5 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

This chapter discusses estimated potential impacts to the environment, including impacts to workers and members of the general public, under the no action alternative (Section 5.1) and the action alternatives (Section 5.2). The general assessment methodologies and major assumptions used to estimate the impacts are described in Chapter 4 and Appendix F of this EIS.

This EIS evaluates the proposed action, which is to construct and operate a conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP DUF_6 inventories into depleted uranium oxide and other conversion products. Three alternative locations at the site are evaluated, one of which has been selected as the preferred location. This EIS also discusses impacts from preparation of cylinders for shipment at ETTP and shipment of these cylinders to the Portsmouth site. Shipment of ETTP cylinders to Portsmouth is part of the proposed action, as is the construction of a new cylinder storage yard for those cylinders, if required.

Under the no action alternative, potential environmental impacts from continued storage and maintenance of the cylinders in their current locations at the Portsmouth and ETTP sites are evaluated primarily through the year 2039, although potential long-term impacts from releases of DUF_6 and HF from future cylinder breaches are also evaluated.

This chapter also discusses the potential cumulative impacts of the alternatives (Section 5.3), potential mitigation actions (Section 5.4), unavoidable adverse impacts of the alternatives (Section 5.5), irreversible and irretrievable commitment of resources (Section 5.6), the relationship between short-term use of the environment and long-term productivity (Section 5.7), pollution prevention and waste minimization (Section 5.8), and D&D of conversion facilities (Section 5.9).

5.1 NO ACTION ALTERNATIVE

5.1.1 Introduction

Under the no action alternative, it is assumed that storage of DUF_6 cylinders would continue indefinitely at the Portsmouth and ETTP sites and that DOE surveillance and maintenance activities would be ongoing to ensure the continued safe storage of cylinders. Potential environmental impacts from this alternative are estimated through 2039 in this EIS, and long-term impacts (i.e., those that would occur after 2039) from cylinder breaches are also estimated. A similarly defined no action alternative is evaluated in the DUF_6 PEIS (DOE 1999a). The assessment of the no

No Action Alternative

The no action alternative assumes that storage of the DUF_6 cylinders would continue for an indefinite period at the Portsmouth site, along with continued cylinder surveillance and maintenance. Impacts were evaluated through the year 2039, and potential long-term (beyond 2039) impacts were also evaluated.

action alternative in this EIS has been updated to reflect changes that have occurred since publication of the PEIS (e.g., changes in plans for new cylinder yard construction and changes in noninvolved worker and general population numbers).

A detailed discussion of the assumptions about and impacts from continued cylinder storage activities is included in Appendix D of the PEIS; changes in impacts due to the addition of USEC-generated cylinders are discussed in Section 6.3.1 of the PEIS (DOE 1999a). Updated information on ongoing and planned cylinder maintenance activities has been compiled from a database on the cylinders at the three sites and from life-cycle baseline documents for cylinder maintenance (Hightower 2002). This information was compiled prior to awarding the conversion contract to UDS and thus represents DOE’s plans for long-term maintenance of cylinders without conversion, as would be the case under the no action alternative. In Section 5.1.1.1, the ongoing and planned cylinder maintenance activities assumed for the Portsmouth and ETTP sites under the no action alternative are reviewed.

Impacts associated with the following activities under the no action alternative are considered in both the PEIS and this EIS: (1) storage yard reconstruction and cylinder relocations, (2) routine and ultrasonic test inspections of cylinders and radiological monitoring and maintenance of the cylinder exteriors and valves, (3) cylinder painting, and (4) repair and removal of the contents of any cylinders that might be breached during the storage period. The frequencies for each activity assumed for the Portsmouth and ETTP sites in the PEIS are compared with planned future frequencies in Table 5.1-1. Overall, the assumptions in the PEIS result in the PEIS impacts bounding the actual impacts that could occur under current and planned future activities.

5.1.1.1 Cylinder Maintenance Activities

The PEIS assessment covered maintenance of up to 16,388 cylinders at the Portsmouth site and 4,683 cylinders at the ETTP site. The actual inventory of cylinders actively managed by DOE is changing over time as USEC transfers cylinders to DOE under three MOAs. As of January 2004, the DOE inventory at the Portsmouth site consisted of 16,109 full, partially full, and heels DUF_6 cylinders; the inventory at the ETTP site consisted of 4,822 full, partially full and heels DUF_6 cylinders (Hightower 2004). Maintenance efforts completed at the two sites include (1) reconstruction/upgrading of a yard at each site to provide stabilized concrete bases and monitored drainage for the cylinder storage areas, and (2) relocation of some cylinders that either were too close to one another to allow for adequate inspections or were located in yards that required reconstruction. Most required cylinder relocations have already been completed; few additional relocations would be required under the no action alternative.

Under the DOE-approved DUF_6 management plan (DOE 1996e), the stored cylinders are regularly inspected for evidence of damage or accelerated corrosion. Each cylinder must be inspected at least once every 4 years; however, annual inspections are required for cylinders that were previously stored in substandard conditions and those that show areas of heavy pitting or corrosion. In addition to these routine inspections, ultrasonic inspections are conducted on some

TABLE 5.1-1 No Action Alternative: Comparison of Frequencies Assumed in the PEIS with Planned Frequencies for Activities at the Portsmouth and ETTP Sites

Activity	Activity-Specific Assumption	PEIS-Assumed Average Annual Activity Frequency for Portsmouth[a]	Planned Average Annual Frequency for 2003–2007 for Portsmouth	PEIS-Assumed Average Annual Activity Frequency for ETTP	Planned Average Annual Frequency for 2003–2007 for ETTP
Routine cylinder inspections	30-min exposure at 1-ft (0.30-m) distance per inspection	5,900	7,000	3,400	3,900
Ultrasonic inspections	90-min exposure at about 2-ft (0.61-m) distance per inspection	165	150	70[b]	120
Radiological monitoring and valve maintenance	1-h exposure at 1-ft (0.30-m) distance per inspection	5	700	2	230
Cylinder relocations	4-h exposure at about 8-ft (2.44-m) distance per relocation	0	0	0	53[c]
Cylinder painting	7-h exposure at 1 to 10 ft (0.30 to 3.05 m) distance per cylinder, 2 gal (8 L) of paint used, 2 gal (8 L) of LLMW generated per cylinder	1,650	0	900	510[d]

[a] Source: Parks (1997), with the addition of the assumption that there would be an overall increase of 22% in Portsmouth activities to address the addition of USEC cylinders.

[b] Average for 1999 to 2008.

[c] Data for 2002.

[d] Average for 2000 to 2004, years for which data are available.

of the cylinders. The ultrasonic testing is a nondestructive method of measuring the thickness of cylinder walls. Radiological monitoring of the cylinder surface, especially around the valves, and maintenance are also conducted for cylinders that exhibit discoloration of the valve or surrounding area during routine inspections. Leaking valves are replaced in the field. Impacts from routine inspections, ultrasonic inspections, and radiological monitoring and valve maintenance are evaluated as components of the no action alternative. In the PEIS assessment, the assumed frequencies of routine inspections were somewhat underestimated (by 20% for Portsmouth and 15% for ETTP) in comparison with rates planned for the period 2003 to 2007 (see Table 5.1-1). Radiological monitoring and valve maintenance was underestimated by a factor of more than 100; however, this activity is of short duration, with little radiological exposure.

At the time the PEIS was prepared, a painting program was undertaken in an effort to arrest corrosion of the cylinders. Because the long-term painting schedule was unknown at the time, the PEIS assessment of the no action alternative assumed that as an upper bound, each cylinder would be painted every 10 years. However, after the PEIS was prepared, it was discovered that painting the cylinders increased toxicity indicators in cylinder yard runoff, such that NPDES Permit violations were occurring. Also, the ongoing rate of cylinder breaches was found to be much less than the rate that had been predicted on the basis of theoretical estimates of cylinder corrosion rates, indicating that the other steps that had been taken to improve storage conditions (e.g., regular inspections and relocating cylinders out of ground contact and onto concrete saddles in well-drained, concrete storage yards) were also effective in controlling corrosion. Therefore, continued cylinder maintenance plans call for a greatly reduced frequency of cylinder painting in comparison with the frequency that was assumed in the PEIS (for the Portsmouth site, no cylinder painting is planned; for the ETTP site, the PEIS-assumed painting schedule overestimated that currently planned by a factor of 1.8; see Table 5.1-1). The most frequent ongoing painting activity is partial painting of the ends of skirted cylinders, which are problem areas for corrosion.

The levels of worker activity, worker exposure, and waste generation associated with cylinder painting are much higher than the levels associated with inspection, relocation, and radiological monitoring and valve maintenance activities (Table 5.1-1). Therefore, because the PEIS assumed a high frequency of cylinder painting, its estimates of impacts in several technical areas (e.g., radiological exposures of involved workers, socioeconomics, waste management) represent an upper bound on the impacts that are expected under the current and planned future cylinder maintenance programs. For this EIS, the continued storage impacts for the Portsmouth and ETTP sites estimated in the PEIS were used as the basis for the no action alternative impacts. The data have been revised as appropriate (e.g., the worker and general population numbers have been updated). Under the no action alternative in this EIS, there would not be any additional cylinder yard construction or reconstruction at either the Portsmouth or the ETTP site. Therefore, for most technical areas, the continued storage impacts for the Portsmouth and ETTP sites estimated in the DUF$_6$ PEIS are presented in this EIS as the no action alternative impacts. Impacts for cylinder yard construction at the ETTP site, included in the PEIS, have been deleted.

5.1.1.2 Assumptions and Methods Used to Assess Impacts Associated with Cylinder Breaches

To estimate the impacts from continued cylinder storage, it is necessary to predict the number of cylinder breaches that might occur in the future. A cylinder is considered breached if it has a hole of any size at some location on the cylinder wall. At the time the PEIS was published (1999), 8 breached cylinders had been identified at the three storage sites; 3 of these were at the Portsmouth site, and 4 were at the ETTP site. Investigation of these breaches indicated that 6 of the 8 were initiated by mechanical damage during stacking; the damage was not noticed immediately, and subsequent corrosion occurred at the point of damage. It was concluded that the other 2 cylinder breaches (both at the ETTP site) had been caused by external corrosion due to prolonged ground contact. The breached cylinders were patched, pending decisions on long-term management. However, patched cylinders may eventually require emptying through cold-feeding (a lengthy process of heating a cylinder to a temperature just below the UF_6 liquefaction point so that the UF_6 changes directly from solid to gaseous form).

From 1998 through 2002, 1 additional breach was discovered at the ETTP site (Hightower 2002).[1] This breach was the result of handling damage. The breach rate over this time period was 0.2 per year (1 breach in 5 years). The breached cylinder was subsequently patched.

For assessment purposes in this EIS, 2 cylinder breach cases were evaluated. The first is a case in which it was assumed that the planned cylinder maintenance and painting program would maintain the cylinders in a protected condition and control further corrosion. It was assumed that after the initial painting, some cylinder breaches would result from handling damage. For this case, the number of future breaches estimated through 2039 was 16 for the Portsmouth site and 7 for the ETTP site. In the second case, it was assumed that external corrosion would not be halted by improved storage conditions, cylinder maintenance, and/or painting. This case was considered in order to account for uncertainties in both the effectiveness of painting in controlling cylinder corrosion and uncertainties in the future painting schedule. For this scenario, the number of breaches estimated through 2039 was 74 for the Portsmouth site and 213 for the ETTP site. These breach estimates are based on the historical corrosion rate determined when the cylinders were stored under poor conditions (i.e., cylinders were stacked too close together, were stacked on wooden chocks, or came in contact with the ground). Details concerning development of the breach estimates are provided in Appendix B of the PEIS (DOE 1999a).

The impacts to human health and safety, surface water, groundwater, soil, air quality, and ecology from uranium and HF releases from breached cylinders are assessed in this EIS. For all hypothetical cylinder breaches, it was assumed that the breach would go undetected for 4 years, which is the period between planned inspections for most of the cylinders. In practice, cylinders that show evidence of damage or heavy external corrosion are inspected annually, so it is very unlikely that a breach would go undetected for a 4-year period. For each hypothetical cylinder breach, it was further assumed that 1 lb (0.45 kg) of uranium (as UO_2F_2) and 4.4 lb (2 kg) of HF would be released from the cylinder annually for a period of 4 years. The DUF_6 Management Plan (DOE 1996e) outlines procedures to be taken in the event of a cylinder breach and/or release of DUF_6 from one or more cylinders.

Radiological exposures of involved workers could result from patching breached cylinders or emptying the contents of breached cylinders into new cylinders. The assumptions used to estimate impacts to involved workers were that (1) it would require 32 hours of exposure at a distance of 1 ft (0.30 m) to temporarily patch each cylinder, and (2) it would require an additional 961 hours of exposure at a distance of about 10 ft (3.05 m) to empty a cylinder by cold-feeding.

Groundwater impacts were assessed by first estimating the amount of uranium that could be transported from the yards in surface runoff, and then by estimating migration through the soil to groundwater. HF air concentrations were also modeled.

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[1] A breach that occurred at the ETTP site in 1998 was discussed in Section B.2 of the PEIS (DOE 1999a). A total of 11 breaches have been identified at the Portsmouth, ETTP, and Paducah sites (Hightower 2002).

The lower breach estimate for breaches due to cylinder handling is likely to be a reasonable upper-bound estimate of a breach rate that would occur during long-term continued storage under a no action alternative (e.g., the actual rate over the last 5 years was 0.2 breach per year; the model estimates 1 breach per year). Because storage conditions have improved dramatically as a result of cylinder yard upgrades and restacking activities over the last several years, the breach estimate based on the historical corrosion rate is likely a worst-case estimate of what could occur if DOE discontinued active management of the cylinders. In this assessment, the worst-case scenario is used to estimate the earliest time when continued cylinder storage could begin to raise regulatory concerns, such as when drinking water standards would be exceeded in groundwater or when air quality criteria would be exceeded (see Sections 5.1.2.3 and 5.1.2.4.2).

5.1.2 Impacts of No Action at the Portsmouth Site

The impacts described in this section are similar to those presented in Section 3.5.2 of the data compilation report for the Portsmouth site (Hartmann 1999a); however, they have been adjusted to account for changes in the numbers of noninvolved workers and general population since the time of that earlier assessment.

5.1.2.1 Human Health and Safety

Under the no action alternative, impacts to human health and safety could result from cylinder maintenance operations during both routine conditions and accidents. In general, the impacts during normal facility operations would be limited to workers directly involved in handling cylinders. Under accident conditions, the health and safety of both workers and members of the general public around the site could be affected.

5.1.2.1.1 Normal Facility Operations

Workers. Cylinders containing DUF_6 emit low levels of gamma and neutron radiation. Involved workers would be exposed to this radiation when working near cylinders, such as during routine cylinder monitoring and maintenance activities, cylinder relocation and painting, and patching or repairing of cylinders. It is estimated that an average of about 20 cylinder yard workers would be required at the Portsmouth site. These workers would be trained to function in a radiation environment, they would use protective equipment as necessary, and their radiation exposure levels would be measured and monitored by safety personnel at the sites. Radiation exposure of workers is required by law to be maintained ALARA and not to exceed 5,000 mrem/yr (10 CFR Part 835).

The radiation exposure of involved workers (cylinder yard workers) in future years through 2039 is estimated to be well within public health standards (10 CFR Part 835). If the same 20 workers conducted all cylinder management activities, the average annual dose to individual involved workers would be about 600 mrem/yr. Worker doses are required by health regulations to be maintained below 5,000 mrem/yr (10 CFR Part 835). The estimated doses do not account for standard ALARA practices that would be used to keep the actual doses as far below the limit as practicable. Thus, the future doses to workers are expected to be less than those estimated because of the conservatism in the assumptions and the models used to generate the estimates. In fact, in 2001, the average measured dose to cylinder yard workers at Portsmouth was about 64 mrem (DOE 2002c). The radiation exposure of the noninvolved workers was estimated to be less than 0.15 mrem/yr.

It is estimated that the total collective dose to all involved cylinder maintenance workers at the Portsmouth site from 1999 through 2039 would be about 460 person-rem. (The collective dose to noninvolved workers would be negligible [i.e., less than 0.01%], compared with the collective dose to involved workers.) This dose would be distributed among all of the workers involved with cylinder activities over the no action period. Although 20 workers would be required each year, the actual number of different individuals involved over the period would probably be much greater than 20 because workers could be rotated to different jobs and could change jobs. This level of exposure could potentially result in less than 1 LCF (i.e., 0.2 LCF) among all the workers exposed, in addition to the cancer cases that would result from all other causes not related to activities under the no action alternative.

As discussed in Chapter 1 and Appendix B of this EIS, some portion of the DUF_6 inventory contains TRU and Tc contamination. The contribution of these contaminants to potential external radiation exposures under normal operations was evaluated on the basis of the bounding concentrations presented in Appendix B. The dose from these contaminants was estimated and compared with the dose from the depleted uranium and uranium decay products in the DUF_6. It is estimated that under normal operational conditions, the TRU and Tc contaminants would make only a very small contribution to the radiation doses, amounting to approximately 0.2% of the dose from the depleted uranium and its decay products.

No impacts to involved workers are expected from exposure to chemicals during normal cylinder maintenance operations. Exposures to chemicals during cylinder painting operations would be monitored to ensure that airborne chemical concentrations were within applicable health standards that are protective of human health and safety. If planned work activities were likely to expose involved workers to chemicals, those workers would be provided with appropriate protective equipment as necessary.

Chemical exposures to noninvolved workers could result from airborne emissions of UO_2F_2 and HF that could be dispersed from hypothetical cylinder breaches into the atmosphere and to ground surfaces. It is estimated that the potential chemical exposures of noninvolved workers from any airborne releases during normal operations would be below levels expected to cause adverse effects. (The hazard index was estimated to be less than 0.0001 for noninvolved workers.)

General Public. Potential health impacts to members of the general public could occur if material released from breached cylinders entered the environment and was transported from the site through the air, surface water, or groundwater. Off-site releases of uranium and HF from breached cylinders are possible; however, the predicted future off-site concentrations of these contaminants would be much less than levels expected to cause adverse effects. Potential exposures of members of the general public would be well within public health standards. No adverse effects (LCFs or chemical effects) are expected to occur among members of the general public residing within 50 mi (80 km) of the Portsmouth site as a result of DUF_6 management activities.

If all the uranium and HF assumed to be released from hypothetical breached cylinders through 2039 were dispersed from the site through the air, the total radiation dose to the general public (all persons within 50 mi [80 km]) would be about 0.07 person-rem through 2039. This level of exposure would most likely result in zero cancer fatalities among members of the general public. For comparison, the average radiation dose from natural background and medical sources to the same population group in 40 years would be about 1×10^7 person-rem. The maximum radiation dose to an individual near the site would be less than about 0.1 mrem/yr, well within health standards. Radiation doses to the general public are required by health regulations to be maintained at below 10 mrem/yr from airborne sources (40 CFR Part 61) and below a total of 100 mrem/yr from all sources combined (DOE 1990). If an individual received the maximum estimated dose every year (1999 to 2039), the total dose would be about 4 mrem, resulting in an additional chance of dying from a latent cancer of about 1 in 500,000. No noncancer health effects from exposure to airborne uranium and HF releases are expected; the estimated hazard index for an MEI is less than 0.01. This means that the total exposure would be at least 100 times less than exposure levels that might cause adverse effects.

The material released from breached cylinders could also potentially be transported from the sites in water, either in surface water runoff or by infiltrating the soil and contaminating groundwater. Members of the general public could be exposed if they used this contaminated surface water or groundwater as a source of drinking water. The results of the surface water and groundwater analyses indicate that the maximum estimated uranium concentrations in surface water accessible to the general public and in groundwater beneath the sites would be less than 20 µg/L (the proposed EPA drinking water standard has now been finalized at 30 µg/L and became effective in December 2003 [EPA 2003a]). Drinking water standards, meant to apply to water "at the tap" of the user, are set at levels protective of human health. In this assessment, 20 µg/L is used as a guideline for surface water and groundwater analyses.

If a member of the general public used contaminated water at the maximum concentrations estimated, adverse effects would be unlikely. Even if a member of the general public used contaminated surface water or groundwater as his or her primary water source, the maximum radiation dose in the future would be less than 0.4 mrem/yr. The corresponding increased risk to this individual of dying from a latent cancer would be less than 1 in 5 million per year. Noncancer health effects from exposure to possible water contamination are not expected; the estimated maximum hazard index for an individual assumed to use the groundwater is less than 0.05. This means that the total exposure would be 20 times less than the exposure level that might cause adverse effects.

If no credit was taken for the reduction in cylinder corrosion rates as a result of cylinder maintenance and painting activities, the groundwater analysis indicates that the uranium concentration in groundwater at the Portsmouth site could exceed 20 μg/L at some time after 2100 (see Hartmann 1999a, Section 3.3). This scenario is highly unlikely because ongoing cylinder inspections and maintenance prevent significant releases from occurring, especially for as many cylinders as are assumed here (i.e., 74 breaches). Nonetheless, if contamination of groundwater used as drinking water occurred in the future, treating the water or supplying an alternative source of water might be required to ensure the safety of those potentially using the water.

5.1.2.1.2 Facility Accidents

Physical Hazards (On-the-Job Injuries and Fatalities). Accidents occur in all work environments. In 2000, about 5,200 people in the United States were killed in accidents while at work, and approximately 3.9 million disabling work-related injuries were reported (National Safety Council 2002). Although all work activities would be conducted in as safe a manner as possible, there is a chance that workers could be accidentally killed or injured under the no action alternative, unrelated to any radiation or chemical exposures.

The numbers of accidental worker injuries and fatalities that might occur through 2039 were estimated on the basis of the number of workers required and on the historical accident fatality and injury rates in similar types of industries. It is estimated that a total of less than 1 accidental fatality (i.e., about 0.03, or about 3 chances in 100 of a single fatality) might occur at the Portsmouth site over the no action period evaluated. Similarly, a total of about 40 accidental injuries (defined as injuries resulting in lost workdays) are estimated. These rates are not unique to the activities required for the no action alternative but are typical of any industrial project of similar size and scope.

Accidents Involving Radiation or Chemical Releases. Under the no action alternative, accidents could release radiation and chemicals from cylinders. Several types of accidents were evaluated. The accidents included those initiated by operational events, such as equipment or operator failure; external hazards; and natural phenomena, such as earthquakes. The assessment considered accidents ranging from those that would be reasonably likely to occur (expected one or more times in 100 years on average) to those that would be extremely rare (estimated to occur less than once in 1 million years on average).

The accidents of most concern at the Portsmouth site under the no action alternative would be those that could cause a release of UF_6 from cylinders. In a given accident, the amount potentially released would depend on the severity of the accident and the number of cylinders involved. Following a release, the UF_6 could 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 living near the site to radiation and chemical effects. The workers considered in the accident assessment were those noninvolved workers not immediately in the vicinity of the accident; fatalities and injuries among involved workers would be possible if accidents were severe.

The estimated consequences of cylinder accidents are summarized in Table 5.1-2 for chemical effects and Table 5.1-3 for radiation effects. The impacts are the maximums estimated for the Portsmouth site. The impacts are presented separately for likely accidents and for rare, low-probability accidents estimated to result in the largest potential impacts. Although other accidents were evaluated (see Hartmann 1999a; Section 3.2.2), the estimated consequences of those other accidents would be less than those summarized in the tables. The estimated consequences are conservative in that they were based on the assumption that at the time of the accident, the wind would be blowing in the direction of the greatest number of people. In addition, the mitigating effects of protective measures, such as evacuation, were not considered.

An exception to the discussion above would be a certain class of accidents that 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 this EIS. All classified information will be presented to state and local officials, as appropriate.

Chemical Effects. The potential likely accident (defined as an accident that is estimated to occur one or more times in 100 years) that would cause the largest chemical health effects is the failure of a corroded cylinder that would spill part of its contents under dry weather conditions. Such an accident could occur, for example, during cylinder handling activities. It is estimated that about 24 lb (11 kg) of UF_6 could be released in such an accident. The potential consequences from this type of accident would affect only on-site workers. The off-site concentrations of HF and uranium were calculated to be less than the levels that would cause adverse effects from exposure to these chemicals. Therefore, no adverse effects are expected among members of the general public. It is estimated that if this accident did occur, up to 48 noninvolved workers might experience potential adverse effects from exposure to HF and uranium (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). It is also estimated that no noninvolved workers would experience potential irreversible adverse effects (such as lung or kidney damage). The number of fatalities following an HF or uranium exposure is expected to be somewhat less than 1% of the number of potential irreversible adverse effects (Policastro et al. 1997). Therefore, no fatalities are expected.

For assessment purposes, the estimated frequency of a corroded cylinder spill accident is assumed to be about once in 10 years. Therefore, over the no action period, about 4 such accidents are expected. The accident risk (defined as consequence × probability) would be about 200 workers with potential adverse effects, and no workers with potential irreversible adverse effects. The number of workers actually experiencing adverse effects would probably be considerably less, depending on the actual circumstances of the accidents and the individual chemical sensitivity of the individual workers. In previous accidental exposure incidents involving liquid UF_6 in gaseous diffusion plants, a few workers were exposed to amounts of uranium estimated to be approximately three times the guidelines used for assessing irreversible adverse effects in this EIS; none of those workers actually experienced irreversible adverse effects (McGuire 1991).

TABLE 5.1-2 No Action Alternative: Estimated Consequences of Chemical Exposures for Cylinder Accidents at the Portsmouth Site[a]

Receptor[b]	Accident Scenario	Accident Frequency Category[c]	Potential Effect[d]	Consequence[e] (no. of persons affected)
Likely Accidents				
General public	Corroded cylinder spill, dry conditions	L	Adverse effects	0
	Corroded cylinder spill, dry conditions	L	Irreversible adverse effects	0
	Corroded cylinder spill, dry conditions	L	Fatalities	0
Noninvolved workers	Corroded cylinder spill, dry conditions	L	Adverse effects	0–48
	Corroded cylinder spill, dry conditions	L	Irreversible adverse effects	0
	Corroded cylinder spill, dry conditions	L	Fatalities	0
Low Frequency-High Consequence Accidents				
General public	Rupture of cylinders – fire	EU	Adverse effects	4–680
	Corroded cylinder spill, wet conditions – water pool	EU	Irreversible adverse effects	0–1
	Corroded cylinder spill, wet conditions – water pool	EU	Potential fatalities	0
Noninvolved workers	Rupture of cylinders – fire	EU	Adverse effects	160–1,000
	Corroded cylinder spill, wet conditions – water pool	EU	Irreversible adverse effects	0–110
	Corroded cylinder spill, wet conditions – water pool	EU	Fatalities	0–1

Footnotes on next page.

TABLE 5.1-2 (Cont.)

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[a] The accidents listed are those estimated to result in the greatest impacts among all the accidents considered (except for certain accidents with security concerns). The site-specific impacts for a range of accidents at the Portsmouth site are given in Hartmann et al. (1999a).

[b] Noninvolved workers are persons who work at the site but who are not involved in handling materials. Depending on the circumstances of the accident, injuries and fatalities among involved workers are possible for all accidents.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr).

[d] Potential adverse effects include exposures that could result in mild and transient injury, such as respiratory irritation. Potential irreversible adverse effects include exposures that could result in permanent injury (e.g., impaired organ function) or death. The majority of the adverse effects would be mild and temporary in nature. It is estimated that less than 1% of the predicted potential irreversible adverse effects would result in fatalities (see text).

[e] The consequence is expressed as the number of individuals with a predicted exposure level sufficient to cause the corresponding health endpoint. The range of estimated consequences reflects different atmospheric conditions at the time of an accident assumed to occur at the cylinder yard closest to the site boundary. In general, maximum risks would occur under the atmospheric conditions of F stability with a 1-m/s (2-mph) wind speed; minimum risks would occur under D stability with a 4-m/s (9-mph) wind speed. For both conditions, it was assumed that the wind would be blowing in the direction of the highest density of worker or public populations.

Accidents that are less likely to occur could have higher consequences. The potential cylinder accident at any of the sites estimated to result in the greatest total number of adverse chemical effects would be an accident involving several cylinders in a fire. It is estimated that about 24,000 lb (11,000 kg) of UF$_6$ could be released in such an accident. It is estimated that if this accident occurred, up to 680 members of the general public and 1,000 noninvolved workers might experience adverse effects from HF and uranium exposure (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). This accident is considered extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years. If the frequency is assumed to be once in 100,000 years, the accident risk over the no action period would be less than one adverse effect for both workers and members of the general public.

The potential cylinder accident estimated to result in the largest total number of irreversible adverse effects is a corroded cylinder spill under wet conditions, with the UF$_6$ being released into a pool of standing water. This accident is considered extremely unlikely, expected to occur between once in 10,000 years and once in 1 million years. It is estimated that if this accident did occur, about 1 member of the general public and 110 noninvolved workers might experience irreversible adverse effects (such as lung damage) from HF and uranium exposure. The number of fatalities would be somewhat less than 1% of the estimated number of potential irreversible adverse effects (Policastro et al. 1997). Thus, no fatalities are expected among the

TABLE 5.1-3 No Action Alternative: Estimated Consequences from Radiation Exposures for Cylinder Accidents at the Portsmouth Site[a]

			MEI		Population	
Receptor[b]	Accident Scenario	Accident Frequency Category[c]	Dose (rem)	Lifetime Risk of LCF	Dose (person-rem)	Number of LCFs
Likely Accidents						
General public	Corroded cylinder spill, dry conditions	L	0.0022	1×10^{-6}	0.22	0.0001
Noninvolved workers	Corroded cylinder spill, dry conditions	L	0.077	3×10^{-5}	2.2	0.0009
Low Frequency-High Consequence Accidents						
General public	Rupture of cylinders – fire	EU	0.013	6×10^{-6}	34	0.02
Noninvolved workers	Rupture of cylinders – fire	EU	0.02	8×10^{-6}	16	0.006

[a] The accidents listed are those estimated to have the greatest impacts among all the accidents considered (except for certain crash accidents with security concerns). The site-specific impacts for a range of accidents at the Portsmouth site are given in Hartmann et al. (1999a). The estimated consequences were based on the assumption that at the time of an accident, the wind would be blowing in the direction of the highest density of worker or public populations and that weather conditions limited dispersion.

[b] Noninvolved workers are persons who work at the site but who are not involved in handling materials. Depending on the circumstances of the accident, injuries and fatalities among involved workers are possible for all accidents.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr).

general public, although 1 fatality could occur among noninvolved workers (1% of 110). If the frequency of this accident is assumed to be once in 100,000 years, the accident risk over the period 1999 through 2039 would be less than 1 (0.1) irreversible adverse health effect among workers and the general public combined.

Radiation Effects. Potential cylinder accidents could release uranium, which is radioactive in addition to being chemically toxic. The potential radiation exposures of members of the general public and noninvolved workers were estimated for the same cylinder accidents as those for which chemical effects were estimated (Table 5.1-3). For all cylinder accidents considered, the radiation doses from released uranium would be considerably below levels likely to cause radiation-induced effects among noninvolved workers and the general public and below the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents (DOE 2000c).

For the corroded cylinder spill accident (dry conditions), the radiation dose to a maximally exposed member of the general public would be less than 3 mrem (lifetime dose), resulting in an increased risk of death from cancer of about 1 in 1 million. The total population dose to the general public within 50 mi (80 km) would be less than 1 person-rem, most likely resulting in zero LCFs. Among noninvolved workers, the dose to an MEI would be 77 mrem, resulting in an increased risk of death from cancer of about 1 in 30,000. The total dose to all noninvolved workers would be about 2.2 person-rem. This dose to workers would result in zero LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 over the period 1999 through 2039.

The cylinder accident estimated to result in the largest potential radiation doses would be the accident involving several cylinders in a fire. For this accident, it is estimated that the radiation dose to a maximally exposed member of the general public would be about 13 mrem, resulting in an increased risk of death from cancer of about 1 in 150,000. The total population dose to the general public within 50 mi (80 km) would be 34 person-rem, most likely resulting in zero LCFs. Among noninvolved workers, the dose to an MEI would be about 20 mrem, resulting in an increased risk of death from cancer of about 1 in 100,000. The total dose to all noninvolved workers would be about 16 person-rem. This dose to workers would result in zero LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 over the period 1999 through 2039.

5.1.2.2 Transportation

Continued cylinder storage under the no action alternative would potentially generate small amounts of LLW and LLMW during cylinder monitoring and maintenance activities. This material could require transportation to a treatment or disposal facility. Shipments would be made in accordance with all DOE and DOT regulations and guidelines. It is estimated that less than one waste shipment would be required each year. Because of the small number of shipments and the low concentrations of contaminants expected, the potential environmental impacts from these shipments would be negligible.

5.1.2.3 Air Quality and Noise

The assessment of potential impacts to air quality from the no action alternative at Portsmouth included a consideration of air pollutant emissions from continued cylinder storage activities, including emissions from operations (cylinder painting and vehicle emissions) and HF emissions from breached cylinders. No cylinder yard construction activities are planned at the Portsmouth site. An atmospheric dispersion model was used to estimate the concentrations of criteria pollutants at the site boundaries: SO_2, NO_2, CO, O_3, PM (PM_{10} and $PM_{2.5}$), and Pb. The site boundary concentrations were compared with existing air quality standards given in Chapter 3. The air concentrations of all criteria pollutants resulting from no action alternative activities would be less than 1% of the respective standards.

Painting activities could generate hydrocarbon emissions. Although no explicit air quality standard has been set for hydrocarbon emissions, these emissions are associated with the formation of O_3, for which standards have been set. For the Portsmouth site, hydrocarbon emissions from painting activities would be about 0.2% of the hydrocarbon emissions from the entire surrounding county. Because O_3 formation is a regional issue affected by emissions for an entire area, this small additional contribution to the county total would be unlikely to substantially alter the O_3 levels of the county. In addition, the actual frequency of cylinder painting would likely be greatly reduced from the frequency assumed for these analyses.

Taking credit for reduced corrosion from better maintenance and painting, the estimated maximum 24-hour and annual average site boundary HF concentrations from hypothetical cylinder breaches occurring under the no action alternative are 0.12 $\mu g/m^3$ and 0.013 $\mu g/m^3$, respectively, at the Portsmouth site. Ohio does not have ambient air quality standards for HF. However, these estimated Portsmouth concentrations are well below the Commonwealth of Kentucky standards (used for comparison) of 2.9 $\mu g/m^3$ (secondary standard) and 400 $\mu g/m^3$ (primary standard), respectively. Calculations indicate that if no credit was taken for the reduction in corrosion as a result of painting and continued maintenance and if storage continued at the Portsmouth site indefinitely, breaches occurring at the site by around 2039 could result in maximum 24-hour average HF concentrations at the site boundaries of less than 0.8 $\mu g/m^3$, also considerably below the Kentucky secondary standard. Because of the ongoing maintenance program, it is not expected that this higher breach rate would occur at the Portsmouth site.

No construction activities are planned under the no action alternative at the Portsmouth site; therefore, there would be no adverse noise impacts.

Continued storage operations could result in somewhat increased noise levels at the site as a result of projected activities such as painting cylinders or repairing any infrequent cylinder breaches. However, it is estimated that the noise levels at off-site residences would not increase noticeably. Noise impacts are expected to be negligible under the no action alternative.

5.1.2.4 Water and Soil

Under the no action alternative, impacts on surface water, groundwater, and soil could occur during continued storage of the cylinders. Important elements in assessing potential impacts on surface water include changes in runoff, floodplain encroachment, and water quality. Groundwater impacts were assessed in terms of changes in recharge to the underlying aquifers, depth to groundwater, direction of groundwater flow, and groundwater quality. Potential soil impacts considered were changes in topography, permeability, erosion potential, and soil quality.

Under the no action alternative, the assessment area in which potentially important impacts might occur was determined to be quality of surface water, groundwater, and soil. The other potential impacts include changes in water use and effluent volumes. Maximum water use during continued cylinder maintenance operations at the site would be 73,000 gal/yr (276,000 L/yr).

A contaminant of concern for evaluating surface water, groundwater, and soil quality is uranium. Surface water and groundwater concentrations of contaminants are generally evaluated through comparison with the EPA MCLs, as given in Safe Drinking Water Act regulations (40 CFR Part 141), although these limits are only directly applicable “at the tap” of the water user. The water concentration value used for comparison in this EIS is 20 µg/L (i.e., the proposed MCL for uranium has now been finalized at 30 µg/L and will become effective in December 2003 [EPA 2003a]). The 20-µg/L value is used as a guideline for evaluating surface water and groundwater concentrations of uranium in this EIS, even though it is not directly applicable as a standard. There is no standard available for limiting concentrations of uranium in soil; a health-based value of 230 µg/g (EPA 1995), applicable for residential settings, is used as a guideline for comparison.

The nearest surface water to the Portsmouth site is Little Beaver Creek, which is a tributary to the Scioto River. The Scioto is used as a drinking water source. Because of very large dilution effects, even high levels of contaminants in Little Beaver Creek would not be expected to cause levels exceeding guidelines at the drinking water intakes of the Scioto River.

5.1.2.4.1 Surface Water. Potential impacts on the nearest receiving water at the site (Little Beaver Creek) were estimated for uranium released from hypothetical cylinder breaches occurring through 2039. The estimated maximum concentration of uranium in Little Beaver Creek would be 0.7 µg/L, considerably below the 20-µg/L level used for comparison.

Cylinder painting activities have been associated with increased toxicity in runoff at the Paducah site. If such an impact occurred at the Portsmouth site as a result of future cylinder painting, mitigating actions, such as treating runoff, might be required.

5.1.2.4.2 Groundwater. Groundwater in the vicinity of the Portsmouth site is used for domestic and industrial supplies. See Chapter 3 for a discussion of existing groundwater quality at the site. At Portsmouth, sampling results indicate that residential water supplies have not been affected by site operations. Activities associated with the no action alternative would not affect migration of existing groundwater contamination or impact off-site water supplies.

Potential impacts on groundwater quality from hypothetical releases of uranium from breached cylinders were also assessed. The maximum future concentration of uranium in groundwater directly below the Portsmouth site is estimated to be 5 µg/L, considerably below the 20-µg/L level used for comparison. It is estimated that if the rate of uranium migration was rapid, this concentration would occur sometime after 2070. A lower concentration would occur if uranium migration through the soil was slower than assumed for this analysis.

Calculations indicate that if no credit was taken for the reduction in corrosion as a result of cylinder painting and maintenance and if storage continued at the Portsmouth site indefinitely, uranium releases from future cylinder breaches occurring prior to about 2050 could result in a sufficient amount of uranium in the soil column to increase the groundwater concentration of uranium to 20 μg/L in the future (about 2100 or later). However, because of the ongoing maintenance program, it is not expected that breaches occurring prior to 2039 would be sufficient to increase the groundwater concentration to 20 μg/L at the site.

5.1.2.4.3 Soil. Potential impacts on soil that could receive contaminated rainwater runoff from the cylinder storage yards were estimated. The source is assumed to be uranium released from hypothetical breached cylinders. It is assumed that any releases from future cylinder painting activities would be controlled or treated to avoid soil contamination. The estimated maximum soil concentration is 1 μg/g for the Portsmouth site, considerably below the 230-μg/g guideline used for comparison.

5.1.2.5 Socioeconomics

The potential socioeconomic impacts of operational activities at the Portsmouth site under the no action alternative would be low. No construction activities are planned for this site under this alternative. Operational activities would create 20 direct jobs and 40 total jobs per year. During operations, direct and total income would be $0.8 million/yr and $1.0 million/yr, respectively.

The employment created in the ROI for the Portsmouth site during continued cylinder maintenance would represent a change of less than 0.1 of a percentage point in the projected annual average growth in employment over the period 2004 to 2039. No migration into the ROI would occur, meaning that there would be no impact expected on local housing markets, local public service employment, or local public finances.

5.1.2.6 Ecology

The no action alternative would have a negligible impact on ecological resources in the area of the Portsmouth site. Because no construction activities are planned, there would be no impacts on wetlands or on federal- and state-protected species.

The assessment results indicate that impacts to ecological resources from continued storage activities, including hypothetical cylinder breaches, would be negligible. Analysis of potential impacts was based on exposure of biota to airborne contaminants or contaminants released (e.g., from painting activities or from breached cylinders) to soil, groundwater, or surface water. Predicted concentrations of contaminants in environmental media were compared with benchmark values for toxic and radiological effects (see Appendix F). At the Portsmouth site, air, soil, and surface water concentrations would be below levels harmful to biota. However, as discussed in Section 5.1.2.4, cylinder painting activities may potentially result in future reductions in surface water quality and may consequently result in impacts to aquatic biota downstream of the cylinder storage yards. Although groundwater uranium concentrations (5 to 20 μg/L) would be below the lowest effects level (150 μg/L) and below radiological benchmark levels (4.55×10^3 pCi/L), they would exceed the ecological screening value for surface water (2.6 μg/L). However, contaminants in groundwater discharging to a surface water body, such as a local stream, would be quickly diluted to negligible concentrations.

5.1.2.7 Waste Management

Under the no action alternative, operations at the Portsmouth site would generate relatively small amounts of LLW and LLMW (including PCB-containing wastes). The volume of LLW generated by continued storage activities would represent less than 1% of the annual generation at the site from all activities. The maximum annual amount of LLMW generation from stripping/painting operations at the Portsmouth site would generate less than 1% of the site's total annual LLMW load, resulting in negligible waste management impacts for this site. The overall impact on waste management operations from the no action alternative would be negligible.

5.1.2.8 Resource Requirements

Operations under the no action alternative would use electricity, fuel, concrete, steel and other metals, and miscellaneous chemicals. The total quantities of commonly used materials would be small compared with local sources and would not affect local, regional, or national availability of these materials. No strategic or critical materials are expected to be consumed. The anticipated utilities requirements would be within the supply capacities at the Portsmouth site. The required material resources would be readily available.

