SUMMARY[1]

S.1 INTRODUCTION

This document is a site-specific environmental impact statement (EIS) for construction and operation of a proposed depleted uranium hexafluoride (DUF_6) conversion facility at the U.S. Department of Energy (DOE) Paducah site in northwestern Kentucky (Figure S-1). The proposed facility would convert the DUF_6 stored at Paducah to a more stable chemical form suitable for use or disposal.

In a Notice of Intent (NOI) published in the *Federal Register* (FR) on September 18, 2001 (*Federal Register*, Volume 66, page 48123 [66 FR 48123]), DOE announced its intention to prepare a single EIS for a proposal to construct, operate, maintain, and decontaminate and decommission two DUF_6 conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky, in accordance with the National Environmental Policy Act of 1969 (NEPA) (*United States Code*, Title 42, Section 4321 et seq. [42 USC 4321 et seq.]) and DOE's NEPA implementing procedures (*Code of Federal Regulation*s, Title 10, Part 1021 [10 CFR Part 1021]). Subsequent to award of a contract on August 29, 2002, to Uranium Disposition Services, LLC (hereafter referred to as UDS), Oak Ridge, Tennessee, for design, construction, and operation of DUF_6 conversion facilities at Portsmouth and Paducah, DOE reevaluated its approach to the NEPA process and decided to prepare separate site-specific EISs. This change was announced in a *Federal Register* Notice of Change in NEPA Compliance Approach published on April 28, 2003 (68 FR 22368); the Notice is included as Attachment B to Appendix C of this EIS.

This EIS addresses the potential environmental impacts from the construction, operation, maintenance, and decontamination and decommissioning (D&D) of the proposed conversion facility at three alternative locations within the Paducah site; from the transportation of depleted uranium conversion products to a disposal facility; and from the transportation, sale, use, or disposal of the fluoride-containing conversion products (hydrogen fluoride [HF] or calcium fluoride [CaF_2]). Although not part of the proposed action, an option of shipping all cylinders (DUF_6, normal and enriched UF_6, and empty) stored at the East Tennessee Technology Park (ETTP) near Oak Ridge, Tennessee, to Paducah rather than to Portsmouth is also considered, as is an option of expanding operations. In addition, this EIS evaluates a no action alternative, which assumes continued storage of DUF_6 in cylinders at the Paducah site. A separate EIS (DOE/EIS-0360) evaluates the potential environmental impacts for the proposed Portsmouth conversion facility.

S.1.1 Background Information

The current DUF_6 conversion facility project is the culmination of a long history of DUF_6 management activities and events. To put the current project into context and provide

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1 Vertical lines in the right margin of this summary and the remainder of this EIS document indicate changes that have been added after the public comment period.

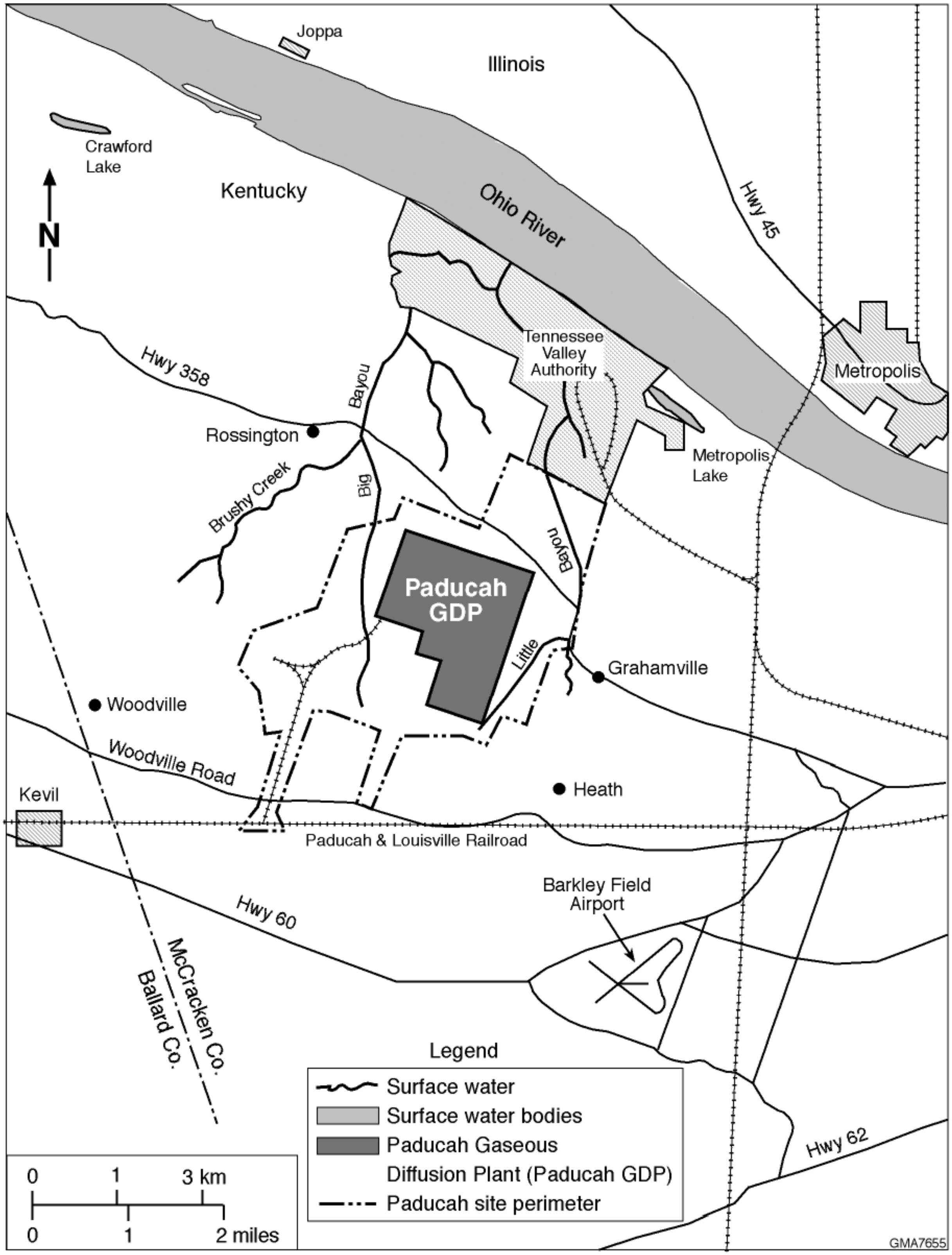

FIGURE S-1 Regional Map of the Paducah, Kentucky, Site Vicinity

perspective, this section briefly discusses the origin and size of the DOE cylinder inventory considered in this EIS and then summarizes the management history.

Uranium enrichment in the United States began as part of the atomic bomb development by the Manhattan Project during World War II. Enrichment for both civilian and military uses continued after the war under the auspices of the U.S. Atomic Energy Commission and its successor agencies, including DOE. Three large gaseous diffusion plants (GDPs) were constructed to produce enriched uranium, first at the K-25 site (now called ETTP) and subsequently at Paducah and Portsmouth. The K-25 plant ceased operations in 1985, and the Portsmouth plant ceased operations in 2001. The Paducah GDP continues to operate.

The DUF_6 produced during enrichment has been stored in large steel cylinders at all three gaseous diffusion plant sites since the 1950s. The cylinders are typically stacked two high and are stored outdoors on concrete or gravel yards. Figure S-2 shows typical arrangements for storing cylinders.

DOE is currently responsible for the management of approximately 700,000 metric tons (t) (770,000 short tons [tons])[2] of DUF_6 stored in about 60,000 cylinders at three storage sites. The cylinder inventory considered in this EIS is provided in Table S-1. This EIS considers the conversion of the approximately 440,000 t (484,000 tons) of DUF_6 stored in about 36,200 cylinders at Paducah. Also in storage at Paducah are approximately 1,940 cylinders of various sizes that contain enriched UF_6 or normal UF_6 (collectively called “non-DUF_6” cylinders in this EIS) or are

DUF_6 Management Time Line

1950–1993	DOE generates DUF_6 stored in cylinders at the ETTP, Portsmouth, and Paducah sites.
1985	K-25 (ETTP) GDP ceases operations.
1992	Ohio EPA issues Notice of Violation (NOV) to Portsmouth.
1993	USEC is created by P.L. 102-186.
1994	DOE initiates DUF_6 PEIS.
1995	DNFSB issues Recommendation 95-1, Safety of Cylinders Containing Depleted Uranium. DOE initiates UF_6 Cylinder Project Management Plan.
1996	USEC Privatization Act (P.L. 104-134) is enacted.
1997	DOE issues Draft DUF_6 PEIS.
1998	DOE and Ohio EPA reach agreement on NOV. Two DOE-USEC MOAs transfer 11,400 DUF_6 cylinders to DOE. P.L. 105-204 is enacted.
1999	DOE and TDEC enter consent order. DOE issues Final DUF_6 PEIS and Record of Decision. DOE issues conversion plan in response to P.L. 105-204. DNFSB closes Recommendation 95-1. DOE issues Draft RFP for conversion services.
2000	DOE issues Final RFP for conversion services.
2001	DOE receives five proposals in response to RFP. DOE identifies three proposals in competitive range. DOE publishes NOI for site-specific DUF_6 Conversion EIS. DOE prepares environmental critique to support conversion services procurement process. Portsmouth GDP ceases operations. DOE holds public scoping meetings for the site-specific DUF_6 Conversion EIS.
2002	DOE-USEC agreement transfers 23,000 t (25,684 tons) of DUF_6 to DOE. P.L. 107-206 is enacted. DOE awards conversion services contract to UDS. DOE prepares environmental synopsis to support conversion services procurement process.
2003	DOE announces Notice of Change in NEPA Compliance Approach and issues the draft EIS. DOE issues draft site-specific conversion facility EISs.
2004	Final site-specific conversion facility EISs issued.

[2] In general, in this EIS, values in English units are presented first, followed by metric units in parentheses. However, when values are routinely reported in metric units, the metric units are presented first, followed by English units in parentheses.

a

b

FIGURE S-2 Storage of DUF_6 Cylinders: (a) New cylinder storage yard at the Paducah site. (b) Overview of cylinder yards at the Paducah site.

TABLE S-1 Inventory of DOE UF_6 Cylinders Considered in This EIS[a]

Location	No. of Cylinders	Weight of UF_6 (t)
Paducah – DUF_6	36,191	436,400
Non-DUF_6		
Enriched UF_6	182	1,600
Normal UF_6	1,485	16,000
Empty	275	0
ETTP[b] – DUF_6	4,822	54,300
Non-DUF_6		
Enriched UF_6	881	7
Normal UF_6	221	19
Empty	20	0
Total		
DUF_6	41,013	490,700
Non-DUF_6	2,769	17,625
Empty	295	0

[a] As of January 26, 2004.

[b] The proposed action calls for shipment of the ETTP cylinders to Portsmouth.

empty. The management of the DOE non-DUF_6 cylinders at Paducah is considered in the EIS; however, the non-DUF_6 cylinders would not be processed in the conversion facility. In addition, in storage at ETTP are approximately 4,800 DUF_6 cylinders and approximately 1,100 non-DUF_6 cylinders. Although not part of the proposed action, this EIS considers as an option the shipment of all ETTP cylinders to Paducah and conversion of the DUF_6 cylinders.

S.1.1.1 Creation of USEC

In 1993, the U.S. government began the process of privatizing uranium enrichment services by creating the United States Enrichment Corporation (USEC), a wholly owned government corporation, pursuant to the *Energy Policy Act of 1992* (Public Law [P.L.] 102-186). The Paducah and Portsmouth GDPs were leased to USEC, but DOE retained responsibility for storage, maintenance, and disposition of 46,422 DUF_6 cylinders produced before 1993 and located at the three gaseous diffusion plant sites (28,351 at Paducah, 13,388 at Portsmouth, and 4,683 at K-25). In 1996, the *USEC Privatization Act* (P.L. 104-134) transferred ownership of USEC from the government to private investors. This act provided for the allocation of USEC's liabilities between the U.S. government (including DOE) and the new private corporation, including liabilities for DUF_6 cylinders generated by USEC before privatization.

In May and June of 1998, USEC and DOE signed two memoranda of agreement (MOAs) regarding the allocation of responsibilities for depleted uranium generated by USEC after 1993. The two MOAs transferred ownership of a total of 11,400 DUF_6 cylinders from USEC to DOE.

On June 17, 2002, DOE and USEC signed a third agreement to transfer up to 23,300 t (25,684 tons) of DUF_6 from USEC to DOE between 2002 and 2006. The exact number of cylinders was not specified. Transfer of ownership of all the material will take place at Paducah. While title to the DUF_6 is transferred to DOE under this agreement, custody and cylinder management responsibility remains with USEC until DOE requests the USEC deliver the cylinders for processing in the conversion facility.

Cylinder-Related Terms Used in This EIS

Types of UF_6

UF_6	A chemical composed of one atom of uranium combined with six atoms of fluorine. UF_6 is a volatile white crystalline solid at ambient conditions.
Normal UF_6	UF_6 made with uranium that contains the isotope uranium-235 at a concentration equal to that found in nature, that is, 0.7% uranium-235.
DUF_6	UF_6 made with uranium that contains the isotope uranium-235 in concentrations less than the 0.7% found in nature. In general, the DOE DUF_6 contains between 0.2% and 0.4% uranium-235.
Enriched UF_6	UF_6 made with uranium containing more than 0.7% uranium-235. In general, DOE enriched UF_6 considered in this EIS contains less than 5% uranium-235.
Reprocessed UF_6	UF_6 made with uranium that was previously irradiated in a nuclear reactor and chemically separated during reprocessing.

Types of Cylinders

Full DUF_6	Cylinders filled to 62% of their volume with DUF_6 (some cylinders are slightly overfilled).
Partially Full	Cylinders that contain more than 50 lb (23 kg) of DUF_6 but less than 62% of their volume.
Heel	Cylinders that contain less than 50 lb (23 kg) of residual nonvolatile material left after the DUF_6 has been removed.
Empty	Cylinders that have had the DUF_6 and heel material removed and contain essentially no residual material.
Feed	Cylinders used to supply UF_6 into the enrichment process. Most feed cylinders contain natural UF_6, although some historically contained reprocessed UF_6.
Non-DUF_6	A term used in this EIS to refer to cylinders that contain enriched UF_6 or normal UF_6.

S.1.1.2 Growing Concern over the DUF_6 Inventory

In May 1995, the Defense Nuclear Facilities Safety Board (DNFSB), an independent DOE oversight organization within the Executive Branch, issued Recommendation 95-1 regarding storage of the DUF_6 cylinders. This document advised that DOE should take three actions: (1) start an early program to renew the protective coating on cylinders containing DUF_6 from the historical production of enriched uranium, (2) explore the possibility of additional measures to protect the cylinders from the damaging effects of exposure to the elements as well as any additional handling that might be called for, and (3) institute a study to determine whether a more suitable chemical form should be selected for long-term storage of depleted uranium.

In response to Recommendation 95-1, DOE began an aggressive effort to better manage its DUF_6 cylinders, known as the *UF_6 Cylinder Project Management Plan*. This plan incorporated more rigorous and more frequent inspections, a multiyear schedule for painting and refurbishing cylinders, and construction of concrete-pad cylinder yards. In December 1999, the DNFSB determined that DOE's implementation of the *UF_6 Cylinder Project Management Plan* was successful, and, as a result, on December 16, 1999, it closed Recommendation 95-1.

Several affected states also expressed concern over the DOE DUF_6 inventory. In October 1992, the Ohio Environmental Protection Agency (OEPA) issued a Notice of Violation (NOV) alleging that DUF_6 stored at the Portsmouth facility is subject to regulation under state hazardous waste laws. The NOV stated that the OEPA had determined DUF_6 to be a solid waste and that DOE had violated Ohio laws and regulations by not evaluating whether such waste was hazardous. DOE disagreed with this assessment and entered into discussions with the OEPA that continued through February 1998, when an agreement was reached. Ultimately, in February 1998, DOE and the OEPA agreed to set aside the issue of whether the DUF_6 is subject to state hazardous waste regulation and instituted a negotiated management plan governing the storage of the Portsmouth DUF_6. The agreement also requires DOE to continue its efforts to evaluate the potential use or reuse of the material. The agreement expires in 2008.

Similarly, in February 1999, DOE and the Tennessee Department of Environment and Conservation (TDEC) entered into a consent order that included a requirement for the performance of two environmentally beneficial projects: the implementation of a negotiated management plan governing the storage of the small inventory (relative to other sites) of all UF_6 (depleted, enriched, and natural) cylinders stored at the ETTP site and the removal of the DUF_6 from the ETTP site or the conversion of the material by December 31, 2009. The consent order further requires DOE to submit a plan, within 60 days of completing NEPA review of its long-term DUF_6 management strategy, that contains schedules for activities related to removal of cylinders from the ETTP site.

In Kentucky, a final Agreed Order between DOE and the Kentucky Natural Resources and Environmental Protection Cabinet concerning DUF_6 cylinder management was entered in October 2003. This Agreed Order requires that DOE provide the Kentucky Department of Environmental Protection with an inventory of all DUF_6 cylinders for which DOE has management responsibility at the Paducah site and, with regard to that inventory, that DOE implement the DUF_6 Cylinder Management Plan, which is Attachment 1 to the Agreed Order.

S.1.1.3 Programmatic NEPA Review and Congressional Interest

In 1994, DOE began work on a *Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DUF_6 PEIS) (DOE/EIS-0269) to evaluate potential broad management options for DOE's DUF_6 inventory. Alternatives considered included continued storage of DUF_6 in cylinders at the gaseous diffusion plant sites or at a consolidated site, and the use of technologies for converting the DUF_6 to a more stable chemical form for long-term storage, use, or disposal. DOE issued the draft DUF_6 PEIS for public review and comment in December 1997 and held hearings near each of the three sites where DUF_6 is currently stored (Paducah, Kentucky; Oak Ridge, Tennessee; and Portsmouth, Ohio) and in Washington, D.C. In response to its efforts, DOE received some 600 comments.

In July 1998, while the PEIS was being prepared, the President signed into law P.L. 105-204. The text of P.L. 105-204 pertinent to the management of DUF_6 is as follows:

> *(a) PLAN. – The Secretary of Energy shall prepare, and the President shall include in the budget request for fiscal year 2000, a Plan and proposed legislation to ensure that all amounts accrued on the books of the United States Enrichment Corporation for the disposition of depleted uranium hexafluoride will be used to commence construction of, not later than January 31, 2004, and to operate, an onsite facility at each of the gaseous diffusion plants at Paducah, Kentucky, and Portsmouth, Ohio, to treat and recycle depleted uranium hexafluoride consistent with the National Environmental Policy Act.*

DOE began, therefore, to prepare a responsive plan while it proceeded with the PEIS.

