drums forcasted to be dislodged from the storage array in the first bullet on P A-9.
- The third bullet identifies 25% of the material spilled. What is the basis for value? If spilled what is assumed on cleanup and when.
- Again metal fires should be considered in a seismic event consequences.
- The second line on P A-10 uses the term conditional probability to reduce the risk from seismic event by a factor of 10. What is the basis for this factor of ten reduction. The arbietariness of all of these values leaves the EA reader questioning the analysis. Try to support conclusions and not make them so arbitrary.
- Near the middle of P A-10, duration of 1 hour is assumed for airborne release. The longer-term aspects of resuspension of released material should be included for the time the material has not been cleaned up.

- The third bullet, on P A-13, assumes the facility workers will be exposed for 10 seconds. This seems very short for workers who are trying to mitigate consequences or to a worker who is hurt from a seismic event and cannot escape.
- The conclusions given in Tables A.11 and A.12 that facility workers will receive negligible dose and maximum consequence seems inconsistent with co-located workers and the public receiving doses. Calculated values should be given in the Appendix so reviewers can make their own judgment as to its significance.
- Appendix C is very difficult to understand. It is full of technical terms and it is not written so it can be understood by a technically trained stakeholder and I do not think it is of any value to a decision maker or to the general public.
- On P C-2, in Section C.2.1.1, need to say why Stability Category F was assumed.
- In section C.2.2.2, why was the assumption made that uranium was deposited in a pond with an average depth of 2 meters. It would seem to me to be worse to deposit it in surface creeks that allow easy access to animals and other ecological system varmints.
- Section C.3, on P C-9, makes the judgment that residential exposure is considered implausible under current site conditions. It is unclear that this is a reasonable judgment. Obviously if one can limit exposure, the consequence of this EA are negligible. This condition should be proven by reasonable analysis not assumed away.
- The table set up of the summary tables (Table C.20 and C.21 is poor. I presume that the last three columns are Radiation Exposure. Likewise three columns are Chemical Exposure. Fix the tables so this differentiation is clear. Add units to the table.
- My conclusion is that calculated data should be given in tables in the appendix so the reader can see the results of calculations. Information in the Appendix should not be decided to be low or negligible. That conversion is not appropriate here nor in Section 4 until the analysis is being summarizing. (This EA did not summarize the analysis in Section 4 nor did it have a Summary.

If you would like to discuss any of these comments, please call me on (803) 642-7297

Sincerely

W. Lee Poe, Jr.

Comments on Draft of PEA for CMP for Re-Usable Uranium

Listed below are several comments on the draft document entitled "Programmatic Environmental Assessment for the U. S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposal of Potentially Re-Usable Uranium Materials", DOE/EA-1393, May, 16, 2002.

1. **Page 2-1**, Section 2.1, 2nd Paragraph, 9th Line; The stated typical percentage of ^{235}U in depleted uranium (DU) does not agree with the value shown in Table B.1 on page B-3. Page 2-1 says DU typically contains 0.25% ^{235}U while Table B.1 says 0.10%.

2. **Page 4-6**, Section 4.4.1, 3rd Paragraph; Paragraph states "DOE has not identified existing buildings at (sites other than PORTS) to accommodate these additional uranium materials at this time. Therefore, for analytical purposes, it is assumed new storage space would have to be constructed." This begs the question of has DOE even made any attempt to identify such existing facilities at sites other than PORTS. Without any such attempt, it would appear any estimates, such as those shown in Table 4.3, would be wholly inaccurate and deliberately skewed in favor of PORTS. This hardly appears to be an unbiased assessment of the adequacy and availability of sites about the DOE complex.

3. **Page 4-20**, Section 4.12, 3rd Paragraph, 1st Sentence; As written, the statement leaves the impression that uranium shipments will increase traffic accidents and fatalities because the cargo is uranium, rather than clearly stating any increase in such events would simply be the result of additional vehicles on the nation's roads, regardless of cargo.

4. **Page 4-20**, Section 4.12, 3rd Paragraph, 3rd Sentence; I don't believe this can be substantiated with the data presented. To state there would be an increase in LCFs to workers and the public from this transportation program, one must calculate both the potential LCFs resulting from the program and the LCFs potentially suffered by workers in the vicinity of the materials in a no-action alternative. I didn't see any such estimate for the no-action alternative in Section 4.3 nor any table presenting estimated LCFs from incident-free operations such as presented in Table 4.1 for accidents. Therefore there is no comparison of the no-action alternative to the other scenarios to determine if there was a net increase or decrease in LCFs.

5. **Page A-12**, Table A.10; The values, in meters, for the distance to site boundaries for several sites such as INEEL and SRS seem inappropriately low. Are values of 526 meters and 727 meters correct for INEEL and SRS, respectively? While not familiar with the assumed locations for the materials at these sites, I can say several sites, such as INEEL and SRS are very large, with site centers greater than 10 miles from their boundaries.

6. **Page B-2**, Section B.3, 8th Dot; I believe the estimated duration of 10 days grossly underestimates the likely transit time for 14,400 km. This would equate to an average vessel speed of 33 knots. I don't believe you'll find many freighters with such speed. The ones currently in use for transporting foreign research reactor spent nuclear fuel back to the U.S. typically are capable of only about 11-12 knots. Only about 1/3 of the apparent speed of the uranium carriers. If one were to state the distances may range from X to 14,400 km with an average of about 5,000 km, an average transit time of 10 days would seem much more reasonable.

7. **Page B-3**, Table B.1; See 1st comment concerning page 2-1.

8. **Page B-3**, Section B.3, 5th Dot; There is no basis provided for the assumption that 1% of accidents would result in release of radioactive materials. Most other stated assumptions appear to have a stated basis.

9. **Page B-3**, Section B.3, Last 4 Dots; These are redundant, considering content of the last two dots on page B-2. They should be consolidated.

10. **Page B-4**, Table B.2; The Eastern Centralized Commercial Storage Site (Barnwell) is located on the SRS Site boundary. Why then, would their values for "Truck Only – Dose Risk" be so different; 0.0036 (SRS) verses 0.00206 (Barnwell)? The values for all other categories for SRS verses Barnwell are almost identical, as they should be.

11. **Page B-7**, Section B.5, 2 Dots and last Paragraph; The last paragraph states the total number of shipments could not be estimated because the amount of material in each shipment may not be known. Without an assumption of the quantity of material in each shipment, how were estimates made of the average doses to the crewmembers? If the estimate is made based on the assumed dose rates on the drums as explained in Section 4.2 on page 4-3, I believe 159 mrem per crewmember per shipment, as stated here and at the bottom of page 4-18, is a gross overestimate. The potentials for such exposures would mandate implementation of a radiation protection program that, in turn, would find such exposures to not be ALARA.)

12. **Page C-12**, Table C.4; When using the values for Intakes in Table C.5, I can reproduce the various values for Dose in Table C.5 and Cancer Intakes in Table C.4, but I can't arrive at the same values shown for Cancer Risks in Table C.4. I am assuming the Cancer Risk values are a product of the CEDE derived from the Cancer Intakes and the appropriate risk values from ICRP-60 (i.e., 1 LCF per 2,000 Person-Rem for the "Resident" and 2,500 Person-Rem for the "Standard Worker". If this is the correct method, it appears the Cancer Risk values are too high by a factor of between 2 and 30. It appears as if the dose-to-risk conversion values vary greatly and range between 70 rem and 1150 rem instead of the expected values of 2,500 rem and 2,000 rem for workers and the public, respectively.

13. **Page C-15**, Table C.7, Upper Table; The issue described above for page C.12 also applies here. Put another way, the Risk/pCi appears to be based on something other than the expected 2,000 or 2,500 (as appropriate) rem/LCF. For example, in the specific case of Inhalation (Risk/pCi) for Uranium-235+D, the stated value appears to be based on a risk-to-dose factor of 756 rem/LCF.

14. **Page C-15**, Table C.7; It appears some of the footnotes are not shown beneath the table.

R. L. Huskin, CHP
Radiation Protection &
Emergency Management Division
Savannah River Operations Office

1-803-952-2575
richard.huskin@srs.gov

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

June 17, 2002

David R. Allen
US Department of Energy
Oak Ridge Operations Office
200 Administration Road
Oak Ridge, Tennessee 37830

Dear Mr. Allen

National Environmental Policy Programmatic Environmental Assessment (PEA) for the U.S Department of Energy, Oak Ridge Operations' Implementation of a Comprehensive Management Program for the storage, transportation, and disposition of potentially re-usable Uranium materials (DOE/EA-1393)

The Tennessee Department of Environment and Conservation, DOE Oversight Division has reviewed the subject document in accordance with the requirements of the National Environmental Policy Act and associated regulations of 40 CFR 1500-1508 and 10 CFR as implemented.

General Comments:

The state of Tennessee concurs with the PEA document supporting the selection of Portsmouth Gaseous Diffusion Plant as the preferred option for the reasons as stated in the following sections located on Page 4-6, Paragraphs 1 and 2. "*PORTS is the only DOE site with sufficient existing storage space to accommodate the entire uranium material inventory. PORTS has several large buildings with sufficient capacity to store these materials. These buildings were evaluated for uranium storage suitability (DOE 1999). and over 450,000 ft^2 of space is still available in them...Even with some new construction, the PORTS site would still be the least expensive site for this alternative" (centralized storage at a single DOE site).*

Acknowledging that uranium wastes are not part of the scope of this PEA, the document should identify and address any waste streams associated with the re-usable uranium materials. The PEA should provide maps of probable transportation routes.

The management plan defined by this PEA is considered a long-term plan describing several possible disposition scenarios; however, the actual disposition of the surplus material is undefined at this time. The state of Tennessee reiterates its position on not being willing to accept any materials designated for re-use/recycle without definite disposition pathways which may accumulate to long term storage or any waste that may require long term storage prior to treatment/disposition.

Specific Comments:

Section 2.1 Page 2-1, the typical end-use products are stated as metal or UO_2. On page 2-3, Fernald's largest inventories that fall within the scope of this PEA are stated to be in the form of metal and UF_4. The UF_4 should be added to the statement on page 2-1 that defines the scope.

If you have any questions concerning these comments, please contact me at 865-481-0995.

Sincerely

John Owsley
Director

xc: Dodd Galbreath-TDEC/EPO
Eddie Nanny-TDEC/DRH

Jao667.99

PIKE COUNTY
CHAMBER OF COMMERCE
P.O. BOX 107 • 12455 STATE ROUTE 104
WAVERLY, OHIO 45690
740-947-7715 • FAX 740-947-7716

June 11, 2002

Mr. David Allen
US Department of Energy
SE-30-1
P.O. Box 2001
Oak Ridge, TN 37831

Dear Mr. Allen,

I am submitting written comments to the Department of Energy on the proposed use of the Portsmouth Gaseous Diffusion Plant at Piketon as a storage facility for uranium that may or may not have a marketable value.

There are two issues here. First, any movement of uranium from other sites to Piketon holds the obvious potential that the material will remain at Piketon. We in Pike County have become increasingly concerned, as production has ceased at Piketon, that the government will not expend the necessary funds to clean the site. An even more fundamental concern is, if money were available whether or not the Department of Energy has the technological expertise to dispose of the nuclear waste produced in the last half century. Moving more material into Pike County would increase the possibility that the Piketon plant's ultimate fate would be a dump site.

