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Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico

Chapters 1 through 10 and Appendices A through G

Final Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555-0001

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surrounding area. The results would be analyzed to show that they were below allowable residual radioactivity limits; otherwise, further decontamination would be performed.

2.1.9 DUF_6 Disposition Options

At full production, the proposed NEF would generate 7,800 metric tons per year (8,600 tons per year) of DUF_6. Initially, the DUF_6 would be stored in Type 48Y cylinders (UBC) on the UBC Storage Pad (LES, 2005a). Each Type 48Y cylinder would hold approximately 12.5 metric tons (13.8 tons), which means that the site, at full production, would generate approximately 627 cylinders of DUF_6 every year. During the operation of the facility, the plant could generate and store up to 15,727 cylinders of DUF_6. LES would own the DUF_6 and maintain the UBC's while they are in storage. Maintenance activities would include periodic inspections for corrosion, valve leakage, or distortion of the cylinder shape, and touch-up painting as required. Problem cylinders would be removed from storage and the material transferred to another storage cylinder. The proposed storage area would be kept neat and free of debris, and all stormwater or other runoff would be routed to the UBC Storage Pad Stormwater Retention Basin for monitoring and evaporation.

Waste Classification of Depleted Uranium

Depleted uranium is different from most low-level radioactive waste in that it consists mostly of long-lived isotopes of uranium, with small quantities of thorium-234 and protactinium-234. Additionally, in accordance with 10 CFR Parts 40 and 61, depleted uranium is a source material and, if treated as a waste, it would fall under the definition of a low-level radioactive waste per 10 CFR § 61.55(a). The Commission reaffirmed this waste classification in the CLI-05-05 Memorandum and Order dated January 18, 2005. This means that it could be disposed of in a licensed low-level radioactive waste facility if it is in a suitably stable form and meets the performance requirements of 10 CFR Part 61. Therefore, under 10 CFR § 61.55(a), depleted uranium is a low-level radioactive waste.

Sources: NRC, 1991; NRC, 2005.

Classification of DUF_6

The U.S. Department of Energy (DOE) has evaluated a number of alternative and potential beneficial uses for DUF_6 (DOE, 1999b; Brown et al, 1997). However, the current DUF_6 consumption rate is low compared to the existing DUF_6 inventory (DOE, 1999b), and the potential for a significant commercial market for the DUF_6 to be generated by the proposed NEF is considered to be low. The NRC has assumed that the excess DOE and commercial inventory of DUF_6 would be disposed of as waste (NRC, 1995).

In Memorandum and Order CLI-05-05, the Commission concluded that depleted uranium is appropriately categorized as a low-level radioactive waste (NRC, 2005). Therefore, for the purpose of this EIS, the DUF_6 generated by the proposed NEF will be treated as a Class A low-level waste.

All DUF_6 would be removed from the proposed NEF for disposition outside the State of New Mexico before decommissioning is completed (LES, 2005a). This EIS evaluates in detail two DUF_6 disposition options. These options are described in the following subsections, and Chapter 4 discusses their potential environmental impacts. Section 2.2 discusses additional DUF_6 disposition options but, for the reasons discussed in that section, these options are not evaluated in detail.

The Defense Nuclear Facilities Safety Board has reported that long-term storage of DUF_6 in the UF_6 form represents a potential chemical hazard if not properly managed (DNFSB, 1995). For this reason, alternatives for the strategic management of depleted uranium include the conversion of DUF_6 stock to a more stable uranium oxide (e.g., triuranium octaoxide [U_3O_8]) form for long-term management (OECD, 2001). DOE also evaluated multiple disposition options for DUF_6 and agreed that conversion to U_3O_8 was preferable for long-term storage and disposal of the depleted uranium due to its chemical stability (DOE, 2000a). Therefore, all the options evaluated in the EIS include conversion of the DUF_6 to U_3O_8.

Two options are proposed for disposition of DUF_6. The first option would be to ship the material to a private conversion facility prior to disposal (Option 1). An alternative available under the provisions of the United States Enrichment Corporation (USEC) Privatization Act of 1996 would be to ship the material to a DOE conversion facility, either at Portsmouth, Ohio, or at Paducah, Kentucky, for temporary storage and eventual processing by the DOE conversion facility prior to disposal by DOE (Option 2). DOE has issued two final EISs to construct and operate conversion facilities at Paducah, Kentucky, and Portsmouth, Ohio (DOE, 2004a; DOE, 2004b). Additionally, DOE has issued two Records of Decision and construction of the conversion facilities began in July 2004 (DOE, 2004c; DOE, 2004d). Figure 2-12 shows the disposal flow paths for DUF_6 evaluated in this EIS.

What is Class A Low-level Radioactive Waste?

Low-level radioactive waste is defined by what it is not; that is, material classified as low-level radioactive waste does not meet the criteria of high-level radioactive waste, transuranic waste, or mill tailings. Low-level radioactive waste represents about 90 percent of all radioactive wastes, by volume. It includes ordinary items such as cloth, bottles, plastic, wipes, etc. that become contaminated with some radioactive material. These wastes can be generated anywhere radioisotopes are produced or used -- in nuclear power stations, local hospitals, university research laboratories, etc.

For regulatory purposes, there are three classes of low-level radioactive wastes. The NRC classifies low-level radioactive waste as Class A, Class B, or Class C based on the concentration of certain long-lived radionuclides as shown in Tables 1 and 2 of 10 CFR § 61.55 and the physical form and stability requirements set forth in 10 CFR § 61.56. Waste that contains the smallest concentration of the identified radionuclides and meets the stability requirement is considered Class A waste and could be considered for near-surface disposal. Classes B and C wastes contain greater concentrations of radionuclides with longer half-lives, and have stricter disposal requirements than Class A.

Sources: 10 CFR § 61.55 and 61.56.

In this EIS, it is assumed that the proposed private conversion facility would be using the same technology adapted for use by DOE in its conversion facilities. This technology would apply a continuous dry-conversion process based on the commercial process used by Framatome Advanced Nuclear Power, Inc., fuel fabrication facility in Richland, Washington (DOE, 2004a; DOE, 2004b; LES, 2005a).

Conversion of UF_6 to U_3O_8 generates hydrogen fluoride gas. This gas is dissolved in water to form aqueous hydrofluoric acid which is easier to store and handle than the hydrogen fluoride gas. The aqueous hydrofluoric acid could be sold to a commercial hydrofluoric acid supplier for reuse if the radioactive content is below free release limits, or it could be converted to calcium fluoride (CaF_2) for sale or disposal. Because conversion of the large quantities of DUF_6 at the DOE Portsmouth and Paducah Gaseous Diffusion Plant sites would be occurring at the same time the proposed NEF would be in operation, it is not certain that the market for aqueous hydrofluoric acid[1] and calcium fluoride would allow for the economic reuse of the material generated by the proposed NEF (DOE, 2000a; DOE, 2000b). Therefore, only immediate neutralization of the hydrofluoric acid by conversion to calcium fluoride with disposal at a licensed low-level radioactive waste disposal facility is considered in this analysis. Descriptions of the options are set forth below.