On March 12, 1999, DOE submitted the plan to Congress; no legislation was proposed. In April 1999, DOE issued the final DUF_6 PEIS. The PEIS identified conversion of DUF_6 to another chemical form for use or long-term storage as part of the preferred management alternative. In the Record of Decision (ROD) (64 FR 43358, August 10, 1999), DOE decided to promptly convert the DUF_6 inventory to a more stable uranium oxide form. DOE also stated that it would use the depleted uranium oxide as much as possible and store the remaining depleted uranium oxide for potential future uses or disposal, as necessary. In addition, DUF_6 would be converted to depleted uranium metal only if uses for metal were available. DOE did not select a specific site or sites for the conversion facilities but reserved that decision for subsequent NEPA review. (This EIS is that site-specific review.)

Then, in July 1999, DOE issued the *Final Plan for the Conversion of Depleted Uranium Hexafluoride as Required by Public Law 105-204*. The Conversion Plan describes the steps that would allow DOE to convert the DUF_6 inventory to a more stable chemical form. It incorporates information received from the private sector in response to a DOE request for expressions of interest; ideas from members of the affected communities, Congress, and other interested stakeholders; and the results of the analyses for the final DUF_6 PEIS. The Conversion Plan describes DOE's intent to chemically process the DUF_6 to create products that would present a lower long-term storage hazard and provide a material suitable for use or disposal.

S.1.1.4 DOE Request for Contractor Proposals and Site-Specific NEPA Review

DOE initiated the final Conversion Plan on July 30, 1999, and announced the availability of a draft Request for Proposals (RFP) for a contractor to design, construct, and operate DUF_6 conversion facilities at the Paducah and Portsmouth sites.

In early 2000, the RFP was modified to allow for a wider range of potential conversion product forms and process technologies than had been previously reviewed in the DUF_6 PEIS (the PEIS considered conversion to triuranium octaoxide [U_3O_8] and uranium dioxide [UO_2] for disposal and conversion to uranium metal for use). DOE stated that if the selected conversion technology would generate a previously unconsidered product (e.g., depleted uranium tetrafluoride [UF_4]), DOE would review the potential environmental impacts as part of the site-specific NEPA review.

On October 31, 2000, DOE issued a final RFP to procure a contractor to design, construct, and operate DUF_6 conversion facilities at the Paducah and Portsmouth sites. The RFP stated that any conversion facilities that would be built would have to convert the DUF_6 within a 25-year period to a more stable chemical form that would be suitable for either beneficial use or disposal. The selected contractor would use its proposed technology to design, construct, and operate the conversion facilities for an initial 5-year period. Operation would include (1) maintaining the DUF_6 inventories and conversion product inventories; (2) transporting all UF_6 storage cylinders currently located at ETTP to a conversion facility at the Portsmouth site, as appropriate; and (3) transporting to an appropriate disposal site any conversion product for which no use was found. The selected contractor would also be responsible for preparing such excess material for disposal.

In March 2001, DOE announced the receipt of five proposals in response to the RFP, three of which proposed conversion to U_3O_8 and two of which proposed conversion to UF_4. In August 2001, DOE deemed three of these proposals to be within the competitive range; two conversion to U_3O_8 proposals and one conversion to UF_4 proposal.

On September 18, 2001, DOE published the NOI in the *Federal Register* (66 FR 48123), announcing its intention to prepare an EIS for the proposed action to construct, operate, maintain, and decontaminate and decommission two DUF_6 conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky. DOE held three scoping meetings to provide the public with an opportunity to present comments on the scope of the EIS and to ask questions and discuss concerns with DOE officials regarding the EIS. The scoping meetings were held in Piketon, Ohio, on November 28, 2001; in Oak Ridge, Tennessee, on December 4, 2001; and in Paducah, Kentucky, on December 6, 2001.

The alternatives identified in the NOI included a two-plant alternative (one at the Paducah site and another at the Portsmouth site), a one-plant alternative (only one plant would be built, at either the Paducah or the Portsmouth site), an alternative using existing UF_6 conversion capacity at commercial nuclear fuel fabrication facilities, and a no action alternative. For alternatives that involved constructing one or two new plants, DOE planned to consider alternative conversion technologies, local siting alternatives within the Paducah and Portsmouth site boundaries, and the shipment of DUF_6 cylinders stored at ETTP to either the Portsmouth site or to the Paducah site. The technologies to be considered in the EIS were those submitted in response to the October 2000 RFP, plus any other technologies that DOE believed must be considered.

S.1.1.5 Public Law 107-206 Passed by Congress

During the site-specific NEPA review process, Congress acted again regarding DUF_6 management, and on August 2, 2002, the President signed the *2002 Supplemental Appropriations Act for Further Recovery from and Response to Terrorist Attacks on the United States* (P.L. 107-206). The pertinent part of P.L. 107-206 had several requirements: that no later than 30 days after enactment, DOE must select for award of a contract for the scope of work described in the October 2000 RFP, including design, construction, and operation of a DUF_6 conversion facility at each of the Department's Paducah, Kentucky, and Portsmouth, Ohio, gasous diffusion sites; that the contract require groundbreaking for construction to occur no later than July 31, 2004; that the contract require construction to proceed expeditiously thereafter; that the contract include as an item of performance the transportation, conversion, and disposition of DU contained in cylinders located at ETTP, consistent with environmental agreements between the State of Tennessee and the Secretary of Energy; and that no later than 5 days after the date of groundbreaking for each facility, the Secretary of Energy shall submit to Congress a certification that groundbreaking has occurred. The relevant portions of the Appropriations Act are set forth in Appendix A of this EIS.

In response to P.L. 107-206, on August 29, 2002, DOE awarded a contract to UDS for construction and operation of two conversion facilities. DOE also reevaluated the appropriate scope of its site-specific NEPA review and decided to prepare two separate EISs, one for the plant proposed for the Paducah site and a second for the Portsmouth site. This change in approach was announced in the *Federal Register* on April 28, 2003 (68 FR 22368).

The two draft site-specific conversion facility EISs were mailed to stakeholders in late November 2003, and a notice of availability was published by the U.S. Environmental Protection Agency (EPA) in the *Federal Register* on November 28, 2003 (68 FR 66824). Comments on the draft EISs were accepted during a 67-day review period, from November 28, 2003, until February 2, 2004. Public hearings on the draft EISs were held near Portsmouth, Ohio, on January 7, 2004; Paducah, Kentucky, on January 13, 2004; and Oak Ridge, Tennessee, on January 15, 2004.

S.1.1.6 Characteristics of DUF_6

The gaseous diffusion process uses uranium in the form of UF_6, primarily because UF_6 can conveniently be used in gaseous form for processing, in liquid form for filling or emptying containers, and in solid form for storage. Solid UF_6 is a white, dense, crystalline material that resembles rock salt. Depleted uranium is uranium that, through the enrichment process, has been stripped of a portion of the uranium-235 that it once contained so that its proportion is lower than the 0.7 percent by weight (wt%) found in nature. The uranium in most of DOE's DUF_6 has between 0.2 wt% and 0.4 wt% uranium-235.

The chemical and physical characteristics of DUF_6 pose potential health risks, and the material is handled accordingly. Uranium and its decay products in DUF_6 emit low levels of alpha, beta, gamma, and neutron radiation. If DUF_6 is released to the atmosphere, it reacts with water vapor in the air to form HF and a uranium oxyfluoride compound called uranyl fluoride (UO_2F_2), which can be harmful to human health if inhaled or ingested in sufficient quantities. Uranium is a heavy metal that, in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it enters the bloodstream by means of ingestion or inhalation. HF is an extremely corrosive gas that can damage the lungs and cause death if inhaled at high enough concentrations. In light of such characteristics, DOE stores DUF_6 in a manner designed to minimize the risk to workers, the public, and the environment.

As the inventory of DUF_6 cylinders ages, some cylinders have begun to show evidence of external corrosion. At Paducah, a total of three cylinder breaches have occurred (see text box on next page). However, since DUF_6 is solid at ambient temperatures and pressures, it is not readily released after a cylinder leak or breach due to corrosion. When a hole develops in a cylinder, moist air reacts with the exposed solid DUF_6 and iron, forming a dense plug of solid uranium and iron compounds and a small amount of HF gas. The plug limits the amount of material released from a breached cylinder. When a hole in a cylinder is identified, the cylinder is typically repaired or its contents are transferred to a new cylinder. Following a large release of solid UF_6 (generally possible only if a cylinder is involved in a fire), the UF_6 would slowly react with moisture in the air, forming UO_2F_2 and HF, which would be dispersed downwind. The presence of a fire can result in a more rapid reaction and a larger release of UO_2F_2 and HF.

Because reprocessed uranium was enriched in the early years of gaseous diffusion, some of the DUF_6 inventory is contaminated with small amounts of technetium (Tc) and the transuranic (TRU) elements plutonium (Pu), neptunium (Np), and americium (Am). The final RFP for conversion services concluded that any DUF_6 contaminated with TRU elements and Tc at the concentrations expected could be safely handled in a conversion facility. As discussed in this EIS, the risk associated with potential contamination would be relatively small, and those cylinders would be processed in the same manner as cylinders not containing TRU and Tc contamination.

Some of the cylinders manufactured before 1978 were painted with coatings containing polychlorinated biphenyls (PCBs). (Although PCBs are no longer in production in the United States, from the 1950s to the late 1970s, PCBs were added to some paints as fungicides and to increase durability and flexibility.) The long persistence of PCBs in the environment and the tendency for bioaccumulation in the foodchain has resulted in regulations to prevent their release and distribution in the environment. Potential issues associated with PCB-containing cylinder coatings are addressed in more detail in Appendix B of the EIS. As discussed in Appendix B, the presence of PCBs in the coatings of some cylinders is not expected to result in health and safety risks to workers or the public.

Summary Data for Breached Cylinders at the Storage Sites through 2003

Paducah Site, three breached cylinders: One identified in 1992 was initiated by mechanical damage during stacking. The breached area was about 0.06 in. × 2 in. (0.16 cm × 5.1 cm). Estimated material loss was 0. The other two cylinder breaches were identified as breached because of missing cylinder plugs; they were identified between 1998 and 2002. Material loss from these cylinders was not estimated.

ETTP Site, five breached cylinders: Four were identified in 1991 and 1992. Two of these were initiated by mechanical damage during stacking, and two were caused by external corrosion due to prolonged ground contact. The breach areas for these four cylinders were about 2 in. (5.1 cm), 6 in. (15 cm), and 10 in. (25 cm) in diameter for three circular breaches, and 17 in. × 12 in. for a rectangular-shaped breach. The mass of material loss from the cylinders could not be estimated because equipment to weigh the cylinders was not available at the ETTP site. The fifth breach occurred in 1998 and was caused by steel grit blasting, which resulted in a breach at the location of an as-fabricated weld defect (immediately repaired without loss of DUF_6).

Portsmouth Site, three breached cylinders: Two identified in 1990 were initiated by mechanical damage during stacking; the damage was not noticed immediately, and subsequent corrosion occurred at the point of damage. The largest breach size was about 9 in. × 18 in. (23 cm × 46 cm); the estimated mass of DUF_6 lost was between 17 and 109 lb (7.7 and 49 kg). The next largest cylinder breach had an area of about 2 in. (5.1 cm) in diameter; the estimated DUF_6 lost was less than 4 lb (1.8 kg). The third breached cylinder occurred in 1996 and was the result of handling equipment knocking off a cylinder plug.

S.1.2 Purpose and Need

DOE needs to convert its inventory of DUF_6 to a more stable chemical form for use or disposal. This need follows directly from (1) the decision presented in the August 1999 ROD for the PEIS, namely, to begin conversion of the DUF_6 inventory as soon as possible, and (2) P.L. 107-206, which directs DOE to award a contract for construction and operation of conversion facilities at both the Paducah site and the Portsmouth site.

S.1.3 Proposed Action

The proposed action evaluated in this EIS is to construct and operate a conversion facility at the Paducah site for converting the Paducah DUF_6 inventory into depleted uranium oxide (primarily U_3O_8) and other conversion products. The action includes construction, operation, maintenance, and D&D of the proposed DUF_6 conversion facility at the Paducah site; transportation of depleted uranium conversion products and waste materials to a disposal facility; transportation and sale of the HF produced as a conversion co-product; and neutralization of HF to CaF_2 and its sale or disposal in the event that the HF product is not sold. Although not part of the proposed action, this EIS considers an option of shipping the cylinders stored at ETTP to Paducah rather than to Portsmouth (under this option, DUF_6 cylinders would be converted and non-DUF_6 cylinders would be stored for ultimate use) and an option of expanding facility operations.

S.1.4 Scope

The scope of an EIS refers to the range of actions, alternatives, and impacts it considers. As noted in Section S.1.1.4, on September 18, 2001, DOE published a NOI in the *Federal Register* (66 FR 48123) announcing its intention to prepare an EIS for a proposal to construct, operate, maintain, and decontaminate and decommission two DUF_6 conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky. The NOI announced that the scoping period for the EIS would be open until November 26, 2001. The scoping period was later extended to January 11, 2002. During the scoping process, the public was given six ways to submit comments on the DUF_6 proposal to DOE, including public meetings, mail, facsimile transmission, voice messages, electronic mail, and through a dedicated Web site. DOE held public scoping meetings near Paducah, Kentucky, Portsmouth, Ohio, and Oak Ridge, Tennessee, to give the public an opportunity to present comments on the scope of the EIS and to ask questions and discuss concerns regarding the EIS with DOE officials. The scoping meeting in Paducah, Kentucky, was held on December 6, 2001. Approximately 140 comments were received from about 30 individuals and organizations during the scoping period via all media. These comments were examined to determine the proposed scope of this EIS. Comments were related primarily to five major issues: (1) DOE policy; (2) alternatives; (3) cylinder inventory, maintenance, and surveillance; (4) transportation; and (5) general environmental concerns. Comments received in response to the April 28, 2003, Notice of Change in NEPA Compliance Approach were similar to those made during the public scoping period and were also considered.

The alternatives that are evaluated and compared in this EIS represent reasonable alternatives for converting DUF_6. Three alternative locations within the Paducah site are evaluated in detail in this EIS for the proposed action as well as a no action alternative. In addition, this EIS considers an option of shipping the cylinders at ETTP to Paducah, although current proposals call for these cylinders to be shipped to Portsmouth, and an option of expanding the conversion facility operations. These alternatives and options, as well as alternatives considered but not evaluated in detail, are described in more detail in Chapter 2.

S.1.5 Public Review of the Draft EIS

The two draft site-specific conversion facility EISs were mailed to stakeholders in late November 2003, and a notice of availability was published by the EPA in the *Federal Register* on November 28, 2003 (68 FR 66824). In addition, each EIS was also made available in its entirety on the Internet at the same time, and e-mail notification was sent to those on the project Web site mailing list. Stakeholders were encouraged to provide comments on the draft EISs during a 67-day review period, from November 28, 2003, until February 2, 2004. Comments could be submitted by calling a toll-free number, by fax, by letter, by e-mail, or through the project Web site. Comments could also be submitted at public hearings held near Portsmouth, Ohio, on January 7, 2004; Paducah, Kentucky, on January 13, 2004; and Oak Ridge, Tennessee, on January 15, 2004. The public hearings were announced on the project Web site and in local newspapers prior to the meetings.

A total of about 210 comments was received during the comment period. The comments received and DOE's responses to those comments are presented in Volume 2 of this EIS. Because of the similarities in the proposed actions and the general applicability of many of the comments to both the Portsmouth and the Paducah site-specific conversion facility EISs, all comments received on both EISs are included in Volume 2. In addition, all comments received were considered in the preparation of both final EISs.

The most common issues raised by reviewers were related to support for the proposed action and preferred alternative, transportation of cylinders, removal of cylinders from the ETTP site, the potential for DOE to accept additional DUF_6 cylinders from other sources, the recently announced USEC American Centrifuge Facility, and general health and safety concerns. Several revisions were made to the two site-specific conversion facility draft EISs on the basis of the comments received (changes are indicated by vertical lines in the right margin of the document). The vast majority of the changes were made to provide clarification and additional detail. Specific responses to each comment received on the draft EISs are presented in Volume 2 of this EIS.

S.1.6 Relationship to Other NEPA Reviews

This DUF_6 Conversion EIS, along with the Portsmouth conversion facility EIS (DOE/EIS-0360), represent the second level of a tiered environmental review process being used to evaluate and implement DOE's DUF_6 Management Program. The project-level review in these conversion facility EISs incorporates, by reference, the programmatic analysis, as appropriate, from the DUF_6 PEIS published by DOE in 1999.

In addition to the Portsmouth conversion facility EIS, which is directly related to this EIS, DOE has prepared (or is preparing) other NEPA reviews that are related to the management of DUF_6 or to the current DUF_6 storage sites. These reviews were evaluated and their results taken into consideration in the preparation of this EIS. The related reviews included continued waste management activities at Paducah, demonstration of a mixed waste vitrification process at Paducah, and long-term management for DOE's inventory of potentially reusable uranium.

In addition, DOE prepared a Supplement Analysis for the shipment of up to 1,700 DUF_6 cylinders that meet transportation requirements from ETTP to Portsmouth in fiscal years (FYs) 2003 through 2005. Based on the Supplement Analysis, DOE issued an amended ROD to the PEIS concluding that the estimated impacts for the proposed transport of up to 1,700 cylinders were less than or equal to those considered in the PEIS and that no further NEPA documentation was required (68 FR 53603). Nonetheless, this EIS considers shipment of all DUF_6 and non-DUF_6 at ETTP to Paducah by truck and rail.

S.1.7 Organization of This Environmental Impact Statement

This DUF_6 Conversion EIS consists of two volumes. Volume 1 contains 10 chapters and 8 appendixes. Chapter 1 describes background information, the purpose and need for the DOE action, the scope of the assessment, and related NEPA reviews and other studies. Chapter 2 defines the alternatives and options considered in this EIS. Chapter 3 discusses the environmental setting at the Paducah and ETTP sites. Chapter 4 addresses the assumptions, approach, and methods used in the impact analyses. Chapter 5 discusses the potential environmental impacts of the alternatives, and Chapter 6 identifies the major laws, regulations, and other requirements applicable to implementing the alternatives. Chapter 7 lists the cited references used in preparing this EIS, and Chapter 8 lists the names of those who prepared this EIS. Chapter 9 is a glossary of technical terms used in this EIS, and Chapter 10 is a subject matter index.