5.1.2.9 Land Use

Because no new construction is planned for the Portsmouth site under the no action alternative, no impacts to land use are expected.

5.1.2.10 Cultural Resources

Impacts to cultural resources at the Portsmouth site would not be likely under the no action alternative. The existing storage yards would continue to be used for cylinder storage. These yards are located in previously disturbed areas (graded during the original construction of the yards) and are unlikely to contain cultural properties or resources listed on or eligible for the NRHP. No new or expanded cylinder storage yards are proposed at Portsmouth under this alternative. Cylinder breaches are not expected to result in HF or criteria pollutant emissions sufficient to impact cultural resources (see Section 5.1.2.3).

5.1.2.11 Environmental Justice

A review of the potential human health and safety impacts anticipated under the no action alternative indicates that no disproportionately high and adverse effects to minority or low-income populations are expected on or in the vicinity of the Portsmouth site during DUF_6 cylinder storage. Although such populations occur in certain areas within the 50-mi (80-km) radius used to identify the maximum geographic extent of human health impacts (see Section 3.1.12), no noteworthy impacts to these populations are anticipated. The results of accident analyses for the no action alternative also did not identify high and adverse impacts to the general public; the risk of accidents (consequence × probability) yields less than 1 fatality for all accidents considered.

5.1.3 ETTP Site

The impacts described in this section are similar to those presented in Section 3.2 of the data compilation report for the ETTP site (Hartmann 1999b); however, they have been adjusted to account for changes in planned activities. For example, no construction activities are currently planned for the ETTP site under the no action alternative.

5.1.3.1 Human Health and Safety

Potential impacts to human health and safety could result from operations during both routine conditions and accidents under the no action alternative. In general, the impacts during normal operations at the ETTP site would be limited to workers directly involved in handling cylinders. Under accident conditions, the health and safety of both workers and members of the general public around the site could potentially be affected.

5.1.3.1.1 Normal Facility Operations

Workers. Cylinders containing DUF_6 emit low levels of gamma and neutron radiation. Involved workers would be exposed to this radiation when working near cylinders, such as during routine cylinder monitoring and maintenance activities, cylinder relocation and painting, and cylinder patching or repairing activities. It is estimated that an average of about 13 cylinder yard workers would be required at the ETTP site. These workers would be trained to work in a radiation environment, they would use protective equipment as necessary, and their radiation exposure levels would be measured and monitored by safety personnel at the sites. Radiation exposure of workers is required by law to be maintained ALARA and not to exceed 5,000 mrem/yr (10 CFR Part 835).

The radiation exposure of involved workers (cylinder yard workers) in future years through 2039 is estimated to be well within public health standards (10 CFR Part 835). It is estimated conservatively that if the same 13 workers conducted all cylinder management activities, the average annual dose to individual involved workers would be about 410 mrem/yr. The estimated future doses do not account for standard ALARA practices that would be used to keep the actual doses as far below the limit as practicable. Thus, the future doses to workers are expected to be less than those estimated because of the conservatism incorporated into the assumptions and models used to generate the estimates. In fact, from 1990 through 1995, the average measured doses to cylinder yard workers at ETTP ranged from about 32 to 92 mrem/yr (Hodges 1996), and the maximum dose resulting from painting of 400 cylinders in 1998 was 107 mrem/yr (Cain 2002b). The radiation exposure of the noninvolved workers was estimated to be less than 0.048 mrem/yr.

It is estimated that the total collective dose to all involved workers at the ETTP site through 2039 would be about 200 person-rem. (The collective dose to noninvolved workers would be negligible [i.e., less than 0.01%] compared with the collective dose to involved workers.) This dose would be distributed among all of the workers involved with cylinder activities over the no action period. Although about 13 workers would be required each year, the actual number of different individuals involved over the period would probably be much greater than 13 because workers could be rotated to different jobs and could change jobs. This level of exposure could potentially result in less than 1 LCF (i.e., 0.1 LCF) among all the workers exposed, in addition to the cancer cases that would result from all other causes not related to activities under the no action alternative.

As discussed in Chapter 1 and Appendix B of this EIS, some portion of the DUF_6 inventory contains TRU and Tc contamination. The contribution of these contaminants to potential external radiation exposures under normal operations was evaluated on the basis of the bounding concentrations presented in Appendix B. The dose from these contaminants was estimated and compared with the dose from the depleted uranium and uranium decay products in the DUF_6. It is estimated that under typical cylinder maintenance conditions, the TRU and Tc contaminants would make only a very small contribution to the radiation doses, amounting to approximately 0.2% of the dose from the depleted uranium and its decay products.

No impacts to involved workers from exposure to chemicals during normal operations are expected. Exposures to chemicals during cylinder painting operations would be monitored to ensure that airborne chemical concentrations were within applicable health standards that are protective of human health and safety. If planned work activities were likely to expose involved workers to chemicals, the workers would be provided with appropriate protective equipment as necessary.

Chemical exposures to noninvolved workers could result from airborne emissions of UO_2F_2 and HF that would be dispersed from any cylinder breaches into the atmosphere and ground surfaces. The potential chemical exposures of noninvolved workers from any airborne releases during normal operations would be below levels expected to cause adverse effects. (The hazard index is estimated to be less than 0.1 for noninvolved workers.)

General Public. Potential health impacts to members of the general public could occur if material released from breached cylinders entered the environment and was transported from the site through the air, surface water, or groundwater. Off-site releases of uranium and HF from breached cylinders are possible. However, the predicted off-site concentrations of these contaminants in the future would be much less than levels expected to cause adverse effects. Potential exposures of members of the general public would be well within public health standards. No adverse effects (LCFs or chemical effects) are expected to occur among members of the general public residing within 50 mi (80 km) of the ETTP site from continued DUF_6 storage activities.

It is estimated that if all the uranium and HF assumed to be released from breached cylinders through 2039 was dispersed from the site through the air, the total radiation dose to the general public (all persons within 50 mi [80 km]) would be less than 0.2 person-rem through 2039. This level of exposure would most likely result in zero cancer fatalities among members of the general public. For comparison, the average radiation dose from natural background and medical sources to the same population group over 40 years would be about 1.3×10^7 person-rem. The maximum radiation dose to an individual near the site is estimated to be less than about 0.2 mrem/yr, well within health standards. Radiation doses to the general public are required by health regulations to be maintained below 10 mrem/yr from airborne sources (40 CFR Part 61) and below a total of 100 mrem/yr from all sources combined (DOE 1990). If an individual received the maximum estimated dose every year, the total dose would be about 8 mrem, resulting in an additional chance of dying from a latent cancer of about 1 in 250,000. No noncancer health effects from exposure to airborne uranium and HF releases are expected; the hazard index for an MEI is estimated to be less than 0.1. This means that the total exposure would be at least 10 times less than exposure levels that might cause adverse effects.

The material released from breached cylinders could also potentially be transported from the site in water, either in surface water runoff or by infiltrating the soil and contaminating groundwater. Members of the general public potentially could be exposed if they used this contaminated surface water or groundwater as a source of drinking water. The results of the surface water and groundwater analyses indicate that the maximum estimated uranium concentrations in surface water accessible to the general public and in groundwater beneath the site would be less than 20 μg/L (the EPA drinking water standard has now been finalized at 30 μg/L). Drinking water standards, meant to apply to water "at the tap" of the user, are set at levels protective of human health.

If a member of the public used contaminated water at the maximum concentrations estimated, adverse effects would be unlikely. Even if a member of the general public used contaminated surface water or groundwater as his or her primary water source, the maximum radiation dose in the future would be less than 0.5 mrem/yr. The corresponding risk to this individual of dying from a latent cancer would be less than 1 in 4 million per year. Noncancer health effects from exposure to possible water contamination are not expected; the estimated maximum hazard index for an individual assumed to use the groundwater is less than 0.05. This means that the total exposure would be 20 times less than the exposure that might cause adverse effects.

The groundwater analysis indicates that if no credit was taken for the reduction in cylinder corrosion rates as a result of cylinder maintenance and painting activities, the uranium concentration in groundwater at the ETTP site could exceed 20 μg/L at some time in the future (see Section 5.1.3.4.2). This scenario is highly unlikely because ongoing cylinder inspections and maintenance would prevent significant releases from occurring, especially for as many cylinders as are assumed here (i.e., 213 breaches). Nonetheless, if contamination of groundwater used as drinking water occurred in the future, treating the water or supplying an alternative source of water might be required to ensure the safety of those potentially using the water.

5.1.3.1.2 Facility Accidents

Physical Hazards (On-the-Job Injuries and Fatalities). Accidents occur in all work environments. In 2002, about 5,200 people in the United States were killed in accidents while at work, and approximately 3.9 million disabling work-related injuries were reported (National Safety Council 2002). Although all work activities would be conducted in as safe a manner as possible, there is a chance that workers could be accidentally killed or injured under the no action alternative, unrelated to any radiation or chemical exposures.

The numbers of accidental worker injuries and fatalities that might occur through 2039 were estimated on the basis of the number of workers required and on the historical accident fatality and injury rates in similar types of industries. It is estimated that a total of less than 1 accidental fatality (i.e., about 0.02, or about 2 chances in 100 of a single fatality) might occur at the ETTP site over the no action period evaluated. Similarly, a total of about 25 accidental injuries (defined as injuries resulting in lost workdays) are estimated. These rates are not unique to the activities required for the no action alternative but are typical of any industrial project of similar size and scope.

Accidents Involving Radiation or Chemical Releases. Accidents that could release radiation and chemicals from cylinders are possible under the no action alternative. Several types of accidents were evaluated, including those initiated by operational events, such as equipment or operator failure; external hazards; and natural phenomena, such as earthquakes. The assessment considered accidents ranging from those that would be reasonably likely to occur (estimated to occur one or more times in 100 years on average) to those that would be extremely rare (estimated to occur less than once in 1 million years on average). A listing of the cylinder accidents considered during storage is provided in the PEIS (DOE 1999a).

The accidents of most concern at the ETTP site would be accidents that could cause a release of UF_6 from cylinders. In a given accident, the amount potentially released would depend on the severity of the accident and the number of cylinders involved. Following a release, the UF_6 could 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 living near the site to radiation and chemical effects. The workers considered in the accident assessment were those noninvolved workers not immediately in the vicinity of the accident. Fatalities and injuries among involved workers would be possible if accidents were severe.

The estimated consequences of cylinder accidents are summarized in Table 5.1-4 for chemical effects and Table 5.1-5 for radiation effects. The impacts shown are the maximums estimated for the ETTP site. The impacts are presented separately for likely accidents and for rare, low-probability accidents estimated to result in the largest potential impacts. Although other accidents were evaluated (see Hartmann 1999b, Section 3.2.2), the estimated consequences of those other accidents would be less than the consequences of the accidents summarized in the tables. The estimated consequences are conservative in that they were based on the assumptions that at the time of the accident, the wind would be blowing in the direction of the greatest number of people. In addition, the effects of protective measures, such as evacuation, were not considered.

An exception to the discussion above would be a certain class of accidents that 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 this EIS. All classified information will be presented to state and local officials, as appropriate.

Chemical Effects. The potential likely accident (defined as an accident that is estimated to occur one or more times in 100 years) that would cause the largest chemical health effects is the failure of a corroded cylinder, spilling part of its contents under dry weather conditions. Such an accident could occur, for example, during cylinder handling activities. It is estimated that about 24 lb (11 kg) of DUF_6 could be released in such an accident. The potential consequences from this type of accident would be limited to on-site workers. The off-site concentrations of HF and uranium were calculated to be less than the levels that would cause adverse effects from exposure to these chemicals, so that no adverse effects would occur among members of the general public. It is estimated that if such an accident did occur, up to 70 noninvolved workers might experience potential adverse effects from exposure to HF and uranium (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). It is estimated that three noninvolved workers might experience potential irreversible adverse effects (such as lung or kidney damage). The number of fatalities following an HF or uranium exposure is expected to be somewhat less than 1% of the number of potential irreversible adverse effects (Policastro et al. 1997). Therefore, no fatalities are expected.

For assessment purposes, the estimated frequency of a corroded cylinder spill accident is assumed to be about once in 10 years. Therefore, over the no action period, about 4 such accidents are expected. The accident risk (defined as consequence × probability) would be about 280 workers with potential adverse effects and 12 workers with potential irreversible adverse effects. The number of workers actually experiencing these effects would probably be considerably less, depending on the actual circumstances of the accidents and the individual chemical sensitivity of the workers. In previous accidental exposure incidents involving liquid UF_6 in gaseous diffusion plants, a few workers were exposed to amounts of uranium estimated to be approximately three times the guidelines used for assessing irreversible adverse effects in this EIS, and none actually experienced irreversible adverse effects (McGuire 1991).

TABLE 5.1-4 No Action Alternative: Estimated Consequences of Chemical Exposures from Cylinder Accidents at the ETTP Site[a]

Receptor[b]	Accident Scenario	Accident Frequency Category[c]	Potential Effect[d]	Consequence[e] (no. of persons affected)
Likely Accidents				
General public	Corroded cylinder spill, dry conditions	L	Adverse effects	0
	Corroded cylinder spill, dry conditions	L	Irreversible adverse effects	0
	Corroded cylinder spill, dry conditions	L	Fatalities	0
Noninvolved workers	Corroded cylinder spill, dry conditions	L	Adverse effects	0–70
	Corroded cylinder spill, dry conditions	L	Irreversible adverse effects	0–3
	Corroded cylinder spill, dry conditions	L	Fatalities	0
Low Frequency-High Consequence Accidents				
General public	Rupture of cylinders – fire	EU	Adverse effects	14–620
	Corroded cylinder spill, wet conditions – water pool	EU	Irreversible adverse effects	0
	Corroded cylinder spill, wet conditions – water pool	EU	Fatalities	0
Noninvolved workers	Rupture of cylinders – fire	EU	Adverse effects	0–770
	Corroded cylinder spill, wet conditions – rain	EU	Irreversible adverse effects	2–140
	Corroded cylinder spill, wet conditions – rain	EU	Fatalities	0–1

Footnotes on next page.

TABLE 5.1-4 (Cont.)

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[a] The accidents listed are those estimated to result in the greatest impacts among all the accidents considered (except for certain accidents with security concerns). The site-specific impacts for a range of accidents at ETTP are given in Hartmann et al. (1999b).

[b] Noninvolved workers are persons who work at the site but who are not involved in handling materials. Depending on the circumstances of the accident, injuries and fatalities among involved workers are possible for all accidents.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr).

[d] Potential adverse effects include exposures that could result in mild and transient injury, such as respiratory irritation. Potential irreversible adverse effects include exposures that could result in permanent injury (e.g., impaired organ function) or death. The majority of the adverse effects would be mild and temporary in nature. It is estimated that less than 1% of the predicted potential irreversible adverse effects would result in fatalities (see text).

[e] The consequence is expressed as the number of individuals with a predicted exposure level sufficient to cause the corresponding health endpoint. The range of consequences reflects different atmospheric conditions at the time of an accident assumed to occur at the cylinder yard closest to the site boundary. In general, maximum risks would occur under the atmospheric conditions of a 1-m/s (2-mph) wind speed; minimum risks would occur under D stability with a 4-m/s (9-mph) wind speed. For both conditions, it was assumed that the wind would be blowing in the direction with the highest density of worker or public populations.

Accidents that are less likely to occur could have higher consequences. The potential cylinder accident at any of the sites estimated to result in the greatest total number of adverse chemical effects would be an accident involving several cylinders in a fire. It is estimated that if this accident occurred, up to 635 members of the general public and 770 noninvolved workers might experience adverse effects from HF and uranium exposure (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). This accident is considered extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years. If the frequency is assumed to be once in 100,000 years, the accident risk over the no action period would be less than 1 adverse effect for both workers and members of the general public.

The potential cylinder accident estimated to result in the largest total number of irreversible adverse effects is a corroded cylinder spill under wet conditions, for which the UF$_6$ is assumed to be released into a pool of standing water. This accident is also considered extremely unlikely, expected to occur only between once in 10,000 years and once in 1 million years. It is estimated that if this accident did occur, no members of the general public but about 140 noninvolved workers might experience irreversible adverse effects (such as lung damage) from HF and uranium exposure. The number of fatalities would be somewhat less than 1% of the estimated number of potential irreversible adverse effects (Policastro et al. 1997). Thus, no fatalities are expected among the general public, but one fatality could occur among noninvolved

TABLE 5.1-5 No Action Alternative: Estimated Consequences from Radiation Exposures for Cylinder Accidents at the ETTP Site[a]

			MEI		Population	
Receptor[b]	Accident Scenario	Accident Frequency Category[c]	Dose (rem)	Lifetime Risk of LCF	Dose (person-rem)	Number of LCFs
Likely Accidents						
General public	Corroded cylinder spill, dry conditions	L	0.003	1×10^{-6}	0.49	0.0002
Noninvolved workers	Corroded cylinder spill, dry conditions	L	0.077	3×10^{-5}	1.3	0.0005
Low Frequency-High Consequence Accidents						
General public	Rupture of cylinders – fire	EU	0.013	7×10^{-6}	73	0.04
Noninvolved workers	Rupture of cylinders – fire	EU	0.02	8×10^{-6}	16	0.006

[a] The accidents listed are those estimated to have the greatest impacts among all accidents considered (except for certain accidents with a security concern). The impacts for a range of accidents at each of the three current storage sites are listed in Appendix D of the DUF_6 PEIS (DOE 1999a). The estimated consequences were based on the assumption that at the time of the accident, the wind would be blowing in the direction of the highest worker or public population density and that meteorological conditions would limit dispersion.

[b] Noninvolved workers are persons who work at the site but who are not involved in handling of materials. Depending on the circumstances of the accident, injuries and fatalities among involved workers are possible for all accidents.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 1 \times 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (1×10^{-4} to 1×10^{-6}/yr).

workers (1% of 140). If this accident is assumed to occur once in 100,000 years, the accident risk through 2039 would be less than 1 (0.1) irreversible adverse health effect among workers and the general public combined.

Radiation Effects. Potential cylinder accidents could release uranium, which is radioactive in addition to being chemically toxic. The potential radiation exposures of members of the general public and noninvolved workers were estimated for the same cylinder accidents as those for which chemical effects were estimated (Table 5.1-5). For all cylinder accidents considered, the radiation doses from released uranium would be considerably below levels likely to cause radiation-induced effects among noninvolved workers and the general public and below the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents (DOE 2000c).

For the corroded cylinder spill accident (dry conditions), it is estimated that the radiation dose to a maximally exposed member of the general public would be less than 3 mrem (lifetime dose), resulting in an increased risk of death from cancer of about 1 in 1 million. The total population dose to the general public within 50 mi (80 km) would be less than 1 person-rem, most likely resulting in zero LCFs. Among noninvolved workers, the dose to an MEI would be 77 mrem, resulting in an increased risk of death from cancer of about 1 in 30,000. The total dose to all noninvolved workers would be about 1.3 person-rem. This dose to workers would result in zero LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 through 2039.

The cylinder accident estimated to result in the largest potential radiation doses would be an accident involving several cylinders in a fire. For this accident, it is estimated that the radiation dose to a maximally exposed member of the general public would be about 13 mrem, resulting in an increased risk of death from cancer of about 1 in 150,000. The total population dose to the general public within 50 mi (80 km) would be 73 person-rem, most likely resulting in zero LCFs. Among noninvolved workers, the dose to an MEI would be about 20 mrem, resulting in an increased risk of death from cancer of about 1 in 100,000. The total dose to all noninvolved workers would be about 16 person-rem. This dose to workers would result in zero LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 through 2039.

5.1.3.2 Transportation

Continued cylinder storage under the no action alternative would have the potential to generate small amounts of LLW and LLMW during cylinder monitoring and maintenance activities. This material could require transportation to a treatment or disposal facility. Shipments would be made in accordance with all DOE and DOT regulations and guidelines. It is estimated that less than one waste shipment would be required each year. Because of the small number of shipments and the low concentrations of contaminants expected, the potential environmental impacts from these shipments would be negligible.

5.1.3.3 Air Quality and Noise

The assessment of potential impacts to air quality under the no action alternative at the ETTP site included a consideration of air pollutant emissions from continued cylinder storage activities, including emissions from operations (cylinder painting and vehicle emissions) and HF emissions from breached cylinders. No cylinder yard construction activities are planned at the ETTP site. Atmospheric dispersion models were used to estimate the concentrations of criteria pollutants at the site boundaries: SO_2, NO_2, CO, O_3, PM (PM_{10} and PM_2), and Pb. The site boundary concentrations were compared with existing air quality standards or with guidelines for pollutants that do not have corresponding standards as given in Chapter 3. The air concentrations of all criteria pollutants resulting from no action alternative activities would be less than 1% of the respective standards.

Painting activities could generate hydrocarbon emissions. No explicit air quality standard has been set for hydrocarbon emissions, but these emissions are associated with O_3 formation. Standards have been set for O_3. For the ETTP site, hydrocarbon emissions from painting activities would be about 0.1% of the hydrocarbon emissions from the entire surrounding county. Because O_3 formation is a regional issue affected by emissions for an entire area, this small additional contribution to the county total would be unlikely to substantially alter the O_3 levels of the county. In addition, the actual frequency of cylinder painting would likely be much reduced in comparison with the frequency assumed for these analyses.

When credit is taken for reduced corrosion from better maintenance and painting, the estimated maximum 24-hour and annual average site boundary HF concentrations from hypothetical cylinder breaches occurring under the no action alternative at the ETTP site are 0.67 $\mu g/m^3$ and 0.084 $\mu g/m^3$, respectively. Tennessee's primary HF 24-hour maximum average air standard is 2.9 $\mu g/m^3$ (there is no annual average standard). The estimated maximum 24-hour average would be about 23% of the standard.

Calculations indicate that if no credit was taken for the reduction in corrosion as a result of painting and continued maintenance and if storage continued at the ETTP site indefinitely, cylinder breaches occurring at the site by around 2020 could result in maximum 24-hour average HF concentrations at the site boundaries of 2.9 $\mu g/m^3$, approximately equal to the Tennessee standard. However, because of the ongoing cylinder maintenance program, it is not expected that a breach rate this high would occur at the ETTP site.

No construction activities are planned under the no action alternative at the ETTP site; therefore, there would be no adverse noise impacts.

Continued storage operations could result in somewhat increased noise levels as a result of projected activities such as painting cylinders or repairing any infrequent cylinder breaches. However, it is expected that noise levels at off-site residences would not increase noticeably. Noise impacts are expected to be negligible under the no action alternative.

5.1.3.4 Water and Soil

Under the no action alternative, impacts on surface water, groundwater, and soil could result from continued storage of the cylinders. Important elements in assessing potential impacts on surface water include changes in runoff, floodplain encroachment, and water quality. Groundwater impacts were assessed in terms of changes in recharge to the underlying aquifers, depth to groundwater, direction of groundwater flow, and groundwater quality. Potential soil impacts considered were changes in topography, permeability, erosion potential, and soil quality.

For the no action alternative at the ETTP site, the assessment area in which potentially important impacts might occur was determined to be quality of surface water, groundwater, and soil. The other potential impacts include changes in water use and effluent volumes. Maximum water use during continued cylinder maintenance operations at the site would be 32,000 gal/yr (120,000 L/yr).

A contaminant of concern in evaluating surface water, groundwater, and soil quality is uranium. Surface water and groundwater concentrations of contaminants are generally evaluated through comparison with EPA MCLs, as given in Safe Drinking Water Act regulations (40 CFR Part 141), although these limits are only directly applicable “at the tap” of the water user. The water concentration value used for comparison in this EIS is 20 μg/L (the proposed MCL for uranium has now been finalized at 30 μg/L and became effective in December 2003 [EPA 2003a]). The 20-μg/L value is used as a guideline for evaluating surface water and groundwater concentrations of uranium in this EIS, even though it is not directly applicable as a standard. There is also no standard available for limiting concentrations of uranium in soil. A health-based value of 230 μg/g (EPA 1995), applicable for residential settings, is used as a guideline for comparison.

The nearest surface water to the ETTP site is Poplar Creek, which is a tributary of the Clinch River. The Clinch River is used as a drinking water source. Because of very large dilution effects, even high levels of contaminants in Poplar Creek would not be expected to cause concentrations to exceed guidelines at the drinking water intakes of the Clinch River.

5.1.3.4.1 Surface Water. Potential impacts on the nearest receiving water at the site (i.e., Poplar Creek) were estimated for uranium released from hypothetical cylinder breaches occurring through 2039. The estimated potential maximum concentration of uranium in Poplar Creek was calculated to be 0.02 μg/L, considerably below the 20-μg/L level used for comparison.

Cylinder painting activities have been associated with increased toxicity in runoff at the Paducah site. If such an impact occurred at the ETTP site as a result of future cylinder painting, mitigating actions, such as treating runoff, might be required.

5.1.3.4.2 Groundwater. Groundwater in the vicinity of the ETTP site discharges to nearby surface waters and is not known to be used as a domestic or industrial source. (See Chapter 3 for a discussion of existing groundwater quality at the site.) Activities associated with the no action alternative would not affect migration of existing groundwater contamination or impact off-site water supplies.

Potential impacts on groundwater quality from hypothetical releases of uranium from breached cylinders were assessed, taking credit for reduced corrosion from better maintenance and painting. The maximum future concentration of uranium in groundwater directly below the ETTP site is estimated to be 7 μg/L, which is considerably below the 20-μg/L level used for comparison. It was estimated that if the rate of uranium migration was rapid, this concentration would occur sometime after 2070. A lower concentration would occur if uranium migration through the soil was slower than assumed for this analysis.

Calculations indicate that if no credit was taken for the reduction in corrosion resulting from cylinder painting and maintenance and if storage continued at the ETTP site indefinitely, uranium releases from future cylinder breaches occurring before about 2025 could result in a sufficient amount of uranium in the soil column to increase the groundwater concentration of uranium to 20 µg/L in the future. The groundwater concentration would not actually reach 20 µg/L at the site until about 2100 or later. However, because of the ongoing maintenance program, it is expected that breaches occurring before 2039 would not be sufficient to increase the groundwater concentration to 20 µg/L at the site.

5.1.3.4.3 Soil. Potential impacts on soil that could receive contaminated rainwater runoff from the cylinder storage yards were estimated. The contaminant source is assumed to be uranium released from hypothetical breached cylinders. It is assumed that any releases from future cylinder painting activities would be controlled or treated to avoid soil contamination. The estimated maximum soil concentration is 3 µg/g for the ETTP site, considerably below the 230-µg/g guideline used for comparison.

5.1.3.5 Socioeconomics

The potential socioeconomic impacts of activities at the ETTP site under the no action alternative would be low. No construction activities are planned for the site under the no action alternative, and operational activities would create 30 direct jobs and 90 total jobs per year. During operations, direct and total income would be $3.1 million/yr and $4.2 million/yr, respectively.

The employment created in the ROI for the ETTP site during continued cylinder maintenance activities would represent a change of less than 0.1 of a percentage point in the projected annual average growth in employment over the period 2004 to 2039. No migration into the ROI would occur because of the ETTP activities; thus, no impacts are expected on local housing markets, local public service employment, or local public finances.

5.1.3.6 Ecology

The no action alternative would have a negligible impact on ecological resources in the area of the ETTP site. Because no construction activities are planned, there would be no new impacts on wetlands or on federal- and state-protected species.

The assessment results indicate that impacts to ecological resources from continued storage activities, including hypothetical cylinder breaches, would be negligible. Analysis of potential impacts was based on exposure of biota to airborne contaminants or contaminants released to soil, groundwater, or surface water (e.g., from painting activities or from breached cylinders). Predicted concentrations of contaminants in environmental media were compared with benchmark values of toxic and radiological effects (see Appendix F). At the ETTP site, air, soil, and surface water concentrations would be below levels harmful to biota. However, as discussed in Section 5.1.3.4, cylinder painting activities may potentially cause future reductions in surface water quality, and they may consequently result in impacts to aquatic biota downstream of the cylinder storage yards. Although groundwater uranium concentrations

(7 to 20 μg/L) would be below the lowest effects level (150 μg/L) and below radiological benchmark levels (4.55×10^3 pCi/L), they would exceed the ecological screening value for surface water (2.6 μg/L). However, contaminants in groundwater discharging to a surface water body, such as a local stream, would be quickly diluted to negligible concentrations.

5.1.3.7 Waste Management

Under the no action alternative, operations at the ETTP site would generate relatively small amounts of LLW and LLMW. The volume of LLW generated by continued storage activities would represent less than 1% of the annual generation at the site from all activities. The maximum annual amount of LLMW generation from stripping/painting operations at the ETTP site would generate less than 1% of the site's total annual LLMW load, resulting in negligible waste management impacts for this site. Thus, the overall impact on waste management operations from the no action alternative would be negligible.

5.1.3.8 Resource Requirements

Operations under the no action alternative would use electricity, fuel, concrete, steel and other metals, and miscellaneous chemicals. The total quantities of commonly used materials would be small compared with local sources and would not affect local, regional, or national availability of these materials. No strategic or critical materials are expected to be consumed. The anticipated utilities requirements would be within the supply capacities at the ETTP site. The required material resources would be readily available.

5.1.3.9 Land Use

Because no new construction is planned for the ETTP site, no impacts on land use are anticipated for the no action alternative.

5.1.3.10 Cultural Resources

Impacts to cultural resources at the ETTP site would not be likely under the no action alternative. The existing cylinder storage yards would continue to be used for cylinder storage. These yards are currently located in previously disturbed areas (graded during the original construction of the yards) and are unlikely to contain cultural properties or resources listed on or eligible for listing on the NRHP. No new or expanded cylinder storage yards are proposed at ETTP. Cylinder breaches are not expected to result in HF or criteria pollutant emissions sufficient to impact cultural resources (see Section 5.1.2.3).

5.1.3.11 Environmental Justice

A review of the potential human health and safety impacts anticipated under the no action alternative indicates that no disproportionately high and adverse effects to minority or low-income populations are expected on or in the vicinity of the ETTP site during DUF_6 cylinder storage. Although such populations occur in certain areas within the 50-mi (80-km) radius used to identify the maximum geographic extent of human health impacts (see Section 3.2.12), no noteworthy impacts to these populations are anticipated. The results of accident analyses for the no action alternative also did not identify high and adverse impacts to the general public; the risk of accidents (consequence × probability) yields less than 1 fatality for all accidents considered.

5.2 PROPOSED ACTION ALTERNATIVES

This section presents the estimated potential environmental impacts for the proposed action alternatives, including:

- Impacts from construction of a new cylinder storage yard at two possible locations at the Portsmouth site (Section 5.2.1);
- Impacts from construction of the conversion facility at the three alternative locations within the Portsmouth site (Section 5.2.2);
- Impacts from operation of the conversion facility at the three alternative locations (Section 5.2.3);
- Impacts at ETTP from preparing cylinders for transportation to Portsmouth (Section 5.2.4);
- Impacts from the transportation of UF_6 cylinders from ETTP to Portsmouth, and uranium conversion products and waste materials from the Portsmouth site to a disposal facility (Section 5.2.5);
- Impacts associated with the potential sale and use of HF and CaF_2 (Section 5.2.6);
- Impacts that would occur if the cylinders at ETTP were shipped to Paducah for conversion rather than to Portsmouth (Section 5.2.7); and
- Impacts from expanded plant operations, including extending the operational period and increasing throughput (Section 5.2.8).

In general, within each technical area, impacts are discussed for the construction and operation of the facility at the preferred location (Location A) as well as for two alternative locations (Locations B and C). The time period considered is a construction period of approximately 2 years and an operational period of 18 years.

5.2.1 Portsmouth Site — Cylinder Storage Yard Construction Impacts

As discussed in Chapter 2, it may be necessary to construct an additional yard at Portsmouth for the storage of the ETTP cylinders, depending on when and at what rate the ETTP cylinders are shipped. DOE will not know if a new yard is required, or if existing storage yard space could be used for the ETTP cylinders, until some time in the future. The potential environmental impacts from the construction of a new cylinder storage yard are included in this section to account for current uncertainties. Two possible areas for new cylinder yard construction are evaluated, as shown in Figure 2.2-4. (Also identified in Figure 2.2-4 is an existing concrete pad being evaluated for temporary storage of the ETTP cylinders.) Both areas are adjacent to current DOE cylinder storage yards. Proposed Area 1 consists of three smaller sections, with a total area of about 5.5 acres (2.2 ha). Proposed Area 2 consists of two smaller sections, with a total area of about 6.3 acres (2.5 ha). A new yard would be constructed of concrete and would be similar to other concrete yards constructed at the Portsmouth site.

5.2.1.1 Human Health and Safety — Normal Construction Activities

5.2.1.1.1 Radiological Impacts. Proposed Area 1 includes three separate sections in close proximity to the existing cylinder yards (X-745E and X-745C). While constructing concrete pads in this area, construction workers, due to proximity to the DUF_6 cylinders, would be exposed to external radiation. On the basis of thermoluminescence dosimeter (TLD) monitoring data at these cylinder yards and the assumption that a worker would spend a total of 500 hours close to the cylinders, potential radiation exposure is estimated to be about 30 mrem.

Proposed Area 2 includes two separate sections. The smaller section to the north is close to existing cylinder yard X-745C; the larger one to the south is away from existing cylinder yards. Construction workers working in the smaller section would receive radiation exposure from cylinders in the X-745C yards. On the basis of the assumption that the total exposure duration would be the same here as at Proposed Area 1 (500 hours), the potential radiation dose to a construction worker would be about 30 mrem. The exposures estimated are conservative because of the use of the TLD data taken from the cylinder yards. Furthermore, the construction work is expected to last for only 3 months (Folga 2003); therefore, the actual time a worker would spend at a distance close to the cylinder yard boundary would be less than 500 hours. For comparison, the average annual dose received by cylinder yard workers was 64 mrem/yr in year 2001 (DOE 2002e). The radiation dose limit set to protect the general public is 100 mrem/yr (DOE 1990), and workers are limited to a dose of 5,000 mrem/yr (10 CFR 835).

5.2.1.1.2 Chemical Impacts. Chemical exposures during construction of the new Portsmouth cylinder storage yard are expected to be low and mitigated by using personal protective equipment and engineering controls to comply with OSHA PELs that are applicable for construction activities.

5.2.1.2 Human Health and Safety — Accidents

The risk of on-the-job fatalities and injuries to cylinder storage yard construction workers was calculated by using industry-specific statistics from the BLS, as reported by the National Safety Council (2002). Annual fatality and injury rates from the BLS construction industry division were used for the 3-month construction phase. Construction of the cylinder storage yard is estimated to require approximately 21 or 24 FTEs over 3 months for Areas 1 or 2, respectively. No on-the-job fatalities are predicted during the cylinder storage yard construction phase; however, approximately 1 injury is predicted (Table 5.2-1).

TABLE 5.2-1 Potential Impacts to Human Health from Physical Hazards during Construction of an Additional Cylinder Storage Yard at the Portsmouth Site

	Impacts to Cylinder Storage Yard Workers[a]	
Area	Incidence of Fatalities	Incidence of Injuries
1	0.003	1
2	0.003	1

[a] Potential hazards were estimated for all cylinder storage yard workers over the 3-month construction phase.

Source: Injury and fatality rates used in calculations were taken from National Safety Council (2002).

5.2.1.3 Air Quality and Noise

5.2.1.3.1 Air Quality Impacts. Emissions of criteria pollutants — SO_2, NO_x, CO, and PM (PM_{10} and $PM_{2.5}$) — and of VOCs would occur during the construction period, which would last about 3 months. These emissions would include fugitive dust emissions from earthmoving activities and exhaust emissions from heavy equipment and commuter/delivery vehicles. The total emissions from fugitive and exhaust sources are estimated to be 0.02 ton (0.02 t) for SO_2, 0.28 ton (0.25 t) for NO_x, 0.19 ton (0.17 t) for CO, 2.96 tons (2.69 t) for PM_{10}, 0.46 ton (0.42 t) for $PM_{2.5}$, and 0.08 ton (0.07 t) for VOCs (Folga 2003). Estimated maximum pollutant concentrations during construction are shown in Table 5.2-2.

All of the pollutant concentration increments would remain below NAAQS and SAAQS. For SO_2, NO_2, and CO, it is predicted that maximum concentration increments would be about 2% of their applicable standards. The highest concentration increment would occur for 24-hour average PM_{10}, which is predicted to be about 49% of the standard for PM_{10}. The highest concentration increment for $PM_{2.5}$ is predicted to be about 12% of its standard.

To obtain the total concentrations for comparison with applicable air quality standards, the modeled concentration increments were added to measured background values (see Table 3.1-3). The total concentrations for SO_2, NO_2, CO, and PM_{10} are estimated to be below 91% of applicable ambient standards. Total $PM_{2.5}$ concentrations are estimated to be near or above applicable ambient standards. In fact, concentrations of $PM_{2.5}$ at most statewide monitoring stations either approach or are above the standards. Construction activities should be conducted so as to minimize potential impacts on ambient air quality. Water could be sprayed on disturbed areas frequently, as needed, and dust suppressant or pavement could be applied to roads with frequent traffic.

TABLE 5.2-2 Maximum Air Quality Impacts at the Construction Site Boundary Due to Emissions from Activities Associated with Construction of a New Cylinder Storage Yard at the Portsmouth Site

			Concentration ($\mu g/m^3$)				Percent of NAAQS/SAAQS[e]	
Candidate Area	Pollutant[a]	Averaging Time	Maximum Increment[b]	Back-ground[c]	Total[d]	NAAQS and SAAQS	Increment	Total
1	SO_2	3 hours	29.5	307	337	1,300	2.3	25.9
		24 hours	5.5	110	115	365	1.5	31.6
		Annual	0.2	18.7	18.9	80	0.2	23.6
	NO_2	Annual	0.2	54.7	54.9	100	0.2	54.9
	CO	1 hour	68.0	13,400	13,500	40,000	0.2	33.7
		8 hours	15.7	4,780	4,800	10,000	0.2	48.0
	PM_{10}	24 hours	63.0	64.0	127	150	42.0	84.7
		Annual	2.4	32.0	34.4	50	4.7	68.7
	$PM_{2.5}$	24 hours	7.4	57.5	64.9	65	11.4	99.9
		Annual	0.36	24.1	24.5	15	2.4	163
2	SO_2	3 hours	29.1	307	336	1,300	2.2	25.9
		24 hours	6.7	110	117	365	1.8	32.0
		Annual	0.1	18.7	18.8	80	0.1	23.5
	NO_2	Annual	0.2	54.7	54.9	100	0.2	54.9
	CO	1 hour	59.5	13,400	13,500	40,000	0.1	33.6
		8 hours	19.7	4,780	4,800	10,000	0.2	48.0
	PM_{10}	24 hours	72.8	64.0	137	150	48.6	91.2
		Annual	1.7	32.0	33.7	50	3.4	67.4
	$PM_{2.5}$	24 hours	7.5	57.5	65.0	65	11.5	100
		Annual	0.3	24.1	24.4	15	1.7	162

[a] Emissions are from equipment and vehicle engine exhaust, except for PM_{10} and $PM_{2.5}$, which are also from soil disturbance.

[b] Data represent the maximum concentration increments estimated, except that the fourth- and eighth-highest concentration increments estimated are listed for 24-hour PM_{10} and $PM_{2.5}$.

[c] See Table 3.1-3.

[d] Total equals the maximum modeled concentration increment plus background concentration.

[e] The values in the next-to-last column are maximum concentration increments as a percent of NAAQS and SAAQS. The values presented in the last column are total concentration increments as a percent of NAAQS and SAAQS.

The potential impacts of PM (PM$_{10}$ and PM$_{2.5}$) released from near-ground level would be limited to the immediate vicinity of the construction site boundaries — areas that the general public is expected to occupy only infrequently. The PM concentrations would decrease rapidly with distance from the source. At the nearest residence (about 1.5 km [0.9 mi] west of the construction Area 2), predicted concentration increments would be less than 2% of the highest concentration increments at construction site boundaries.

Potential air quality impacts due to emissions from new cylinder yard construction activities were predicted to be comparable between the two alternative areas. However, potential impacts for Area 2 would be slightly higher than those for Area 1 if construction of the new cylinder yard occurred simultaneously with construction of the conversion facility.

5.2.1.3.2 Noise Impacts. During construction, the commuting/delivery vehicular traffic around the construction site would generate intermittent noise. However, the contribution to noise from these intermittent sources would be limited to the immediate vicinity of the traffic route and would be minor in comparison with the contribution from the continuous noise sources, such as a compressor or bulldozer, during construction. Noise sources during the construction of the cylinder yard would include site clearing followed by concrete padding. Noise levels from these activities would be comparable to those from other construction sites of similar size.

Average noise levels for construction equipment range from 76 dB(A) for a pump to 89 dB(A) for a scraper (Harris Miller Miller & Hanson, Inc. [HMMH] 1995). To estimate noise levels at the nearest residence, it was assumed that the two noisiest pieces of equipment would operate simultaneously (HMMH 1995). A scraper and a heavy truck operating continuously typically generate noise levels of 89 and 88 dB(A), respectively, at a distance of 15 m (50 ft) from the source, which results in a combined noise level of about 91.5 dB(A) at a distance of 15 m (50 ft).

The nearest residences to the proposed cylinder yard Areas 1 and 2 are located about 1.6 km (1.0 mi) and 1.5 km (0.9 mi) west-southwest and west of them, respectively. An analysis of the potential noise impacts was performed for the construction of cylinder yard Area 2, which is closer to the nearest residence. Noise levels decrease about 6 dB per doubling of distance from the point source because of the way sound spreads geometrically over an increasing distance. Thus, construction activities would result in an estimated noise level of about 52 dB(A) at the nearest residence. This level would be 47 dB(A) as DNL if it is assumed that construction activities would be limited to an 8-hour daytime shift. This value is below the EPA guideline of 55 dB(A) as DNL for residential zones (see Section 3.1.3.4), which was established to prevent interference with activity, annoyance, or hearing impairment. This 47-dB(A) estimate is probably an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease further. The resulting noise levels would be barely noticeable at the nearest residence.