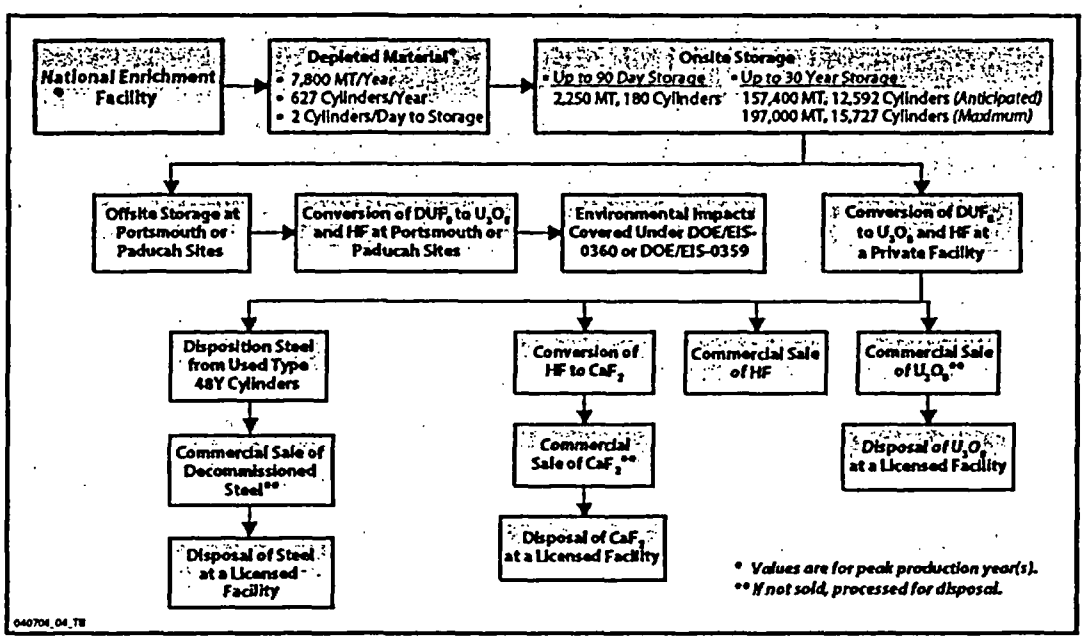

Figure 2-12 Disposal Flow Paths for DUF_6

Option 1: Private Sector Conversion and Disposal

This disposition option is private sector conversion of the depleted uranium hexafluoride into uranium oxide and hydrofluoric acid. The conversion could occur within the region of influence of the proposed NEF or at some other site within the United States. On February 3, 2005, LES and AREVA announced the signing of a memorandum of understanding that could lead to the construction of a privately owned uranium hexafluoride conversion plant to support the operation of the proposed NEF. The memorandum of understanding is only the first step in licensing, building, and operating the conversion facility. No final location has been identified for this private conversion facility. This EIS considers that the private conversion facility could be located beyond the region of influence of the proposed NEF site (this is known as Option 1a).

[1]For the purposes of this EIS, when discussing the conversion of DUF_6 to U_3O_8, the wording of hydrofluoric acid refers to aqueous hydrofluoric acid. Releases of hydrofluoric acid refers to the vapor that forms from the reaction of UF_6 to the moisture in the atmosphere.

One potential location for a private conversion facility would be near the ConverDyn UF_6 generation facility in Metropolis, Illinois (LES, 2005a; LES, 2005b). The existing ConverDyn plant converts natural U_3O_8 (yellowcake) from mining and milling operations into UF_6 for feed to enrichment facilities such as the proposed NEF (ConverDyn, 2004). Construction of a private DUF_6 to U_3O_8 conversion facility near the ConverDyn plant in Metropolis, Illinois, could allow for the possible reuse of the hydrogen fluoride produced during the DUF_6 to U_3O_8 conversion process to generate more UF_6 feed material while the depleted U_3O_8 would be shipped for final dispositioning.

The NRC staff has determined that construction of a private DUF_6 to U_3O_8 conversion plant near Metropolis, Illinois, would have similar environmental impacts as construction of an equivalent facility anywhere in the United States. The advantage of selecting the Metropolis, Illinois, location is the proximity of the ConverDyn natural U_3O_8 (yellowcake) to UF_6 conversion facility and, for the purposes of assessing impacts, the DOE conversion facility in nearby Paducah, Kentucky, for converting DOE-owned DUF_6 to U_3O_8. Because the proposed private plant would be similar in size and the effective area would be the same as the Paducah conversion plant, the environmental impacts would be similar. DOE has completed an EIS for the Paducah conversion facility which defines the impacts of the proposed DOE conversion facility (DOE, 2004a).

The DUF_6 would be shipped from the proposed NEF site to the new conversion facility. The hydrofluoric acid produced by the conversion process could be re-used by ConverDyn in its existing hydrofluorination process to convert natural U_3O_8 (yellowcake) to UF_6 (ConverDyn, 2004). Once converted, U_3O_8 and the associated waste streams would be transported to a licensed low-level radioactive waste disposal facility for final disposition, as discussed below.

This EIS also considers that the private conversion facility could be located near the proposed NEF, (this is known as Option 1b). This would involve a private sector company constructing and operating a new conversion facility close (within 6.4 kilometers [4 miles]) to the proposed NEF. By constructing and operating a private conversion facility in close proximity to the proposed NEF, the environmental impacts from the private conversion facility would affect the same area as the proposed NEF. Additionally, shipping and conversion of the depleted uranium could be accomplished within days of the filling of the Type 48Y cylinders, which would minimize the amount of DUF_6 stored onsite. The nearby conversion facility would be proportionally sized to meet the annual generation of 7,800 metric tons (8,600 tons) of DUF_6 per year. It is further assumed that the hydrofluoric acid generated at the adjacent conversion facility would not be marketable for reuse due to the large amount that would be available from the DOE conversion plants. The hydrofluoric acid would be converted to calcium fluoride for disposal at a licensed low-level radioactive waste disposal site.

Option 2: DOE Conversion and Disposal

DOE is constructing two conversion plants to convert the DUF_6 now in storage at Portsmouth, Ohio; Paducah, Kentucky; and Oak Ridge, Tennessee, to U_3O_8 and hydrofluoric acid. LES proposes to transport the DUF_6 generated by the proposed NEF to either of these new facilities and paying DOE to convert and dispose of the material. This plan is based on Section 3113 of the 1996 *USEC Privatization Act* that states the DOE "shall accept for disposal low-level radioactive waste, including depleted uranium if it were ultimately determined to be low-level radioactive waste, generated by [...] any person licensed by the Nuclear Regulatory Commission to operate a uranium enrichment facility under Sections 53, 63, and 193 of the *Atomic Energy Act of 1954* (42 U.S.C. 2073, 2093, and 2243)."

On January 18, 2005, the Commission issued its ruling that depleted uranium is considered a form of low-level radioactive waste (NRC, 2005). The Commission also stated that "pursuant to Section 3113 of the USEC Privatization Act, disposal of the LES depleted uranium tails at a DOE facility represents a "plausible strategy" for the disposition of depleted uranium tails" (NRC, 2005).

Disposal Options

Converted DUF_6 in the form of U_3O_8 can be considered a Class A low-level radioactive waste (NRC, 1991). Following conversion, the only currently available viable disposal option would be disposal of the depleted U_3O_8, based on its waste classification and site-specific evaluation, in a near-surface emplacement at a licensed low-level radioactive waste disposal facility within the borders of the United States. LES proposed disposal of the U_3O_8 in an abandoned mine as its preferred option but no existing mine is currently licensed to receive or dispose of low-level radioactive waste nor has any application been made to license such a facility.

DUF_6 Conversion Process

DUF_6 conversion is a continuous process in which DUF_6 is vaporized and converted to U_3O_8 by reaction with steam and hydrogen in a fluidized-bed conversion unit. The hydrogen is generated using anhydrous ammonia, although an option of using natural gas is being investigated. 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 hydrofluoric acid recovery system, and process off-gas scrubbers. The Paducah facility would have four parallel conversion lines. Equipment would also be installed to collect the hydrofluoric acid co-product and process it into any combination of several marketable products. A backup hydrofluoric acid neutralization system would be provided to convert up to 100 percent of the hydrofluoric acid to calcium fluoride for storage and/or sale in the future, if necessary.