The eight appendixes in Volume 1 include a summary of the pertinent text from P.L. 107-206 (Appendix A), a discussion of issues associated with potential TRU and Tc contamination (Appendix B), comments received during public scoping and from the Notice of Change in NEPA Compliance Approach (Appendix C), the environmental synopsis prepared to support the DUF_6 conversion procurement process (Appendix D), the potential sale of HF and CaF_2 and estimated health and socioeconomic impacts associated with their use (Appendix E), a description of discipline-specific assessment methodologies (Appendix F), letters of consultation (Appendix G), and the contractor disclosure statement (Appendix H).

Volume 2 of the EIS is the comment response document prepared after the public review of the draft EIS. Volume 2 contains an overview of the public review process, copies of the letters or other documents that contained comments to DOE, and the responses to all comments received.

S.2 ALTERNATIVES

The alternatives considered in this EIS are summarized in Table S-2 and described below.

S.2.1 No Action Alternative

Under the no action alternative, it is assumed that DUF_6 cylinder storage would continue indefinitely at the Paducah site. The no action alternative assumes that DOE would continue surveillance and maintenance activities to ensure the continued safe storage of cylinders. Potential environmental impacts are estimated through the year 2039. The year 2039 was selected to be consistent with the PEIS, which evaluated a 40-year cylinder storage period (1999–2039). In addition, long-term impacts (i.e., occurring after 2039) from potential cylinder breaches are assessed.

Specifically, the activities assumed to occur under no action include routine cylinder inspections, ultrasonic testing of the wall thicknesses of selected cylinders, painting of cylinders to prevent corrosion, cylinder yard surveillance and maintenance, reconstruction of several storage yards, and relocation of some cylinders to the new or improved yards. It was assumed that cylinders would be painted every 10 years. On the basis of these activities, an assessment of the potential impacts on workers, members of the general public, and the environment was conducted.

TABLE S-2 Summary of Alternatives Considered for the Paducah Conversion Facility EIS

Alternative	Description	Options Considered
No Action	Continued storage of the DUF_6 cylinders indefinitely at the Paducah site, with continued cylinder surveillance and maintenance.	None.
Proposed Action	Construction and operation of a conversion facility at the Paducah site for conversion of the Paducah DUF_6 inventory into depleted uranium oxide (primarily U_3O_8) and other conversion products. This EIS assesses the potential environmental impacts from the following proposed activities: • Construction, operation, maintenance, and D&D of the proposed DUF_6 conversion facility at the Paducah site; • Conversion to depleted U_3O_8 based on the proposed UDS technology; • Transportation of uranium conversion products and waste materials to a disposal facility; • Transportation and sale of the HF conversion product; and • Neutralization of HF to CaF_2 and its sale or disposal in the event that the HF product is not sold.	*ETTP Cylinders:* This EIS considers an option of shipping DUF_6 and non-DUF_6 cylinders at ETTP to Paducah. *Transportation:* This EIS evaluates the shipment of cylinders and conversion products by both truck and rail. *Expanded Operations:* This EIS discusses the impacts associated with potential expansion of plant operations by extending the operational period and by increasing throughput through efficiency improvements.
Alternative Location A (Preferred)	Construction of the conversion facility at Location A, an area that encompasses 35 acres (14 ha) located south of the administration building and its parking lot, immediately west of and next to the primary location of the DOE cylinder yards and east of the main plant access road.	
Alternative Location B	Construction of the conversion facility at Location B, an area that encompasses 59 acres (23 ha) directly south of the Paducah maintenance building and west of the main plant access road.	
Alternative Location C	Construction of the conversion facility at Location C, an area that encompasses 53 acres (21 ha) east of the Paducah pump house and cooling towers.	

For assessment purposes in this EIS, two cylinder breach cases were evaluated. In the first case, it was assumed that the planned cylinder maintenance and painting program would maintain the cylinders in a protected condition and control further corrosion. For this case, it was assumed that after initial painting, some breaches would occur from handling damage; a total of 36 future breaches were estimated to occur through 2039. In the second case, it was assumed that external corrosion would not be halted by improved storage conditions, cylinder maintenance, and painting. This case was considered in order to account for uncertainties with regard to how effective painting would be in controlling cylinder corrosion and uncertainties in the future painting schedule. In this case, the number of future breaches estimated through 2039 was 444 for the Paducah site (i.e., 11 per year).

Alternatives Considered in This EIS

No Action: NEPA regulations require evaluation of a no action alternative as a basis for comparing alternatives. In this EIS, the no action alternative is storage of DUF_6 and non-DUF_6 cylinders indefinitely in yards at the Paducah site, with continued cylinder surveillance and maintenance activities.

Proposed Action: Construction and operation of a conversion facility at the Paducah site for conversion of the Paducah DUF_6 inventory into depleted uranium oxide (primarily U_3O_8) and other conversion products.

Action Alternatives: Three action alternatives focus on where to construct the conversion facility within the Paducah site (Alternative Locations A, B, and C). The preferred alternative is Location A.

The estimated number of future breaches at the Paducah site was used to estimate potential impacts that might occur during the repair of breached cylinders and impacts from releases that might occur during continued cylinder storage.

S.2.2 Proposed Action Alternatives

Proposed Action

The proposed action in this EIS is construction and operation of a conversion facility at the Paducah site for conversion of the Paducah DUF_6 inventory into depleted uranium oxide (primarily U_3O_8) and other conversion products. Three alternative locations within the Paducah site are evaluated (Locations A, B, and C).

The proposed action evaluated in this EIS is to construct and operate a conversion facility at the Paducah site for converting the DUF_6 inventory stored at Paducah into depleted uranium oxide (primarily U_3O_8) and other conversion products. Three alternative locations within the Paducah site are evaluated (Table S-2). The conversion facility would convert DUF_6 into a stable chemical form for beneficial use/reuse and/or disposal. The off-gas from the conversion process would yield aqueous HF, which would be processed and marketed or converted to a solid for sale or disposal. To support the conversion operations, the emptied DUF_6 cylinders would be stored, handled, and processed for reuse as uranium oxide disposal containers to the extent practicable. The time period considered is a construction period of approximately 2 years, an operational period of 25 years, and a 3-year period for the D&D of the facility. Current plans call for construction to begin in the summer of 2004. The assessment is based on the conceptual conversion facility design proposed by UDS, the selected contractor (see text box).

The action alternatives focus on where to site the conversion facility within the Paducah site. The Paducah site was evaluated to identify alternative locations for a conversion facility. The three alternative locations identified at the Paducah site, denoted Locations A, B, and C, are shown in Figure S-3.

Conversion Facility Design

This EIS is based on the conversion facility design being developed by UDS, the selected conversion contractor. At the time the draft EIS was prepared, the UDS design was in the 30% conceptual stage, with several facility design options being considered.

Following the public comment period, the draft EIS was revised on the basis of comments received and on the basis of UDS 100% conceptual facility design. This final EIS identifies and evaluates design options where possible.

S.2.2.1 Alternative Location A (Preferred Alternative)

Location A is the preferred location for the conversion facility. It is located south of the administration building and its parking lot, immediately west of and next to the primary location of the DOE cylinder yards and east of the main plant access road. This location is an L-shaped tract consisting mostly of grassy field. However, the southeastern section is a wooded area. A drainage ditch crosses the northern part of the site, giving the cylinder yard storm water access to the Kentucky Pollution Discharge Elimination System (KPDES) Outfall 017. This location is about 35 acres (14 ha) in size. This location was identified in the RFP for conversion services as the site for which bidders were to design their proposed facilities.

S.2.2.2 Alternative Location B

Location B is directly south of the Paducah maintenance building and west of the main plant access road. The northern part of this location is mowed grass and has a slightly rolling topography. The southern part has a dense covering of trees and brush, and some high-voltage power lines cross it, limiting its use. This location has an area of about 59 acres (23 ha).

S.2.2.3 Alternative Location C

Location C is east of the Paducah pump house and cooling towers. It has an area of about 53 acres (21 ha). Dykes Road runs through the center of this location from north to south. Use of the eastern half of this location could be somewhat limited because several high-voltage power lines run through this area.

S.2.2.4 Conversion Process Description

The proposed conversion system is based on a proven commercial process in operation at the Framatome Advanced Nuclear Power fuel fabrication facility in Richland, Washington. The UDS dry conversion is a continuous process in which DUF_6 is vaporized and converted to

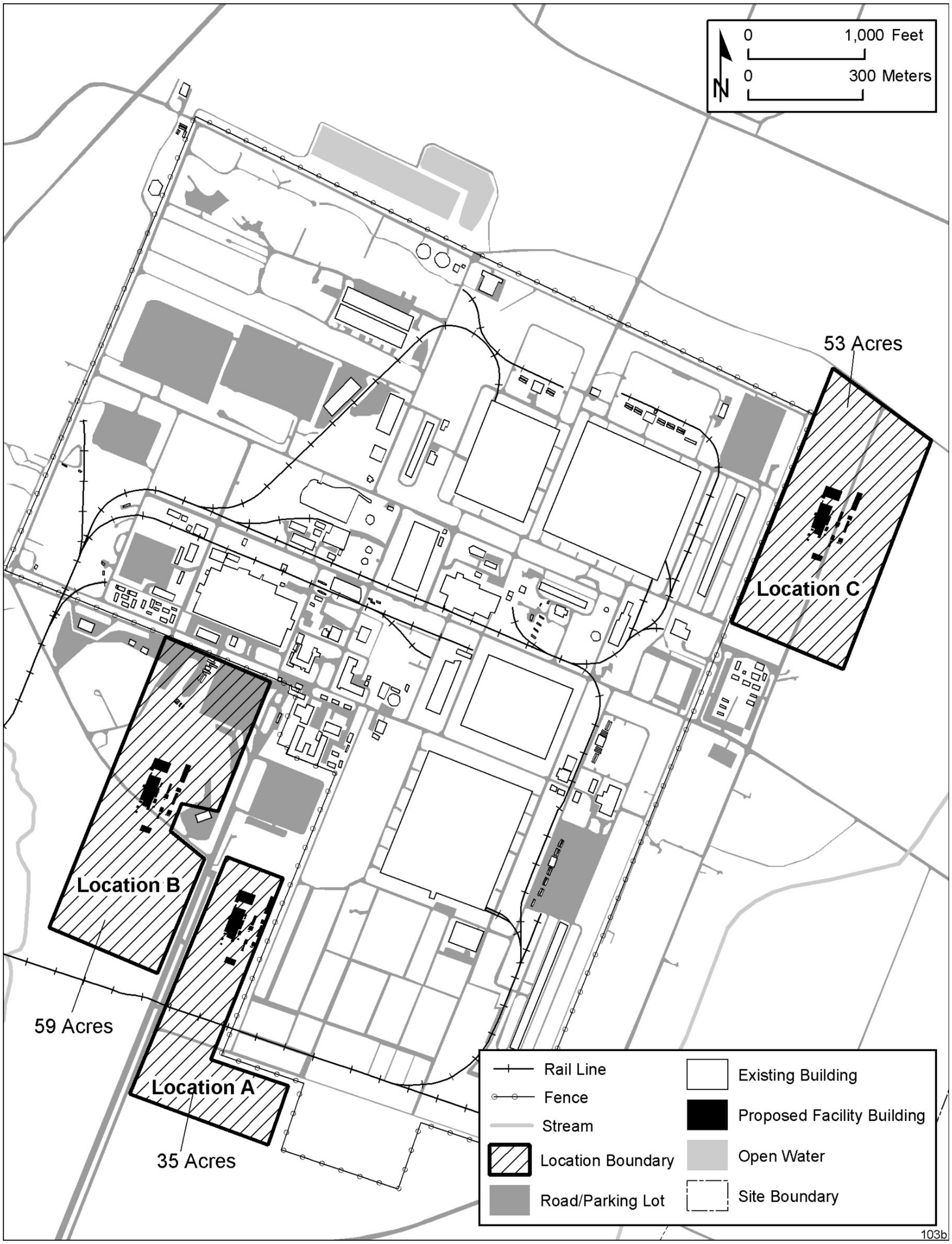

FIGURE S-3 Three Alternative Conversion Facility Locations within the Paducah Site, with Location A Being the Preferred Alternative (A representative conversion facility footprint is shown within each location.)

a mixture of uranium oxides (primarily U_3O_8) by reaction with steam and hydrogen in a fluidized-bed conversion unit. The hydrogen is generated using anhydrous ammonia (NH_3). Nitrogen is also used as an inert purging gas and is released to the atmosphere through the building stack as part of the clean off-gas stream. The depleted U_3O_8 powder is collected and packaged for disposition. The process equipment would be arranged in parallel lines. Each line would consist of two autoclaves, two conversion units, a HF recovery system, and process off-gas scrubbers. The Paducah facility would have four parallel conversion lines. Equipment would also be installed to collect the HF co-product and process it into any combination of several marketable products. A backup HF acid neutralization system would be provided to convert up to 100% of the HF acid to CaF_2 for storage, sale, or disposal in the future, if necessary. Figure S-4 is an overall material flow diagram for the conversion facility; Figure S-5 is a conceptual facility site plan. A summary of key facility characteristics is presented in Table S-3.

The conversion facility will be designed to convert 18,000 t (20,000 tons) of DUF_6 per year, requiring 25 years to convert the Paducah inventory. The Paducah processing facility would be approximately 148 ft × 271 ft (45 m × 83 m). The conversion facility would occupy a total of approximately 10 acres (4 ha), with up to 45 acres (18 ha) of land disturbed during construction (including temporary construction lay-down areas and utility access). Some of the disturbed areas would be areas cleared for railroad or utility access, not adjacent to the construction area.

The conversion process would generate four conversion products that have a potential use or reuse: depleted U_3O_8, HF, CaF_2, and steel from emptied DUF_6 cylinders (if not used as disposal containers). DOE has been working with industrial and academic researchers for several years to identify potential uses for these products. Some potential uses for depleted uranium exist or are being developed, and DOE believes that a viable market exists for the HF generated during conversion. To take advantage of these to the extent possible, DOE requested in the RFP that the bidders for conversion services investigate and propose viable uses. Table S-4 summarizes the probable disposition paths identified by UDS for each of the conversion products.

S.2.2.5 Option of Shipping ETTP Cylinders to Paducah

DOE proposes to ship the DUF_6 and non-DUF_6 cylinders at ETTP to Portsmouth. However, this EIS considers an option of sending the ETTP cylinders to Paducah. All shipments of ETTP cylinders would have to be made consistent with U.S. Department of Transportation (DOT) regulations for the shipment of radioactive materials as specified in Title 49 of the CFR (see text box on page S-24). A large number of the ETTP DUF_6 cylinders do not meet the DOT requirements intended to maintain the safety of shipments during both routine and accident conditions. Some cylinders have physically deteriorated such that they no longer meet the DOT requirements. Currently, it is estimated that 1,700 cylinders are DOT compliant.

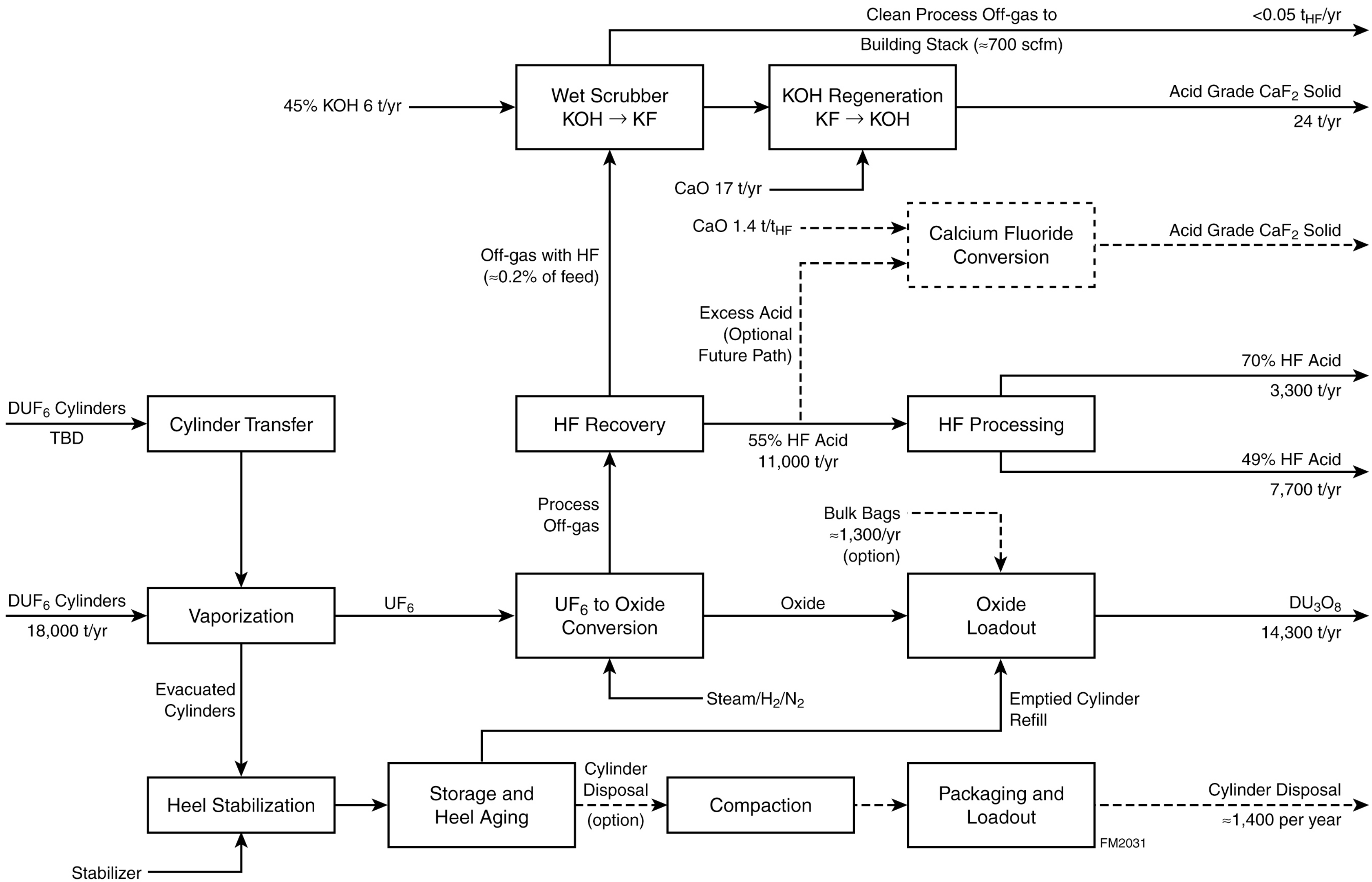

FIGURE S-4 Conceptual Overall Material Flow Diagram for the Paducah Conversion Facility

