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> The Physical Security Plan, Safeguards Contingency Plan, Guard Force Training and Qualification Plan, and the Standard Practice Procedure Plan for the Protection of Classified Matter are not included, as these documents contain or reference safeguards information.

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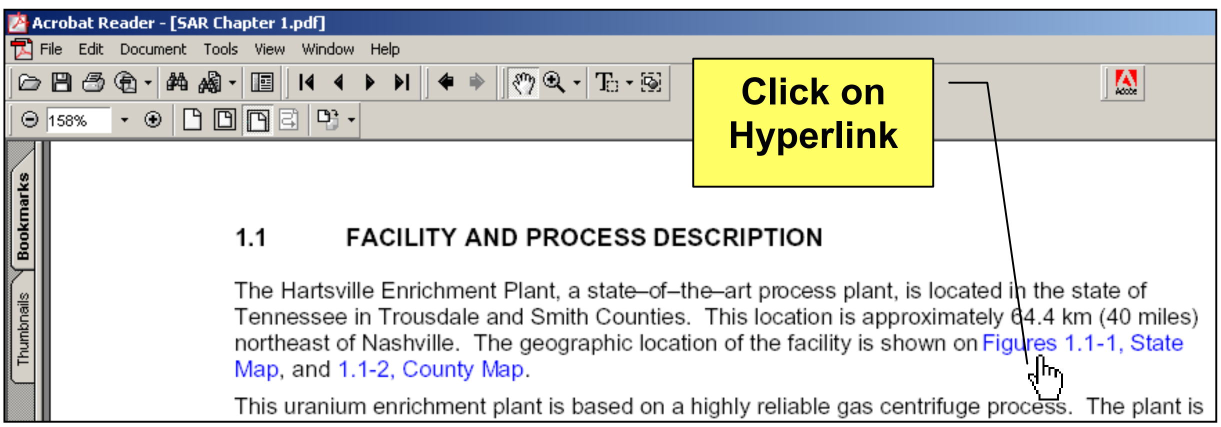

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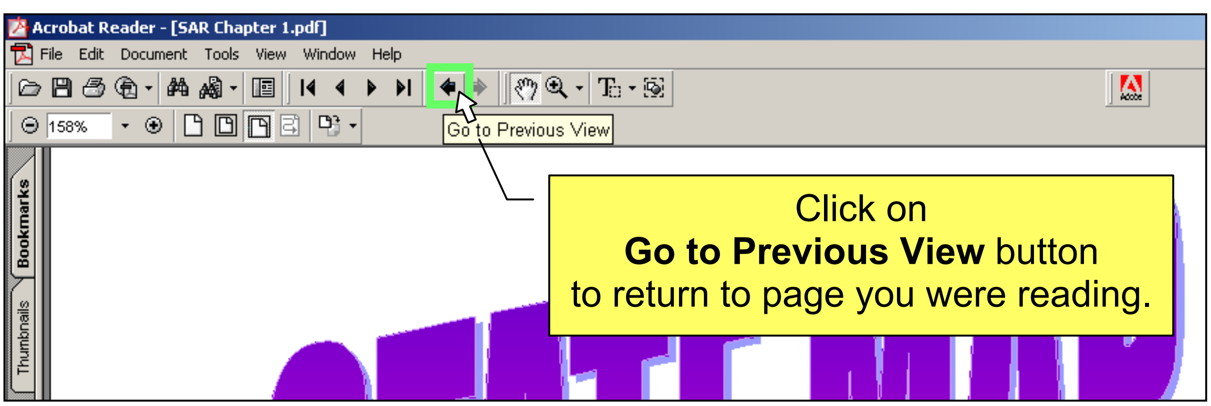

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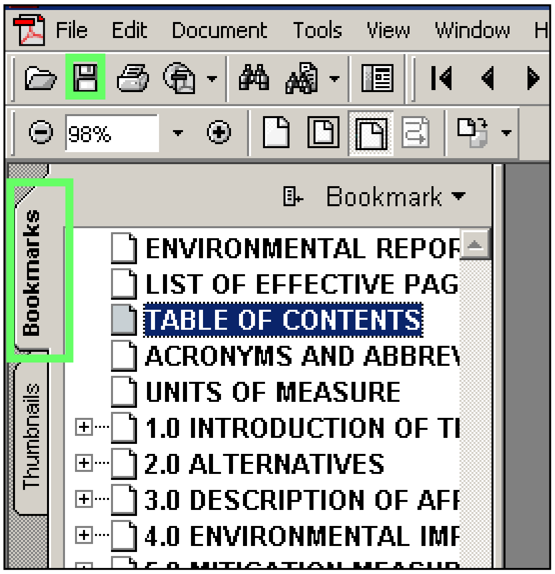

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5. Files are organized by **chapters** and **sections**.

Revision 1, February 2004

NATIONAL ENRICHMENT FACILITY

ENVIRONMENTAL REPORT

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4.0 ENVIRONMENTAL IMPACTS

This chapter evaluates the potential environmental impacts associated with the construction and operation of the proposed National Enrichment Facility (NEF). The chapter is divided into sections that assess the impact to each related resource described in Chapter 3, Description of Affected Environment. These include land use (4.1), transportation (4.2), geology and soils (4.3), as well as water resources (4.4), ecological (4.5), air quality (4.6), noise (4.7), historic and cultural (4.8), and visual/scenic (4.9). Other topics included are socioeconomic (4.10), environmental justice (4.11), public and occupational health (4.12), and waste management (4.13).

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4.1 LAND USE IMPACTS

4.1.1 Construction Impacts

The proposed NEF will be built on land for which a 35-year easement has been granted by the State of New Mexico. Since the site is currently undeveloped, potential land use impacts will be from site preparation and construction activities.

The proposed NEF site comprises an area of approximately 220 ha (543 acres). Construction activities, including permanent plant structures and temporary construction facilities, will disturb about 73 ha (180 acres). An additional 8 ha (20 acres) will be used for contractor parking and lay-down areas during plant construction. The total disturbed area will therefore be 81 ha (200 acres). The contractor lay-down and parking area will be restored after completion of plant construction. This includes the cutting and filling of approximately 322,000 m^3 (420,000 yd^3) of soil and caliche with the deepest cut at 4 m (13 ft) and the deepest fill at 3.3 m (11 ft). The cut and fill will be balanced, i.e., no soil will be brought onsite or transferred and disposed offsite. The balance of the property (147 ha or 363 acres) will be left in a natural state with no designated use for the life of the NEF. The plot plan and site boundaries of the permanent facilities indicating the areas to be cleared for construction activities are shown in ER Figure 2.1-2, Site Area and Facility Layout Map, and Figure 2.1-3, Existing Conditions Site Aerial Photograph.

During the construction phase of the NEF site, conventional earthmoving and grading equipment will be used. The removal of very dense soil or caliche may require the use of heavy equipment with ripping tools. Soil removal work for foundations will be controlled to reduce over-excavation to minimize construction costs. In addition, loose soil and/or damaged caliche will be removed prior to installation of foundations for seismically designed structures. Only about one-third of the total site area will be disturbed, affording wildlife of the site an opportunity to move to undisturbed onsite areas as well as additional areas of suitable habitat bordering the NEF site. The loss of cattle grazing lands represented by site construction will be minimal due to the abundance of other nearby grazing areas. No mitigation is necessary to offset this minimal impact.

The relocation of the CO_2 pipeline will be performed in accordance with all applicable regulations, so as to minimize any direct or indirect impacts on the environment.

The anticipated effects on the soil during construction activities are limited to a potential short-term increase in soil erosion. However, this will be mitigated by proper construction best management practices (BMPs). These practices include minimizing the construction footprint to the extent possible, limiting site slopes to a horizontal to vertical ratio of three to one or less, the use of a sedimentation detention basin, protection of undisturbed areas with silt fencing and straw bales as appropriate, and site stabilization practices such as placing crushed stone on top of disturbed soil in areas of concentrated runoff. In addition, as indicated in ER Section 4.2.5, Mitigation Measures, onsite construction roads will be periodically watered down, if required, to control fugitive dust emissions. Water conservation will be considered when deciding how often dust suppression sprays will be applied. After construction is complete, the site will be stabilized with natural, low-water maintenance landscaping and pavement.

Impacts to land and groundwater will be controlled during construction through compliance with the National Pollution Discharge Elimination System (NPDES) general construction permit obtained from Region 6 of the Environmental Protection Agency (EPA). A Spill Prevention, Control and Countermeasures (SPCC) plan will also be implemented during construction to minimize environmental impacts from potential spills and to ensure prompt and appropriate remediation. Potential spills during construction are likely to occur around vehicle maintenance and fueling locations, storage tanks, and painting operations. The SPCC plan will identify sources, locations and quantities of potential spills and response measures. The plan will also identify individuals and their responsibilities for implementation of the plan and provide for prompt notifications of state and local authorities, as required.

Waste management BMPs will be used to minimize solid waste and hazardous materials. These practices include the placement of waste receptacles and trash dumpsters at convenient locations and the designation of vehicle and equipment maintenance areas for the collection of oil, grease and hydraulic fluids. Where practicable, materials suitable for recycling will be collected. If external washing of construction vehicles is necessary, no detergents will be used, and the runoff will be diverted to onsite retention basins. Adequately maintained sanitary facilities will be provided for construction crews.

4.1.2 Utilities Impacts

The NEF will require the installation of water, natural gas and electrical utility lines. In lieu of connecting to the local sewer system, three onsite underground septic tanks with a common leach field will be installed for the treatment of sanitary wastes.

A new potable water supply line will be extended from the city of Eunice, New Mexico to the NEF site and another potable water supply line will be extended from the city of Hobbs, New Mexico. The line from Eunice will be about 8 km (5 mi) in length. The line from Hobbs will be about 32 km (20 mi) in length. Placement of the new water supply lines along New Mexico Highways 18 and 234 would minimize impacts to vegetation and wildlife. (Refer to Figure 3.1-1, Land Use Map.) Since there are no bodies of water between the site and the city of Eunice, New Mexico, no waterways will be disturbed. Likewise, there are no bodies of water between the site vicinity and the city of Hobbs. However, as indicated in ER Section 3.2.1, Transportation Access, there is a 61-m (200-ft) right-of-way easement along both sides of New Mexico Highway 234. Therefore, an application for utility line installation within highway easements will be submitted to the New Mexico State Highway and Transportation Department. Utility line installation coordinated with state planned highway upgrades would minimize traffic impact on New Mexico Highway 234 between the site and the city of Eunice, New Mexico.

The natural gas line feeding the site will connect to an existing, nearby line. This will minimize impacts of short-term disturbances related to the placement of the tie-in line.

Two new electrical transmission lines on a large loop system are proposed for providing electrical service to the NEF. These lines would tie into a trunk line about 13 km (8 mi) to the west. Similar to the new water supply lines, land use impacts would be minimized by placing associated support structures along New Mexico Highway 234. An application for highway easement modification will be submitted to the state. As noted in ER Chapter 2, Alternatives, there are currently several power poles along the highway in front of the adjacent, vacant parcel east of the site. In conjunction with the new electrical lines serving the site, the local company

providing electrical service, Xcel Energy, will install two independent substations to ensure redundant service. Three underground septic tanks will be installed onsite. The common leach field will require about 1,219 m (4,000 ft) of drain pipe. The drain pipe will either be placed below grade or buried in a mound consisting of sand, aggregate and soil.

Overall land use impacts to the site and vicinity will be minimal considering that the majority of the site will remain undeveloped, the current industrial activity on neighboring properties, the nearby expansive oil and gas well fields, and the placement of most utility installations along highway easements. LES is not aware of any Federal action that would have cumulatively significant land use impacts.

4.1.3 Comparative Land Use Impacts of No Action Alternative Scenarios

ER Chapter 2 provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The impact would be less since less land is disturbed by building only one centrifuge plant instead of two.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The land use would be the same if undisturbed land is used for the original or increased capacity site(s). If the site(s) were previously disturbed, the impact would be less.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The impact of this would be less because no new land would be disturbed.

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4.2 TRANSPORTATION IMPACTS

The NEF site is located in southeastern New Mexico near the New Mexico/Texas state line in Lea County, New Mexico. The site lies along the north side of New Mexico Highway 234, which provides direct access to the site. To the north, U.S. Highway 62/180 intersects New Mexico Highway 18 providing access from the city of Hobbs, New Mexico south to New Mexico Highway 234. To the east in Texas, U.S. Highway 385 intersects Texas Highway 176 providing access from the town of Andrews, Texas, west to New Mexico Highway 234. To the south in Texas, Interstate 20 intersects Texas Highway 18 which becomes New Mexico Highway 18, providing access from the city of Jal, New Mexico north to New Mexico Highway 234. West of the site, New Mexico Highway 8 provides access from the city of Eunice east to New Mexico Highway 234. See ER Figure 2.1-1, 80-Kilometer (50-Mile) Radius With Cities and Roads, which depicts highways in the vicinity of the NEF.

4.2.1 Construction of Access Road

Near the proposed NEF site, New Mexico Highway 234 is a two-lane highway with 3.6-m (12-ft) driving lanes, 2.4-m (8-ft) shoulders and a 61-m (200-ft) right-of-way easement on either side. Access to the site is directly off of New Mexico Highway 234. An onsite, gravel covered road currently bisects the east and west halves of the site. Two construction access roadways off of New Mexico Highway 234 will be built to support construction. The materials delivery construction access road will run north off of New Mexico Highway 234 along the west side of the NEF. The personnel construction access road will run north off of New Mexico Highway 234 along the east side of the NEF. Both roadways will eventually be converted to permanent access roads upon completion of construction. Therefore, impacts from access road construction will be minimized.