Sources: DOE, 2004a; DOE 2004b.

DOE recognizes that there could be commercial applications for the U_3O_8, and the possibility exists that other disposal options could become available in the future (after the satisfactory completion of appropriate NEPA or environmental review and licensing processes). If the U_3O_8 could be applied in a commercial application (e.g., as radiation shielding), then it would reduce the disposition impacts in proportion to the amount of U_3O_8 diverted to commercial applications. At this time, no viable commercial application for the material generated by the proposed NEF has been identified.

There are currently three active, licensed commercial low-level radioactive waste disposal facilities, all of which are located in Agreement States (licensing of the use and disposal of radioactive material is regulated by the State in accordance with agreements established with the NRC [NRC, 2003]). Additionally, DOE operates its own low-level radioactive waste disposal facility within the Nevada Test Site that is restricted to DOE-generated waste. Another company, Waste Control Specialists (WCS) is a commercial RCRA waste disposal facility located less than 3.2 kilometers (2 miles) east of the proposed NEF. WCS recently submitted an application to the State of Texas to license the company to dispose of low-level radioactive waste (WCS, 2004). The following summarizes the disposal sites and the regions of the United States that can ship low-level radioactive waste to each site (NRC, 2003):

- Barnwell, located in Barnwell, South Carolina. Currently, Barnwell accepts waste from most U.S. generators, as permitted by Atlantic Compact law. Beginning in 2008, Barnwell would only accept

waste from the Atlantic Compact States (Connecticut, New Jersey, and South Carolina). Barnwell is licensed by the State of South Carolina to receive Class A, B, and C wastes.

- Hanford, located in Hanford, Washington. Hanford accepts waste from the Northwest and Rocky Mountain compacts. Hanford is licensed by the State of Washington to receive Class A, B, and C wastes, but not mixed waste (*i.e.*, radioactive and hazardous waste). As New Mexico is a member of the Rocky Mountain Compact, the proposed NEF would be able to ship low-level radioactive waste to Hanford for disposal provided that the waste meets the Waste Acceptance Criteria for the facility.

- Envirocare, located in Clive, Utah. Envirocare accepts waste from all regions of the United States. Envirocare is licensed by the State of Utah to accept for disposal Class A waste only. Therefore, Envirocare is a disposal option for radioactive wastes generated at the proposed NEF.

- Nevada Test Site, located in southern Nye County, Nevada. The Nevada Test Site is a DOE disposal site for low-level radioactive waste from the various DOE sites and facilities across the United States. The Nevada Test Site was selected as the secondary disposal site for converted DUF_6 material generated at the Paducah, Kentucky, and Portsmouth, Ohio, DUF_6 conversion facilities (DOE, 2004a; DOE, 2004b). Because the Nevada Test Site is a DOE disposal site, it could receive low-level radioactive wastes generated by the proposed NEF only if ownership of these wastes is first transferred to the DOE.

- Waste Control Specialists (WCS) disposal facility, located in Andrews County, Texas. The WCS disposal facility is less than 3.2 kilometers (2 miles) east of the proposed NEF site. This facility is currently permitted to dispose of RCRA hazardous waste and licensed to temporarily store, but not dispose of, radioactive material under its current State of Texas Bureau of Radiation Control license L04971 (BRC, 2003). WCS recently submitted an application to the State of Texas to allow them to dispose of Class A, B, and C low-level radioactive waste (WCS, 2004). The application is for two separate facilities, a low-level radioactive waste disposal facility for the Texas Compact and a low-level radioactive waste and mixed low-level radioactive and hazardous waste Federal Waste Disposal Facility. Both the Compact Facility and Federal Waste Disposal Facility would be located within the boundaries of the WCS site in Andrews County, Texas.

  In 1980, Congress passed the "Low-Level Radioactive Waste Policy Act" which requires States to provide for disposal of low-level radioactive waste generated within their own borders. The States of Texas and Vermont have joined together to form the Texas Compact for disposal of low-level radioactive waste generated by these member States. If its August 2, 2004 application is approved, WCS would become the low-level radioactive waste disposal site for the Texas Compact. As previously stated, a disposal site within the Texas Compact can only accept waste generated by the compact member States, unless the Compact specifically approves the disposal of out-of-compact waste. Approval of the other Compact (in this case, the Rocky Mountain Compact, in which the proposed NEF would be located) also would be required.

  The WCS application includes a request for a separate Federal Waste Disposal Facility to dispose of both low-level radioactive waste and mixed low-level radioactive and hazardous wastes from federal facilities such as the DOE. If the license application is approved, the WCS facility would be able to dispose of Class A, B, and C low-level radioactive and mixed wastes (WCS, 2004).

Before the depleted uranium generated by the proposed NEF could be disposed at the proposed WCS Compact Facility, a series of legal procedures and approval processes would have to be successfully addressed. These procedures and processes include:

1. Approval by the State of Texas of WCS's application, including authorization by the State for the WCS Compact Facility to accept for disposal depleted uranium oxides of the type and quantities expected to be generated as a result of the proposed NEF's operations;
2. Approval by the Rocky Mountain Compact (in which the proposed NEF would be located) for the export of the depleted uranium oxides from the Compact; and
3. Approval by the Texas Compact for the import and disposal of the depleted uranium oxides generated as a result of the proposed NEF's operations.

The disposition of the depleted U_3O_8 generated from the DOE conversion facilities at Paducah and Portsmouth would be either at the Envirocare site (DOE's proposed disposition site) or at the Nevada Test Site (DOE's optional disposal site) (DOE, 2004a; DOE, 2004b). Due to the need for separate regulatory actions prior to disposal at WCS, it is assumed that the depleted U_3O_8 generated from the adjacent or offsite private conversion process would be disposed at another disposal site licensed to accept this material. For example, under its Radioactive Materials License issued by the State of Utah, Envirocare is authorized to accept for disposal the quantities of depleted uranium oxides expected to be generated by the conversion of the proposed NEF's DUF_6 (Envirocare, 2004).

2.2 Alternatives to the Proposed Action

This section examines the alternatives considered for the proposed action described in section 2.1. The range of alternatives was determined by considering the underlying need and purpose for the proposed action. From this analysis, a set of reasonable alternatives was developed and the impacts of the proposed action were compared with the impacts that would result if a given alternative was implemented. These alternatives include:

- A no-action alternative under which the proposed NEF would not be constructed.
- An evaluation of alternative sites for the proposed NEF.
- A discussion of alternative conversion and disposition methods for DUF_6.
- A review of alternative technologies available for uranium enrichment.
- An evaluation of potential alternative sources of low-enriched uranium.

2.2.1 No-Action Alternative

The no-action alternative would be to not construct, operate, or decommission the proposed NEF in Lea County, New Mexico. The NRC would not approve the license application for the proposed NEF. Under the no-action alternative, the fuel-fabrication facilities in the United States would continue to obtain low-enriched uranium from the currently available sources. Currently, the only domestic source of low-enriched uranium available to fuel fabricators is from production of the Paducah Gaseous Diffusion Plant, the only operating uranium enrichment facility in the United States, and the downblending of highly enriched uranium under the "Megatons to Megawatts" program (USEC, 2003a). Foreign enrichment sources are currently supplying more than 85 percent of the U.S. nuclear power plants demand (EIA, 2004).