Most of these construction activities would occur during the day, when noise is tolerated better than at night because of the masking effect of background noise. Nighttime noise levels would drop to the background levels of a rural environment because construction activities would cease at night.

If construction of the cylinder yard would occur simultaneously with construction of the conversion facility, noise levels at the nearest residence would increase by about 3 dB at most, but resultant noise levels would still be below the EPA guideline level. At the end of the 3-month construction period, noise impacts associated with construction of the cylinder yard would cease to exist.

5.2.1.4 Water and Soil

Construction and operation of a new cylinder storage yard at Portsmouth could impact surface water, groundwater, and soil resources. Potential impacts are discussed below for the two alternative locations, Areas 1 and 2.

5.2.1.4.1 Proposed Area 1

Surface Water. Construction of the storage yard would require about 0.75 million gal (2.8 million L) of water. This water would be obtained from groundwater resources. Because all water needs would be met by using groundwater, there would be no direct impacts to surface waters.

Construction of the storage yard at Portsmouth would also generate sanitary wastewater (0.11 million gal [0.42 million L]). If it was discharged at a constant rate over a year, the rate of release would be about 0.2 gal/min (0.8 L/min). After treatment in the existing wastewater treatment facility, the wastewater would be released to Little Beaver Creek or piped directly to the Scioto River under an existing NPDES permit. For average flow conditions in Little Beaver Creek (940 gal/min [3,558 L/min]), contaminant concentrations would be diluted by a factor of about 4,700. Additional dilution would occur at the confluence with Big Beaver Creek and again at the confluence with the Scioto River. Even under low-flow conditions, contaminants would be diluted by a factor of about 140,000.

Although water resources would not be impacted by withdrawals, surface waters could be affected indirectly by receiving contaminated runoff from the construction sites. By following good construction practices (e.g., stockpiling materials away from surface drainage paths, covering construction materials with tarps, and cleaning up any spills thoroughly as soon as they occur), indirect impacts to surface water quality could be minimized.

Groundwater. Construction of the storage yard would require about 0.75 million gal (2.8 million L) of water. Construction is expected to be completed in about 3 months. However, even if it was completed in 1 year, and the rate of water use was constant, a withdrawal rate of about 1.4 gal/min (5.4 L/min) would be required. Current water use at the Portsmouth facility is about 4,312 million gal/yr (16,323 million L/yr). The maximum capacity of the well system is about 13,900 million gal/yr (52,617 million L/yr). The water required for yard construction would, therefore, be about 0.02% of the existing use and 0.005% of the existing capacity. Groundwater withdrawal for construction would, therefore, have no measurable impact on the groundwater system beneath Portsmouth.

Construction of the storage yards at Portsmouth would also affect the permeability of the surface soil and its ability to transmit water as recharge to the underlying aquifers. However, impacts to recharge would not be measurable because the total area of land that would be permanently altered by construction of the yards would be very small (about 5.5 acres [2.2 ha] or about 0.2% of the total site area). Similarly, the quality of groundwater beneath the storage yards could be affected by construction activities through infiltration of surface water contaminated from spills of construction materials. By following good engineering and construction practices (e.g., covering chemicals with tarps to prevent contact with rainfall, promptly and thoroughly cleaning up spills, and providing retention basins to catch and hold any contaminated runoff), impacts to groundwater quality would be minimal.

Soils. Construction of the cylinder storage yard at Portsmouth would affect a total of 5.5 acres (2.2 ha). This amount of land is small (about 0.2% of the land area available), and impacts would be negligible. By following good engineering and construction practices, impacts to soil quality would also be minimal.

Operations. Operation of the proposed new cylinder storage areas at Portsmouth could affect water and soil resources, primarily from breached cylinders releasing a maximum of 4 lb (2 kg) of uranium over a 4-year period. As discussed above, approximately 5,000 cylinders containing DUF_6 would be stored in the new yards. This number of cylinders is less than 32% of the current inventory (about 16,000 cylinders). Because the number of additional cylinders stored would be less than the current inventory, impacts associated with their storage would be correspondingly smaller than the impacts predicted for continued cylinder storage at Portsmouth under the no action alternative (Section 5.1). For such conditions, impacts to surface water would not be measurable; a maximum groundwater concentration of 5 μg/L would occur somewhat before 2080 (assuming that the uranium in the groundwater was fairly mobile [Tomasko 1997]), and concentrations in the soil adjacent to the yards would be below the recommended EPA guideline of 230 μg/g for residential soil and 6,100 μg/g for industrial soil (EPA 2003a). These impacts could be reduced further by surrounding the storage yards with drainage ditches that could capture potentially contaminated runoff from the new yards and divert it for treatment, as needed.

5.2.1.4.2 Proposed Area 2. The quantity of water needed to construct the two storage yards for Proposed Area 2 would be about 0.85 million gal (3.2 million L). About 0.13 million gal (0.50 million L) of sanitary wastewater would be generated. Because the resources required to construct these yards are about the same as those discussed above for Proposed Area 1, the impacts would be about the same.

5.2.1.5 Socioeconomics

The potential socioeconomic impacts of construction and operation of a new cylinder yard at Portsmouth would be low. Construction activities would create short-term employment (60 direct jobs, 150 total jobs). Direct and total personal income from construction would be $1.7 million and $5.6 million, respectively.

The employment created in the ROI for the Portsmouth site would represent a change of less than 0.1 of a percentage point in the projected average annual growth in employment over the period of operations. Since no population in-migration is expected during either construction or operation, there would be no impact on local housing, local public finances, or local public service employment.

5.2.1.6 Ecology

Construction of a yard at Proposed Area 1 would result in the disturbance of approximately 6.1 acres (2.5 ha) of land, due to construction-related activities, and in the loss of previously disturbed managed grassland vegetation. The yard would not replace undisturbed natural communities. Managed grassland communities comprise most of the vegetation on the Portsmouth site, within the Perimeter Road. Thus, the loss of up to 6.1 acres (2.5 ha) would represent a minor decrease in this vegetation type on the Portsmouth site. Immediate replanting of areas disturbed by temporary construction-related activities with native species would help reduce impacts to vegetation.

Construction at Proposed Area 1 would primarily impact wildlife species commonly associated with managed grassland communities. Wildlife would be disturbed by land clearing, noise, and human presence. Wildlife with restricted mobility, such as burrowing species or juveniles of nesting species, would be destroyed during land clearing activities. More mobile individuals would relocate to adjacent areas with similar habitat, which is commonly available in the area. Wildlife in nearby woodland communities might also be disturbed by noise up to 91.5 dB(A) at 15 m (50 ft) during the construction period.

Wetlands do not occur within the areas that would be disturbed at Proposed Area 1. Therefore construction would not directly impact wetlands. Wetlands downgradient of the construction sites could be impacted by storm water runoff; however, the implementation of good construction practices, including erosion and sediment controls, would minimize impacts to surface water quality. Because surface water impacts from breached cylinders during use of the storage yards would be negligible, impacts to wetlands from cylinder storage would not be expected. The increase in impervious surface and discharge of storm water runoff from the yards could result in a greater fluctuation in flows within the stream northeast of the yards, across Perimeter Road. However, because the yard would not be located adjacent to the stream and only a small portion of the watershed would be involved, such effects would likely be very small.

Construction would not be expected to result in direct or indirect impacts to any federal- or state-listed species. Although the riparian forest along the stream north of Perimeter

Road might include trees that can be used by Indiana bats (federal- and state-listed as endangered) for roosting, this area has not been identified as summer roosting habitat. Although noise associated with construction activities might disturb wildlife, Indiana bats that might use habitats near the Portsmouth site are currently exposed to noise and other effects of human disturbance. Consequently, these effects related to construction activities would be expected to be minor.

Construction of a yard at Proposed Area 2 would result in the disturbance of approximately 6.9 acres (2.8 ha) of land, due to construction-related activities. Impacts to vegetation and wildlife would be similar to those for Proposed Area 1. Two intermittent streams originate in the area northeast of “A” Road and flow to the west, converging to form the stream immediately north of Location A. Storage yard construction would result in the elimination of the northernmost of these streams and partial filling of the other. Placement of a storage yard in this area could also result in a greater fluctuation in flows in downstream areas and reduced water quality. Impacts to federal- or state-listed species would not be expected.

5.2.1.7 Waste Management

The construction of a cylinder storage yard at Portsmouth would generate a total of about 353 yd^3 (270 m^3) of nonhazardous solid waste and 130,000 gal (470,000 L) of nonhazardous sanitary wastewater (Folga 2003). Only minimal impacts would result from these construction-generated wastes.

5.2.1.8 Resource Requirements

A new storage yard would be an 8-in. (20-cm) thick concrete pad on top of a 12-in. (30-cm) layer of crushed stone. Table 5.2-3 provides an estimate of the construction requirements. None of the identified construction resources is in short supply, and all should be readily available in the local region.

TABLE 5.2-3 Materials/Resources Consumed during Construction of a Cylinder Storage Yard at the Portsmouth Site

Materials/Resources	Total Consumption	Unit
Utilities		
Water	840,000	gal
Solids		
Concrete	7,400	yd^3
Aggregate (gravel)	11,000	yd^3
Special coatings	33,000	yd^2
Liquids		
Fuel	2.8×10^3	gal

5.2.1.9 Land Use

Both locations being considered for a storage yard are in an area of existing structures and on a site with more than 150 structures. Constructing an additional storage yard on the Portsmouth site would involve very slight modifications of existing land use. The resulting storage yard would be consistent with the heavy industrialized land use currently found at the Portsmouth site — a consequence of producing enriched uranium and its DUF_6 by-product, as well as storing the latter. As a consequence, no land use impacts are anticipated as a result of construction of a new yard.

5.2.1.10 Cultural Resources

The construction of a new cylinder storage yard at Portsmouth could potentially impact cultural resources. The amount of data available on cultural resources within the project area at Portsmouth is not sufficient to determine whether or not the construction would adversely impact significant cultural resources. Consequently, the possibility of adverse effects on cultural resources as a result of the construction cannot be excluded.

Archaeological and architectural surveys were undertaken for Portsmouth in 1996. The findings of these surveys have not been finalized and have not received concurrence from the Ohio SHPO. Past ground disturbance resulting from grading and construction make it unlikely that intact archaeological remains are present at the proposed locations for a new cylinder storage yard (Anderson 2002). However, unless these findings receive SHPO concurrence, a separate archaeological assessment of the proposed location for the construction of the cylinder storage yard (conducted by a qualified professional archaeologist) would be required to ensure that cultural material is not present and that Section 106 obligations under the National Historic Preservation Act (NHPA) of 1966 are met. If archaeological resources were encountered and a site or sites were determined to be significant, a mitigation plan would have to be developed and executed in consultation with the Ohio SHPO prior to construction. In general, mitigation of an adverse effect of yard construction on cultural resources could entail site avoidance, site monitoring during construction, or site excavation/data recovery. No buildings or structures are located at the proposed construction locations for a new cylinder storage yard; thus, no impacts to historic structures are anticipated.

No Native American traditional cultural properties have been identified at Portsmouth to date. Consultations with the SHPO and Native American groups have been initiated (Appendix G). If construction of a cylinder storage yard would result in an adverse effect on any such property identified, appropriate mitigation, as determined through continued consultation, would have to be undertaken before construction could begin.

5.2.1.11 Environmental Justice

The evaluation of environmental justice impacts associated with constructing a cylinder storage yard at the Portsmouth site is based on the identification of high and adverse impacts in other impact areas considered in this EIS, followed by a determination if those impacts would affect minority and low-income populations disproportionately. Disproportionate impacts could take two forms: (1) when the environmental justice population is present at a higher percentage in the affected area than in the reference population (i.e., the state in which a potentially impacted population occurs) and (2) when the environmental justice population is more susceptible to impacts than the population as a whole. In either case, high and adverse impacts are a necessary precondition for environmental justice concerns in an EIS.

Analyses of impacts from constructing a cylinder storage yard do not indicate the presence of high and adverse impacts for any of the other impact areas considered in this EIS (see Sections 5.2.1.1 through 5.2.1.10). Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 mi (80 km) of the proposed cylinder yard, no environmental justice impacts from constructing this yard are anticipated. Similarly, no evidence indicates that minority or low-income populations would experience high and adverse impacts from the proposed construction in the absence of such impacts in the population as a whole.

5.2.2 Portsmouth Site — Conversion Facility Construction Impacts

This section discusses the potential environmental impacts during construction of a conversion facility at the three alternative locations within the Portsmouth site. When completed, the conversion facility would occupy approximately 10 acres (4 ha), including process and support buildings and parking areas. However, up to 65 acres (26 ha) of land might be disturbed during construction, including temporary lay-down areas (areas for staging construction material and equipment or for excavated material) and areas for utility access. Some of the disturbed areas would not be adjacent to the construction area. The disturbed area would include access roads, rail lines, and utility corridors.

The preferred conversion facility location (Location A) is adjacent to the RCRA X-616 chromium sludge lagoon unit and its related monitoring wells, an area that has a deed notice and associated restrictions. The X-616 chromium sludge lagoon and monitoring wells are, at their nearest point, located approximately 100 ft (30 m) from the DUF_6 conversion facility site boundary. To prevent direct impacts and ensure the integrity of this area, it will be clearly marked and identified, a suitable buffer zone will be established around it, and the entry of conversion facility personnel or equipment into these areas will be prohibited. To prevent indirect impacts, best available technologies will be identified and implemented to prevent the transport of air particulates and liquid effluents or discharges originating at the conversion facility site from trespassing at or impacting the RCRA unit. Technologies to prevent air particulate transport could include covering and/or spraying exposed bare soil, prohibiting open burning, and using windbreaks around construction areas. Technologies to prevent impacts from liquid discharges could include storm water and sediment controls such as silt fences, sediment traps, and seeding; secondary containment around liquid storage areas; and prompt cleanup of any inadvertent spills.

5.2.2.1 Human Health and Safety — Normal Construction Activities

5.2.2.1.1 Radiological Impacts. Of the three alternative locations at the Portsmouth site, none are close to the existing cylinder storage yards. According to site-specific external radiation data (DOE 2001d), external gamma radiation at all three locations is close to the background level. Therefore, construction workers at Locations A, B, or C are not expected to incur any external radiation from the depleted uranium currently stored in the cylinder yards.

However, if Proposed Area 2 is selected as the new yard and the larger lot to the south is used, potential external exposure could result from constructing the conversion facility at Location A, the preferred alternative. The incurred radiation dose would be less than 60 mrem/yr, calculated by using the TLD data from cylinder yard X-745C and an exposure duration of 1,000 hours per year. Once the surrounding walls of the conversion facility were built, radiation exposure would be further reduced because of the shielding provided by the walls. No radiological impacts would be expected at alternative Locations B and C from the new cylinder yard because of the greater distance between them and the yard.

5.2.2.1.2 Chemical Impacts. Chemical exposures during construction at the Portsmouth site are expected to be low and mitigated by using personal protective equipment and engineering controls to comply with OSHA PELs that are applicable for construction activities. No differences among the three alternative locations are expected.

5.2.2.2 Human Health and Safety — Accidents

The risk of on-the-job fatalities and injuries to conversion facility construction workers would not be dependent on the location of the facility. The estimated injuries and fatalities were calculated by using industry-specific statistics from the BLS, as reported by the National Safety Council (2002). Annual fatality and injury rates from the BLS construction industry division were used for the 20-month construction phase. Construction of the conversion facility is estimated to require approximately 164 FTEs per year. For all three alternative locations, no on-the-job fatalities are predicted during the construction phase; however, approximately 11 injuries are predicted (Table 5.2-4).

5.2.2.3 Air Quality and Noise

5.2.2.3.1 Air Quality Impacts. Currently, detailed information on the location of facility boundaries is available only for the preferred Location A. For modeling air quality impacts at Locations B and C, the proposed facilities were assumed to be located in the middle of the alternative locations.

Emissions of criteria pollutants — SO_2, NO_x (emissions are in NO_x but the ambient air quality standards are in NO_2), CO, and PM (PM_{10} and $PM_{2.5}$) — and of VOCs would occur during the construction period. These emissions would include fugitive dust emissions from earthmoving activities and exhaust emissions from heavy equipment and commuter/delivery vehicles. The annual emissions of criteria pollutants and VOCs expected during facility

TABLE 5.2-4 Potential Impacts to Human Health from Physical Hazards during Conversion Facility Construction and Operations at the Portsmouth Site

	Impacts to Conversion Facility Workers[a]			
	Incidence of Fatalities		Incidence of Injuries	
Activity	Construction	Operations	Construction	Operations
Conversion to U_3O_8	0.04	0.10	11	142
Conversion to U_3O_8 (without ETTP cylinders)	0.04	0.08	11	110

[a] Potential hazards were estimated for all conversion facility workers over the entire construction (20 months) and operation (18 and 14 years, with and without ETTP cylinders, respectively) phases.

Source: Injury and fatality rates used in calculations were taken from National Safety Council (2002).

construction are presented in Table 5.2-5. Estimated maximum pollutant concentrations during construction are shown in Table 5.2-6 for the three alternative locations.

All of the pollutant concentration increments would remain below NAAQS and SAAQS. For SO_2, NO_2, and CO, it is predicted that concentration increments would be below 32% of their applicable standards. The highest concentration increment would occur for 24-hour average PM_{10}, which is predicted to be up to about 79% of the standard for PM_{10}. The highest concentration increment for $PM_{2.5}$ is predicted to be less than 43% of its standard.

To obtain the total concentrations for comparison with applicable air quality standards, the modeled PM_{10} concentration increments were added to measured background values (Table 3.1-3). The total concentrations for SO_2, NO_2, and CO would be below 86% of applicable ambient standards. Total PM_{10} and $PM_{2.5}$ concentrations are estimated to either approach or be above their applicable ambient standards. In fact, concentrations of $PM_{2.5}$ at most statewide monitoring stations either approach or are above the standard. Predicted PM (PM_{10} and $PM_{2.5}$) concentration increments at the site boundaries would be high for the following two reasons: (1) the conversion facility would be constructed outside the current fenced site boundaries, so the general public would have access,[2] and (2) wind speeds measured at the on-site meteorological tower were relatively low, about half the speed of those at the Paducah GDP. Accordingly, construction activities should be conducted so as to minimize potential impacts on ambient air quality. Water could be sprayed on disturbed areas frequently, as needed, and/or dust suppressant or pavement could be applied to roads with frequent traffic.

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[2] Formerly, the general public had access to the existing fenced boundaries. However, since the September 11, 2001, terrorist attack, site access for the general public has been restricted indefinitely to the DOE property boundaries.

TABLE 5.2-5 Annual Criteria Pollutant and Volatile Organic Compound Emissions from Construction of the Conversion Facility at the Portsmouth Site

	Emission Rate (tons/yr)					
Emission Source	SO_2	NO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Exhaust	1.7	24.9	16.8	7.0	2.5	2.5[a]
Fugitive	–[b]	–	–	–	15.8[c]	2.3[c]

[a] For exhaust emissions, $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions.

[b] A dash indicates no emissions.

[c] Fugitive dust emissions were estimated under the assumption that the conversion facility construction area would continuously disturb about 8.5 acres (3.4 ha). This is the maximum amount of the approximate 10-acre (4-ha) facility footprint that would be disturbed at one time. A conventional control measure of water spraying with an emission control efficiency of 50% would be applied over the disturbed area. For fugitive dust emissions from earthmoving activities, $PM_{2.5}$ emissions were assumed to be 15% of PM_{10} emissions (EPA 2002).

Source: Folga (2003).

The potential impacts of PM (PM_{10} and $PM_{2.5}$) released from near-ground level would be limited to the immediate vicinity of the site boundaries — areas that the general public is expected to occupy only infrequently. The PM concentrations would decrease rapidly with distance from the source. At the nearest residence just off DOE's southern boundary (about 0.9 km [0.6 mi] from alternative Location B), predicted concentration increments would be less than 10% of the highest concentration increments at the site boundaries.

Among the three alternative locations, potential air quality impacts due to emissions from construction activities would be similar, with the highest at Location B and the lowest at Location A, as shown in Table 5.2-6. However, as mentioned previously, locations of facility boundaries for Locations B and C are assumed arbitrarily; thus, results for the two alternative locations should be interpreted in that context.

5.2.2.3.2 Noise Impacts. Noise levels from construction would be similar among the alternative locations. During construction, the commuting/delivery vehicular traffic around the facilities would generate intermittent noise. However, the contribution to noise from these intermittent sources would be limited to the immediate vicinity of the traffic route and would be minor in comparison with the contribution from continuous noise sources, such as compressors

TABLE 5.2-6 Maximum Air Quality Impacts at the Construction Site Boundary Due to Emissions from Activities Associated with Construction of the Conversion Facility at the Portsmouth Site

			Concentration ($\mu g/m^3$)					
							Percent of NAAQS/SAAQS[e]	
Location	Pollutant[a]	Averaging Time	Maximum Increment[b]	Back-ground[c]	Total[d]	NAAQS and SAAQS	Increment	Total
A	SO_2	3 hours	55.4	307	362	1,300	4.3	27.9
		24 hours	13.7	110	124	365	3.8	33.9
		Annual	1.5	18.7	20.2	80	1.8	25.2
	NO_2	Annual	21.8	54.7	76.5	100	21.8	76.5
	CO	1 hour	1,100	13,400	14,500	40,000	2.7	36.2
		8 hours	405	4,780	5,190	10,000	4.1	51.9
	PM_{10}	24 hours	95.8	64.0	160	150	63.9	107
		Annual	16.7	32.0	48.7	50	33.3	97.3
	$PM_{2.5}$	24 hours	19.7	57.5	77.2	65	30.3	119
		Annual	4.3	24.1	28.4	15	28.7	189
B	SO_2	3 hours	63.5	307	371	1,300	4.9	28.5
		24 hours	15.2	110	125	365	4.2	34.3
		Annual	2.1	18.7	20.8	80	2.7	26.0
	NO_2	Annual	31.5	54.7	86.2	100	31.5	86.2
	CO	1 hour	1,180	13,400	14,600	40,000	2.9	36.4
		8 hours	441	4,780	5,220	10,000	4.4	52.2
	PM_{10}	24 hours	118	64.0	182	150	78.6	121
		Annual	25.7	32.0	57.7	50	51.4	115
	$PM_{2.5}$	24 hours	24.0	57.5	81.5	65	37.0	126
		Annual	6.5	24.1	30.6	15	43.1	204
C	SO_2	3 hours	56.6	307	364	1,300	4.4	28.0
		24 hours	13.0	110	123	365	3.6	33.7
		Annual	1.8	18.7	20.5	80	2.2	25.6
	NO_2	Annual	26.4	54.7	81.1	100	26.4	81.1
	CO	1 hour	1,130	13,400	14,500	40,000	2.8	36.3
		8 hours	411	4,780	5,190	10,000	4.1	51.9
	PM_{10}	24 hours	115	64.0	179	150	76.7	119
		Annual	21.5	32.0	53.5	50	43.0	107
	$PM_{2.5}$	24 hours	24.2	57.5	81.7	65	37.3	126
		Annual	5.4	24.1	29.5	15	36.1	197

Footnotes on next page.

TABLE 5.2-6 (Cont.)

[a] Emissions are from equipment and vehicle engine exhaust, except for PM_{10} and $PM_{2.5}$, which are also from soil disturbance.

[b] Data represent the maximum concentration increments estimated, except that the fourth- and eighth-highest concentration increments estimated are listed for 24-hour PM_{10} and $PM_{2.5}$.

[c] See Table 3.1-3.

[d] Total equals maximum modeled concentration plus background concentration.

[e] The values presented in the next-to-last column are maximum concentration increments as a percent of NAAQS and SAAQS. The values in the last column are total concentration increments as a percent of NAAQS and SAAQS.

or bulldozers during construction. Sources of noise during the construction of the conversion facility would include standard commercial and industrial activities for moving earth and erecting concrete and steel structures. Noise levels from these activities would be comparable to those from other construction sites of similar size.

The noise levels would be highest during the early phases of construction, when heavy equipment would be used to clear the site. This early phase of construction would last for about 6 months of the entire construction period of 1.5 years. Average noise levels for typical construction equipment range from 76 dB(A) for a pump, to 85 dB(A) for a bulldozer, to 101 dB(A) at peak for a pile driver (HMMH 1995). To estimate noise levels at the nearest residence, it was assumed the two noisiest pieces of equipment would operate simultaneously. A scraper and a heavy truck operating continuously typically generate noise levels of 89 and 88 dB(A), respectively, at a distance of 15 m (50 ft) from the source (HMMH 1995),[3] which results in a noise level of about 91.5 dB(A) at a distance of 15 m (50 ft).

The nearest residences to alternative Locations A, B, and C are located west, south-southeast, and northeast of them, respectively. The nearest residence, located about 0.9 km (0.6 mi) south-southeast of Location B and just off DOE's southern boundary, was selected as the receptor for the analysis of potential noise impacts. Noise levels decrease about 6 dB per doubling of distance from the point source because of the way sound spreads geometrically over an increasing distance. Thus, construction activities, which result in a combined noise level of about 91.5 dB(A) at a distance of 15 m (50 ft), would result in an estimated noise level of about 56 dB(A) at the nearest residence. This level would be 51 dB(A) as DNL, if it is assumed that construction activities would be limited to an 8-hour daytime shift. This 51-dB(A) estimate is below the EPA guideline of 55 dB(A) as DNL for residential zones (see Section 3.1.3.4), which was established to prevent interference with activity, annoyance, and hearing impairment. The 51-dB(A) estimate is probably an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. If only ground effects were considered (HMMH 1995), more than 10 dB(A) of attenuation would occur at the nearest residence, which would result in about 41 dB(A).

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[3] Pile drivers were excluded because piles would not be required for buildings at the site.

Most of these construction activities would occur during the day, when noise is tolerated better than at night because of the masking effects of background noise. The resulting noise levels would be barely noticeable to the nearest residence for all three alternative locations. Nighttime noise levels would drop to the background levels of a rural environment because construction activities would cease at night.

5.2.2.4 Water and Soil

Construction of a conversion plant at Portsmouth would disturb land, use water, and produce liquid wastes. Impacts from constructing a conversion plant on surface water, groundwater, and soil resources are discussed below. Because site-specific impacts were not identified, impacts to water and soil at alternative Locations A, B, and C would be the same.

5.2.2.4.1 Surface Water. Construction of a conversion facility at the Portsmouth site would result in increased runoff to nearby surface waters because soil and vegetation would be replaced by either buildings or paved areas. The amount of increased runoff from the new, impermeable land surface would be negligible compared with the existing area that contributes to runoff (less than about 2% of the site area). None of the construction activities would measurably affect the existing floodplains.

During construction, water would be needed. Peak water consumption would be 5,500 gal/d (20,800 L/d) or 2.0 million gal/yr (7.6 million L/yr). This water would include 1,500 gal/d (5,700 L/d) for construction use and 4,000 gal/d (15,100 L/d) for the workforce. Water requirements for construction would be independent of the specific location selected at Portsmouth. Although the Portsmouth site has the ability to use water from the Scioto River, almost all water is currently obtained from four on-site wells and 31 off-site wells. Because construction water needs would be met by using groundwater, there would be no impacts on surface water resources.

Wastewater would also be produced during construction. For the assumed workforce, about 4,000 gal/d (15,140 L/d) or 1.5 million gal/yr (5.7 million L/yr) of sanitary wastewater would be generated. There would be no sanitary wastewater discharge to the environment because portable toilets would be used.

5.2.2.4.2 Groundwater. Potential impacts to groundwater could occur during construction. These impacts could include changes in effective recharge to underlying aquifers, changes in the depth to groundwater, changes in the direction of groundwater flow, and changes in groundwater quality.

Current water use at Portsmouth is about 4,312 million gal/yr (16,323 million L/yr). The maximum capacity of the well system is about 13,900 million gal/yr (52,617 million L/yr). If the rate of withdrawal was constant over time, about 3.8 gal/min (14.4 L/min) would be needed to construct the conversion plant. This rate of withdrawal would be about 0.05% of the annual average withdrawal and 0.01% of the excess well capacity. Direct impacts from such a withdrawal on groundwater resources (e.g., depth to groundwater and flow direction) would not be measurable and would be the same for all three alternative locations.

Construction could also affect the permeability of the surface soil and its ability to transmit water as recharge to the underlying aquifers. Because of the small associated operational areas (less than 2% of the land area available), these differences in permeability would produce changes in the effective recharge that would not be measurable. Similarly, the quality of groundwater beneath the selected location could be affected by surface construction activities through infiltration of contaminated surface water from spills. These impacts would be indirect because there would be no direct releases of contaminants to groundwater. Indirect contamination could result from the mobilization of exposed chemicals by precipitation, followed by infiltration of contaminated runoff water. Following good engineering and construction practices and implementing storm water and erosion control measures would minimize impacts to groundwater quality.

5.2.2.4.3 Soils. Potential impacts on soil could occur during construction and postulated accident scenarios. These impacts would include changes in topography, permeability, quality, and erosion potential.

Construction of a conversion facility at Portsmouth would disturb about 65 acres (26 ha) of land. Location A, however, has only 26 acres (11 ha) available. An additional 39 acres (16 ha) would be required for the disturbed area. An additional 19 acres (8 ha) of land would be required at the 46-acre (19-ha) Location B site. No additional land would be needed for the 78-acre (32-ha) Location C site. Because the conversion plant sites are relatively flat, there would be no significant changes in topography, and the maximum amount of land needed for construction would be small relative to the total land available at the site (less than about 2%). Erosion potential would increase during construction; the impacts, however, would be local and temporary.

Construction activities could also affect the quality of the land at the location selected for the conversion facility. The impacts could result from spills and other construction activities that could release contaminants to the surface. By following good engineering and construction practices (e.g., covering chemical stockpiles, cleaning up spills thoroughly as soon as they occur, and installing detention basins), impacts to soil quality would be minimized.

5.2.2.5 Socioeconomics

The socioeconomic analysis covers the effects from construction on population, employment, income, regional growth, housing, and community resources in the ROI around the Portsmouth site. Impacts from construction are summarized in Table 5.2-7. The socioeconomic impacts are not dependent on the location of the conversion facility; thus, the impacts would be the same for alternative Locations A, B, and C.

The potential socioeconomic impacts would be relatively small. Construction activities would create direct employment of about 190 people in the peak construction year and about 90 additional indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by about 0.1 percentage point over the duration of construction. A conversion facility at Portsmouth would produce about $9 million in personal income in the peak year of construction.

In the peak year of construction, it is estimated that about 300 people would in-migrate to the ROI. However, in-migration would only marginally affect population growth and would only require about 4% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and fewer than 5 local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Pike and Scioto Counties.

5.2.2.6 Ecology

Potential impacts to vegetation, wildlife, wetlands, and threatened and endangered species that could result from the construction of a conversion facility are described below. Additional information regarding wetlands and federally listed species can be found in Van Lonkhuyzen (2004).

5.2.2.6.1 Vegetation. Existing vegetation within the disturbed area would be destroyed during land clearing activities. Construction of a conversion facility at any of the three alternative locations at the Portsmouth site is not expected to threaten the local population of any species. Replanting disturbed areas with native species would

TABLE 5.2-7 Socioeconomic Impacts from Construction of the Conversion Facility at the Portsmouth Site

Impact Area	Construction Impacts[a]
Employment	
Direct	190
Total	290
Income (millions of 2002 $)	
Direct	5.3
Total	8.9
Population (no. of new ROI residents)	300
Housing (no. of units required)	110
Public finances (% impact on fiscal balance)	
Cities in Pike County[b]	0.3
Pike County	0.2
Schools in Pike County[c]	0.3
Cities in Scioto County[d]	0.2
Scioto County	0.2
Schools in Scioto County[e]	0.2
Public service employment (no. of new employees)	
Pike County	
Police officers	0
Firefighters	0
General	1
Physicians	0
Teachers	1
Scioto County	
Police officers	0
Firefighters	0
General	2
Physicians	0
Teachers	1
No. of new staffed hospital beds	
Pike County	1
Scioto County	1

[a] Impacts are shown for the peak year of construction (2005).

[b] Includes impacts that would occur in the cities of Waverly and Piketon.

[c] Includes impacts that would occur in Waverly and Pike County school districts.

[d] Includes impacts that would occur in the City of Portsmouth.

[e] Includes impacts that would occur in New Boston, Portsmouth, Wheelersburg, and Scioto County school districts.

comply with Executive Order 13148, *Greening the Government through Leadership in Environmental Management* (U.S. President 2000). Erosion of exposed soil at construction sites could reduce the effectiveness of restoration efforts and create sedimentation downgradient of the construction site. However, the implementation of standard erosion control measures, installation of storm water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts to vegetation. Deposition of fugitive dust resulting from construction activities could adversely affect vegetation; however, the use of control measures to reduce dust production could minimize impacts (see Section 5.2.2.3).

Constructing a facility at Location A, the preferred alternative, would result in the loss of about 10 acres (4 ha) of previously disturbed managed grassland and old field vegetation. The facility would not replace undisturbed natural communities. Managed grassland and old field communities comprise most of the vegetation on the Portsmouth site, within the Perimeter Road. The loss of 10 acres (4 ha) would, therefore, represent a minor decrease in these habitats on the Portsmouth site. This area represents about 38% of the area available at the 26-acre (11-ha) Location A. The total area of construction-related disturbance, however, would be approximately 65 acres (26 ha) in size. Although construction-related activities would primarily affect managed grassland and old field vegetation, impacts to the wooded areas at this location would also occur during the construction period. Construction of the conversion facility access road and rail lines would result in impacts to several wooded areas within Location A. These areas, east of Building X-744-S (and “C” Road), north of Building X-744-U, and northwest of Building X-744-T, primarily support sapling and mature black locust. Additional impacts to wooded areas could occur unless temporary construction areas, such as lay-down areas, were positioned outside Location A in adjacent, previously disturbed areas. If facility construction required the disturbance of all of Location A, the entire wooded area at this location, including the riparian forest community, would potentially be eliminated. Riparian forest represents only a small portion (only about 4%) of the Portsmouth site. The construction of utility lines, access roads, and rail lines would extend beyond Location A and would result in additional impacts to vegetation. Construction of rail lines west of Location A would primarily affect managed grassland vegetation. However, impacts to the riparian forest community along the intermittent stream might occur near the point of connection of the new rail line with the existing line east of Perimeter Road.

Construction at Location B would affect previously disturbed managed grassland vegetation. The type of vegetation community affected by construction would not depend on the positioning of the facility within this 46-acre (19-ha) location. However, impacts to vegetation in the western portion of this location would be small because buildings and paved areas are already located there. A facility 10 acres (4 ha) in size would occupy approximately 22% of the area available at this location. However, the total area expected to be disturbed would likely require the use of areas outside Location B for construction-related activities.

The vegetation communities affected by construction at Location C would depend on the placement of the facility within the 78-acre (32-ha) area; however, construction at Location C would not directly affect undisturbed natural communities. A facility 10 acres (4 ha) in size would occupy only 13% of the area available at this location. Facility construction would primarily affect previously disturbed managed grassland vegetation. The wooded areas in the west-central portion of Location C could be avoided by placing the facility in other areas of the location. Impacts to these wooded areas from construction-related activities could be avoided by positioning of the facility in the northern portion of Location C.

5.2.2.6.2 Wildlife. Wildlife would be disturbed by land clearing, noise, and human presence. Construction noise, up to 91.5 dB(A) at 15 m (50 ft), would disturb wildlife in the vicinity of the construction site during daylight construction hours. Wildlife with restricted mobility, such as burrowing species or juveniles of nesting species, would be destroyed during land clearing activities. More mobile individuals would relocate to adjacent available areas with suitable habitat. Population densities, and thus competition for food and nesting sites, would increase in these areas, potentially reducing the survivability or reproductive capacity of displaced individuals. Some wildlife species would be expected to recolonize replanted areas near the conversion facility following completion of construction. Construction of a conversion facility at any of the three locations is not expected to threaten the local population of any wildlife species because similar habitat would be available near the site.

Constructing a conversion facility at Location A would primarily impact those species commonly associated with managed grasslands and old field communities. Large areas of similar habitat would be available nearby. Construction would also affect the habitat of woodland species, such as neotropical migratory birds. Woodland habitat would be impacted by construction of the access roads and rail lines, and additional woodland habitat could be eliminated unless temporary construction areas were positioned outside Location A. However, the wooded areas that would be affected by rail line and access road construction are small and previously disturbed and do not represent a mature forest community. Similar habitat would be available nearby. The construction of the new rail line adjacent to the riparian woodland along the northern margin of Location A could limit the suitability of this habitat for some wildlife species. If facility construction required the disturbance of all of Location A, the entire wooded habitat at this location would potentially be eliminated. The construction of utility lines, access roads, and rail lines would extend beyond Location A and would result in additional impacts to wildlife habitat.

Constructing a conversion facility at Location B would affect the habitat of those species commonly associated with managed grasslands. Similar habitat would be abundant in areas near the Portsmouth site. Impacts to wildlife would be minimized in the western portion of Location B since buildings already exist there.

Facility construction at Location C would also affect the habitat of species associated with managed grasslands. However, similar habitat would be abundant in other areas of the Portsmouth site. Impacts to species associated with the open woodland areas in the west-central portion of Location C could be avoided by placing the facility in the northern portion of this location. Construction of a facility immediately adjacent to the woodlands could reduce the habitat's suitability for some wildlife species. However, the wooded areas that would be affected are small and previously disturbed and do not represent mature forest communities.

5.2.2.6.3 Wetlands. Wetlands could be affected by filling or draining during construction. Impacts to wetlands due to alteration of surface water runoff patterns, soil compaction, or groundwater flow could occur if the conversion facility was located immediately adjacent to wetland areas. Impacts to wetlands could be minimized, however, by maintaining a buffer area around them during facility construction. Executive Order 11990, *Protection of Wetlands* (U.S. President 1977a), requires federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial uses of wetlands. 10 CFR Part 1022 sets forth DOE regulations for implementing Executive Order 11990 as well as Executive Order 11988, *Floodplain Management* (U.S. President 1977b). Unavoidable impacts to wetlands that are within the jurisdiction of the USACE might require a CWA Section 404 Permit, which would trigger the requirement for a CWA 401 water quality certification from Ohio. An approved mitigation plan might be required prior to the initiation of construction.

Surface water sources are not expected to be used to meet water requirements during construction. Changes in groundwater as a result of withdrawing water for construction and the increase in the impermeable surface related to facility construction would be small to negligible (Section 5.2.2.4). Therefore, except for the potential local indirect impacts noted above, impacts to regional wetlands due to groundwater or surface water levels or flow patterns are not expected to occur.

Construction of a conversion facility at Location A would result in impacts to the small wetland located within the drainage channel in the east-central portion of this location (Figure 5.2-1). Construction of the south access road connecting to “C” Road would eliminate much of this wetland. Approximately 950 ft^2 (88 m^2) of palustrine emergent wetland would likely be eliminated by direct placement of fill material. In addition, portions of the facility fence line cross this wetland, and a small building would be adjacent to the wetland. Portions of this wetland that are not filled might be indirectly affected by an altered hydrologic regime because of the proximity of construction, possibly resulting in a decreased frequency or duration of inundation or soil saturation, and potential loss of hydrology necessary to sustain wetland conditions, which would result in likely changes to the wetland plant and animal communities. However, the impact may potentially be avoided by an alternative routing of the entrance road, or mitigation may be developed in coordination with the appropriate regulatory agencies. Placement of temporary construction areas outside Location A might be necessary to avoid additional impacts to this wetland. Construction of a conversion facility could also affect the hydrology of the intermittent stream along the northern margin of Location A. The increase in impervious surface and discharge of storm water runoff could result in a greater fluctuation in flows, with a greater amplitude in high flows and extended low flows within the stream. However, because the facility would not be located adjacent to the stream and only a small portion of the watershed would be involved, impacts would likely be small. Downstream wetlands could be affected by sedimentation during construction; however, the implementation of erosion control measures would reduce the likelihood of impacts. Direct impacts to the stream would occur if a storm water outfall structure was located within the streambed.