4.2.2 Transportation Route

The transportation route for conveying construction material from areas north and south of the site is by way of New Mexico Highway 18 to New Mexico Highway 234. The intersection of New Mexico Highways 18 and 234 is a short distance west of the site. Construction material may also be transported from the east by way of Texas Highway 176 which becomes New Mexico Highway 234 at the New Mexico/Texas state line. Construction material transported from the west will be by way of New Mexico Highway 8 which becomes Highway 234 near the city of Eunice, west of the site. The mode of transportation for conveying construction material will consist of over-the-road trucks, ranging from heavy-duty 18-wheeled delivery trucks, heavy-duty trucks and dump trucks, to box and flatbed type light-duty delivery trucks. Due to the presence of a quarry directly north of the site, concrete mixing trucks might also use the onsite gravel road which currently leads to the quarry.

4.2.3 Traffic Pattern Impacts

New Mexico Highway 234 provides direct access to the site. Considering that New Mexico Highway 234 serves as a main east-west trucking thoroughfare for local industry, it should be

able to handle the increased heavy-duty traffic adequately. However, similar to nearby industrial properties to the east, the construction of dedicated turning lanes would help alleviate congestion that might otherwise occur from increased truck traffic. According to the New Mexico Department of Transportation, upgrades to New Mexico Highway 234 are planned and include the resurfacing, restoration and rehabilitation of existing lanes in order to improve roadway quality, enhance safety and for economic development (NMDOT, 2003).

No timeframe has been established for the upgrades; however, the highway upgrade bonds were recently approved and signed by the Governor of New Mexico. The upgrades could start as soon as January 2004, but no definitive schedule has been established.

Operational shift changes for site personnel are estimated to average 40 to 50 vehicles per shift change. Most vehicles would likely travel west from the site on New Mexico Highway 234, towards the city of Eunice, New Mexico or turn north onto New Mexico Highway 18 towards the city of Hobbs, New Mexico or south towards the city of Jal, New Mexico. Eastbound vehicles would travel from the site on New Mexico Highway 234 and continue on Texas Highway 176.

Referring to ER Table 4.10-1, Estimated Number of Construction Workers by Annual Pay, the maximum number of construction workers is 800 during the peak of the eight-year construction period. Work shifts will be implemented to minimize the impact to traffic in the site vicinity. Car pooling will also be encouraged.

Current traffic volume for nearby impacted road systems as shown below:

Road Name	Traffic Volume Per Day
New Mexico Highway 234	Refer to Texas Highway 176
New Mexico Highway 18	5,417[a,b,e]
U.S. Highway 62/180	9,522[b,c,e]
Texas Highway 176	2,550[a,d]

Notes:

[a]At junction with New Mexico Highway 234

[b]Source: (NMSHTD, 2003)

[c]At junction with New Mexico Highway 18

[d]Source: (TDOT, 2002)

[e]Denoted as a major intersection

Considering the amount of traffic that nearby roadways experience on a daily average, the temporary increase in vehicle flow associated with onsite operations is considered tolerable for short periods of time. Generally, as distance from the site increases, impacts to the transportation network decrease as traffic becomes more dispersed.

4.2.4 Construction Transportation Impacts

Impacts from construction transportation will include the generation of fugitive dust, changes in scenic quality, and added noise.

Dust will be generated to some degree during the various stages of construction activity. The amount of dust emissions will vary according to the types of activity. The first five months of construction will likely be the period of highest emissions since approximately one-third of the 220 ha (543 acres) will be involved, along with the greatest number of construction vehicles operating on an unprepared surface. However, it is expected that no more than 18 ha (45 acres) will be involved in this type of work at any one time.

Air quality impacts from construction site preparation for the NEF were evaluated using emission factors and air dispersion modeling. Emission rates for fugitive dust were calculated using emission factors provided in AP-42, the U.S. Environmental Protection Agency's Compilation of Air Pollutant Emission Factors (EPA, 1995). A more detailed discussion of air emissions and dispersion modeling can be found in ER Section 4.6.1, Air Quality Impacts from Construction.

Emission rates for fugitive dust, as listed in Table 4.6-1, Peak Emission Rates were estimated for a 10-hour workday assuming peak construction activity levels were maintained throughout the year. The calculated Total Work-Day Average Emissions result for fugitive emission particulates is 2.4 g/s (32.5 lbs/hr). Fugitive dust will originate predominantly from vehicle traffic on unpaved surfaces, earth moving, excavating and bulldozing, and to a lesser extent from wind erosion. Fugitive dust emissions were estimated using an AP-42 emission factor for construction site preparation that was adjusted to account for dust suppression measures, and the fraction of total suspended particulate that is expected to be in the range of particulates less than or equal to 10 micrometers (PM_{10}) in diameter.

Emissions were modeled as a uniform area source with emissions occurring 10 hours per day, 5 days per week, and 50 weeks per year. PM_{10} emissions from fugitive dust were also below the National Ambient Air Quality Standards (NAAQS) (CFR, 2003w). The results of the fugitive dust estimates should be viewed in light of the fact that the peak anticipated fugitive emissions were assumed to occur throughout the year, and that only 50% reduction in the fugitive dust emissions was assumed for dust suppressant activities. These conservative assumptions will result in predicted air concentrations that tend to overestimate the potential impacts.

Although site construction will significantly alter its natural state, and considering that there are no high quality viewing areas and the industrial development of surrounding properties, impacts to the scenic quality of the site are not considered to be significant. Also, construction vehicles will be comparable to trucks servicing neighboring facilities.

As detailed in ER Section 4.7, Noise Impacts, the temporary increase in noise levels along New Mexico Highways 18 and 234 and Texas Highway 176 due to construction vehicles are not expected to impact nearby receptors significantly, due to substantial truck traffic currently using these roadways.

4.2.5 Mitigation Measures

To control fugitive dust production, reasonable precautions will be taken to prevent particulate matter and/or suspended particulate matter from becoming airborne. These precautions will include the following:

- The use of water in the control of dust on dirt roads, when necessary, in clearing and grading operations, and construction activities. Water conservation will be considered when

deciding how often dust suppression sprays will be applied. See ER Section 4.4.7, Control of Impacts for Water Quality, for a discussion of water conservation measures;

- The use of adequate containment methods during excavation and other similar operations;
- Open-bodied trucks transporting materials likely to give rise to airborne dust will be covered when in motion;
- The prompt removal of earthen materials on paved roads placed there by trucks or earth moving equipment, or by wind erosion; and
- Prompt stabilization or covering of bare areas once earthmoving activities are completed.

4.2.6 Agency Consultations

Based on conversations with officials from the New Mexico State Highway and Transportation Department and the Texas Department of Transportation, except for potential weight, height and length restrictions placed on trucks traveling certain routes, there are no roadway restrictions. Should the decision be made to provide dedicated turning lanes for site access from New Mexico Highway 234, an application for a state highway access permit for highway modification will be submitted to the New Mexico State Highway and Transportation Department. Modifications would be coordinated with the planned upgrades to New Mexico Highway 234 by the state. Likewise, an application for the installation of utilities and other easement modifications along New Mexico Highway 234 will be submitted.

4.2.7 Radioactive Material Transportation

Radioactive material shipments will be transported in packages that meet the requirements of 10 CFR 71 and 49 CFR 173 (CFR, 2003e; CFR, 2003l). The Nuclear Regulatory Commission (NRC) has evaluated the environmental impacts resulting from the transport of nuclear materials in NUREG-0170, Final Environmental Statement on the Transportation of Radioactive Material By Air and Other Modes (NRC, 1977a), updated by NUREG/CR-4829, Shipping Container Response to Severe Highway and Railway Accident Conditions (NRC, 1987a). These references include accident scenarios related to the transportation of radioactive material. The NRC found that these accidents have no significant environmental impacts. The materials that will be transported to and from the NEF are within the scope of the environmental impacts previously evaluated by the NRC. Because these impacts have been addressed in a previous NRC environmental impact statement, these impacts do not require further evaluation in this report (NRC, 1977a).

The dose equivalent to the public and worker for incident-free transportation has been conservatively calculated to illustrate the relative impact resulting from transporting radioactive material. Uranium feed, product and associated low-level waste (LLW) will be transported to and from the NEF. The following sections describe each of these conveyances, associated routes, and the dose contribution to the public and worker.

4.2.7.1 Uranium Feed

The uranium feed for the NEF is natural uranium in the form of uranium hexafluoride (UF_6). No reprocessed uranium is used as feed material for the facility. The UF_6 is transported to the

facility predominantly in 48Y cylinders; however, a small amount may be shipped in 48X cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standards Institute (ANSI) N14.1, Uranium Hexafluoride – Packaging for Transport (ANSI, applicable version). Feed cylinders are transported to the site by 18-wheeled trucks, one per truck (48Y) or two per truck (48X). Since the NEF has an operational capacity of 690 feed cylinders per year, it is anticipated that approximately 690 shipments of feed cylinders per year will arrive at the site per year.

4.2.7.2 Uranium Product

The product of the NEF is transported in 30B cylinders. These cylinders are designed, fabricated and shipped in accordance with the ANSI standard for packaging and transporting UF_6 cylinders, N14.1 (ANSI, applicable version). Product cylinders are transported from the site to fuel fabrication facilities by modified flat bed truck. A shipment frequency of one shipment per three days (122 per year) is typical, which equals approximately three cylinders per truck to meet the facility output of 350 cylinders per year.

4.2.7.3 Depleted Uranium and Uranium Wastes

Depleted uranium in UBCs will be shipped to conversion or storage facilities via truck in 48Y cylinders similar to feed cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSI N14.1, Uranium Hexafluoride – Packaging for Transport (ANSI, applicable version). UBCs will be transported from the site by 18-wheeled trucks, one per truck (48Y). In the future, rail transport may also be used for ship UBCs from the site. Since the NEF has an operational capacity of 627 UBCs per year (type 48Y), 627 shipments of UBCs per year will leave the site. At present, UBCs will be temporarily stored onsite until conversion or storage facilities are available.

Waste materials are transported in packages by truck via highway in accordance with 10 CFR 71 and 49 CFR 171-173 (CFR, 2003e; CFR, 2003k; CFR 2003l). Detailed descriptions of radioactive waste materials which will be shipped from the NEF facility for disposal are presented in ER Section 3.12, Waste Management. ER Table 3.12-1, Estimated Annual Radiological and Mixed Wastes, presents a summary of these waste materials.

4.2.7.4 Transportation Modes, Routes, and Distances

The feed and product materials of the facility will be transported by truck by way of highway travel only. However, the use of rail for feed and product shipments is being investigated. Feed material is obtainable from UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL. The product could be transported to fuel fabrication facilities near Hanford, WA, Columbia, SC, and Wilmington, NC. The designation of the supplier of UF_6 and the product receiver is the responsibility of the customer. Waste generated from the enrichment process may be shipped to a number of disposal sites or processors depending on the physical and chemical form of the waste. Potential disposal sites or processors are located near Barnwell, SC (if available to New Mexico), Clive, UT, Oak Ridge, TN, Paducah, KY and Portsmouth, OH. Refer to ER Section 3.12.2.1.2.9 for disposition option of other wastes.

The primary transportation route between the site and the conversion, fuel fabrication and disposal facilities is via New Mexico Highway 234 to northbound New Mexico Highway 18. These two highways intersect one another a short distance west of the site. New Mexico Highway 18 is accessible from eastbound and westbound highways in the city of Hobbs, approximately 32 km (20 mi) north of the site. ER Table 4.2-1, Possible Radioactive Material Transportation Routes, lists the approximate highway distances from the NEF to the respective conversion facilities, fuel fabrication facilities, and radioactive waste disposal sites.

4.2.7.5 Radioactive Treatment and Packaging Procedure

There will be no treatment of hazardous materials or mixed waste at the NEF that would require a Treatment, Storage and Disposal Permit. Specific handling of radioactive and mixed wastes are discussed in detail in ER Section 3.12, Waste Management.

Packaging of product material, radioactive waste and mixed waste will be in accordance with plant implementation procedures that follow 10 CFR 71 (CFR, 2003e) and 49 CFR 171-173 (CFR, 2003k; CFR, 2003l). Product shipments will have additional packaging controls in accordance with ANSI N14.1, Uranium Hexafluoride - Packaging For Transport (ANSI, applicable version). Waste materials will have additional packaging controls in accordance with each respective disposal or processing site's acceptance criteria (CFR, 2003e; ANSI, 2001).

4.2.7.6 Incident-Free Scenario Dose

The radiological dose equivalents from incident-free transportation for categories of shipping are presented in Table 4.2-2, Incident-Free Transportation Dose to the Public and Worker. Each shipment category represents the various material shipments to and from the NEF. Within each category, radioactive material may be shipped to different locations. For calculation purposes, the worst-case dose equivalent was calculated and showed minimal impact. The collective dose equivalent to the general public from the worst case (highest dose) route in each shipping category (feed, product, waste and depleted UF_6) totaled 2.33×10^{-6} Sv (2.33×10^{-4} rem). Similarly, the dose equivalent to the onlooker, driver and worker were 1.05×10^{-3}, 9.47×10^{-2}, 6.98×10^{-4} Sv (1.05×10^{-1}, 9.47 and 6.98×10^{-2} rem), respectively.

The source of radiation is that from the uranium isotopes and their progeny in each of the following:

- Natural uranium (in the feed to the process)
- Enriched uranium (final product, at 5 wt % ^{235}U)
- Depleted uranium (at 0.34 wt % ^{235}U), and
- Solid waste (at 370 Bq (10 nanocuries) of natural uranium per gram of waste).