Currently, the "Megatons to Megawatts" program will expire by 2013, potentially eliminating downblending as a source of low-enriched uranium. Opened in 1952, the Paducah Gaseous Diffusion

al., 1997). However, the current DUF_6 consumption rate is low compared to the DUF_6 inventory (DOE, 1999b), and the NRC has assumed that excess DOE and commercial inventory of DUF_6 would be disposed of as a waste product (NRC, 1995).

The NRC staff has determined that unless LES can demonstrate a viable use, the DUF_6 generated by the proposed NEF should be considered a waste product. Because the current available inventory of depleted uranium in the form of metal (UF_6 and U_3O_8) is in excess of the current and projected future demand for the material, this EIS will not further evaluate DUF_6 disposition alternatives involving its use as a resource, including continued storage at the proposed NEF site for more than 30 years in order to be used in the future.

Conversion at Existing Fuel Fabrication Facilities

Another potential alternative disposition strategy would be to perform the conversion of DUF_6 to U_3O_8 at an existing fuel-fabrication facility. The existing fuel-fabrication facilities are Global Nuclear Fuel-Americas, LLC, in Wilmington, North Carolina; Westinghouse Electric Company, LLC, in Columbia, South Carolina; and Framatome ANP, Inc., in Richland, Washington. These facilities have existing processes and conversion capacities. They also use Type 30B cylinders. Therefore, the existing fuel-fabrication facilities would need to install new equipment to handle the larger Type 48Y cylinders. The facilities would probably need to install separate capacity to process the DUF_6 to avoid quality control issues related to processing enriched UF_6. The facilities would also need to manage and dispose of the hydrofluoric acid that would be generated from the conversion process. Furthermore, these existing facilities have not expressed an interest in performing these services, and the cost for the services would be difficult to estimate. For these reasons, this alternative is eliminated from further consideration in this EIS.

Conclusion

Although DUF_6 does have alternative and beneficial uses, the current U.S. inventory is estimated to be approximately 480,000 metric tons of uranium (OECD, 2001), which far exceeds the existing and projected demand for the material. Consequently, the NRC staff has assumed that all of the DUF_6 to be generated by the proposed NEF would be converted to U_3O_8 and disposed of in a licensed disposal facility.

2.2.2.5 Anhydrous Hydrofluoric Acid Option

As discussed in section 2.1.9, a byproduct of the conversion from DUF_6 to U_3O_8 is hydrofluoric acid. The hydrofluoric acid can be processed in two forms, aqueous (dissolved in water) or anhydrous (without water; especially without water of crystallization). In a Programmatic EIS (DOE, 1999b) addressing the potential impacts of alternative management strategies for DUF_6 stored at various DOE facilities, DOE proposed and discussed the potential environmental impacts from further processing of the aqueous hydrofluoric acid with a yet to be determined distillation process to generate anhydrous hydrofluoric acid. This process was proposed by DOE, because anhydrous hydrofluoric acid has a greater commercial value than does aqueous hydrofluoric acid. DOE assessed the impacts of two conversion options for the DUF_6. The two conversion options considered were (1) a distillation process for anhydrous hydrofluoric acid; and (2) the neutralization of the aqueous hydrofluoric acid with lime to generate calcium fluoride (CaF_2).

Based on its Programmatic EIS, DOE published a request for proposals for the construction and operation of two DUF_6 conversion facilities, one each at DOE's Paducah, Kentucky, and Portsmouth, Ohio, gaseous diffusion plant sites, to process its large inventory of DUF_6. In the request for proposals, DOE allowed for a range of potential conversion product forms and process technologies; however, DOE required that any of the proposed conversion forms must have an assured, environmentally acceptable path for final disposition (DOE, 2004a; DOE, 2004b).

In response to the request for proposals, DOE received five proposals, three of which were deemed to be in the competitive range. Of the three, two proposals would either sell or neutralize aqueous hydrofluoric acid and the other proposal would sell anhydrous hydrofluoric acid. DOE selected a proposal that did not involve the distillation to anhydrous hydrofluoric acid, but rather the sale of aqueous hydrofluoric acid with neutralization to form CaF_2 if the aqueous hydrofluoric acid could not be sold. Therefore, the possibility of distilling the aqueous hydrofluoric acid was not presented as a conversion process in either of DOE's site specific Final EISs prepared for DUF_6 conversion facilities at the Paducah and Portsmouth sites.

Cogema has experience with efforts to generate anhydrous hydrofluoric acid from aqueous hydrofluoric acid. At its DUF_6 conversion facility in Pierrelatte, France, Cogema attempted to generate anhydrous hydrofluoric acid using a process similar to that proposed in the DOE Programmatic EIS (Hartmann, 2001). However, technical issues proved difficult and so Cogema canceled further efforts to generate anhydrous hydrofluoric acid from aqueous hydrofluoric acid.

LES has reviewed the issue of the generation of anhydrous hydrofluoric acid from aqueous hydrofluoric acid. In Revision 4 of its Environmental Report, LES states that "LES will not use a deconversion facility that employs a process that results in the production of anhydrous [hydrofluoric acid]" (LES, 2005a).

In summary, the option of generating anhydrous hydrofluoric acid has not been analyzed because:

- A proven commercially viable technology is not available to distill the aqueous hydrofluoric acid. Cogema was unable to develop a conversion technology to effectively generate anhydrous hydrofluoric acid from the aqueous form.

- DOE selected sale of aqueous hydrofluoric acid followed by sale or by neutralization with lime to generate CaF_2, rather than distillation of aqueous hydrofluoric acid to anhydrous hydrofluoric acid, for its conversion facilities being built at Paducah and Portsmouth.

- LES has committed to not pursuing a private conversion process that employs a process that results in the production of anhydrous hydrofluoric acid. In a letter dated March 29, 2005, LES formally requested a license condition be issued stating that "For the disposition of depleted UF_6, LES shall not use a depleted UF_6 deconversion facility that employs a process that results in the production of anhydrous [hydrofluoric acid]" (LES, 2005e). The NRC staff is proposing the following license condition:

  > For the disposition of depleted UF_6, the licensee shall not use a depleted UF_6 deconversion facility that employs a process that results in the production of anhydrous hydrofluoric acid.

For these reasons, distillation to anhydrous hydrofluoric acid was eliminated from further consideration in this EIS.

2.3 Comparison of Predicted Environmental Impacts

Chapter 4 of this EIS presents a more detailed evaluation of the environmental impacts of the proposed action and the no-action alternative. Table 2-9 summarizes the environmental impacts for the proposed NEF and the no-action alternative.

2.4 Staff Recommendation Regarding the Proposed Action

After weighing the impacts of the proposed action and comparing alternatives, the NRC staff, in accordance with 10 CFR § 51.71(e), sets forth its NEPA recommendation regarding the proposed action. The NRC staff recommends that, unless safety issues mandate otherwise, the proposed license be issued to LES. In this regard, the NRC staff has concluded that the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 5 would eliminate or substantially lessen any potential adverse environmental impacts associated with the proposed action.

The NRC staff has concluded the overall benefits of the proposed NEF outweigh the environmental disadvantages and costs based on consideration of the following:

- The need for an additional, reliable, economical, domestic source of enrichment services.
- The beneficial economic impacts of the proposed NEF on the local communities which have been determined to be MODERATE.
- The remaining impacts on the physical environment and human communities would be small with the exception of short-term impacts associated with construction traffic, accidents, and waste management, which would be SMALL to MODERATE.

assumed 10-percent annual increase in gate receipts previously documented in the landfill's permit application. Based on the quantities of solid wastes and the application of industry-accepted procedures, the impacts from solid wastes would be SMALL.