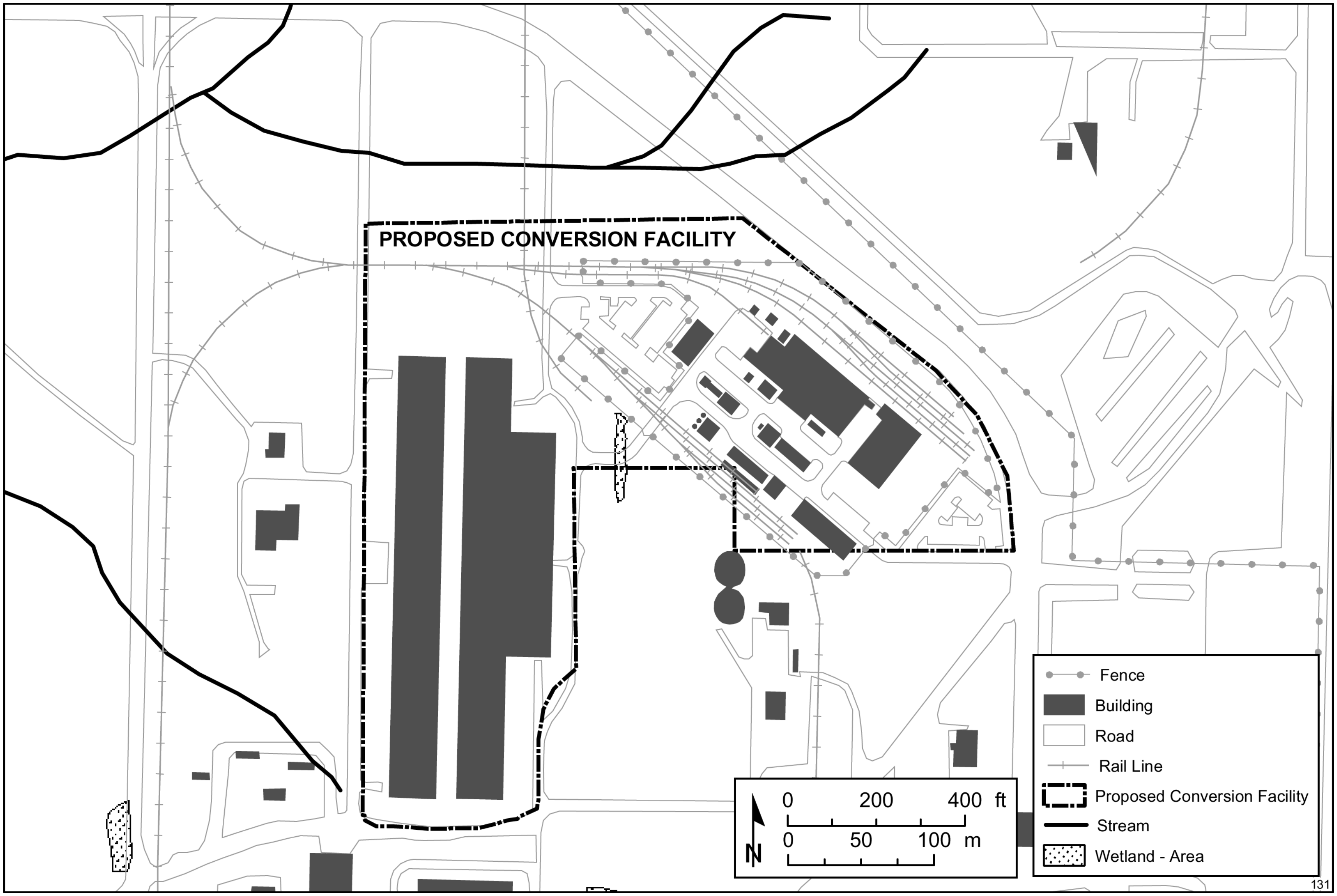

FIGURE 5.2-1 Wetlands within Location A at the Portsmouth Site

Construction of a facility at Location B would not result in direct impacts to wetlands. However, the hydrologic characteristics of wetlands in areas next to and south of this location could be indirectly affected by adjacent construction, possibly resulting in a decreased frequency or duration of inundation or soil saturation. Indirect impacts could be minimized by maintaining a buffer near adjacent wetlands. Downstream wetlands could be affected by sedimentation during construction; however, the implementation of erosion control measures would reduce the likelihood of sediment impacts.

Construction of a facility at Location C would not result in direct impacts to wetlands. However, the hydrologic characteristics of the wetland next to the northwest boundary of this location could be indirectly affected by adjacent construction, possibly resulting in a decreased frequency or duration of inundation or soil saturation. Indirect impacts could be minimized by maintaining a buffer near adjacent wetlands. Placement of a conversion facility next to the drainages along the western margin of Location C could alter the hydrology, including the X-230K Holding Pond, causing greater fluctuations in high and low flows. However, because only a small portion of the watershed would be involved, impacts would likely be small. Downstream wetlands could be affected by sedimentation during construction; however, the implementation of erosion control measures would reduce the likelihood of impacts.

5.2.2.6.4 Threatened and Endangered Species. Construction of a conversion facility at Location A is not expected to result in direct or indirect impacts to any federal- or state-listed species. However, impacts to wooded areas at Location A would occur as a result of the construction of facility access roads and rail lines, and additional woodland habitat could be eliminated unless temporary construction areas were positioned outside Location A. 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) for roosting during the summer. However, the wooded areas at Location A have not been identified as summer habitat. If facility construction required the disturbance of all of Location A, the entire wooded habitat at this location would potentially be eliminated. In addition, impacts to the riparian forest community along the intermittent stream might occur west of Location A, near the point of connection of the new rail line with the existing line east of Perimeter Road. If live or dead trees with exfoliating bark are encountered in construction areas, they should be saved if possible. If necessary, the trees should be cut before April 15 or after September 15. Disturbance due to increased noise, lighting, and human presence during the construction of the new rail line adjacent to the riparian forest habitat along the northern margin of Location A could decrease the quality of this habitat for the Indiana bat. However, Indiana bats that might use habitat near the Portsmouth site would be currently exposed to noise and other effects of human disturbance. Consequently, these effects related to construction activities would be expected to be minor.

Location B does not support habitat for federal- or state-listed species; therefore, construction at this location would not impact listed species. Although impacts to the woodland habitats at Location C could occur, these wooded areas have not been identified as Indiana bat summer habitat. In addition, impacts to the wooded areas at Location C could likely be avoided by facility placement in the northern portion of this location. Because of existing human disturbance in the vicinity of Locations A, B, and C, the construction of a conversion facility would not affect the quality of potential Indiana bat habitat along Little Beaver Creek, the Northwest Tributary Stream, or the wooded area east of the X-100 facility.

5.2.2.7 Waste Management

Potential waste management impacts at Portsmouth during construction were evaluated by determining the types and estimating the volumes of wastes that would be generated. Waste management impacts would not depend on the location of the conversion facility within the site and would therefore be the same for alternative Locations A, B, and C. The estimates are presented in Table 5.2-8 and are compared with projected site generation volumes.

Construction of the conversion facility would generate both hazardous and nonhazardous wastes. Hazardous waste would be sent to off-site permitted contractors for disposal. Nonhazardous waste would be disposed of off site at a state-permitted landfill. No radioactive waste would be generated during the construction phase. Overall, only minimal waste management impacts would result from the construction-generated wastes.

TABLE 5.2.8 Wastes Generated from Construction Activities for the Conversion Facility at the Portsmouth Site[a]

Waste Category	Volume
Hazardous waste	115 m^3
Nonhazardous waste	
Solids	700 m^3
Wastewater	3.8×10^6 L
Sanitary wastewater	1.1×10^7 L

[a] Total waste generated during a construction period of 2 years. Because data were not available for the UDS conversion facility, data developed for the DUF$_6$ PEIS (Dubrin et al. 1997) were used.

5.2.2.8 Resource Requirements

The resources required for facility construction would not be dependent on the location of the facility. Materials related to construction would include concrete, sand, gravel, steel, and other metals (Table 5.2-9). At this time, no unusual construction material requirements have been identified. The construction resources, except for those that could be recovered and recycled with current technology, would be irretrievably lost. None of the identified construction resources are in short supply, and all should be readily available in the local region.

Small to moderate amounts of specialty materials (i.e., Monel and Inconel) would be required for construction of the conversion facility in quantities that would not seriously reduce the national or world supply. This material would be used throughout the facilities and is used in the generation of HF in the conversion process. The autoclaves and conversion units (process reactors) are long-lead-time procurements with few qualified bidders. Many suppliers are available for the remainder of the equipment.

TABLE 5.2-9 Materials/Resources Consumed during Construction of the Conversion Facility at the Portsmouth Site

Materials/Resources	Total Consumption	Unit	Peak Demand	Unit
Utilities				
Water	4×10^6	gal	1,500	gal/h
Electricity	1,500	MWh	7.2	MWh/d
Solids				
Concrete	9,139	yd^3	NA[a]	NA
Steel	511	tons	NA	NA
Inconel/Monel	33	tons	NA	NA
Liquids				
Fuel	73,000	gal	250	gal/d
Gases				
Industrial gases (propane)	15,000	gal	50	gal/d

[a] NA = not applicable.

5.2.2.9 Land Use

The preferred location for the facility (Location A) covers 26 acres (10 ha) and presently features three structures on a site with more than 150 additional structures. Constructing a conversion facility at Location A would involve very slight modifications of existing land use. The resulting facility would be consistent with the heavy industrialized land use currently found at the Portsmouth site — a consequence of producing enriched uranium and its DUF_6 by-product. As a consequence, no land use impacts are anticipated as a result of constructing a conversion facility at Location A.

Use of either Location B or C considered for the conversion facility would have similar impacts. Location B is larger than the preferred location and covers about 50 acres (20 ha); it currently has two structures within its boundary. Location C also is larger than the preferred location, covering 78 acres (31 ha) and consisting of a grassy field. Land use impacts from construction on Location B would be very like those on Location A, with only slight modifications of existing land use. Land use impacts from construction on Location C would entail greater shifts in land use on the specific tract proposed, but within a site that already is heavily industrialized. In either case, the resulting facility would be consistent with current land use, and, as a result, negligible (for Location C) or no land use impacts are anticipated.

5.2.2.10 Cultural Resources

Construction could potentially impact cultural resources. Currently, the amount of data on cultural resources within the project area at Portsmouth (Locations A, B, and C) is not sufficient to determine whether or not the proposed construction would adversely affect significant resources. Consequently, the possibility of adverse effects on cultural resources cannot be excluded.

Archaeological and architectural surveys were undertaken for Portsmouth in 1996. The findings from these surveys have not been finalized and have not received concurrence from the Ohio SHPO. Past ground disturbance resulting from grading and construction make it unlikely that intact archaeological remains are present at the proposed alternative locations. Preliminary results from the 1996 archaeological survey suggest that these locations are too disturbed to warrant subsurface testing (Anderson 2002). However, unless these findings receive SHPO concurrence, a separate archaeological assessment of the proposed area for the construction would be required to ensure that cultural material is not present and that Section 106 obligations under the NHPA are met. If archaeological resources were encountered and determined to be significant, a mitigation plan would have to be developed and executed in consultation with the Ohio SHPO prior to construction. In general, mitigation of an adverse effect of facility construction on cultural resources could entail site avoidance, monitoring during construction, or excavation/data recovery.

Two of the alternative locations (A and B) include existing structures dating to the Cold War era. It is possible that these structures would be demolished or modified during construction of a new facility. The historical significance of these structures, if any, has yet to be determined. Location A includes three warehouses formerly used to store lithium hydroxide. Location B includes two structures (X-3346 and X-1107F) associated with the Gaseous Centrifuge Enrichment Plant complex. The historical significance of these structures and any other standing structures that would be affected by the proposed action should be evaluated prior to any modification or demolition with respect to their contribution to the significance of the Portsmouth GDP operations during the Cold War. Following the Section 106 consultation process, if these structures were determined to be historically significant, either individually or as contributing members of a historic district, appropriate mitigation activities (e.g., avoidance, data recovery, monitoring) would have to be determined in consultation with the Ohio SHPO and implemented before the facility could be constructed. Location C does not contain standing structures.

No Native American traditional cultural properties have been identified at Portsmouth to date. Government-to-government consultations with Native American groups have been initiated (Appendix G). If the proposed action would result in an adverse effect on any such property identified, appropriate mitigation as determined through continued consultation would have to be undertaken before construction could begin.

5.2.2.11 Environmental Justice

The evaluation of environmental justice impacts associated with construction is based on the identification of high and adverse impacts in other impact areas considered in this EIS, followed by a determination if those impacts would affect minority and low-income populations disproportionately. Analyses of impacts from conversion facility construction under the action alternatives do not indicate the presence of high and adverse impacts for any of the other impact areas considered in this EIS (see Sections 5.2.2.1 through 5.2.2.10). Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 mi (80 km) of the site, no environmental justice impacts from constructing the conversion facility are anticipated for Locations A, B, or C. Similarly, no evidence indicates that minority or low-income populations would experience high and adverse impacts from the proposed construction in the absence of such impacts in the population as a whole.

5.2.3 Portsmouth Site — Operational Impacts

This section discusses the potential environmental impacts during operation of a conversion facility at the three alternative locations within the Portsmouth site. During normal operations, the facility would emit only small amounts of contaminants through air emissions; no contaminated liquid effluents would be produced during the dry conversion process. The operational period would be 18 years, including conversion of the DUF_6 cylinders from ETTP. If the ETTP cylinders were not converted at Portsmouth, the operational period would be 14 years.

5.2.3.1 Human Health and Safety — Normal Facility Operations

5.2.3.1.1 Radiological Impacts. Radiological impacts to involved workers during normal operation of the conversion facility would result primarily from external radiation from the handling of depleted uranium materials. Impacts to noninvolved workers and members of the public would result primarily from trace amounts of uranium compounds released to the environment. Background information on radiation exposure is provided in Chapter 4; details on the methodologies are provided in Appendix F. Impacts to involved workers, noninvolved workers, and the general public would be similar for the three alternative locations.

Radiation exposures of the involved workers in the conversion facility were estimated on the basis of the measurement data on worker exposures in the Framatome ANP, Inc., facility in Richland, Washington. The Framatome facility uses a dry conversion process to convert UF_6 into uranium oxide and has been in operation since 1997. UDS would implement a similar conversion technology in the Portsmouth facility, and the key components would be similar to those of the Framatome ANP facility. Therefore, conditions for potential worker exposures at Portsmouth are expected to be similar to those at Framatome. However, the processing rate of uranium at Portsmouth (38 t [42 tons] of DUF_6 per day) would be greater than that at Framatome (9 t [10 tons] of UF_6 per day). To process more uranium materials, three conversion lines would be installed, and more workers or longer work hours from each worker would be required. On the other hand, the specific activity of the uranium materials handled at Framatome (about 3.5×10^6 pCi/g [Edgar 1994]) is greater than that of depleted uranium (about 4.0×10^5 pCi/g). Consequently, the total radiological activities contained in each key component at Portsmouth would be less than those at Framatome, resulting in a smaller radiation dose rate from each component at Portsmouth. Because the actual worker activities and the activity duration and frequencies are not available for the conversion facility at this time, using worker exposure data from the Framatome facility is expected to provide a reasonable estimate of the potential radiation exposures of the involved workers at the Portsmouth facility. According to UDS (2003a,b), the conversion process would be very automated; therefore, the requirement of working at close distances to radiation sources would be limited. Potential radiation exposures of workers would be monitored by a dosimetry program and would be kept below the regulatory limit. The implementation of ALARA practices would further reduce the potential of exposures.

Potential radiation exposures of the involved cylinder yard workers would result mainly from the following activities: (1) receiving and inspecting ETTP cylinders upon arrival and putting them into storage; (2) regularly maintaining cylinders at the storage yards, including the current inventory of both DUF_6 and non-DUF_6 cylinders and the ETTP cylinders; and (3) preparing and transferring cylinders to the conversion facility. The first activity could last up to 6 years (from 2004 up to December 2009, when all cylinders are required to have been removed from ETTP); however, for the purpose of analysis and to provide bounding estimates of annual impacts, it is assumed to last for only 2 years. The other two activities would last for about 18 years — the operation period of the conversion facility. Under the action alternatives, cylinder maintenance activities during the conversion period would most likely stay the same as those currently implemented, except that the number of depleted uranium cylinders maintained would decrease steadily from the starting level. Therefore, potential radiation exposures caused by maintenance activities were estimated by scaling the current cylinder yard exposure data.

Potential exposures resulting from transferring cylinders to the conversion facility were estimated by using the following assumptions: (1) retrieving each cylinder to transportation equipment would involve two workers each spending half an hour at a distance of 3 ft (1 m) from the cylinder, (2) inspecting a cylinder would require two workers each spending half an hour at a distance of 1 ft (0.30 m) from the cylinder, and (3) each transfer from the cylinder yard to the conversion facility would require two workers for about half an hour at a distance of 6 ft (2 m) from the cylinders. Similar assumptions were used for estimating potential radiation exposures from receiving and placing the ETTP cylinders in storage. After inspection, the cylinder would be transported to the designated cylinder yard for storage. In the cylinder yard, each cylinder would be placed into storage position by two workers. This would take about half an hour at an exposure distance of 3 ft (1 m). All the above assumptions were developed for the purpose of modeling potential radiation exposures; in actuality, inspection, preparation, and transferring activities would probably take less time and involve fewer workers. As a result, radiation doses estimated on the basis of these assumptions are conservative.

Noninvolved workers would be those who would work in the conversion facility but would not perform hands-on activities and those who would work elsewhere on the Portsmouth site. Depending on the location of the conversion facility, the location of the MEI would be different, and the associated radiation exposure might also vary. However, according to the previous analyses in the DUF_6 PEIS and the small uranium emission rate provided by UDS (2003b) for the conversion facility, potential radiation exposures of the noninvolved workers would be very small. An estimate of the bounding exposure, on the basis of the estimated maximum downwind air concentrations, is provided for the MEI in this section. According to the estimated bounding exposure, which is less than 6×10^{-6} mrem/yr, it is anticipated that the potential collective exposure of the noninvolved workers would also be very small and would be less than the product of the bounding MEI dose and the number of the noninvolved workers.

The location of the conversion facility within the Portsmouth site would have very little impact on collective exposures of the off-site public because of the much larger area (a circle with a radius of 50 mi [80 km]) considered for the collective exposures than the area of the Portsmouth site. The estimate of the collective exposure was obtained by using the emission rate (< 0.25 g/yr for uranium) provided in UDS (2003b) and the population distribution information obtained from the 2000 census. The actual location of the off-site public MEI would depend on the selected location of the conversion facility and the site boundary. The potential exposure would be bounded by the exposure associated with the maximum air concentrations, which are the same as those used for estimating the bounding exposure of the noninvolved worker MEI. The bounding exposure of the off-site public MEI would be greater than that of the noninvolved worker MEI because of the longer exposure duration (8,760 h/yr versus 2,000 h/yr) assumed for the off-site public than for the noninvolved workers, and because of consideration of the food ingestion pathway for the off-site public (see Appendix F for more detailed information).

As discussed in Chapter 1 and Appendix B, some portion of the DUF_6 inventory contains TRU and Tc contamination. The TRU materials and most of the Tc material are expected to remain in the emptied cylinders after the withdrawal of DUF_6. A small quantity of Tc might become vaporized and end up in the conversion process equipment, having been converted to technetium oxide. However, airborne emission of Tc is not anticipated because the oxide particles would be captured in the U_3O_8 product. The contribution to the potential external radiation exposures from these contaminants under normal operations were evaluated on the basis of bounding concentrations presented in Appendix B. The dose from these contaminants was estimated and compared with the dose from the depleted uranium and uranium decay products in the DUF_6. It is estimated that under normal operational conditions, the TRU and Tc contaminants would result in a very small contribution to the radiation doses — approximately 0.2% of the dose from the depleted uranium and its decay products.

Estimated potential annual radiation exposures and corresponding LCFs of the various receptors as a result of normal operations of the conversion facility are presented in Table 5.2-10 (impacts would be the same for all three alternative locations). The average individual dose for involved workers in the conversion facility is estimated to be about 75 mrem/yr (UDS 2003b). Collective exposures of the involved workers would depend on the number of workers required in the conversion facility. A total of about 135 involved workers would be required (UDS 2003b). The total collective exposure of the involved workers in the conversion facility would then be about 10.1 person-rem/yr. The estimated average cancer risk for individual workers would be about 3×10^{-5}/yr (1 chance in 33,000 of developing 1 LCF per year).

TABLE 5.2-10 Estimated Radiological Doses and Cancer Risks under Normal Conversion Facility Operations at the Portsmouth Site[a]

	Receptors					
	Involved Workers[b]		Noninvolved Workers[c]		General Public	
Location	Average Dose/Risk (mrem/yr) / (risk/yr)	Collective Dose/Risk (person-rem/yr) / (fatalities/yr)	MEI Dose/Risk[d] (mrem/yr) / (risk/yr)	Collective Dose/Risk (person-rem/yr) / (fatalities/yr)	MEI Dose/Risk[e] (mrem/yr) / (risk/yr)	Collective Dose/Risk[f] (person-rem/yr) / (fatalities/yr)
Radiation doses						
Conversion facility	75	10.1	$< 5.5 \times 10^{-6}$	$< 9.9 \times 10^{-6}$	$< 2.1 \times 10^{-5}$	6.2×10^{-5}
Cylinder yards[g]	510 – 600 (1180)	2.6 – 3.0 (9.4)	–[h]	–	–	–
Cancer risks						
Conversion facility	3×10^{-5}	4×10^{-3}	$< 3 \times 10^{-12}$	$< 5 \times 10^{-9}$	$< 1 \times 10^{-11}$	3×10^{-8}
Cylinder yards[g]	2×10^{-4} (5×10^{-4})	1×10^{-3} (4×10^{-3})	–	–	–	–

[a] Impacts are reported as best estimates or bounding values. They are the same regardless of the location of the conversion facility.

[b] Involved workers are those workers directly involved with handling radioactive materials. For the conversion facility, 135 involved workers were assumed. Calculation results are presented as average individual dose and collective dose for the worker population.

[c] Noninvolved workers include individuals who work at the conversion facility but are not directly involved in handling materials, and individuals who work at the Portsmouth site but not within the conversion facility. The population size of noninvolved workers is about 1,800.

[d] The noninvolved worker MEI doses are the bounding estimates corresponding to the estimated maximum downwind air concentrations. The exposures would result from inhalation, external radiation, and incidental soil ingestion.

[e] The general public MEI doses are the bounding estimates corresponding to the estimated maximum downwind air concentrations. The exposure would result from inhalation; external radiation; and ingestion of plant foods, meat, milk, and soil.

[f] Collective exposures were estimated for the population (about 670,000 persons) within a 50-mi (80 km) radius around the Portsmouth site. The exposure pathways considered were inhalation; external radiation; and ingestion of plant foods, meat, milk, and soil.

[g] Radiation exposures estimated for cylinder yard workers were obtained by considering maintenance, preparation, and transferring activities, with the assumption of a total of 5 workers every year. These exposures are expected to last for the entire conversion operation period. Results listed in parentheses include radiation exposures resulting from unloading, inspecting, and placing the ETTP cylinders into storage position, in addition to maintaining, preparing, and transferring cylinders. A total of 8 workers is assumed every year. These higher levels of exposures are assumed to last only for the first 2 years.

[h] A dash indicates that potential air emissions from cylinder maintenance or preparation activities are expected to be negligible. Therefore, no impacts were estimated for the noninvolved workers and the off-site general public.

The average individual dose for workers working at the cylinder yards would vary over the conversion period. For the first 2 years(based on the assumption discussed above), because of receiving, inspecting, and putting the ETTP cylinders into storage position, potential radiation exposures are expected to be greater than those in the following years. It is estimated that handling the arriving cylinders would result in a collective exposure of about 12.3 person-rem. The total person-hours estimated to be required for the handling activities is about 13,000. For the purpose of calculating an average individual exposure, a total of eight workers is assumed. The average individual exposure for the first 2 years is thus estimated to be about 1,180 mrem/yr. Beyond the first 2 years, it is judged that five workers would be sufficient to handle the planned activities. The average individual exposure for the remaining years is estimated to range from about 510 to 600 mrem/yr (the collective dose ranges from 2.5 to 3.0 person-rem/yr). The larger exposure corresponds to the third year of conversion operations, and the smaller exposure corresponds to the last year of operations. The estimated average doses for cylinder yard workers are well below the dose limit of 5,000 mrem/yr set for radiation workers (10 CFR Part 835). The corresponding latent cancer risk for an average worker would be about 5×10^{-4} per year (1 chance in 2,000 of developing 1 LCF per year) or less. UDS has proposed 28 workers for cylinder management activities (UDS 2003b); therefore, the actual average dose to individual workers is likely to be less than the above estimated values.

Because of the small airborne release rates of depleted uranium during normal operations, potential radiation exposures of the noninvolved workers would be very small regardless of where the conversion facility was located within the Portsmouth site. The radiation dose incurred by the MEI was modeled to be less than 6.0×10^{-6} mrem/yr. This small radiation dose would correspond to potential excess latent cancer risks of less than 3×10^{-12} per year (1 chance in 330 billion of developing 1 LCF per year). For comparison, the dose limit set for airborne releases from operations of DOE facilities is 10 mrem/yr (40 CFR 61).

Radiation exposures of the off-site public also would be very small regardless of the location of the conversion facility. The MEI dose was modeled to be less than 3.0×10^{-5} mrem/yr. This dose is much less than the radiation dose limits of 100 mrem/yr (DOE 1990) from all pathways and 10 mrem/yr (40 CFR Part 61) from airborne pathways set to protect the general public from operations of DOE facilities. The corresponding latent cancer risk would be less than 1×10^{-11} per year (1 chance in 100 billion of developing 1 LCF per year). Because of no waterborne discharge of uranium (UDS 2003b), radiation exposure to the off-site public from using surface water near the facility would be negligible.

5.2.3.1.2 Chemical Impacts. Potential chemical impacts to human health from normal operations at the conversion facility would result primarily from exposure to trace amounts of the insoluble uranium compound U_3O_8 and to HF released from the process exhaust stack. Risks from normal operations were quantified on the basis of calculated hazard indices. General information concerning the chemical impact analysis methodology is provided in Chapter 4.

The hazard indices were calculated on the basis of air dispersion modeling, which identified the locations of maximum ground-level concentrations of uranium compounds and HF emitted from the conversion facility. Since the maximum concentration locations were used for modeling both noninvolved worker and general public exposures, the impacts would be the same for the three alternative locations assessed.

Conversion to U_3O_8 would result in very low levels of exposure to hazardous chemicals. No adverse health effects to noninvolved workers or the general public are expected during normal operations. Human health impacts resulting from exposure to hazardous chemicals during normal operations of the conversion facilities are estimated as hazard indices of 3.8×10^{-7} and 4.1×10^{-5} for the noninvolved worker and general public MEI, respectively. The hazard indices for the conversion process would be at least three orders of magnitude lower than the hazard index of 1, which is the level at which adverse health effects might be expected to occur in some exposed individuals.

Impacts to involved workers from exposure to chemicals during normal operations are not expected. The workplace would be monitored to ensure that airborne chemical concentrations were within applicable health standards that are protective of human health and safety. If planned work activities were likely to expose involved workers to chemicals, workers would be provided with appropriate protective equipment, as necessary.

5.2.3.2 Human Health and Safety — Facility Accidents

A range of accidents covering the spectrum from high-frequency/low-consequence events to low-frequency/high-consequence accidents was considered for DUF_6 conversion operations. The accident scenarios considered such events as releases due to cylinder damage, fires, plane crashes, equipment leaks and ruptures, hydrogen explosions, earthquakes, and tornadoes. The accident scenarios considered in the assessment were those identified in the DUF_6 PEIS (DOE 1999a), modified to take into account the specific conversion technology and facility design proposed by UDS (UDS 2003b; Folga 2003). A list of bounding radiological and chemical accidents – that is, those accidents expected to result in the highest consequences in each frequency category should the accident occur – for the UDS conversion facility is provided in UDS (2003b). The bounding accident scenarios and their estimated consequences are discussed below for both radiological and chemical impacts.

5.2.3.2.1 Radiological Impacts. Potential radiation doses from accidents were estimated for noninvolved workers at the Portsmouth site and members of the public within a 50-mi (80-km) radius of the site for both MEIs and the collective populations. 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.

Table 5.2-11 lists the bounding accidents in each frequency category (i.e., the accidents that were found to have the highest consequences) for radiological impacts. The estimated

TABLE 5.2-11 Bounding Radiological Accidents Considered for Conversion Operations at the Portsmouth Site[a]

Accident Scenario	Accident Description	Chemical Form	Amount (lb)	Duration (min)	Release Level[b]
Likely Accidents (frequency: 1 or more times in 100 years)					
Corroded cylinder spill, dry conditions	A 1-ft (0.30 m) hole results during handling, with solid UF_6 forming a 4-ft^2 (0.37-m^2) area on the dry ground.	UF_6	24	60	Ground
U_3O_8 drum spill	A single U_3O_8 drum is damaged by a forklift and spills its contents onto the ground outside the storage facility.	U_3O_8	2.4	30	Ground
Extremely Unlikely Accidents (frequency: 1 time in 10,000 years to 1 time in 1 million years)					
Earthquake	The U_3O_8 storage building is damaged during a design-basis earthquake, and 10% of the stored containers are breached.	U_3O_8	135	30	Stack
Rupture of cylinders – fire	Several cylinders hydraulically rupture during a fire.	UF_6	0 11,500 8,930 3,580	0–12 12 12–30 30–121	Ground
Tornado	A windblown missile from a design-basis tornado pierces a single U_3O_8 container in the storage building.	U_3O_8	1,200	0.5	Ground

[a] Potential accidents in the unlikely and incredible frequency categories would not result in radiological releases, but they are considered in the chemical assessment. The accident assessment considered a spectrum of accidents in four categories: likely, unlikely, extremely unlikely, and incredible.

[b] Ground-level releases were assumed to occur outdoors on concrete pads in the cylinder storage yards. To prevent contaminant migration, cleanup of residuals was assumed to begin immediately after the release was stopped.

radiation doses to members of the public and noninvolved workers (both MEIs and collective populations) for these accidents are presented in Table 5.2-12. The corresponding risks of LCFs associated with the estimated doses for these accidents are given in Table 5.2-13. The doses and risks are presented as ranges (minimum and maximum) because two different atmospheric conditions were considered for each accident. The estimated doses and LCFs were calculated on the basis of the assumption that the accidents would occur, without taking into account the probability of the accident's occurring. The probability of occurrence for each accident is indicated by the frequency category to which it is assigned. For example, accidents in the extremely unlikely category have an estimated probability of occurrence of between 1 in 10,000 and 1 in 1 million per year.

TABLE 5.2-12 Estimated Radiological Doses per Accident Occurrence during Conversion at the Portsmouth Site[a]

		Maximum Dose				Minimum Dose			
		Noninvolved Workers		General Public		Noninvolved Workers		General Public	
Conversion Product/Accident[b]	Frequency Category[c]	MEI (rem)	Population[d] (person-rem)	MEI (rem)	Population (person-rem)	MEI (rem)	Population[d] (person-rem)	MEI (rem)	Population (person-rem)
Corroded cylinder spill, dry conditions	L	7.8×10^{-2}	1.1/1.4/1.1	7.8×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	$(4.4/5.6/4.6) \times 10^{-2}$	3.3×10^{-3}	1.9×10^{-2}
Failure of U_3O_8 container while in transit	L	5.3×10^{-1}	7.3/9.6/7.4	5.3×10^{-1}	5.1×10^{-1}	2.3×10^{-2}	$(3.0/3.8/3.1) \times 10^{-1}$	2.3×10^{-2}	1.2×10^{-1}
Earthquake	EU	30	$(4.0/5.3/4.3) \times 10^{2}$	30	30	1.2	$(1.7/2.1/1.8) \times 10^{-1}$	1.1	6.5
Rupture of cylinders – fire	EU	2.0×10^{-2}	3.9/3.3/5.1	2.0×10^{-2}	23	3.7×10^{-3}	$(2.4/2.5/6.1) \times 10^{-1}$	3.7×10^{-3}	7.3×10^{-1}
Tornado[e]	EU	7.5	100/130/110	7.5	17	7.5	100/130/110	7.5	17

[a] Maximum and minimum doses reflect differences in meteorological conditions at the time of the accident. In general, maximum doses would occur under meteorological conditions of F stability with a 1-m/s (2-mph) wind speed, whereas minimum doses would occur under D stability with a 4-m/s (9-mph) wind speed.

[b] The bounding accident chosen to represent each frequency category is the one that would result in the highest dose to the general public MEI. Health impacts in that row represent that accident only and not the range of impacts among accidents in that category. Absence of an accident in a certain frequency category indicates that the accident would not result in a release of radioactive material.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr).

[d] For the noninvolved worker population dose, three estimates are provided, corresponding to Locations A, B, and C within the Portsmouth site.

[e] Meteorological conditions analyzed for the tornado were D stability with a 20-m/s (45-mph) wind speed.

TABLE 5.2-13 Estimated Radiological Health Risks per Accident Occurrence during Conversion at the Portsmouth Site[a]

		Maximum Risk[d] (LCFs)				Minimum Risk[d] (LCFs)			
		Noninvolved Workers		General Public		Noninvolved Workers		General Public	
Conversion Product/Accident[b]	Frequency Category[c]	MEI	Population[d]	MEI	Population	MEI	Population[d]	MEI	Population
Corroded cylinder spill, dry conditions	L	3×10^{-5}	$(0.4/1/0.2) \times 10^{-3}$	3×10^{-5}	3×10^{-5}	1×10^{-6}	$(2/3/2) \times 10^{-5}$	1×10^{-6}	9×10^{-6}
U_3O_8 drum spill	L	2×10^{-4}	$(3/7/2) \times 10^{-3}$	3×10^{-4}	3×10^{-4}	9×10^{-6}	$(1/2/2) \times 10^{-4}$	1×10^{-5}	6×10^{-5}
Earthquake	EU	2×10^{-2}	$(2/2/2) \times 10^{-1}$	2×10^{-2}	2×10^{-2}	4×10^{-4}	$(8/10/9) \times 10^{-3}$	5×10^{-4}	3×10^{-3}
Rupture of cylinders – fire	EU	8×10^{-6}	$(4/3/3) \times 10^{-3}$	8×10^{-6}	1×10^{-2}	1×10^{-6}	$(1/1/3) \times 10^{-4}$	1×10^{-6}	5×10^{-4}
Tornado[e]	EU	3×10^{-3}	$(5/6/5) \times 10^{-2}$	4×10^{-3}	8×10^{-3}	3×10^{-3}	$(5/6/5) \times 10^{-1}$	4×10^{-3}	8×10^{-3}

[a] Maximum and minimum risks reflect differences in meteorological conditions at the time of the accident. In general, maximum risks would occur under meteorological conditions of F stability with a 1-m/s (2-mph) wind speed; minimum risks would occur under D stability with a 4-m/s (9-mph) wind speed. Values shown are the consequences if the accident did occur. The risk of an accident is the consequence (LCFs) times the estimated frequency times 18 years of operations.

[b] The bounding accident chosen to represent each frequency category is the one that would result in the highest risks to the general public MEI. Health impacts in that row represent that accident only and not the range of impacts among accidents in that category. Absence of an accident in a certain frequency category indicates that the accident would not result in a release of radioactive material.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations ($10^{-4} – 10^{-6}$/yr).

[d] For the noninvolved worker population dose, three estimates are provided, corresponding to Locations A, B, and C within the Portsmouth site.

[e] Meteorological conditions analyzed for the tornado were D stability with a 20-m/s (45-mph) wind speed.

The accident assessment took into account the three alternative locations within the Portsmouth site. Because of the close proximity of the alternative locations to the site boundary and the uncertainty associated with both the wind direction at the time of the accident and the exact location of the release point, it was conservatively assumed that both the noninvolved worker MEI and the general public MEI would be located 328 ft (100 m) from accidents with a ground-level release. For accidents with the potential for plume rise due to a fire or for releases from a stack, both the worker and public MEIs were assumed to be located at the point of maximum ground-level concentrations of the released contaminants. As discussed in Chapter 4, the noninvolved worker MEI was assumed to be exposed to the passing plume for 2 hours after the accident, after which time he or she would be evacuated; the public MEI was assumed to remain indefinitely in the path of the passing plume and consume contaminated food grown on site.

The estimated doses and risks to the noninvolved worker and public MEIs are presented in Tables 5.2-12 and 5.2-13. The estimated impacts to the noninvolved worker MEI and public MEI are similar because 99% of the dose is due to the inhalation pathway within the first 2 hours after the accident.

For the off-site public, the location of the conversion facility within the Portsmouth site would have very little impact on collective exposures because the area considered (a circle with a radius of 80 km [50 mi]) would be so much larger than the area of the Portsmouth site. The population dose estimates are based on population distributions from the 2000 census. The collective dose to noninvolved workers, however, would depend on the location of the conversion facility with respect to other buildings within the site. Therefore, for the noninvolved worker population, three estimates are provided in Tables 5.2-12 and 5.2-13, corresponding to Locations A, B, and C within the site.

The postulated accident estimated to have the largest consequence is the extremely unlikely accident caused by an earthquake involving the conversion facility. In this scenario, it is assumed that the U_3O_8 storage building would be damaged during the earthquake and that 10% of the stored containers would be breached. Under conservative meteorological conditions (F stability class with a 1-m/s [2-mph] wind speed) expected to result in the highest possible exposures, it is estimated that the dose to the MEI member of the public and noninvolved worker from this accident would be approximately 30 rem, if it is assumed that the product storage building contained 6 month’s worth of production. The RFP for conversion services required the bidders to provide enough capacity to be able to store up to 6 month’s worth of inventory on site. The estimated MEI doses are well below levels expected to cause immediate fatalities from radiation exposure (approximately 450 rem) and would result in a lifetime increase in the probability of developing an LCF of about 0.02 (about 1 chance in 50) in the public MEI and about 0.02 (about 1 chance in 50) in the worker MEI.

It is estimated that the collective doses from the U_3O_8 storage building earthquake accident would be 400 to 530 person-rem to the worker population and 30 person-rem to the off-site general population. These collective doses would result in less than 1 additional LCF in the worker population (0.2 LCF) and in the general population (0.02 LCF).

The accident scenario with the second-highest impacts was the extremely unlikely scenario caused by a tornado strike. In this scenario, it is assumed that a windblown missile from a tornado would pierce a single U_3O_8 container in storage. In this hypothetical accident, if bulk bags were used to transport and dispose of the U_3O_8 product, approximately 1,200 lb (550 kg) of U_3O_8 could be released at ground level. Under conservative meteorological conditions, it is estimated that the dose to the MEI and noninvolved worker would be 7.5 rem. The collective doses would be up to 130 person-rem to the worker population and up to 17 person-rem to the general population. If the emptied cylinders rather than the bulk bags were used as U_3O_8 containers, the resulting doses would be approximately half of the above results.

To account for the possible TRU and Tc contamination in some of the cylinders, a ratio of the dose from the TRU and Tc radionuclides at bounding maximum concentrations to the dose from the depleted uranium was calculated (see Appendix B for details). For accidents involving full DUF_6 cylinders, the relative dose contribution from TRU and Tc was found to be less than 0.02% of the dose from the depleted uranium. This approach is conservative because only a fraction of the cylinders in the inventory are contaminated with TRU and because it is expected that the concentration in any one cylinder would be less than the bounding concentrations assumed in the analysis.

The following conclusions may be drawn from the radiological health impact results:

- No cancer fatalities are predicted for any of the accidents.

- The maximum radiological dose to the noninvolved worker and general public MEIs (assuming that an accident occurred) would be about 30 rem. This dose would thus be greater than the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents (DOE 2000c). Therefore, more detailed analysis during facility design and siting may be necessary.

- The overall radiological risk to noninvolved worker and general public MEI receptors (estimated by multiplying the risk per occurrence [Table 5.2-13] by the annual probability of occurrence by the number of years of operations) would be less than 1 for all of the conversion facility locations.

- The differences in noninvolved worker population impacts among the three locations would be relatively small.

5.2.3.2.2 Chemical Impacts. This section presents the results for chemical health impacts for the highest-consequence accident in each frequency category for conversion operations at the Portsmouth site. The estimated numbers of adverse and irreversible adverse effects among noninvolved workers and the general public were calculated separately for each of the three alternative locations within the site by using 2000 census data for the off-site population. The methodology and assumptions used in the calculations are summarized in Appendix F, Section F.2.

The bounding conversion facility chemical accidents are listed in Table 5.2-14 and cover events that could occur during conversion. Note that an anhydrous NH_3 tank rupture is one of the bounding chemical accidents and the accident expected to cause the greatest impacts. NH_3 is used to produce hydrogen required for the conversion process. Although the use of NH_3 for hydrogen production is part of the UDS facility design, the use of natural gas for hydrogen production, which would eliminate the need for NH_3, is also possible.

The consequences from accidental chemical releases derived from the accident consequence modeling for conversion are presented in Tables 5.2-15 and 5.2-16. The results are presented as the number of people with the potential for (1) adverse effects and (2) irreversible adverse effects. Within each frequency category, the tables present the results for the accident that would affect the largest number of people (total of workers and off-site population). The numbers of noninvolved workers and members of the off-site public represent the impacts if the associated accident occurred. The accident scenarios given in Tables 5.2-15 and 5.2-16 are not identical because an accident with the largest impacts for adverse effects might not lead to the largest impacts for irreversible adverse effects.

The impacts may be summarized as follows:

- The largest impacts would be caused by the following accident scenarios: an HF storage tank rupture; a corroded cylinder spill under wet conditions (i.e., rain and formation of a water pool); an NH_3 tank rupture; and the rupture of several cylinders in a fire. Accidents involving stack emissions would have smaller impacts compared with accidents involving releases at ground level because of the relatively larger dilution and smaller release rates (due to filtration) involved with the stack emissions.

- If the accidents identified in Tables 5.2-15 and 5.2-16 did occur, the number of persons in the off-site population with the potential for adverse effects would range from 0 to around 2,300 (maximum corresponding to an HF tank rupture), and the number of off-site persons with the potential for irreversible adverse effects would range from 0 to around 210 (maximum corresponding to an NH_3 pressurized tank rupture).

- The maximum number of adverse effects among noninvolved workers would occur for Location B for most accident scenarios. For the general public, maximum impacts may occur at Locations A or C, depending on the specific scenario; however, the differences are relatively small among the three locations.

- The greatest number of irreversible adverse effects among the noninvolved workers would occur at Location C for most scenarios and at Location B for the NH_3 tank rupture. Among members of the public, impacts are very similar for all three locations.