That leads into the second issue. The people of Pike County will not willingly agree to receive any material at Piketon without an iron-clad agreement with DOE that the uranium will either be marketed or removed in a timely manner.

That brings an even more fundamental question? What is an iron-clad guarantee? Over the past five years, Pike Countians have experienced the following:

1. Privatization. The Gaseous Diffusion plant at Piketon could handle all phases of enrichment; a sister plant in Kentucky could not. Piketon ceases operation.

2. After discarding lazer isotope technology, the Department of Energy seems committed to a centrifuge process. The Piketon facility may get the new centrifuge process. In 1985, Piketon was ready to go online with centrifuge when the government pulled the plug.

3. Congressman Strickland, Congressman Portman and Governor Taft have expended endless time and influence on the Piketon plant. Congress passed a law providing for the construction of two DUF6 conversion facilities, and appropriated monies for a conversion plant at Piketon and Paducah. There have been rumors of one plant, no plant, not much talk of two plants. One thing is certain; No construction contracts have been let for Piketon.

4. The Department of Energy assigns a site management team to Piketon. The team has repeatedly shown its dedication to the site and the community. It is the local site team the catches most of the flak from frustrated Pike Countians. The actual decision makers are burrowed deep in murky bureaucracies in Oak Ridge and Washington that makes it impossible for the average citizen in Pike County to reach them.

5. For the past four years, the Southern Ohio Diversification Initiative has been negotiating with DOE to obtain land not being utilized by DOE or USEC. In particular, a 340 - acre parcel was proposed as the site of a $1 billion coal-fired electric generating plant. The land was not transferred to SODI in a timely manner, and the project, with a loss of jobs and tax money to Pike County, is now dead. In fact the only land returned to SODI from the 3900- acre government reservation is a two-acre site for a cemetery in Scioto Township.

It is very difficult for the people of Pike County to accept mere reassurances from the Department of Energy about the ultimate fate of the material currently being proposed to be brought to Piketon. The simplest way to handle the situation to the satisfaction of every Pike Countian is to choose one of the other sites in consideration. Perhaps DOE's credibility is better in those locations.

Sincerely,

Blaine Beekman
Executive Director

cc: P.O. Box 700
Piketon, OH

APPENDIX D.2 COMMENTS AND RESPONSES

DRAFT URANIUM MANAGEMENT PROGAMMATIC ENVIRONMENTAL ASSESSMENT

APPENDIX D.2. COMMENTS AND RESPONSES

Response to Comments on the Programmatic Environmental Assessment for the U.S. Department of Energy, Oak Ridge Operations Implementation of a Comprehensive Management Program for the Storage, Transportation, and Disposition of Potentially Re-usable Uranium Materials (DOE/EA-1393)

Gregory L. Simonton
Executive Director
Southern Ohio Diversification Initiative

1. Please identify any other potentially reusable uranium material/uranium feed currently located at PORTS.

Response: Materials deposited throughout the cold standby and shutdown cells are a source of future potentially reusable uranium.

2. What buildings would be used at PORTS for this project?

Response: Due to security concerns, specific building locations cannot be identified in the PEA. However, should an alternative involving the PORTS site be selected, the UMG Program commits not to exceed the storage capacity of the existing UMG storage facility. This commitment to limit material within the confines of the existing UMG facility will further ensure that the disposition of material remains a priority. As uranium in the inventory is dispositioned, additional uranium materials in the UMG inventory at other DOE sites could then be stored at PORTS on an interim basis.

3. What building(s) are included in the 450,000 square feet of available building space cited in the Draft Environmental Assessment (DOE/EA 1393)?

Response: See response to comment #2.

4. What other facilities would be required to support the DOE preferred option to consolidate all of the material at PORTS?

Response: The PEA identifies the need for approximately 168,000 ft^2 of additional storage space. Assuming additional space is required, then with the exception of temporary use of roads and the equipment needed to offload and store the uranium materials, no other facility use is anticipated. However, in consideration of comments received, the UMG Program does not plan to use additional buildings at PORTS. DOE anticipates storage at PORTS will be limited to the current UMG storage facility.

5. Why is the material considered "valuable" and "reusable"?

Response: These materials have a market value and have potential reuse in various government and commercial applications. There is an expressed interest by third parties to acquire some of these materials in the near future. It is anticipated that other potential users of these materials will be found. Reusing this material helps protect the environment since recycling avoids having to bury the material in the earth. Its potential use in down-blending with highly enriched uranium promotes nonproliferation goals.

6. If more potentially reusable material is shipped to PORTS, please identify the impacts/restrictions on other buildings and facilities at the site (in the context of production reuse).
Response: Should an alternative involving the PORTS site be selected, the UMG Program commits not to exceed the storage capacity of the existing UMG facility. As uranium in the inventory is dispositioned, additional uranium materials in the UMG inventory at other DOE sites could then be stored at PORTS on an interim basis. Thus, there should be no impacts or restrictions on the other buildings and facilities.

7. Please identify the method of shipment, mode of transportation, and route(s).
Response: Routing was calculated using the Transportation Routing Analysis Information System (TRAGIS) with two modes being considered—all shipment by truck and shipment by rail where appropriate with all other shipment by truck (termed the "truck/rail option"). See Appendix B for more details regarding routing assumptions and calculations.

8. What guarantees will the local community receive regarding the ultimate disposition date?
Response: DOE will attempt to disposition the uranium materials as quickly as reasonably possible and is committed to making periodic reassessments of materials in storage.

9. Please provide the proposed schedule of re-classification to ensure the material is reusable, marketable, and not deemed a waste.
Response: The UMG Program is proposing a review and documentation of material assessment not to exceed 5 years.

10. What happens to the material if it is subsequently determined to be a waste?
Response: If material is declared waste, additional funding will be requested from appropriate DOE Programs to dispose as waste.

11. Please identify the markets for this material.
Response: The potential markets are discussed in Section 2.3.8. They include commercial processing and domestic sales to commercial nuclear vendors for the manufacture of nuclear fuel for commercial nuclear power plants, maintenance of a strategic reserve, down-blending of HEU in conjunction with arms reductions treaties (with the resulting LEU available for use in commercial nuclear power plants), use by research facilities, other government agencies and foreign sales.

12. When did the DOE preferred option first receive consideration?
Response: During the internal DOE scoping process for this proposed action several alternatives were formulated including an alternative for Interim Consolidated storage at a Single DOE Site. Recent successful DOE experience at PORTS in storing the Fernald and Hanford uranium materials suggested that PORTS would be the preferred site under this alternative.

13. How would the importation of the material affect current clean up project? Future D&D activities?
Response: No impact to cleanup or D&D activities is anticipated.

14. How many permanent jobs are associated with this project? Newly created full-time permanent positions with the DOE preferred option?

Response: The number of permanent workers (and initial construction workers) is shown for each site under each alternative in Chapter 4. See specifically Tables 4.3, 4.6, 4.9, 4.13, 4.16 and 4.19. For the Interim Storage at a Single DOE Site, the analysis performed in the PEA assumes an additional 168,000 ft2 of space would need to be upgraded. As shown in Table 4.3, this results in 9 new permanent workers at PORTS (and 210 temporary construction workers). This assumes upgrades of buildings to increase effective storage space. However, as noted in response to comment #4, the UMG Program has decided to limit storage to the existing UMG storage facility. Therefore, permanent workers shown in the table would be significantly less.

15. Please identify the community benefits associated with the importation of this material to PORTS.

Response: This proposed action would continue to use the uranium-experienced and trained work force at PORTS. PORTS, with the uranium conversion plant and UMG activities, would be considered a multipurpose site versus a closure or D&D site.

16. Will the full proceeds, including applicable taxes, of the sale of this material be returned to the community?

Response: Proceeds will be used to cover costs incurred by the sale of the material, salaries, handling, and shipping at the PORTS site. Surplus would be returned to the U.S. Treasury as required by law.

17. Will the DOE utilize the designated CRO for disposal/sale of this material?

Response: Current plans are for the UMG to sale/disposition this material.

18. Define temporary storage.

Response: As stated in Section 2.3, DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially re-usable LEU, NU and DU. Six interim storage alternatives are considered. Each of these alternatives also has associated with them the disposition of these uranium materials. Thus, the action will cover a greater than 20-year period. Further, this PEA does not provide for permanent storage at Portsmouth.

19. Assuming there is a market for this material, is there a prohibition or moratorium that would prevent or affect its sale?

Response: Under the disposition options discussed in Section 2.3.8, commercial process/domestic sales, transfer to research facilities and transfer to other government agencies can proceed in compliance with existing laws and regulations governing such sales or transfers. Before these materials can be sold, a Secretarial Determination is required to evaluate the potential for adverse impact on the market.

20. Does USEC have any need for any of this material?

Response: No. USEC uses UF_6 for their Paducah enrichment operations, which is not in the scope of the PEA.

21. Has the DOE considered transferring ownership of any of the material to USEC?
Response: USEC cannot use this material in its current form. USEC uses UF_6, which is not in the scope of this PEA.

22. Will additional security be needed at PORTS if any of the material is imported?
Response: DOE will review the security needs at PORTS should a decision be made to move these materials there. DOE is committed to ensuring appropriate security forces are maintained.

23. Has DOE consulted with and sought the input of the Ohio Congressional Delegation regarding the importation of nuclear material to PORTS? If so, what was the outcome?
Response: DOE has hosted several public meetings with attendance from members of the Ohio delegation. The delegation accepted the program and holds DOE accountable for maintaining interim storage in DOT-certified containers; not storing waste; and not receiving funding as part of the Portsmouth cleanup plan. DOE is obligated to honor the commitments for the UMG Program in the same manner as has been maintained for the Hanford, Fernald, and university materials received to date.

24. Of the 158 sites currently storing the material, is there any more "reusable" or "potentially marketable" material being generated? If yes, will it automatically be transferred to the storage site chosen during this action?
Response: The 14,200 MTU of uranium inventory is all this is addressed in this PEA. No other materials are being considered for consolidation.

25. Has any of this material ever been classified as a waste?
Response: No. All material is carefully screened prior to acceptance.

26. Please identify all of the sites currently storing this material and provide a brief description of the material at those sites.
Response: Table 2.1 provides the uranium management inventory (amount in MTU) at the various sites. Table A.3 gives some indication of types of uranium at some of the larger DOE sites. However, for security reasons the exact amount by type is not shown for all sites.

27. Please explain the relationship (on page 3-2/Environmental Justice Section) between race, income and the decisions to store this material at any location.
Response: DOE is required to determine if low-income or minority populations would be adversely and disproportionately affected by the proposed action. If this is the case then DOE must take this into consideration when making a final decision. There were no adverse environmental effects which would disproportionately affect low-income or minority populations for any of the alternatives considered.

28. Please provide brief details on the nature of retrofitting/upgrade required at PORTS for the DOE preferred alternative.
Response: The Uranium PEA analysis assumes 168,000 ft^2 of building upgrades. This would result in the receiving capability for loading/unloading needing to be improved. However, DOE is

committed to using only the UMG storage facility. Some additional modification to the current storage facility may be required as well as continued upgrades for the UMG facility.

29. Who will be used to complete retrofitting required at PORTS?

Response: Prior to the start of retrofitting existing facilities, a labor determination will be made to identify the work force that will be required to perform the work. This determination will take into consideration the type and extent of work to be performed.