The cumulative dose equivalent to the general public from transportation of UF_6 and solid waste was based on the model in NUREG/CR-0130 (NRC, 1978), which in turn was based on WASH-1238 (NRC, 1972). NUREG/CR-0130 (NRC, 1978) defines the dose to the general public resulting from the transportation of radioactive materials as equal to 1.2×10^{-7} Person-Sieverts/km (1.9×10^{-5} Person-rem/mi), based on several demographic variables. This dose equivalent per distance was corrected for each route to or from the NEF. New 2000 census demographics information was proportioned to each route, resulting in a correlated dose

equivalent to the general public, while still employing the same assumption in NUREG/CR-0130 (NRC, 1978) and WASH-1238 (NRC, 1972).

The dose to the onlooker, worker and driver were based on a calculated dose rate from containerized radioactive material at a distance of 2.0 m (6.6 ft). The same assumptions from the above references were similarly applied to identify durations and the associated dose. Other assumptions used in the transportation dose calculations are listed in the footnotes for Table 4.2-2, Incident-Free Transportation Dose to the Public and Worker.

4.2.7.7 Environmental Impacts from Transportation of Radioactive Material

The NRC has evaluated the environmental impacts resulting from the transport of nuclear materials in NUREG-0170, Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes (NRC, 1977a), updated by NUREG/CR-4829, Shipping Container Response to Severe Highway and Railway Accident Conditions (NRC,1987a). These references include accident scenarios related to the transportation of radioactive material. The NRC found that these accidents have no significant environmental impacts (NRC, 1977a; NRC, 1987a).

The most current NRC studies analyzing transportation impacts of high level waste and spent fuel resulting from the license renewal of power reactors found the associated impacts to be small. Cumulative impacts of transporting high-level waste to a single repository site at Yucca Mountain, Nevada and the impacts of transporting spent fuel enriched up to 5% ^{235}U with average burn-up for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU are found to not appreciably change the impact values contained in 10 CFR 51.52(c), Summary Table S-4-Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. (See 10 CFR 51.53(c)(3)(ii)(M)) (CFR, 2003a). Note that radioactive shipments from the NEF will be low-level only.

The data supporting these newest studies are contained in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC, 1996) and NUREG-1437, Addendum 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Supplemental Analysis for Cumulative Environmental Impacts of Spent Nuclear Fuel Transport and Implications of Higher Burnup Fuel for the Conclusions in 10 CFR 51.52, 'Environmental Effects of Transportation of Fuel and Waste -Table S-4," December 1998; (NRC, 1998).

The materials that will be transported to and from the NEF are uranium feed cylinders, product cylinders, and radioactive waste (listed in Table 3.12-1, Estimated Annual Radiological and Mixed Wastes). The radioactivity contained in those materials is substantially lower than the amount of radioactivity contained in the high-level waste and spent fuel used in the NRC studies. The impacts associated with transportation of radioactive materials to and from the NEF are well within the scope of the environmental impacts previously evaluated by the NRC. Because these impacts have been addressed in a previous NRC environmental impact statement, these impacts do not require further evaluation.

4.2.8 Comparative Transportation Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The transportation impact for the USEC centrifuge plant would be greater if the plant is located near the GDP facility because it would concentrate the shipments in one location. The transportation impact for the USEC centrifuge plant would be the same as NEF, if located at a site other than the GDP site.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The transportation impact for a USEC centrifuge plant with increased capability would be greater because it would concentrate the shipments in one location.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The transportation impact would be greater because it would concentrate the shipments in one location.

TABLES

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Table 4.2-1 Possible Radioactive Material Transportation Routes

Facility	Description	Distance, km (mi)
UF_6 Conversion Facility Port Hope, Ontario	Feed	2,869 (1,782)
UF_6 Conversion Facility Metropolis, IL	Feed	1,674 (1,040)
Fuel Fabrication Facility Hanford, WA	Product	2,574 (1,599)
Fuel Fabrication Facility Columbia, SC	Product	2,264 (1,406)
Fuel Fabrication Facility Wilmington, NC	Product	2,576 (1,600)
Barnwell Disposal Site Barnwell, SC	LLW Disposal	2,320 (1,441)
Envirocare of Utah Clive, UT	LLW and Mixed Disposal	1,636 (1,016)
GTS Duratek[1] Oak Ridge, TN	Waste Processor	1,993 (1,238)
Depleted UF_6 Conversion Facility[2] Paducah, KY	Depleted UF_6 Disposal	1,670 (1,037)
Depleted UF_6 Conversion Facility[2] Portsmouth, OH	Depleted UF_6 Disposal	2,243 (1,393)

[1]Other offsite waste processors may also be used.

[2]To be operational in approximately 3-5 years.

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Table 4.2-2 Annual Incident-Free Transportation Dose Equivalent To The Public And Worker

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		Dose Equivalent to General Public[1,6]		Dose Equivalent to the Onlookers[2,6]		Dose Equivalent to the Drivers[3,6]		Dose Equivalent to the Garage Personnel[4,6]	
Facility	**Description[5]**	**Person-Sv**	**Person-rem**	**Person-Sv**	**Person-rem**	**Person-Sv**	**Person-rem**	**Person-Sv**	**Person-rem**
UF_6 Conversion Facility Port Hope, Ontario	Feed (48Y, 690)	1.46E-06	1.46E-04	4.84E-04	4.84E-02	4.96E-02	4.96E+00	3.23E-04	3.23E-02
UF_6 Conversion Facility Metropolis, IL	Feed (48Y, 690)	4.32E-07	4.32E-05	4.84E-04	4.84E-02	2.89E-02	2.89E+00	3.23E-04	3.23E-02
Fuel Fabrication Facility Hanford, WA	Product (30B, 350)	6.03E-08	6.03E-06	1.24E-04	1.24E-02	1.01E-02	1.01E+00	8.25E-05	8.25E-03
Fuel Fabrication Facility Columbia, SC	Product (30B, 350)	1.77E-07	1.77E-05	1.24E-04	1.24E-02	8.90E-03	8.90E-01	8.25E-05	8.25E-03
Fuel Fabrication Facility Wilmington, NC	Product (30B, 350)	2.16E-07	2.16E-05	1.24E-04	1.24E-02	1.01E-02	1.01E+00	8.25E-05	8.25E-03
Barnwell Disposal Site Barnwell, SC	Waste (55-gal, 160)	1.53E-09	1.53E-07	1.03E-06	1.03E-04	1.54E-04	1.54E-02	6.86E-07	6.86E-05
Envirocare of Utah Clive, UT	Waste (55-gal, 160)	2.91E-10	2.91E-08	1.03E-06	1.03E-04	1.08E-04	1.08E-02	6.86E-07	6.86E-05
GTS Duratek Oak Ridge, TN	Waste (55-gal, 160)	1.35E-09	1.35E-07	1.03E-06	1.03E-04	1.32E-04	1.32E-02	6.86E-07	6.86E-05
Depleted UF_6 Conversion Facility Paducah, KY	Depleted UF_6 Disposal (48Y, 625)	3.87E-07	3.87E-05	4.38E-04	4.38E-02	2.60E-02	2.60E+00	2.92E-04	2.92E-02
Depleted UF_6 Conversion Facility Portsmouth, OH	Depleted UF_6 Disposal (48Y, 625)	6.52E-07	6.52E-05	4.38E-04	4.38E-02	3.50E-02	3.50E+00	2.92E-04	2.92E-02

[1]Collective dose equivalent based on population density along route.

[2]Collective dose equivalent to onlookers was calculated by multiplying the dose equivalent rate at 2 m (6.6 ft) on side from the container, times 3 minutes, times 10 people exposed to each container, times number of shipments.

[3]Collective dose equivalent based on two truck drivers per shipment.

[4]Collective dose equivalent to garage personnel was calculated by multiplying the dose equivalent rate at 2 m (6.6 ft) on side from the container times 10 minutes, times two garage personnel exposed, times the number of shipments.

[5]Type and number of containers shipped per year given parenthetically. The dose equivalent for 48Y containers (feed or tails) bound those from 48X containers.

[6]Annual collective doses assuming all containers (type and numbers) are shipped to/from the site during the year.

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4.3 GEOLOGY AND SOIL IMPACTS

Site geology and soils, briefly summarized here, are fully described in ER Section 3.3, Geology and Soils. A physiographic summary for the site area is presented in Figure 3.3-1, Regional Physiography.

Subsurface geologic materials at the NEF site generally consist of competent clay red beds, a part of the Chinle Formation of the Triassic-aged Dockum Group. Bedrock is covered with about 12.2 to 18.3 m (40 to 60 ft) of silty sand, sand, and sand and gravel, an alluvium that is part of the Antlers and/or Gatuña Formations.

Foundation conditions at the site are generally good and no potential for mineral development exists or has been found at the site, as discussed in ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems.

The site terrain currently ranges in elevation from +1,033 to +1,045 m (+3,390 to +3,430 ft) mean sea level (msl) (Figure 3.3-3, Site Topography). Because the NEF facility requires an area of flat terrain, cut and fill will be required for significant portions of the site to bring it to a final grade of +1,041 m (+3,415 ft) msl. It is planned that the volume of material excavated from the higher portions of the site will be fully utilized for fill at the lower areas of the site, with a total of about 611,033 m^3 (797,000 yd^3) cut and used as fill. The modification of the site to a finished grade of +1,041 m (+3,415 ft) msl will cause about 36 ha (90 acres) of the site to be raised with soil fill, and 36 ha (90 acres) to be excavated down to that elevation. There are no plans to excavate or dispose of excavated materials offsite. The resulting terrain change for the site from gently sloping to flat topography is not expected to cause significant environmental impact. Numerous such areas of flat terrain exist in the region due to natural erosion processes. Surface stormwater runoff for the permanent facility will be controlled by an engineered system described in ER Section 3.4.1.2, Facility Withdrawals and/or Discharges to Hydrologic Systems. Those controls will essentially eliminate any potential for discharge of runoff from the NEF site.

Construction activities may cause some short-term increases in soil erosion at the site, although rainfall in the region is limited. Erosional impacts due to site clearing and grading will be mitigated by utilization of construction and erosion control BMPs. (See ER Section 4.1, Land Use Impacts, for a discussion of construction BMPs.) Disturbed soils will be stabilized as part of construction work. Earth berms, dikes and sediment fences will be utilized as necessary during all phases of construction to limit runoff. Much of the excavated areas will be covered by structures or paved, limiting the creation of new dust sources. Watering will be used to control potentially fugitive construction dust. Water conservation will be considered when deciding how often dust suppression sprays will be applied. See ER Section 4.4.7, Control of Impacts for Water Quality, for a discussion of water conservation measures.

The Lea County Soils Survey (USDA, 1974) describes soils found at the NEF site (Figure 3.3-6, Site Soil Map Per USDA Data) as applicable for range, wildlife and recreation areas, and not for any standard agricultural activities. Construction and operation of the NEF plant are thus not anticipated to displace any potential agrarian use.

4.3.1 Comparative Geology and Soil Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of “no action,” i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three “no action” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios. .

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The geology and soil impacts would be less since less land is disturbed by building only one centrifuge plant instead of two.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The geology and soil impacts would be the same if the centrifuge plant is located on previously undisturbed land; otherwise, the impact would be less if the plant is located on previously disturbed land.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The geology and soil impacts would be less because no new geology or soil would be disturbed.

4.4 WATER RESOURCES IMPACTS

Water resources at the site are virtually nonexistent. There are no surface waters on the site and appreciable groundwater resources are only at depths greater than approximately 244 m (800 ft). The site region has semi-arid climate, with low precipitation rates and minimal surface water occurrence. Thus, the potential for negative impacts on those water resources are very low due to lack of water presence and formidable natural barriers to any surface or subsurface water occurrences. Groundwater at the site would not likely be impacted by any potential releases. The pathways for planned and potential releases are discussed below.

Permits related to water must be obtained for site construction and NEF operation are described in ER Section 1.3, Applicable Regulatory Requirements, Permits and Required Consultation. The purpose of these permits is to address the various potential impacts on water and provide mitigation as needed to maintain state water quality standards and avoid any degradation to water resources at or near the site. These include:

- *A National Pollutant Discharge Elimination System (NPDES) General Permit for Industrial Stormwater:* This permit is required for point source discharge of stormwater runoff from industrial or commercial facilities to the waters of the state. All new and existing point source industrial stormwater discharges associated with industrial activity require a NPDES Stormwater Permit from the EPA Region 6 and an oversight review by the New Mexico Water Quality Bureau (NMWQB). Most common is a general permit which is available to almost any industry, but there is also an option to obtain an individual NPDES permit. NEF may be required to obtain this type of permit because of the water discharge into the site detention/retention basins.
- *NPDES General Permit for Construction Stormwater:* Because construction of the NEF will involve the disturbance of more than 1.6 ha (5 acres) of land (disturbance of about 81 ha (200 acres) will be required for the construction phase of the project), an NPDES Construction Stormwater General Permit from the EPA Region 6 and an oversight review by the New Mexico Water Quality Bureau (NMWQB) are required.
- *Groundwater Discharge Permit/Plan:* The NMWQB requires that facilities that discharge an aggregate waste water of more than 7.6 m^3 (2,000 gal) per day to surface impoundments or septic systems apply for and submit a groundwater discharge permit and plan. This requirement is based on the assumption that these discharges have the potential of affecting groundwater. NEF will discharge treated process water, stormwater and cooling tower blowdown water to surface impoundments, as well as domestic septic wastes. A groundwater discharge permit/plan will be required under 20.6.2.3104 NMAC (NMAC, 2002a). Section 20.6.2.3.3104 NMAC (NMAC, 2002a) of the New Mexico Water Quality Control Commission (NMWQCC) Regulations (20.6.2 NMAC) requires that any person proposing to discharge effluent or leachate so that it may move directly or indirectly into groundwater must have an approved discharge permit, unless a specific exemption is provided for in the Regulations.
- *Aquatic Resource Alteration Permit (ARAP/Section 401 Certification)*: This permit is required for activities that involve physically altering waters (streams and wetlands) of the

state, including water withdrawals that have the potential to significantly degrade the water quality in the stream (USACE, 1987). Persons who conduct any activity that involves the alteration of waters of the state require a state and possibly a federal permit. Federal permits are required for projects involving the discharge of dredged or fill material into waters of the U.S. or wetlands. Aquatic Resource Alteration Permits (ARAP) are required for any alteration of state waters, including wetlands that do not require a federal permit. Currently, LES does not anticipate having to obtain an ARAP unless an arroya is identified on the NEF site. LES has made a determination that a dry arroya is not present; however, New Mexico Environmental Department (NMED) has not made an official determination on this issue.