TABLE 5.2-14 Bounding Chemical Accidents during Conversion Operations at the Portsmouth Site

Frequency Category/ Accident Scenario	Accident Description	Chemical Form of Release	Release Amount (lb)	Release Duration (min)	Release Level/ Medium
Likely Accidents (frequency: 1 or more times in 100 years)					
Corroded cylinder spill, dry conditions	A 1-ft (0.30-m) hole results during handling, with solid UF_6 forming a 4-ft^2 (0.37-m^2) area on the dry ground.	UF_6	24	60	Ground/ air
Unlikely Accidents (frequency: 1 in 100 years to 1 in 10,000 years)					
Corroded cylinder spill, wet conditions – rain	A 1-ft (0.30-m) hole results during handling, with solid UF_6 forming a 4-ft^2 (0.37-m^2) area on the wet ground.	HF	96	60	Ground/ air
Aqueous HF pipe rupture	An earthquake ruptures an aboveground pipeline transporting aqueous HF, releasing it to the ground.	HF	910[a]	10	Ground/ air
Anhydrous NH_3 line leak	An NH_3 fill line is momentarily disconnected, and NH_3 is released at grade.	NH_3	255	1	Ground/ air
Extremely Unlikely Accidents (frequency: 1 in 10,000 years to 1 in 1 million years)					
Corroded cylinder spill, wet conditions – water pool	A 1-ft (0.30-m) hole results during handling, with solid UF_6 forming a 4-ft^2 (0.37-m^2) area into a 0.25-in. (0.64-cm)-deep water pool.	HF	147	60	Ground/ air
Rupture of cylinders – fire	Several cylinders hydraulically rupture during a fire.	UF_6	0 11,500 8,930 3,580	0 to 12 12 12 to 30 30 to 121	Ground/ air
Incredible Accidents (frequency: less than 1 in 1 million years)					
Aqueous HF (70%) tank rupture	Large seismic or beyond-design-basis event causes rupture of a filled HF storage tank.	HF	F1: 8,710[b] D4: 25,680[b]	120	Ground/ air
Anhydrous NH_3 tank rupture	Large seismic or beyond-design-basis event causes rupture of a filled anhydrous NH_3 storage tank.	NH_3	29,500	20	Ground/ air

[a] The estimate assumes that 10% of the spill evaporates, with the remainder absorbed into the soil. It should be noted that the soil/groundwater assessment conservatively assumed that 100% of the spill is absorbed into the soil.

[b] The two separate atmospheric conditions considered would cause different amounts to be released. These release amounts were computed based on evaporation rates estimated by assuming 77°F (25°C; F-1 conditions) and 95°F (35°C; D-4 conditions).

TABLE 5.2-15 Consequences of Chemical Accidents during Conversion at the Portsmouth Site: Number of Persons with the Potential for Adverse Effects[a]

		Maximum No. of Persons per Location[d]												Minimum No. of Persons per Location[d]											
		Noninvolved Worker						General Public						Noninvolved Workers						General Public					
		MEI[e]			No. Affected			MEI[e]			No. Affected			MEI[e]			No. Affected			MEI[e]			No. Affected		
Accident[b]	Freq. Cat.[c]	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Corroded cylinder spill, dry conditions	L	Yes	Yes	Yes	4	22	48	No	No	Yes[f]	0	0	0	Yes	Yes	Yes	0	0	0	No	No	No	0	0	0
Corroded cylinder spill, wet conditions – rain	U	Yes	Yes	Yes	490	480	480	Yes	Yes	Yes	13	13	14	Yes	Yes	Yes	0	14	0	No	No	No	0	0	0
Rupture of cylinders – fire	EU	Yes	Yes	Yes	540	660	450	Yes	Yes	Yes	650	600	570	Yes	Yes	Yes	110	110	160	Yes	Yes	Yes	5	5	5
HF tank rupture	I	Yes	Yes	Yes	660	920	330	Yes	Yes	Yes	2,200	2,000	2,300	Yes	Yes	Yes	600	800	330	Yes	Yes	Yes	29	30	33
NH_3 tank rupture	I	Yes	Yes	Yes	810	1,400	1,100	Yes	Yes	Yes	1,700	1,500	1,500	Yes	Yes	Yes	580	880	850	Yes	Yes	Yes	21	21	24

[a] Values shown are the consequences if the accident did occur. The risk of an accident is the consequence (number of persons) times the estimated frequency, times 18 years of operations. The estimated frequencies are as follows: L = likely, 0.1; U = unlikely, 0.001; EU = extremely unlikely, 0.00001; I = incredible, 0.000001.

[b] The bounding accident chosen to represent each frequency category is the one in which the largest number of people (workers plus off-site population) would be affected. Health impacts in that row represent that accident only and not the range of impacts among accidents in that category.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations ($> 10^{-2}$/yr); U = unlikely, estimated to occur between once in 100 years and once in 10,000 years of facility operations (10^{-2} to 10^{-4}/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr); I = incredible, estimated to occur less than one time in 1 million years of facility operations ($< 10^{-6}$/yr).

[d] Maximum and minimum values reflect differences in assumed meteorological conditions at the time of the accident. In general, the maximum risks would occur under meteorological conditions of F stability with a 1-m/s (2-mph) wind speed; the minimum risks would occur under D stability with a 4-m/s (9-mph) wind speed.

[e] At the MEI location, the determination is either “Yes” or “No” for potential adverse effects to an individual.

[f] MEI locations were evaluated at 100 m (328 ft) from ground-level releases for workers and at the location of highest off-site concentration for members of the general public; the population risks are 0 because the worker and general public population distributions for the site were used, which did not show receptors at the MEI locations.

TABLE 5.2-16 Consequences of Chemical Accidents during Conversion at the Portsmouth Site: Number of Persons with the Potential for Irreversible Adverse Effects[a]

		Maximum No. of Persons per Location[d]												Minimum No. of Persons per Location[d]											
		Noninvolved Worker						General Public						Noninvolved Workers						General Public					
		MEI[e]			No. Affected			MEI[e]			No. Affected			MEI[e]			No. Affected			MEI[e]			No. Affected		
Conversion Product/Accident[b]	Freq. Cat.[c]	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Conversion to U$_3$O$_8$																									
Corroded cylinder spill, dry conditions	L	Yes[f]	Yes	Yes	0	0	0	No	No	No	0	0	0	Yes	Yes	Yes	0	0	0	No	No	No	0	0	0
Corroded cylinder spill, wet conditions – rain	U	Yes	Yes	Yes	97	120	130	Yes	Yes	Yes	0	0	0	Yes	Yes	Yes	0	0	0	No	No	No	0	0	0
Corroded cylinder spill, wet conditions – water pool	EU	Yes	Yes	Yes	170	170	190	Yes	Yes	Yes	0	0	1	Yes	Yes	Yes	0	0	0	No	No	No	0	0	0
NH$_3$ tank rupture[g]	I	Yes	Yes	Yes	810	1,400	1,100	Yes	Yes	Yes	200	210	210	Yes	Yes	Yes	400	370	50	Yes	Yes	Yes	2	2	4

[a] The values shown are the consequences if the accident did occur. The risk of an accident is the consequence (number of persons) times the estimated frequency, times 18 years of operations. The estimated frequencies are as follows: L = likely, 0.1; U = unlikely, 0.001; EU = extremely unlikely, 0.00001; I = incredible, 0.000001.

[b] The bounding accident chosen to represent each frequency category is the one in which the largest number of people (workers plus off-site population) would be affected. Health impacts in that row represent that accident only and not the range of impacts among accidents in that category.

[c] Accident frequencies: L = likely, estimated to occur one or more times in 100 years of facility operations (> 10^{-2}/yr); U = unlikely, estimated to occur between once in 100 years and once in 10,000 years of facility operations (10^{-2} to 10^{-4}/yr); EU = extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years of facility operations (10^{-4} to 10^{-6}/yr); I = incredible, estimated to occur less than one time in 1 million years of facility operations (< 10^{-6}/yr).

[d] Maximum and minimum values reflect differences in assumed meteorological conditions at the time of the accident. In general, the maximum risks would occur under meteorological conditions of F stability with a 1-m/s (2-mph) wind speed; the minimum risks would occur under D stability with a 4-m/s (9-mph) wind speed.

[e] At the MEI location, the determination is either “Yes” or “No” for potential adverse effects to an individual.

[f] MEI locations were evaluated at 100 m (328 ft) from ground-level releases for workers and at the location of highest off-site concentration for members of the general public; the population risks are 0 because the worker and general public population distributions for the site were used, which did not show receptors at the MEI locations.

[g] Under D-stability, 4-m/s (9-mph) meteorological conditions (minimum no. of persons affected), an aqueous HF tank rupture would have higher consequences to noninvolved workers than would the NH$_3$ tank rupture, resulting in about 150 to 200 more irreversible adverse effects at all three proposed locations. However, under F-stability, 1-m/s (2-mph) meteorological conditions (maximum no. of persons affected), the NH$_3$ tank rupture would have the maximum consequences to noninvolved workers and the general public.

- If the accidents identified in Tables 5.2-15 and 5.2-16 did occur, the number of noninvolved workers with the potential for adverse effects would range from 0 to around 1,400 (maximum corresponding to an NH_3 tank rupture), and the number of noninvolved workers with the potential for irreversible adverse effects would range from 0 to around 1,400 (maximum also corresponding to an NH_3 tank rupture).

- For the most severe accidents in each frequency category, the noninvolved worker MEI and the public MEI would have the potential for both adverse effects and irreversible adverse effects. The likely accidents for each conversion option (frequency of more than 1 chance in 100 per year) would result in no potential adverse or irreversible adverse effects for the general public.

- The maximum risk was computed as the product of the consequence (number of people) times the frequency of occurrence (occurrences per year) times the number of years of operations (18 years). These risk values are conservative because the numbers of people affected were based on the following assumptions: (1) occurrence of very low wind speed and moderately stable meteorological conditions that would result in the maximum reasonably foreseeable plume size (i.e., F stability and a 1-m/s [2-mph] wind speed) and (2) steady or nonmeandering wind direction, lasting up to 3 hours and blowing toward locations that would lead to the maximum number of individuals exposed for noninvolved workers or for the general population. The results indicate that the maximum risk values would be less than 1 for all accidents except the following:

  – *Potential Adverse Effects:*
  Corroded cylinder spill, dry conditions (L, likely), workers
  Assuming the accident occurred once every 10 years, 7, 40, and 90 workers would potentially experience adverse effects at Locations A, B, and C, respectively, over the entire 18-year operational period.
  Corroded cylinder spill, wet conditions – rain (U, unlikely), workers
  Assuming the accident occurred once every 1,000 years (frequency = 10^{-3}/yr), about 9 workers would potentially experience adverse effects over the 18-year operational period at any of the three alternative locations.

  – *Potential Irreversible Adverse Effects:*
  Corroded cylinder spill, wet conditions – rain (U, unlikely), workers
  Assuming the accident occurred once every 1,000 years (frequency = 10^{-3}/yr), about 2 workers would potentially experience an irreversible adverse health effect over the 18-year operational period at all three locations.

The number of fatalities that could potentially be associated with the estimated irreversible adverse effects was also calculated. Previous analyses indicated that exposure to HF and uranium compounds, if sufficiently high, could result in death to 1% or fewer of the persons experiencing irreversible adverse effects (Policastro et al. 1997). Similarly, it was estimated that exposure to NH_3 could result in death to about 2% of the persons experiencing irreversible adverse effects (Policastro et al. 1997). Therefore, if the corroded cylinder spill, wet conditions – rain accident occurred (Table 5.2-16), about one fatality might be expected among the noninvolved workers at any of the three locations: A, B, or C. However, this accident is classified as an unlikely accident, meaning that it is estimated to occur between once in 100 years and once in 10,000 years of facility operation. Assuming that it would occur once every 1,000 years, the risk of fatalities among the noninvolved workers from this accident over the 18-year operational period would be less than 1 ($1 \times 0.0001 \times 18 = \approx 0.02$). (See Section 4.3 for discussion on the interpretation of risk numbers that are less than 1.)

Similarly, if the higher-consequence accident in the extremely unlikely frequency category (corroded cylinder spill, wet conditions – water pool) in Table 5.2-16 occurred, approximately 2 fatalities might be expected among the noninvolved workers, irrespective of the location chosen. However, because of the low frequency of this accident, the risk of a fatality over the lifetime of the conversion facility would be about 0.0004, assuming a frequency of 0.00001 per year.

For the NH_3 tank rupture accident, which belongs to the incredible frequency category (frequency of less than 0.000001 per year), the expected numbers of fatalities among the noninvolved workers would be about 16, 28, and 22 for Locations A, B, and C, respectively. However, the risk of a fatality would be much less than 1 at any of the locations (0.0001 at Location A, 0.0003 at Location B, and 0.0002 at Location C, assuming a frequency of 5×10^{-7} per year) over the facility lifetime. Among the general public, 4 fatalities might be expected if the same accident occurred. However, because of the low frequency of the accident, the risk of fatalities would be much less than 1 (about 0.00004).

Even though the risks are relatively low, the consequences for a few of the accidents are considered to be high. These high-consequence accidents are generally associated with the storage of anhydrous NH_3 and aqueous HF on site. The consequences can be reduced or mitigated through design (e.g., by limiting tank capacity), operational procedures (e.g., by controlling accessibility to the tanks), and emergency response actions (e.g., by sheltering, evacuation, and interdiction of contaminated food materials following an accident). For example, UDS is proposing to reduce the size of the anhydrous NH_3 storage tanks from 9,200 to 3,300 gal (35,000 to 12,000 L). This change would reduce the consequences of an NH_3 release accident. However, to conservatively estimate the consequences of an anhydrous NH_3 tank rupture and preserve process flexibility, this analysis retained the assumption of a 9,200-gal (35,000-L) tank size.

5.2.3.2.3 Physical Hazards. The risk of on-the-job fatalities and injuries to conversion facility workers was calculated by using industry-specific statistics from the BLS, as reported by the National Safety Council (2002). Annual fatality and injury rates from the BLS manufacturing industry division were used for the 18-year operations phase, assuming ETTP cylinders are processed there. Operation of the conversion facility is estimated to require approximately 175 FTEs per year. No on-the-job fatalities are predicted during the conversion facility operational phase. It is estimated, however, that about 142 injuries would occur (Table 5.2-4).

5.2.3.3 Air Quality and Noise

5.2.3.3.1 Air Quality Impacts. Three alternative locations (Locations A, B, and C) were considered for air quality impacts. Detailed information on facility boundaries and the orientations and locations of buildings and stacks is currently available for the preferred Location A only. For Locations B and C, the layout of the facility for Location A was assumed to be placed in the middle of the other two locations.

At the conversion facility, air pollutants would be emitted from four point sources: the boiler stack, backup generator stack, conversion building stack, and HF processing building stack. UDS is proposing to use electrical heating in the conversion facility, but it is evaluating other options. If natural gas was chosen, furnaces or boilers could be used. To assess bounding air quality impacts, a boiler option was analyzed because it would result in more emissions than furnaces or electric heat. The boiler could be used to generate process steam and building heat, and a backup generator would be used to provide emergency electricity. Primary emission sources for criteria pollutants and VOCs would be the boiler and the emergency generator. The conversion building stack would release uranium, fluoride, criteria pollutants, and VOCs in minute amounts, while the HF processing building stack would release fluorides into the atmosphere. Although nitrogen would be used as a purge gas in the process, its use would not generate additional NO_X emissions because of the absence of oxygen in contact with the nitrogen stream at high temperatures. Annual total stack emission rates during operations are given in the Engineering Support Document (Folga 2003); these emission rates are presented in Table 5.2-17. Other sources during operations would include vehicular traffic to and from the facility, associated with cylinder transfer, commuting, and material delivery. Parking lots and access roads to the facility would be paved with asphalt or concrete to minimize fugitive dust emissions. In addition, fugitive emissions would include those from storage tanks, silos, cooling towers, etc., but in negligible amounts.

The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$, and HF due to emissions from the proposed facility operations are summarized in Table 5.2-18. The results are maximum modeled concentrations at or beyond the conversion facility boundary. The total concentrations (modeled concentration increments plus background concentrations) are also presented in the table for comparison with applicable NAAQS and SAAQS.

Because of low emissions during operations, all air pollutant concentration increments would be well below applicable standards. As shown in Table 5.2-18, the estimated maximum concentration increments due to operation of the proposed facility would amount to about 16% of the applicable standard for 3-hour average SO_2. These concentration increments are primarily

TABLE 5.2-17 Annual Point Source Emissions of Criteria Pollutants, Volatile Organic Compounds, Uranium, and Fluoride from Operation of the Conversion Facility at the Portsmouth Site

	Emission Rate[a]			
Pollutant	Boiler[b]	Backup Generator	Conversion Building Stack	HF Processing Building Stack
SO_2	0.01	0.17	9.7×10^{-4}	–[c]
NO_x	2.09	1.20	2.5×10^{-2}	–
CO	1.25	0.17	4.0×10^{-2}	–
VOC	0.08	0.17	1.2×10^{-2}	–
PM_{10}[d]	0.11	0.07	6.8×10^{-3}	–
Uranium	–	–	< 0.25 g/yr	–
Fluoride	–	–	<0.005 ppm[e]	< 0.05 ppm[f]

[a] Tons/yr unless otherwise noted.

[b] Boiler emissions were estimated on the basis of annual natural gas usage given in Table 5.2-22.

[c] A dash indicates no or negligible emissions.

[d] $PM_{2.5}$ emissions are assumed to be the same as PM_{10} emissions.

[e] Annual emission is about 0.8 kg (1.8 lb) as HF.

[f] Annual emission is about 55.8 kg (123 lb) as HF.

due to a backup generator, which is located next to the conversion building and the site boundaries and within the building cavity/wake region. However, the generator would be operating on an intermittent basis; thus, air quality impacts would be limited to the period of its operation. The maximum total concentrations, except for $PM_{2.5}$, would be about 64%, well below their applicable standards. However, it is estimated that total $PM_{2.5}$ concentration would be approaching (91%) or above (161%) the standard. However, concentration increments from operations are predicted to account for only 2.8% of the standard. As previously mentioned, the annual average $PM_{2.5}$ concentration at most statewide monitoring stations would either approach or exceed the standard.

The air quality impacts would be limited to the immediate vicinity of the site boundaries. For example, maximum predicted concentrations at the nearest residence would be about 11% of

TABLE 5.2-18 Maximum Air Quality Impacts Due to Emissions from Activities Associated with Operation of the Conversion Facility at the Portsmouth Site

Location	Pollutant	Averaging Time	Concentration ($\mu g/m^3$)				Percent of NAAQS/SAAQS[d]	
			Maximum Increment[a]	Background[b]	Total[c]	NAAQS and SAAQS	Increment	Total
A	SO_2	3 hours	127	307	434	1,300	9.8	33.4
		24 hours	57.1	110	167	365	15.6	45.8
		Annual	0.08	18.7	18.8	80	0.1	23.5
	NO_2	Annual	0.6	54.7	55.3	100	0.6	55.3
	CO	1 hour	245	13,400	13,600	40,000	0.6	34.1
		8 hours	84.9	4,780	4,860	10,000	0.8	48.6
	PM_{10}	24 hours	11.8	64	75.8	150	7.8	50.5
		Annual	0.03	32	32.0	50	0.1	64.1
	$PM_{2.5}$	24 hours	1.7	57.5	59.2	65	2.6	91.1
		Annual	0.03	24.1	24.1	15	0.2	161
	HF[e]	12 hours	0.07	0.45	0.52	3.68	1.9	14.3
		24 hours	0.05	0.37	0.42	2.86	1.8	14.8
		1 week	0.02[f]	0.21	0.23	1.64	1.1	13.9
		1 month	0.01	0.14	0.14	0.82	0.9	17.6
		Annual	0.003	0.07	0.07	400	0.001	0.02
B	SO_2	3 hours	161	307	468	1,300	12.4	36.0
		24 hours	47.8	110	158	365	13.1	43.2
		Annual	0.06	18.7	18.8	80	0.1	23.5
	NO_2	Annual	0.5	54.7	55.2	100	0.5	55.2
	CO	1 hour	258	13,400	13,700	40,000	0.6	34.1
		8 hours	86.7	4,780	4,870	10,000	0.9	48.7
	PM_{10}	24 hours	14.8	64	78.8	150	9.8	52.5
		Annual	0.03	32	32.0	50	0.1	64.1
	$PM_{2.5}$	24 hours	1.9	57.5	59.4	65	2.8	91.3
		Annual	0.03	24.1	24.1	15	0.2	161
	HF[e]	12 hours	0.07	0.45	0.52	3.68	1.8	14.1
		24 hours	0.05	0.37	0.42	2.86	1.6	14.6
		1 week	0.02[f]	0.21	0.23	1.64	1.0	13.8
		1 month	0.01	0.14	0.14	0.82	0.6	17.4
		Annual	0.003	0.066	0.07	400	0.001	0.02

TABLE 5.2-18 (Cont.)

		Concentration ($\mu g/m^3$)						
							Percent of NAAQS/SAAQS[d]	
Location	Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS and SAAQS	Increment	Total
C	SO_2	3 hours	208	307	515	1,300	16.0	39.6
		24 hours	45.3	110	155	365	12.4	42.6
		Annual	0.08	18.7	18.8	80	0.1	23.5
	NO_2	Annual	0.6	54.7	55.3	100	0.6	55.3
	CO	1 hour	260	13,400	13,700	40,000	0.7	34.2
		8 hours	88.1	4,780	4,870	10,000	0.9	48.7
	PM_{10}	24 hours	14.2	64	78.2	150	9.5	52.1
		Annual	0.04	32	32.0	50	0.1	64.1
	$PM_{2.5}$	24 hours	1.7	57.5	59.2	65	2.5	91.0
		Annual	0.04	24.1	24.1	15	0.2	161
	HF[e]	12 hours	0.15	0.45	0.61	3.68	4.1	16.5
		24 hours	0.11	0.37	0.48	2.86	3.7	16.7
		1 week	0.04[f]	0.21	0.25	1.64	2.2	15.0
		1 month	0.01	0.14	0.15	0.82	1.3	18.1
		Annual	0.006	0.066	0.07	400	0.001	0.02

[a] Data represent the maximum concentration increments estimated, except that the fourth- and eighth-highest concentration increments estimated are listed for 24-hour PM_{10} and $PM_{2.5}$.

[b] See Table 3.1-3 for criteria pollutants and DOE (2002b) for highest weekly and annual HF. Background HF for other averaging times was estimated based on highest weekly annual background concentrations.

[c] Total equals the maximum modeled concentration increment plus background concentration.

[d] The values in the next-to-last column are maximum concentration increments as a percent of NAAQS and SAAQS. The values presented in the last column are total concentrations as a percent of NAAQS and SAAQS.

[e] State HF standards in Ohio are not available, so Kentucky standards were used for comparative purposes.

[f] Estimated by interpolation.

the highest concentration. It is also expected that potential impacts from the proposed facility operations on the air quality of nearby communities would be insignificant.[4]

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations would be about 63% of the applicable PSD

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[4] Formerly, the general public had access to the existing fenced gaseous diffusion plant boundaries. However, since the September 11, 2001, terrorist attack, site access for the general public has been restricted indefinitely to the DOE property boundaries.

increments (Table 3.2-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 3% of the applicable PSD increments. The 24-hour and annual PM_{10} concentration increases predicted to result from the proposed operations would be about 49% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) from the proposed facility (the maximum distance for which the Industrial Source Complex [ISC3] short-term model [EPA 1995] could reliably estimate concentrations) in the direction of the nearest Class I PSD area (Otter Creek Wilderness Area, West Virginia) would be far less than 0.5% of the applicable PSD increments. Concentration increments at this wilderness area, which is located about 177 mi (285 km) west of Portsmouth, would be negligible.

Concentration increments for the two remaining criteria pollutants, Pb and O_3, were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average Pb concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of Pb from the proposed facility operations would be negligible and would therefore have no adverse impacts on Pb concentrations in surrounding areas. Contributions to the production of O_3, a secondary pollutant formed from complex photochemical reactions involving O_3 precursors, including NO_x and VOCs, cannot be accurately quantified. As discussed in Section 3.1.3.2, Pike County, including the Portsmouth site, is currently in attainment for O_3 (40 CFR 81.336). The O_3 precursor emissions from the proposed facility stacks would make up about 0.7% and 3.8% of the year 2001 combined Portsmouth DOE and USEC emissions of NO_x and VOCs, respectively (see Table 3.1-2). These emission levels would be negligible in absolute terms (compared with statewide emissions). As a consequence, the cumulative impacts of potential releases from Portsmouth facility operations on regional O_3 concentrations would not be of any concern.

Maximum HF air quality impacts are also listed in Table 5.2-18. State HF standards in Ohio are not available; thus, Kentucky standards were used for comparative purposes. The estimated maximum short-term ($\leq$1 month) HF concentration increment and total concentrations would be about 4.1% and 18.1% of the state standard, respectively, which are still well below the standards. The annual average concentration increment and total concentration would be several orders of magnitude lower than the HF air quality standard.

In summary, except for annual average $PM_{2.5}$, total concentrations of criteria pollutants would be well below their respective standards. Total maximum estimated concentrations of criteria pollutants, except $PM_{2.5}$, would be less than 64% of NAAQS and SAAQS. Predicted total concentrations of 24-hour and annual average $PM_{2.5}$ would be near or above their respective standards, respectively; however, their concentration increments associated with site operations would account for only about 2.8% of the standards. In particular, the annual average $PM_{2.5}$ concentration at most statewide monitoring stations would either approach or exceed the standard.

Accidents. Among chemicals released due to accidents, HF is the only one subject to an ambient air quality standard (the state of Ohio does not have ambient air quality standards for HF, so those for the state of Kentucky were used for comparison purposes). Most accidental releases would occur over a short duration, about 2 hours at most. The passage time of an elevated-concentration plume for any receptor location would be a little longer than its release duration. The HF concentration in the plume's path would exceed the 12-hour or 24-hour ambient standard for the HF tank rupture accident scenario; however, when concentrations are averaged over a year, the annual ambient air quality standard would not be exceeded. Therefore, potential impacts of accidental releases on ambient air quality would be short-term and limited to along the plume path, and long-term impacts would be negligible.

5.2.3.3.2 Noise Impacts. Many noise sources associated with operation would be inside the buildings. The highest noise levels are expected inside the conversion facility in the area of the powder receiver vessels, with measured readings at 77 to 79 dB(A), and in the area of the dry conversion, with a reading of 72 to 74 dB(A) (UDS 2003b). Ambient facility noise levels, measured in various processing areas (inside buildings) for continuous operations of a facility at Richland, Washington, ranged from 70 to 79 dB(A). Major outdoor noise sources associated with operation would include the cooling tower, trucks and heavy equipment moving cylinders, and traffic moving to and from the facility, which are typical industrial noise sources. Heavy equipment and truck traffic would be intermittent, so noise levels would be low except when the equipment was moving or operating. For noise impact analyses, a continuous noise source during operation was assumed to be about 79 dB(A) at a distance of 15 m (50 ft), on the basis of the highest noise level measured inside buildings at the Richland facility (UDS 2003b).[5]

The nearest residence, located about 0.9 km (0.6 mi) south-southeast of Location B and just off DOE's southern boundary, was selected as the receptor for the analysis of potential noise impacts. Noise levels decrease about 6 dB per doubling of distance from the point source because of the way sound spreads geometrically over an increasing distance. The estimated noise level would result in about 43 dB(A) at the nearest residence. This level would be about 49 dB(A) as DNL, if 24-hour continuous operation is assumed. The 49-dB(A) estimate is just below the EPA guideline of 55 dB(A) as DNL for residential zones (see Section 3.1.3.4), which was established to prevent interference with activity, annoyance, and hearing impairment. If other attenuation mechanisms, such as ground effects or air absorption, are considered, noise levels at the nearest residence would considerably decrease. If only ground effects are considered (HMMH 1995), more than 10 dB(A) of attenuation would occur at the nearest residence, which would result in about 39 dB(A) as DNL, well below the EPA guideline.

Most trains would blow their whistle loud enough to ensure that all motorists and pedestrians nearby would be aware of an approaching train. These excessive noises could disturb those who live or work near the train tracks. Typical noise levels of train whistles would range from 95 to 115 dB(A) at a distance of 30 m (100 ft), comparable to noise levels of low-flying aircraft or emergency vehicle sirens (DOT 2003a). The total number of shipments (railcars) associated with facility operations would be less than 5,000. This would be equivalent to about one train per week, assuming five railcars per train. Accordingly, the noise level from train

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[5] The noise level from one of the continuous outdoor noise sources, a cooling tower, to be used at this size of facility would be less than 79 dB(A) at a distance of 15 m (50 ft).

operations would be high along the rail tracks and particularly near the crossings. However, noise impacts would be infrequent and of short duration.

In general, facility operations produce less noise than construction activities. For all three alternative locations, except for intermittent vehicular traffic and infrequent rail traffic, the noise level at the nearest residence would be somewhat higher than the ambient background level discussed in Section 3.1.3.4, and it would be barely distinguishable from the background level, depending on the time of the day. In conclusion, noise levels generated by plant operation would have minor impacts on the residence located nearest to the proposed facility and would be well below the EPA guideline limits for residential areas.

5.2.3.4 Water and Soil

Operating a conversion facility at Portsmouth could disturb land, use water, and produce liquid wastes. Impacts on surface water, groundwater, and soil resources are discussed below. Because no site-specific impacts to water and soil were identified, impacts at alternative Locations A, B, and C would be the same.

5.2.3.4.1 Surface Water. Impacts from operating a conversion facility at Portsmouth would be independent of the location selected at Portsmouth; all of the water needed would be withdrawn from the system of on-site and off-site wells. Because all of the water needed for operating a conversion plant at Portsmouth would be obtained from groundwater wells, there would be no impacts on surface water resources.

During facility operations, about 4,000 to 8,000 gal/d (15,140 to 30,280 L/d) of sanitary wastewater would be processed. There would also be about 3,000 gal/d (11,400 L/d) of process wastewater produced during normal operations. This water would not contain any radionuclides. Another 23,000 gal/d (87,100 L/d) (8.4 million gal/yr [31.8 million L/yr]) of wastewater would be produced by cooling tower blowdown, and 36,000 gal/d (136,300 L/d) of wastewater would be produced if HF neutralization was required. These wastewaters would not contain any radionuclides and could be disposed of to the existing process wastewater treatment system at Portsmouth, or discharged under a NPDES permit, or treated and reused at the conversion facility. Disposition of these wastewaters is under evaluation.

Discharge effluent would be treated prior to discharge. The existing water treatment plant processes about 4,533 million gal (17,160 million L) of wastewater per year. The additional wastewater produced by a conversion plant would be a maximum of about 0.2% of the current treatment volume. Once in surface water, the effluent would be diluted. At Portsmouth, effluent discharge would go to Little Beaver Creek or the Scioto River. If released at a constant rate, the approximately 30,000 gal/d (114,000 L/d) of wastewater would flow at about 21 gal/min (80 L/min). This small increase in flow would produce negligible impacts to Little Beaver Creek, Big River Creek, and the Scioto River. Because the release water would be treated, impacts to water quality would also be negligible, even without the additional dilution expected (45 for Little Beaver Creek).

Accidents. An earthquake could rupture an aboveground HF pipeline that would carry liquid HF from the conversion building to the HF storage building at a rate of 10 gal/min (38 L/min). Approximately 910 lb (410 kg) of liquid HF would be released. Because response and cleanup would occur within a relatively short time after the release (i.e., days or weeks), the HF would have little time to migrate into the soil, and very little would be transported by runoff to nearby surface waters. Removal of the contaminated soil would prevent any contamination of surface water or groundwater resources. Therefore, there would be no impacts on surface water or groundwater from this accident. A similar quick response and cleanup would minimize impacts for an HF spill to the ground during transfer to railcars.

5.2.3.4.2 Groundwater. All operational water needs at the Portsmouth site would be satisfied by using groundwater resources. Peak potable and nonpotable water use for the Portsmouth plant would be about 33 million gal/yr (125 million L/yr). An additional 1.1 million gal (4.2 million L) of process water per year would be required. If this water was withdrawn at a constant rate, the withdrawal would represent an increase of about 0.8% of the current water use and 0.3% of the existing capacity. Impacts from this rate of extraction would be small.

In addition, the quality of groundwater beneath the selected location could be affected by infiltrating contaminated surface water from spills. Indirect contamination could result from the dissolution and mobilization of exposed chemicals by precipitation and subsequent infiltration of the contaminated runoff into the surficial aquifers. By following good engineering and operating practices (e.g., covering chemicals to prevent interaction with rain, promptly and thoroughly cleaning up any spills, and providing retention basins to catch and hold any contaminated runoff), impacts on groundwater quality would be minimized.

Accidents. An earthquake could rupture the aboveground HF pipeline that would carry liquid HF from the conversion building to the HF storage building. Because of rapid response and cleanup times, the travel distance of the released HF would be small. Removal of the contaminated soil would prevent any contamination of underlying groundwater resources. Therefore, there would be no impacts on groundwater from this type of accident. A similar quick response and cleanup would minimize impacts for an HF spill to the ground during transfer to railcars.

5.2.3.4.3 Soils. Normal operations of a conversion facility at the Portsmouth site would have no direct impacts on soil at all three alternative locations.

Accidents. The only accidents identified that could potentially affect soil would be an HF pipeline rupture and an HF spill to the ground during transfer to railcars. Because mitigation would be initiated rapidly and because the volume of HF released would be small (910 lb [410 kg]), impacts on soil would be negligible.

5.2.3.5 Socioeconomics

The socioeconomic analysis covers the effects on population, employment, income, regional growth, housing, and community resources in the ROI around the Portsmouth site. Impacts from operations, which are the same for all three alternative locations, are summarized in Table 5.2-19.

The potential socioeconomic impacts from operations would be relatively small. Operational activities would create about 160 direct jobs annually and about 160 more indirect jobs in the ROI. A conversion facility would produce about $13 million in personal income annually during operations.

It is estimated that about 220 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 1% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and fewer than five new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Pike and Scioto Counties.

TABLE 5.2-19 Socioeconomic Impacts from Operation of the Conversion Facility at the Portsmouth Site[a]

Impact Area	Operation
Employment	
Direct	160
Total	320
Income (millions of 2002 $)	
Direct	5.8
Total	12.9
Population (no. of new ROI residents)	220
Housing (no. of units required)	80
Public finances (% impact on fiscal balance)	
Cities in Pike County[b]	0.2
Pike County	0.1
Schools in Pike County[c]	0.2
Cities in Scioto County[d]	0.2
Scioto County	0.2
Schools in Scioto County[e]	0.2
Public service employment (no. of new employees)	
Pike County	
Police officers	0
Firefighters	0
General	1
Physicians	0
Teachers	1
Scioto County	
Police officers	0
Firefighters	0
General	1
Physicians	0
Teachers	1
No. of new staffed hospital beds	
Pike County	1
Scioto County	1

[a] Impacts are shown for the first year of operations (2006).

[b] Includes impacts that would occur in the cities of Waverly and Piketon.

[c] Includes impacts that would occur in Waverly and Pike County school districts.

[d] Includes impacts that would occur in the City of Portsmouth.

[e] Includes impacts that would occur in New Boston, Portsmouth, Wheelersburg, and Scioto County school districts.

5.2.3.6 Ecology

5.2.3.6.1 Vegetation. A portion of the conversion product released from the process stack of the conversion facility would become deposited on the soils surrounding the site. Uptake of uranium-containing compounds could cause adverse effects to vegetation. Deposition of uranium compounds on soils, resulting from atmospheric emissions, would result in soil uranium concentrations considerably below the lowest concentration known to produce toxic effects in plants. Because there would not be a release of process effluent from the facility to surface waters, impacts to vegetation along nearby streams would not occur. Therefore, toxic effects on vegetation due to uranium uptake would be expected to be negligible.

5.2.3.6.2 Wildlife. Noise generated by the operation of a conversion facility at Location A and disturbance from human presence would likely result in a minor disturbance to wildlife in the vicinity. Movement of railcars along the new rail line west of the facility might potentially render the adjacent riparian forest habitat unsuitable for some species. In addition, the rail line might impede the movement of some small wildlife species.

During operations, ecological resources in the vicinity of the conversion facility would be exposed to atmospheric emissions from the boiler stack, cooling towers, and process stack; nevertheless, emission levels are expected to be extremely low. The highest average air concentration of uranium compounds would result in a radiation exposure to the general public (nearly 100% due to inhalation) of 2.07×10^{-5} mrem/yr, well below the DOE guideline of 100 mrem/yr (DOE 2002f). Wildlife species are less sensitive to radiation than humans. (DOE guidelines require an absorbed dose limit to terrestrial animals of less than 0.1 rad/d [DOE 2002f].) Therefore, impacts on wildlife due to radiation effects are expected to be negligible. Toxic effect levels of chronic inhalation of uranium are many orders of magnitude greater than expected emissions. Therefore, toxic effects on wildlife as a result of inhalation of uranium compounds are also expected to be negligible.

The maximum annual average air concentration of HF that would result from operation of a conversion facility would be 0.0028 $\mu g/m^3$. Toxic effect levels of chronic inhalation of HF are many orders of magnitude greater than expected emissions. Therefore, toxic effects on wildlife from HF emissions are expected to be negligible.

Impacts to wildlife from the operation of a conversion facility at Locations B or C would be similar to impacts at Location A. Noise and human presence would likely result in a minor disturbance to wildlife in the vicinity.

5.2.3.6.3 Wetlands. Liquid process effluents would not be discharged to surface waters during the operation of the conversion facility (Section 5.2.3.4). Surface water sources are also not expected to be used to meet water requirements during operations. Changes in groundwater as a result of the withdrawal of groundwater for facility operations would be small to negligible (Section 5.2.2.4). Therefore, except for potential local indirect impacts near the facility, impacts to regional wetlands due to changes in groundwater or surface water levels or flow patterns are not expected to occur. As a result, adverse effects on wetlands or aquatic communities from effluent discharges or water use are not expected.

Storm water runoff from conversion facility parking areas and other paved surfaces might carry contaminants commonly found on these surfaces to local streams. Biota in receiving streams might be affected by these contaminants, resulting in reduced species diversity or changes in community composition. Storm water discharges from the conversion facility would be addressed under a new or existing NPDES permit for industrial facility storm water discharge. The streams near Locations A, B, and C currently receive runoff and associated contaminants from various roadways on the Portsmouth site, and their biotic communities are likely indicative of developed areas.

5.2.3.6.4 Threatened and Endangered Species. Impacts to federal- or state-listed species during operation of a conversion facility at Location A are not expected. However, although the wooded areas at Location A have not been identified as summer roosting habitat for the Indiana bat (federal- and state-listed as endangered), disturbances from increased noise, lighting, and human presence due to facility operation and the movement of railcars along the new rail line west of the facility might decrease the quality of the adjacent riparian forest habitats for use by Indiana bats. However, Indiana bats that might currently be using habitat near the Portsmouth site would already be exposed to noise and other effects of human disturbance due to operation of the site, including vehicle traffic. In addition, Indiana bats have been observed to tolerate increased noise levels (U.S. Fish and Wildlife Service [USFWS] 2002). Consequently, disturbance effects related to conversion facility operation are expected to be minor. The operation of a conversion facility at Location C might similarly decrease the quality of wooded areas at that location for Indiana bat summer habitat, although these locations have also not been identified as containing Indiana bat habitat. Location B does not support habitat suitable to the Indiana bat.

5.2.3.7 Waste Management

Operations at the conversion facility would generate radioactive, hazardous, and nonhazardous waste, as shown in Table 5.2-20. Waste volumes generated would be the same for all three alternative locations. The total waste volumes for 18 years of operation would be 772 yd^3 (590 m^3) of LLW and 98 yd^3 (74 m^3) of hazardous waste. These volumes would result in low impacts on site annual projected volumes. If ETTP cylinders were not processed at Portsmouth, the waste volumes would be reduced by 26 yd^3 (20 m^3) of LLW, 5 yd^3 (4 m^3) of hazardous waste, and 125 yd^3 (96 m^3) of nonhazardous solid waste.

CaF_2 would be produced in the U_3O_8 conversion process and is assumed to have a low uranium content. It is currently unknown whether this CaF_2 could be sold (e.g., as feedstock for commercial production of anhydrous HF) or whether the low uranium content would force disposal. If CaF_2 disposal is necessary, it could be either as a nonhazardous solid waste (provided that authorized limits have been established in accordance with DOE Order 5400.5

[DOE 1990] and its associated guidance) or as LLW. The nonhazardous solid waste generation estimate for conversion to U_3O_8, as shown in Table 5.2-20, is based on the assumption that CaF_2 would be disposed of as nonhazardous solid waste at a rate of approximately 13 yd^3/yr (10 m^3/yr). This represents a negligible impact to the annual site generation rate for this waste type. If CaF_2 was disposed of as LLW, it would represent less than 1% of the projected site annual LLW load.

If the HF was not marketable, neutralization of HF to CaF_2 would produce approximately 3,745 yd^3/yr (2,860 m^3/yr) of CaF_2. This volume represents approximately 89% and 4% of nonhazardous solid waste and LLW, respectively, of the projected annual generation volumes for Portsmouth. It is unknown whether CaF_2 LLW would be considered DOE waste if the conversion was conducted by a private commercial enterprise. If CaF_2 could be sold, the nonhazardous solid waste or LLW management impacts would be lower.

The U_3O_8 produced from the conversion process would generate about 4,700 yd^3/yr (3,570 m^3/yr) of LLW. This volume is about 5% of the annual site-projected volume for LLW and constitutes a low impact on site LLW management.

Current UDS plans are to leave the heels in the emptied cylinders, fill them with the depleted U_3O_8 product, and dispose of them at either Envirocare or NTS. This approach is expected to meet the waste acceptance criteria of the disposal facilities and eliminate the potential for generating TRU waste (see Appendix B for additional information concerning TRU and PCB contamination). However, it is possible that the heels could be washed from the emptied cylinders if it was decided to reuse the cylinders for other purposes. In this case, the TRU in the heels of some cylinders at the maximum postulated concentrations could also result in the generation of some TRU waste at the conversion facility (see Appendix B). It is estimated that up to 30% (or 244 drums) of the heels could contain enough TRU to qualify this material as TRU waste if it was disposed of as waste. In this case, it is estimated that a volume of about 2.6 yd^3/yr (2.0 m^3/yr) of TRU and 6.0 yd^3/yr (4.4 m^3/yr) of LLW would be generated.

TABLE 5.2-20 Wastes Generated from Operation of the Conversion Facility at the Portsmouth Site

Waste Category	Annual Volume[a]
LLW	
Combustible waste	26 m^3
Noncombustible	6.4 m^3
Others	<1.0 m^3
Total[b]	33 m^3
Hazardous waste[c]	4.1 m^3
Nonhazardous waste	
Solids[d]	144 m^3
Sanitary wastewater	5.5×10^6 L

[a] Represents annual volume generated from Portsmouth cylinders only.