30. Who regulates the safe storage of the material at PORTS?

Response: The program to ensure the safe storage of the uranium material at PORTS is administered by U.S.DOE.

31. On behalf of the southern Ohio region, and before any decision on this matter is made, we respectfully request a meeting with the Secretary of Energy or his designee with authority to make decisions regarding this issue.

Response: Comment noted.

32. We believe this proposed action is contrary to our efforts, the stated DOE mission to reindustrialize, and the tireless efforts of our elected representatives in Columbus and Washington for productive, job intensive reuse of the PORTS facility in Piketon. Therefore, the SODI Board of Directors opposes the subject material being stored at the Piketon site. The residents of Southern Ohio desire projects that have recognizable value and benefit for the community. We want input into our future, the goals for the site, and new missions.

Response: Comment noted.

Graham E. Mitchell
Chief
Office of Federal Facilities Oversight
State of Ohio Environmental Protection Agency

33. During the meeting on June 4, it was noted that funding just became available to help with proper disposition of the uranium material currently stored at the Portsmouth facility and that additional funding would be needed to continue to find a new use for this material. Please state how US DOE intends to continue funding this program so that material will not be stored in perpetuity but rather shipped to other entities for re-use. US DOE must make funding this program a priority within each budget in order to continue disposition of the uranium material. Without proper funding, the necessary research to determine potential uses for this material cannot be accomplished. The cost for management and research for re-use of this material should not come from the budget for the clean up and remediation of the Portsmouth facility.

Response: Funding for specific activities associated with disposition of material will continue to be requested as part of the annual budget process. Requests for this funding continue to be separate from funding requests for cleanup and remediation of the Portsmouth facility.

34. Portions of the revenues generated from the Uranium Management Group should be maintained in Portsmouth to off set the cost of storing the material as well as cleanup activities.

Response: Comment noted. See response to comment #16.

35. Ohio EPA understands US DOE's goal to consolidate uranium materials to reduce costs and promote more efficient management of these materials. However, to really develop credibility, US DOE is going to have to prove that this material does have economic value and other companies or government agencies are interested in it. Uranium materials need to be leaving the site rather than just arriving for storage. US DOE should establish goals and commitments to stakeholders to remove a certain percentage of material per year. These commitments could be in the form of a letter of intent or other type of agreement with the State of Ohio.

Response: Comment noted. The UMG is developing a disposition strategy to remove the material from the site as quickly and reasonably as possible. DOE will provide a letter of intent to the State of Ohio regarding this strategy. The disposition strategy will include DOE's commitment to make periodic, not to exceed five years, assessments and documentation of the material in storage in order to ensure that the material continues to have reuse potential.

36. The draft EA noted that US DOE considers 20 years or greater to be interim storage. At what point within the 20 years will US DOE determine that this material is no longer of value and deem that it should no longer be stored but treated as a waste? What plan(s) does US DOE have to evaluate this material over the next 20 years to determine if it is of value? Because of past problems with storage of materials that later became waste, US DOE must make a commitment in the EA to establish a process where the inventory is reevaluated on a regular basis (3-5 years) to ensure that it still has economic value. Please refer to the comment above in regard to establishing an agreement with the State of Ohio to continually evaluate the material and remove a percentage of this material from the site each year. US DOE cannot continually accept material at the Portsmouth facility without establishing that the material is of economic value.

Response: The UMG is developing a disposition strategy to move the material off the site as quickly and reasonably as possible. A process to re-evaluate the material in order to make sure it is not waste will be incorporated into the disposition strategy, as noted in response 35 above.

37. US DOE mentions that disposition is a major function of this uranium management effort. US DOE must also include disposition as waste as an additional component of this effort. Over time, as US DOE reevaluates this material, some of it may no longer have economic value and US DOE should be able to disposition it as waste under this EA. US DOE must ensure that funding is available to remove the material that is no longer of economic value as a waste.

Response: Comment noted. Text has been added to Sections 1.2, 2.3, and 4.10 to address potential waste streams. The UMG has received funding to evaluate disposition activities. If the material in storage is declared waste in the future, additional funding will be requested from the appropriate DOE program.

38. The material currently at Portsmouth was moved there in order for US DOE to meet its regulatory requirements at several other sites. US DOE-Portsmouth has a regulatory requirement to address contamination at the site per the requirements of the Ohio Consent Decree. Currently, the material stored on site is in a building, which sits upon and is adjacent to a groundwater plume, which is to be addressed during the next fiscal year. The storage of the uranium material may interfere with the overall site clean up. Please state how US DOE will ensure that storage of the additional material will not interfere with the requirements of the Ohio Consent Decree to clean-up the site. US DOE

should conduct environmental characterization of buildings to be upgraded to meet the potential storage needs for incoming material. This effort could avoid future disruption of uranium management efforts.

Response: As noted in responses to comments #2 and #6, the UMG Program is committing not to exceed the storage capacity of the existing UMG facility. Thus, no conflicts with the Ohio Consent Decree are anticipated. No activities that conflict with planned or ongoing remediation are anticipated.

39. Please state how storage of this material will not interfere with the other potential missions at the US DOE-Portsmouth site? For example, if Portsmouth were to become a D&D site, would it still be a good location for this facility? How does the storage of this material fit in with the current mission of Portsmouth to clean-up the current contamination at the site and potential re-use of the site for future industrial purposes?

Response: PORTS is an active DOE site with a uranium mission. It is not anticipated that interim warehousing of these uranium materials would adversely affect DOE's ability to conduct its other mission requirements at the site nor would this action interfere with ongoing cleanup efforts.

40. US DOE should evaluate the long-term storage of the uranium material at a facility such as the Nevada Test Site. The material could be easily obtained if it is determined to be of economic value and should US DOE determine that it is a waste the material may not have to be moved again for final disposition. Storing the uranium material in this manner may save the US DOE valuable economic resources.

Response: The Nevada Test Site (NTS) handles some forms of nuclear waste for the Department. The uranium materials evaluated in this PEA are not wastes and would not be appropriate to be stored at the NTS.

41. Please state if the material will be tested for evaluation of RCRA characteristics including TCLP prior to shipping and storing the material to ensure that it meets regulatory requirements? Prior to shipping US DOE should make this evaluation to avoid potential regulatory issues at the site. As you are aware this site is not permitted to accept any hazardous waste from other facilities, to do so would be a violation of the permit.

Response: Uranium materials are evaluated prior to acceptance by the UMG for shipment. UMG does not accept any materials that are determined to be waste. Therefore, the RCRA/TCLP testing would be unnecessary. In addition, these materials are "source materials" as defined by the Atomic Energy Act of 1954, and are exempt from the requirements by RCRA.

42. If additional buildings/space will be needed for this effort, US DOE should coordinate with SODI in an effort to make the best future use of buildings.

Response: Should an alternative be selected involving the PORTS site, the UMG Program commits to using the existing UMG storage facility.

43. US DOE should evaluate who the likely users of the material may be prior to shipment to Portsmouth. US DOE should avoid shipment of material over long distances for storage only to have the material re-locate to a user near its origin (e.g. shipping the material from the Hanford Facility to Portsmouth then back to a western user). Conducting this type of evaluation up front will save US DOE economic resources as well as avoid potential risks associated with transportation of this material over long distances.

Response: Comment noted.

Larry Scaggs
Seal Township
Pike County Ohio Trustees

44. I am writing on behalf of the Seal Township, Pike County, Ohio, Trustees to oppose the DOE bringing in wastes from other sites to store at Piketon. The Piketon Gaseous Diffusion Plant is partially located in Seal Township. I am also a Board Member of the Southern Ohio Diversification Initiative.

Response: The UMG has no intent to accept waste materials.

45. DOE has called this waste a valuable material, but cannot explain how or why it is valuable. Furthermore, by bringing this waste to Piketon, 157 other sites will be cleaned up. We want to know why 157 other communities are more important than Piketon.

Response: See response to comment #5. Since the uranium materials at all 158 sites listed in Table 2.1 are product and not a waste, the other 157 sites are not being "cleaned up." DOE is attempting to consolidate the materials to increase efficiency and reduce costs.

46. I do support projects that accelerate the cleanup of the Piketon site and provide a safe environment for our residents. The DOE should build and operate the DUF_6 plant and accelerate cleanup of the lands and buildings, such as the 340 acres SODI tried to get for economic development. These project benefit the community be creating jobs and cleaning up our environment. Storing waste here for 20 years does not.

Response: Comment noted.

Teddy L. West
Scioto Township Trustee

47. I am a Scioto Township Trustee elected by the residents surrounding the Piketon gaseous diffusion plant, a member of the Southern Ohio Diversification Initiative Board of Directors, and owner of property adjoining the Piketon gaseous diffusion plant. I am opposed to the storage of uranium waste that is described as "reusable material" in the draft programmatic environmental assessment DOE/EA-1393. As a neighbor of the plant and representative of the people surrounding the plant, I do not want our community to become DOE's dumping ground. How can you tell our community that the waste is valuable material, yet you can tell the other communities that the material is a waste and they are now cleaned up? As a SODI Board member and Scioto Township Trustee, I support projects that will benefit our community by providing jobs and a safe environment for our people. We want DOE to accelerate cleanup, building the DUF_6 plant, transfer land to SODI, and bring new enrichment technology to Piketon.

Response: Comment noted. The uranium materials evaluated in this EA are potentially re-usable and, thus, valuable materials. They are not wastes.

Gilbert D. Drexel
Manager of Projects
Portsmouth Site Office

48. Sec. 1.1 ("Purpose and Need for Agency Action", pg. 1-1). We suggest that the paragraph be revised by adding a new sentence (shown in italics), so that the paragraph reads as follows:

"The U.S. Department of Energy (DOE) proposes to implement a comprehensive management program to safely, efficiently, and effectively manage its potentially reusable low enriched uranium (LEU), normal uranium (NU) and depleted uranium (DU). *Uranium materials which are presently located at multiple sites are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition.* Management would include the storage, transport, and ultimate disposition of these materials."

Response: Text added as recommended.

49. Sec. 2.2 ("No Action Alternative", pg. 2-9). In the last sentence in the paragraph, suggest changing "disposed" to "dispositioned".

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

50. Sec. 2.3 ("Proposed Action", pg. 2-9). In the first paragraph, we suggest that the 1st sentence be revised to create two sentences, to read, "DOE proposes to implement a long-term (greater than 20 years) management plan for its inventory of potentially reusable LEU, NU, and DU. Uranium materials which are presently located at multiple sites are to be consolidated by transporting the materials to one or several storage locations, to facilitate ultimate disposition.

Response: Text changed as suggested.

51. Sec. 2.3 ("Proposed Action", pg. 2-9). In the third paragraph, suggest revising the first sentence to read, "DOE must determine the safest, most effective, and most efficient approach for the consolidation and storage of this material."

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

52. Sec. 4.11, "Summary and Conclusions", pg. 4-19. The 1st paragraph currently reads as follows:

"Normal operations result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Environmental impacts associated with normal operations vary substantially from alternative to alternative and, occasionally, by site within a given alternative. General handling accidents result in no more than negligible acute or chronic consequences and risk at any site under any storage alternative or disposition option. Chronic human health and ecological consequences and risk are negligible to low for all sites under all alternatives. The highest transportation consequences are for alternatives that involve moving uranium materials to a western location, either to a commercial site or to INEEL."