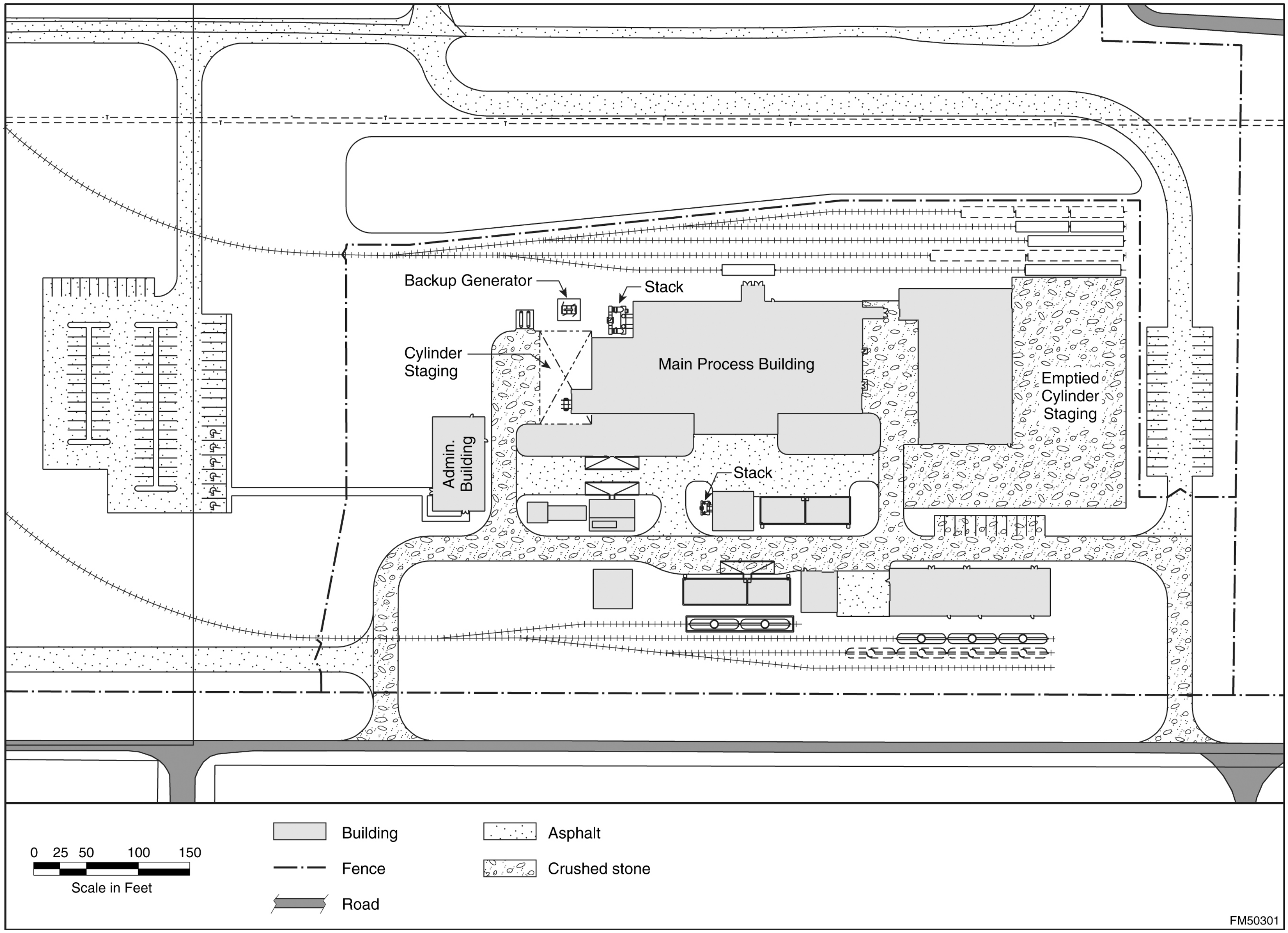

FIGURE S-5 Conceptual Conversion Facility Site Layout for Paducah

TABLE S-3 Summary of Paducah Conversion Facility Parameters

Parameter/Characteristic	Value
Construction start	2004
Construction period	2 years
Start of operations	2006
Operational period	25 years
Facility footprint	10 acres (4 ha)
Facility throughput	18,000 t/yr (20,000 tons/yr) DUF_6 (≈1,400 cylinders/yr)
Conversion products	
Depleted U_3O_8	14,300 t/yr (15,800 tons/yr)
CaF_2	24 t/yr (26 tons/yr)
70% HF acid	3,300 t/yr (3,600 tons/yr)
49% HF acid	7,700 t/yr (8,500 tons/yr)
Steel (emptied cylinders, if not used as disposal containers)	1,980 t/yr (2,200 tons/yr)

TABLE S-4 Summary of Proposed Conversion Product Treatment and Disposition

Conversion Product	Packaging/Storage	Proposed Disposition	Optional Disposition
Depleted U_3O_8	Packaged in emptied cylinders for disposal (bulk bags are an option).	Disposal at Envirocare of Utah, Inc.[a]	Disposal at Nevada Test Site (NTS).[a]
CaF_2	Packaged for sale or disposal.	Commercial sale pending DOE approval of authorized release limits, as appropriate.	Disposal at Envirocare of Utah, Inc.[a]
HF acid (70% and 49%)	HF would be commercial grade and stored on site until loaded into rail tank cars.	Sale to commercial HF acid supplier pending DOE approval of authorized release limits, as appropriate.	Neutralization of HF to CaF_2 for use or disposal.
Steel (emptied cylinders)	If bulk bags were used for U_3O_8 disposal, emptied cylinders would be processed for disposal; otherwise used for disposal of U_3O_8.	Disposal at Envirocare of Utah, Inc.[a]	Disposal at NTS.[a]

[a] DOE plans to decide the specific disposal location(s) for the depleted U_3O_8 conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.

Before shipment, each cylinder would be inspected to determine if it met DOT requirements. This inspection would include a record review to determine if the cylinder was overfilled; a visual inspection for damage or defects; a pressure check to determine if the cylinder was overpressurized; and an ultrasonic wall thickness measurement (based on a visual inspection, if necessary). If a cylinder passed the inspection, the appropriate documentation would be prepared, and the cylinder would be loaded directly for shipment.

This EIS considers three options for shipping noncompliant cylinders from ETTP: obtaining an exemption from the DOT to ship the cylinders “as-is” or following repairs, use of cylinder overpacks, and use of a cylinder transfer facility. For an exemption to be granted, DOE would have to demonstrate that the proposed shipments would achieve a level of safety that would be at least equal to the level required by the regulations, likely requiring some type of compensatory measures. An overpack (the second option) is a container into which a cylinder is placed for shipment. The overpack would be designed, tested, and certified to meet all DOT shipping requirements. It would be suitable for containing, transporting, and storing the cylinder contents regardless of cylinder condition. The third option considers the transfer of the DUF_6 from substandard cylinders to new or used cylinders that would meet all DOT requirements. This option could require the construction of a new cylinder transfer facility at ETTP, for which there are no current plans. If a decision were made to construct such a facility, additional NEPA review would be conducted. Transportation impacts are estimated for shipment by both truck and rail after cylinder preparation.

S.2.2.6 Option of Expanding Conversion Facility Operations

The conversion facility at Paducah is currently being designed to process the DOE DUF_6 cylinder inventory at the site over 25 years by using four process lines (see Sections S.2.2.4 and 2.2.2). There are no current plans to operate the conversion facility beyond this time period or to increase the throughput of the facility by adding an additional process line. However, a future decision to extend conversion facility operations or increase throughput at the site could be made for several reasons. Consequently, this EIS includes an evaluation of the environmental impacts associated with expanding conversion facility operations at the site in order to provide future planning flexibility. (Impacts are discussed in Section S.5.22 and presented in detail in Section 5.2.6.) The possible reasons for expanding operations in the future are discussed below.

The DOE Office of Inspector General (OIG) issued a final audit report in March 2004 reviewing the proposed depleted uranium hexafluoride conversion project. The OIG report recommends that the Office of Environmental Management (EM) conduct a cost benefit analysis to determine the optimum size of the Portsmouth conversion facility and, on the basis of the results of that review, implement the most cost-effective approach. The report states that by adding an additional process line to the Portsmouth facility, the time to process the Portsmouth and ETTP inventories of DUF_6 could be shortened by 5 years at a substantial cost savings of 55 million dollars.

In contrast to the findings at Portsmouth, the OIG report notes that it would not be feasible to add an additional conversion line to the Paducah facility. Consequently, this EIS evaluates the potential environmental impacts associated with increasing the Paducah plant throughput by implementing process improvements (see Section S.5.22). On the basis of experience with other projects, DOE believes that higher throughput rates can be achieved by improving the efficiency of the planned equipment.

A future decision to extend operations or expand throughput might also result from the fact that DOE could assume management responsibility for DUF_6 in addition to the current inventory. Possible reasons include future DOE management responsibility for DUF_6 due to regulatory changes or possible MOAs between USEC and DOE; development of an advanced enrichment technology by USEC (currently proposed for the Portsmouth site); and new commercial uranium enrichment facilities that may be built and operated in the United States by commercial companies other than USEC. In addition, because the Portsmouth facility would conclude operations approximately 7 years before the current Paducah inventory would be converted at the Paducah site, it is possible that some DUF_6 cylinders could be transferred from Paducah to Portsmouth, particularly if DOE assumes responsibility for additional DUF_6 at Paducah. These possibilities are discussed and evaluated in this EIS in order to provide future planning flexibility.

Transportation Requirements for DUF_6 Cylinders

All shipments of UF_6 cylinders have to be made in accordance with applicable DOT regulations for the shipment of radioactive materials; specifically, the provisions of 49 CFR Part 173, Subpart I. The DOT regulations require that each UF_6 cylinder be designed, fabricated, inspected, tested, and marked in accordance with the various engineering standards that were in effect at the time the cylinder was manufactured. The DOT requirements are intended to maintain the safety of shipments during both routine and accident conditions. The following provisions are particularly important relative to DUF_6 cylinder shipments:

1. A cylinder must be filled to less than 62% of the certified volumetric capacity (the fill limit was reduced from 64% to 62% in about 1987).

2. The pressure within a cylinder must be less than 14.8 psia (subatmospheric pressure).

3. A cylinder must be free of cracks, excessive distortion, bent or broken valves or plugs, and broken or torn stiffening rings or skirts, and it must not have a shell thickness that has decreased below a specified minimum value. (Shell thicknesses are assessed visually by a code vessel inspector, and ultrasonic testing may be specified at the discretion of the inspector to verify wall thickness, when and in areas the inspector deems necessary.)

4. A cylinder must be designed so that it will withstand (1) a hydraulic test at an internal pressure of at least 1.4 megapascals (200 psi) without leakage; (2) a free drop test onto a flat, horizontal surface from a height of 1 ft (0.3 m) to 4 ft (1.2 m), depending on the cylinder's mass, without loss or dispersal; and (3) a 30-minute thermal test equivalent to being engulfed in a hydrocarbon fuel/air fire having an average temperature of at least 800°C (1,475°F) without rupture of the containment system.

S.2.3 Alternatives Considered but Not Analyzed in Detail

S.2.3.1 Use of Commercial Conversion Capacity

An alternative examined was using existing UF_6 conversion capacity at commercial nuclear fuel fabrication facilities that convert natural or enriched UF_6 to UO_2 in lieu of constructing new conversion capacity for DUF_6. This alternative was not analyzed in detail because the small capacity possibly available to DOE, coupled with the low interest level expressed by facility owners, indicates that the feasibility of this suggested alternative is low, and the duration of the conversion period is long (more than 125 years).

S.2.3.2 Sites Other Than Paducah

The consideration of alternative sites was limited to alternative locations within the Paducah site in response to Congressional direction. As discussed in detail in Section 1.1, Congress has acted twice regarding the construction and operation of DUF_6 conversion facilities at Portsmouth and Paducah. Both P.L. 105-204 and P.L. 107-206 directed DOE to construct and operate conversion facilities at these two sites.

S.2.3.3 Alternative Conversion Processes

Potential environmental impacts associated with alternative conversion processes were considered during the procurement process, including the preparation of an environmental critique and environmental synopsis (Appendix D of this EIS), which were prepared in accordance with the requirements of 10 CFR 1021.216. The environmental synopsis concluded that, on the basis of assessment of potential environmental impacts presented in the critique, no proposal received by DOE was clearly environmentally preferable. The potential environmental impacts associated with the proposals were found to be similar to, and generally less than, those presented in the DUF_6 PEIS for representative conversion technologies.

S.2.3.4 Long-Term Storage and Disposal Alternatives

There are no current plans for long-term storage of conversion products; long-term storage alternatives were analyzed in the PEIS, including storage as DUF_6 and storage as an oxide (either U_3O_8 or UO_2). The potential environmental impacts from long-term storage were evaluated in the PEIS for representative and generic sites. Therefore, long-term storage alternatives were not evaluated in this EIS.

With respect to disposal, this EIS evaluates the impacts from packaging, handling, and transporting depleted uranium conversion products from the conversion facility to a LLW disposal facility that would be (1) selected in a manner consistent with DOE policies and orders, and (2) authorized or licensed to receive the conversion products by DOE (in conformance with

DOE orders), the U.S. Nuclear Regulatory Commission (NRC) (in conformance with NRC regulations), or an NRC Agreement State agency (in conformance with state laws and regulations determined to be equivalent to NRC regulations). Assessment of the impacts and risks from on-site handling and disposal at the LLW disposal facility is deferred to the disposal site's site-specific NEPA or licensing documents. However, this EIS covers the impacts from transporting the DUF_6 conversion products to both the Envirocare of Utah, Inc., facility and the NTS. DOE plans to decide the specific disposal location(s) for the depleted U_3O_8 conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.

S.2.3.5 Other Transportation Modes

Transportation by air and barge were considered but not analyzed in detail. Transportation by air was deemed to not be reasonable for the types and quantities of materials that would be transported to and from the conversion site. Transportation by barge was also considered and deemed to be unreasonable. ETTP is the only site with a nearby barge facility. Paducah would either have to build new facilities at a distance of at least 6 mi (10 km) or use existing facilities located 20 to 30 mi (32 to 48 km) from the site, and an additional loading/unloading step and on-land transport by truck or rail over this distance would be required. If barge shipment was proposed in the future and considered to be reasonable, an additional NEPA review would be conducted.

S.2.3.6 One Conversion Plant for Two Sites

In the NOI published in the *Federal Register* on September 18, 2001, construction and operation of one conversion plant was identified as a preliminary alternative that would be considered in the conversion EIS. However, with the passage of P.L. 107-206, which mandates the award of a contract for the construction and operation of conversion facilities at both Paducah and Portsmouth, the one conversion plant alternative was considered but not analyzed in this EIS.

S.3 AFFECTED ENVIRONMENT

This EIS considers the proposed action at the Paducah site for conversion of the Paducah DUF_6 inventory, including the option of shipping cylinders from the ETTP site to the Paducah site. Chapter 3 presents a detailed description of the affected environment at and around the Paducah and ETTP sites. Environmental resources and values that could potentially be affected include the following:

- Cylinder yards,
- Site infrastructure,
- Air quality,
- Noise,
- Soils,
- Surface and groundwater,
- Vegetation,
- Wildlife,
- Wetlands,
- Threatened and endangered species,
- Public and occupational safety and health,
- Socioeconomics,
- Waste management,
- Land use,
- Cultural resources, and
- Environmental justice.

S.4 ENVIRONMENTAL IMPACT ASSESSMENT APPROACH, ASSUMPTIONS, AND METHODOLOGY

Potential environmental impacts were assessed by examining all of the activities required to implement each alternative, including construction of the required facility, operation of the facility, and transportation of materials between sites (Figure S-6). For continued cylinder storage under the no action alternative, potential long-term impacts were also estimated. For each alternative, potential impacts to workers, members of the general public, and the environment were estimated for both normal operations and for potential accidents.

The analysis for this EIS considered all potential areas of impact and emphasized those that might have a significant impact on human health or the environment, would be different under different alternatives, or would be of special interest to the public (such as potential radiation effects). The estimates of potential environmental impacts for the action alternatives were based on characteristics of the proposed UDS conversion facility.

The process of estimating environmental impacts from the conversion of DUF_6 is subject to some uncertainty because final facility designs are not yet available. In addition, the methods used to estimate impacts have uncertainties associated with their results. This EIS impact assessment was designed to ensure — through selection of assumptions, models, and input parameters — that impacts would not be underestimated and that relative comparisons among the alternatives would be valid and meaningful. Although uncertainty may characterize estimates of the absolute magnitude of impacts, a uniform approach to impact assessment enhances the ability to make valid comparisons among alternatives. This uniform approach was implemented in the analyses conducted for this EIS to the extent practicable.

Table S-5 summarizes the major assumptions and parameters that formed the basis of the analyses in this EIS.