[b] Includes LLW from high-efficiency particulate air (HEPA) filters and laboratory acids and residues. The total volume of LLW from ETTP cylinders is about 20 m^3 (26 yd^3).

[c] Includes the total volume of hazardous waste from ETTP cylinders of 4 m^3 (5 yd^3).

[d] Includes CaF_2 generation from the conversion process. The total volume of nonhazardous waste from ETTP cylinders is about 95 m^3 (125 yd^3).

Source: UDS (2003b).

In addition, a small quantity of TRU could be entrained in the gaseous DUF_6 during the cylinder emptying operations and carried out of the cylinders. These contaminants would be captured in the filters between the cylinders and the conversion equipment. The filters would be monitored and replaced routinely to prevent buildup of TRU. The spent filters would be disposed of as LLW. It is estimated that the amount of LLW generated in the form of spent filters would be about 1 drum per year for a total of 18 drums (drums are 55 gal [208 L] in size) for the duration of the conversion operations (see Appendix B). This converts to a total volume of 5.0 yd^3 (3.7 m^3) of LLW. In the unlikely event that small amounts of TRU waste are generated from the conversion facility, the waste would be managed in accordance with DOE's policy for TRU waste, which includes the packaging and transport of these wastes to the Waste Isolation Pilot Plant (WIPP) in New Mexico for disposal.

5.2.3.8 Resource Requirements

Resource requirements during operations would not depend on the location of the conversion facility. Facility operations would consume electricity, fuel, and miscellaneous chemicals that are generally irretrievable resources. Estimated annual consumption rates of operating materials are provided in Table 5.2-21. The total quantity of commonly used materials is not expected to be significant and would not affect their local, regional, or national availability. In general, facility operational resources required are not considered rare or unique.

TABLE 5.2-21 Materials Consumed Annually during Normal Conversion Facility Operations at the Portsmouth Site[a]

Chemical	Quantity (tons/yr)
Solid	
Lime (CaO)[b]	14
Liquid	
Ammonia (99.95% minimum NH_3)	510
Potassium hydroxide (KOH)	6
Gas	
Nitrogen (N_2)	7,800

[a] Material estimates are based on conceptual-design-status facility design data (UDS 2003b). A number of studies are planned to evaluate design alternatives, the results of which may affect the above materials needs.

[b] Assuming lime is used only for potassium hydroxide regeneration. If HF neutralization is required, the annual lime requirement would be approximately 7,000 tons/yr (6,350 t/yr).

Operation of the facility could include the consumption of fossil fuels used to generate steam and heat and electricity (Table 5.2-22). Energy would also be expended in the form of diesel fuel and gasoline for cylinder transport equipment and transportation vehicles. The existing infrastructure at the site appears to be sufficient to supply the required utilities.

5.2.3.9 Land Use

Because the preferred location (Location A) for the facility already contains structures, operations would be generally consistent with current land use. As a consequence, no land use impacts are anticipated as a result of operating the facility and cylinder storage pad.

TABLE 5.2-22 Utilities Consumed during Conversion Facility Operations at the Portsmouth Site[a]

Utility	Annual Average Consumption	Unit	Peak Demand[b]	Unit
Electricity	31,084	MWh	6.2	MW
Liquid fuel	3,000	gal	NA[c]	NA
Natural gas[d,e]	4.0×10^7	scf[f]	180	scfm[f]
Process water	30×10^6	gal	215	gal/min
Potable water	3×10^6	gal	350	gal/min

[a] Utility estimates are based on facility conceptual-design-status data (UDS 2003b). A number of studies are planned to evaluate design alternatives, the results of which may affect the above utility needs.

[b] Peak demand is the maximum rate expected during any hour.

[c] NA = not applicable.

[d] Standard cubic feet measured at 14.7 psia and 60°F (16°C).

[e] The current facility design uses electrical heating. However, an option of using natural gas is being evaluated.

[f] scf = standard cubic feet; scfm = standard cubic feet per minute.

Alternative Locations B and C would have impacts similar to those at the preferred Location A during operations. Both locations occur on a site developed for the production of enriched uranium (and its DUF_6 by-product); as a consequence, operations would be generally consistent with current land use.

5.2.3.10 Cultural Resources

The routine operation of a DUF_6 conversion facility at Portsmouth is unlikely to adversely affect cultural resources at all three alternative locations because no ground-disturbing activities are associated with facility operation.

Air emissions or chemical releases from the facility were evaluated to determine their potential to affect significant cultural resources, predominantly historic structures, in the surrounding area. On the basis of the analysis of air emissions presented in Section 5.2.3.3, there would be only a negligible contribution of $PM_{2.5}$ within 150 m (500 ft) of the facility. This would not result in an adverse effect to cultural resources.

Accidental radiological and chemical releases, including HF, uranium compounds, and NH_3, would be possible, although unlikely, during the operation of the plant (Section 5.2.3.2). HF emissions are not projected to exceed secondary standards beyond site boundaries and would have no effect on cultural resources. Any release of uranium compounds would be as PM and could affect building surfaces in close proximity to the facility. NH_3 releases would be gaseous and would quickly disperse, although some surface deposits could occur. Careful washing of building surfaces could be required to remove such deposits if any contamination was detected following an accidental release.

5.2.3.11 Environmental Justice

The evaluation of environmental justice impacts is predicated on the identification of high and adverse impacts in other impact areas considered in this EIS, followed by a determination if those impacts would affect minority and low-income populations disproportionately. Analyses of impacts from operating the proposed facilities do not indicate high and adverse impacts for any of the other impact areas considered in this EIS (see Sections 5.2.3.1 through 5.2.3.10). Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 mi (80 km) of the Portsmouth site, no environmental justice impacts are anticipated at any of the three alternative locations because of the lack of high and adverse impacts. Similarly, no evidence exists indicating that minority or low-income populations would experience high and adverse impacts from operating the facility or storage pad in the absence of such impacts in the population as a whole.

5.2.4 Cylinder Preparation Impacts at ETTP

Transporting the cylinders at ETTP to Portsmouth could result in potential environmental impacts at ETTP from the preparation of the cylinders for shipment. As described in Chapter 2, some of the DUF_6 cylinders in storage no longer meet DOT requirements for the shipment of radioactive materials. It is currently unknown exactly how many cylinders do not meet DOT requirements, although current estimates are that 1,700 cylinders are DOT-compliant. Before transportation, cylinders would have to be prepared to meet the requirements. As described in Chapter 2, for the purposes of this EIS, environmental impacts were evaluated for three options for preparing cylinders for shipment: use of cylinder overpacks, cylinder transfer and obtaining a DOT exemption.

An overpack is a container into which a cylinder would be placed for shipment. The overpack would be designed, tested, and certified to meet all DOT shipping requirements. The overpack would be suitable to contain, transport, and store the cylinder contents regardless of cylinder condition. According to UDS (2003b), the use of cylinder overpacks is considered the most likely approach for shipping noncompliant cylinders.

The cylinder transfer option would involve the transfer of the DUF_6 from noncompliant cylinders to cylinders that meet all DOT requirements. If selected, this option would likely require the construction of a cylinder transfer facility at ETTP. Currently, there are no plans or proposals to build or use a cylinder transfer facility to prepare DUF_6 cylinders for shipment. If such a decision were made, additional NEPA review would be conducted. The use of a cylinder transfer facility for cylinder preparation is considered much less likely than the use of overpacks, because the former approach would be more resource intensive and costly and would generate additional contaminated emptied cylinders requiring treatment and disposal.

The third option is to obtain an exemption from DOT that would allow the DUF_6 cylinders to be transported either "as is" or following repairs. The primary finding that DOT would have to make to justify granting an exemption is this: the proposed alternative would have to achieve a safety level that would be at least equal to the level required by the otherwise applicable regulation or, if the otherwise applicable regulation did not establish a required safety level, would be consistent with the public interest and adequately protect against the risks to life and property that are inherent when transporting hazardous materials in commerce. It is likely that some type of compensatory measures during the transportation would have to be employed to justify the granting of an exemption. No specific measures were evaluated in this EIS. However, because the granting of an exemption would be based on a demonstration of equivalent safety, the transportation impacts for this option would be similar to those presented for the overpack and cylinder transfer options. Therefore, transportation impacts for the exemption option are not presented separately in this section.

The site-specific impacts of preparing both compliant and noncompliant cylinders (using overpacks and cylinder transfer) for shipment at ETTP were evaluated in Appendix E of the DUF_6 PEIS (DOE 1999a). In that evaluation, it was assumed for ETTP that the total number of cylinders not meeting DOT requirements ranged from 2,342 to 4,683 (50% to 100% of the ETTP DUF_6 inventory); correspondingly, from 0 to 2,342 compliant cylinders would require preparation for shipment.

The following paragraphs summarize the impacts from the cylinder preparation activities at ETTP as presented in Appendix E of the DUF_6 PEIS (DOE 1999a). The site-specific impacts from operation of a transfer facility at ETTP were evaluated on the basis of the assumption that the facility would be located at the center of the site, since no proposal exists for such a facility and no specific location has been proposed. For the same reasons, the site-specific impacts from construction were not evaluated. Therefore, an additional NEPA review might be required to construct a cylinder transfer facility if a decision was made to do so in the future.

5.2.4.1 Cylinder Overpack Option

For normal operations, the PEIS analysis concluded that the potential on-site impacts from preparing compliant cylinders and from placing noncompliant cylinders into overpacks would be small and limited to involved workers. No impacts to the off-site public or the environment would occur, since no releases are expected and no construction activities would be required. The only equipment required would be similar to the equipment currently used during routine cylinder handling and maintenance activities.

It is estimated that at ETTP, the total collective dose to involved workers would range from 42 to 85 person-rem (resulting in less than 0.03 LCF) for overpacking operations and from 0 to 27 person-rem (resulting in less than 0.01 LCF) for preparation of compliant cylinders. The total collective dose to workers preparing all the ETTP cylinders would range from 69 to

85 person-rem (resulting in less than 0.03 LCF). This dose to workers would be incurred over the duration of the cylinder preparation operations (annual doses can be estimated by dividing the total dose by the duration of the operation in years). It should be noted that the assumptions used in the PEIS for estimating worker exposure were very conservative, with the purpose of bounding potential exposures. In practice, cylinder preparation activities, such as inspecting, unstacking, and loading cylinders, would involve fewer workers and be of shorter duration, resulting in significantly lower worker exposures than the estimates presented here.

The PEIS also evaluated the potential for accidents during cylinder preparation operations. The types of accident considered were the same as those considered for the continued storage of cylinders under the no action alternative in this EIS, such as spills from corroded cylinders during wet and dry conditions and vehicle accidents causing cylinders to be involved in fires. The consequences of such accidents are described under the no action alternative in Section 5.1.

5.2.4.2 Cylinder Transfer Facility Option

A summary of environmental parameters associated with the construction and operation of a cylinder transfer facility with various throughputs is presented in Table 5.2-23. In the PEIS, it was assumed that the ETTP transfer facility would process 320 cylinders per year, requiring about 15 years to transfer 4,683 cylinders. Although the three facility sizes shown in Table 5.2-23 have vastly different throughputs (ranging over a factor of 5), the differences in the environmental parameters among them are relatively small because of economies of scale. If transfer operations at ETTP occurred over a shorter period of time than 15 years, a larger facility would be required, with environmental parameters similar to those listed for the 1,600-cylinder/yr facility or the 960-cylinder/yr facility.

TABLE 5.2-23 Summary of Environmental Parameters for a Cylinder Transfer Facility at ETTP

	Facility Size (annual throughput)		
Affected Parameter	1,600 Cylinders	960 Cylinders	320 Cylinders
Disturbed land area (acres)	21	14	12
Paved area (acres)	15	10	8
Construction water (million gal/yr)	10	8	6.5
Construction wastewater (million gal/yr)	5	4	3.3
Operations water (million gal/yr)	9	7	6
Operations wastewater (million gal/yr)	7.1	5.7	4.4
Radioactive release (Ci/yr)	0.00078	0.00063	0.00049

Source: Appendix E in DOE (1999a).

For the cylinder transfer option, impacts during construction and normal operations would generally be small and limited primarily to involved workers. It is estimated that at ETTP, the total collective dose to involved workers would range from 410 to 480 person-rem (resulting in less than 0.2 LCF) for cylinder transfer operations, and it would range from 0 to 27 person-rem (resulting in less than 0.01 LCF) for preparing compliant cylinders. The total collective dose to workers preparing all the ETTP cylinders would range from 437 to 480 person-rem (resulting in less than 0.2 LCF). This dose to workers would be incurred over the duration of the cylinder preparation operations (annual doses can be estimated by dividing the total dose by the duration of the operation in years).

In the PEIS, the size of the transfer facility was estimated to be less than about 20 acres (8 ha); such a facility would likely be constructed in a previously disturbed area. Some small off-site releases of hazardous and nonhazardous materials could occur, although such releases would have negligible impacts on the off-site public and the environment. Construction activities could temporarily impact air quality; however, all criteria pollutants concentrations would be within applicable standards.

Impacts on cultural resources would be possible if a transfer facility was built at ETTP. Depending on the location chosen, the K-25 Main Plant Historical District, significant archaeological resources, or traditional cultural properties could be adversely affected. The ORR CRMP has been approved by the Tennessee SHPO. It includes procedures for determining the effect of an undertaking on cultural resources, consulting with the Tennessee SHPO and Native American groups, and mitigating adverse effects (Souza et al. 2001). These procedures, including additional surveys and any necessary mitigation, would have to be completed before any ground-disturbing activities for construction of a new facility could begin.

5.2.5 Transportation

The action alternatives involve transportation of DUF_6 and non-DUF_6 cylinders from ETTP to Portsmouth, in addition to transportation of the conversion products to a disposal site or to commercial users. The ETTP cylinders are expected to be shipped by truck and the conversion products by rail. However, a viable option is to ship some ETTP cylinders via rail and the conversion products by truck. For purposes of this EIS, transportation of all cargo is considered for both truck and rail modes of transport. In a similar fashion, conversion products declared to be wastes are expected to be sent to Envirocare of Utah for disposal; another viable option is to send the products to NTS. Thus, both options are evaluated. If not used as disposal containers for depleted U_3O_8 products, the emptied heel cylinders would be crushed and shipped in 20-ft (6-m) cargo containers, approximately 10 to a container. However, up to 10% of these cylinders might not meet Envirocare acceptance criteria and would be shipped as-is to NTS for disposal (UDS 2003b).

As discussed in Appendix F, Section F.3, the impacts of transportation were calculated in three areas: (1) collective population risks during routine conditions and accidents (Section 5.2.5.1), (2) radiological risks to MEIs during routine conditions (Section 5.2.5.2), and

(3) consequences to individuals and populations after the most severe accidents involving a release of radioactive or hazardous chemical material (Section 5.2.5.3).

5.2.5.1 Collective Population Risk

The collective population risk is a measure of the total risk posed to society as a whole by the actions being considered. For a collective population risk assessment, the persons exposed are considered as a group, without specifying individual receptors. The collective population risk is used as the primary means of comparing various options. Collective population risks are calculated for both vehicle- and cargo-related causes for routine transportation and accidents. Vehicle-related risks are independent of the cargo in the shipment and include risks from vehicular exhaust emissions and traffic accidents (fatalities caused by physical trauma).

5.2.5.1.1 ETTP Cylinders. The total collective population risks for shipment of the entire ETTP inventory to Portsmouth are presented in Table 5.2-24 for DUF_6 and non-DUF_6 cylinders. Annual impacts would depend on the duration of the shipping campaign and can be computed by dividing the total risk by the campaign duration. No fatalities are expected as a result of the shipping campaign because all estimated collective fatality risks would be much less than 0.5. The estimated radiation doses from the shipments are much less than levels expected to cause an appreciable increase in the risk of cancer in crew members and the public. The highest fatality risks are from vehicle-related causes, with the risks for truck shipments being higher than for rail.

The highest radiological risks would be for routine transport by general train (0.03 crew LCFs) followed by truck (0.01 crew LCFs). In RADTRAN (Neuhauser and Kanipe 1992), rail crew risks are calculated for railcar inspectors in rail yards. During transport, members of the rail crew are assumed to be shielded completely by the locomotive(s) and any intervening railcars. The radiological risks from accidents are approximately 10 times lower than those for routine transport. No chemical impacts would occur under normal transport conditions because the package contents are assumed to remain confined. Chemical accident risks for the entire shipping campaign would be negligible for any transport option. No adverse effects (3.6×10^{-6} or less) or irreversible adverse effects (2.6×10^{-6} or less) are expected.

5.2.5.1.2 Ammonia. Anhydrous NH_3 would be transported to the conversion facility for generation of hydrogen, which is used in the conversion process. Collective population risks associated with the transport of NH_3 to the site are shown in Table 5.2-25 for three different distances between the origin of NH_3 and the site. When a distance of 620 mi (1,000 km) from the site is assumed and average accident rates and population densities are used, the number of adverse effects that are expected among the crew and the population along the transportation route would be about 5 for the truck option and about 1 for the rail option. For the same distance, less than 1 irreversible adverse effect or fatality would be expected for either transportation mode. As expected, the risks would be smaller for distances of less than 620 mi (1,000 km) and higher for greater distances.

TABLE 5.2-24 ETTP UF_6 Cylinder Shipments to Portsmouth

	DUF_6		Non-DUF_6	
Mode	Truck	Rail[a]	Truck	Rail[a]
Shipment summary				
Number of shipments	4,900	1,225	503	181
Total distance traveled (km)	2,380,000	872,000	244,000	129,000
Cargo-related[b]				
Radiological impacts				
Dose risk (person-rem)				
Routine crew	26	82	3.5	17
Routine public				
Off-link	0.28	1.2	0.11	0.25
On-link	0.82	0.046	0.32	0.0094
Stops	7.8	1.4	3.1	0.29
Total	8.9	2.6	3.5	0.55
Accident[c]	0.24	0.022	0.0011	5.2×10^{-5}
Latent cancer fatalities[d]				
Crew fatalities	0.01	0.03	0.001	0.007
Public fatalities	0.005	0.001	0.002	0.0003
Chemical impacts				
Adverse effects	3.6×10^{-6}	9.9×10^{-8}	0	0
Irreversible adverse effects	2.6×10^{-6}	7.6×10^{-8}	0	0
Vehicle-related[e]				
Emission fatalities	0.2	0.01	0.02	0.002
Accident fatalities	0.069	0.029	0.007	0.0043

[a] Risks are presented on a railcar basis. One shipment is equivalent to one railcar.

[b] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[c] Dose risk is a societal risk and is the product of accident probability and accident consequence.

[d] Latent cancer fatalities are calculated by multiplying dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

[e] Vehicle-related impacts are impacts independent of the cargo in the shipment.

TABLE 5.2-25 Collective Population Transportation Risks for Shipment of Anhydrous NH_3 to the Portsmouth Conversion Facility

	Distance to Conversion Facility (km)		
Mode	250	1,000	5,000
Truck Option			
Shipment summary			
Number of shipments	704	704	704
Total distance (km)	176,000	704,000	3,520,000
Cargo-related[a]			
Chemical impacts			
Adverse effects	1.3	5.3	26
Irreversible adverse effects	0.19	0.77	3.9
Vehicle related[b]			
Emission fatalities	0.02	0.07	0.3
Accident fatalities	0.0026	0.01	0.052
Rail Option			
Shipment summary			
Number of shipments	352	352	352
Total distance (km)	88,000	352,000	1,760,000
Cargo-related[a]			
Chemical impacts			
Adverse effects	0.29	1.2	5.8
Irreversible adverse effects	0.041	0.17	0.83
Vehicle-related[b]			
Emission fatalities	0.0009	0.004	0.02
Accident fatalities	0.0069	0.028	0.14

[a] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[b] Vehicle-related impacts are impacts independent of the cargo in the shipment.

5.2.5.1.3 Conversion Products. The transportation assessment for the shipment of depleted uranium conversion products for disposal considers several options. The proposed disposal site is the Envirocare facility. (A small number of empty cylinders may require disposal at NTS.) For shipments to Envirocare, rail is evaluated as the proposed mode and truck is evaluated as an alternative. In addition, NTS is considered as an alternative disposal site. For this alternative, both truck and rail modes are evaluated, although neither is currently proposed.

For assessment of the rail option to NTS, it is assumed that a rail spur would be built in the future to provide rail access to NTS. Currently, the nearest rail terminal is about 70 mi (113 km) from NTS. If a rail spur was not available in the future and if NTS was selected as the disposal site, shipments could be made by truck, or rail could be used with an intermodal transfer to trucks at some place near NTS. (Transportation impacts for the intermodal option would be slightly greater than those presented for rail assuming NTS rail access, but less than those presented for the truck alternative.) If a rail spur to NTS was built, the impacts would require additional NEPA review.

Estimates of the collective population risks for shipment of the U_3O_8, emptied cylinders, and CaF_2 to Envirocare over the entire 18-year operational period are presented in Table 5.2-26, by assuming the U_3O_8 product is shipped in bulk bags. As an option, risks for the shipment of these materials to NTS are provided in Table 5.2-27. No radiological LCFs, traffic fatalities, or emission fatalities are expected for rail transport under either option. If the truck option was used, about 1 traffic fatality would occur and up to 7 fatalities from vehicle emissions might occur over the project period. No LCFs are expected.

If the emptied DUF_6 cylinders were refilled with the U_3O_8 product and used to transport the product to the disposal facility, as proposed, the risks shown in Tables 5.2-26 and 5.2-27 for transportation of emptied cylinders would not be applicable, and the risks associated with transportation of CaF_2 would be the same. The risks of transporting the U_3O_8 product in cylinders would be about the same as the sum of the risks for transporting the product in bulk bags plus the risk of shipping the crushed cylinders for the truck option (Table 5.2-28), assuming two refilled cylinders per truck. If one cylinder per truck were shipped, routine risks to the crew and vehicle-related risks would approximately double because the number of shipments would double. If the rail option was used, the risks would be slightly higher for the cylinder refill option, primarily because the quantity of U_3O_8 shipped in a single railcar would be less under the cylinder refill option than under the bulk bag option, and the number of shipments would be proportionally higher.

The risks for shipping the HF co-product are presented in Table 5.2-29 for representative shipment distances of 250, 1,000, and 5,000 km (155, 620, and 3,100 mi) by using average accident rates and population densities. For shipment distances up to 5,000 km (3,100 mi), 1 traffic fatality might be expected for shipment of the HF by either truck or rail and up to 4 emission fatalities could occur for shipment by truck, with none expected for rail shipments. For chemical risks, approximately 1 irreversible adverse effect is estimated for both truck and rail transport. Thus, no chemical fatalities are expected because approximately 1% of the cases with irreversible adverse effects are expected to result in fatality (Policastro et al. 1997). Table 5.2-30 presents the risks associated with the shipment of CaF_2 to either Envirocare or NTS should the HF be neutralized and disposed of as waste. Shipment of the CaF_2 to either Envirocare or NTS would have similar impacts, approximately 10 and 0 emission fatalities for truck or rail, respectively, and about 1 traffic fatality if shipped by truck.

The results of the transportation analysis discussed above indicate that the largest impact during normal transportation conditions would be associated with vehicle exhaust and fugitive dust emissions (unrelated to the cargo). Health risks from cardiovascular and pulmonary diseases have been linked to incremental increases in particulate concentrations in air. However, estimating the health risks associated with vehicle emissions is subject to a great deal of

TABLE 5.2-26 Collective Population Transportation Risks for Shipment of Conversion Products to Envirocare as the Primary Disposal Site, Assuming the U_3O_8 Is Disposed of in Bulk Bags

	U_3O_8		Emptied Cylinders				CaF_2	
	Portsmouth to Envirocare		Portsmouth to Envirocare[a]		Portsmouth to NTS[b]		Portsmouth to Envirocare	
Mode	Truck (option)	Rail (proposed)[c]	Truck (option)	Rail (proposed)[c]	Truck (proposed)	Rail (option)[c]	Truck (option)	Rail (proposed)[c]
Shipment summary								
Number of shipments	8,846	2,212	2,007	1,004	2,232	558	15	4
Total distance (km)	25,860,000	7,315,000	5,866,000	3,320,000	7,504,000	2,240,000	43,850	13,230
Cargo-related[d]								
Radiological impacts								
Dose risk (person-rem)								
Routine crew	150	350	35	88	79	170	NA[e]	NA
Routine public								
Off-link	2.6	12	0.7	2.9	1.2	3.9	NA	NA
On-link	7.2	0.31	1.9	0.077	3.0	0.12	NA	NA
Stops	60	5.4	16	1.3	23	2.7	NA	NA
Total	70	17	19	4.3	27	6.6	NA	NA
Accident[f]	28	9.3	0.24	0.075	0.02	0.0062	NA	NA
Latent cancer fatalities[g]								
Crew fatalities	0.06	0.1	0.01	0.04	0.03	0.07	NA	NA
Public fatalities	0.05	0.01	0.009	0.002	0.01	0.003	NA	NA
Chemical impacts								
Adverse effects	0.0009	0.0003	NA	NA	NA	NA	NA	NA
Irreversible adverse effects	0.0001	0.00009	NA	NA	NA	NA	NA	NA
Vehicle-related[h]								
Emission fatalities	5	0.2	1	0.1	2	0.05	0.008	0.0005
Accident fatalities	0.53	0.24	0.12	0.11	0.13	0.061	0.0009	0.00043

[a] Emptied cylinders are crushed and shipped 10 per cargo container, with 1 container per truck or 2 containers per railcar.

[b] Cylinders assumed not to meet waste acceptance criteria for Envirocare. Shipped “as-is” one per truck or four per railcar.

[c] Risks are presented on a railcar basis. One shipment is equivalent to one railcar. For assessment purposes, it was assumed that rail access to NTS would be available in the future.

[d] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[e] NA = not applicable.

[f] Dose risk is a societal risk and is the product of accident probability and accident consequence.

[g] Latent cancer fatalities were calculated by multiplying the dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

[h] Vehicle-related impacts are impacts independent of the cargo in the shipment.

TABLE 5.2-27 Collective Population Transportation Risks for Shipment of Conversion Products to NTS as an Optional Disposal Site, Assuming the U_3O_8 Is Disposed of in Bulk Bags

	U_3O_8		Emptied Cylinders				CaF_2	
	Portsmouth to NTS		Portsmouth to NTS[a]		Portsmouth to NTS[b]		Portsmouth to Envirocare	
Mode	Truck (option)	Rail (option)[c]	Truck (option)	Rail (option)[c]	Truck (option)	Rail (option)[c]	Truck (option)	Rail (option)[c]
Shipment summary								
Number of shipments	8,846	2,212	2,007	1,004	2,232	558	15	4
Total distance (km)	29,740,000	8,879,000	6,748,000	4,030,000	7,504,000	2,240,000	43,850	13,230
Cargo-related[d]								
Radiological impacts								
Dose risk (person-rem)								
Routine crew	180	410	41	100	79	170	NA[e]	NA
Routine public								
Off-link	3.6	9.2	0.96	2.3	1.2	3.9	NA	NA
On-link	9.0	0.28	2.4	0.069	3.0	0.12	NA	NA
Stops	69	6.4	18	1.6	23	2.7	NA	NA
Total	82	16	22	3.9	27	6.6	NA	NA
Accident[f]	20	7.5	0.18	0.053	0.02	0.0062	NA	NA
Latent cancer fatalities[g]								
Crew fatalities	0.07	0.2	0.02	0.04	0.03	0.07	NA	NA
Public fatalities	0.05	0.01	0.01	0.002	0.01	0.003	NA	NA
Chemical impacts								
Adverse effects	0.001	0.0004	NA	NA	NA	NA	NA	NA
Irreversible adverse effects	0.0002	0.0001	NA	NA	NA	NA	NA	NA
Vehicle-related[h]								
Emission fatalities	6	0.2	1	0.09	2	0.05	0.008	0.0005
Accident fatalities	0.53	0.24	0.12	0.11	0.13	0.061	0.0009	0.00043

[a] Cylinders are crushed and shipped 10 per cargo container, with 1 container per truck or 2 containers per railcar.

[b] Cylinders assumed not to meet waste acceptance criteria for Envirocare. Shipped “as-is” one per truck or four per railcar.

[c] Risks are presented on a railcar basis. One shipment is equivalent to one railcar. For assessment purposes, it was assumed that rail access to NTS would be available in the future.

[d] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[e] NA = not applicable.

[f] Dose risk is a societal risk and is the product of accident probability and accident consequence.

[g] Latent cancer fatalities were calculated by multiplying the dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

[h] Vehicle-related impacts are impacts independent of the cargo in the shipment.

TABLE 5.2-28 Collective Population Transportation Risks for Shipment of U_3O_8 Conversion Products in Emptied Cylinders

Mode	Portsmouth to Envirocare (proposed)			Portsmouth to NTS (option)		
	Truck (option)		Rail (proposed)	Truck (option)		Rail[a] (option)
	1 cylinder	2 cylinders		1 cylinder	2 cylinders	
Shipment summary						
Number of shipments	21,000	10,500	4,200	21,000	10,500	4,200
Total distance (km)	61,380,000	30,690,000	13,890,000	70,600,000	35,300,000	16,860,000
Cargo-related[b]						
Radiological impacts						
Dose risk (person-rem)						
Routine crew	330	180	520	390	210	600
Routine public						
Off-link	4.5	4.5	19	6.1	6.2	15
On-link	12	12	0.52	15	15	0.46
Stops	100	100	8.8	120	120	10
Total	120	120	29	140	140	26
Accident	31	31	10	21	21	8
Latent cancer facilities						
Crew fatalities	0.1	0.07	0.2	0.2	0.08	0.2
Public fatalities	0.07	0.08	0.02	0.08	0.08	0.02
Chemical impacts						
Adverse effects	0.0008	0.0008	0.0004	0.0009	0.0009	0.0005
Irreversible adverse effects	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Vehicle-related[c]						
Emission fatalities	10	5	0.5	10	7	0.4
Accident fatalities	1.3	0.63	0.45	1.3	0.63	0.46

[a] For assessment purposes, it was assumed that rail access to NTS would be available in the future.

[b] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[c] Vehicle-related impacts are impacts independent of the cargo in the shipment.

uncertainty. The estimates presented in this EIS were based on very conservative health risk factors presented in Biwer and Butler (1999) and should be considered an upper bound. For perspective, in a recently published EIS for a geologic repository at Yucca Mountain, Nevada, (DOE 2002h), 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.

TABLE 5.2-29 Collective Population Transportation Risks for Shipment of the HF Conversion Co-Product from the Portsmouth Site to Commercial Users

	49% HF			70% HF		
Mode	250 km	1,000 km	5,000 km	250 km	1,000 km	5,000 km
Truck Option						
Shipment summary						
Number of shipments	5,792	5,792	5,792	2,417	2,417	2,417
Total distance (km)	1,448,000	5,792,000	28,960,000	604,250	2,417,000	12,085,000
Cargo-related[a]						
Chemical impacts						
Adverse effects	0.13	0.54	2.7	0.50	2.0	10
Irreversible adverse effects	0.011	0.045	0.23	0.040	0.16	0.81
Vehicle-related[b]						
Emission fatalities	0.1	0.5	3	0.06	0.2	1
Accident fatalities	0.022	0.086	0.43	0.0090	0.036	0.18
Rail Option						
Shipment summary						
Number of shipments	1,159	1,159	1,159	484	484	484
Total distance (km)	289,750	1,159,000	5,795,000	121,000	484,000	2,420,000
Cargo-related[a]						
Chemical impacts						
Adverse effects	0.19	0.74	3.7	0.48	1.9	9.7
Irreversible adverse effects	0.012	0.047	0.23	0.04	0.16	0.79
Vehicle-related[b]						
Emission fatalities	0.003	0.01	0.06	0.001	0.005	0.02
Accident fatalities	0.023	0.091	0.45	0.0095	0.038	0.19

[a] Cargo-related impacts are impacts attributable to the radioactive or chemical nature of the material being transported.

[b] Vehicle-related impacts are impacts independent of the cargo in the shipment.

5.2.5.2 Maximally Exposed Individuals during Routine Conditions

During the routine transportation of radioactive material, specific individuals may be exposed to radiation in the vicinity of a shipment. RISKIND (Yuan et al. 1995) has been used to estimate the risk to these individuals for a number of hypothetical exposure-causing events. The receptors include transportation crew members, inspectors, and members of the public exposed during traffic delays, while working at a service station, or while living near an origin or a destination site. The assumptions about exposure are given in Biwer et al. (2001). The scenarios for exposure are not meant to be exhaustive; they were selected to provide a range of

TABLE 5.2-30 Collective Population Transportation Risks for Shipment of CaF_2 for the Neutralization Option

Parameter	Truck (option)	Rail (proposed)[a]
Number of shipments	13,559	3,390
Portsmouth to Envirocare option		
Total distance (km)	39,630,000	11,210,000
Emission fatalities	7	0.4
Accident fatalities	0.81	0.37
Portsmouth to NTS option		
Total distance (km)	45,590,000	13,610,000
Emission fatalities	10	0.3
Accident fatalities	0.82	0.37

[a] Risks are presented on a railcar basis. One shipment is equivalent to one railcar.

representative potential exposures. Doses were assessed and are presented in Table 5.2-31 on a per-event basis for the shipments of all radioactive materials.

On a per-shipment basis, the radiological risks to an MEI during routine transportation would be slightly higher for non-DUF_6 shipments than for depleted uranium shipments because a higher external dose rate is assumed. The highest potential routine radiological exposure to an MEI, with an LCF risk of 3×10^{-7}, would be for a person stopped in traffic near a rail shipment of non-DUF_6 cylinders from ETTP for 30 min at a distance of 3 ft (1 m). There is also the possibility for multiple exposures. For example, if an individual lived near the Portsmouth site and all shipments of U_3O_8 were made by rail in bulk bags, the resident could receive a combined dose of approximately 2.4×10^{-5} rem if present for all shipments (calculated as the product of about 2,200 shipments and an estimated exposure per shipment of 1.1×10^{-8} rem). The individual dose would increase by a factor of 2 approximately if the U_3O_8 product was shipped in refilled cylinders. This dose is still very low, however — more than 6,000 times lower than the individual average annual exposure of 0.3 rem from natural background radiation.

5.2.5.3 Accident Consequence Assessment

Whereas the collective accident risk assessment considers the entire range of accident severities and their related probabilities, the accident consequence assessment assumes that an accident of the highest severity category has occurred. The consequences, in terms of committed dose (rem) and LCFs for radiological impacts and in terms of adverse affects and irreversible adverse effects for chemical impacts, were calculated for both exposed populations and

TABLE 5.2-31 Estimated Radiological Impacts to the MEI from Routine Shipment of Radioactive Materials from the Portsmouth Conversion Facility

Material	Mode	Inspector	Resident	Person in Traffic	Person at Gas Station	Person near Rail Stop
Routine Radiological Dose from a Single Shipment (rem)						
DUF_6	Truck	6.3×10^{-5}	5.4×10^{-9}	2.3×10^{-4}	7.5×10^{-6}	NA[a]
	Rail	1.1×10^{-4}	1.5×10^{-8}	2.6×10^{-4}	NA	9.3×10^{-7}
Non-DUF_6	Truck	1.4×10^{-4}	2.0×10^{-8}	5.0×10^{-4}	2.7×10^{-5}	NA
	Rail	1.8×10^{-4}	2.5×10^{-8}	5.0×10^{-4}	NA	1.6×10^{-6}
Depleted U_3O_8 (in bulk bags)[b]	Truck	4.0×10^{-5}	3.1×10^{-9}	1.6×10^{-4}	4.4×10^{-6}	NA
	Rail	9.3×10^{-5}	1.1×10^{-8}	2.7×10^{-4}	NA	6.9×10^{-7}
Crushed heel cylinders[c]	Truck	5.3×10^{-5}	5.7×10^{-9}	1.6×10^{-4}	7.7×10^{-6}	NA
	Rail	6.6×10^{-5}	9.4×10^{-9}	1.7×10^{-4}	NA	6.1×10^{-7}
Heel cylinders[d]	Truck	6.8×10^{-5}	5.4×10^{-9}	2.7×10^{-4}	7.5×10^{-6}	NA
	Rail	1.5×10^{-4}	2.0×10^{-8}	4.0×10^{-4}	NA	1.3×10^{-6}
Routine Radiological Risk from a Single Shipment (lifetime risk of a LCF)[e]						
DUF_6	Truck	3×10^{-8}	3×10^{-12}	1×10^{-7}	4×10^{-9}	NA
	Rail	6×10^{-8}	8×10^{-12}	1×10^{-7}	NA	5×10^{-10}
Non-DUF_6	Truck	9×10^{-8}	1×10^{-11}	3×10^{-7}	1×10^{-8}	NA
	Rail	9×10^{-8}	1×10^{-11}	3×10^{-7}	NA	8×10^{-10}
Depleted U_3O_8 (in bulk bags)[b]	Truck	2×10^{-8}	2×10^{-12}	8×10^{-8}	2×10^{-9}	NA
	Rail	5×10^{-8}	6×10^{-12}	1×10^{-7}	NA	4×10^{-10}
Crushed heel cylinders[c]	Truck	3×10^{-8}	3×10^{-12}	8×10^{-8}	4×10^{-9}	NA
	Rail	3×10^{-8}	5×10^{-12}	8×10^{-8}	NA	3×10^{-10}
Heel cylinders[d]	Truck	3×10^{-8}	3×10^{-12}	1×10^{-7}	4×10^{-9}	NA
	Rail	7×10^{-8}	1×10^{-11}	2×10^{-7}	NA	6×10^{-10}

[a] Not applicable.

[b] Per-shipment doses and LCFs would be approximately the same for the cylinder refill option.

[c] Crushed heel cylinders are shipped 10 per cargo container, with 1 container per truck or 2 containers per railcar.

[d] Cylinders assumed not to meet waste acceptance criteria for Envirocare. Shipped “as-is,” one per truck or four per railcar.

[e] LCFs were calculated by multiplying the dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

individuals in the vicinity of an accident. Tables 5.2-32 and 5.2-33 present the radiological and chemical consequences, respectively, to the population from severe accidents involving shipment of DUF_6, depleted U_3O_8, emptied heel cylinders, anhydrous NH_3, and aqueous HF.

Because the average uranium content of each non-DUF_6 cylinder shipment is much less than that of a DUF_6 cylinder shipment (the *total* amount of UF_6 in the non-DUF_6 cylinders is approximately 25 t [28 tons], compared with approximately 12 t [13 tons] in *each* DUF_6 cylinder), a separate accident consequence assessment was not conducted for non-DUF_6 cylinder shipments. The potential impacts of the highest-consequence accidents for non-DUF_6 cylinder shipments would be much less than those presented in Tables 5.2-32 and 5.2-33 for DUF_6 shipments.

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 cylinders of enriched UF_6 in transit during routine and accident conditions is ensured by use of regulatory approval packages that provide protection against impact and fire. Consequently, because of these controls and the relatively small number of shipments containing enriched UF_6, the occurrence of an inadvertent criticality is not considered to be credible and therefore is not analyzed in the accident consequence assessment in this EIS.

No LCFs are expected for accidents involving heel cylinders; however, up to 3 or 60 LCFs might occur following a severe urban rail accident involving a railcar of U_3O_8 or DUF_6, respectively. Severe rail accidents could have higher consequences than truck accidents because each railcar would carry more material than each truck. The highest consequences were estimated on the basis of the assumption that the accident occurred in an urban area under stable weather conditions (such as at nighttime).

In a highly populated urban area, it is estimated that about 3 million people could be exposed to small amounts of uranium as it was dispersed by the wind. Among those exposed, it is estimated that approximately 60 LCFs could occur in the urban population in addition to those occurring from all other causes. For comparison, in a population of 3 million people, approximately 700,000 are expected to die of cancer from all causes. The occurrence of a severe rail accident in an urban area under stable weather conditions are expected to be rare. The consequences of cylinder accidents occurring in rural environments, during unstable weather conditions (typical of daytime) or involving a truck shipment, were also assessed. The consequences of all other accident conditions are estimated to be considerably less than those described above for the severe urban rail accident.

A comparison of Tables 5.2-32 and 5.2-33 indicates that severe accidents involving chemicals transported to and from the conversion facility site could have higher consequences

TABLE 5.2-32 Potential Radiological Consequences to the Population from Severe Transportation Accidents[a]

		Neutral Meteorological Conditions			Stable Meteorological Conditions		
Material	Mode	Rural	Suburban	Urban[b]	Rural	Suburban	Urban[b]
Radiological Dose (person-rem)							
DUF_6	Truck	590	580	1,300	15,000	15,000	32,000
	Rail	2,400	2,300	5,200	60,000	58,000	130,000
Depleted U_3O_8 (in bulk bags)	Truck	250	250	550	630	610	1,400
	Rail	1,000	990	2,200	2,500	2,400	5,400
Depleted U_3O_8 (1 cylinder)	Truck	120	110	250	280	280	620
	Rail	290	280	630	710	690	1,500
Depleted U_3O_8 (2 cylinders)	Truck	230	230	500	570	550	1,200
	Rail	580	560	1,300	1,400	1,400	3,100
Crushed heel cylinders[c]	Truck	2.5	0.67	1.5	4.4	1.2	2.6
	Rail	5.0	1.3	3.0	8.7	2.3	5.2
Heel cylinders[d]	Truck	0.25	0.067	0.15	0.44	0.12	0.26
	Rail	1.0	0.27	0.60	1.7	0.47	1.0
Radiological Risk (LCF)[e]							
DUF_6	Truck	0.3	0.3	0.6	7	7	20
	Rail	1	1	3	30	30	60
Depleted U_3O_8 (in bulk bags)	Truck	0.1	0.1	0.3	0.3	0.3	0.7
	Rail	0.5	0.5	1	1	1	3
Depleted U_3O_8 (1 cylinder)	Truck	0.06	0.06	0.1	0.1	0.1	0.3
	Rail	0.1	0.1	0.3	0.4	0.3	0.8
Depleted U_3O_8 (2 cylinders)	Truck	0.1	0.1	0.3	0.3	0.3	0.6
	Rail	0.3	0.3	0.6	0.7	0.7	2
Crushed heel cylinders[c]	Truck	0.001	0.0003	0.0007	0.002	0.0006	0.001
	Rail	0.002	0.0007	0.001	0.004	0.001	0.003
Heel cylinders[d]	Truck	0.0001	3×10^{-5}	7×10^{-5}	0.0002	6×10^{-5}	0.0001
	Rail	0.0005	0.0001	0.0003	0.0009	0.0002	0.0005

[a] National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons/km^2, 719 persons/km^2, and 1,600 persons/km^2 for rural, suburban, and urban zones, respectively. Potential impacts were estimated for the population within a 50-mi (80-km) radius, assuming a uniform population density for each zone.