We suggest that this summary paragraph be reworded to more broadly discuss the PEA's conclusions. The conclusion/summary as we see the overall PEA analysis is that there were none-to-minor impacts for all of the alternatives from the standpoint of environmental impact; negligible-to-low impacts from the standpoint of facility accidents (fire and seismic) for all the alternatives; while transportation effects for the alternatives generally reflected the extent of material transport associated with the alternative being analyzed. The overall conclusion is that potential impacts appear not be significant for any of the material consolidation alternatives which were analyzed.

Response: Text in the Summary and Conclusions in the PEA has been modified. Should DOE determine that a Finding of No Significant Impact (FONSI) is warranted, the FONSI will be where "significance" of impacts will be discussed.

53. Sec. 4.11, "Summary and Conclusions", pg. 4-19. We also suggest that discussion be added to the paragraph to summarize the reasons for proposing the PORTS option, given that at least one other option (i.e., the partial consolidated storage at several DOE sites) is forecast to have a less expensive construction cost. The reasons for proposing the PORTS option, are that a single consolidated storage location affords greater flexibility and ease of future disposition of the material, and reduces the overall expected future cost for facility surveillance & maintenance (S&M) and material accountability/material S&M, than if the material was at several locations. These benefits outweigh the potentially greater up-front renovation/construction costs.

Response: Comment noted. The focus of the PEA is to address the potential environmental impacts associated with each of the alternatives considered. The PORTS site due to the existence of sufficient storage space to accommodate the entire uranium inventory under consideration has the least environmental impacts of a single consolidated storage site. DOE can consider factors in addition to environmental impacts when making an agency decision. In addition to those noted in the comment, PORTS has a work force trained in handling uranium materials and a very recent, successful experience in storing uranium materials from the Fernald and Hanford sites.

54. Sec. 4.11, "Summary and Conclusions", pg. 4-19. Consideration should be given to adding an overall summary table (example attached).

Response: Comment noted.

55. Sec. 4.11, "Summary and Conclusions", pg. 4-19. The statement that "environmental impacts ...vary substantially from alternative to alternative" appears inconsistent with the analysis, which indicated that for all the alternatives, the environmental impacts were negligible, minimal, or at most minor. "Vary substantially" seems to imply that there are significant impacts, when the analysis says there were none or minimal.

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

56. Sec. 4.11, "Summary and Conclusions", pg. 4-19. The statement that "General handling accidents result in no more than negligible acute or chronic consequences... appears correct, based on the analysis. However, "general handling" is part of "normal operations" – which from the 1st sentence have no impacts. It is unclear as to why the extra emphasis is being given to the impacts from "Normal operations".

Response: The PEA addresses both accident conditions and normal operations (meaning those situations and activities in which accidents are not occurring). Normal operations, including general handling accidents, have no more than negligible acute or chronic consequences.

57. Sec. 4.11, "Summary and Conclusions", pg. 4-19. The paragraph omits discussion of the negligible-to-low risk associated with facility accidents (fire and seismic).

Response: Text added to Section 4.11.1.

58. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. The 3rd paragraph currently reads as follows:

"In addition to surface contamination, radiation dose from the stored uranium materials can be expected. Dose rates from any single stored container are no more than 3 to 4 mrem/h. The dose rate at a distance of 0.3 m (ft.) from a container is about 1 mrem/h, and the dose rate at a distance of 6 m (20 ft.) is < 0.5 mrem/hr (approximately the same as normal background radiation doses). These dose rates are not affected by stacking the containers, because the containers and the materials themselves provide substantial shielding. These dose rates are considered negligible to any receptor (facility worker, co-located worker, or public)."

Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. Suggest specifying whether the "3 to 4 mrem/h" dose rate is "on contact". Also, we suggest to citing the basis for indicating the dose is 3 – 4 mrem/h maximum.

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

59. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. Based on calculations, a dose at 6 m (20 ft.) would be < 0.05 mrem/hr. Suggest using "<0.05 mrem/hr" – rather than "<0.5 mrem/hr."

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

60. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. It is unclear as to what the information in the parenthesis – "(approximately the same as normal background radiation doses)" refers to. If what is being referred to is 0.5 mrem/hr, this would not seem to be "approximately background", as 0.5 mrem/hr at 2000 hrs/year would result in 1 rem/yr., which exceeds background. On the other hand, if what is being referred to is 0.05 mrem/yr, then this does more closely approximate background.

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

61. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. The phrase "dose rates not affected by stacking the containers" is somewhat unclear. "Stacking" typically refers to one container on top of another. We would think that dose rate would be affected if there were multiple containers stacked on top of each other, or containers side by side. The next statement regarding containers providing shielding seems to be referring to the containers behind one another – not container "stacking". Suggest clarifying whether we're referring to "stacking" containers on top of one another, or those behind each other. Overall, while there may be mitigation of dose from shielding, it would also seem that there could be dose contribution from adjacent or stacked containers.

Response: This comment presumably refers to the text in the Preliminary Draft PEA (internal DOE review copy). This change has already been made in the Draft PEA.

The assumption is that the shielding (side-by-side locating of containers) cancels out the two-deep stacking of containers. However, for the purposes of calculating doses to the public, the more conservative assumption of no shielding is used.

62. Sec. 4.2, "Consequences Common to All Alternatives", pg. 4-3. The conclusion that "these dose rates are considered negligible to any receptor" may be correct, but it is not clear from this paragraph how this is so, given the above comments.

Response: Corrections and clarifications made in the Draft PEA hopefully make this clear.

63. Sec. 4, "Consequences" – General. Consideration should be given in Sec. 4 ("Consequences") to adding specific Appendix references so that the reader can easily trace the amounts given in Sec. 4 back to where the amounts were calculated and appear in the appendices. As an example, for the "transportation effects" amount shown in table 4.17, add a reference or footnote to indicate where these amounts are shown in Appendix B ("Transportation Analysis").

Response: Chapter 4 addresses the environmental consequences of the various alternatives. Detailed information supporting the chapter 4 discussion is contained in various appendices, to which the reader is directed for more detailed information.

64. In Sec. 4 ("Environmental Consequences"), in the "Impacts" tables – tables 4.3, 4.6, 4.9, 4.13, 4.16, and 4.19 – the cost of upgrades appears in each table. This is referred to in each table as "construction/upgrades cost". From the methodology (Sec. 4.1, "Methods", 2nd paragraph, pg. 4-1), it appears that the intent of these cost figures is that they include not only the cost of construction/upgrades but also the cost of surveillance & maintenance (S&M). However, it is not clear that S&M costs – either facility S&M or material S&M (which would also include maintaining nuclear material control & accountability) – are fully included by this approach.

Response: The cost numbers in the tables cited are for construction costs only. They represent a one-time impact occurring over a short period of time (assumed to be one year). As such these costs help demonstrate the socioeconomic differences among the various alternatives. They are used to estimate job creation and to quantify the effects of the action on the economic region of concern. S&M costs are not included; however, the number of permanent workers is estimated.

65. Sec. 4, "Consequences" – General. It may be more appropriate to base facility and material S&M costs on the total square footage of storage space for the material – not just on the upgraded space. The conclusion that would likely emerge is that there would be a significant cost component associated with S&M, at each facility where material would be stored. Eliminating this duplicative S&M cost at multiple storage facilities would appear to be a strong supporting rationale for the proposed approach – consolidating material at a single DOE site. Consideration should be given to discussing these S&M costs and/or including S&M costs in the affect "impact" tables.

Response: See response to previous comment.

Harry Rider
Vice Chairman
Pike County Board of Commissioners
Waverly, Ohio

66. This proposed action raises numerous concerns. Specifically, safe transportation concerns, and security of all material at the Piketon Plant is in question. Health of workers, residents and environmental safety issues are also of major concern.

Response: Comment noted. Transportation, facility accidents, and normal operations have been evaluated for all alternatives with risks to workers and the public identified.

67. The perception of Pike County, our home, being a national dump site for the governments excess waste is appalling, to say the least.

Response: Comment noted. The uranium materials evaluated in this PEA are not wastes but potentially reusable materials.

68. This project has *no* financial, environmental, education or social benefits to Pike County and its people. For these reasons, I am very much opposed to bringing any material to Piketon for storage.

Response: Comment noted. To date approximately $5.7 million dollars have been spent at Portsmouth for previous uranium management activities. It also provided five direct jobs and numerous indirect jobs for the area.

Tom Reiser
Vern Riffe, III
Opal M. Spears
Scioto County Commissioners

69. Whereas, the Scioto County Board of Commissioners believe the storage of this excess uranium and the marketing of these materials over a 20+ year time frame will have a negative effect on our current and future marketing of the PGDP and GCEP sites for re-use and on the marketing of industrial sites for new business development in south central Ohio.

Response: Comment noted.

70. Whereas, the Scioto County Board of Commissioners also have a matter of concern over the downgrading of security forces at the PGDP in recent years.

Response: Comment noted.

Lee A. Barclay, Ph.D.
Field Supervisor
U.S. Fish and Wildlife Service
U.S. Department of the Interior

71. The draft PEA does not include copies of correspondence requesting informal Section 7 consultation with U.S. Fish and Wildlife Service (Service) Ecological Services Field Offices in Ohio, South

Carolina, or Idaho. Service personnel have reviewed the information submitted and offer the following comments relative to the PGDP in McCracken County, Kentucky and the Oak Ridge Reservation (ORR) in Roane and Anderson Counties, Tennessee, for consideration.

Response: DOE sent letters requesting informal consultation to subject USFWS offices on May 20, 2002. Copies of these letters and letters of response have been added to Chapter 7.

72. The description of Federally endangered and threatened species present in the vicinity of PGDP (Section 3.2.5) generally reflects information provided by this office to DOE on February 23, 2001. The evening bat (*Nycticeius humeralis*) does not currently have Federal protection pursuant to the Endangered Species Act.

Response: Text in 3.2.5 was modified.

73. According to our records, the following federally listed endangered species are known from or have the potential to occur within the project impact areas on the ORR:

gray bat	*Myotis grisescens*
Indiana bat	*Myotis sodalis*
pink mucket	*Lampsilis abrupta*

We recommend that qualified biologists assess potential impacts and determine if the proposed ORR alternative may affect the species. We recommend that you submit a copy of your assessment and finding to this office for review and concurrence. A finding of "may affect" could require the initiation of formal consultation procedures.

Response: Text in Sections 3.3.5 and 3.4.5 has been modified to reflect information provided. Since the potential acreage to be impacted would be in the middle of already industrial sites, it is reasonable to assume the potential for impacts to the species noted above is virtually non-existent. A Biological Assessment was prepared and sent to your office under separate cover; it is also included as part of the agency correspondence in Chapter 7 of this PEA.

74. Since the Portsmouth Gaseous Diffusion Plant has been tentatively selected as the preferred alternative storage location, we recommend that the ecological resources section of this draft PEA referenced above be modified to accurately reflect the current extent of knowledge regarding biological/ecological resources of the Y-12 and ETTP areas, including East Fork Poplar Creek, Poplar Creek, and the Clinch River.

Response: See response to comment #73.

75. Since the American robin (*Turdus migratorius*) was modeled in the risk assessment in Appendix C of this draft PEA and given the responsibilities placed on Federal agencies by Executive Order 13186, we believe it would also be prudent to include discussions regarding migratory birds.