NEF site design addresses:

- Discharge of stormwater and waste water to site retention/detention basins
- Septic system design and construction
- General construction activities
- Potential for filling or alteration of an arroyo, should one be identified on the site

Discharge of operations waste water will be made exclusively to the Treated Effluent Evaporative Basin for only those liquids that meet physical and chemical criteria per prescribed standards. That basin, described in ER Section 3.4.1.2, is double-lined to prevent infiltration, provided with leak detection, and open to allow evaporation. An annual volume of about 2,535 m^3/yr (669,844 gal/yr) will be discharged to the Treated Effluent Evaporative Basin for evaporation.

Collection and discharge of stormwater runoff will be made to two basins, the Site Stormwater Detention Basin and the Uranium Byproduct Cylinder (UBC) Storage Pad Stormwater Retention Basin. These basins are described in ER Section 3.4.1.2. The Site Stormwater Detention Basin will allow infiltration into the ground as well as evaporation and it has an outlet structure to allow its drainage. The UBC Storage Pad Stormwater Retention Basin is single-lined and will not have an outfall. For an average annual rainfall at the site of 35.94 cm/yr (14.15 in/yr) the potential runoff volumes (before evapotranspiration) are about 57,850 m^3/yr (15,186,900 gal/yr), 137,950 m^3/yr (36,440,600 gal/yr) and 587,700 m^3/yr (155,270,800 gal/yr) for the UBC Storage Pad Stormwater Retention Basin area, the Site Stormwater Detention Basin area, and the balance (i.e., undeveloped) of the site area, respectively.

Industrial construction for the NEF site will provide a short-term risk with regard to a variety of operations and constituents used in construction activities. These will be controlled by employing BMPs including control of hazardous materials and fuels. BMPs will assure stormwater runoff related to construction activities will be detained prior to release to the surrounding land surface. BMPs will also be used for dust control associated with excavation and fill operations during construction. See ER Section 4.1, Land Use Impacts, for more information on construction BMPs. Impact from stormwater runoff generated during plant operations is not expected to differ significantly from impacts currently experienced at the site.

Potential sources for runoff contamination during plant operation include an outdoor storage pad containing UBCs of depleted uranium. Although a highly unlikely occurrence, this pad is a

potential source of low-level radioactivity that could enter runoff. The engineering of cylinder storage systems (high-grade sealed cylinders as described in ER Section 2.1.2, Proposed Action) and environmental monitoring of the UBC Storage Pad Stormwater Retention Basin, combine to make the potential for contamination release through this system extremely low. An initial analysis of maximum potential levels of radioactivity in rainwater runoff due to surface contamination of UBCs shows that any potential levels of radioactivity in discharges will be well below (two orders of magnitude or more) the effluent discharge limits of 10 CFR 20, Appendix B (CFR, 2003q). The UBC Storage Pad Stormwater Retention Basin is also the discharge location for cooling tower blowdown water.

4.4.1 Receiving Waters

The NEF will not obtain any water or discharge any process effluents onto the site or into surface waters other than into engineered basins. Sanitary waste water discharges will be made through a site septic system. Rain runoff from developed portions of the site will be collected in retention/detention basins, described previously and in ER Section 3.4, Water Resources. These include the Site Stormwater Detention Basin and the UBC Storage Pad Stormwater Retention Basin.

Discharge from the Site Stormwater Detention Basin will be by evaporation and by infiltration into the ground. Discharge from the UBC Storage Pad Stormwater Retention Basin will be by evaporation only.

Discharge from the double-lined Treated Effluent Evaporative Basin, with leak detection, will be by evaporation only. NEF effluent flow rates providing input to this basin are relatively low, as described in ER Section 3.4.1.2.

The NEF site includes no surface hydrologic features. Groundwater occurs in small, dispersed accumulations at shallow depths 61 to 76 m (200 to 250 ft). Significant quantities of groundwater are only found at a depth over 244 m (800 ft) where cover for that aquifer is provided by 46 to 61 m (150 to 200 ft) or more of clay, as described in ER Section 3.4.1.1.1, Site Groundwater Investigations.

Due to high evapotranspiration rates for the area, it is not anticipated that there will be any receiving waters for runoff derived from the NEF facility other than residual amounts from that collected in the Site Stormwater Detention Basin. At shallower depths vegetation at the site provides highly efficient evapotranspiration processes, as described in ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems. That natural process will remove the major part of stormwater runoff at the site.

Stormwater runoff detention/retention basins for the site, shown in Figure 4.4-1, Site Plan with Stormwater Detention/Retention Basins are designed to provide a means of controlling discharges of rainwater and runoff chemistry for about 39 ha (96 acres) of the NEF site plus an additional 16.2 ha (40 acres) of the UBC Storage Pad. These areas represent a combined 55.2 ha (136 acres) of the 220 ha (543 acre) total NEF site area.

The UBC Storage Pad Stormwater Retention Basin, which will exclusively serve that paved, outdoor storage area, will be lined to prevent any infiltration, and designed to retain a volume

slightly more than twice that for the 24-hour duration, 100-year frequency storm plus an allowance for cooling tower blowdown 53,607 m^3 (43.46 acre-ft) for the area served. The basin configuration will allow for radiological testing of water and sediment (see ER Section 4.4.2, Impacts on Surface Water and Groundwater Quality), but the basin will contain no flow outlet. All discharge for the UBC Storage Pad Retention Basin will be through evaporation. The UBC Storage Pad will be constructed of reinforced concrete with a minimal number of construction joints, and pad joints will be provided with joint sealer and water stops as a leak-prevention measure. The ground surface around the UBC Storage Pad will be contoured to prevent rainfall in the area surrounding the pad from entering the pad drainage system.

The Site Stormwater Detention Basin will be designed with an outlet structure for drainage, as needed. Receiving waters for the portion of that basin are thus local groundwater. The basin will be included in the site environmental monitoring program as described in ER Section 6.1, Radiological Monitoring and ER Section 6.2, Physiochemical Monitoring.

4.4.2 Impacts on Surface Water and Groundwater Quality

Although quantities are severely limited, local shallow groundwater is of a minimally suitable quality to provide sources of potable water. Water for most domestic and industrial uses should contain less than 1,000 mg/L Total Dissolved Solids (TDS) (Davis, 1966), and this compares with a EPA secondary standard of 500 mg/L TDS (CFR, 2003h). The nearby Waste Control Specialists (WCS) facility wells have routinely been analyzed with TDS concentrations between about 2,880 and 6,650 mg/L.

The NEF will not obtain any water from the site or discharge process effluents to groundwater and surface waters other than to the double-lined Treated Effluent Evaporative Basin with leak detection. Therefore, no impacts on natural water systems quality due to facility water use are expected.

Control of surface water runoff will be required for NEF construction activities, covered by the NPDES General Permit. As a result, no significant impacts are expected for either surface water bodies or groundwater.

During NEF operation, stormwater from the site will be collected in a collection system that includes runoff detention/retention basins, as described in ER Section 4.4.1, Receiving Waters and shown in ER Figure 4.4-1, Site Plan with Stormwater Detention/Retention Basins.

No wastes from facility operational systems will be discharged to stormwater. In addition, stormwater discharges during plant operation will be regulated by an NPDES Stormwater Permit.

The UBC Storage Pad Stormwater Retention Basin will collect the runoff water from the UBC Storage Pad. This water runoff has the extremely remote potential to contain low-level radioactivity from cylinder surfaces or leaks. Runoff from the pad will be channeled to a dedicated retention basin that is single-lined with a synthetic fabric with ample soil cover over the liner to prevent surface damage and ultraviolet degradation. This basin is described in ER Section 3.4.1.2, Facility Withdrawal and/or Discharges to Hydrologic Systems. It is suitable to contain at least the volume of water from slightly more than twice the 100-year, 24-hour-

frequency rainfall of 15.2 cm (6.0 in) plus an allowance for cooling tower blowdown. The drainage system will include precast catch basins and concrete trench drains; piping will be reinforced concrete with rubber gasketed joints to preclude leakage. An assessment was made by LES that assumed a conservative level of radioactive contamination level on cylinder surfaces and 100% washoff to the UBC Storage Pad Stormwater Retention Basin from a single rainfall event. Results show the level of radioactivity in such a discharge to the basin will be well below the regulatory unrestricted release criteria (CFR, 2003q).

The UBC Storage Pad Stormwater Retention Basin will be provided with a means to sample sediment. Refer to ER Section 6.1, Radiological Monitoring, for more information regarding environmental monitoring of stormwater site detention/retention basins.

4.4.3 Hydrological System Alterations

Excavation and placement of fill will provide the site with a finished level grade of about +1,041 m (+3,415 ft), msl. This work will not require alteration or filling of any surface water features on the site.

No alterations to groundwater systems will occur due to facility construction.

4.4.4 Hydrological System Impacts

Due to absence of water extraction, limited effluent discharge from the facility operations, and the considerable depth to groundwater at the NEF site, no significant impacts are expected for the site's hydrologic systems.

Control of surface water runoff will be required for NEF construction activities, covered by the NPDES General Permit. As a result, no significant impacts are expected to either surface or groundwater bodies. Control of impacts from construction runoff is discussed in ER Section 4.4.7, Control of Impacts to Water Quality.

The volume of water discharged into the ground from the Site Stormwater Detention Basin is expected to be minimal, as evapotranspiration is expected to be the dominant natural influence on standing water.

4.4.5 Ground and Surface Water Use

The NEF will not obtain any water from the site or have any planned surface discharges at the site other than to the retention and detention basins. All potable, process and fire water supply used at the NEF will be obtained from the Eunice and/or Hobbs, New Mexico, municipal water systems. Wells serving these systems are about 32 km (20 mi) from the site. Anticipated normal plant water consumption and peak plant water requirements are provided in Table 3.4-4, Anticipated Normal Plant Water Consumption, and Table 3.4-5, Anticipated Peak Plant Water Consumption, respectively.

Site groundwater will not be utilized for any reason, and therefore, should not be impacted by routine NEF operations. The NEF water supply will be obtained from the city of Eunice, New Mexico and the city of Hobbs, New Mexico. Current capacities for the Eunice and Hobbs, New Mexico municipal water supply system are 16,350 m^3/day (4.32 million gpd) and 75,700 m^3/day (20 million gpd), respectively and current usages are 5,600 m^3/day (1.48 million gpd) and 23,450 m^3/day (6.2 million gpd), respectively. Average and peak potable water requirements for operation of the NEF are expected to be approximately 240 m^3/day (63,423 gpd) and 85 m^3/hr (378 gpm), respectively. These usage rates are well within the capacities of both water systems.

For both peak and the normal usage rates, the needs of the NEF facility should readily met by the municipal water systems. Impacts to water resources onsite and in the vicinity of the NEF are expected to be negligible.

4.4.6 Identification of Impacted Ground and Surface Water Users

Location of an intermittent surface water feature and groundwater users in the site vicinity including an area just beyond a 1.6-km (1-mi) radius of the site boundary are shown on Figure 3.4-7, Water and Oil Wells in the Vicinity of the NEF Site. These locations were provided by the Office of New Mexico State Engineer (NMSE) (NMSE, 2003), the Texas Water Development Board (TWDB) (TWDB, 2003) and the United States Geological Survey (USGS) (USGS, 2003b). No producing supply water wells are within 1.6 km (1 mi) of the boundaries of the NEF site as shown on Figure 3.4-7. However, nearby facilities do have groundwater monitoring wells within this region.

The absence of near-surface groundwater users within 1.6 km (1 mi) from the site and the absence of surface water on the NEF site will prevent any impact to local surface or groundwater users. Due to the lack of process water discharge from the facility to the environment, no impact is expected for these water users.

Effluent discharges will be controlled in a way that will also prevent any impacts. The locations of the closest municipal water systems for both Eunice and Hobbs are in Hobbs, New Mexico, 32 km (20 mi) north northwest of the site. There is no potential to impact these sources.

4.4.7 Control of Impacts to Water Quality

Site runoff water quality impacts will be controlled during construction by compliance with NPDES General Permit requirements and BMPs will be described in a site Stormwater Pollution Prevention (SWPP) plan.

Wastes generated during site construction will be varied, depending on activities in progress. Any hazardous wastes from construction activities will be handled and disposed of in accordance with applicable state regulations. This includes proper labeling, recycling, controlling and protected storage and shipping offsite to approved disposal sites. Sanitary wastes generated at the site will be handled by portable systems until such time that the site septic system is available for use.