[b] It is important to note that the urban population density generally applies to a relatively small urbanized area — very few, if any, urban areas have a population density as high as 1,600 persons/km^2 extending as far as 50 mi (80 km). The urban population density corresponds to approximately 32 million people within the 50-mi (80-km) radius, well in excess of the total populations along the routes considered in this assessment.

[c] Crushed heel cylinders are shipped 10 per cargo container, with 1 container per truck or 2 containers per railcar.

[d] Cylinders assumed not to meet waste acceptance criteria for Envirocare. Shipped "as-is," one per truck or four per railcar.

[e] LCFs were calculated by multiplying the dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

TABLE 5.2-33 Potential Chemical Consequences to the Population from Severe Transportation Accidents[a]

		Neutral Meteorological Conditions			Stable Meteorological Conditions		
Chemical Effect	Mode	Rural	Suburban	Urban[b]	Rural	Suburban	Urban[b]
Number of Persons with the Potential for Adverse Health Effects							
DUF_6	Truck	0	2	4	6	760	1,700
	Rail	4	420	940	110	13,000	28,000
Depleted U_3O_8 (in bulk bags)	Truck	0	1	1	0	12	28
	Rail	0	3	9	0	47	103
Depleted U_3O_8 (in cylinders)	Truck (1 cylinder)	0	0	1	0	6	13
	Truck (2 cylinders)	0	1	1	0	11	26
	Rail	0	2	5	0	27	58
Anhydrous NH_3	Truck	6	710	1,600	55	6,600	15,000
	Rail	10	1,100	2,500	90	11,000	24,000
49% HF	Truck	0.35	42	93	3.4	400	900
	Rail	0.99	120	270	7.3	880	1,900
70% HF	Truck	2.8	340	760	44	5,200	12,000
	Rail	9.3	1,100	2,500	110	14,000	30,000
Number of Persons with the Potential for Irreversible Adverse Health Effects[c]							
DUF_6	Truck	0	1	2	0	1	3
	Rail	0	1	3	0	2	4
Depleted U_3O_8 (in bulk bags)	Truck	0	0	0	0	5	10
	Rail	0	0	0	0	17	38
Depleted U_3O_8 (in cylinders)	Truck (1 cylinder)	0	0	0	0	2	5
	Truck (2 cylinders)	0	0	0	0	4	8
	Rail	0	1	1	0	10	22
Anhydrous NH_3	Truck	0.8	100	200	10	1,000	3,000
	Rail	1	200	400	20	2,000	5,000
49% HF	Truck	0.025	3.0	6.6	0.25	30	66
	Rail	0.081	9.7	22	0.62	74	160
70% HF	Truck	0.23	27	60	2.0	240	540
	Rail	0.77	92	210	6.7	800	1,800

Footnotes on next page.

TABLE 5.2-33 (Cont.)

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[a] National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons/km^2, 719 persons/km^2, and 1,600 persons/km^2 for rural, suburban, and urban zones, respectively. Potential impacts were estimated for the population within a 50-mi (80-km) radius, assuming a uniform population density for each zone.

[b] It is important to note that the urban population density generally applies to a relatively small urbanized area — very few, if any, urban areas have a population density as high as 1,600 persons/km^2 extending as far as 50 mi (80 km). The urban population density corresponds to approximately 32 million people within the 50-mi (80-km) radius, well in excess of the total populations along the routes considered in this assessment.

[c] The potential for irreversible adverse effects from chemical exposures. Exposure to HF or uranium compounds is estimated to result in fatality to approximately 1% or less of those persons experiencing irreversible adverse effects (Policastro et al. 1997). Exposure to anhydrous NH_3 is estimated to result in fatality to approximately 2% of those persons experiencing irreversible adverse effects (Policastro et al. 1997).

than radiological accidents. For example, a severe rail accident involving transportation of anhydrous NH_3 to a site in an urban area under stable meteorological conditions could lead to 5,000 irreversible adverse effects. Among the individuals experiencing these irreversible effects, there could be close to 100 fatalities (about 2% of the irreversible adverse effects [Policastro et al. 1997]). Similarly, a 70% aqueous HF rail accident under the same conservative assumptions could result in approximately 1,800 irreversible adverse effects and 18 fatalities. As indicated in Table 5.2-33, the consequences would be considerably less if the accident occurred in a less populated area under neutral meteorological conditions. Consequences would also be less if a truck was involved in the accident rather than a railcar, because the truck would carry less material than a railcar.

Accidents for which consequences are provided in Tables 5.2-32 and 5.2-33 are extremely rare. For example, the average accident rate for interstate-registered heavy combination trucks is approximately 3.0×10^{-7} per kilometer (Saricks and Tompkins 1999). The conditional probability that a given accident would be a severe accident is on the order of 0.06 in rural and suburban areas and about 0.007 in urban areas (NRC 1977). Therefore, the frequency of a severe accident per kilometer of travel in an urban area is about 2×10^{-9}. For shipment of NH_3 to the site, the total distance traveled is estimated to be about 435,000 mi (700,000 km) if the NH_3 is transported from a location 620 mi (1,000 km) away from the conversion site (Table 5.2-25). The fraction of the distance traveled in urban areas is generally less than 5% (DOE 2002g, Table 6.10). If 5% is assumed, the total distance traveled in urban areas would be about 22,000 mi (35,000 km). On the basis of these assumptions, the probability of a severe NH_3 accident occurring in an urban area is about 7×10^{-5}. In general, stable weather conditions occur only about one-third of the time, resulting in a probability for the most severe anhydrous NH_3 accident listed in Table 5.2-33 of about 2×10^{-5} (or a 1-in-50,000 chance of occurrence) during the 18-year operational period. This means that such an accident is expected to occur about once every 900,000 years. Similarly, the severe aqueous 70% HF transportation truck accident is expected to occur about once in every 250,000 or more years of operation (i.e., it has about a 1-in-10,000 chance of occurring over the 18-year operational period).

The probability of a rail accident involving anhydrous NH_3 or 70% HF is even less than 2×10^{-5} or 1×10^{-4}, respectively, over the 18-year operational period, because the accident rates for railcars are lower (generally by about a factor of 5, see Table 6 in Saricks and Tompkins [1999]) and the total distance traveled by train is less (generally by about a factor of 2 to 4) for shipments of the same quantity of material over the same distance (because the railcar capacity is larger than the truck capacity). The conditional probability of a severe rail accident is about the same as that of a severe truck accident (about 0.05 in rural and suburban areas and about 0.008 in urban areas). Therefore, the probabilities of severe rail accidents over the same operational period are about 10 to 20 times less than the severe truck accidents.

Conservative estimates of consequences to the MEI located 100 ft (30 m) away from the accident site along the transportation route are also made for shipment of DUF_6 cylinders, depleted U_3O_8, emptied heel cylinders (assuming they are not used as containers for depleted U_3O_8), anhydrous NH_3, and aqueous HF. The results for radiological impacts are shown in Table 5.2-34. Under the conservative assumptions described above for consequences to the population, it is estimated that the MEI could receive a dose of up to 3.7 rem in accidents involving DUF_6 cylinders and up to 1.3 rem in accidents involving emptied cylinders. However, for shipment of the depleted U_3O_8 product by train, the MEI dose could be as high as 670 rem if the product was shipped in bulk bags and 380 rem if it was shipped in emptied DUF_6 cylinders. For shipment by truck, the MEI dose would be 170 rem with bulk bags and 150 rem with refilled cylinders (two per truck). The dose received by the individual would decrease quickly as the person's distance from the accident site increased. For example, at a distance of 328 ft (100 m), the dose would be reduced by a factor of about 6 (to about 110 rem and 60 rem for train accidents with bulk bags and refilled cylinders, respectively, and to about 28 rem and 25 rem for truck accidents with bulk bags and refilled cylinders, respectively). If the person was located at a distance of 100 ft (30 m) and if the accident occurred under the most severe conditions described above, the individual could suffer acute and potentially lethal consequences from both radiation exposure and the chemical effects of uranium. At 328 ft (100 m) or farther from the accident, the MEI would not be expected to suffer acute effects. However, the chance of the MEI developing a latent cancer would increase by about 10% for the train accident and about 3% for the truck accident under those conditions. For accidents involving DUF_6 cylinders, anhydrous NH_3, and aqueous HF, the MEI would likely experience an irreversible health effect or death, depending on the severity of the accident, weather conditions, and distance at the time of the accident.

Even though the risks are relatively low, the consequences of a few of the transportation accidents are considered to be high. These high-consequence accidents are generally associated with the transportation of anhydrous NH_3 to the site and aqueous HF and depleted U_3O_8 from the site. The consequences can be reduced or mitigated through design (e.g., by limiting the quantity of material per vehicle), operational procedures (e.g., by judicial selection of routes and times of travel, increased protection and tracking of transport vehicles), and emergency response actions (e.g., by sheltering, evacuation, and interdiction of contaminated food materials following an accident.)

TABLE 5.2-34 Potential Radiological Consequences to the MEI from Severe Transportation Accidents Involving Shipment of Radioactive Materials

	Neutral Meteorological Conditions		Stable Meteorological Conditions	
Mode	Dose (rem)	Radiological Risk (LCF)[a]	Dose (rem)	Radiological Risk (LCF)[a]
DUF_6				
Truck	0.43	0.0002	0.91	0.0004
Rail	1.7	0.0009	3.7	0.002
Depleted U_3O_8 (in bulk bags)				
Truck	11	0.005	170[b]	0.08
Rail	42	0.02	670[b]	0.3
Depleted U_3O_8 (1 cylinder)				
Truck	4.8	0.002	76	0.04
Rail	12	0.006	190	0.09
Depleted U_3O_8 (2 cylinders)				
Truck	9.6	0.005	150[b]	0.08
Rail	24	0.01	380[b]	0.2
Crushed heel cylinders[c]				
Truck	0.28	0.0001	0.63	0.0003
Rail	0.55	0.0003	1.3	0.0006
Heel cylinders[d]				
Truck	0.028	1×10^{-5}	0.063	3×10^{-5}
Rail	0.11	6×10^{-5}	0.25	0.0001

[a] LCFs were calculated by multiplying the dose by the ICRP Publication 60 health risk conversion factors of 4×10^{-4} fatal cancers per person-rem for workers and 5×10^{-4} for the public (ICRP 1991).

[b] See text for discussion. Because of the conservative assumptions made in deriving the numbers in this table, the MEI is likely to receive a dose that is less than shown here. However, if the doses were as high as those shown in the table, the MEI could develop acute radiation effects. The individual might also suffer from chemical effects due to uranium intake.

[c] Crushed heel cylinders are shipped 10 per cargo container, with 1 container per truck or 2 containers per railcar.

[d] Shipped “as is,” one cylinder per truck or four cylinders per railcar.

5.2.5.4 Historical Safety Record of Anhydrous NH_3 and HF Transportation in the United States

Anhydrous NH_3 is routinely shipped commercially in the United States for industrial and agricultural applications. Information provided in the DOT *Hazardous Material Incident System (HMIS) Database* (DOT 2003b) for 1990 through 2002 indicates that 2 fatalities and 19 major injuries to the public or to transportation or emergency response personnel occurred as a result of anhydrous NH_3 releases during 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, greater than 10,000 gal (38,000 L), occurred; however, these spills were 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 of Texas and Idaho and resulted in 1 major injury. The Idaho spill in 1990 required the evacuation of 200 people. For highway shipments, 1 truck transport and 3 loading/unloading accidents occurred that involved large anhydrous NH_3 spills of between 4,000 and 8,000 gal (15,000 and 30,000 L). The 1 en route truck accident involving the largest truck spill (in Iowa on May 3, 1996) resulted in 1 fatality and the evacuation of 40 people. The other 3 large truck shipment spills occurred during loading/unloading operations but did not result in any fatalities. However, one of the spills involved a major injury and required the evacuation of 14 people in addition to the treatment of 26 with minor injuries.

Over the past 30 years, the safety record for transporting anhydrous NH_3 has significantly improved as a result of several factors. Hazardous compressed gas truck shipment loading and unloading operations require strict conformance with DOT standards for safety valve design and specifications, in addition to requirements on the installation of measuring and sampling devices. Federal rules governing the transportation of hazardous materials (49 CFR 173) require that valves installed for tank venting, loading, and unloading operations must be “of approved design, made of metal not subject to rapid deterioration by the lading, and must withstand the tank test pressure without leakage.” The MC331 compressed gas tanker trucks, which would most likely be used to ship anhydrous NH_3 to the DUF_6 conversion facility, must be equipped with check valves to prevent the occurrence of a large spill (e.g., a spill from a feed line disconnection during a loading operation). These valves are typically located near the front end of a MC331 tanker truck and close to the driver’s cab. Although not specifically required by DOT regulations, excess flow valves may be installed to prevent a catastrophic spill in the event that the driver is unable to reach the manual check valve to cut off flow from a failed feed line or loading tank valve. Safety measures contributing to the improved safety record over the past 30 years 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.

Most of the HF transported in the United States is anhydrous HF, which is more hazardous than the aqueous HF. Since 1971, which is the period covered by DOT records (DOT 2003b), 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. Over the period 1971 to 2003, 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 discussed above for NH_3.

5.2.6 Impacts Associated with HF and CaF_2 Conversion Product Sale and Use

During the conversion of the DUF_6 inventory to depleted uranium oxide, products having some potential for reuse would be produced. These products would include HF and CaF_2, which are commonly used as commercial materials. An analysis of impacts associated with their potential reuse 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 within the United States if the products were sold. Because there would be some residual radioactivity associated with these materials, a description of the DOE process for authorizing release of materials for unrestricted use (referred to as “free release”) and a bounding estimate of the potential human health effects of such free release were included in the analysis. Details on the analysis are presented in Appendix E and are summarized below.

One of the chemicals produced during conversion would be an aqueous HF acid-water solution of 55% strength. The predominant markets for HF acid call for 49% and 70% HF solutions; consequently, this product would be further processed to yield these strengths. In the preferred design, a small amount of solid CaF_2 would also be produced.

Table 5.2-35 gives the approximate quantities of HF and CaF_2 that would be produced annually in the preferred designs. The quantities are based on the assumption that there would be a viable economic market for the aqueous HF produced. If such a market did not exist, UDS proposes that it would convert all of the HF to CaF_2 and then either sell this product or dispose of it as LLW or solid waste. The approximate quantity of CaF_2 produced in this scenario would be 8,800 t (9,700 tons) at the Portsmouth site.

Because it is expected that the UDS-produced HF and CaF_2 would contain small amounts of volumetrically distributed residual radioactive material, neither could be sold for unrestricted use, and CaF_2 could not be disposed of as solid waste, unless DOE established authorized limits for radiological contamination in HF and CaF_2. UDS would be required to apply for appropriate authorized limits, according to whether HF and CaF_2 were sold, or CaF_2 was disposed of as solid

TABLE 5.2-35 Products from DUF_6 Conversion (t/yr)

Product	Portsmouth	Paducah	Total
Depleted uranium oxide	10,800	14,300	25,100
HF acid (55% solution)	8,200	11,000	19,300
CaF_2	18	24	42

waste. In this context, authorized limits would be the maximum concentrations of radioactive contaminants allowed to remain volumetrically distributed within the HF or CaF_2. The dose analysis presented in this EIS was not conducted to establish authorized limits.

The potential, bounding exposure rate for a hypothetical worker working in close proximity to an HF storage tank was estimated to be 0.034 mrem/yr on the basis of very conservative assumptions. Similar bounding estimates of the exposure rate to a worker in close proximity to a CaF_2 handling process yielded 0.23 mrem/yr. The radiation sources contributing to the bounding exposure rate for HF were external radiation and inhalation. For CaF_2, in addition to external radiation and inhalation, the bounding exposure also resulted from an assumed incidental ingestion. Given more realistic exposure conditions, the potential dose would be much smaller than the bounding estimates. Potential exposures to product users would be much smaller than those to workers. Detailed discussions on the assumptions for bounding exposure are provided in Appendix E.

Socioeconomic impact analyses were conducted to evaluate the impacts of the introduction of the UDS-produced HF or CaF_2 into the commercial marketplace. The current aqueous HF acid producers have been identified as a potential market for the aqueous HF acid (UDS 2003b), with UDS-produced aqueous HF replacing some or all of current U.S. production. The impact of HF sales on the local economy in which the existing producers were located and on the U.S. economy as a whole would likely be minimal.

No market for the 22,000 t (24,000 tons) of CaF_2 that might be produced in the proposed conversion facilities at Paducah and Portsmouth has been identified (UDS 2003a). Should such a market be found, the impact of CaF_2 sales on the U.S. economy would likely be minimal.

In the event that no market for either HF or CaF_2 is established, the HF would be neutralized in a process that would produce additional CaF_2. It is likely that the CaF_2 would be disposed of as waste. This would require shipping it to an approved solid waste or LLW disposal facility. While disposal activities would produce a small number of transportation jobs and might lead to additional jobs at the waste disposal facility, the impact of these activities in the transportation corridors, at the waste disposal site(s), and on the U.S. economy would be minimal.

5.2.7 Impacts If ETTP Cylinders Are Shipped to Paducah Rather Than to Portsmouth

Current DOE plans call for the cylinders at ETTP to be shipped to Portsmouth. However, the option of sending the ETTP cylinders to Paducah instead is considered in this section.

If the ETTP DUF_6 cylinders were shipped to Paducah, the Portsmouth conversion plant would operate for 14 years rather than 18 years to convert the Portsmouth inventory. Potential impacts associated with transportation to and conversion of the ETTP cylinders at Paducah are evaluated in detail in the site-specific Paducah conversion facility EIS (DOE/EIS-0359). Facility construction impacts would be the same as discussed in Section 5.2.2. The annual operational impacts would be the same as described in Section 5.2.3 because the facility throughput would be the same; however, impacts would occur over only a 14-year period rather than 18 years. In addition, the radiation doses to cylinder yard workers handling the ETTP cylinders, described in Section 5.2.2.1, would not be incurred.

5.2.8 Potential Impacts Associated with the Option of Expanding Conversion Facility Operations

As discussed in Section 2.2.7, 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. Specifically, the throughput of the facility could be increased through process improvements or a fourth process line could be added at Portsmouth. The facility also could be operated beyond the currently planned 18-year period in order to process additional DUF_6 that might be transferred to DOE at some time in the future (such as DUF_6 generated by USEC or another commercial enrichment facility). In addition, it is possible that DUF_6 cylinders could be transferred from Paducah to Portsmouth to facilitate conversion of the entire inventory, particularly if DOE assumes responsibility for additional DUF_6 at Paducah and not at Portsmouth.

To account for these future possibilities and provide future planning flexibility, this section includes an evaluation of the environmental impacts associated with expanding conversion facility operations at Portsmouth, either by increasing throughput or by extending operations. In addition, potential environmental impacts associated with possible Paducah-to-Portsmouth cylinder shipments are also evaluated in this section.

5.2.8.1 Potential Impacts Associated with Increasing Plant Throughput

The throughput of the Portsmouth facility could be increased either by process efficiency improvements or by adding an additional (fourth) process line. DOE believes that higher throughput rates can be achieved by improving the efficiency of the planned equipment (DOE 2004b). The conversion contract provides significant incentives to the conversion contractor to improve efficiency. For example, the current facility designs are based on an assumption that the conversion plant would have an 84% on-line availability (percent of time system is on line and operational). However, on the basis of Framatome's experience at the Richland plant, the on-line availability is expected to be at least 90%. Therefore, there is additional capacity expected to be realized in the current design.

If the plant throughput was marginally increased by process improvements, the environmental impacts during operations could increase for some areas but still would be similar to those discussed in Section 5.2.3 for the base design. For example, annual radiation doses to workers and the public from site emissions might increase in proportion to throughput. 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. As discussed in Section 5.2.3, the estimated annual impacts during operations are well within applicable guidelines and regulations, with collective and cumulative impacts being quite low.

In contrast to process efficiency improvements, the addition of a fourth process line at the Portsmouth facility would require the installation of additional plant equipment and would result in a nominal 33% increase in throughput when compared with the current base design. The plant capacity would be similar to the capacity planned for the Paducah site (evaluated in DOE/EIS-0359). This throughput increase would reduce the time necessary to convert the Portsmouth and ETTP DUF_6 inventories by about 5 years.

The potential environmental impacts associated with a 33% increase in throughput (for example, by the addition of a fourth conversion process line) at Portsmouth are discussed below by technical discipline. In general, the potential impacts are discussed relative to the operational impacts presented previously in Section 5.2.3 for the base design facility (i.e., three process lines). The construction impacts presented in Section 5.2.2 for three process lines were already based on a process building large enough to accommodate a fourth process line.

A parametric analysis was conducted for conversion facilities of different sizes as part of the PEIS (DOE 1999a). As discussed in Appendix K of the PEIS, potential environmental impacts resulting from the construction and operation of a conversion facility were estimated for throughputs ranging from 7,000 to 28,000 t/yr (7,716 to 30,865 tons/yr) of DUF_6. In comparison, the throughput of the Portsmouth conversion facility is 13,500 t/yr (14,881 tons/yr) with three process lines and 18,000 t/yr (19,842 tons/yr) when a 33% increase is assumed — well within the range analyzed in the parametric study conducted for the PEIS.

The results presented in Appendix K of the PEIS indicated that some impacts would not vary with throughput (e.g., certain accident consequences), whereas other impacts would. However, it was found that in most cases, impacts would not increase in direct proportion with throughput because of economies of scale. For example, if the throughput increased by 33%, the expected increase in the impacts generally would be less than 33%. In spite of this less than one-to-one relationship, in some cases, the analyses that follow conservatively assume that impacts would increase in the same proportion as throughput.

In addition, DOE analyzed the impacts of a larger conversion facility with four process lines at Paducah in a separate EIS (DOE/EIS-0359). The resource requirements, environmental releases, and product and waste generation rates would be the same irrespective of where the facility was constructed. In addition, some of the impacts (e.g., the involved worker doses) would also be same. Whenever applicable, the results from the Paducah conversion facility EIS were used in the evaluation of impacts for the expanded capacity conversion facility option at Portsmouth in the following sections.

5.2.8.1.1 Human Health and Safety — Normal Operations. In general, a 33% increase in throughput at Portsmouth would result in an annual increase in the radiation exposure of workers and members of the public. However, it is expected that the cumulative doses for conversion of the entire inventory of Portsmouth and ETTP DUF_6 would be the same, regardless of the annual throughput or number of process lines. This is because the higher annual doses associated with increased throughput would be offset by a shorter operational duration.

When an increase in the annual radiation dose to individual involved workers of 33% (proportional to the throughput increase) is assumed, the maximum annual individual worker doses would be approximately 100 mrem/yr to workers in the conversion facility and approximately 800 mrem/yr to cylinder yard workers (on the basis of results presented in Table 5.2-10). These doses would remain well below applicable regulatory limits and below levels expected to cause appreciable health effects. The annual collective dose to involved workers would increase from approximately 10.1 person-rem/yr to 10.7 person-rem/yr (on the basis of the involved worker doses estimated for the Paducah conversion facility [DOE 2004a]).

It is estimated that the annual airborne emissions of uranium would be the same for the Portsmouth conversion facility (three process lines) and the Paducah conversion facility (four process lines) (UDS 2003b). Therefore, annual doses to off-site members of the public and noninvolved workers from uranium emissions would be expected to be the same as presented in Table 5.2-10. However, even if it was assumed that emissions would increase 33% proportionally with throughput, the estimated dose to the MEI public and noninvolved workers would be much less than 1×10^{-4} mrem/yr. This dose is much less than the radiation dose limits of 100 mrem/yr (DOE 1990) from all pathways and 10 mrem/yr (40 CFR Part 61) from airborne pathways set to protect the general public from operations of DOE facilities.

Potential chemical exposures would also remain well below levels expected to cause health effects, even with a 33% increase in throughput. Human health impacts resulting from exposure to hazardous chemicals during normal operations of the conversion facilities are estimated as hazard indices of 5×10^{-6} and 5.4×10^{-5} for the noninvolved worker and general public MEI, respectively. The hazard indices for the conversion process would be at least three orders of magnitude lower than the hazard index of 1, which is the level at which adverse health effects might be expected to occur in some exposed individuals.

5.2.8.1.2 Human Health and Safety — Facility Accidents. As discussed in Section 5.2.3, there is a risk of on-the-job fatalities and injuries to conversion facility workers because of the industrial nature of the work environment. This risk is directly related to the amount of labor required (measured in terms of full-time equivalent employees). UDS estimated that there would be the same number of workers employed in the conversion facility at Paducah (four process lines) and at Portsmouth (three process lines) (UDS 2003b). Therefore, when it is assumed that the total amount of labor required to convert the Portsmouth and ETTP DUF_6 inventories would be the same regardless of throughput (e.g., whether three or four process lines were used), the risks from physical hazards if the throughput was increased 33% would be the same as those described in Section 5.2.3 for the base design. No on-the-job fatalities are predicted during the conversion facility operational phase. It is estimated, however, that about 142 injuries would occur over the life of the project (Table 5.2-4). Therefore, if the processing time was reduced by 5 years, about 40 fewer on-the-job injuries would be expected.

In general, for accidents involving the release of radioactive or hazardous materials, the consequences and risks if the throughput was increased by 33% would be the same as those discussed in Sections 5.2.3.2.1 and 5.2.3.2. This is because most of the bounding accidents would involve a limited amount of material that would be at risk under accident conditions, regardless of the facility throughput. For example, the consequences of accidents involving cylinders do not depend on the facility throughput. Similarly, the HF and NH_3 storage tanks would be the same size regardless of the facility throughput; therefore the consequences of a tank rupture would be the same.

The one exception would be the bounding radiological accident involving an earthquake that affects 6 months' worth of conversion product storage (an extremely unlikely accident). If the throughput was increased 33% (for instance, by adding a fourth process line), the amount of uranium oxide in storage could be 33% greater than the amount under the base design. Therefore, the amount of material potentially released would be 33% greater than that shown in Table 5.3-11. The resulting consequences (Tables 5.2-12 and 5.2-13) would also increase by 33%. However, because of the low probability of such an accident, the overall accident risk (calculated as the product of the accident consequence and the accident probability) would remain the same as discussed in Section 5.2.3.2.1; that is, no fatalities would be expected.

Although the estimated frequencies of some accidents could increase somewhat in association with an increased throughput, this increase would not be large enough to change the frequency category designations of the accidents given in Section 5.2.3. Any small increase in the annual frequency of some accidents would be offset by the reduced operational period of the facility. Therefore, the overall probability of occurrence of the accidents over the operational periods would be about the same. As a result, the total accident risk would not change.

5.2.8.1.3 Air Quality and Noise. If the throughput was increased 33% at the Portsmouth facility, emissions of criteria pollutants would increase in negligible amounts. However, emissions of HF would increase by 33% as a result of the increase in throughput. Potential impacts of criteria pollutants on ambient air quality would remain almost the same as presented in Table 5.2-18. In other words, total (background plus project increment) concentrations would be well below their applicable standards, except for $PM_{2.5}$, which would approach or exceed the standards because of the regionally high background concentrations (similar to the case with three process lines). The background data used are the maximum values from the last 5 years of monitoring at the nearest monitoring location (operated by the OEPA) to the site, located about 20 mi (32 km) away in the town of Portsmouth. On the basis of these values, exceedance of the annual $PM_{2.5}$ standard would be unavoidable, because the background concentration already exceeds the standard (background is 24.1 $\mu g/m^3$, in comparison with the standard of 15 $\mu g/m^3$).

The potential impacts of HF on ambient air quality would increase by about 33%, with estimated maximum HF concentration increments and total concentrations remaining well below their state standards: about 6% and 20% for the standards, respectively.

With respect to noise, a throughput increase of 33% is estimated to result in an increase in the noise level within the conversion facility of about 1 dB. This increase would attenuate significantly while passing through the conversion building walls. Accordingly, noise levels at the nearest residence would be almost the same as those for three processing lines, which would be below the EPA guideline of 55 dB(A).

5.2.8.1.4 Water and Soil. Increasing the throughput 33% at Portsmouth (for example, by increasing the number of process lines from three to four) would increase the quantity of process water needed for operations from 30 million gal/yr (114 million L/yr) to 37 million gal/yr (141 million L/yr), the same amount of process water needed at the Paducah facility. Groundwater withdrawn from wells for average use would still represent an increase of less than 1% of the current water use at the facility and 0.3% of the existing well capacity. Such impacts would remain small. No additional impacts to surface water or soils would be expected.

5.2.8.1.5 Socioeconomics. The socioeconomic impacts of a 33% increase in throughput at Portsmouth would be minimal. There could be a slight increase in capital and material expenditures if an additional process line was constructed (estimated to be $5.6 million by the OIG), with a corresponding increase in labor expenditures to install the necessary equipment and facilities. However, as would be the case with capital expenditures associated with a three-process-line facility, it is assumed that there would be no local vendors or a limited number of them for the required specialized equipment, with a large majority of capital expenditures being made outside the ROI at the Portsmouth site. The impact of capital expenditures for an additional process line would therefore be minimal in the ROI.

Wage and salary spending associated with the installation of additional process line equipment would produce impacts in the ROI. The size of these impacts would depend on the size of the additional labor force required and the timing of the corresponding labor expenditures. However, since the additional process-line installation would most likely require no increase or only a small increase in the size of the overall labor force beyond that required for the three-process-line facility, the relative impact of the additional wage and salary expenditures in the ROI would likely be small. No additional impacts on local housing or local public services and education would be expected.

Operation of the facility with the additional process line would not require any increase in employment at the Portsmouth site. Impacts of operating the additional process line would be limited to any increase in expenditures on materials that might be made in the ROI. These expenditures would be unlikely to differ significantly from those associated with a three-process-line facility, meaning that the local impacts of the additional process line are also likely to be minimal.

A 33% increase in the throughput at Portsmouth would reduce the operational period of the facility by approximately 5 years. Consequently, positive socioeconomic impacts associated with employment of the conversion facility workforce would last approximately 13 years, compared to 18 years under the base design.

5.2.8.1.6 Ecology. Because a 33% increase in throughput at Portsmouth would not require the disturbance of any areas beyond those disturbed for the base design facility, and because the emissions would remain well below levels expected to have adverse effects on vegetation and biota, no impacts to ecological resources would be expected.

5.2.8.1.7 Waste Management. Over the life of the project, the total amounts of conversion products and waste (including low level, hazardous, and non-hazardous waste) generated at the conversion facility for conversion of the Portsmouth and ETTP DUF_6 inventories would be the same regardless of the annual facility throughput. However, the annual amounts of waste produced, provided in Table 5.2-20, would increase by approximately 33% as a result of the higher plant throughput when compared with that of the base design. This annual increase would not be expected to appreciably increase the annual impacts to waste management capabilities discussed in Section 5.2.3.7. As noted in Section 5.2.3.7, in the event that the HF was not marketable and it was neutralized to CaF_2, the site's projected generation of nonhazardous waste would increase substantially (increasing by approximately 90% with three process lines and 120% with four process lines, assuming the CaF_2 was determined to be a nonhazardous waste).

5.2.8.1.8 Resource Requirements. A 33% increase in annual throughput at Portsmouth could require an increase of up to 33% in the quantities of materials required for operations, as shown in Table 5.2-21. As noted in Section 5.2.3.8, the material resources required during operations are not considered rare or unique, and the total quantities required would not affect their local, regional, or national availability. Therefore, negligible impacts on resource requirements would be expected if the throughput was increased 33% at the Portsmouth facility.

5.2.8.1.9 Land Use. A 33% increase in the annual throughput at Portsmouth would not increase the amount of land required for the conversion facility and would not alter the current or proposed site land use. The base design facility is already large enough to accommodate a fourth process line if one is required. Therefore, no impacts on land use would occur.

5.2.8.1.10 Cultural Resources. A 33% increase in the annual throughput at Portsmouth is unlikely to adversely affect cultural resources at all three alternative locations because no ground-disturbing activities would be associated with the throughput increase. In addition, facility air emissions would be well below levels that would adversely affect cultural resources.

5.2.8.1.11 Environmental Justice. As discussed in Section 5.2.3.11, the evaluation of environmental justice impacts is predicated on the identification of high and adverse impacts in other impact areas considered in this EIS, followed by a determination of whether those impacts would affect minority and low-income populations disproportionately. Analyses of impacts from operating the conversion facility with an increased throughput do not indicate high and adverse impacts for any of the other impact areas considered. Despite the presence of disproportionately high percentages of low-income populations within 50 mi (80 km) of the Portsmouth site, no environmental justice impacts are anticipated at any of the three alternative locations because of the lack of high and adverse impacts.

5.2.8.1.12 Transportation. The transportation impacts presented in Section 5.2.5 for the base design (three process lines) are cumulative totals for the shipment of all materials associated with the conversion of the Portsmouth and ETTP DUF_6 inventories. Therefore, the overall transportation impacts would be the same regardless of whether or not the annual throughput was increased 33%. However, the annual number of shipments would increase 33%. The annual transportation impacts can be estimated by dividing the collective population impacts presented in Section 5.2.5 by the shipping campaign duration. Thus, annual impacts would be greater if the throughput was increased 33% because the inventory would be converted and transported at a higher rate, but the total impacts would be the same as for the three-process-line base design.

5.2.8.1.13 Cumulative Impacts. The potential cumulative impacts at the Portsmouth site from operation of the conversion facility are discussed in Section 5.3 for the base design, a three-process-line facility. As discussed in that section, the cumulative impacts, including the proposed action and other current or reasonably foreseeable activities at the site, are within regulatory limits and generally well below levels expected to cause adverse environmental impacts (with the exception of $PM_{2.5}$ concentrations, which might exceed standards because of the regionally high background level). Because the incremental impacts of increasing the throughput by 33% at the Portsmouth facility would not significantly increase the potential environmental impacts from the conversion facility, as discussed above, the cumulative impacts would be the same as those discussed in Section 5.3.

5.2.8.1.14 Decontamination and Decommissioning. Potential environmental impacts associated with the D&D of the conversion facility after the facility is closed are discussed in Section 5.9 for the three-process-line base design. If the throughput was increased by adding a fourth process line, additional process equipment would require D&D. This would be expected to result in a potential increase in the radiation dose to involved workers and an increase in the amount of LLW generated, when compared with a three-process-line facility. However, there is a large amount of uncertainty concerning D&D activities because they will not likely occur for 15 to 20 years, and the activities required would be very dependent on the operational history of the facility. Thus, the D&D impacts presented in Section 5.9 are considered representative of both a three- and a four-process-line facility. As noted in Section 5.9, additional NEPA review would likely need to be performed before D&D occurred. It is also expected that such a review would be based on the actual condition of the facilities and a more definite identification of the resulting waste materials.

5.2.8.1.15 Other Issues and Impacts. Sections 5.4 through 5.8 of this EIS discuss mitigation, unavoidable adverse impacts, irreversible and irretrievable commitment of resources, the relationship between short-term use of the environment and long-term productivity, and pollution prevention and waste minimization. The discussion in these sections would also apply if the throughput of the Portsmouth facility was increased 33%.

5.2.8.2 Potential Impacts Associated with Extending the Plant Operational Period

As noted above, the Portsmouth conversion facility is currently being designed to process the Portsmouth and ETTP DUF_6 cylinder inventories over 18 years. There are no current plans to operate the conversion facilities beyond this period. However, with routine facility and equipment maintenance and periodic equipment replacements or upgrades, it is believed the conversion facility could be operated safely beyond this time period to process additional DUF_6 for which DOE might assume responsibility.

The estimated annual environmental impacts during conversion facility operations were presented and discussed previously in Section 5.2.3; these impacts are expected to continue each year for the planned 18 years of operations at Portsmouth. If operations were extended beyond 18 years and if the operational characteristics (e.g., estimated releases of contaminants to air and water) of the facility remained unchanged, the annual impacts would be expected to be essentially the same as those presented in Section 5.2.3. However, continued operations would result in the impacts being incurred over a greater number of years. The total radiation dose to the workers and the public would increase in proportion to the number of additional years that the facility operated. Although the annual frequency of accidents would remain unchanged, the overall probability of a severe accident would increase proportionately with the additional operational time period. In addition, the total quantities of depleted uranium and secondary waste products requiring disposal would increase proportionately, as would the amount of HF or CaF_2 produced. As discussed in Section 5.2.3, the estimated annual impacts during operations are within applicable guidelines and regulations, with collective and cumulative impacts being quite low. This would also be expected during extended operations.

5.2.8.3 Potential Impacts Associated with Possible Future Paducah-to-Portsmouth Cylinder Shipments

As noted above, it is possible that in the future, DUF_6 cylinders could be transferred from Paducah to Portsmouth to facilitate conversion of the entire inventory, particularly if DOE assumes responsibility for additional DUF_6 at Paducah. At this time, it is uncertain whether such transfers would take place and how many cylinders would be transferred if such a decision was made. Therefore, for comparative purposes, this section provides estimates of the potential impacts from transporting 1,000 DUF_6 cylinders from Paducah to Portsmouth by either truck or rail. Shipment of 1,000 cylinders per year roughly corresponds to the annual base design throughput of the Portsmouth conversion facility.

The transportation assessment methodology discussed in Appendix F, Section F.3, was used to estimate the collective population risk for shipment of 1,000 cylinders between Paducah and Portsmouth by both truck and rail. It was assumed that only compliant cylinders that met DOT requirements would be shipped between the sites. The estimated highway and rail route distances between the sites are 395 mi (636 km) and 478 mi (769 km), respectively. The estimated collective risks are provided in Table 5.2-36. No cargo-related or vehicle-related fatalities are expected for the shipment of 1,000 cylinders per year between the sites.

The estimated consequences of severe accidents and the potential impacts to MEIs would be the same as those presented and described in Section 5.2.5 for the shipment of ETTP cylinders.

5.3 CUMULATIVE IMPACTS

5.3.1 Issues and Assumptions

The CEQ guidelines for implementing NEPA define cumulative effects as the impacts on the environment resulting from the incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). Cumulative effects include other actions regardless of what agency (federal or nonfederal), organization, or person undertakes them. Noteworthy cumulative impacts can result from individually minor, but collectively significant, effects of all actions.

The activities considered in this cumulative analysis comprise those that might affect environmental conditions at or near the Portsmouth site, including activities occurring on the site itself and activities occurring nearby whose impacts could affect the site. A summary of impacts associated with various actions is presented in Table 5.3-1 for impacts associated with most of the technical areas assessed in this EIS. When possible, these summaries are quantitative;

TABLE 5.2-36 Annual Transportation Impacts for the Shipment of DUF_6 Cylinders from Paducah to Portsmouth, Assuming 1,000 DUF_6 Cylinders Shipped per Year

				Cargo-Related			Vehicle-Related	
				Radiological Risk (LCF)[a]				
Route	Mode	No. of Shipments	Total Distance (10^6 mi)	Crew	Public	Irreversible Adverse Effects	Latent Emission Fatalities	Accident Fatalities
Paducah to Portsmouth								
	Truck	1,000	0.395	0.002	0.001	5×10^{-7}	0.1	0.01
	Rail[b]	250	0.12	0.007	0.0003	2×10^{-8}	0.008	0.006

[a] The lifetime risk of an LCF for an individual was estimated from the calculated doses by using a dose-to-risk conversion factor of 0.0005 fatality per person-rem for members of the general public, as recommended in ICRP Publication 60 (ICRP 1991). The approximate corresponding dose received for each radiological fatality risk listed in this table may be obtained by multiplying the fatality risk by 2,000 (i.e., 1 ÷ 0.0005).

[b] Assumes four DUF_6 cylinders per railcar.

TABLE 5.3-1 Cumulative Impacts of DUF_6 Activities and Other Past, Present, or Reasonably Foreseeable Future Actions at the Portsmouth Site

		Impacts of DUF_6 Management[a]			Cumulative Impacts[d]	
Impact Category	Existing Conditions	No Action	Action Alternatives[b]	Impacts of Other Actions[c]	No Action	Action Alternatives[b]
Radiological, off-site population						
Public, collective dose (person-rem)	3.6	0.03[e]	1.1×10^{-3}	16.1[f]	19.7	19.7
Public, number of LCFs[g]	2×10^{-3}	2×10^{-5}	6×10^{-7}	8×10^{-3}	1×10^{-2}	1×10^{-2}
Off-site MEI, annual dose (mrem/yr)[h]	2.0	0.1	2.1×10^{-5}	0.5–0.9	3.0	2.5
Radiological, worker population						
Worker, collective dose (person-rem)	27.2	207.0[e]	245.4	NA[f,i,j]	234.2	267.2
Worker, number of LCFs[k]	1×10^{-2}	8×10^{-2}	1×10^{-1}	NA[i,j]	9×10^{-2}	1×10^{-1}
Transportation[l]						
Number of truck shipments	600[m]	0	7,800[n]	3,900	4,500	12,300
Number of rail shipments	0	0	3,300[n]	3,500	3,500	6,800
Annual MEI dose, truck (mrem/yr)	7.4×10^{-4} [o]	0	2.8×10^{-3}	4.2×10^{-3}	4.9×10^{-3}	7.7×10^{-3}
Annual MEI dose, rail (mrem/yr)	0	0	1.9×10^{-3}	4.3×10^{-3}	4.3×10^{-3}	6.2×10^{-3}
Air quality (nonattainment)	None[p]	None	None	None[q]	None[p]	PM (PM_{10} and $PM_{2.5}$) above SAAQS during construction; annual $PM_{2.5}$ above SAAQS during operation[r]
Water and soil						
Surface water quality (exceedance)	None	None	Negligible	None	Negligible	Negligible
Groundwater quality (exceedance)	7 parameters[s]	None	Small	None	7 parameters[s]	7 parameters[s]
Soil (exceedance)	None	None	None	None	None	None
Ecology (adverse impacts)	Negligible	Negligible	Negligible to minor	Negligible	Negligible	Negligible to minor
Land use (changes from current)	None	None	None	None	None	None

TABLE 5.3-1 (Cont.)