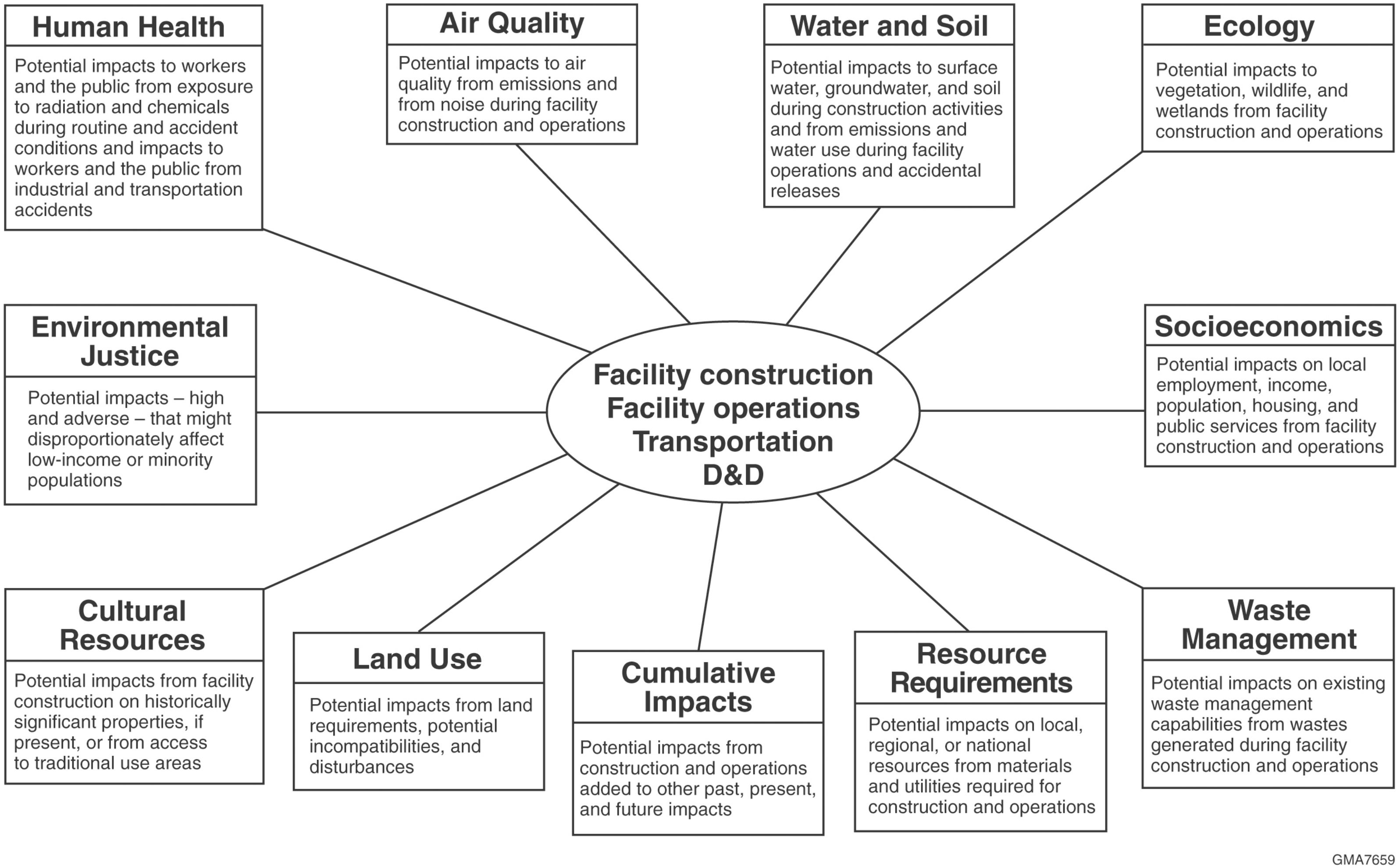

FIGURE S-6 Areas of Potential Impact Evaluated for Each Alternative

TABLE S-5 Summary of Major EIS Data and Assumptions

Parameter/Characteristic	Data/Assumption
General	
Paducah DUF_6 inventory	36,191 cylinders; 436,400 t (484,000 tons)
Paducah non-DUF_6 inventory	1,667 cylinders; 17,600 t (19,400 tons)
ETTP DUF_6 inventory	4,822 cylinders; 54,300 t (60,000 tons)
ETTP non-DUF_6 cylinder inventory	1,102 cylinders; 26 t (27 tons)
No Action Alternative	No conversion facility constructed; continued long-term storage of DUF_6 and non-DUF_6 in cylinders at Paducah.
Assessment period	Through 2039, plus long-term impacts
Construction	3 storage yards reconstructed
Cylinder management	Continued surveillance and maintenance activities consistent with current plans and procedures.
Assumed total number of future cylinder breaches:	
Controlled-corrosion case	36
Uncontrolled-corrosion case	444
Action Alternatives	Build and operate a conversion facility at the Paducah site for conversion of the Paducah DUF_6 inventory.
Construction start	2004
Construction period	≈2 years
Start of operations	2006
Operational period	25 years (28 years if ETTP cylinders are converted at Paducah)
Facility footprint	10 acres (4 ha)
Facility throughput	18,000 t/yr (20,000 tons/yr) DUF_6
Conversion products	
Depleted U_3O_8	14,300 t/yr (15,800 tons/yr)
CaF_2	24 t/yr (26 tons/yr)
70% HF acid	3,300 t/yr (3,600 tons/yr)
49% HF acid	7,700 t/yr (8,500 tons/yr)
Steel (empty cylinders, if not used as disposal containers)	1,980 t/yr (2,200 tons/yr)

S.5 CONSEQUENCES AND COMPARISON OF ALTERNATIVES

This EIS analyzes potential impacts at the Paducah site under the no action alternative and the proposed action alternatives. Under the no action alternative, potential impacts associated with the continued storage of DUF_6 cylinders in yards are evaluated through 2039; in addition, the long-term impacts that could result from releases of DUF_6 and HF from future cylinder breaches are evaluated. For the proposed action, potential impacts are evaluated at three alternative locations for a construction period of 2 years and an operational period of 25 years.

The potential environmental impacts at Paducah under the proposed action alternatives and the no action alternative are presented in Table S-6 (placed at the end of this summary). To supplement the information in Table S-6, each area of impact evaluated in this EIS is discussed below. Major similarities and differences among the alternatives are highlighted. Additional details and discussion are provided in Chapter 5 for each alternative.

S.5.1 Human Health and Safety — Construction and Normal Facility Operations

Under the no action alternative and the action alternatives, it is estimated that potential exposures of workers and members of the general public to radiation and chemicals would be well within applicable public health standards and regulations during normal facility operations (including 10 CFR 835, 40 CFR 61 Subpart H, and DOE Order 5400.5). The estimated doses and risks from radiation and/or chemical exposures of the general public and noninvolved workers would be very low, with zero latent cancer fatalities (LCFs) expected among these groups over the time periods considered, and with minimal adverse health impacts from chemical exposures expected. (Dose and risk estimates are shown in Table S-6.) In general, the location of a conversion facility within the Paducah site would not significantly affect potential impacts (i.e., no significant differences in impacts from Location A, B, or C were identified) to workers or the general public during normal facility operations. Construction workers at Locations A and C and cylinder yard reconstruction workers under the no action alternative would receive low doses (i.e., up to 40 mrem/yr for the action alternatives and up to 230 mrem/yr for the no action alternative) because of the proximity of the construction sites to the cylinder yards.

Key Concepts in Estimating Risks from Radiation

The health effect of concern from exposure to radiation at levels typical of environmental and occupational exposures is the inducement of cancer. Radiation-induced cancers may take years to develop following exposure and are generally indistinguishable from cancers caused by other sources. Current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, can result in detrimental health effects (cancer) and that the number of effects produced is in direct proportion to the radiation dose. Therefore, doubling the radiation dose is assumed to result in doubling the number of induced cancers. This approach is called the "linear-no-threshold hypothesis" and is generally considered to result in conservative estimates (i.e., over-estimates) of the health effects from low doses of radiation.

Involved workers (persons directly involved in the handling of radioactive or hazardous materials) could be exposed to low-level radiation emitted by uranium during the normal course of their work activities, and this exposure could result in a slight increase in the risk for radiation-induced LCFs to individual involved workers. (The possible presence of TRU and Tc contamination in the cylinder inventory would not contribute to exposures during normal operations.) The annual number of workers exposed could range from about 40 (under the no action alternative) to 172 under the action alternatives. Under the no action alternative, it is estimated that radiation exposure of involved workers would result in a 1-in-2 chance of one additional LCF among the entire involved worker population over the life of the project. Under the action alternatives, a 1-in-7 chance of one additional LCF among involved workers over the life of the project was estimated.

Possible radiological exposures from using groundwater potentially contaminated as a result of releases from breached cylinders or facility releases were also evaluated. In general, these exposures would be at very low levels and within applicable public health standards and regulations. However, the uranium concentration in groundwater could exceed 20 μg/L (the drinking water guideline used for comparison in this EIS) at some time in the future under the no action alternative if cylinder corrosion was not controlled. This scenario is highly unlikely because ongoing cylinder inspections and maintenance would prevent significant releases from occurring.

S.5.2 Human Health and Safety — Facility Accidents

S.5.2.1 Physical Hazards

Under all alternatives, workers could be injured or killed as a result of on-the-job accidents unrelated to radiation or chemical exposure. On the basis of accident statistics for similar industries, it is estimated that under the no action alternative, zero fatalities and about 84 injuries might occur through 2039 at the Paducah site (about 2 injuries per year). Under the action alternatives, the risk of physical hazards would not depend on the location of the conversion facility. No fatalities are predicted, but about 11 injuries during construction and about 200 injuries during operations could occur at the conversion facility (about 6 injuries per year during a 2-year construction period and 8 injuries per year during operations). Accidental injuries and deaths are not unusual in industries that use heavy equipment to manipulate heavy objects and bulk materials.

S.5.2.2 Facility Accidents Involving Radiation or Chemical Releases

Under all alternatives, it is possible that accidents could release radiation or chemicals to the environment, potentially affecting workers and members of the general public. Of all the accidents considered, those involving DUF_6 cylinders and those involving chemicals at the conversion facility would have the largest potential effects.

The cylinder management plan (Commonwealth of Kentucky and DOE 2003) outlines required cylinder maintenance activities and procedures to be undertaken in the event of a cylinder breach and/or release of DUF_6 from one or more cylinders. Under all alternatives, there is a low probability that accidents involving DUF_6 cylinders could occur at the current storage locations. If an accident occurred, DUF_6 could be released to the environment. If a release occurred, the DUF_6 would combine with moisture in the air, forming gaseous HF and UO_2F_2, a soluble solid in the form of small particles. The depleted uranium and HF could be dispersed downwind, potentially exposing workers and members of the general public to radiation and chemical effects. The amount released would depend on the severity of the accident and the number of cylinders involved. The probability of cylinder accidents would decrease under the action alternatives as the DUF_6 was converted and the number of cylinders in storage decreased as a result.

Health Effects from Accidental Chemical Releases

The impacts from accidental chemical releases were estimated by determining the numbers of people downwind who might experience adverse effects and irreversible adverse effects:

Adverse Effects: Any adverse health effects from exposure to a chemical release, ranging from mild and transient effects, such as respiratory irritation or skin rash (associated with lower chemical concentrations), to irreversible (permanent) effects, including death or impaired organ function (associated with higher chemical concentrations).

Irreversible Adverse Effects: A subset of adverse effects, irreversible adverse effects are those that generally occur at higher concentrations and are permanent in nature. Irreversible effects may include death, impaired organ function (such as central nervous system or lung damage), and other effects that may impair everyday functions.

For releases involving DUF_6 and other uranium compounds, both chemical and radiological effects could occur if the material was ingested or inhaled. The chemical effect of most concern associated with internal uranium exposure is kidney damage, and the radiological effect of concern is an increase in the probability of developing cancer. With regard to uranium, chemical effects occur at lower exposure levels than do radiological effects. Exposure to HF from accidental releases could result in a range of health effects, from eye and respiratory irritation to death, depending on the exposure level. Large anhydrous NH_3 releases could also cause severe respiratory irritation and death (NH_3 is used to generate hydrogen, which is required for the conversion process).

Chemical and radiological exposures to involved workers under accident conditions would depend on how rapidly the accident developed, the exact location and response of the workers, the direction and amount of the release, the physical forces causing or caused by the accident, meteorological conditions, and the characteristics of the room or building if the accident occurred indoors. Impacts to involved workers under accident conditions would likely be dominated by physical forces from the accident itself; thus, quantitative dose/effect estimates would not be meaningful. For these reasons, the impacts to involved workers during accidents are not quantified in this EIS. However, it is recognized that injuries and fatalities among involved workers would be possible if an accident did occur.

Under the no action alternative, for accidents involving cylinders that might happen at least once in 100 years (i.e., likely accidents [see text box]), it is estimated that the off-site concentrations of HF and uranium would be considerably below levels that would cause adverse chemical effects among members of the general public from exposure to these chemicals. However, up to 10 noninvolved workers might experience potential adverse effects from exposure to HF and uranium (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function). It is estimated that one noninvolved worker might experience potential irreversible adverse effects that are permanent in nature (such as lung damage or kidney damage), with no fatalities expected. Radiation exposures would be unlikely to result in additional LCFs among noninvolved workers or members of the general public for these types of accidents.

Cylinder accidents that are less likely to occur could be more severe, having greater consequences that could potentially affect off-site members of the general public. These types of accidents are considered extremely unlikely, expected to occur with a frequency of between once in 10,000 years and once in 1 million years of operations. Based on the expected frequency, through 2039, the probability of this type of accident was estimated to be about 1 chance in 2,500. Among all the cylinder accidents analyzed, the postulated accident that would result in the largest number of people with adverse effects (including mild and temporary as well as permanent effects) would be an accident that involves rupture of cylinders in a fire. If this type of accident occurred at the Paducah site, it is estimated that up to 2,000 members of the general public and 910 noninvolved workers might experience adverse chemical effects from HF and uranium exposure (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function). It is estimated that more adverse effects would occur among the general public than among noninvolved workers because of the buoyancy effects from the fire on contaminant plume spread (i.e., the concentrations that would occur would be higher at points farther from the release than at closer locations).

The postulated cylinder accident that would result in the largest number of persons with irreversible adverse health effects is a corroded cylinder spill under wet conditions, with an estimated frequency of between once in 10,000 years and once in 1 million years of operations. If this accident occurred, it is estimated that 1 member of the general public and 300 noninvolved workers might experience irreversible adverse effects (such as lung damage or kidney damage). No fatalities are expected among the members of the general public; there would be a potential for 3 fatalities among noninvolved workers from chemical effects. Radiation exposures would be unlikely to result in additional LCFs among noninvolved workers (1 chance in 170) or the general public (1 chance in 70).

Accident Categories and Frequency Ranges

Likely: Accidents estimated to occur one or more times in 100 years of facility operations (frequency $\geq 1 \times 10^{-2}$/yr).

Unlikely: Accidents estimated to occur between once in 100 years and once in 10,000 years of facility operations (frequency = from 1×10^{-2}/yr to 1×10^{-4}/yr).

Extremely Unlikely: Accidents estimated to occur between once in 10,000 years and once in 1 million years of facility operations (frequency = from 1×10^{-4}/yr to 1×10^{-6}/yr).

Incredible: Accidents estimated to occur less than one time in 1 million years of facility operations (frequency $< 1 \times 10^{-6}$/yr).

In addition to the cylinder accidents discussed above is a certain class of accidents that the DOE investigated; however, because of security concerns, information about such accidents is not available for public review but is presented in a classified appendix to the EIS. All classified information will be presented to state and local officials, as appropriate.

The number of persons actually experiencing adverse or irreversible adverse effects from cylinder accidents would likely be considerably fewer than those estimated for this analysis and would depend on the actual circumstances of the accident and the individual chemical sensitivities of the affected persons. For example, although exposures to releases from cylinder accidents could be life-threatening (especially with respect to immediate effects from inhalation of HF at high concentrations), the guideline exposure level of 20 parts per million (ppm) of HF used to estimate the potential for irreversible adverse effects from HF exposure is likely to result in overestimates. This is because no animal or human deaths have been known to occur as a result of acute exposures (i.e., 1 hour or less) at concentrations of less than 50 ppm; generally, if death does not occur quickly after HF exposure, recovery is complete.

Similarly, the guideline intake level of 30 mg used to estimate the potential for irreversible adverse effects from the intake of uranium in this EIS is the level suggested in NRC guidance. This level is somewhat conservative; that is, it is intended to overestimate rather than underestimate the potential number of irreversible adverse effects in the exposed population following uranium exposure. In more than 40 years of cylinder handling activities, no accidents involving releases from cylinders containing *solid* UF_6 have occurred that have caused diagnosable irreversible adverse effects among workers. In previous accidental exposure incidents involving *liquid* UF_6 in gaseous diffusion plants, some worker fatalities occurred immediately after the accident as a result of inhalation of HF generated from the UF_6. However, no fatalities occurred as a result of the toxicity of the uranium exposure. A few workers were exposed to amounts of uranium estimated to be about three times the guideline level (30 mg) used for assessing irreversible adverse effects; none of these workers, however, actually experienced such effects.

Under the action alternatives, low-probability accidents involving chemicals at the conversion facility could have large potential consequences for noninvolved workers and members of the general public. At a conversion site, accidents involving chemical releases, such as NH_3 and HF, could occur. NH_3 is used to generate hydrogen for conversion, and HF can be produced as a co-product of converting DUF_6. Although the UDS proposal uses NH_3 to generate hydrogen, hydrogen can be produced using natural gas. In that case, the accident impacts would be less than those discussed in this section for NH_3 accidents. (Further details are provided about potential NH_3 and other accidents in Section 5.2.2.2 for the conversion facility and in Section 5.2.3 for transportation.)

The conversion accident estimated to have the largest potential consequences is an accident involving the rupture of an anhydrous NH_3 tank. Such an accident could be caused by a large earthquake and is expected to occur with a frequency of less than once in 1 million years per year of operations. The probability of this type of accident occurring during the operation of a conversion facility is a function of the period of operation; over 25 years of operations, the accident probability would be less than 1 chance in 40,000.

If an NH_3 tank ruptured at the conversion facility, a maximum of up to about 6,700 members of the general public might experience adverse effects (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function) as a result of chemical exposure. A maximum of about 370 people might experience irreversible adverse effects (such as lung damage or kidney damage), with the potential for about 7 fatalities. With regard to noninvolved workers, up to about 1,600 workers might experience adverse effects (mild and temporary) as a result of chemical exposures. A maximum of about 1,600 noninvolved workers might experience irreversible adverse effects, with the potential for about 30 fatalities.

The location of the conversion facility within the Paducah site would affect the number of noninvolved workers who might experience adverse or irreversible adverse effects from an HF or NH_3 tank rupture accident. However, the accident analyses indicate that the impacts would not be consistently higher or lower at any of the alternative locations.

Although such high-consequence accidents at a conversion facility are possible, they are expected to be extremely rare. The risk (defined as consequence × probability) for these accidents would be less than 1 fatality and less than 1 irreversible adverse health effect for noninvolved workers and members of the public combined. NH_3 and HF are commonly used for industrial applications in the United States, and there are well-established accident prevention and mitigative measures for HF and NH_3 storage tanks. These include storage tank siting principles, design recommendations, spill detection measures, and containment measures. These measures would be implemented, as appropriate.

Under the action alternatives, the highest consequence radiological accident is estimated to be an earthquake damaging the depleted U_3O_8 product storage building. If this accident occurred, it is estimated that about 180 lb (82 kg) of depleted U_3O_8 would be released to the atmosphere outside of the building. The maximum collective dose received by the general public and the noninvolved workers would be about 70 person-rem and 1,300 person-rem, respectively. There would be about a 1-in-40 chance of an LCF among the general public and a 1-in-5 chance of an LCF among the noninvolved workers. Because the accident has a probability of occurrence that is about 1 chance in 4,000, the risk posed by the accident would be essentially zero LCFs among both the public and the workers.

S.5.3 Human Health and Safety — Transportation

Under the no action alternative, only small amounts of the LLW and low-level radioactive mixed waste (LLMW) that would be generated during routine cylinder maintenance activities would require transportation (about one shipment per year). Only negligible impacts are expected from such shipments. No DUF_6 or non-DUF_6 cylinders would be transported between sites.