The need to level the site for construction will require some soil excavation as well as soil fill. Fill placed on the site will provide the same characteristics as the existing natural soils thus providing the same runoff characteristics as currently exist due to the presence of natural soils on the site.

During operation, the NEF's stormwater runoff detention/retention system will provide a means to allow controlled release of site runoff from the Site Stormwater Detention Basin only. Stormwater discharge will be periodically monitored in accordance with state and/or federal permits. This system will also be used for routine sampling of runoff as described in ER Section 6.1.1.2, Liquid Effluent Monitoring. A Spill Prevention Control and Countermeasure (SPCC) plan will be implemented for the facility to identify potential spill substances, sources and responsibilities. A SWPP will also be implemented for the NEF to assure that runoff released to the environment will be of suitable quality. These plans are described in ER Section 4.1, Land Use Impacts.

Water discharged to the NEF site septic system will meet required levels for all contaminants stipulated in any permit or license required for that activity, including the 10 CFR 20 (CFR, 2003q) and a Groundwater Discharge Permit/Plan. The facility's Liquid Effluent Collection and Treatment System provides a means to control liquid waste within the plant. The system is fully described in SAR Section 3.2 and ER Section 3.12, and it provides for collection, treatment, analysis, and processing of liquid wastes for disposal. Effluents unsuitable for release to the Treated Effluent Evaporative Basin are processed onsite or disposed of offsite in a suitable manner in conformance with pertinent regulations.

The UBC Storage Pad Stormwater Retention Basin, which exclusively serves the UBC Storage Pad and cooling tower blowdown water discharges, is lined to prevent infiltration. It is designed to retain a volume slightly more than twice that for the 24-hour, 100-year frequency storm plus an allowance for cooling tower blowdown. Designed for sampling and radiological testing of the contained water and sediment, this basin has no flow outlet. All discharge is through evaporation.

The Site Stormwater Detention Basin is designed with an outlet structure for drainage. Local terrain serves as the receiving area for this basin.

Discharge of operations-generated potentially contaminated waste water is made exclusively to the Treated Effluent Evaporative Basin. Only liquids meeting site administrative limits (based on

prescribed standards) are discharged to this basin. The basin is double-lined with leak detection and open to allow evaporation.

Mitigation measures will be in place to minimize potential impact on water resources. These include employing BMPs and the control of hazardous materials and fuels. In addition, the following controls will also be implemented:

- Construction equipment will be in good repair without visible leaks of oil, greases, or hydraulic fluids.
- The control of spills during construction will be in conformance with Spill Prevention Control and Countermeasures (SPCC) plan.
- Use of the BMPs will assure stormwater runoff related to these activities will not release runoff into nearby sensitive areas (EPA, 2003g). See ER Sections 4.1.1 and 4.2.5 for construction BMPs.
- BMPs will also be used for dust control associated with excavation and fill operations during construction. Water conservation will be considered when deciding how often dust suppression sprays will be applied (EPA, 2003g).
- Silt fencing and/or sediment traps will be used.
- External vehicle washing (no detergents, water only).
- Stone construction pads will be placed at entrance/exits if unpaved construction access adjoins a state road.
- All temporary construction and permanent basins are arranged to provide for the prompt, systematic sampling of runoff in the event of any special needs.
- Water quality impacts will be controlled during construction by compliance with the National Pollution Discharge Elimination System – General Permit requirements and by applying BMPs as detailed in the site Stormwater Pollution Prevention (SWPP) plan.
- A Spill Prevention Control and Countermeasure Plan (SPCC), will be implemented for the facility to identify potential spill substances, sources and responsibilities.
- All above-ground diesel storage tanks will be bermed.
- Any hazardous materials will be handled by approved methods and shipped offsite to approved disposal sites. Sanitary wastes generated during site construction will be handled by portable systems, until such time that plant sanitary facilities are available for site use. An adequate number of these portables systems will be provided.
- The NEF Liquid Effluent Collection and Treatment System provides a means to control liquid waste within the plant including the collection, analysis, and processing of liquid wastes for disposal.
- Control of surface water runoff will be required for activities covered by the EPA Region 6 NPDES General Permit.

The NEF is designed to minimize the use of natural and depletable water resources as shown by the following measures:

- The use of low-water consumption landscaping versus conventional landscaping reduces water usage.
- The installation of low flow toilets, sinks and showers reduces water usage when compared to standard flow fixtures.
- Localized floor washing using mops and self-contained cleaning machines reduces water usage compared to conventional washing with a hose twice per week.
- The use of high efficiency washing machines compared to standard machines reduces water usage.
- The use of high efficiency closed cell cooling towers (water/air cooling) versus open cell design reduces water usage.
- Closed-loop cooling systems have been incorporated to reduce water usage.

4.4.8 Identification of Predicted Cumulative Effects on Water Resources

The NEF will not extract any surface or groundwater from the site or discharge any effluent to the site other than into the engineered basins. As a result, no significant effects on natural water systems are anticipated. Thus no cumulative effects are predicted.

4.4.9 Comparative Water Resources Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

The discussion of alternative scenarios in ER Section 2.0 compares the impacts of NEF with those that could result from expansion of the existing USEC gaseous diffusion plant (GDP) and a proposed centrifuge plant. Plant water usage by the GDP is reported to be 26 million gal/d (USEC, 2003a). NEF water usage is projected to be 87,625 m^3/yr (23.15 million gal/yr), less than 0.5% of the GDP usage.

Significant water usage is also required to generate the electric power needed for GDP operations. NEF will use far less electric power and thus far less water per SWU compared with GDP.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The water resources impact would be greater because of the higher water usage of the GDP and the water use to meet GDP electricity needs.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The water resources impact would be greater in the short term to

support the GDP operation, while the centrifuge plant capability is increased. The impact would be the same or greater in the long term once GDP production is terminated.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The water resources impact for continued operation of the GDP would be significantly greater since additional water consumption would be necessary to meet the increased production and associated electricity needs of the GDP.

FIGURES

Figure removed under 10 CFR 2.390.

4.5 ECOLOGICAL RESOURCES IMPACTS

4.5.1 Maps

See Figure 4.5-1, Ecological Resource Impacts.

4.5.2 Proposed Schedule of Activities

The following is a tentative, abbreviated schedule of proposed activities. Refer to ER Section 1.2.4, Schedule on Major Steps Associated With the Proposed Action, for a complete schedule of all major steps in the proposed action:

- December 2003 — Submit Facility License Application
- April 2006 — Initiate Facility Construction
- June 2008 — Start First Cascade
- December 2013 — Achieve Full Nominal Production Output
- April 2025 — Submit License Termination Plan to NRC
- April 2027 — Complete Construction of Decommissioning and Decontamination (D&D) Facilities
- April 2036 — D&D Completed

4.5.3 Area of Disturbance

The area of land to be disturbed is approximately 81 ha (200 acres). This area includes 8 ha (20 acres) that will be used for contractor parking and lay-down areas. The contractor lay-down and parking area will be restored after completion of plant construction. (See ER Figure 3.4-1, Local Hydrological Features, for a map indicating proposed buildings, land to be cleared and surrounding areas.)

4.5.4 Area Of Disturbance By Habitat Type

The proposed NEF site consists of one vegetation community type. The Plains Sand Scrub vegetation community is identified by the dominant presence of deep sand tolerant and deep sand adapted plants. The Plains Sand Scrub vegetation community is common in parts of southeastern New Mexico. Density of specific plant species, quantified by individuals per acre, varies slightly across the proposed site. Differences in the composition of the vegetation community within the proposed site are accounted for by slight variations in soil texture and structure and small changes in aspect.

The Plains Sand Scrub vegetation community is interrupted by a single access road through the NEF site. The road is void of vegetation. This area represents a small fraction of the total area and is not considered a habitat type.

The majority of the proposed site is suitable for use by wildlife resources. The Plains Sand Scrub provides potential habitat for an assortment of birds, mammals, and reptiles (Reference ER Section 3.5.2, General Ecological Conditions of the Site).

The total area of disturbance proposed for the NEF site is approximately 81 ha (200 acres) of the 220-ha (543-acre) site. The disturbance would affect the Plains Sand Scrub vegetation community.

4.5.5 Maintenance Practices

Maintenance practices such as the use of chemical herbicides, roadway maintenance, and clearing practices will be employed both during construction and/or plant operation. However, none of the practices are anticipated to permanently affect biota (see ER Sections 4.1.1 and 4.2.5 for construction and maintenance BMPs) (EPA, 2003g).

No herbicides will be used during construction, but may be used in limited amounts according to government regulations and manufacturer's instructions to control unwanted noxious vegetation during operation of the facility. Additionally, natural, low-water consumption landscaping will be used and maintained. Any eroded areas that may develop will be repaired and stabilized.

Roadway maintenance practices will be employed both during construction and operational phases of the NEF. However, these practices are currently being employed by the Wallach Quarry along the existing access road, and do not represent a new or significant impact to biota.

Clearing practices will be employed during the construction phase of the NEF project. The additional noise, dust and other factors associated with the clearing practices will be short-lived in duration and will represent only a temporary impact to the biota of the NEF site.

Additionally, only 81 ha (200 acres) of the 220 ha (543 acres) total site area will be disturbed affording the biota of the site an opportunity to move to undisturbed areas within the NEF site as well as additional areas of suitable habitat bordering the NEF site. Refer to ER Section 4.1, Land Use Impacts, for construction and clearing BMPs.

4.5.6 Short Term Use Areas And Plans For Restoration

The area to be used on a short-term basis during construction, including contractor parking and lay-down areas, will be limited to approximately 8.1 ha (20 acres). These areas will be revegetated with native plant species and other natural, low-water consumption landscaping to control erosion upon completion of site construction and returned as close as possible to original conditions. Lay-down (short term use areas) will be selected as to minimize the impacts to local vegetation.

4.5.7 Activities Expected To Impact Sensitive Communities Or Habitats

No communities or habitats that have been defined as rare or unique or that support threatened and endangered species have been identified on the 220-ha (543-acre) NEF site. Thus, no proposed activities are expected to impact communities or habitats defined as rare or unique or that support threatened and endangered species within the 220-ha (543-acre) site.

The vegetation community at the NEF Site does have the potential to provide habitat for the lesser prairie chicken (*Tympanchus pallidicinstus*) and the sand dune lizard (*Sceloporus arenicolus*). The lesser prairie chicken is currently on the federal candidate list for listing as a threatened species. The sand dune lizard is currently listed as a threatened species on the New Mexico State Rare, Threatened and Endangered (RTE) Species List.

No lesser prairie chickens (*Tympanchus pallidicinstus*) have been observed at the NEF site. The closest known occurrence of this species to the NEF site is a breeding ground or lek, located approximately 6.4 km (4 mi) north of the NEF site. Located in the vegetation community, the NEF site does provide potential habitat for the lesser prairie chicken, although the vegetation community is not uncommon in the general area. There have been no known sightings of the lesser prairie chicken at the NEF site. A field survey for the lesser prairie chicken on the NEF site, conducted in September 2003, indicated that the specie does not occur on the NEF site.

Dune formations in combination with the Plains Sand Scrub vegetation community at the NEF site have the potential to provide habitat for the sand dune lizard (*Sceloporus arenicolus*). Some dune formations are included in the proposed area of disturbance. A survey was conducted at the NEF site in October 2003 to detect the presence of the sand dune lizard. No individuals were identified during the survey and although the area has some components of sand dune lizard habitat, various factors make it unsuitable. (See ER Section 3.5.3, Description of Important Wildlife and Plant Species.) The closest documented sand dune lizard population is approximately 8 to 9.7 km (5 to 6 mi) north of the NEF site. Areas to the west, south and east of the site have no suitable habitat for the sand dune lizard within 16 to 32 km (10 to 20 mi).

The sand dune lizard formation on the NEF site, that has been determined not to be suitable habitat for the sand dune lizard, comprises approximately 40.5 ha (100 acres). The percent of the sand dune formation that will be impacted by the NEF footprint is approximately 26.7 ha (66 acres). In the general region of the NEF site, there are several thousand acres of sand dune formation that will not be impacted by the project.

4.5.8 Impacts Of Elevated Construction Equipment Or Structures

The construction of new towers can create a potential impact on migratory birds, especially night-migrating species. Some of the species affected are also protected under the Endangered Species Act and Bald and Golden Eagle Act. However, the estimate of the potential impacts of elevated construction equipment or structures on species is extremely low for the NEF site. The tallest proposed structure is 40 m (131 ft), which is well under the 61 m (200 ft) threshold that requires lights for aviation safety. This avoidance of lights, which attract species, and the low above ground level structure height, also reduces the relative potential for impacts. Additionally,

security lighting for all ground level facilities and equipment will be down-shielded to keep light within the boundaries of the site, also helping to reduce the potential for impacts (USFWS, 1998).

4.5.9 Tolerances And Susceptibilities Of Important Biota To Pollutants

Three of the four species indicated as important species in ER Section 3.5.3 (i.e., game species) are highly mobile species and are not as susceptible to localized physical and chemical pollutants as other less mobile species such as invertebrates and aquatic species. Due to the lack of direct discharge of water, stormwater management practices (i.e., detention and retention basins), and the lack of aquatic systems at the NEF site, no significant impacts to aquatic systems are expected. Additionally, the two identified species of concern in the general area, the lesser prairie chicken and the sand dune lizard, do not occur on the NEF site. The tolerances and susceptibilities of important biota to physical and chemical pollutants are relatively high.