Impact Category	Existing Conditions	Impacts of DUF_6 Management[a]		Impacts of Other Actions[c]	Cumulative Impacts[d]	
		No Action	Action Alternatives[b]		No Action	Action Alternatives[b]
Cultural resources (adverse impacts)	None	None	Unlikely	Unlikely	Unlikely	Unlikely
Environmental justice (impacts)	None	None	None	None	None	None

[a] Based on results presented in Sections 5.1 and 5.2 of this EIS. No action impacts were considered over 40 years. Proposed action impacts were considered for both construction (over 2 years) and operation (over 18 years), with calculations shown including whichever had the greatest impacts.

[b] For purposes of estimating cumulative impacts, all three facility locations would yield identical environmental consequences and, as a result, are not presented in separate columns.

[c] Includes impacts of current UF_6 management activities by DOE and USEC (DOE 1999a); waste management activities (DOE 1997a) and continued storage of cylinders under the no action alternative; converting the Portsmouth GDP to standby (DOE 2001c); reindustrialization of the Portsmouth GDP (DOE 2001b); and current environmental restoration activities that have proceeded to the point that their consequences can be defined: X-749 Contaminated Materials Disposal Facility, Quadrant I Groundwater Investigative Area, X-701C Neutralization Pit/X-701A Lime House Removal, X-720 Neutralization Pit, X-740 Waste Oil Handling Facility (with associated phytoremediation), X-701B in situ chemical oxidation, X-326 L-cage Glove Box, X-744G Glove Box, X-623 Groundwater Treatment Facility, and X-624 Groundwater Treatment Facility (DOE 2002d). Future actions include construction and operation of a gas centrifuge enrichment facility at Portsmouth (U.S. Energy Research and Development Administration [ERDA] 1977).

[d] Cumulative impacts represent the sum of the impacts of the DUF_6 management alternatives and other past, present, and reasonably foreseeable future actions.

[e] Estimated for 18 years, to enable comparison with proposed action.

[f] No dose estimates given for surrogate reuse activities for Portsmouth in the assessment of impacts from reindustrialization (DOE 2001b), apart from suggesting that the magnitude would be similar to the estimated public dose (which is estimated at 0.02% of the DOE limit for public exposure).

[g] Assumes 0.0005 LCF/person-rem.

[h] Cumulative impacts assume all facilities operate simultaneously and are located at the same point.

[i] No worker dose given for possible enrichment facility or Lead Cascade test facility for enrichment, thus cumulative figures will be slightly low; the individual dose would still be monitored to remain under 5 rem/person annually.

[j] NA = Not available.

[k] Includes both facility workers and noninvolved workers; assumes 0.0004 LCF/person-rem.

[l] Concerns shipments of radioactive materials; all estimates of numbers of shipments rounded upward to nearest hundred.

TABLE 5.3-1 (Cont.)

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[m] Assumes monthly average of 1 LLW shipment and 0.67 LLMW shipment from USEC, and 1 LLW shipment from DOE activities (Coriell 2003; Hawk 2003; Kelly 2003), rounded upward to the nearest hundred for the 18-yr duration of shipments.

[n] Estimates for transportation under the action alternatives consider the proposed mode of transport of radiological materials, to or from Portsmouth when such a mode has been specified. In the cases of transporting DUF_6 and non-DUF_6 from ETTP, this analysis assumes truck transport (in the absence of a proposed mode) since trucks would result in the greatest impacts to an MEI.

[o] Actual shipments are monitored to ensure external dose is below regulatory limits; calculations here reflect estimates based on empirical data recorded in DOE complex of 1.6×10^{-8} rem to public from passing truck shipment (DOE 1997a).

[p] Although currently classified as an attainment area, measured concentrations for both O_3 and $PM_{2.5}$ (of regional concern) currently are higher than state and national air quality standards.

[q] Air impacts are not discussed for the enrichment facility (see ERDA 1977).

[r] $PM_{2.5}$ exceedance is primarily due to higher background concentrations, already above the standards

[s] Drinking water standards exceeded for alpha activity, americium, beta activity, beryllium, chloroethane, TCE, and uranium.

however, some are, by necessity, qualitative. For technical areas without data that can be aggregated, this analysis evaluates potential cumulative impacts in a qualitative manner as systematically as possible. When it is not appropriate for estimates of impacts to be accumulated, they are not included in the table. For example, it is not appropriate to accumulate chemical impacts (anticipated to be extremely small under the alternatives considered in this EIS) because hazard index estimates are not expected to be additive for different materials and conditions.

5.3.2 Portsmouth Site

Past, ongoing, and future actions at the Portsmouth site include continued waste management activities (DOE 1997a), waste disposal activities (DOE 2002d), environmental restoration activities (DOE 2002d), industrial reuse of sections of the site (DOE 2001b), consolidation of reusable uranium from other sites in the DOE complex (DOE 2003c), continued management of DUF_6 cylinders by USEC and DOE, and other DUF_6 management activities considered in this EIS (see also DOE 1999a). Uranium enrichment activities at Portsmouth were discontinued early in 2002 (see DOE 2001c). However, in late 2002, Portsmouth was identified as the future location of USEC's Lead Cascade test enrichment facility (NRC 2004). Table 5.3-1 identifies the anticipated cumulative impacts that could result from the construction and operation of a DUF_6 conversion facility at the Portsmouth site, as well as impacts from continued management of DUF_6 at the Portsmouth site under the no action alternative.

One action that is considered in this analysis to be reasonably foreseeable and that deserves special mention is the future development of a permanent uranium enrichment facility at the Portsmouth site. In January 2004, USEC announced that it had selected Portsmouth as the site of the American Centrifuge Facility. This cumulative assessment assumes that the facility would use existing gas centrifuge technology. The assessment further assumes that the impacts of such a facility would be the same as those outlined in a 1977 analysis of environmental consequences for such an action (ERDA 1977). (The facility proposed in 1977 was never completed.)

Together with the alternatives assessed in Sections 5.1 and 5.2 of this EIS, the cumulative analysis (the final two columns of Table 5.3.1) includes the following:

- *No Action Alternative:* The cumulative impacts of no action include impacts of UF_6 generation and management activities by USEC and DOE (management only) (DOE 1999a) and continued, long-term storage of cylinders under the no action alternative; waste management activities at the Portsmouth site (DOE 1997a; see also DOE 2002d); conversion of the Portsmouth GDP to standby (DOE 2001b); construction, operation, and D&D of the Lead Cascade test uranium enrichment facility at Portsmouth (NRC 2004); construction, operation, and D&D of a uranium enrichment facility at the Portsmouth site (ERDA 1977); consolidation of reusable uranium in the DOE complex at the Portsmouth site (DOE 2003c); and current environmental restoration activities that have proceeded to the point that their consequences can be defined (DOE 2002d).

- *Proposed Action Alternatives:* The cumulative impacts of the proposed action alternatives include impacts related to the preferred alternative, including the impacts of constructing an additional storage pad and facility to convert DUF_6 to U_3O_8 by using UDS technology; conversion of DUF_6 currently stored at the Portsmouth and ETTP sites to U_3O_8 at the proposed facility; waste management activities at the Portsmouth site (DOE 1997a; see also DOE 2002d); conversion of the Portsmouth GDP to standby (DOE 2001c); construction, operation, and D&D of the Lead Cascade test uranium enrichment facility at Portsmouth (NRC 2004); construction, operation and D&D of a uranium enrichment facility at the Portsmouth site (ERDA 1977); consolidation of reusable uranium in the DOE complex at the Portsmouth site (DOE 2003c); and environmental restoration activities that have proceeded to the point that their consequences can be defined (DOE 2002d).

The results of the cumulative analysis are summarized in Table 5.3-1. The first data column of the table summarizes existing conditions at the site, as presented in Section 3.1 of this EIS. The second and third data columns of the table, in turn, summarize the results of the assessment of impacts of alternatives presented in Sections 5.1 and 5.2 of this EIS. The fourth data column summarizes aggregated impacts of past, present, and reasonably foreseeable future actions at the Portsmouth site, while the final two columns present cumulative impacts under the no action and proposed action alternatives. Transporting cylinders currently stored at the ETTP site to Portsmouth is considered as part of the proposed action.

5.3.2.1 Radiological Releases — Normal Operations

For both the no action alternative and the action alternatives, impacts to human health and safety could result from radiological facility operations and accidents. As shown in Table 5.3-1, cumulative collective radiological exposure to the off-site population would be well below the maximum DOE dose limit of 100 mrem/yr to the off-site MEI for both alternatives and below the limit of 25 mrem/yr specified in 40 CFR 190 for uranium fuel cycle facilities. Annual radiological doses to individual involved workers would be monitored to maintain exposure below the regulatory limits.

5.3.2.2 Accidental Releases — Radiological and Chemical Materials

For both the no action alternative and the action alternatives, doses and consequences of releases of radiological materials were considered for a range of accidents from *likely* (occurring an average of 1 or more times in 100 years) to *extremely rare* (occurring an average of less than 1 time in a million years). Because of the low probability of two accidents happening at the same time, the consequences of these accidents are not considered to be cumulative. The probability of even *likely* accidents occurring at the same time is very low, even for the most frequently expected accidents — the likelihood of this co-occurrence being the product of their individual probabilities (1 in 100 years multiplied by 1 in 100 years equals 1 in 10,000 years [$0.01 \times 0.01 =$

0.0001]). Moreover, in the event that two facility accidents from the *likely* category occurred at the same time, the consequences for the public would be low.

5.3.2.3 Transportation

The number of shipments of DUF_6, non-DUF_6, U_3O_8, crushed heel cylinders, and heel cylinders associated with the action alternatives at the Portsmouth site would involve rail and truck transport. Calculations prepared for cumulative impacts, which are based on analytical results presented in Section 5.2.5, consider proposed transport modes for the various materials or items moved. Results indicate a total of 12,300 truck shipments and 6,800 rail shipments, with radiological impacts presented as an annual dose to the MEI. Radiological impacts resulting from transportation of all materials under both modes would be very small, as would the cumulative impacts.

5.3.2.4 Chemical Exposure — Normal Operations

Impacts associated with chemical exposure are expected to be very small under the alternatives considered in this EIS. As noted previously, the calculation of cumulative impacts is not possible because of the absence of necessary measures (hazard indices) for other actions and the inappropriateness of aggregating these measures across the different chemicals used in different industries. Under normal operations, no impacts to the public are expected from chemical exposure for the action or the no action alternatives.

5.3.2.5 Air Quality

The Portsmouth site is currently located in an attainment region, although measured concentrations for certain criteria pollutants (O_3 and $PM_{2.5}$) were above the state and national air quality standards (see Section 3.1.3.3). During construction at the site for additional on-site storage or the conversion facility, total PM_{10} and/or $PM_{2.5}$ concentrations would be higher than applicable ambient standards, due in part to their high background concentrations. Because of their near-ground-level releases, high concentrations would be limited to the immediate vicinity of the site. However, these impacts would be temporary and could be minimized by using good engineering and construction practices and standard dust suppression methods. During the period of conversion at the Portsmouth site, total annual-average $PM_{2.5}$ concentrations would exceed state and national standards, primarily because of higher background concentrations.

5.3.2.6 Noise

No cumulative noise impacts are expected for the alternatives considered in this EIS. Noise energy dissipates within short distances from the sources, and significant noise impacts are not expected in the vicinity of the conversion facility.

5.3.2.7 Water and Soil

Cumulative impacts on surface water at the Portsmouth site for construction and normal operations would not exceed the 30 µg/L of uranium used for comparison in discharges to Little Beaver Creek, Big Beaver Creek, or the Scioto River, even under low-flow conditions for the first two. Cumulative impacts on surface water would be localized and temporary even for small creeks, with adequate dilution occurring once such a creek entered larger waterways. Under the no action alternative, care would be taken during cylinder painting to prevent a further toxicity effect.

Data from the 2000 annual groundwater monitoring at the Portsmouth site indicated that seven pollutants exceeded primary drinking water standards in groundwater: alpha activity, americium, beta activity, beryllium, chloroethane, TCE, and uranium (DOE 2001d,e). Such impacts would continue under cumulative impacts, although site management practices that continue to stabilize plume movement and improve current groundwater quality should not allow further noteworthy contamination under the cumulative case. The groundwater analysis indicates that current cylinder maintenance practices would control cylinder corrosion under the no action alternative; thus, the maximum uranium concentration in groundwater (from cylinder breaches) would be 5 µg/L, considerably below the 30-µg/L guideline level used for comparison. Direct contamination of groundwater could occur during the construction and operation of a conversion facility (e.g., from the dissolution and infiltration of stockpiled chemicals into aquifers). However, good engineering and construction practices should ensure that impacts associated with construction would be minimal and not change existing groundwater conditions. Slight contamination similarly could occur during normal operation of a conversion facility. However, the contamination is not anticipated to reach a noteworthy magnitude. Cumulative impacts might contribute slightly to groundwater contamination, although the combination of efforts to address existing contaminants and practices to minimize increasing contamination should limit the magnitude of increases.

No noteworthy cumulative impacts to soils are anticipated.

5.3.2.8 Ecology

Cumulative ecological impacts are anticipated to be negligible under the no action alternative and negligible to minor under the action alternatives, in conjunction with the effects of existing conditions and other activities. Habitat disturbance would involve settings commonly found in this part of Ohio, in many cases previously disturbed. Construction of a conversion facility at Location A could directly affect a small wetland. Construction of a conversion facility at Location C would also remove trees that could provide habitat for the Indiana bat; this federally endangered species is not known to utilize this area. No impacts on this or other state- or federal-listed species are anticipated.

5.3.2.9 Land Use

All DUF_6 activities under the alternatives would be confined to the Portsmouth site, which is already used for similar activities. Other activities on the site similarly are consistent with existing land use at Portsmouth, while activities already in the vicinity of the site change land uses to, at most, only relatively very small areas. No cumulative land use impacts are anticipated.

5.3.2.10 Cultural Resources

The probability of encountering significant archaeological resources at the Portsmouth site would vary, depending on the area disturbed by a proposed activity or activities and the amount of disturbance. Further cultural resource surveys in consultation with the SHPO would be required for areas as yet unsurveyed that have not been previously disturbed. Consultation with Native Americans, conducted under this project, similarly would have to occur. If significant cultural resources were encountered during any of the activities under cumulative impacts, adverse effects would need to be mitigated. If any structures at the Portsmouth GDP were determined to be historically significant and there was a potential for a short-term adverse effect from the deposit of particulate matter on building surfaces, these adverse effects would be mitigated. All additional survey and mitigation would be conducted in consultation with the Ohio SHPO.

5.3.2.11 Environmental Justice

No environmental justice cumulative impacts are anticipated for the Portsmouth site. Although disproportionately high percentages of minority and low-income populations occur in the vicinity of the site, no cumulative impacts in the vicinity of Portsmouth are high and adverse.

5.3.2.12 Socioeconomics

Socioeconomic impacts under all alternatives are anticipated to be generally positive, often temporary, and relatively small. Growth in population could occur to meet labor demands during construction and operation, but it would not be so great as to place excessive demands on existing housing or public services. Cumulative socioeconomic impacts similarly are expected to be relatively small and positive, although some would be more long-lived than others.

5.3.3 ETTP Site

Because some of the DUF_6 processed at the Portsmouth conversion facility under the action alternatives would come from the ETTP site, cumulative impacts also would involve activities at this locality. Under the no action alternative, in contrast, existing DUF_6 at ETTP would continue to be stored at the site, similarly causing cumulative impacts. Although the focus of this EIS is on impacts (including cumulative impacts) associated with the Portsmouth site, this section briefly examines cumulative impacts at ETTP.

Cumulative impacts associated with the no action alternative would involve the effects of continued storage of DUF_6 at ETTP in conjunction with other activities at or near that site, as summarized in the PEIS for long-term storage of this material (DOE 1999a). Reasonably foreseeable future actions at or in the vicinity of ETTP include waste management activities (DOE 1997a, 2000b, 2001a); stockpile, stewardship, and management activities (DOE 1996b); the disposition of highly enriched uranium (DOE 1996c); the disposition of potentially reusable uranium (DOE 2002b); interim storage of enriched uranium (DOE 1994b); construction and operation of the Spallation Neutron Source Facility (DOE 1999d); tritium production in a commercial light-water reactor (DOE 1999g); transfer of non-nuclear functions (DOE 1993); changes in the sanitary sludge land application program (DOE 1996d); reindustrialization of ETTP (DOE 1997b, 2002a); and environmental restoration activities at ETTP (DOE 2001f). The absence of noteworthy negative impacts under the no action alternative, described in Section 5.1.3, is consistent with the absence of large cumulative impacts in the no action case (see also DOE 1999a).

Cumulative impacts at ETTP under the action alternatives would involve activities associated with preparing cylinders stored at this site for transportation, followed by their shipment to the Portsmouth site. The other past, present, and reasonably foreseeable activities listed in the preceding paragraph for ETTP would be the same. Cylinder preparation impacts, described in Section 5.2.4, are anticipated to be minimal. When aggregated with other activities at or near the ETTP site, cumulative impacts would not be large or serious for any impact area. Transportation impacts associated with ETTP cylinders, described in Section 5.2.5, similarly are not anticipated to be large. Cumulative impacts of transportation, discussed in Section 5.3.2 and presented in Table 5.3-1, likewise would not be large or serious.

5.4 MITIGATION

In general, the impacts of the alternatives presented in this chapter are conservative estimates of impacts expected for each alternative. Factors such as flexibility in siting at and within the three alternative locations at Portsmouth and facility design and construction options could be used to reduce impacts from these conservative levels. This section identifies what impacts could be mitigated to reduce adverse impacts. On the basis of the analyses conducted for this EIS, the following recommendations can be made:

- Potential future impacts on site air and groundwater could be avoided by inspecting cylinders, carrying out cylinder maintenance activities (such as painting), and promptly cleaning up releases from any breached DUF_6 cylinders. 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 permit violations, treating cylinder yard runoff prior to release may be required.

- Temporary impacts on air quality from fugitive dust emissions during 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 would 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 Portsmouth site could be minimized or eliminated by maintaining a buffer near adjacent wetlands during construction. Impacts at Location A may potentially be avoided by an alternative routing of the entrance road, or mitigation 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 April 15 or after September 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 Portsmouth would have the potential to impact cultural resources. Neither an archaeological nor an architectural survey has been completed for the Portsmouth 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 NHPA, 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 OSHA 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 cylinders of enriched UF_6 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 on site such as anhydrous NH_3 and aqueous HF would be designed to all applicable codes and standards, and special procedures would be in place for gaining access to the tanks and for filling of the tanks. In addition, although the probabilities of occurrence for high consequence accident are extremely low, emergency response plans and procedures would be in place to respond to any emergencies should an accident occur. Additional details are discussed below.

Although the probability of transportation accidents involving hazardous chemicals such as HF and NH_3 is very low, the consequences could be severe. For this EIS, the assessment of transportation accidents involving HF assumed conservative conditions. Currently, a number of industry practices are commonly employed to minimize the potential for large HF releases, as discussed below.

HF is usually shipped in 100-ton (91-t), 23,000-gal (87,000-L) shell, full, noncoiled, noninsulated tank cars. Most HF railcars today meet DOT Classification 112S500W, which represents the current state of the art. To minimize the potential for accidental releases, these railcars have head protection and employ shelf couplers, which help prevent punctures during an accident. The use of these improved tank cars has led to an improved safety record with respect to HF accidents over the last several years. In fact, the HF transportation accident rate has steadily decreased since 1985. Industry recommendations for the new tank car guideline appear in *Recommended Practices for the Hydrogen Fluoride Industry* (Hydrogen Fluoride Industry Practices Institute 1995b).

Accidents involving HF and NH_3 at a conversion facility could have potentially serious consequences. However, a wide variety of good engineering and mitigative practices are available that are related to siting, design, and accident mitigation for HF and NH_3 storage tanks, which might be present at a conversion facility. Many are summarized in *Guideline for the Bulk Storage of Anhydrous Hydrogen Fluoride* (Hydrogen Fluoride Industry Practices Institute 1995a). There is an advanced set of accident prevention and mitigative measures that are recommended by industry for HF storage tanks, including storage tank siting principles (e.g., evaluating seismic, high wind, and drainage conditions), design recommendations, and tank appurtenances, as well as spill detection, containment, and mitigation. Measures to mitigate the consequences of an accident include detection systems, spill containment systems such as dikes, remote storage tank isolation valves, water spray systems, and rapid acid deinventory systems (that rapidly remove acid from a leaking vessel). Details on these mitigative strategies are also provided in the Hydrogen Fluoride Industry Practices Institute (1995a) guidelines.

5.5 UNAVOIDABLE ADVERSE IMPACTS

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

The cylinders currently in storage would require continued monitoring and maintenance under all alternatives. These activities would result in the exposure of workers in the vicinity of the cylinders to low levels of radiation. The radiation exposure of workers could be minimized, but some level of exposure would be unavoidable. The radiation doses to workers are estimated to be well within public health standards under all alternatives. Radiation exposures of workers would be monitored at each facility and would be kept ALARA. Cylinder monitoring and maintenance activities would also emit air pollutants, such as vehicle exhaust and dust (PM_{10}), and produce small amounts of sanitary waste and LLW. Concentrations of air emissions during operations are estimated to be within applicable standards and guidelines, and waste generation would not appreciably affect waste management operations.

Under all alternatives, workers would have a potential for accidental on-the-job injuries and fatalities that would be unrelated to radiation or chemical exposures. These would be a consequence of unanticipated events in the work environment, typical of all workplaces. On the basis of statistics in similar industries, it is estimated that less than 1 fatality and on the order of several hundred injuries would occur under the alternatives, including the required transportation among sites associated with the alternatives. The chance of fatalities and injuries occurring would be minimized by conducting all work activities in as safe a manner as possible, in accordance with occupational health and safety rules and regulations. However, the chance of these types of impacts cannot be completely avoided.

Conversion would require the construction of a new facility at the Portsmouth site. Up to 65 acres (26 ha) of land could be disturbed during construction, with approximately 10 acres (4 ha) required for the facility footprint. Construction of the facility could result in losses of terrestrial and aquatic habitats. Dispersal of wildlife and temporary elimination of habitats would result from land clearing and construction activities involving movement of construction personnel and equipment. The construction of the facility could cause both short-term and long-term disturbances of some biological habitats. Although some destruction would be inevitable during and after construction, these losses could be minimized by careful site selection and construction practices.

5.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The major irreversible and irretrievable commitments of natural and man-made resources related to the alternatives analyzed in this EIS are discussed below. 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 decisions to be made in the ROD following the publication of this EIS would commit resources required for implementing the selected alternative. Three major resource categories would be committed irreversibly or irretrievably under the alternatives considered in this EIS: land, materials, and energy.

5.6.1 Land

Land that is currently occupied by UF_6 cylinder storage or selected for the conversion facility could ultimately be returned to open space if the yards, buildings, roads, and other structures were removed, the areas cleaned up, and the land revegetated. Future use of these tracts of land, although beyond the scope of this EIS, could include restoring them for unrestricted use. Therefore, the commitment of this land would not necessarily be irreversible. However, the land used to dispose of any conversion products or construction or D&D wastes would represent an irretrievable commitment, because wastes in belowground disposal areas could not be completely removed, the land could not be restored to its original condition, and the site could not feasibly be used for other purposes following the closure of the disposal facility. All disposal activities associated with alternatives analyzed in this EIS would take place at DOE or commercial disposal facilities that would be permitted or licensed to accept such wastes.

5.6.2 Materials

The irreversible and irretrievable commitment of material resources for the various EIS alternatives would include construction materials that could not be recovered or recycled, materials rendered radioactive that could not be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Materials related to construction could include wood, concrete, sand, gravel, steel, aluminum, and other metals (Table 5.6-1). At this time, no unusual construction material requirements have been identified. The construction resources, except for those that could be recovered and recycled with current technology, would be irretrievably lost. None of the identified construction resources is in short supply, and all should be readily available in the local region.

TABLE 5.6-1 Materials/Resources Consumed during Conversion Facility Construction at the Portsmouth Site

Materials/Resources	Total Consumption	Unit	Peak Demand	Unit
Utilities				
Water	550,000	gal	1,500	gal/h
Electricity	1,500	MWh	7.2	MWh/d
Solids				
Concrete	9,139	yd^3	NA[a]	NA
Steel	511	tons	NA	NA
Inconel/Monel	33	tons	NA	NA
Liquids				
Fuel	73,000	gal	250	gal/d
Gases				
Industrial gases (propane)	15,000	gal	50	gal/d

[a] NA = not applicable.

Strategic and critical materials (e.g., Monel and Inconel) would not be required in quantities that would seriously reduce the national or world supply. This material would be used throughout the facilities and would be used in the generation of HF in the conversion process. The autoclaves and conversion units (process reactors) are long-lead-time procurements with few qualified bidders. Many suppliers are available for the remainder of the equipment.

Estimated annual consumption rates of raw materials are provided in Table 5.6-2. Consumption of operating supplies (e.g., miscellaneous chemicals such as lime and potassium hydroxide, and gases such as nitrogen), although irretrievable, would not constitute a permanent drain on local sources or involve any material in critically short supply in the United States as a whole.

5.6.3 Energy

The irretrievable commitment of energy resources during the operation of the various facilities considered under the alternatives would include the consumption of fossil fuels used to generate steam and heat and electricity for the facilities (Table 5.6-3). Energy also would be expended in the form of diesel fuel and gasoline for cylinder transport equipment and transportation vehicles. Consumption of these utilities, although irretrievable, would not constitute a permanent drain on local sources or involve any utility in critically short supply in the United States as a whole.

TABLE 5.6-2 Materials Consumed Annually during Conversion Facility Operations at the Portsmouth Site[a]

Chemical	Quantity (tons/yr)
Solid	
Lime (CaO)[b]	14
Liquid	
Ammonia (99.95% minimum NH_3)	510
Potassium hydroxide (45% KOH)	6
Gaseous	
Nitrogen (N_2)	7,800

[a] Material estimates are based on facility conceptual-design-status data (UDS 2003b). A number of studies are planned to evaluate design alternatives, the results of which may affect the above materials needs.

[b] Assuming lime is used only for potassium hydroxide regeneration. If HF neutralization is required, the annual lime requirement would be approximately 7,000 tons/yr (6,350 t/yr).

5.7 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

For this EIS, *short term* is considered the period of construction activities for the alternatives analyzed — the time when most short-term (or temporary) environmental impacts would occur. 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 the of conversion facility, the associated construction activities would result in both short-term and long-term losses of terrestrial and aquatic habitats from natural productivity. Dispersal of wildlife and temporary elimination of habitats would result from land clearing and construction activities involving movement and staging of construction personnel and equipment. The building of new facilities could cause long-term disturbances of some biological habitats, potentially causing long-term reductions in the biological activity of an area. Although some habitat loss would be inevitable during and after construction, these losses would be minimized by careful site selection and by thorough environmental reviews of specific proposals. Short-term impacts would be reduced and mitigated as necessary. After closure of the new facilities, they would be decommissioned and could be reused, recycled, or remediated.

5.8 POLLUTION PREVENTION AND WASTE MINIMIZATION

Implementation of the EIS alternatives would be conducted in accordance with all applicable pollution prevention and waste minimization guidelines. Pollution prevention is designed to reduce risk to public health, safety, welfare, and the environment through source reduction techniques and environmentally acceptable recycling processes. The Pollution Prevention Act of 1990 (42 USC 11001–11050) established a national policy that pollution should be prevented or reduced at the source, whenever feasible. The act indicates that when pollution cannot be prevented, polluted products should be recycled in an environmentally safe

TABLE 5.6-3 Utilities Consumed during Conversion Facility Operations at the Portsmouth Site[a]

Utility	Annual Average Consumption	Unit	Peak Demand[b]	Unit
Electricity	31,084	MWh	6.2	MW
Liquid fuel	3,000	gal	NA[c]	NA
Natural gas[d,e]	4.0×10^7	scf[f]	180	scfm[f]
Process water	30×10^6	gal	215	gal/min
Potable water	3×10^6	gal	350	gal/min

[a] Utility estimates are based on facility conceptual-design-status data (UDS 2003b). A number of studies are planned to evaluate design alternatives, the results of which may affect the above utility needs.

[b] Peak demand is the maximum rate expected during any hour.

[c] NA = not applicable.

[d] Standard cubic feet measured at 14.7 psia and 60°F (16°C).

[e] The current facility design (UDS 2003b) uses electrical heating. However, an option of using natural gas is being evaluated.

[f] scf = standard cubic feet; scfm = standard cubic feet per minute.

manner. Disposal or other releases into the environment should be employed only as a last resort. Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements* (U.S. President 1993), and DOE Order 5400.1, *General Environmental Protection Program* (DOE 1988), implement the provisions of the Pollution Prevention Act of 1990. Pollution prevention measures could include source reduction, recycling, treatment, and disposal. The emphasis would be on source reduction and recycling to prevent the creation of wastes (i.e., waste minimization).

Waste minimization is the reduction, to the extent feasible, of the generation of radioactive and hazardous waste. Source reduction and waste minimization techniques include good operating practices, technology modifications, changes in input material, and product changes. An example of waste minimization would be to substitute nonhazardous materials, when possible, for materials that contribute to the generation of hazardous or mixed waste.

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.

5.9 DECONTAMINATION AND DECOMMISSIONING OF THE CONVERSION FACILITY

When operations at the conversion facility are complete, D&D would be performed to protect both public health and safety and the environment from accidental releases of any remaining radioactivity and hazardous materials. The conversion facility is being designed to facilitate D&D activities. This analysis assumes that the D&D activity would provide for the disassembly and removal of all radioactive and hazardous components, equipment, and structures associated with the conversion facility. The objective assumed in this EIS would be to completely dismantle the various buildings and achieve “greenfield” (unrestricted use) conditions. The design requirements for the D&D of this facility can be found in two DOE Directives from 1999: DOE Guide 430.1-3, *Deactivation Implementation Guide*, and DOE Guide 430.1-4, *Decommissioning Implementation Guide* (DOE 1999e,f).

Because the D&D of the conversion facility is not expected to occur for at least 18 years, it is likely that an additional environmental review would need to be performed before it occurred. It is also expected that such a review would be based on the actual condition of the facilities and a more definite identification of the resulting waste materials.

5.9.1 Human Health and Safety — Off-Site Public

It is expected that D&D of the DUF_6 conversion facility would result in low radiation doses to members of the public and would be accomplished with no significant adverse environmental impacts.

DOE has established a primary dose limit for any member of the public of 0.1 rem (1 mSv) total effective dose equivalent (TEDE) per year for protection of public health and safety. Compliance with the limit is based not just on an individual DOE source or practice but on the sum of internal and external doses resulting from all modes of exposure to all radiation sources other than background and medical sources (DOE 1993). However, it could be very difficult to determine doses from all radiation sources for the purpose of demonstrating compliance. Therefore, DOE elements are instructed to apply a public dose constraint of 0.025 rem (0.25 mSv) of TEDE per year to each DOE source or practice (DOE 2002h). Also, DOE elements are required to implement a process to ensure, on a case-specific basis, that public radiation exposures will be ALARA below the dose constraint (DOE 1993).

To be consistent with DOE’s general approach to protecting the public from radiation exposure as explained above, the release of radioactive material from D&D activities at a DOE-controlled site, such as a DUF_6 conversion or cylinder treatment facility, would be limited to an amount determined on a case-specific basis through the ALARA process to be ALARA but, in any event, less than 0.025 rem/yr (0.25 mSv/yr). This would ensure that doses to the public from DOE real property releases following D&D were consistent with NRC requirements for commercial nuclear facilities, as stated in 10 CFR 20, Subpart E, “Radiological Criteria for License Termination.”

In its final generic EIS for decommissioning of NRC-licensed nuclear facilities (NRC 1994), the NRC concluded that at any site where the 0.025-rem/yr (0.25-mSv/yr) dose criterion established in 10 CFR 20, Subpart E, is met, the likelihood that individuals who use the site would be exposed to multiple sources with cumulative doses approaching 0.1 rem/yr (1 mSv/yr) would be very low. Accordingly, the likelihood would also be very low that a member of the public would be exposed in excess of the DOE primary dose limit after D&D of the DUF_6 conversion and cylinder treatment facilities to meet site-specific limits that are ALARA below the dose constraint of 0.025 mrem/yr (0.25 mSv/yr).

The total public dose from D&D of the DUF_6 conversion facility is estimated to range from 4 to 5 person-rem. This estimate was scaled from data on public exposure doses found in NRC (1988) to account for the capacity of the conversion facility and the effort required for its D&D. Because of the low specific activity of uranium, the estimate is very small and primarily would result from the transportation of D&D wastes for ultimate disposition (NRC 1988). Radiation doses to the public resulting from accidents during D&D activities would be low enough to be considered insignificant (NRC 1988).

5.9.2 Human Health and Safety — On-Site Workforce

Radiological impacts to involved workers during D&D of the conversion facility would result primarily from external radiation due to the handling of depleted uranium materials. Because of the low radiation exposures from depleted uranium, one of the initial D&D activities would be removal of any residual uranium from the process equipment, significantly reducing radiation exposure to the involved workforce.

Radiation exposure estimates for the involved workforce during D&D activities involving nuclear facilities licensed by the NRC are provided in NRC (1988) and NRC (1994). These nuclear facilities include UF_6 production plants and uranium fuel fabrication plants that are similar to the conversion facilities considered in this EIS. Average radiation dose rates in the conversion facility during the initial cleaning are expected to be much less than 2 mrem/h, which is the radiation dose rate from bulk quantities of uranium (NRC 1988).

Table 5.9-1 lists the estimated LCFs of the involved workforce during decontamination and cleanup activities at the facility as a function of the residual dose rate (NRC 1994). The radiological impacts in Table 5.9-1 were estimated on the basis of the dose rates to which the workers are subjected and the collective effort required to reduce the residual contamination levels.

One of the most critical parameters in developing the decommissioning plan would be the release criterion applicable for the project. Subpart E of 10 CFR Part 20 addresses release criteria for NRC licensees, while DOE Order 5400.5 (DOE 1990) governs the development of release limits for DOE facilities. On the basis of a residual dose rate of 25 mrem/yr, the estimated LCFs of the involved workforce would be much lower than unity (i.e., no radiation-related fatalities), since the radiation dose to involved workers would be a small fraction of the exposure experienced over the operating lifetime of the facility and well within the occupational exposure limits imposed by regulatory requirements.

Radiation exposure of the involved D&D workers would be monitored by a dosimetry program and maintained below regulatory limits.

The risk of on-the-job fatalities and injuries to conversion facility D&D workers was calculated by using industry-specific statistics from the BLS, as reported by the National Safety Council (2002). Annual fatality and injury rates from the BLS construction industry division were used for the D&D phase. On the basis of D&D cost information provided in Elayat et al. (1997), it is assumed that the D&D workforce would be approximately 10% of the construction workforce. On the basis of these assumptions and information provided in UDS (2003b), the estimated incidences of fatalities and injuries for the D&D of the conversion facilities are 0.01 and 5, respectively.

TABLE 5.9-1 Estimated Latent Cancer Fatalities from Radiation Exposure Resulting from Conversion Facility D&D Activities at the Portsmouth Site[a]

Residual Dose Rate (mrem/yr)	Low[b]	High[c]
100	2.12×10^{-3}	3.61×10^{-3}
60	2.12×10^{-3}	3.63×10^{-3}
30	2.12×10^{-3}	3.65×10^{-3}
15	2.14×10^{-3}	3.66×10^{-3}
10	2.16×10^{-3}	3.67×10^{-3}
3	2.18×10^{-3}	3.68×10^{-3}
1	2.19×10^{-3}	3.69×10^{-3}
0.3	2.19×10^{-3}	3.70×10^{-3}
0.1	2.20×10^{-3}	3.71×10^{-3}
0.03	2.20×10^{-3}	3.72×10^{-3}

[a] Values in this table are unscaled values taken directly from NRC (1994).

[b] Based on the D&D of a uranium fuel fabrication plant that converts enriched UF$_6$ into UO$_2$ for production of light-water reactor fuel (DOE 1999g).

[c] Based on the D&D of a UF$_6$ production plant where yellowcake is converted to UF$_6$.

5.9.3 Air Quality

Before structural dismantlement, all contaminated surfaces would be cleaned manually. Best construction management practices, such as dust control measures, would be used to protect air quality and to mitigate any airborne releases during the D&D process. As discussed in Section 5.9.1, it is anticipated that the D&D activities would not produce any significant radiological emissions that would affect the off-site public.

D&D can be considered to be the reverse of the construction of buildings and structures. Available information (Elayat et al. 1997) indicates that the level of construction-related activities during D&D would be an order of magnitude lower than during conversion facility construction. Air quality during D&D activities would thus be bounded by the results presented in Sections 5.2.1.3 and 5.2.2.3 for construction activities, if it is assumed that the existing emission control systems were efficiently maintained.

5.9.4 Socioeconomics

The potential consequences from D&D of the conversion facilities would be lower than those discussed in Section 5.2.1.5 for conversion facility construction, because the total D&D workforce would be smaller for facility D&D than for facility construction.

To decommission the conversion facility, many of the same people who operated the facility could do the cleaning; however, the dismantling and moving of equipment would have to be performed by electricians, plumbers, mechanics, and equipment operators, most of whom would be hired or contracted (NRC 1988) specifically for this purpose.

5.9.5 Waste Management

The major challenge of the D&D activity would be to remove and dispose of radioactive and hazardous wastes while keeping occupational and other exposures ALARA. Section 3.7 of DOE Guide 420.1-1 (DOE 2000c) requires facilities where radioactive or other hazardous contaminating materials will be used to be designed so as to simplify periodic decontamination and ultimate decommissioning. For example, if necessary, all cracks, crevices, and joints would have to be caulked or sealed and finished smooth to prevent the accumulation of contaminated material in inaccessible areas. These design features should minimize the generation of radioactive and/or hazardous materials during D&D activities.

There are three major classes of D&D waste, based on the composition and radioactivity of the materials involved: LLW, mixed LLW, and hazardous waste. It is assumed that TRU waste would not be present (any TRU waste generated during facility operations would be removed prior to D&D activities). A fourth class is “clean” material; this is any material resulting from D&D activities, including metal, which can be safely reused or recycled without any further radiological or hazardous controls. If no further need is established for these clean materials, they can be disposed of at sanitary landfills without requiring any further radiological or hazardous controls.

D&D-related waste can also be categorized into two general groups: contaminated materials and other wastes. Contaminated materials are standard materials such as steel and concrete that contain or have embedded trace amounts of radioactivity. In general, contamination is caused by the settling or adherence of uranium and its progeny products on internal surfaces such as piping. The average concentrations of the radionuclides contaminating the conversion facility are expected to be generally low enough to rank these materials as Class-A LLW.

Other wastes, the second general group of D&D-related wastes, are composed of materials that can become radioactively contaminated when plant workers use them. They include gloves, rags, tools, plastic sheeting, and chemical decontaminants. These wastes are also expected to have an average radioactivity low enough to be ranked as Class-A LLW. This analysis assumes that the quantities of other wastes would be much lower than those generated during facility deconstruction.

It is assumed that the soil within the conversion facility perimeters would not be contaminated with radiological or hazardous materials as a result of normal facility operations and, therefore, would not require excavation and subsequent treatment and disposition. If soil was contaminated due to an accidental release, it would be cleaned up as quickly as feasible after the release occurred and would not be part of the D&D wastes.

The methodology outlined in Forward et al. (1994) was used to estimate the volumes and types of wastes that would be generated from the D&D of the conversion facilities. Because contaminant inventories for these facilities are unavailable, reference data on the contaminant inventory data compiled by the NRC were applied. Facilities are categorized in Forward et al. (1994) into different types on the basis of their function, structure, design, and degree of D&D difficulty. This analysis assumes that the conversion facilities could be considered to be "radioactively contaminated buildings" with a "low" degree of D&D difficulty.

On the basis of the above assumptions and information provided in UDS (2003a), the annual and total waste generation rates from the D&D of the conversion facility were estimated and are provided in Table 5.9-2. Of the total materials generated during the D&D of the conversion facility, both LLMW and hazardous wastes would make up 2% to 3% of the total, and LLW would constitute about 6% to 7%. The majority of the D&D materials (approximately 88% of the total) would be "clean."

The "clean" waste would be sent to a landfill that accepts construction debris. Low-level waste would be sent to a licensed 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 would be disposed of in a licensed facility in accordance with applicable regulatory requirements.

TABLE 5.9-2 Annual and Total Waste Volume Estimates from Conversion Facility D&D Activities at the Portsmouth Site

Waste Type	Annual D&D Waste (m^3/yr)[a]	Total D&D Waste (m^3)
LLMW	40	110
Hazardous waste	40	110
LLW	70	200
Clean	1,200	4,000

[a] Annual rates based on 3-year D&D.