Under the action alternatives, the number of shipments would include the following:

1. If U_3O_8 was disposed of in emptied cylinders, there would be approximately 7,240 railcar shipments of depleted U_3O_8 from the conversion facility to Envirocare (proposed) or NTS (option), or up to 36,200 truck shipments

(alternative) to either Envirocare or NTS. The numbers of shipments would be about 16,400 for trucks or 4,100 for railcars if bulk bags were used as disposal containers.

2. About 15,300 truck or 3,060 railcar shipments of aqueous (70% and 49%) HF could occur; alternatively, the aqueous HF could be neutralized to CaF_2, requiring a total of about 25,000 truck or 6,300 railcar shipments. Currently, the destination for these shipments is not known.

3. About 1,300 truck or 650 railcar shipments of anhydrous NH_3 from a supplier to the site. Currently, the origin of these shipments is not known.

4. Emptied heel cylinders to Envirocare or NTS, if bulk bags were used to dispose of the depleted U_3O_8.

5. For the option of shipping ETTP cylinders to Paducah, approximately 5,400 truck or 1,400 railcar shipments of cylinders from ETTP.

During normal transportation operations, radioactive material and chemicals would be contained within their transport packages. Health impacts to crew members (i.e., workers) and members of the general public along the routes could occur if they were exposed to low-level external radiation in the vicinity of uranium material shipments. In addition, exposure to vehicle emissions (engine exhaust and fugitive dust) could potentially cause latent fatalities from inhalation.

The risk estimates for emissions are based on epidemiological data that associate mortality rates with particulate concentrations in ambient air. (Increased latent mortality rates resulting from cardiovascular and pulmonary diseases have been linked to incremental increases in particulate concentrations.) Thus, the increase in ambient air particulate concentrations caused by a transport vehicle, with its associated fugitive dust and diesel exhaust emissions, is related to such premature latent fatalities in the form of risk factors. Because of the conservatism of the assumptions made to reconcile results among independent epidemiological studies and associated uncertainties, the latent fatality risks estimated for normal vehicle emissions should be considered to be an upper bound.[3] For the transport of conversion products and co-products (depleted U_3O_8, aqueous HF, and emptied cylinders, if not used as disposal containers), it is conservatively estimated that a total of up to 20 fatalities from vehicle emissions could occur if shipments were only by truck and if aqueous HF product was sold and transported 620 mi (1,000 km) from the site (about 30 fatalities are estimated if HF was neutralized to CaF_2 and transported 620 mi [1,000 km]). The number of fatalities occurring from exhaust emissions if shipments were only by rail would be less than 1 if HF was sold and about 1 if the HF was neutralized to CaF_2.

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3 For perspective, in a recently published EIS for a geologic repository at Yucca Mountain, Nevada, the same risk factors were used for vehicle emissions; however, they were adjusted to reduce the amount of conservatism in the estimated health impacts. As reported in the Yucca Mountain EIS, the adjustments resulted in a reduction in the emission risks by a factor of about 30.

Exposure to external radiation during normal transportation operations is estimated to cause less than 1 LCF under both truck and rail options. Members of the general public living along truck and rail transportation routes would receive extremely small doses of radiation from shipments, about 0.1 mrem or less over the duration of the program. This would be true even if a single person was exposed to every shipment of radioactive material during the program.

Traffic accidents could occur during the transportation of radioactive materials and chemicals. These accidents could potentially affect the health of workers (i.e., crew members) and members of the general public, either from the accident itself or from accidental releases of radioactive materials or chemicals.

The total number of traffic fatalities (unrelated to the type of cargo) was estimated on the basis of national traffic statistics for shipments by both truck and rail. If the aqueous HF was sold to users about 620 mi (1,000 km) from the site, about 2 traffic fatalities under the truck option would be estimated and 1 traffic fatality would be estimated under the rail option. If HF was neutralized to CaF_2, about 4 fatalities would be estimated for the truck option, and 2 fatalities for the rail option.

Severe transportation accidents could also result in a release of radioactive material or chemicals from a shipment. The consequences of such a release would depend on the material released, location of the accident, and atmospheric conditions at the time. Potential consequences would be greatest in urban areas because more people could be exposed. Accidents that occurred when atmospheric conditions were very stable (typical of nighttime) would have higher potential consequences than accidents that occurred when conditions were unstable (i.e., turbulent, typical of daytime) because the stability would determine how quickly the released material dispersed and diluted to lower concentrations as it moved downwind.

For the action alternatives, the highest potential accident consequences during transportation activities would be caused by a rail accident involving anhydrous NH_3. Although anhydrous NH_3 is a hazardous gas, it has many industrial applications and is commonly safely transported by industry as a pressurized liquid in trucks and rail tank cars.

The occurrence of a severe anhydrous NH_3 railcar accident in a highly populated urban area under stable atmospheric conditions is extremely rare. The probability of such an accident occurring if all the anhydrous NH_3 needed was transported 620 mi (1,000 km) is estimated to be less than 1 chance in 200,000. Nonetheless, if such an accident (i.e., release of anhydrous NH_3 from a railcar in a densely populated urban area under stable atmospheric conditions) occurred, up to 5,000 persons might experience irreversible adverse effects (such as lung damage), with the potential for about 100 fatalities. If the same type of NH_3 rail accident occurred in a typical rural area, which would have a smaller population density than an urban area, potential impacts would be considerably less. It is estimated that in a rural area, approximately 20 persons might experience irreversible adverse effects, with no expected fatalities. The atmospheric conditions at the time of an accident would also significantly affect the consequences of a severe NH_3 accident. The consequences of an NH_3 accident would be less severe under unstable conditions, the most likely conditions in the daytime. Unstable conditions would result in more rapid dispersion of the airborne NH_3 plume and lower downwind concentrations. Under unstable conditions in an urban area, approximately 400 persons could experience irreversible adverse effects, with the potential for about 8 fatalities. If the accident occurred in a rural area under unstable conditions, one person would be expected to experience an irreversible adverse effect, with zero fatalities expected. When the probability of an NH_3 accident occurring is taken into account, it is expected that no irreversible adverse effects and no fatalities would occur over the shipment period.

For perspective, anhydrous NH_3 is routinely shipped commercially in the United States for industrial and agricultural applications. On the basis of information provided in the DOT *Hazardous Material Incident System (HMIS) Database*, for 1990 through 2002, 2 fatalities and 19 major injuries to the public or to transportation or emergency response personnel have occurred as a result of anhydrous NH_3 releases during nationwide commercial truck and rail operations. These fatalities and injuries occurred during transportation or loading and unloading operations. Over that period, truck and rail NH_3 spills resulted in more than 1,000 and 6,000 evacuations, respectively. Five very large spills, more than 10,000 gal (38,000 L), have occurred; however, these spills were all en route derailments from large rail tank cars. The two largest spills, both around 20,000 gal (76,000 L), occurred in rural or lightly populated areas and resulted in 1 major injury. Over the past 30 years, the safety record for transporting anhydrous NH_3 has significantly improved. Safety measures contributing to this improved safety record include the installation of protective devices on railcars, fewer derailments, closer manufacturer supervision of container inspections, and participation of shippers in the Chemical Transportation Emergency Center.

After anhydrous NH_3, the types of accidents that are estimated to result in the second highest consequences are those involving shipment of 70% aqueous HF produced during the conversion process. The estimated numbers of irreversible adverse effects for 70% HF rail accidents are about one-third of those from the anhydrous NH_3 accidents. However, the number of estimated fatalities is about one-sixth of those from NH_3 accidents, because the percent of fatalities among the individuals experiencing irreversible adverse effects is 1% as opposed to 2% for NH_3 exposures. For perspective, since 1971, the period covered by DOT records, no fatal or serious injuries to the public or to transportation or emergency response personnel have occurred as a result of anhydrous HF releases during transportation. (Most of the HF transported in the United States is anhydrous HF, which is more hazardous than aqueous HF.) Over that period, 11 releases from railcars were reported to have no evacuations or injuries associated with them. The only major release (estimated at 6,400 lb [29,000 kg] of HF) occurred in 1985 and resulted in approximately 100 minor injuries. Another minor HF release during transportation occurred in 1990. The safety record for transporting HF has improved in the past 10 years for the same reasons as those discussed above for NH_3. Transportation accidents involving the shipment of DUF_6 cylinders were also evaluated, with the estimated consequences being less than those discussed above for NH_3 and HF (see Section 5.2.5.3).

S.5.4 Air Quality and Noise

Under the no action alternative, air quality from construction and operations would be within national and state ambient air quality standards. However, estimated concentrations of particulate matter (PM) that could be generated during yard reconstruction activities at Paducah would be close to air quality standards; these temporary emissions could be controlled by good construction practices. Continued cylinder maintenance and painting are expected to be effective in controlling corrosion, and concentrations of HF would be kept within regulatory standards at the Paducah site.

Under the action alternatives, air quality impacts during construction were found to be similar for all three alternative locations. The total (modeled plus the measured background value representative of the site) concentrations due to emissions of most criteria pollutants — such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide (CO) — would be well within applicable air quality standards. As is often the case for construction, the primary concern would be PM released from near-ground-level sources. Total concentrations of PM_{10} and $PM_{2.5}$ (PM with an aerodynamic diameter of 10 μm or less and 2.5 μm or less, respectively) at the construction site boundary would be close to or above the standards because of the high background concentrations and the proposed facility's proximity to potentially publicly accessible areas. Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality. To mitigate impacts, water could be sprayed on disturbed areas more often, and dust suppressant or pavement could be applied to roads with frequent traffic.

During operations, it is estimated that total concentrations for all criteria pollutants (except for $PM_{2.5}$) would be well within standards. The background level of annual average $PM_{2.5}$ in the area of the Paducah site approaches the standard. Again, impacts during operations were found to be similar for all three alternative locations.

Noise impacts are expected to be negligible under the no action alternative. Under the action alternatives, estimated noise levels at the nearest residence (located 1.3 km [0.8 mi] from the construction location) would be below the U.S. Environmental Protection Agency (EPA) guideline of 55 dB(A)[4] as day-night average sound level (DNL)[5] for residential zones during construction and operations.

S.5.5 Water and Soil

Under the no action alternative, uranium concentrations in surface water, groundwater, and soil would remain below guidelines throughout the project duration. However, if cylinder maintenance and painting were not effective in reducing cylinder corrosion rates, the uranium concentration in groundwater could be greater than the guideline at some time in the future (no earlier than about 2100). If continued cylinder maintenance and painting were effective in

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4 dB(A) is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in the *American National Standard Specification for Sound Level Meters*, ANSI S1.4-1983, and in Amendment S1.4A-1985.

5 DNL is the 24-hour average sound level, expressed in dB(A), with a 10-dB penalty artificially added to the nighttime (10 p.m.–7 a.m.) sound level to account for noise-sensitive activities (e.g., sleep) during these hours.

controlling corrosion, as expected, groundwater uranium concentrations would remain less than the guideline.

During construction of the conversion facility, construction material spills could contaminate surface water, groundwater, or soil. However, by implementing storm water management, sediment and erosion control (e.g., temporary and permanent seeding; mulching and matting; sediment barriers, traps, and basins; silt fences; runoff and earth diversion dikes), and good construction practices (e.g., covering chemicals with tarps to prevent interaction with rain, promptly cleaning up any spills), concentrations in soil and wastewater (and therefore surface water and groundwater) could be kept well within applicable standards or guidelines.

During operations, no appreciable impacts on surface water or groundwater would result from the conversion facility because no contaminated liquid effluents are anticipated, and because airborne emissions would be at very low levels (e.g., <0.25 g/yr of uranium). Impacts among the three alternative locations would be similar.

Contaminated soil associated with solid waste management unit (SWMU) 194 could be excavated during construction at Locations A and C; these soils would be managed as described in Section S.5.8.

S.5.6 Socioeconomics

The socioeconomic analysis evaluates the effects of construction and operation on population, employment, income, regional growth, housing, and community resources in the region of influence (ROI) around the site. In general, socioeconomic impacts tend to be positive, creating jobs and income, with only minor impacts on housing, public finances, and employment in local public services.

The no action alternative would result in a small socioeconomic impact, creating 110 jobs during cylinder yard reconstruction (over 2 construction years) and 130 jobs during operations (direct and indirect jobs) and generating $3.2 million in personal income during construction and $3.8 million in personal income per operational year. No significant impacts on regional growth and housing, local finances, and public service employment in the ROI are expected.

Under the action alternatives, jobs and direct income would be generated during both construction and operation. Construction of the conversion facility would create 290 jobs and generate almost $10 million in personal income in the peak construction year (construction occurs over a 2-year period). Operation of the conversion facility would create 330 jobs and generate $13 million in personal income each year. Only minor impacts on regional growth and housing, local finances, and public service employment in the ROI are expected. The socioeconomic impacts are not dependent on the location of the conversion facility; therefore, the impacts would be the same for alternative Locations A, B, and C.

S.5.7 Ecology

Under the no action alternative, continued cylinder maintenance and surveillance activities would have negligible impacts on ecological resources (i.e., vegetation, wildlife, threatened and endangered species). Only a small amount of yard reconstruction, in a previously disturbed area, would occur at the Paducah site. It is estimated that potential concentrations of contaminants in the environment from future cylinder breaches would be below levels harmful to biota. However, there is a potential for impacts to aquatic biota from cylinder yard runoff during painting activities.

For the action alternatives, the total area disturbed during conversion facility construction would be 45 acres (18 ha). Vegetation communities would be impacted in this area with a loss of habitat. However, for all three alternative locations, impacts could be minimized depending on exactly where the facility was placed within each location. These habitat losses would constitute less than 1% of available land at the site. It was found that concentrations of contaminants in the environment during operations would be below harmful levels. Negligible impacts to vegetation and wildlife are expected at all locations.

Wetlands at or near Locations A, B, and C could be adversely affected at the Paducah site. Impacts to wetlands could be minimized depending on where exactly the facility was placed within each location. Mitigation for unavoidable impacts may be developed in coordination with the appropriate regulatory agencies. Unavoidable impacts to wetlands that are within the jurisdiction of the U.S. Army Corps of Engineers may require a Clean Water Act (CWA) Section 404 Permit, which would trigger the requirement for a CWA Section 401 water quality certification from the Commonwealth of Kentucky. A mitigation plan might be required prior to the initiation of construction.

Construction of the conversion facility in the eastern portion of Location C could impact potential habitat for cream wild indigo (state-listed as a species of special concern) and compass plant (state-listed as threatened). For construction at all three locations, impacts on deciduous forest might occur. Impacts to forested areas could be avoided if temporary construction areas were placed in previously disturbed locations. Trees with exfoliating bark, such as shagbark hickory or dead trees with loose bark, can be used by the Indiana bat (federal- and state-listed as endangered) as roosting trees during the summer. If either live or dead trees with exfoliating bark are encountered on construction areas, they should be saved if possible. If necessary, the trees should be cut before March 31 or after October 15.

S.5.8 Waste Management

Under the no action alternative, LLW, LLMW, and PCB-containing waste could be generated from cylinder scraping and painting activities. The amount of LLMW generated could represent an increase of less than 1% in the site's LLMW load, representing a negligible impact on site waste management operations.

Under the action alternatives, waste management impacts would not depend on the location of the conversion facility within the site and would be the same for alternative Locations A, B, and C. Waste generated during construction and operations would have negligible impacts on the Paducah site waste management operations, with the exception of possible impacts from disposal of CaF_2. Industrial experience indicates that HF, if produced, would contain only trace amounts of depleted uranium (less than 1 ppm). It is expected that HF would be sold for use. If sold for use, the sale would be subject to review and approval by DOE in coordination with the NRC, depending on the specific use (as discussed in Appendix E of this EIS).

The U_3O_8 produced during conversion would generate about 7,850 yd^3 (6,000 m^3) per year of LLW. This is 83% of Paducah's annual projected LLW volume and could have potentially large impacts on site LLW management. However, plans for off-site disposal of this LLW are included in the proposed action.

If the HF was not sold but instead neutralized to CaF_2, it is currently unknown whether (1) the CaF_2 could be sold, (2) the low uranium content would allow the CaF_2 to be disposed of as nonhazardous solid waste, or (3) disposal as LLW would be required. The low level of uranium contamination expected (i.e., less than 1 ppm) suggests that sale or disposal as nonhazardous solid waste would be most likely. If sold for use, the sale would be subject to review and approval by DOE in coordination with the NRC, depending on the specific use. Waste management for disposal as nonhazardous waste could be handled through appropriate planning and design of the facilities. If the CaF_2 had to be disposed of as LLW, it could represent a potentially large impact on waste management operations.

A small quantity of TRU could be entrained in the gaseous DUF_6 during the cylinder emptying operations. These contaminants would be captured in the filters between the cylinders and the conversion equipment. The filters would be monitored and replaced routinely to maintain concentrations below regulatory limits for TRU waste. The spent filters would be disposed of as LLW, generating up to 25 drums of LLW waste over the life of the project.

Current UDS plans are to leave the heels in the emptied cylinders, add a stabilizer, and use the cylinders as disposal containers for the U_3O_8 product, to the extent practicable. An alternative is to process the emptied cylinders and dispose of them directly as LLW. Either one of these approaches is expected to meet the waste acceptance criteria of the disposal facilities and minimize the potential for generating TRU waste through washing of the cylinders to remove the heels. Although cylinder washing is not considered a foreseeable option at this time, for completeness, an analysis of the maximum potential quantities of TRU waste that could be generated from cylinder washing is included in Appendix B of this EIS, as is a discussion of PCBs contained in some cylinder coatings.

In addition, potentially contaminated soil associated with SWMU 194 could be excavated during construction at Locations A and B. The excavated soil would be managed consistent with Resource Conservation and Recovery Act (RCRA) regulations and coordinated between the Commonwealth of Kentucky (Division of Waste Management) and DOE.

S.5.9 Resource Requirements

Resource requirements include construction materials, fuel, electricity, process chemicals, and containers. In general, all alternatives would have a negligible effect on the local or national availability of these resources.

S.5.10 Land Use

Under the no action alternative, all activities would occur in areas previously used for conducting similar activities; therefore, no land use impacts are expected. Under the action alternatives, a total of 45 acres (18 ha) could be disturbed, with some areas cleared for railroad or utility access and not adjacent to the site. All three alternative locations are within an already-industrialized facility, and impacts to land use would be similar for the three alternative locations. The permanently altered areas represent less than 1% of available land already developed for industrial purposes. Negligible impacts on land use are thus expected.

S.5.11 Cultural Resources

Under the no action alternative, impacts on cultural resources at the current storage locations would be unlikely because all activities would occur in areas already dedicated to cylinder storage. Under the action alternatives, impacts on cultural resources could be possible. Archaeological and architectural surveys have not been completed for the candidate locations and must be undertaken prior to initiation of the action alternatives. However, if archaeological resources were encountered, or historical or traditional cultural properties were identified, a mitigation plan would be required.