Response: The interior forest habitat required by many species of migratory birds has been evaluated for the Oak Ridge Reservation with particular emphasis on the lands surrounding the ETTP site (SAIC 2002, *Draft Land Use Technical Report*, June). The proposed action would not affect interior forest habitat and the bird species that utilize them at any of the DOE sites. Some migratory birds, such as the American Robin, use more open, often man-altered habitats. It is possible that new construction in the middle of these industrialized sites could affect the foraging and nesting areas for some migratory bird species.

James A. Brushart
Chairman
Pike County Board of Commissioners
Waverly, Ohio

76. In Pike County, we are trying to pick up the pieces and make economic development attractive. If we are made a dumping ground for the governments waste to be stored, this will severely hamper any possibilities of economic development in the future. Pike County would be recognized as a national dumping site for waste, thus creating a more negative image of Southern Ohio.

Response: Comment noted. The uranium materials covered by the proposed action are potentially re-usable and would be stored temporarily until they could be dispositioned. These materials are not wastes.

77. In closing, I ask you on behalf of thousands of Pike County Constituents, to please take your waste elsewhere. I challenge the Department of Energy to do something good for Pike County and its people. We certainly deserve much better treatment than what we have received in the past.

Response: Comment noted.

H. E. King
8339 SR 139
Minford, Ohio 45253

78. Please please don't let Washington and Cincinnati dump excess uranium at the Portsmouth Diffusion Plant in Pike County. Southern Ohio has a rate of more cancer here than any place of the U.S. We have fought for years to have it cleaned up. EPA says its safe one month and unsafe the next month. It is densely populated in this area. There are many other places to take it like Idaho Falls and Hanford, Washington and others more safe. We do not want it here and pray you don't dump it on us.

Response: Comment noted.

Cindy Newsom
2315 Grandview Avenue
Portsmouth, Ohio 45662

79. I am writing in response to the June 7, 2002, article in the Portsmouth Daily Times. I would like to strongly suggest that you find somewhere else to store your material (other than at the Portsmouth Gaseous Diffusion Plant). I support Rep. Ted Strickland when he said, "You can't trust them (DOE) on anything they've said to us. They've lied to us before." I do not think that using PGD Plant is in the best interest of our area – we have enough problems without needing dumped on with nuclear waste. I don't believe the DOE will "re-use" or re-sale the material. A dump site is a dump site.

Response: Comment noted.

D. E. Culver
878 Shawnee Road
W. Portsmouth, Ohio 45665

80. No! No! No! No more excess uranium or any uranium at Portsmouth Gaseous Diffusion Plant. We've had this killer here since the 50's. No More. The fish in Scioto River are covered with sores, the bottom feeders are already dead. The wells are contaminated. The trees are dying. People are dying – go to hospital in Columbus nurses ask "Where are you from?" Your reply "Portsmouth". Their response "Oh the Cancer Capital of the state."

Response: Comment noted. The risks to the workers and general population from transportation and interim storage of these materials at each site, including PORTS, were determined in the PEA. The risks were negligible to low.

81. You clean this killer up at Fernald and Hanford and ship it someplace else to contaminate another place. How stupid can you get? For years you've talked "Jobs" well you know what you can do with your "Jobs".

Response: Comment noted.

Norman A. Mulvenon
Chair
LOC Citizen's Advisory Panel

82. The CAP reviewers find the document poorly written and the alternatives presented in an unclear and confusing manner, such that the average reader cannot make an intelligent evaluation. It appears that no quality assurance was performed on this document prior to release for public comment. At the very minimum, the subcontractor, Science Applications International Corporation, should have read their own material for content and used the appropriate annotated outline to guarantee that all text material was included and properly organized to allow proper evaluation. At the maximum, all involved parties as listed on page 6-1 should have properly reviewed and vetted this document. The CAP's primary recommendation is that DOE retract the document and have it internally reviewed, rewritten, corrected, amended, and then re-issued for public comment.

Response: Comment noted.

83. The PEA lacks an Executive Summary.

Response: A Summary and Conclusions section (4.11) summarizes many aspects of the PEA results. An Executive Summary is not required for a PEA.

84. The preferred alternative – Portsmouth – is not stated until pages 2-10. Even then, it is unclear whether this is the preferred alternative of all alternatives or only of the DOE sites under consideration. The PEA should present the compelling rational for the preference. The reasons listed are not "unique" as most are applicable to the Y-12 National Security Complex also.

Response: Section 2.3.1 is the appropriate section in which to address PORTS as the preferred interim storage location. DOE's preferred alternative is to locate these materials at PORTS; thus, it is preferred among all the alternatives not just among the DOE sites. The combination of the characteristics listed in Section 2.3.1 makes PORTS preferred. The word "unique" has been deleted from the text in Section 2.3.1.

85. The various alternatives are not numbered or consistently named in such a way as to easily identify them for comparison. The various alternatives also appear in random order throughout the document causing additional confusion for the reader. An example of this is the final interim storage alternative listed in Table 2.2 "interim partially consolidated storage based on physical form" which is apparently the same as "Interim Partially Consolidated Storage at Several DOE Sites" in Section 4.11.1, Comparison of Alternatives.

Response: The order in which the alternatives are evaluated in Chapter 4 parallels the order in which they are introduced in Chapter 2. The reference to "One DOE site" in the alternative title has been changed to "a Single DOE site" to be consistent. The discussion in Section 4.11, "Summary and Conclusions," addresses the alternative with the greatest potential for environmental impacts (Interim Storage at a Single Commercial Site) first and the alternative with the least environmental impact (No Action) last.

86. There are errors or unexplained inconsistencies between the final interim storage alternative listed in Table 2.2 "interim partially consolidated storage based on physical form: and the unnumbered, unnamed table in Section 4.9 that shows the storage plan for materials based on physical form.

Response: Table 2.2 has been corrected. The referenced material in Section 4.9 is intended as text not a table.

87. NU in the acronym list is defined as normal uranium. The definition used in Appendix A, page A-iv is natural uranium. The terms "natural uranium" and "normal uranium" are interchangeably and randomly used throughout the EA text and appendices. This is confusing to the reader and technically inaccurate, as "natural uranium" is the proper term.

Response: The definitions will be changed to reflect the following: Natural uranium, as found in nature, is unaltered isotopically with an isotopic content of 0.711% ^{235}U. Normal uranium contains the same percent of ^{235}U as occurs in nature, but the 0.711% ^{235}U signature may have been attained by blending uranium of different isotopic compositions or by processing in a gaseous diffusion cascade.

88. The missions of the various sites for storage were not properly considered.

- Portsmouth is no longer used as a gaseous diffusion facility and its future role may be limited to being one of the two sites for a conversion plant for depleted uranium hexafluoride (Paducah being the other site).

- The three sites at Oak Ridge are lumped together in Table 2.1 and Oak Ridge is the only designator listed in later tables. In reality, the three major DOE sites in Oak Ridge have separate missions and two of the sites are not suitable for the proposed storage mission. ETTP is a closure site, and DOE has stated an intention to transfer the site to other ownership by 2008. ETTP should not even be on the list of alternatives, in that there is no future DOE mission contemplated once the site is cleaned up and closed. ORNL is listed in Table 2.1, but then is not included in any of the analyses. As a national laboratory, it is a poor candidate for a storage site.

Response: Section 2.1, "Background," discusses the historical missions of the various DOE sites. It was noted (p. 2-2) that ETTP is undergoing reindustrialization, D&D, and environmental restoration. ETTP is a DOE site; DOE has not transferred the land. Thus, DOE believes that, under the NEPA, the ETTP would be a reasonable site. The intent of Table 2.1 is to show where the UMG uranium inventory is located; 1,445 MTU are located at the three DOE sites in Oak Ridge. Later in

the EA, DOE explains that both ETTP and Y-12 (but not ORNL) are considered as potential interim storage sites.

89. Information is scattered and difficult to find in the PEA. For example, on page 2-3 it is stated that the uranium trioxide at SRS is not considered within the scope of this PEA. We don't learn why (that these oxides are not part of the UMG inventory) until page 4-21.

Response: Text on page 2-3 clarified.

90. The option of transportation by barge is not evaluated.

Response: Comment noted. This option was not evaluated because it is unlikely that the material would be transferred by this mode of transportation.

91. The PEA doesn't seem to focus on the most logical analysis of alternatives for interim storage. This would be the consolidation of uranium at sites with compatible enrichment forms or with potential future uses. Some examples:

    1. Portsmouth and Paducah will both have facilities for conversion of depleted uranium hexafluoride to oxide or metallic forms. Either of these locations would be a logical choice for the national stockpile of DU.
    2. Paducah has a continuing mission of gaseous diffusion enrichment of uranium for commercial nuclear fuel. It would be a logical location for the storage of LEU.
    3. Y-12 has exceptional capabilities for handling and storing HEU, and could act as a repository for any of the forms, particularly those that are more reactive such as metallic uranium. Because proposals for future disposition of HEU include down-blending to a lower enrichment, Y-12 might be a logical place to store compatible forms that could be used for this purpose at a later date.

Response: Comment noted. Each of these facilities was evaluated in the PEA.

92. The transportation analysis relies too heavily on computer modeling without actual analysis of the existing roads. Portsmouth is not accessible by interstate and for this reason would be a poor choice for storage of all forms/enrichments, making it a hub for a major shipping campaign involving sensitive cargos. It is more logical to minimize transportation on secondary roads and express a preference for sites close to interstate highways or other major bulk transportation options (rail or barge). In particular, if multiple shipments of a particular form or enrichment to a variety of end users are likely, the preferred storage location should weigh access to good transportation routes more heavily.

Response: Comment noted. The transportation analysis focused on the potential environmental impacts associated with shipment of the uranium materials.

93. With so much uncertainty about end states, one wonders why DOE has undertaken an assessment at this time. It also makes little sense that DOE's huge stock of depleted uranium hexafluoride in cylinders – soon to be converted to a more stable chemical form – is outside the scope of the PEA.

Response: Comment noted. An EIS is being prepared for this DUF_6. The UMG inventory of uranium does not include UF_6. Other forms of uranium that are included in the PEA have been addressed.

LOC/CAP Member

94. I also find the document exasperating, in that information is either not there or hard to find. I haven't found the form the uranium is at the various sites. With so much uncertainty about end states, one wonders why DOE is bothering with an assessment at this time. Particularly when the gorilla of depleted uranium hexafluoride in cylinders appears to be outside the scope.

Response: Information on the form of uranium at various sites is in Table 2.2, page 2-5, under the "Interim partially consolidated storage based on physical form" alternative.

The uncertainties associated with final disposition do not preclude the need for DOE to find a more efficient management plan for its UMG inventory in the interim.

Larry R. Hurley
(email)—no address or affiliation provided

95. Feedback: I'd like to see this material stored at the Yucca Mountain site (along with all the rest of the nation's nuclear materials).

Response: Comment noted.

Lee Poe
(email)-- no address or affiliation provided

96. I am reading the PEA on uranium and I find that it doesn't include most of the uranium at SRS. Please provide me with the rational on why the uranium selected was selected and why other uranium at DOE sites was not included? On the surface it sounds like the PEA should consider all of DOE's U. (Please note that this comment has been modified because of security concerns.)

Response: The material selected for consideration is viewed to be high quality, stable material with a substantial volume for potential reuse.

97. Why was UF_6 not covered in the EA?

Response: It is outside the scope of the Department's analysis for this PEA. UF_6 is being addressed in an EIS.