Three of the four species indicated as important species in ER Section 3.5.3, Description of Important Wildlife and Plant Species (i.e., game species), are highly mobile species and are not susceptible to localized physical and chemical pollutants as other less mobile species such as invertebrates and aquatic species. Due to the lack of direct discharge of water, stormwater management practices (i.e., fenced detention basins), and the lack of aquatic systems at the NEF site, no significant impacts to aquatic systems are expected. Additionally, the two identified species of concern in the general area, the lesser prairie chicken and the sand dune lizard, do not occur on the NEF site.

The fourth specie, the mule deer, has a relatively high tolerance to physical pollution such as noise, as do other smaller wildlife species such as rodents and coyotes that may inhabit the NEF site. Larger wildlife species such as mule deer, may be effected by chemical pollution by direct ingestion or contamination of plant species that serve as a food source. Depending on the type of chemical pollution, mule deer have tolerance levels that range from low to high (Newman, 1979; DOE, 2001h; Haney, 1996). Small wildlife species will exhibit a greater susceptibility to chemical pollution by direct ingestion. The important biota identified at the NEF site will generally have a high tolerance to physical pollutants and will have varying susceptibility to chemical pollution depending on the nature and extent of the pollutant.

4.5.10 Construction Practices

Standard land clearing methods, primarily the use of heavy equipment, will be used during the construction phase of the NEF site. Erosion, runoff and situation control methods both temporary and permanent will follow the BMPs referenced in ER Section 4.1, Land Use Impacts. Additionally, stormwater detention basins will be constructed prior to land clearing and used as sedimentation collection basins during construction then converted to detention basins once the site is revegetated and stabilized. When required, applications of controlled amounts of water will be used to control dust in construction areas. Water conservation will be considered when deciding how often dust suppression sprays will be applied. See ER Section

4.4.7 for water conservation measures. After construction is complete the site will be stabilized with native grass species, pavement, and crushed stone to control erosion. Ditches, unless excavated in rock, will be lined with riprap, vegetation, or other suitable material as dictated by water velocity to control erosion. Furthermore, any eroded areas that may develop will be repaired and stabilized. See ER Section 4.1 for additional information on BMPs that LES will use for the NEF construction activities.

4.5.11 Special Maintenance Practices

No important habitats (e.g.; marshes, natural areas, bogs) have been identified within the 220-ha (543-acre) NEF site. Therefore, no special maintenance practices are proposed.

4.5.12 Wildlife Management Practices

LES is proposing to incorporate several wildlife management practices in association with the NEF. These wildlife management practices include:

- Use of BMPs recommended by the State of New Mexico to minimize the construction footprint to the extent possible.
- The use of detention and retention ponds.
- Site stabilization practices to reduce the potential for erosion and sedimentation.

Proposed wildlife management practices include:

- The placement of a raptor perch in an unused open area.
- The use of bird feeders at the visitor's center.
- The placement of quail feeders in the unused open areas away from the NEF buildings.
- The use of native, low-water consumption landscaping in and around the stormwater retention/detention basins.
- The management of unused open areas (i.e. leave undisturbed), including areas of native grasses and shrubs for the benefit of wildlife.
- The use of native plant species to revegetate disturbed areas to enhance wildlife habitat.
- The use of netting or other suitable material to ensure migratory birds are excluded from evaporative ponds that do not meet New Mexico Water Quality Control Commission (NMWQCC) surface water standards for wildlife usage.
- The use of animal-friendly fencing around the site so that wildlife cannot be injured or entangled in the site security fence.
- During plant construction and relocation of the CO_2 pipeline, minimize the amount of open trenches at any given time and keep trenching and backfilling crews close together.
- During plant construction and relocation of the CO_2 pipeline, trench during the cooler months (when possible).

- During plant construction and relocation of the CO_2 pipeline, avoid leaving trenches open overnight. Escape ramps will be constructed at least every 90 m (295 ft). The slope of the ramps will be less than 45 degrees. Trenches that are left open overnight will be inspected and animals removed prior to backfilling.

In addition to these proposed wildlife management practices, LES will consider all recommendations of appropriate state and federal agencies including the U.S. Fish and Wildlife Service (USFWS) and the New Mexico Department of Game and Fish.

4.5.13 Practices And Procedures To Minimize Adverse Impacts

Several practices and procedures have been designed to minimize adverse impacts to the ecological resources of the NEF site. These practices and procedures include the use of BMPs recommended by various state and federal management agencies (refer to ER Section 4.5.10, Construction Practices), minimizing the construction footprint to the extent possible, avoiding all direct discharge (including stormwater) to any waters of the United States (i.e., the use of detention ponds), the protection of all undisturbed naturalized areas, and site stabilization practices to reduce the potential for erosion and sedimentation. Based on recommendations from the New Mexico Department of Game and Fish, ponds will be fenced to exclude wildlife and the pond surface areas netted, or other suitable means utilized, to minimize the use of process ponds by birds and waterfowl. The use of native plant species in disturbed area revegetation will enhance and maximize the opportunity for native wildlife habitat to be re-established at the site.

4.5.14 Comparative Ecological Resource Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of “no action,” i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three “no action” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The ecological resource impact would be greater because the continued GDP operation and associated electric generation needs increases the impacts on ecological resources.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The ecological resource impact would be the same or greater since there is additional concentration of activity at a single location.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at increased capacity: The ecological resource impact would be significantly greater because of the significant amount of energy required to operate the GDP at the increased capacity.

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FIGURES

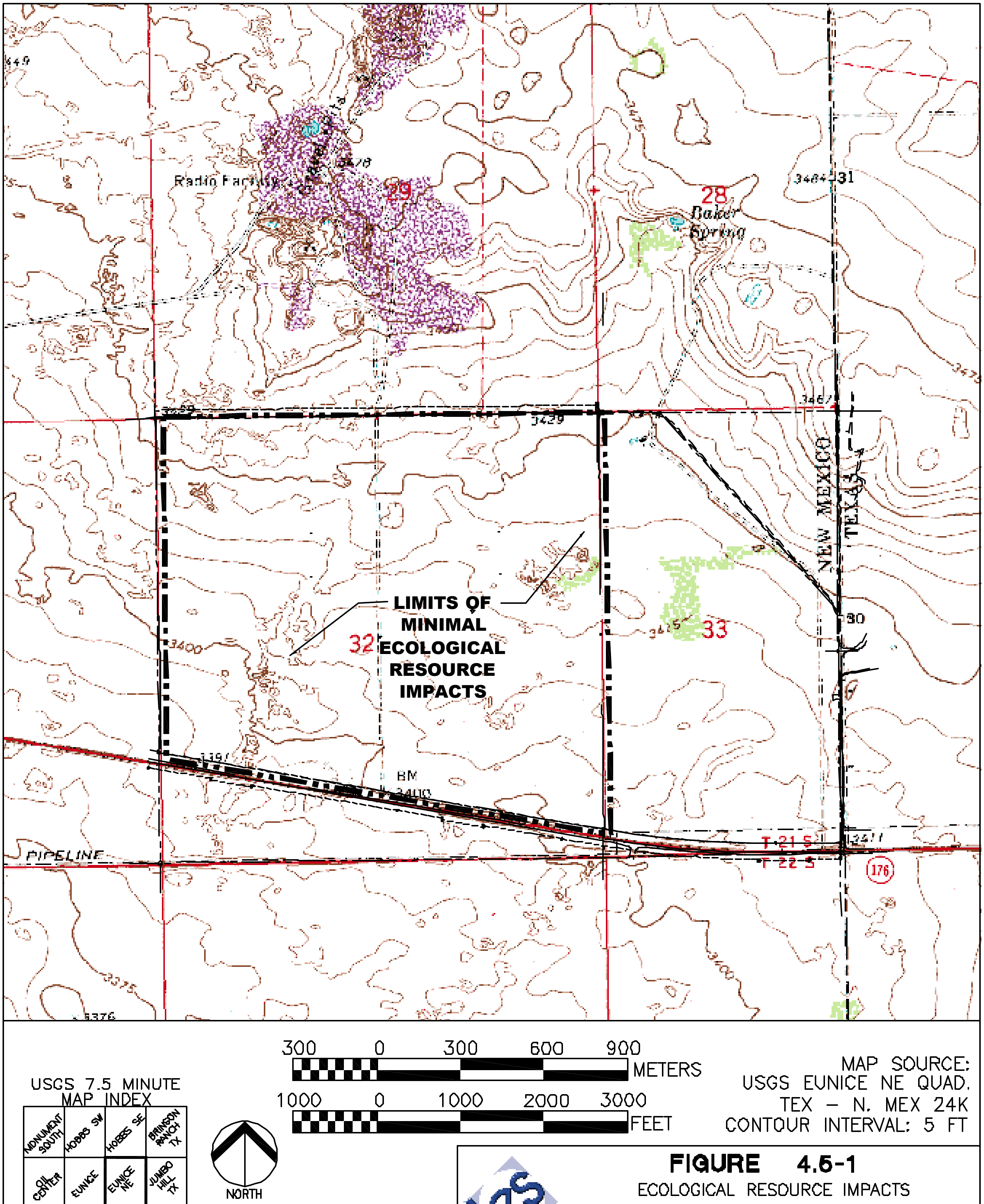

FIGURE 4.6-1

ECOLOGICAL RESOURCE IMPACTS

ENVIRONMENTAL REPORT

REVISION DATE: DECEMBER 2003

4.6 AIR QUALITY IMPACTS

This section describes the air quality impacts of the proposed action (construction and operation of the NEF).

4.6.1 Air Quality Impacts From Construction

Air quality impacts from site preparation for the NEF were evaluated using emission factors and air dispersion modeling. Emission rates of Clean Air Act Criteria Pollutants and non-methane hydrocarbons (a precursor of ozone, a Criteria Pollutant) were estimated for exhaust emissions from construction vehicles and for fugitive dust using emission factors provided in AP-42, the U.S. Environmental Protection Agency's Compilation of Air Pollutant Emission Factors (EPA, 1995). The total emission rates were used to scale the output from the Industrial Source Complex Short-Term (ISCST3) air dispersion model (air concentrations derived using a unit source term) to estimate both short-term and annual average air concentrations at the facility property boundary. ISCST3 is a refined, U.S. EPA-approved air dispersion model in the Users Network for Applied Modeling of Air Pollution (UNAMAP) series of air models (EPA, 1987). It is a steady-state Gaussian plume model that can be used to estimate ground-level air concentrations from industrial sources out to a distance of 50 km (31 mi). The air emissions calculations and air dispersion modeling are discussed in more detail in Appendix B.

Emission rates from vehicle exhaust and fugitive dust, as listed in Table 4.6-1, Peak Emission Rates, were estimated for a 10-hour workday assuming peak construction activity levels were maintained throughout the year. Fugitive dust will originate predominantly from vehicle traffic on unpaved surfaces, earth moving, excavating and bulldozing, and to a lesser extent from wind erosion. Fugitive dust emissions were estimated using an AP-42 emission factor for construction site preparation that was adjusted to account for dust suppression measures and the fraction of total suspended particulate that is expected to be in the PM_{10} range. It was assumed that the total disturbed area of the site was 81 ha (200 acres) and that no more than 18 ha (45 acres) would be involved in construction work at any one time.

Of the combustion sources, vehicle exhaust will be the dominant source. Fugitive volatile emissions will also occur because vehicles will be refueled onsite. Estimated vehicles that will be operating on the site during construction consist of two types: support vehicles and construction equipment. The support vehicles will include twenty pickup trucks, ten gators (a gasoline powered cart), three stakebody trucks, five fuel trucks, five mechanic's trucks and five boom trucks. Emission factors in AP-42 for "highway mobile sources" were used to estimate emissions of criteria pollutants and non-methane hydrocarbons for these vehicles. The construction equipment that will be operating on the site during peak construction consists of five bulldozers, three graders, three pans (diesel-powered fill transporter), six dump trucks, three backhoes, four loaders, four rollers, three water trucks and two tractors. Emission factors provided in AP-42 for diesel-powered construction equipment were used for these vehicles.

Emissions were modeled in ISCST3 as a uniform area source with emissions occurring 10 hours per day, 5 days per week, and 50 weeks per year. The maximum predicted air

concentrations at the site boundary for the various averaging periods predicted using five years (1987 to 1991) of hourly meteorological data from the Midland-Odessa, Texas, National Weather Service (NWS) station are presented in ER Table 4.6-2, Predicted Property Boundary Air Concentrations and Applicable NAAQS. These concentrations are compared to the appropriate National Ambient Air Quality Standard (NAAQS). No NAAQS has been set for hydrocarbons; however, the total annual emissions of hydrocarbons predicted from the site (approximately 4,535 kg (5 tons)) are well below the level of 36,287 kg (40 tons) that defines a significant source of volatile organic compounds (40 CFR 50.21) (CFR, 2003w). Air concentrations of the Criteria Pollutants predicted for vehicle emissions were all at least an order of magnitude below the NAAQS. PM_{10} emissions from fugitive dust were also below the NAAQS. The results of the fugitive dust estimates should be viewed in light of the fact that the peak anticipated fugitive emissions were assumed to occur throughout the year. These conservative assumptions will result in predicted air concentrations that tend to overestimate the potential impacts. Note that construction permits from the Permitting Section of the New Mexico Air Quality Bureau will be obtained prior to construction of the facility. ER Section 1.3.2, State Agencies, presents additional information regarding the required permits.