Because over 20 years' worth of disposal space is currently available in the United States for Class A low-level radioactive wastes (GAO, 2004), the impact of low-level radioactive wastes generation would be SMALL on disposal facilities. EPA and New Mexico regulations, including 20.4.1 *New Mexico Administrative Code* 20.4.1, "Hazardous Waste Management," would be the guiding laws to manage hazardous wastes (LES, 2005a).

4.2.14.3 DUF_6 Waste-Management Options

As discussed in Chapter 2 of this EIS, until a conversion facility is available, UBCs (i.e., DUF_6-filled Type 48Y cylinders) would be temporarily stored on the UBC Storage Pad. Storage of UBCs at the proposed NEF could occur for up to 30 years during operations and before removal of DUF_6 from the site through one of the disposition options (see text box *DUF_6 Disposition Options Considered*). However, LES has committed to a disposal path outside of the State of New Mexico which would be utilized as soon as possible and would aggressively pursue economically viable paths for UBCs as soon as they become available (LES, 2005a).

DUF_6 Disposition Options Considered

Option 1a: Private Conversion Facility (LES Preferred Option). Transporting the UBCs from the proposed NEF to an unidentified private conversion facility outside the region of influence. After conversion to U_3O_8, the wastes would then be transported to a licensed disposal facility for final disposition.

Option 1b: Adjacent Private Conversion Facility. Transporting the UBCs from the proposed NEF to an adjacent private conversion facility. This facility is assumed to be adjacent to the site and would minimize the amount of DUF_6 onsite by allowing for ship-as-you-generate waste management of the converted U_3O_8 and associated conversion byproducts (i.e., CaF_2). The wastes would then be transported to a licensed disposal facility for final disposition.

Option 2: DOE Conversion Facility. Transporting UBCs from the proposed NEF to a DOE conversion facility. For example, the UBCs could be transported to one of the DOE conversion facilities either at Paducah, Kentucky, or Portsmouth, Ohio (DOE, 2004a; DOE, 2004b). The wastes would then be transported to a licensed disposal facility for final disposition.

Temporary Onsite Storage Impacts

Proper and active cylinder management, which includes routine inspections and maintaining the anti-corrosion layer on the cylinder surface, has been shown to limit exterior corrosion or mechanical damage necessary for the safe storage of DUF_6 (DNFSB, 1995a; DNFSB, 1995b; DNFSB, 1999). DOE has stored DUF_6 in Type 48Y or similar cylinders at the Paducah and Portsmouth Gaseous Diffusion Plants and the East Tennessee Technical Park in Oak Ridge, Tennessee, since approximately 1956. Cylinder leaks due to corrosion led DOE to implement a cylinder management program (ANL, 2004). Past evaluations and monitoring by the Defense Nuclear Facility Safety Board of DOE's cylinder maintenance program confirmed that DOE met all of the commitments in its cylinder maintenance implementation plan, particularly through the use of a systems engineering process to develop a workable and technically justifiable cylinder management program (DNFSB, 1999). Thus, an

active cylinder maintenance program by LES would assure the integrity of the UBCs for the period of time of temporary onsite storage of DUF_6 on the UBC Storage Pad.

The principal impacts would be the radiological exposure resulting from the radioactive material temporarily stored in 15,727 UBCs under normal conditions and the potential release (slow or rapid) of DUF_6 from the UBCs due to an off-normal event or accidents (operational, external, or natural hazard phenomena events). These radiation exposure pathways are analyzed in sections 4.2.12 and 4.2.13, and based on these results, the impacts from temporary storage would be SMALL to MODERATE. The annual impacts from temporary storage would continue until the UBCs are removed from the proposed NEF site.

Option 1a: Private Conversion Facility Impacts

Under Option 1a, the Type 48Y cylinders, or UBCs, would be transported from the proposed NEF to an unidentified private facility (potentially ConverDyn facility in Metropolis, Illinois). After being converted to U_3O_8, the waste would be further transported to a licensed disposal facility. The impacts of conversion at a private conversion facility or at DOE conversion facilities are similar because it is assumed that the facility design of a private conversion facility would be similar to the DOE conversion facilities.

The transportation of the Type 48Y cylinders from the proposed NEF to the conversion facility would have environmental impacts. Appendix D provides the transportation impact analysis of shipping the Type 48Y cylinders, and section 4.2.11 summarizes the impacts. The selected routes would be from Eunice, New Mexico, to Metropolis, Illinois.

If the private conversion facility cannot immediately process the Type 48Y cylinders upon arrival, potential impacts would include radiological impacts proportional to the time of temporary storage at the conversion facility. The DOE has previously assessed the impacts of temporary storage during the operation of a DUF_6 conversion facility (DOE, 2004a; DOE, 2004b). The proposed action is not expected to change the impacts of temporary storage of Type 48Y cylinders at the conversion facility site from that previously considered in these DOE conversion facility Final EISs. Therefore, the NRC staff has concluded that the environmental impacts of temporary storage at the private conversion facility are bounded by the environmental impacts previously evaluated in the DOE conversion facility Final EISs. At the Paducah and Portsmouth conversion facilities, the maximum collective dose to a worker would be 0.055 person-sieverts (5.5 person-rem) per year and 0.03 person-sieverts (3 person-rem) per year, respectively. There would be no exposure to noninvolved workers or the public because air emissions from the cylinder preparation and maintenance activities would be negligible (DOE, 2004a; DOE, 2004b).

Because Metropolis, Illinois, lies just across the Ohio River from the Paducah conversion facility site (within 6.4 kilometer [4 miles]), if a private conversion facility is built at Metropolis, Illinois, then the public and occupational health impacts from this conversion facility would be bounded by the impacts from the Paducah conversion facility because both conversion facilities would be located in the same area and would be approximately the same size. In addition, other impacts to resources such as land use, historic and cultural, visual, air quality, geology, water quality, ecology, noise, and waste management, would be similar to the Paducah conversion facility. Therefore, the NRC staff considers the impacts for these resources from the construction and operation of a conversion facility at Metropolis, Illinois, to be bounded by the impacts previously considered in the Paducah conversion facility Final EIS (DOE,

2004a). Because the impacts to resources discussed above and the health impacts are within regulatory requirements, the impacts from the private conversion facility would be SMALL.

Option 1b: Adjacent Private Conversion Facility Impacts

The conversion facility could be constructed adjacent to the proposed NEF. For the purposes of analyzing impacts, "adjacent" is defined as being within at least 6.4 kilometers (4 miles) of the proposed NEF. Although no adjacent conversion facility site has been identified, there would be advantages (i.e., transportation and speed of processing) to having a conversion facility adjacent to the proposed NEF. With an adjacent conversion facility, transfer and conversion could be completed within days of the filling of the Type 48Y cylinder, thus minimizing the amount of DUF_6 onsite. Once the waste was converted to U_3O_8, depleted uranium and the associated waste streams would subsequently be transported to a licensed disposal facility for final disposition. Such immediate waste-management action would allow for no buildup of DUF_6 wastes at the proposed NEF and would removes the impacts and risks associated with the temporary storage of UBCs at the proposed NEF and the potential conversion facility.