98. Was scoping performed on this NEPA document? If so, please send me the scoping document summary.

Response: Scoping is not required for a PEA.

Kathleen E. Trever
Coordinator-Manager
INEEL Oversight

99. In stating a need for this EA, DOE emphasizes increasing budget pressures, good stewardship of resources, and ensuring maximum cost-effectiveness. DOE does not, however, provide a clear

explanation of how its alternatives for moving materials around before deciding on their disposition addresses these goals. This explanation is essential to supporting a sound policy decision.

Response: The consolidation of the potentially reusable DOE uranium material provides an opportunity to retain a valuable asset while supporting the critical mission of DOE nuclear facility closures. For example, in the case of the Fernald site, a sizable quantity of potentially reusable uranium had to be dispositioned in order to support the site clean-up schedule. Fernald's review of the options for disposition of this material concluded that ~ $23M was saved in the shipment of the material to PORTS versus the site removal and burial option. In addition, Fernald estimated that if the PORTS option had not been available, the costs due to schedule delays may have exceeded $75M. Each of the UMG activities to date, and future UMG activities to relocate potentially reusable uranium, have/will utilize a deliberate decision-making process.

100. Although DOE may be able to "bound" impacts based on hypothetical disposition paths, the geographical locations for disposition of the various physical forms could form a discriminator among alternatives that require transport, facility upgrade or construction. If, for example, there may be future activities using materials at their current or nearby location, it probably does not make sense to "consolidate" them elsewhere.

Response: DOE makes decisions based on the best information available at the time of an action. If changes occur in the future, previous decisions will be re-evaluated to determine if adjustments need to be made. The PEA is an input to these future decisions.

101. To support a sound decision, DOE should also provide information as to whether other activities at the storage facilities in question would still require similar monitoring or upkeep regardless of whether the reusable uranium materials remain. To enable fair evaluation of the alternative for consolidation by physical form versus solely geographical approaches, DOE should also provide information as to how physical form can relate to ultimate disposition, as well as identifying any differences in interim storage needs.

Response: DOE estimated the manpower required to monitor the storage sites. Under the No Action alternative, the current level of monitoring would presumably continue at the various sites. At PORTS the existing buildings proposed for storage, under several alternatives, would have some level of monitoring if none of these alternatives is selected and the buildings continue in their present state. The level of monitoring for present uses was not estimated but is assumed to be similar to the proposed action.

Regarding consolidation by physical form, DOE has received inquiries and expressions of interest in some of the uranium materials in the UMG inventory; however, there is not sufficient certainty in the final disposition paths to allow a detailed analysis.

102. The document's simplified assumptions prevent much quantitative analysis, but do allow some qualitative comparisons.

Response: Transportation risks, various accident scenarios, and socioeconomic impacts (including construction costs, permanent and temporary jobs, and acres potentially affected by new construction) have been quantified using a variety of assumptions documented in the PEA.

103. The fundamental, outstanding question left by the EA, however, is to what extent the alternatives can achieve DOE's stated purpose of achieving management efficiencies.

Response: The PEA addresses a portion of that question, namely what would be the expected environmental impacts of implementing the various alternatives. Estimates of construction costs are part of this analysis. DOE will also consider other costs, such as surveillance and maintenance, transportation, and facility upgrades, as well as other factors in reaching a decision on interim storage.

Richard Demming

104. All references to aircraft impact as shown on page 4-1, last paragraph, last sentence. This suggestion is made after the 9/11 attack. Replace references with external events.

Response: Reference to aircraft impact has been removed.

Steven T. Carter
Executive Director
Scioto County Economic Development Office

105. The Scioto County Economic Development Office and the Scioto County Commissioners, along with U.S. Congressman Ted Strickland, are opposed to the siting of the 14,200 metric tons of re-usable excess uranium from other DOE sites that are proposed to be stored at DOE's Portsmouth Gaseous Diffusion Plant. Even though we are a rural/small city community, our region is densely populated. We believe there are other DOE sites that are much larger than our 3,700 acre site where these materials can be stored and marketed over time. We also believe the storage of these materials over a 20+ year time frame will have a negative effect on our current marketing efforts of the site for re-use and on the marketing of industrial sites for new business development in South Central Ohio.

Response: Comment noted. More important than the size of the plant are the amount and availability of storage space and a trained/qualified workforce. PORTS has sufficient existing storage space to accommodate the entire 14,200 MTU inventory. PORTS is already storing approximately 4,500 MTU. However, as noted in the response to comment #4, the UMG Program commits to limiting use to the existing UMG storage facility.

106. Another major concern has been the downgrading of security forces in both manpower and armaments of PGD's security forces over the last several years.

Response: Comment noted.

W. Lee Poe, Jr. (Additional Comments—received after close of comment period)

107. P2-1, 1st Paragraph. Broaden this paragraph to cover UO_3 and state why UF_6 is not included. This sets the stage for the NEPA document.

Response: The information in this paragraph is general background and is not intended as a detailed list of what is included in the PEA. UF_6 is not part of the UMG inventory because the UMG is seeking uranium materials with minimal nuclear safety requirements. A PEIS was prepared for DUF_6, and a separate EIS is being prepared to further address DUF_6. UO_3 is included in the PEA.

108. Table 2.1 on P 2-2 should be expanded to include other uranium materials stored for reuse or disposition.

Response: Text acknowledges that other uranium materials are at several DOE sites, which are not part of the UMG inventory and are not part of the proposed action. They are addressed as appropriate under the cumulative impacts analysis but are not included as part of the tables referenced.

109. P 2-3 states most of the uranium is in the form of uranium metal. Where is this covered in the EA? How much of the 14,200 MTU is metal. EA should provide a table that provides the breakdown of the inventory into it associated form.

Response: Table 2.1 provides the uranium management inventory (amount in MTU) at the various sites. Table A.3 gives some indication of types of uranium at the larger DOE sites. However, for security reasons, the exact amount by type is not shown for all sites.

110. In the fourth paragraph on P 2-3 the SRS inventory is described as contained in wooden boxes, cardboard boxes for metal and drums for LEU Oxide. I was never able to determine if the EA contained environmental consequences from repackaging of that inventory. Later the EA discusses storage of drums and steel boxes.

Response: The impacts associated with repackaging are covered in Section 4.2 of the PEA.

111. Figure 2.1 shows example storage of metal boxes and drum storage. This figure is unclear in the printed version of the EA. It is basically a black photo with a large white box in the center. When I looked at the electronic version, it was legible. Should be legible in all forms of the EA. The title of the figure should specify the multi-stack storage being discussed when the figure was called out.

Response: Commented noted. The intent of the figure is to show the relative sizes of drums and boxes, which contain uranium materials.

112. The No Action alternative described in Section 2.2 on P 2-9 should provide clarify the small site storage. How many sites are assumed to store this uranium and for how long? The last sentence says the uranium would not be dispositioned. In my mind this means very long term consequences and none were discussed in the EA.

Response: The first sentence in Section 2.2 states that ongoing storage would continue at all existing facilities. The impacts of the No Action Alternative are discussed in Section 4.3.

113. As already pointed out the scope of the EA needs be expanded to discuss the other uranium being stored and discusses in fifth paragraph on P 2-9.

Response: Comment noted.

114. The last paragraph on P 2-9 says the analysis associated with the action alternatives discusses the bounding assumption associated with disposition. There is very little additional information in the EA on the bounding assumptions.

Response: The bounding assumptions are discussed in Section 4.10. Additional text has been added on waste streams.

115. P 2-10 in Section 2.3.2 says that DOE has not selected a commercial site for uranium consolidation in this alternative but for analysis purposes, a western and an eastern site were selected for the transportation analysis. Does the selection of Utah and South Carolina maximize transportation consequences? The justification for this selection should be given a few more sentences of description to convince the reader that this assumption is reasonable.

Response: The selection of these two sites for transportation analysis does not result in the absolute maximum distance. The sites are realistic possibilities and serve as a "reasonable worst case." More text was added to Section 2.3.2.

116. The alternative for interim partially consolidated storage by physical form described on P 2-11 in paragraph 2.3.6 calls for SRS to be the metal storage site. I could find no information to support metal storage at SRS. In my technical judgment, metal storage has much larger consequence that does storage of oxides. As I indicated in my earlier letter, metal has a unique hazard, not analyzed in this EA, of metal fire potential which is exaggerated in long-term storage.

Response: Comment noted. We found that oxides have a potential greater than metal for environmental impact in the case of an accidental release (from a fire, etc.). Powdered oxides are readily transported to the atmosphere and, subsequently, to a number of potential receptors in a fire scenario.

117. Paragraph 2.4 discusses DOE's belief that uranium storage is a government asset. Two sentences later it says DOE might declare other inventory a waste. This seems to be a two-forked statement. This paragraph should be rewritten to eliminate this apparently inconsistency. I would really like to know what it is saying. What makes some uranium a national asset and other uranium a waste product?

Response: Section 2.4 states that the uranium materials in the UMG inventory and, thus, part of this PEA are potentially re-usable. Therefore, the alternative of addressing them as waste is not considered further. This statement recognizes the fact that DOE has other uranium materials, which have been legally declared as wastes.

118. Section 3 discusses the affected environment at Portsmouth, Paducah, Y-12, K-25 (both in Oak Ridge), and Savannah River Site. There is no mention of the other sites that currently store some of the uranium or those planned as alternatives for possible storing and managing uranium within this EA. These sites should be discussed in this section, but probably not in the detail of the five major sites.

Response: The affected environment of sites DOE is considering for interim storage is discussed in Chapter 3.

119. The Method's section (P 4-1 in Section 4.1) says that 14 people are required for managing the uranium inventory. This seems like a low staffing level to manage 243,000 square foot of storage space with ~71,900 containers in storage. I could find no further information on what these personnel were assumed to do. If this uranium is a true national asset, it probably has the lowest surveillance staff of any of our national treasurers. The uranium management staffing should be reexamined.

Response: The UMG staff would be primarily responsible for surveillance and maintenance, inventory tracking and related activities, and to some extent security. The UMG storage facility has been configured to require minimum staffing levels, and the storage of material has been established to ensure cost-effective service.

120. In the fourth paragraph of Section 4.1, I find the statement "worst case assumptions ... are employed". As I have said, I do not think this statement is correct. One such statement is that 14 people can manage this uranium. I will point out other assumptions I do not think appropriate as I proceed with these comments.

Response: Comment noted. See response to comment #120.

121. The EA should analyze and present sabotage scenarios. These might range from theft of uranium (remember it is a national asset) for its value to those that would blow it up to disperse the radionuclides and cause bad publicity. Those 14 people would not be able to prevent either.

Response: Text has been added to Section 4.2.

122. The third paragraph on P 4-2 lists K_d units as L/kg. Please correct the units on this term.

Response: The units have been re-evaluated and have been determined to be correct.

123. P 4-6 Table 4-3 lists PORT upgrade cost as $8.4M and the second paragraph says it is considered to be $10.9M. Please correct all tables listing the earlier value. The other values in the table for PORT should also be corrected.

Response: On page 4-6, paragraph 2, the $10.9M refers to the PORTS construction costs if 125,000 ft^2 of space is built new instead of using all existing space and upgrading it. While existing storage space is available, it seemed prudent to indicate what impacts could be expected if, for some reason, not all of this space could be used. Also, see responses to comments #2 and #6.