S.5.12 Environmental Justice

No disproportionately high and adverse human health or environmental impacts are expected to minority or low-income populations during normal facility operations under the action alternatives. Although the consequences of facility accidents could be high if severe accidents occurred, the risk of irreversible adverse effects (including fatalities) among members of the general public from these accidents (taking into account the consequences and probability of the accidents) would be less than 1. Furthermore, transportation accidents with high and adverse impacts are unlikely; their locations cannot be projected, and the types of persons who would be involved cannot be reliably predicted. Thus, there is no reason to expect that minority and low-income populations would be affected disproportionately by high and adverse impacts.

S.5.13 Option of Shipping ETTP Cylinders to Paducah

If cylinders from ETTP were transported to Paducah, the cylinders would have to be prepared to be shipped by either truck or rail. Approximately 4,800 DUF_6 cylinders for conversion and about 1,100 non-DUF_6 cylinders would require preparation for shipment at ETTP. Three cylinder preparation options are considered for the shipment of noncompliant cylinders.

In general, the use of cylinder overpacks would result in small potential impacts. Overpacking operations would be similar to current cylinder handling operations, and impacts would be limited to involved workers. No LCFs among involved workers from radiation exposure are expected. Impacts would be similar if noncompliant cylinders were shipped “as-is” or following repairs under a DOT exemption, assuming appropriate compensatory measures.

The use of a cylinder transfer facility would likely require the construction of a new facility at ETTP; there are no current plans to build such a facility. Operational impacts would generally be small and limited primarily to external radiation exposure of involved workers, with no LCFs expected. Transfer facility operations would generate a large number of emptied cylinders requiring disposition. If a decision were made to construct and operate a transfer facility at ETTP, additional NEPA review would be conducted.

Impacts from extended operations of the conversion plant from 25 to 28 years would not be expected to significantly increase overall impacts.

S.5.14 Impacts Associated with Conversion Product Sale and Use

The conversion of the DUF_6 inventory produces products having some potential for reuse (no large-scale market exists for depleted U_3O_8). These products include HF and CaF_2, which are commonly used as commercial materials. An investigation of the potential reuse of HF and CaF_2 has been included as part of this EIS. Areas examined include the characteristics of these materials as produced within the conversion process, the current markets for these products, and the potential socioeconomic impacts should these products be provided to the commercial sector. Because there would be some residual radioactivity associated with these materials, the DOE process for authorizing release of materials for unrestricted use (referred to as “free release”) and an estimate of the potential human health effects of such free release have also been included in this investigation. The results of the analysis of HF and CaF_2 use are included in Table S-6.

If the products were to be released for restricted use (e.g., in the nuclear industry for the manufacture of nuclear fuel), the impacts would be less than those for unrestricted release.

Conservative estimates of the amount of uranium and technetium that might transfer into the HF and CaF_2 were used to evaluate the maximum expected dose to workers using the material if it was released for commercial use. On the basis of very conservative assumptions concerning use, the maximum dose to workers was estimated to be less than 1 mrem/yr, much less than the regulatory limit of 100 mrem/yr specified for members of the general public. Doses to the general public would be even lower.

Socioeconomic impact analyses were conducted to evaluate the impacts of the introduction of the conversion-produced HF or CaF_2 into the commercial marketplace. A potential market for the aqueous HF has been identified as the current aqueous HF acid producers. The impact of HF sales on the local economy in which the existing producers are located and on the U.S. economy as a whole is likely to be minimal. No market for the CaF_2 that might be produced in the conversion facility has been identified. Should such a market be found, the impact of CaF_2 sales on the U.S. economy is also predicted to be minimal.

S.5.15 Impacts from D&D Activities

D&D would involve the disassembly and removal of all radioactive and hazardous components, equipment, and structures. For the purposes of analysis in this EIS, it was also assumed that the various buildings would be dismantled and "greenfield" (unrestricted use) conditions would be achieved. The "clean" waste will be sent to a landfill that accepts construction debris. LLW will be sent to a licensed or DOE disposal facility, where it will likely be buried in accordance with the waste acceptance criteria and other requirements in effect at that time. Hazardous and mixed waste will be disposed of in a licensed facility in accordance with regulatory requirements. D&D impacts to involved workers would be primarily from external radiation; expected exposures would be a small fraction of operational doses; no LCFs would be expected. It is estimated that no fatalities and up to five injuries would result from occupational accidents. Impacts from waste management would include a total generation of about 275 yd^3 (210 m^3) of LLW, 157 yd^3 (120 m^3) of LLMW, and 157 yd^3 (120 m^3) of hazardous waste; these volumes would result in low impacts compared with projected site annual generation volumes.

S.5.16 Cumulative Impacts

The Council on Environmental Quality (CEQ) guidelines for implementing NEPA define cumulative effects as the impacts on the environment resulting from the incremental impact of an action under consideration when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7) Activities considered for cumulative analysis include those in the vicinity of the site.

Actions planned at the Paducah site include the continuation of uranium enrichment operations (by USEC), waste management activities, waste disposal activities, environmental restoration activities, and DUF_6 management activities considered in this EIS. Although Portsmouth was identified by USEC in January 2004 as the site of the American Centrifuge Facility, construction and operation of such a facility at Paducah has been included in the cumulative impacts analysis.

Actions occurring near the Paducah site that, because of their diffuse nature, could contribute to existing or future impacts on the site include continued operation of the Tennessee Valley Authority's Shawnee power plant; the Joppa, Illinois, power plant; and the Honeywell International uranium conversion plant in Metropolis, Illinois. Cumulative impacts of these actions at Paducah would be as follows for the no action alternative and the proposed action alternatives:

- The cumulative collective radiological exposure to the off-site population would be well below the maximum DOE dose limit of 100 mrem per year to the off-site maximally exposed individual (MEI) and below the limit of 25 mrem/yr specified in 40 CFR 190 for uranium fuel cycle facilities. Annual individual doses to involved workers would be monitored to maintain exposure below the regulatory limit of 5 rem per year.

- Under the no action alternative cumulative impacts assessment, although less than 1 shipment per year of radioactive wastes is expected from cylinder management activities, up to 14,400 truck shipments could be associated with existing and planned actions (no rail shipments are expected). Under the action alternatives, up to 6,000 rail shipments and 18,600 truck shipments of radioactive material could occur. The cumulative maximum dose to the MEI along the transportation route near the site entrance would be less than 1 mrem per year under all alternatives and for all transportation modes.

- The Paducah site is located in an attainment region. However, the background annual-average $PM_{2.5}$ concentration is near the regulatory standard. Cumulative impacts would not affect attainment status.

- Data from the 2000 annual groundwater monitoring showed that four pollutants exceeded primary drinking water regulation levels in groundwater at the Paducah site. Good engineering and construction practices should ensure that indirect cumulative impacts on groundwater associated with the conversion facility would be minimal.

- Cumulative ecological impacts on habitats and biotic communities, including wetlands, would be negligible to minor for all alternatives. Construction of a conversion facility might remove a type of tree preferred by the Indiana bat; however, this federal- and state-listed endangered species is not known to utilize these areas.

- No cumulative land use impacts are anticipated for any of the alternatives.

- It is unlikely that any noteworthy cumulative impacts on cultural resources would occur under any alternative, and any such impacts would be adequately mitigated before activities for the chosen action would begin.

- Given the absence of high and adverse cumulative impacts for any impact area considered in this EIS, no environmental justice cumulative impacts are anticipated for the Paducah site, despite the presence of disproportionately high percentages of low-income populations in the vicinity.

- Socioeconomic impacts under all alternatives considered are anticipated to be generally positive, often temporary, and relatively small.

S.5.17 Mitigation

On the basis of the analyses conducted for this EIS, the following recommendations can be made to reduce the impacts of the proposed action:

- Current cylinder management activities, including inspecting cylinders, carrying out cylinder maintenance activities (such as painting), and promptly cleaning up releases from any breached DUF_6 cylinders, should be continued to avoid potential future impacts on site air and groundwater. In addition, runoff from cylinder yards should be collected and sampled so that contaminants can be detected and their release to surface water or groundwater can be avoided. If future cylinder painting results in KPDES Permit violations, treating cylinder yard runoff prior to release may be required.

- Temporary impacts on air quality from fugitive dust emissions during reconstruction of cylinder yards or construction of any new facility should be controlled by the best available practices to avoid temporary exceedances of the PM_{10} and $PM_{2.5}$ standard. Technologies that will be used to mitigate air quality impacts during construction include using water sprays on dirt roadways and on bare soils in work areas for dust control; covering open-bodied trucks transporting materials likely to become airborne when full and at all times when in motion; water spraying and covering bunkered or staged excavated and replacement soils; maintaining paved roadways in good repair and in a clean condition; using barriers and windbreaks around construction areas such as soil banks, temporary screening, and/or vegetative cover; mulching or covering exposed bare soil areas until vegetation has time to recover or paving has been installed; and prohibiting any open burning.

- During construction, impacts to water quality and soil can be minimized through implementing storm water management, sediment and erosion controls (e.g., temporary and permanent seeding; mulching and matting; sediment barriers, traps, and basins; silt fences; runoff and earth diversion dikes), and good construction practices (e.g., covering chemicals with tarps to prevent interaction with rain, promptly cleaning up any spills).

- Potential impacts to wetlands at the Paducah site could be minimized or eliminated by maintaining a buffer near adjacent wetlands during construction. Mitigation for unavoidable impacts may be developed in coordination with the appropriate regulatory agencies.

- If trees (either live or dead) with exfoliating bark are encountered on construction areas, they should be saved if possible to avoid destroying potential habitat for the Indiana bat. If necessary, the trees should be cut before March 31 or after October 15.

- The quantity of radioactive and hazardous materials stored on site, including the products of the conversion process, should be minimized.

- The construction of a DUF_6 conversion facility at Paducah would have the potential to impact cultural resources. Neither an archaeological nor an architectural survey has been completed for the Paducah site as a whole or for any of the alternative locations, although an archaeological sensitivity study has been conducted. In accordance with Section 106 of the National Historic Preservation Act, the adverse effects of this undertaking must be evaluated once a location is chosen.

- Testing should be conducted either prior to or during the conversion facility startup operations to determine if the air vented from the autoclaves should be monitored or if any alternative measures would need to be taken to ensure that worker exposures to PCBs above allowable Occupational Safety and Health Administration limits do not occur.

- The nuclear properties of DUF_6 are such that the occurrence of a nuclear criticality is not a concern, regardless of the amount of DUF_6 present. However, criticality is a concern for the handling, packaging, and shipping of enriched UF_6. For enriched UF_6, criticality control is accomplished by employing, individually or collectively, specific limits on uranium-235 enrichment, mass, volume, geometry, moderation, and spacing for each type of cylinder. The amount of enriched UF_6 that may be contained in an individual cylinder and the total number of cylinders that may be transported together are determined by the nuclear properties of enriched UF_6. Spacing of enriched UF_6 cylinders in transit during routine and accident conditions is ensured by use of regulatory approval packages that provide protection against impact and fire.

- Because of the relatively high consequences estimated for some accidents, special attention will be given to the design and operational procedures for components that may be involved in such accidents. For example, the tanks holding hazardous chemicals, such as anhydrous NH_3 and aqueous HF, on site would be designed to meet all applicable codes and standards, and special procedures would be in place for gaining access to the tanks and for filling the tanks. In addition, although the probabilities of occurrence for a high-consequence accident are extremely low, emergency response plans and procedures would be in place to respond to any emergencies should an accident occur.

S.5.18 Unavoidable Adverse Impacts

Unavoidable adverse impacts are those impacts that cannot be mitigated by choices associated with siting and facility design options. Such impacts would be unavoidable, no matter which options were selected, and would include the following:

- Exposure of workers to radiation in the storage yards and the conversion facility that would be below applicable standards;

- Generation of vehicle exhaust and particulate air emissions during construction (emissions that would exceed air quality standards would be mitigated);

- Disturbance of up to 45 acres (18 ha) of land during construction, with approximately 10 acres (4 ha) required for the facility footprint;

- Loss of terrestrial and aquatic habitats from construction and disturbance of wildlife during operations; and
- Generation of vehicle exhaust and particulate air emissions during transportation.

S.5.19 Irreversible and Irretrievable Commitment of Resources

A commitment of a resource is considered *irreversible* when the primary or secondary impacts from its use limit the future options for its use. An *irretrievable* commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for later use by future generations. The major irreversible and irretrievable commitments of natural and man-made resources related to the alternatives analyzed in this EIS include the land used to dispose of any conversion products, energy usage, and materials used for construction of the facility that could not be recovered or recycled.

S.5.20 Relationship between Short-Term Use of the Environment and Long-Term Productivity

Disposal of solid nonhazardous waste resulting from new facility construction, operations, and D&D would require additional land at a sanitary landfill site, which would be unavailable for other uses in the long term. Any radioactive or hazardous waste generated by the various alternatives would involve the commitment of associated land, transportation, and disposal resources, and resources associated with the processing facilities for waste management. For the construction and operation of the conversion facility, the associated construction activities would result in both short-term and long-term losses of terrestrial and aquatic habitats from natural productivity. After closure of the new facility, it would be decommissioned and could be reused, recycled, or remediated.

S.5.21 Pollution Prevention and Waste Minimization

Implementation of the EIS alternatives would be conducted in accordance with all applicable pollution prevention and waste minimization guidelines. A consideration of opportunities for reducing waste generation at the source, as well as for recycling and reusing material, will be incorporated to the extent possible into the engineering and design process for the conversion facility. Pollution prevention and waste minimization will be major factors in determining the final design of any facility to be constructed. Specific pollution prevention and waste minimization measures will be considered in designing and operating the final conversion facility.

S.5.22 Potential Impacts Associated with the Option of Expanding Conversion Facility Operations

As discussed in Sections S.2.2.6 and 2.2.5, several reasonably foreseeable activities could result in a future decision to increase the conversion facility throughput or extend the operational period at one or both of the conversion facility sites. Although there are no current plans to do so, to account for these future possibilities and provide future planning flexibility, Section 5.2.6 includes an evaluation of the environmental impacts associated with expanding conversion facility operations at Paducah, either by increasing throughput (by process improvements) or by extending operations.

As described in Section 5.2.6, a throughput increase through process improvements would not be expected to significantly change the overall environmental impacts when compared with those of the current plant design. Efficiency improvements are generally on the order of 10%, which is within the uncertainty that is inherent in the impact estimate calculations. Slight variations in plant throughput are not unusual from year to year because of operational factors (e.g., equipment maintenance or replacement) and are generally accounted for by the conservative nature of the impact calculations.

The conversion facility operations could also be expanded by operating the facility longer than the currently anticipated 25 years. There are no current plans to operate the conversion facility beyond this period. However, with routine facility and equipment maintenance and periodic equipment replacements or upgrades, it is believed that the conversion facility could be operated safely beyond this time period to process any additional DUF_6 for which DOE might assume responsibility. As discussed in Section 5.2.6, if operations were extended beyond 25 years and if the operational characteristics (e.g., estimated releases of contaminants to air and water) of the facility remained unchanged, it is expected that the annual impacts would be essentially the same as those presented above and summarized in Table S-6. The overall cumulative impacts from the operation of the facility would increase proportionately with the increased life of the facility.

S.6 ENVIRONMENTAL AND OCCUPATIONAL SAFETY AND HEALTH PERMITS AND COMPLIANCE REQUIREMENTS

DUF_6 cylinder management as well as construction and operation of the proposed DUF_6 conversion facility would be subject to many federal, state, local, and other legal requirements. In accordance with such legal requirements, a variety of permits, licenses, and other consents must be obtained. Chapter 6 of this EIS contains a detailed listing of applicable requirements.

S.7 PREFERRED ALTERNATIVE

The preferred alternative is to construct and operate the proposed DUF_6 conversion facility at alternative Location A, which is south of the administration building and its parking lot and east of the main Paducah GDP access road.