4.6.2 Air Quality Impacts From Operation

NUREG-1748 (NRC, 2003a) requires that atmospheric dispersion factors (χ/Q's) be used to assess the environmental effects of normal plant operations and facility accidents. In this section, information is presented about the gaseous effluents, the gaseous effluent control systems, and computer models and data used to calculate atmospheric dispersion and deposition factors.

4.6.2.1 Description of Gaseous Effluents

Uranium hexafluoride (UF_6) will be the radioactive effluent for gaseous pathways. Average source term releases to the atmosphere are estimated to be 8.9 MBq (240 µCi) per year. Urenco's experience in Europe indicates that uranium discharges from gaseous effluent vent systems are less than 10 g (0.35 ounces) per year. Therefore, 8.9 MBq (240 µCi) is a very conservative estimate (NRC, 1994a) and is based upon an NRC estimate (NRC, 1994a) for a 1.5 million SWU plant that LES has doubled for the 3 million SWU NEF.

Nonradioactive gaseous effluents include hydrogen fluoride (HF) and acetone. HF releases are estimated to be less than 6.4 kg (14 lbs) each year. Approximately 100 kg (221 lbs) of acetone are estimated to be released each year. Two natural gas-fired boilers (one in operation, one spare) will be used to provide hot water for the plant heating system. These boilers will be located in the Central Utilities Building (CUB). Emission data provided by the vendor for the boilers (Cleaver-Brooks) indicate that they will not emit more than 90,700 kg (100 tons) per year of any regulated air pollutant, and therefore, the boilers will not be considered Title V sources by either the EPA or the State of New Mexico. At 100% power, each boiler will emit 4,990 kg (5.50 tons) per year of Carbon Monoxide (CO), 3,910 kg (4.31 tons) per year of Nitrogen Oxides (NO_x,) 36.3 kg (0.04 tons) per year of Sulfur Oxide (SO_x) 535 kg (0.59 tons) per year of

Hydrogen Chloride (HC), and 336 kg (0.37 tons) per year of Particulate Matter (PM). The boilers will have to be permitted for operation as non-Title V sources.

In addition, there will be two diesel generators onsite for use as emergency power sources. Since the diesel generators have the potential to emit more than 90,700 kg (100 tons) per year of a regulated air pollutant, the use of these diesel generators will be administratively controlled (i.e., only run a limited number of hours per year) to avoid being classified as Title V sources. This must be negotiated with the State of New Mexico in an operating permit.

4.6.2.2 Description of Gaseous Effluent Vent System

The principal function of the gaseous effluent vent system (GEVS) is to protect both the operator during the connection/disconnection of uranium hexafluoride (UF_6) process equipment, and the environment, by collecting and cleaning all potentially hazardous gases from the plant prior to release to the atmosphere. Releases to the atmosphere will be in compliance with regulatory limits.

The stream of air and water vapor drawn into the GEVS can have suspended within it uranium hexafluoride (UF_6), hydrogen fluoride (HF), oil and uranium particulates (mainly UO_2F_2). Online instrument measurements will provide a continuous indication to the operator of the quantity of radioactive material and HF in the emission stream. This will enable rapid corrective action to be taken in the event of any deviation from the normal operating conditions.

There are two Gaseous Effluent Vent Systems for the plant: (1) the Separations Building Gaseous Effluent Vent System and (2) the Technical Services Building (TSB) Gaseous Effluent Vent System. In addition, the Centrifuge Test and Post Mortem Facilities have an exhaust filtration system that serves the same purpose as the GEVS. The Technical Services Building (TSB) heating, ventilation and air conditioning (HVAC) system performs a confinement ventilation function for potentially contaminated areas in the TSB.

The Separations Building GEVS sub-atmospheric duct system transports potentially contaminated gases to a set of redundant filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated charcoal filter) and fans. The cleaned gases are discharged via rooftop stacks to the atmosphere. The fan will maintain an almost constant sub-atmospheric pressure in front of the filter section by means of a differential pressure controller. The TSB GEVS is the same as the Separations Building GEVS except that it has one set of filters and a single fan. The GEVS and TSB HVAC exhaust points are on the roof of the TSB. The Centrifuge Test and Post Mortem Exhaust Filtration System is similar to the Separations Building GEVS except that it has one set of filters and two redundant fans. This system exhausts on the roof of the Centrifuge Assembly Building (CAB).

Instrumentation is provided to detect and signal via alarm all non-routine process conditions so that the process can be returned to normal by local operator actions. Trip actions from the same instrumentation automatically put the system into a safe condition.

4.6.2.3 Calculation of Atmospheric Dispersion and Deposition Factors

NUREG-1748 (NRC, 2003a) requires that atmospheric dispersion factors (χ/Q's) be used to assess the environmental effects of normal plant operations and facility accidents. In the absence of onsite meteorological data, the analysis may be conducted using data from 5-year NWS summaries, provided applicability of these data to the proposed site is established. The χ/Q's have been calculated using meteorological data from Midland-Odessa, Texas (1987 to 1991) and the XOQDOQ dispersion computer program listed in NUREG/CR-2919 (NRC, 1982a). Use of the Midland-Odessa data for predicting the dispersion of gaseous effluents was deemed appropriate. Midland-Odessa, Texas is the closest first-order NWS station to the NEF site and both Midland-Odessa and the NEF site have similar climates. A first-order weather data source is one that is a major weather station staffed by NWS personnel.

The Nuclear Regulatory Commission (NRC) computer program XOQDOQ is intended to provide estimates of atmospheric transport and dispersion of gaseous effluents in routine releases from nuclear facilities. XOQDOQ implements NRC Regulatory Guide 1.111 (NRC, 1977b) and has been used by the NRC staff in their independent meteorological evaluation of routine airborne radionuclide releases.

XOQDOQ is based on the theory that material released to the atmosphere will be normally distributed (Gaussian distribution) about the plume centerline. In predicting concentrations for longer time periods, the horizontal plume distribution is assumed to be evenly distributed within the directional sector, the so-called sector average model. A straight-line trajectory is assumed between the point of release and all receptors.

The meteorological data used were discussed in ER Section 3.6. XOQDOQ requires the meteorological data to be in the form of a joint frequency distribution (either number of hours or percent). The Midland-Odessa, Texas data, obtained from the EPA Support Center for Regulatory Air Models was converted into joint frequency distributions.

The EPA computer program STAR (STability ARray) was used to produce joint frequency distribution. The STAR program processes NWS meteorological data to generate joint frequencies of six wind speeds, sixteen wind directions, and six stability categories (Pasquill – Gifford stability classes A through F) for the station and time period provided as input, one year at a time.

Distances to the site boundary were determined using guidance from NRC Regulatory Guide 1.145 (NRC, 1982b). The distance to the nearest resident was determined using global positioning system (GPS) measurements.

Annual average atmospheric dispersion and deposition factors for the site boundary, nearest resident, and nearest business and school are presented in Table 4.6-3A, Annual Average Atmospheric Dispersion and Deposition Factors from NWS (1987 to 1991) Data. The highest site boundary χ/Q was 1.0×10^{-5} s/m^3 at a distance of 17 km (1,368 ft) in the south sector. The nearest resident χ/Q was 2.0×10^{-7} s/m^3 at a distance of 4.3 km (2.63 mi) in the west sector. Tables 4.6-3B through 4.6-3D present atmospheric dispersion and deposition factors out to 80 km (50 mi).

4.6.3 Visibility Impacts

Visibility impacts from construction will be limited to fugitive dust emissions. Fugitive dust will originate predominantly from vehicle traffic on unpaved surfaces, earth moving, excavating and bulldozing, and to a lesser extent from wind erosion. The only potential visibility impacts from operation of the NEF is from the cooling towers. The cooling towers that NEF will use at the site combine adiabatic and evaporative heat transfer processes to significantly reduce visible plumes. Therefore, LES has concluded that any visibility impacts from cooling tower plumes will be minimal.

4.6.4 Mitigative Measures for Air Quality Impacts

Air concentrations of the Criteria Pollutants for vehicle emissions and fugitive dust will be below the NAAQS and thus will not require mitigative measures. Visibility impacts from fugitive dust emissions will be minimized by watering of the site, during the construction phase to suppress dust emissions. Water conservation will be considered when deciding how often dust suppression sprays will be applied.

Mitigative measures for all credible accident scenarios considered in the Safety Analysis Report (SAR) are summarized in ER Section 4.12, Public and Occupational Health Impacts and ER Chapter 5, Mitigation Measures.

Mitigation measures will be in place to minimize potential impact on air quality. These include the following items:

- The TSB and Separations Building Gaseous Effluent Vent Systems (GEVS) are designed to collect and clean all potentially hazardous gases from the plant prior to release into the atmosphere. Instrumentation is provided to detect and signal via alarm, all non-routine process conditions, including the presence of radionuclides or hydrogen fluoride in the exhaust stream that will trip the system to a safe condition, in the event of effluent detection beyond routine operational limits.
- The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is designed to collect and clean all potentially hazardous gases from the serviced areas in the CAB prior to release into the atmosphere. Instrumentation is provided to detect and signal the Control Room via alarm, all non-routine process conditions, including the presence of radionuclides or hydrogen fluoride in the exhaust stream. Operators will then take appropriate actions to mitigate the release.
- Construction BMPs will be applied as described previously to minimize fugitive dusts.
- Air concentrations of the criteria pollutants for vehicle emissions and fugitive dust will be below the National Ambient Air Quality Standards (NAAQS) and thus will not require further mitigation measures.

Waste Control Specialists (WCS) produces Total Suspended Particulate (TSP) emissions during the process of treating hazardous waste contaminated soils. Therefore, the only potential air quality cumulative effect is increases in TSP from combined emissions from the

WCS and construction activities at the NEF. This potential cumulative effect (impact) will be transitioning and limited to the construction period.

The only potential air quality cumulative effect is increases in the Total Suspended Particulate (TSP) from combined emissions from the Waste Control Specialists (WCS) and construction activities at the NEF. This potential cumulative effect (impact) will be transitory and limited to the construction period.

4.6.5 Comparative Air Quality Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The air quality impact would be greater because of continued GDP operation and the associated electric generation needs.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The air quality impact would be greater in the short term because of continued GDP operation and associated electric generation needs while the centrifuge capability is increased. Air quality impact would be the same or greater in the long term once GDP operation is terminated.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The air quality impact for continued operation of the GDP would be significantly greater since a significant amount of additional energy is required to operate the GDP at the increased capacity.

TABLES

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Table 4.6-1 Peak Emission Rates
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Pollutant	Total Work-Day Average Emissions g/s (lbs/hr)
VEHICLE EMISSIONS:	
Hydrocarbons	0.58 (4.6)
Carbon Monoxide	3.70 (29.4)
Nitrogen Oxides	7.53 (59.8)
Sulfur Oxides	0.76 (6.0)
Particulates	0.54 (4.3)
FUGITIVE EMISSIONS:	
Particulates	2.4 (19.1)

Table 4.6-2 Predicted Property-Boundary Air Concentrations And Applicable NAAQS

	Maximum 1-Hr Average (µg/m^3)		Maximum 3-Hr Average (µg/m^3)		Maximum 8-Hr Average (µg/m^3)		Maximum 24-Hr Average (µg/m^3)		2nd Highest 24-Hr Average (µg/m^3)		Maximum Annual Average (µg/m^3)	
Pollutant	**Predicted**	**NAAQS**	**Predicted**	**NAAQS**	**Predicted**	**NAAQS**	**Predicted**	**NAAQS**	**Predicted**	**NAAQS**	**Predicted**	**NAAQS**
VEHICLE EMISSIONS												
Hydrocarbons	635.3	NA	238.9	NA	84.5	NA	36.9	NA	18.8	NA	2.9	NA
Carbon Monoxide	4,036.5	40,000	1,518.1	NA	537.0	10,000	234.4	NA	119.6	NA	18.5	NA
Nitrogen Oxides	8,204.2	NA	3,085.5	NA	1,091.5	NA	476.5	NA	243.1	NA	37.6	100
Sulfur Oxides	822.9	NA	309.5	1,310(a)	109.5	NA	47.8	365	24.4	NA	3.8	80
Particulates	591.8	NA	222.6	NA	78.7	NA	34.4	NA	17.5	150	2.7	50
FUGITIVE DUST												
Particulates	2,615.8		983.8		348.0		151.9		77.5	150	12.0	50

(a) Secondary standard

Table 4.6-3A Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) NO DECAY DEPLETED	D/Q (PER SQ.METER)
B	TSB to SB (m)	S	.26	417.	1.0E-05	9.6E-06	3.1E-08
B	TSB to SB (m)	SSW	.26	417.	5.2E-06	4.9E-06	2.2E-08
B	TSB to SB (m)	SW	.26	422.	5.4E-06	5.1E-06	2.6E-08
B	TSB to SB (m)	WSW	.31	503.	3.8E-06	3.6E-06	2.0E-08
B	TSB to SB (m)	W	.48	769.	3.0E-06	2.8E-06	1.3E-08
B	TSB to SB (m)	WNW	.67	1071.	1.5E-06	1.3E-06	6.8E-09
B	TSB to SB (m)	NW	.67	1072.	2.2E-06	1.9E-06	9.2E-09
B	TSB to SB (m)	NNW	.62	995.	3.8E-06	3.4E-06	1.5E-08
B	TSB to SB (m)	N	.62	995.	5.6E-06	5.0E-06	2.8E-08
B	TSB to SB (m)	NNE	.47	754.	4.3E-06	4.0E-06	1.6E-08
B	TSB to SB (m)	NE	.36	581.	4.0E-06	3.7E-06	1.8E-08
B	TSB to SB (m)	ENE	.34	540.	4.3E-06	4.0E-06	1.7E-08
B	TSB to SB (m)	E	.34	540.	4.6E-06	4.3E-06	1.6E-08
B	TSB to SB (m)	ESE	.34	540.	3.8E-06	3.5E-06	8.9E-09
B	TSB to SB (m)	SE	.30	487.	5.2E-06	4.8E-06	1.2E-08
B	TSB to SB (m)	SSE	.26	417.	6.8E-06	6.4E-06	1.7E-08
B	NRESTRES	W	2.63	4232.	2.0E-07	1.6E-07	7.2E-10
B	NRESTRES	ESE	6.87	11063.	3.6E-08	2.5E-08	5.0E-11
B	BUSINESS	NNW	1.16	1871.	1.3E-06	1.1E-06	5.2E-09