124. P 4-6. It is obvious that DOE from major sites other than PORTS and also at the minor site have not been consulted on this EA. I make this judgment based upon the many tables in this section have say space availability is unknown. This lack of communication with other DOE site personnel should be eliminated and the same level of knowledge applied for each site. The lead statement in the third paragraph on this page confirms the lack of communication.

Response: All DOE sites considered for interim storage were consulted and specifically asked to provide information about existing space, which could be used for uranium storage.

125. Table 4.5 (P 4-7), Table 4.7 and Appendix B need units added for the two columns giving transportation fatalities. Are these fatalities per year or per activity?

Response: The columns for latent cancer fatalities and traffic fatalities are totals for all transportation required for a specific destination/alternative. Column headings have been revised to say "Excess latent cancer fatalities (total)" and "Traffic fatalities (total)."

126. Section 4.7 on P 4-17 is a very weak analysis for disposition. As I indicated earlier in this set of comments and in my General Comments, the section talks about bounding conditions and impacts then makes an arbitrary statement that all they did was double the impacts of storage. If these are bounding, please explain how you know since no analysis was performed.

Response: In Section 4.10, DOE states that a rough bounding of impacts would be to take the alternative with the greatest environmental impacts and double them; however, several factors would lessen this effect. These are then discussed in detail in the subsections that follow.

127. Third bullet on P 4-19 gives the $8.4M that was later changed to $10.5M. (See P4-6 comment.)
Response: See response to comment #124.

128. Combine the fourth and fifth bullets on P 4-19. They seem to be saying the same thing.
Response: Comment noted.

129. Expand the sixth bullet. It is not clear where the judgment came from. It says that commercial sites are less efficient than DOE sites. I continually hear from DOE that they want to do things using commercial approaches since it is more efficient than the DOE system. At best what does this add?
Response: It is assumed that a commercial site would have to build the entire 243,000 ft^2 of storage space to accommodate this material. Thus, impacts from construction would be the greatest at commercial (and the PDGP) sites.

130. Section A.2 describes overpacking all containers prior to shipping. Where are the environmental impacts of this action included in the EA. If they are not included, why not?
Response: See Section 4.2.

131. The last sentence on P A-2 says worker dose commitment from surveillance and maintenance of this uranium is expected to be less than detectable. I doubt this is a correct statement. The top paragraph on P A-4 goes on to describe the expected radiation dose from containers. These doses were detectable. The last sentence of this top paragraph goes on to make an unsupported conclusion. It says "these dose rates are considered negligible to any receptor". What about doses to workers who purified this uranium and developed illnesses that DOE (or the government) is now paying for?
Response: The intermittent nature of surveillance and maintenance activities, combined with a dose rate at 6 meters, which approximates background, would result in dose rates that are considered negligible.

132. Second paragraph in Section A.3.1 on P A-4 uses a slang approach (1E-6) with no description of what is meant by that notation. Use the proper scientific notation then describe what it means.
Response: Comment noted.

133. As I read Section A.3.1.1 on P A-5, particularly the last couple of sentences, I do not know what conclusion you are trying to make.
Response: Comment noted.

134. Section A.3.1.2 on PA-6 describes a single container breach as being a bounding accident. This same event could breach multiple containers on adjacent pallets. Why then is a single breach bounding?
Response: Section A.3.1.2 states that single-container handling accidents are bounding for the accident category "container breach" because these events dominate risk to workers. A container breach is not bounding for all types of accidents.

135. The next to last sentence in Section A.3.1.2 says that container breach is insignificant compared with a fire. Multiple drum ruptures are speculated above. The logic that shows fire is more significant than rupture should be clearly made or both analysis given.

Response: Some fires can result in multiple containers breached whereas a forklift rupture or dropping of a drum would more likely result in a single container rupture. Also, fire provides a mechanism for airborne transport once containers are breached. Thus, a multiple container breach with fire to mobilize the uranium materials is a more serious accident than a single or multiple container breach without an associated fire.

136. The basis for the frequencies given in Table A.7 should be given.

Response: This is discussed in Section A.3.1.3.

137. How can the frequencies for tornadoes at all sites be the same as shown on Table A.7? I likewise have the same comment for earthquakes.

Response: The frequencies in Table A.7 are <u>not</u> the frequencies of earthquake or tornado occurrences at the DOE sites. These vary from site to site. Frequencies shown in Table A.7 indicate the threshold earthquake or tornado loading for which damage is expected from the event. The frequencies are the same because, for example, a higher-intensity earthquake at Paducah occurs at the same frequency as a lesser-intensity earthquake at Oak Ridge.

138. P A-7. Describe your judgment of how long seismically damaged facilities will be left in the damaged condition while personnel repair other higher risk damaged facilities. This duration of exposure to the elements should be included in the analysis for these facilities.

Response: Because the vast majority of the materials released would occur during and/or immediately after the seismic event, the assumptions used in the analysis will bound the risks. No estimate of how long damaged facilities would remain damaged is included in the analysis. It should be noted that depletion of the initial source term occurs over time, so the assumption of all material released during the initial phase of the event is conservative.

139. P A-7 second paragraph references reinforced concrete and structural steel debris as fire mitigation. All storage facilities will not be constructed of concrete thus the concrete and steel should not be relied upon as a fire mitigator. It is unclear from the text of that paragraph how much reliance is afforded by this building material.

Response: As noted in Section A.3.1.3, following a direct seismic event, a number of small fires may occur. No building structure is assumed to remain, and fire suppression systems are assumed to be totally destroyed. The buildings are assumed to be constructed of steel and concrete, and these materials, unlike wooden structures for example, would not readily support combustion. In addition, the debris and rubble act as shields to prevent the subsequent small fires from spreading and involving the entire stored material inventory.

140. The second paragraph on page A-8 seems to use the MAR yet MAR is not given on Table A.8.

Response: Your observation is correct. In order to reduce the complexity of the tables, the MAR and release factor values were not repeated in Table A.9.

141. The DRs in Table A.8 seem to be totally subjective. Support for the values used should be provided in this appendix.

Response: References for release factors are given in Section A.3.2.

142. The ARF × RIF values given in Table A.8 should be referenced.

Response: References for release factors are given in Section A.3.2.

143. Add a section describing storage facilities (similar to that given in Section 2 of the EA) to this appendix on page A-9 to support the analysis given in Section A.3.3.2.

Response: Comment noted. The addition of this information will not affect the intent of the document.

144. U metal is pyrophoric and when ignited, I would expect that all of the metal would be at risk. U fires are not easily extinguished.

Response: Comment noted. The degree to which uranium material ignites depends on several factors, including the physical form. For example, uranium metal shavings are easily ignitable, whereas uranium metal in large ingots is not. This factor is included in the assignment of DR, ARF, and RF values for fires involving metals.

145. The source terms discussed in the second paragraph are very subjective. Add information so your reader will understand why the values were picked. References, showing why values were picked, are always beneficial.

Response: References for many factors have been provided. See responses to comments #142 and #143, for example.

146. The frequency of facility fires is stated to be unlikely. Be more quantitative. Is this one chance in 10 years or a frequency of 0.1/year. My judgment says it is a frequency of 10^{-4} to 10^{-6} is unlikely. DOE experience of fires is probably in the range of 10^{-2} to 10^{-3} and with the number of facilities described in this EA fires can be expected to occur during the time interval for this uranium storage.

Response: DOE guidance for accident analysis states that qualitative estimates of frequency are sufficient and that a frequency range of 1E-2 to 1E-4/year is unlikely. This frequency applies independently to each storage location and alternative; it is not additive.

147. In Section A.3.3.3 include the long-term consequences as well as short-term consequences. Material lost from containment during a seismic event will probably remain in an exposed condition (to the environment) for weeks and some of it will be transported to surface streams before the low priority uranium cleanup can be accomplished.

Response: Comment noted. See response to comment #140.

148. Identify the basis for the 10% and 15% of drums forecasted to be dislodged from the storage array in the first bullet on P A-9.

Response: These assumptions are documented in the cited reference (Hand 1998).

149. The third bullet identifies 25% of the material spilled. What is the basis for value? If spilled what is assumed on cleanup and when.

Response: These assumptions are documented in the cited reference (Hand 1998).

150. Again metal fires should be considered in a seismic event consequences.

Response: Comment noted. See response to comment #145.

151. The second line on P A-10 uses the term conditional probability to reduce the risk from seismic event by a factor of 10. What is the basis for this factor of ten reduction. The arbitrariness of all of these values leaves the EA reader questioning the analysis. Try to support conclusions and not make them so arbitrary.

Response: Comment noted. As noted on page A-10, this value is an estimate.

152. Near the middle of P A-10, duration of 1 hour is assumed for airborne release. The longer-term aspects of resuspension of released material should be included for the time the material has not been cleaned up.

Response: Comment noted. See response to comment #139.

153. The third bullet, on P A-13, assumes the facility workers will be exposed for 10 seconds. This seems very short for workers who are trying to mitigate consequences or to a worker who is hurt from a seismic event and cannot escape.

Response: The assumption of 10 seconds is standard for facility worker response to an accident (i.e., "see and flee" policies). Subsequent recovery actions are not included in accident analysis evaluations, as accident response personnel are adequately protected to respond safely to events.

154. The conclusions given in Tables A.11 and A.12 that facility workers will receive negligible dose and maximum consequence seems inconsistent with co-located workers and the public receiving doses. Calculated values should be given in the Appendix so reviewers can make their own judgment as to its significance.

Response: Comment noted. See, also, response to comment #154.

155. Appendix C is very difficult to understand. It is full of technical terms and it is not written so it can be understood by a technically trained stakeholder and I do not think it is of any value to a decision maker or to the general public.

Response: Comment noted. In order to provide a complete analysis, an assessment of chronic risks to humans and ecological receptors of airborne uranium deposited on soil and surface water and from water to sediment is provided in Appendix C.

156. On P C-2, in Section C.2.1.1, need to say why Stability Category F was assumed.

Response: Stability Category F was assumed because it is the most stable (results in least mixing or dilution) and, thus, provides the most conservative risk estimate. Text was added to Section C.2.1.1.

157. In Section C.2.2.2, why was the assumption made that uranium was deposited in a pond with an average depth of 2 meters? It would seem to me to be worse to deposit it in surface creeks that allow easy access to animals and other ecological system varmints.

Response: Moving water, such as creeks, permits much more mixing (dilution) than a pond; thus, assuming standing water is a more conservative approach, which results in a greater potential for ecological impacts.

158. Section C.3, on P C-9, makes the judgment that residential exposure is considered implausible under current site conditions. It is unclear that this is a reasonable judgment. Obviously if one can limit exposure, the consequence of this EA are negligible. This condition should be proven by reasonable analysis not assumed away.

Response: The risks to residents were calculated and documented in Section C.3 even though such exposure is unlikely. Risks were not "assumed away."

159. The table set up of the summary tables (Table C.20 and C.21) is poor. I presume that the last three columns are Radiation Exposure. Likewise three columns are Chemical Exposure. Fix the tables so this differentiation is clear. Add units to the table.

Response: Table headings have been clarified per comment. Hazard quotients (HQs) are unitless.

160. My conclusion is that calculated data should be given in tables in the appendix so the reader can see the results of calculations. Information in the Appendix should not be decided to be low or negligible. That conversion is not appropriate here nor in Section 4 until the analysis is being summarizing. (This EA did not summarize the analysis in Section 4 nor did it have a Summary).