TABLE S-6 Summary Comparison of Potential Environmental Consequences of the Alternatives[a]

	Proposed Action			
Environmental Consequence	Location A (Preferred)	Location B	Location C	No Action
Human Health and Safety — Normal Facility Operations				
Radiation exposure				
Construction				
Involved workers	Potential external radiation exposures (above background) because of proximity to cylinder storage yards. Estimated maximum annual individual worker dose of 35 mrem/yr over a 2-year construction period.	Background	Potential external radiation exposures (above background) because of proximity to cylinder storage yards. Estimated maximum annual individual worker dose of 40 mrem/yr over a 2-year construction period.	Potential external radiation exposures (above background) to construction workers for yard reconstruction because of proximity to cylinder storage yards. Estimated maximum total individual worker dose is 230 mrem/yr.
Operations				
Involved workers				
Average dose to individual involved workers	Conversion facility: 75 mrem/yr Cylinder yards: 430–690 mrem/yr	Same as Location A	Same as Location A	740 mrem/yr
Collective dose to involved workers	Conversion facility: 10.7 person-rem/yr Cylinder yards: 3–6 person-rem/yr	Same as Location A	Same as Location A	33 person-rem/yr

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Location B	Location C	No Action
Total health effects among involved workers for the life of the project (through 2039 for no action)	1 in 7 chance of 1 latent cancer fatality (LCF)	Same as Location A	Same as Location A	1 in 2 chance of 1 LCF
Noninvolved workers				
Maximum dose to noninvolved worker maximally exposed individual (MEI)	1×10^{-5} mrem/yr	Same as Location A	Same as Location A	0.15 mrem/yr
Collective dose to noninvolved workers	<1.9×10^{-5} person-rem/yr	Same as Location A	Same as Location A	0.003 person-rem/yr
Total health effects among noninvolved workers for the life of the project (through 2039 for no action)	<1 in 1 million chance of 1 LCF	Same as Location A	Same as Location A	<1 in 100,000 chance of 1 LCF
General public				
Maximum dose to the general public MEI	<3.9×10^{-5} mrem/yr	Same as Location A	Same as Location A	<0.1 mrem/yr (during storage) <0.5 mrem/yr (long-term)
Collective dose to the general public within 50 mi (80 km)	4.7×10^{-5} person-rem/yr	Same as Location A	Same as Location A	0.008 person-rem/yr
Total health effects among members of the public over the life of the project (through 2039 for no action)	<1 chance in 1 million of 1 LCF	Same as Location A	Same as Location A	1 chance in 7,000 of 1 LCF

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Chemical exposure of concern[b] (concern = hazard index >1)				
Noninvolved worker MEI	Well below levels expected to cause health effects (hazard index <0.1).	Same as Location A	Same as Location A	Well below levels expected to cause health effects (hazard index <0.1).
General public MEI	Well below levels expected to cause health effects (hazard index <0.1).	Same as Location A	Same as Location A	Well below levels expected to cause health effects (hazard index <0.1).
Human Health and Safety — Facility Accidents[c]				
Physical hazards (involved and noninvolved workers)				
Construction: on-the-job fatalities and injuries	0 fatalities; 11 injuries	Same as Location A	Same as Location A	0 fatalities; 2 injuries
Operations: on-the-job fatalities and injuries	0 fatalities/yr; 8 injuries/yr	Same as Location A	Same as Location A	0 fatalities/yr; 2 injuries/yr

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Location B	Location C	No Action
Accidents involving chemical or radiation releases, low frequency-high consequence accidents				
Bounding chemical accident	Anhydrous ammonia (NH_3) tank rupture	Same as Location A	Same as Location A	Cylinder ruptures – fire (high for adverse effects); corroded cylinder spill, wet conditions (high for irreversible adverse effects).
Release amount	29,500 lb (13,400 kg) of NH_3	Same as Location A	Same as Location A	24,000 lb (11,000 kg) of DUF_6 (fire); 96 lb (44 kg) of HF (spill, wet conditions)
Estimated frequency	<1 time in 1,000,000 years	Same as Location A	Same as Location A	≈1 time in 100,000 years (both accidents)
Probability – life of the project (through 2039 for no action)	<1 chance in 40,000	Same as Location A	Same as Location A	≈1 chance in 2,500
Consequences (per accident)[d]				
Chemical exposure – public				
Adverse effects	26–4,800 persons	14–4,900 persons	17–6,700 persons	0–2,000 persons
Irreversible adverse effects	2–370 persons	0–320 persons	1–220 persons	0–1 person
Fatalities	0–7 persons	0–6 persons	0–4 persons	0 persons

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Chemical exposure – noninvolved workers[e]				
Adverse effects	1,100–1,600 persons	1,100–1,400 persons	1,400–1,600 persons	4–910 persons
Irreversible adverse effects	600–1,600 persons	730–1,400 persons	130–1,600 persons	1–300 persons
Fatalities	0–30 persons	0–30 persons	0–30 persons	0–3 persons
Accident risk (consequence × probability)				
General public	0 fatalities	Same as Location A	Same as Location A	0 fatalities
Noninvolved workers[e]	0 fatalities	Same as Location A	Same as Location A	0 fatalities
Bounding radiological accident	Earthquake accident damages U_3O_8 storage building containing 6 months' of product.	Same as Location A	Same as Location A	Cylinder ruptures – fire
Release amount	180 lb (82 kg) of depleted U_3O_8	Same as Location A	Same as Location A	24,000 lb (11,000 kg) of UF_6
Estimated frequency	≈1 time in 100,000 years	Same as Location A	Same as Location A	≈1 time in 100,000 years
Probability – life of the project (through 2039 for no action)	≈1 chance in 4000	Same as Location A	Same as Location A	≈1 chance in 2,500
Consequences (per accident)				
Radiation exposure – public				
Dose to MEI	2–40 rem	Same as Location A	Same as Location A	15 mrem
Risk of LCF	1 chance in 50	Same as Location A	Same as Location A	7 in 1 million
Total dose to population	13–73 person-rem	Same as Location A	Same as Location A	29 person-rem
Total LCFs	1 chance in 40 of 1 LCF	Same as Location A	Same as Location A	1 chance in 70 of 1 LCF

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Radiation exposure – noninvolved workers[e]				
Dose to MEI	2–40 rem	Same as Location A	Same as Location A	20 mrem
Risk of LCF	1 chance in 50	Same as Location A	Same as Location A	8 in 1 million
Total dose to workers	0.2–530 person-rem	0.5–1,300 person-rem	0.1–300 person-rem	15 person-rem
Total LCFs	1 chance in 5 of 1 LCF	1 chance in 2 of 1 LCF	1 chance in 8 of 1 LCF	1 chance in 170 of 1 LCF
Accident risk (consequence × probability)				
General public	0 LCFs	Same as Location A	Same as Location A	0 LCFs
Noninvolved workers[e]	0 LCFs	Same as Location A	Same as Location A	0 LCFs
Human Health and Safety — Transportation				
Transportation impacts during normal operations				Negligible impacts due to small number of shipments (1 shipment/yr) and low concentration of expected contamination.
Total fatalities from exposure to vehicle exhaust emissions				
Maximum use of truck	20 (30 if hydrogen fluoride [HF] is neutralized to calcium fluoride [CaF_2] for disposal)	Same as Location A	Same as Location A	Negligible
Maximum use of rail	<1 (1 if HF is neutralized to CaF_2)	Same as Location A	Same as Location A	Negligible

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Location B	Location C	No Action
Total fatalities from exposure to external radiation				
Maximum use of truck	<1	Same as Location A	Same as Location A	Negligible
Maximum use of rail	<1	Same as Location A	Same as Location A	Negligible
Maximum radiation exposure to a person along a route (MEI)	Negligible (<0.045 mrem)	Same as Location A	Same as Location A	Negligible
Traffic accident fatalities (life of the project); (physical hazards, unrelated to cargo)				
Maximum use of truck	2 (4 if CaF_2 shipped for disposal)	Same as Location A	Same as Location A	Negligible
Maximum use of rail	1 (including CaF_2)	Same as Location A	Same as Location A	Negligible
Traffic accidents involving radiation or chemical releases				
Low frequency-high consequence cylinder accidents				NA[f]
Bounding accident scenario	Urban rail accident involving DUF_6 cylinders (only if East Tennessee Technology Park [ETTP] cylinders are shipped to Paducah by rail).	Same as Location A	Same as Location A	NA
Release	Uranium, HF	Same as Location A	Same as Location A	NA

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Probability – life of the project	≈1 chance in 120,000	Same as Location A	Same as Location A	NA
Consequences (per accident)				
Chemical exposure – all workers and members of general public				
Irreversible adverse effects	4	Same as Location A	Same as Location A	NA
Fatalities	0	Same as Location A	Same as Location A	NA
Radiation exposure – all workers and members of the general public				
Total LCFs	60	Same as Location A	Same as Location A	NA
Accident risk (consequence × probability)				
Workers and the general public	0 fatalities	Same as Location A	Same as Location A	NA
Low frequency-high consequence accidents with all other materials				NA
Bounding accident scenario	Urban rail accident involving anhydrous NH_3	Same as Location A	Same as Location A	NA
Release	Anhydrous NH_3	Same as Location A	Same as Location A	NA
Probability – life of project	≈1 chance in 200,000	Same as Location A	Same as Location A	NA
Consequences (per accident)				
Chemical exposure – all workers and members of the general public				
Irreversible adverse effects	5,000	Same as Location A	Same as Location A	NA

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Fatalities	100	Same as Location A	Same as Location A	NA
Accident risk (consequence × probability)				
Irreversible adverse effects	0	Same as Location A	Same as Location A	NA
Fatalities	0	Same as Location A	Same as Location A	NA
Air Quality and Noise				
Pollutant emissions during conversion facility construction	Total (modeled plus background) concentrations for particulate matter (PM) with an aerodynamic diameter of less than or equal to 10 and 2.5 µm, respectively (PM_{10} and $PM_{2.5}$), would exceed standards at the construction site boundary because of the high background concentrations; construction-related concentrations would be negligible at the nearest residence. Other criteria pollutants are well within standards.	Same as Location A	Same as Location A	For yard reconstruction, the maximum 24-hour PM_{10} concentration is up to 90% of the standard; other criteria pollutants are well within standards.

TABLE S-6 (Cont.)

	Proposed Action			
Environmental Consequence	Location A (Preferred)	Location B	Location C	No Action
Pollutant emissions during conversion facility operations	Average-annual $PM_{2.5}$ concentrations close to standards because of high background concentrations; operations-related concentrations would be negligible at the nearest residence. Other criteria pollutants would be well within standards. No concentration increment would exceed applicable prevention of significant deterioration (PSD) increments at the site boundary (for Class II area), and all increments would well below the PSD increment for the nearest Class I area.	Same as Location A	Same as Location A	Under the controlled cylinder corrosion scenario, the maximum 24-hour HF concentration would be less than 3% of the Commonwealth of Kentucky secondary standard; criteria pollutants would be well within standards. Under the uncontrolled cylinder corrosion scenario, the maximum 24-hour HF concentration at the site boundary could be up to 69% of the Commonwealth of Kentucky secondary standard.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action			No Action
	Location A (Preferred)	Location B	Location C	
Estimated noise levels at the nearest residence	Below the U.S. Environmental Protection Agency (EPA) guideline of 55 dB(A) as day-night average sound level (DNL) during construction and operation.	Same as Location A	Same as Location A	Below the EPA guideline of 55 dB(A) as DNL during construction and operation.
Water and Soil				
Surface water				
Construction	Negligible impacts from changes to runoff, from floodplains, or from water use and discharge.	Same as Location A	Same as Location A	Negligible impacts from changes to runoff, from floodplains, or from water use and discharge.
Operations	Negligible impacts from water use and discharge.	Same as Location A	Same as Location A	Negligible impacts from water use and discharge.
Groundwater				
Construction	No direct impacts to groundwater recharge, depth, or flow direction; impacts to groundwater quality unlikely.	Same as Location A	Same as Location A	No direct impacts to groundwater recharge, depth, or flow direction; impacts to groundwater quality unlikely.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Operations	No direct impacts to groundwater recharge, depth, or flow direction; impacts to groundwater quality unlikely.	Same as Location A	Same as Location A	Under the controlled corrosion case, maximum uranium groundwater concentration (occurring in around 2070) of 6 µg/L, below the guideline of 20 µg/L.[g] Under the uncontrolled corrosion case, cylinder breaches occurring before 2020 could result in groundwater concentrations exceeding the guideline sometime after 2100.
Soils				
Construction	Local and temporary increase in erosion; impacts to soil quality unlikely. Potentially contaminated soil associated with solid waste management unit (SWMU) 194 could be excavated.	Same as Location A	Local and temporary increase in erosion; impacts to soil quality unlikely.	Local and temporary increase in erosion; impacts to soil quality unlikely.
Operations	No direct impacts to soil.	Same as Location A	Same as Location A	Negligible impacts to soils.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Socioeconomics				
Construction	Direct employment of 190 people in peak year; 290 total jobs in the region of influence (ROI); total personal income of $9.5 million in peak year; marginal impacts on public services. Two-year duration of impacts.	Same as Location A	Same as Location A	Direct employment of 30 people; 110 total jobs in ROI; total personal income of $3.2 million; no significant impacts on public services.
Operations	Direct employment of 160 people; 330 total jobs in ROI; total personal income of $13 million per year; no significant impacts on public services.	Same as Location A	Same as Location A	Direct employment of 90 people; 130 total jobs in ROI; total personal income of $3.8 million per year through 2039; no significant impacts on public services.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action			No Action
	Location A (Preferred)	Location B	Location C	
		Ecology		
Ecological resources (habitat loss, vegetation, wildlife)	Total area disturbed during construction: 45 acres (18 ha). Vegetation and wildlife communities impacted and potential loss of habitat; impacts could be minimized by facility placement.	Same as Location A	Same as Location A	Negligible impact to ecological resources; all activities would occur in previously developed areas; however, there is a potential for impacts to aquatic biota from cylinder yard runoff during painting activities.
Concentrations of chemical or radioactive materials	Well below harmful levels; negligible impacts on vegetation and wildlife.	Same as Location A	Same as Location A	Potential for adverse impacts to aquatic biota associated with cylinder painting.
Wetlands	Potential direct and indirect impacts to wetlands from facility construction; impacts could be minimized by facility placement.	Same as Location A	Same as Location A	Negligible impacts

TABLE S-6 (Cont.)

	Proposed Action			
Environmental Consequence	Location A (Preferred)	Location B	Location C	No Action
Threatened or endangered species	No direct impacts from construction or operations; destruction of trees with exfoliating bark could indirectly impact the Indiana bat by destroying roosting habitat.	Same as Location A	Same as Location A; in addition; construction in the eastern portion of Location C could impact potential habitat for wild indigo and compass plant.	Negligible impacts
Waste Management				
Construction	Minimal impacts to site waste management capabilities from construction-generated waste. Potentially contaminated soil associated with SWMU 194 could be excavated and require management and disposal.	Same as Location A	Same as Location A, except contaminated soil unlikely.	Negligible impacts from yard reconstruction.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Operations	Negligible impacts to site management capabilities from low-level radioactive waste (LLW) and hazardous waste generation. The triuranium octaoxide (U_3O_8) produced would generate about 7,850 yd^3 (6,000 m^3)/yr of LLW. This is 83% of Paducah's annual projected volume; potentially large impact on site LLW management. If HF is neutralized to CaF_2, generation of about 4,900 yd^3/yr (3,800 m^3/yr) of CaF_2. Generation of transuranic (TRU) waste unlikely under current proposals.	Same as Location A	Same as Location A	No impacts from LLW generation; less than 1% of annual site totals for each. Low-level radioactive mixed waste (LLMW) generated from cylinder stripping and painting operations could generate less than a 1% increase in site LLMW, resulting in a negligible impact to on-site waste operations.

TABLE S-6 (Cont.)

	Proposed Action			
Environmental Consequence	Location A (Preferred)	Location B	Location C	No Action
		Resource Requirements[h]		
Construction and operations	No effects on local, regional, or national availability of materials required are expected.	Same as Location A	Same as Location A	No effects on local, regional, or national availability of materials required are expected.
		Land Use		
Construction and operations	Up to 45 acres (18 ha) would be disturbed, with 10 acres (4 ha) permanently altered, representing about 1% of available land already developed for industrial purposes, resulting in negligible impacts to land use.	Same as Location A	Same as Location A	Reconstruction of one existing cylinder storage yard within the boundaries of existing yards is planned; negligible impacts to land use.
		Cultural Resources		
Construction and operations	Impacts to cultural resources are possible; archaeological and architectural surveys have not been completed and must be initiated prior to initiation of the proposed action.	Same as Location A	Same as Location A	Impacts would be unlikely because the storage yards are located in previously disturbed areas already dedicated to cylinder storage.

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Location B	Location C	No Action
	Environmental Justice			
Construction and operations	No disproportionately high and adverse impacts to minority or low-income populations in the general public during normal operations or from accidents.	Same as Location A	Same as Location A	No disproportionately high and adverse impacts to minority or low-income populations in the general public during normal operations or from accidents.
	Conversion of ETTP Cylinders at Paducah (option)			
Cylinder preparation				
Location of cylinder preparation activities	ETTP: approximately 5,900 ETTP cylinders prepared for shipment to Paducah.	Same as Location A	Same as Location A	NA
Impacts from using cylinder overpacks	No facility construction required; operational impacts limited to external radiation exposure of involved workers; total collective dose to the worker population of 69 to 85 person-rem at ETTP, with no LCFs expected.	Same as Location A	Same as Location A	NA

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Impacts from using cylinder transfer facility	Construction of a transfer facility would be required at ETTP. Operational impacts would generally be small and limited primarily to external radiation exposure of involved workers; total collective dose to the worker population of 440 to 480 person-rem at ETTP, with no LCFs expected.	Same as Location A	Same as Location A	NA
Impact of extended conversion operations	If ETTP cylinders were transported to Paducah, the operational period would extend to 28 years. Annual impacts would be the same as discussed for each technical discipline. No significant increase in overall impacts is expected.	Same as Location A	Same as Location A	NA

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Location B	Location C	No Action
	Decontamination and Decommissioning			
Activities involved	Disassembly and removal of all radioactive and hazardous components, equipment, and structures, with the objective of completely dismantling the various buildings and achieving greenfield (unrestricted use) conditions.	Same as Location A	Same as Location A	NA
Human health and safety impacts	Decontamination and decommissioning (D&D) impacts primarily limited to external radiation exposure of involved workers; expected exposures would be a small fraction of operational doses; no LCFs expected. No fatalities from occupational accidents expected; up to 5 injuries.	Same as Location A	Same as Location A	NA

TABLE S-6 (Cont.)

Environmental Consequence	Proposed Action: Location A (Preferred)	Proposed Action: Location B	Proposed Action: Location C	No Action
Other impacts	Generation of LLW, LLMW, and hazardous waste; approximately 90% of D&D materials generated are expected to be clean.	Same as Location A	Same as Location A	NA
Impacts Associated with Conversion Product Sale				
Products potentially marketed	HF and/or CaF_2	Same as Location A	Same as Location A	NA
Annual Paducah production	55% HF solution: 11,000 t/yr (12,000 tons/yr)	Same as Location A	Same as Location A	NA
	CaF_2: 24 t/yr (26 tons/yr)	Same as Location A	Same as Location A	NA
CaF_2 produced if HF is neutralized	11,800 t/yr (13,000 tons/yr)	Same as Location A	Same as Location A	NA
Maximum estimated radiation dose to a worker from HF or CaF_2 use	<1mrem/yr	Same as Location A	Same as Location A	NA
Potential socioeconomic impacts from use	Negligible socioeconomic impacts	Same as Location A	Same as Location A	NA

Footnotes on next page.

TABLE S-6 (Cont.)

a Potential environmental impacts are summarized and compared in this table for the no action alternative and the action alternatives. For the action alternatives, impacts are presented for the three alternative locations within the site; annual impacts are based on the assumption of a 25-year operational period. For the no action alternative, annual impacts are based on the assumption of a 40-year operational period. Potential impacts associated with expanding throughput through process improvements and with extending the operational period would be similar to those presented for the base design.

b Chemical exposures for involved workers during normal operations were not estimated; the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable exposure limits.

c On the basis of calculations performed for this EIS, the accidents that are listed in this table have been found to have the highest consequences of all the accidents analyzed. In general, accidents that have lower probabilities have higher consequences.

d The ranges in accident impacts reflect differences in possible atmospheric conditions at the time of the accident.

e In addition to noninvolved worker impacts, chemical and radiological exposures for involved workers under accident conditions (workers within 100 m [328 ft] of a release) would depend in part on specific circumstances of the accident. Involved worker fatalities and injuries resulting from the accident initiator or the accident itself are possible.

f NA = not applicable.

g The guideline concentration used for comparison with estimated surface water and groundwater uranium concentrations is the former proposed EPA maximum concentration limit (MCL) of 20 µg/L; a revised value of 30 µg/L became effective in December 2003. These values are applicable for water “at the tap” of the user and are not directly applicable for surface water or groundwater (no such standard exists). The guideline concentration used for comparison with estimated soil uranium concentrations is a health-based guideline value for residential settings of 230 µg/g.

h Resources evaluated include construction materials (e.g., concrete, steel, special coatings), fuel, electricity, process chemicals, and containers (e.g., drums and cylinders).