Because the operations would be the same as for the DOE conversion facilities, the environmental impacts from normal operations of an adjacent conversion facility would be representative of the impacts of the DOE facilities (occupational) and the proposed NEF (members of the public). Therefore, the maximum occupational and member of the public annual exposures would be approximately 6.9 millisieverts (690 millirem) and 5.3×10^{-5} millisieverts (5.3×10^{-3} millirem), respectively. The impacts due to accidents would be bounded by the proposed NEF's highest accident consequence—the hydraulic rupture of a UF_6 cylinder. This maximum accident impact could be a collective dose of 120 person-sieverts (12,000 person-rem) or equivalent to 7 latent cancer fatalities. Similarly as presented in section 4.2.13.3 for the proposed NEF, the combination of responses by Items Relied on for Safety that mitigate or prevent emergency conditions, and the implementation of emergency procedures and protective actions in accordance with an Emergency Plan, would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond an adjacent private conversion facility boundaries.

Based on water use at the existing conversion facility at Portsmouth, Ohio (DOE, 2004b), and allowing for the decreased throughput of a facility built to handle only the proposed NEF's output, such a facility's operational water needs could be approximately 200 cubic meters per day (19 million gallons per year), approximately 82 percent of the water use of the proposed NEF. If such a facility were built in nearby Andrews County, Texas, the water would be withdrawn from the Ogallala Aquifer. Therefore, the water resource impacts would be SMALL.

Other impacts to resources such as land use, historic and cultural, visual and scenic, geology, ecology, socioeconomics, and environmental justice would be similar to the proposed NEF because they would be located in the same area and would be approximately the same size. Therefore, the NRC staff considers the impacts for these resources from the construction and operation of an adjacent conversion facility to be bounded by the impacts considered in this EIS for the proposed NEF. Based on the description and design parameters of the Portsmouth DOE conversion facility, the adjacent conversion facility would likely affect a similar area of land, employ a similar number of workers, and involve a building of a similar size. Due to similar construction methods and design, impacts to resources at the adjacent conversion facility, such as air quality, water quality, noise, and waste management, would be similar to the Portsmouth conversion facility (DOE, 2004b). Because the radiological impacts are within regulatory requirements, the impacts from an adjacent conversion facility would be SMALL.

Option 2: DOE Conversion Facilities Impacts

Under option 2, the Type 48Y cylinders would be transported from the proposed NEF to either of the DOE's conversion facilities (Paducah, Kentucky, or Portsmouth, Ohio). After being converted to U_3O_8, the waste would be further transported to a licensed disposal facility. The transportation of the Type 48Y cylinders from the proposed NEF to the conversion facility would have environmental impacts. Appendix D provides the transportation impact analysis of shipping the Type 48Y cylinders, and section 4.2.11 summarizes the impacts. The selected routes are from Eunice, New Mexico, to Paducah, Kentucky, and Portsmouth, Ohio.

If the DOE conversion facility could not immediately process the UBCs upon arrival, potential impacts would include radiological impacts proportional to the time of temporary storage at the conversion facility. The DOE has previously assessed the impacts of UBC storage during the operation of a DUF_6 conversion facility (DOE, 2004a; DOE, 2004b) and bound the impacts of temporary storage of LES's UBCs at the conversion facility site. At the Paducah and Portsmouth conversion facilities, the maximum collective dose to a worker (i.e., a worker at the cylinder yard) would be 0.055 person-sieverts (5.5 person-rem) per year and 0.03 person-sieverts (3 person-rem) per year, respectively. There would be no exposure to noninvolved workers or the public because air emissions from the cylinder preparation and maintenance activities would be negligible (DOE, 2004a; DOE, 2004b).

To assess the impacts of the proposed NEF generated DUF_6 on the DOE's conversion facilities, one must understand the relative amount of additional material as compared to the DOE's existing DUF_6 inventory. The Paducah conversion facility would operate for approximately 25 years beginning in 2006 to process 436,400 metric tons (481,000 tons) (DOE, 2004a). The Portsmouth conversion facility would operate for 18 years also beginning in 2006 to process 243,000 metric tons (268,000 tons) (DOE, 2004b). Based on the projected maximum amount of DUF_6 generated by the proposed NEF (197,000 metric tons [217,000 tons]), this would represent 81 percent of the Portsmouth (243,000 metric tons [268,000 tons]) and 45 percent of the Paducah (436,400 metric tons [481,000 tons]) existing inventories. The proposed NEF would produce approximately 7,800 metric tons (8,600 tons) of DUF_6 per year at full production capacity (LES 2005a). This value represents 43 percent of the annual conversion capacity of the Paducah facility (18,000 metric tons [20,000 tons] per year) and 58 percent of the Portsmouth facility (13,500 metric tons [15,000 tons] per year). The proposed NEF maximum DUF_6 inventory could extend the time of operation by approximately 11 years for the Paducah conversion facility or 15 years for the Portsmouth conversion facility.

With routine facility and equipment maintenance, and periodic equipment replacements or upgrades, DOE indicates that the conversion facilities could be operated safely beyond this time period to process the DUF_6 such as that originating at the proposed NEF. In addition, DOE indicates the estimated impacts that would occur from prior conversion facility operations would remain the same when processing DUF_6 such as the proposed NEF wastes. The overall cumulative impacts from the operation of the conversion facility would increase proportionately with the increased life of the facility (DOE, 2004a; DOE, 2004b).

Table 4-16 presents a summary of the potential treatment and disposition pathways for the Paducah and Portsmouth conversion facilities that could also be appropriate for conversion of the DUF_6 originating at the proposed NEF. Based on the above assumptions and data, Tables 4-17 and 4-18 show the environmental impacts from the conversion of the DUF_6 from the proposed NEF at an offsite location such as Portsmouth or Paducah. The additional impacts for converting the proposed NEF DUF_6 at these conversion facilities would be SMALL.

Table 4-16 Conversion Waste Streams, Potential Treatments, and Disposition Paths

Conversion Product	Annual Waste Stream Portsmouth	Paducah	Treatment	Proposed Disposition	Optional Disposition
Depleted U_3O_8	10,800 MT (11,800 tons)	14,300 MT (15,800 tons)	Loaded into bulk bags and loaded into rail or truck[a].	Envirocare.	Nevada Test Site[a].
CaF_2	18 MT (20 tons)	24 MT (26 tons)	Similar to depleted U_3O_8.	Sale to commercial CaF_2 supplier.	Envirocare[a].
70% HF Acid	2,500 MT (2,800 tons)	3,300 MT (3,600 tons)	HF acid should be commercial grade.	Sale to commercial HF acid supplier.	Neutralization by CaF_2.
49% HF Acid	5,800 MT (6,300 tons)	7,700 MT (8,500 tons)	HF acid should be commercial grade.	Sale to commercial HF acid supplier.	Neutralization by CaF_2.
Type 48Y Cylinders[b]	~1,000 cylinders 1,777 MT (1,300 tons)	~1,100 cylinders 1,980 MT (2,200 tons)	Emptied cylinders would have a stabilizing agent added to neutralize residual fluorine, be stored for 4 months, crushed to reduce size, sectioned, and packaged in intermodal containers.	Envirocare.	Nevada Test Site[c].

[a] U_3O_8 would be loaded into bulk bags (lift liners, 25,000-pound [11,340-kilogram] capacity) and loaded into gondola railcars (8 to 9 bags per car, depending on the car selected) or on a commercial truck (one bag per truck).
[b] Empty cylinders to be disposed if not used as U_3O_8 disposal containers.
[c] For DUF_6 converted at DOE facilities, final disposition at the Nevada Test Site is an option.
HF - hydrogen fluoride; MT - metric ton.
Sources: DOE, 2004a; DOE, 2004b.