Response: The numerical definitions of high, moderate, low, and negligible risks are presented in Section C.3.5. The summary tables in Appendix C use these word definitions instead of specific numerical values to aid reader understanding.

R. L. Huskin
Savannah River Operations Office

161. **Page 2-1**, Section 2.1, 2nd Paragraph, 9th Line; The stated typical percentage of ^{235}U in depleted uranium (DU) does not agree with the value shown in Table B.1 on page B-3. Page 2-1 says DU typically contains 0.25% ^{235}U while Table B.1 says 0.10%.

Response: The values citied in Table B.1 are the values used in the analysis. While the percentage differs from the typical DU of 0.25%, ^{235}U use of 0.10% would produce only a very minor difference in the results. This was verified by re-running the analysis using 0.25% U235.

162. **Page 4-6**, Section 4.4.1, 3rd Paragraph; Paragraph states "DOE has not identified existing buildings at (sites other than PORTS) to accommodate these additional uranium materials at this time. Therefore, for analytical purposes, it is assumed new storage space would have to be constructed." This begs the question of has DOE even made any attempt to identify such existing facilities at sites other than PORTS. Without any such attempt, it would appear any estimates, such as those shown in Table 4.3, would be wholly inaccurate and deliberately skewed in favor of PORTS. This hardly

appears to be an unbiased assessment of the adequacy and availability of sites about the DOE complex.

Response: See the response to comment #125.

163. **Page 4-20**, Section 4.12, 3 rd Paragraph, 1st Sentence; As written, the statement leaves the impression that uranium shipments will increase traffic accidents and fatalities because the cargo is uranium, rather than clearly stating any increase in such events would simply be the result of additional vehicles on the nation's roads, regardless of cargo.

Response: Text cited has been modified to clarify this point.

164. **Page 4-20**, Section 4.12, 3 rd Paragraph, 3rd Sentence; I don't believe this can be substantiated with the data presented. To state there would be an increase in LCFs to workers and the public from this transportation program, one must calculate both the potential LCFs resulting from the program and the LCFs potentially suffered by workers in the vicinity of the materials in a no-action alternative. I didn't see any such estimate for the no-action alternative in Section 4.3 nor any table presenting estimated LCFs from incident-free operations such as presented in Table 4.1 for accidents. Therefore there is no comparison of the no-action alternative to the other scenarios to determine if there was a net increase or decrease in LCFs.

Response: The text, as written, indicates that the increased LCFs are due to exposure during transport. Since the uranium materials would be stored somewhere under any alternative, including No Action, the transport risk is in addition to storage risks.

165. **Page A-12**, Table A.10; The values, in meters, for the distance to site boundaries for several sites such as INEEL and SRS seem inappropriately low. Are values of 526 meters and 727 meters correct for INEEL and SRS, respectively? While not familiar with the assumed locations for the materials at these sites, I can say several sites, such as INEEL and SRS are very large, with site centers greater than 10 miles from their boundaries.

Response: Because specific storage locations were not provided for several sites, a location central to roads, warehouses, and other similar facilities was postulated. Actual distances may be greater; however, the shorter distances used in this analysis are conservative.

166. **Page B-2**, Section B.3, 8th Dot; I believe the estimated duration of 10 days grossly underestimates the likely transit time for 14,400 km. This would equate to an average vessel speed of 33 knots. I don't believe you'll find many freighters with such speed. The ones currently in use for transporting foreign research reactor spent nuclear fuel back to the U.S. typically are capable of only about 11-12 knots. Only about 1/3 of the apparent speed of the uranium carriers. If one were to state the distances may range from X to 14,400 km with an average of about 5,000 km, an average transit time of 10 days would seem much more reasonable.

Response: The text has been changed to indicate that 14,400 km is the maximum distance port-to-port. The dose to crew members is now stated in mrem per person per day to account for various distances of shipments.

167. **Page B-3**, Table B.1; See 1st comment concerning page 2-1.

Response: The values cited in Table B.1 are the actual values used in the analysis. See the response to comment #162.

168. **Page B-3**, Section B.3, 5th Dot; There is no basis provided for the assumption that 1% of accidents would result in release of radioactive materials. Most other stated assumptions appear to have a stated basis.

Response: The 1% value is a conservative engineering estimate. The only good test and modeling data that exist are for Type B spent fuel casks and TRUPACT-II containers, and those values range from 0.01% to 0.1%. Sandia has historically used, and currently is using, 1% for Type A and IP3 packages. It has been used in previous DOE NEPA projects [for example: DOE/EA-1290, *Environmental Assessment: Disposition of Russian Federation Titled Natural Uranium* (1999)].

169. **Page B-3**, Section B.3, Last 4 Dots; These are redundant, considering content of the last two dots on page B-2. They should be consolidated.

Response: The bullets were consolidated.

170. **Page B-4**, Table B.2; The Eastern Centralized Commercial Storage Site (Barnwell) is located on the SRS Site boundary. Why then, would their values for "Truck Only – Dose Risk" be so different; 0.0036 (SRS) verses 0.00206 (Barnwell)? The values for all other categories for SRS verses Barnwell are almost identical, as they should be.

Response: The Barnwell site was selected to represent the location for an eastern centralized commercial storage site since it has existing infrastructure and experience in handling these materials. Other locations in the eastern United States could have been selected. The actual storage location, should a commercial storage site alternative be selected, could be anywhere in the eastern United States. However, we concur with the logic presented in the comment that adjacent storage sites should have virtually identical risk results.

The values in Table B.2 are different because in selecting the nodes to use in the TRAGIS routing code, there are several SRS nodes from which to select and two nodes for Barnwell to choose from. Most likely, the nodes selected to run the analysis are not exactly at the Barnwell LLW site, and the SRS node is almost certainly not at the exact location of the material to be shipped or at the fence line adjacent to the Barnwell site. We used the same node for each origin and destination in all of the analyses. Differences in routing will result in differences in collective dose risks since the RADTRAN code allocates a population weighting factor to rural, suburban, and urban portions of a given route.

Neither routing results in appreciable risks due to transport; however, since we know that the Barnwell and SRS destinations are essentially in the same place, the reader can use the Barnwell route results in Table B.2 for both Barnwell and SRS destinations.

171. **Page B-7**, Section B.5, 2 Dots and last Paragraph; The last paragraph states the total number of shipments could not be estimated because the amount of material in each shipment may not be known. Without an assumption of the quantity of material in each shipment, how were estimates made of the average doses to the crewmembers? If the estimate is made based on the assumed dose rates on the drums as explained in Section 4.2 on page 4-3, I believe 159 mrem per crewmember per shipment, as stated here and at the bottom of page 4-18, is a gross overestimate. The potentials for such exposures would mandate implementation of a radiation protection program that, in turn, would find such exposures to not be ALARA.)

Response: DOE concurs that the assumptions used were overly conservative and overstated the risk. Some assumptions have been modified (e.g., 2-hour exposure per crew member to

material between 1 and 16 m, instead of 12 hours, and 4 mrem/hour instead of 6 mrem/hour to be consistent with packaging calculations). The dose rate is 1.8 mrem/hour per crew member.

172. **Page C-12**, Table C.4; When using the values for Intakes in Table C.5, I can reproduce the various values for Dose in Table C.5 and Cancer Intakes in Table C.4, but I can't arrive at the same dose values shown for Cancer Risks in Table C.4. I am assuming the Cancer Risk values are a product of the CEDE derived from the Cancer Intakes and the appropriate risk values from ICRP-60 (i.e., 1 LCF per 2,000 Person-Rem for the "Resident" and 2,500 Person-Rem for the "Standard Worker". If this is the correct method, it appears the Cancer Risk values are too high by a factor of between 2 and 30. It appears as if the dose-to-risk conversion values vary greatly and range between 70 rem and 1150 rem instead of the expected values of 2,500 rem and 2,000 rem for workers and the public, respectively.

Response: Cancer risks are estimated by multiplying the intake (pCi or pCi-yr/g)) in Table C.4 by the cancer slope factor (risk/pCi or risk/yr/pCi/g) in Table C.7. For example, the risk to the Short-term Emergency Worker from ingestion of U-234 is 8.8E-02 (pCi) × 1.58E-10 (risk/pCi) = 1.4E-11. Slope factors are from HEAST, per standard risk assessment practice.

173. **Page C-15**, Table C.7, Upper Table; The issue described above for page C.12 also applies here. Put another way, the Risk/pCi appears to be based on something other than the expected 2,000 or 2,500 (as appropriate) rem/LCF. For example, in the specific case of Inhalation (Risk/pCi) for Uranium-235+D, the stated value appears to be based on a risk-to-dose factor of 756 rem/LCF.

Response: See response to comment #173. Slope factors are from HEAST, per standard risk assessment practice.

174. Page C-15, Table C.7: It appears some of the footnotes are not shown beneath the table.

Response: Table has been modified. The extraneous footnoting was removed.

John Owsley
Director
Tennessee Department of Environment and Conservation
DOE Oversight Division

175. Acknowledging that uranium wastes are not part of the scope of this PEA, the document should identify and address any waste streams associated with the re-usable uranium materials. The PEA should provide maps of probable transportation sources.

Response: Text in the PEA has been added to acknowledge waste streams associated with disposition or in the event product is later declared to be a waste. Since the waste streams are dependent on the specific end use, and these are only known in general terms, this was not evaluated in detail in the PEA. However, the many thousands of containers used to transport the uranium product would eventually become a waste stream. Either the containers are considered waste and disposed or they are cleaned for reuse, creating a waste stream from the cleaning operations. It is unlikely that the empty containers could be reused as is, except in very limited circumstances.

176. The PEA should provide maps of probably transportation routes.
Response: Transportation routes were identified for analysis purposes in the PEA using the TRAGIS routing model. Potential impacts from accidents and exposure were addressed in the PEA; however, for security reasons, DOE cannot publish map routes.

177. The state of Tennessee reiterates its position on not being willing to accept any materials designated for recycle/reuse without definite disposition pathways which may accumulate to long term storage or any waste that may require long term storage prior to treatment/disposal.
Response: Comment noted.

178. **Section 2.1 Page 2-1**, the typical end-use products are stated as metal or UO_2. On page 2-3, Fernald's largest inventories that fall within the scope of this PEA are stated to be in the form of metal and UF_4. The UF_4 should be added to the statement on page 2-1 that defines the scope.
Response: The intent of the introductory paragraphs in Section 2.1 is to provide general background information on uranium, not to provide an exhaustive list of all uranium forms covered by the PEA. The list of materials included in the PEA is detailed in Section 2.3.

179. Moving more material into Pike County would increase the possibility that the Piketon plant's ultimate fate would be a dump site.
Response: The UMG is developing a disposition strategy to move the material offsite as quickly and reasonably as possible. As noted in responses 35 and 36, the UMG is committed to provide a letter of intent to the State of Ohio regarding this strategy. The disposition strategy will include DOE's commitment to make periodic, not to exceed 5 years, assessments and documentation of the material in storage in order to ensure that the material continues to have reuse potential.

180. The people of Pike County will not willingly agree to receive any material at Piketon without an iron-clad agreement with DOE that the uranium will either be marketed or removed in a timely manner.
Response: DOE has committed to aggressively and periodically evaluate disposition strategies at Portsmouth. See response to 179 above.