Table 4-17 Radiological Impacts from an Offsite DUF_6 Conversion Facility During Normal Operations

	Occupational		Members of the Public	
Radiation Doses	Dose, mSv per year (mrem per year)	Collective Dose, person-Sv per year (person-rem per year)	MEI Dose, mSv per year (mrem per year)	Collective Dose, person-Sv per year (person-rem per year)
Portsmouth Conversion Facility	0.75 (75)	0.101 (10.1)	$<2.1\times10^{-7}$ ($<2.1\times10^{-5}$)	6.2×10^{-7} (6.2×10^{-5})
Portsmouth Cylinder Yard	5.10-6.00 (510-600)	0.026-0.030 (2.6-3.0)	N/A	N/A
Paducah Conversion Facility	0.75 (75)	0.107 (10.7)	$<3.9\times10^{-7}$ ($<3.9\times10^{-5}$)	4.7×10^{-7} (4.7×10^{-5})
Paducah Cylinder Yard	4.30-6.90 (430-690)	0.034-0.055 (3.4-5.5)	N/A	N/A

Cancer Risks	Average Risk[a] (LCF per year)	Collective Risk[a] (LCF per year)	MEI Risk[a] (LCF per year)	Collective Risk[a] (LCF per year)
Portsmouth Conversion Facility	5×10^{-5}	6×10^{-3}	1×10^{-11}	4×10^{-8}
Portsmouth Cylinder Yard	3×10^{-4} – 4×10^{-4}	2×10^{-3}	N/A	N/A
Paducah Conversion Facility	5×10^{-5}	6×10^{-3}	2×10^{-11}	3×10^{-8}
Paducah Cylinder Yard	3×10^{-4} – 4×10^{-4}	2×10^{-3} – 3×10^{-3}	N/A	N/A

[a] DOE risk values adjusted for a conversion factor of 6×10^{-4} LCF per person-rem.
LCF - latent cancer fatalities; Sv - sieverts; mSv - millisieverts; mrem - millirem; MEI - maximally exposed individual.
Sources: DOE, 2004a; DOE, 2004b.

Table 4-18 Radiological Impacts from an Offsite DUF_6 Conversion Facility Under Accident Conditions

		Onsite Worker		Members of the Public	
Accident	Frequency (per year)	MEI Dose, Sv (rem) PORTS/PGDP	Population, person-Sv (person-rem) PORTS/PGDP	MEI Dose, Sv (rem) PORTS/PGDP	Population, person-Sv (person-rem) PORTS/PGDP
Corroded Cylinder	$>1.0\times10^{-2}$	0.00078 / 0.00078 (0.078/0.078)	0.014 / 0.024 (1.4 / 2.4)	0.00078 / 0.00078 (0.078/0.078)	0.0012 / 0.0024 (0.12 / 0.24)
Failure of U_3O_8 Container While in Transit	$>1.0\times10^{-2}$	0.0053 / 0.0053 (0.53 / 0.53)	0.096 / 0.17 (9.6 / 17)	0.0053 / 0.0053 (0.53 / 0.53)	0.0051 / 0.01 (0.51 / 1.0)
Earthquake	1.0×10^{-4} to 1.0×10^{-6}	0.30 / 0.40 (30 / 40)	5.3 / 12.7 (530 / 1,270)	0.30 / 0.40 (30 / 40)	0.30 / 0.73 (30 / 73)
Rupture of UBC – Fire	1.0×10^{-4} to 1.0×10^{-6}	0.0002 / 0.0002 (0.02 / 0.02)	0.051 / 0.080 (5.1 / 8.0)	0.0002 / 0.0002 (0.02 / 0.02)	0.23 / 0.21 (23 / 21)
Tornado	1.0×10^{-4} to 1.0×10^{-6}	0.075 / 0.075 (7.5 / 7.5)	1.3 / 2.3 (130 / 230)	0.075 / 0.075 (7.5 / 7.5)	0.17 / 0.34 (17 / 34)

Sv - sieverts; MEI - maximally exposed individual; PORTS - Portsmouth Gaseous Diffusion Plant; PGDP - Paducah Gaseous Diffusion Plant.
Sources: DOE, 2004a; DOE, 2004b.

4.2.14.4 Impacts from Disposal of the Converted Waste

Under option 1a or 1b, once converted to U_3O_8, the waste would subsequently be transported to a licensed commercial disposal facility for final disposition, as discussed in section 2.1.9 of this EIS. Section 4.2.11 of this chapter discusses the impacts of transporting the waste to a licensed disposal facility for final disposition. The impacts due to transportation would be SMALL.

The environmental impacts at the shallow disposal sites considered for disposition of low-level radioactive wastes would have been assessed at the time of the initial license approvals of these disposal facilities or as a part of any subsequent amendments to the license. For example, under its Radioactive Materials License issued by the State of Utah, the Envirocare disposal facility is authorized to accept depleted uranium for disposal with no volume restrictions (Envirocare, 2004). Several site-specific factors contribute to the acceptability of depleted uranium disposal at the Envirocare site, including highly saline groundwater that makes it unsuitable for use in irrigation and for human or animal consumption, saline soils unsuitable for agriculture, and low annual precipitation (NRC, 2005c). As Utah is an NRC Agreement State and Envirocare has met Utah's low-level radioactive waste licensing requirements, which are compatible with 10 CFR Part 61, the impacts from the disposal of depleted uranium generated by the proposed NEF at the Envirocare facility would be SMALL.

The quantity of depleted uranium generated as a result of the proposed NEF's operations would also affect the available disposal capacity for such material. Since the depleted U_3O_8 to be generated by the conversion of the proposed NEF's depleted tails would be a Class A low-level radioactive waste, it would need to be disposed of in a facility licensed to accept Class A waste. In a June 2004 report, the Government Accountability Office reported that sufficient disposal capacity exists at currently licensed low-level radioactive waste disposal facilities for Class A low-level radioactive wastes generated for more than the next 20 years (GAO, 2004). Therefore, the potential impact on national disposal space that would be incurred due to the proposed NEF's operations would be considered SMALL.

In addition to shallow disposal, LES also presented the potential for disposition in an abandoned mine as a geologic disposal site. Although no existing mine is currently licensed to receive or dispose of low-level radioactive waste nor has any application been made to license such a facility, the postulated radiological impacts from such a disposal site are also presented in this section. The analysis of the radiological impacts from the disposal of the converted wastes as U_3O_8 in a geologic disposal site was previously presented in the EIS for the Claiborne Enrichment Center (NRC, 1994). Two postulated geologic disposal sites (i.e., an abandoned mine in granite or in sandstone/basalt) were evaluated for impacts from contaminated well or river water. The pathways included drinking the water or the consumption of crops irrigated by the well water or of fish from a contaminated river. The potential impacts from the disposal of the proposed NEF-generated U_3O_8 for similar geologic disposal sites would be proportional to the quantity of material postulated from the Claiborne Enrichment Center enrichment facility. In the year of maximum exposure, the estimated doses for both scenarios and for both potential mine sites for the proposed NEF-generated U_3O_8 are presented in Table 4-19. All estimated impacts for either geologic disposal site would not result in an annual dose exceeding an equivalent of 0.25 millisieverts (25 millirem) to the whole body provided in 10 CFR § 61.41; thus, the overall disposal impacts would be SMALL.

Table 4-19 Maximum Annual Exposure from Postulated Geologic Disposal Sites[a]

Scenario	Pathway	Granite Site		Sandstone/Basalt Site	
		millisieverts	millirem	millisieverts	millirem
Well	Drinking Water	3×10^{-4}	3×10^{-2}	2×10^{-7}	2×10^{-5}
	Agriculture	4×10^{-3}	4×10^{-1}	3×10^{-6}	3×10^{-4}
River	Drinking Water	9×10^{-13}	9×10^{-11}	3×10^{-11}	3×10^{-9}
	Fish Ingestion	2×10^{-12}	2×10^{-10}	5×10^{-11}	5×10^{-9}

[a] Values based on models and analysis presented in Appendix A of NRC, 1994.

4.2.14.5 Mitigation Measures

LES would implement a materials waste recycling plan to limit the amount of nonhazardous waste generation. LES would perform a waste assessment to determine waste-reduction opportunities and what materials would best be recycled. Employee training would be performed regarding the materials to be recycled and the use of recycling bins and containers. For low-level radioactive wastes, the cost of disposal necessitates the need for a waste-minimization program that includes decontamination and reuse of these materials when practicable. The use of chemical solutions for decontamination processes would be limited to minimize the volume of mixed waste that would be generated (LES, 2005a). An active DUF_6 cylinder management program would maintain "optimum storage conditions" to mitigate the potential for adverse events. Surveys of the UBC Storage Pad would be regularly conducted to inspect parameters that are outlined in Table 5-2 of Chapter 5 of this EIS.

4.3 Decontamination and Decommissioning Impacts

This section summarizes the potential environmental impacts of decontamination and decommissioning of the site through comparison with normal operational impacts. Decontamination and decommissioning involves the removal and disposal of all operating equipment while leaving the structures and most support equipment decontaminated to free release levels in accordance with 10 CFR Part 20. Decommissioning activities are generally described in section 2.1.8 of this EIS based on the information provided by LES in the Safety Analysis Report (LES, 2005d). However, a complete description of actions taken to decommission the proposed NEF at the expiration of its NRC license period cannot be fully determined at this time. In accordance with 10 CFR § 70.38, LES must prepare and submit a Decommissioning Plan to the NRC at least 12 months prior to the expiration of the NRC license for the proposed NEF. LES would submit a final decommissioning plan to the NRC prior to the start of decommissioning. This plan would be the subject of further NEPA review, as appropriate, at the time the Decommissioning Plan is submitted to the NRC. Decontamination and decommissioning activities would be conducted to comply with all applicable Federal and State regulations in effect at the time of these activities.

The Cascade Halls would undergo decontamination and decommissioning sequentially over a nine-year period (LES, 2005d). Cascade Halls 1 and 2 in Separations Building Module 1 are scheduled to be the first enrichment cascades to operate and would be the first to undergo decontamination and decommissioning. Cascade Halls 3 through 6 would follow in turn. Once all the UF_6 containment and

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APPENDIX C
DOSE METHODOLOGY AND IMPACTS

C.1 Introduction

This appendix presents the methodology, assumptions, data, and results for the potential impacts on individual workers and members of the public resulting from routine or normal operations and accidents from the Louisiana Energy Services (LES) proposed National Enrichment Facility (NEF), including a description of how radioactive material, such as uranium, results in radiation doses and a comparison of these doses to applicable standards.

The consequence of internal and external radiation exposure due to the deposition of energy from radioactive material in body tissues is represented as absorbed dose. Absorbed dose is quantified as energy absorbed per unit of tissue mass. The biological effect on individual tissues is estimated by multiplying the absorbed dose by a factor that accounts for the relative biological effect of differing types of radiation. This modified tissue dose is called dose equivalent. Dose equivalent can represent external radiation (i.e., radiation absorbed through the skin from a source external to the body) or internal radiation (i.e., radiation absorbed by internal tissues of the body due to inhalation or ingestion). The effect on the whole body from external and/or internal radiation is represented as a risk-weighted sum of the set of tissue dose equivalents. This dose, called the effective dose equivalent (EDE), can be integrated over a period of years to account for the accumulated effect from a single year's exposure. The time-integrated measure of effect for internal radiation is called the committed effective dose equivalent (CEDE). CEDEs are combined with dose estimates for external exposure to calculate a measure of effect for both exposure modes, called the total effective dose equivalent (TEDE) (ANL, 2004).

C.1.1 Regulatory Limits

Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Part 20 provides the regulatory limits for occupational doses and radiation dose for individual members of the public. For occupational doses, 10 CFR § 20.1201 states that licensees must limit the occupational dose to individual adults to an annual limit, which is the more limiting of:

- The TEDE being equal to 0.05 sievert (5 rems).
- The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.5 sievert (50 rems).

Additionally, the annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities are:

- A lens dose equivalent of 0.15 sievert (15 rems).
- A shallow-dose equivalent of 0.5 sievert (50 rem) to the skin of the whole body or to the skin of any extremity.

In addition to the annual occupational dose limits, 10 CFR § 20.1201 would limit the soluble uranium intake by an individual to 10 milligrams in a week because of chemical toxicity.

An explicit TEDE limit of 1.0 millisievert per year (100 millirem per year) from all sources is provided for individual members of the public. This limit includes both internal and external doses through all pathways (including food). External dose rates cannot exceed 0.02 millisievert (2 millirem) in any one hour. Further, LES would be subject to the generally applicable standards in 10 CFR § 20.1101 and 40 CFR Part 190. 40 CFR Part 190 requires that routine releases from uranium fuel-cycle facilities to the general environment would not result in annual doses exceeding 0.25 millisievert (25 millirem) to the whole body, 0.75 millisievert (75 millirem) to the thyroid, and 0.25 millisievert (25 millirem) to any other organ.

C.2 Pathway Assessment

Exposure to uranium processed by the proposed NEF could occur from routine operations as a result of small controlled releases to the atmosphere from the uranium enrichment process lines and decontamination and maintenance of equipment, releases of radioactive liquids to surface water, and direct radiation from the uranium material. Radioactive material released to the atmosphere, surface water, and groundwater is dispersed during transport through the environment and transferred to human receptors through inhalation, ingestion, and direct exposure pathways. Therefore, evaluation of impacts requires consideration of potential receptors, source terms, environmental transport, exposure pathways, and conversion of estimates of intake to dose.

Under the proposed action, the major source of occupational exposure would be expected to be from direct radiation from the uranium hexafluoride (UF_6) with the largest exposure source being the cylinders (empty and full) that hold the UF_6. These cylinders are as follows:

- Type 48Y cylinders containing either the feed material (natural UF_6) or the depleted uranium hexafluoride (DUF_6) called uranium byproduct cylinders (UBCs), or empty with residual material.
- Type 48X cylinders containing the feed material or empty with residual material.
- Type 30 product cylinders holding the enriched UF_6 for shipping to nuclear fuel manufacturers.

In addition to direct radiation, there could be the potential for serious internal exposure from long-term contact with UF_6 leaking from the process equipment and acute exposure resulting from accidents.

The major source of exposure to the general public would be expected to come from atmospheric releases. Such releases would be primarily controlled through the Technical Services Building and Separations Building gaseous effluent vent systems. The principal function of the gaseous effluent vent system is to protect both the operator during the connection/disconnection of UF_6 process equipment and the surrounding population and environment by collecting and cleaning all potentially hazardous gases from the plant prior to release to the atmosphere. In addition, the Centrifuge Test and Postmortem Facilities would have an exhaust filtration system that would serve the same purpose as the gaseous effluent vent system. The Technical Services Building heating, ventilation, and air-conditioning system would perform a confinement ventilation function for potentially contaminated areas in the building. Members of the public, if close enough, could be affected by direct radiation and skyshine (radiation reflected from the atmosphere).

The principal source for direct radiation offsite would be from the storage of UBCs filled with DUF_6 that could be stored within the site boundaries of the proposed NEF. Direct radiation and skyshine from the UF_6 within the Separations Building (i.e., the gaseous centrifuge cascades) would be undetectable