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) NO DECAY DEPLETED	D/Q (PER SQ.METER)
B	BUSINESS	NNW	1.06	1712.	1.5E-06	1.3E-06	6.0E-09
B	BUSINESS	NE	2.72	4377.	1.6E-07	1.2E-07	5.9E-10
B	BUSINESS	ENE	.94	1520.	7.5E-07	6.6E-07	3.2E-09

Table 4.6-3A Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) NO DECAY DEPLETED	D/Q (PER SQ.METER)
B	BUSINESS	SE	.57	925.	1.8E-06	1.6E-06	4.2E-09
B	SCHOOL	W	4.91	7895.	7.9E-08	5.9E-08	2.4E-10
B	CHURCH	W	4.41	7090.	9.2E-08	7.0E-08	2.9E-10
B	CAB to SB (m)	S	.44	707.	4.3E-06	4.0E-06	1.4E-08
B	CAB to SB (m)	SSW	.44	707.	2.2E-06	2.0E-06	9.6E-09
B	CAB to SB (m)	SW	.44	714.	2.3E-06	2.1E-06	1.2E-08
B	CAB to SB (m)	WSW	.53	853.	1.6E-06	1.4E-06	8.7E-09
B	CAB to SB (m)	W	.69	1114.	1.6E-06	1.5E-06	7.2E-09
B	CAB to SB (m)	WNW	.62	996.	1.7E-06	1.5E-06	7.6E-09
B	CAB to SB (m)	NW	.48	768.	3.8E-06	3.5E-06	1.6E-08
B	CAB to SB (m)	NNW	.44	713.	6.6E-06	6.0E-06	2.6E-08
B	CAB to SB (m)	N	.44	713.	9.8E-06	9.0E-06	4.8E-08
B	CAB to SB (m)	NNE	.43	694.	5.0E-06	4.6E-06	1.8E-08
B	CAB to SB (m)	NE	.33	534.	4.6E-06	4.3E-06	2.0E-08
B	CAB to SB (m)	ENE	.31	496.	4.9E-06	4.6E-06	2.0E-08

Table 4.6-3A Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) NO DECAY DEPLETED	D/Q (PER SQ.METER)
B	CAB to SB (m)	E	.31	496.	5.2E-06	4.9E-06	1.9E-08
B	CAB to SB (m)	ESE	.31	496.	4.3E-06	4.0E-06	1.0E-08
B	CAB to SB (m)	SE	.34	540.	4.4E-06	4.1E-06	9.9E-09
B	CAB to SB (m)	SSE	.44	707.	2.9E-06	2.7E-06	7.3E-09

Notes:

TSB = Technical Services Building
SB = Site Boundary
NRESTRES = Nearest Resident
BUSINESS = Nearest Business
CAB = Centrifuge Assembly Building

Table 4.6-3B Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

NO DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	1.080E-05	3.494E-06	1.757E-06	1.095E-06	5.772E-07	3.720E-07	2.665E-07	2.037E-07	1.628E-07	1.342E-07	1.134E-07
SSW	5.492E-06	1.739E-06	8.701E-07	5.404E-07	2.829E-07	1.812E-07	1.291E-07	9.821E-08	7.813E-08	6.420E-08	5.405E-08
SW	5.821E-06	1.840E-06	9.207E-07	5.714E-07	2.986E-07	1.909E-07	1.358E-07	1.032E-07	8.201E-08	6.731E-08	5.662E-08
WSW	5.537E-06	1.743E-06	8.720E-07	5.410E-07	2.826E-07	1.806E-07	1.285E-07	9.758E-08	7.753E-08	6.362E-08	5.351E-08
W	8.833E-06	2.822E-06	1.417E-06	8.810E-07	4.626E-07	2.971E-07	2.121E-07	1.617E-07	1.289E-07	1.060E-07	8.939E-08
WNW	7.700E-06	2.447E-06	1.227E-06	7.619E-07	3.992E-07	2.559E-07	1.825E-07	1.389E-07	1.106E-07	9.095E-08	7.662E-08
NW	1.088E-05	3.501E-06	1.761E-06	1.097E-06	5.772E-07	3.714E-07	2.656E-07	2.028E-07	1.618E-07	1.333E-07	1.125E-07
NNW	1.661E-05	5.372E-06	2.704E-06	1.685E-06	8.882E-07	5.722E-07	4.096E-07	3.130E-07	2.499E-07	2.060E-07	1.739E-07
N	2.491E-05	7.979E-06	4.008E-06	2.493E-06	1.309E-06	8.407E-07	6.003E-07	4.577E-07	3.648E-07	3.002E-07	2.531E-07
NNE	1.206E-05	3.898E-06	1.960E-06	1.221E-06	6.431E-07	4.143E-07	2.967E-07	2.267E-07	1.811E-07	1.493E-07	1.261E-07
NE	7.304E-06	2.342E-06	1.175E-06	7.304E-07	3.834E-07	2.463E-07	1.759E-07	1.342E-07	1.070E-07	8.808E-08	7.429E-08
ENE	6.847E-06	2.202E-06	1.105E-06	6.877E-07	3.616E-07	2.325E-07	1.663E-07	1.269E-07	1.013E-07	8.343E-08	7.041E-08
E	7.321E-06	2.364E-06	1.188E-06	7.398E-07	3.895E-07	2.508E-07	1.795E-07	1.371E-07	1.095E-07	9.024E-08	7.620E-08
ESE	5.981E-06	1.952E-06	9.832E-07	6.135E-07	3.243E-07	2.095E-07	1.504E-07	1.151E-07	9.212E-08	7.607E-08	6.433E-08
SE	6.962E-06	2.274E-06	1.146E-06	7.149E-07	3.781E-07	2.445E-07	1.756E-07	1.345E-07	1.077E-07	8.894E-08	7.524E-08
SSE	7.142E-06	2.330E-06	1.174E-06	7.328E-07	3.874E-07	2.503E-07	1.796E-07	1.375E-07	1.100E-07	9.085E-08	7.682E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	9.760E-08	5.527E-08	3.716E-08	2.142E-08	1.458E-08	1.084E-08	8.524E-09	6.962E-09	5.847E-09	5.014E-09	4.373E-09
SSW	4.639E-08	2.599E-08	1.734E-08	9.888E-09	6.683E-09	4.944E-09	3.871E-09	3.150E-09	2.638E-09	2.256E-09	1.963E-09
SW	4.857E-08	2.713E-08	1.806E-08	1.027E-08	6.926E-09	5.116E-09	4.001E-09	3.254E-09	2.722E-09	2.327E-09	2.023E-09
WSW	4.589E-08	2.562E-08	1.704E-08	9.679E-09	6.521E-09	4.813E-09	3.761E-09	3.056E-09	2.555E-09	2.183E-09	1.897E-09
W	7.682E-08	4.321E-08	2.890E-08	1.654E-08	1.120E-08	8.299E-09	6.505E-09	5.299E-09	4.441E-09	3.801E-09	3.309E-09
WNW	6.580E-08	3.694E-08	2.468E-08	1.410E-08	9.539E-09	7.063E-09	5.533E-09	4.506E-09	3.774E-09	3.230E-09	2.811E-09
NW	9.674E-08	5.457E-08	3.658E-08	2.099E-08	1.424E-08	1.056E-08	8.287E-09	6.756E-09	5.665E-09	4.852E-09	4.226E-09
NNW	1.496E-07	8.456E-08	5.675E-08	3.262E-08	2.216E-08	1.645E-08	1.292E-08	1.054E-08	8.842E-09	7.577E-09	6.602E-09
N	2.175E-07	1.223E-07	8.183E-08	4.684E-08	3.174E-08	2.352E-08	1.844E-08	1.503E-08	1.260E-08	1.078E-08	9.389E-09
NNE	1.085E-07	6.142E-08	4.127E-08	2.377E-08	1.618E-08	1.204E-08	9.464E-09	7.731E-09	6.492E-09	5.568E-09	4.855E-09
NE	6.388E-08	3.602E-08	2.414E-08	1.386E-08	9.421E-09	6.999E-09	5.498E-09	4.487E-09	3.766E-09	3.228E-09	2.813E-09
ENE	6.057E-08	3.422E-08	2.296E-08	1.321E-08	8.984E-09	6.678E-09	5.249E-09	4.286E-09	3.598E-09	3.085E-09	2.690E-09
E	6.558E-08	3.711E-08	2.494E-08	1.436E-08	9.775E-09	7.270E-09	5.716E-09	4.669E-09	3.920E-09	3.362E-09	2.932E-09
ESE	5.544E-08	3.152E-08	2.126E-08	1.230E-08	8.394E-09	6.255E-09	4.926E-09	4.029E-09	3.388E-09	2.908E-09	2.538E-09
SE	6.486E-08	3.694E-08	2.494E-08	1.445E-08	9.872E-09	7.363E-09	5.802E-09	4.748E-09	3.993E-09	3.429E-09	2.994E-09
SSE	6.620E-08	3.763E-08	2.537E-08	1.467E-08	9.999E-09	7.446E-09	5.860E-09	4.791E-09	4.026E-09	3.455E-09	3.014E-09

Table 4.6-3C Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data
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DECAY, DEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	1.022E-05	3.190E-06	1.566E-06	9.583E-07	4.902E-07	3.081E-07	2.159E-07	1.618E-07	1.270E-07	1.030E-07	8.572E-08
SSW	5.198E-06	1.588E-06	7.754E-07	4.730E-07	2.403E-07	1.500E-07	1.046E-07	7.801E-08	6.097E-08	4.928E-08	4.086E-08
SW	5.509E-06	1.680E-06	8.205E-07	5.002E-07	2.536E-07	1.581E-07	1.100E-07	8.196E-08	6.399E-08	5.167E-08	4.281E-08
WSW	5.240E-06	1.592E-06	7.770E-07	4.735E-07	2.400E-07	1.496E-07	1.040E-07	7.751E-08	6.050E-08	4.884E-08	4.046E-08
W	8.359E-06	2.577E-06	1.262E-06	7.712E-07	3.929E-07	2.460E-07	1.718E-07	1.284E-07	1.006E-07	8.140E-08	6.759E-08
WNW	7.288E-06	2.235E-06	1.093E-06	6.670E-07	3.390E-07	2.119E-07	1.478E-07	1.104E-07	8.632E-08	6.982E-08	5.793E-08
NW	1.029E-05	3.197E-06	1.570E-06	9.600E-07	4.902E-07	3.075E-07	2.152E-07	1.611E-07	1.263E-07	1.023E-07	8.504E-08
NNW	1.572E-05	4.905E-06	2.410E-06	1.475E-06	7.543E-07	4.738E-07	3.318E-07	2.486E-07	1.950E-07	1.581E-07	1.315E-07
N	2.357E-05	7.286E-06	3.571E-06	2.182E-06	1.112E-06	6.961E-07	4.863E-07	3.636E-07	2.846E-07	2.304E-07	1.914E-07
NNE	1.141E-05	3.559E-06	1.747E-06	1.069E-06	5.462E-07	3.431E-07	2.403E-07	1.801E-07	1.413E-07	1.146E-07	9.534E-08
NE	6.913E-06	2.138E-06	1.047E-06	6.394E-07	3.256E-07	2.039E-07	1.425E-07	1.066E-07	8.349E-08	6.762E-08	5.617E-08
ENE	6.480E-06	2.011E-06	9.851E-07	6.020E-07	3.071E-07	1.926E-07	1.347E-07	1.008E-07	7.903E-08	6.405E-08	5.324E-08
E	6.929E-06	2.159E-06	1.059E-06	6.476E-07	3.308E-07	2.077E-07	1.454E-07	1.089E-07	8.543E-08	6.927E-08	5.761E-08
ESE	5.660E-06	1.783E-06	8.762E-07	5.371E-07	2.754E-07	1.735E-07	1.218E-07	9.146E-08	7.188E-08	5.839E-08	4.864E-08
SE	6.589E-06	2.077E-06	1.021E-06	6.258E-07	3.211E-07	2.024E-07	1.422E-07	1.068E-07	8.401E-08	6.827E-08	5.689E-08
SSE	6.759E-06	2.128E-06	1.046E-06	6.415E-07	3.290E-07	2.072E-07	1.455E-07	1.092E-07	8.586E-08	6.974E-08	5.809E-08

Table 4.6-3C Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	7.275E-08	3.897E-08	2.496E-08	1.332E-08	8.512E-09	5.999E-09	4.496E-09	3.515E-09	2.835E-09	2.342E-09	1.971E-09
SSW	3.458E-08	1.832E-08	1.165E-08	6.149E-09	3.903E-09	2.736E-09	2.041E-09	1.591E-09	1.279E-09	1.054E-09	8.847E-10
SW	3.620E-08	1.912E-08	1.213E-08	6.383E-09	4.045E-09	2.831E-09	2.110E-09	1.643E-09	1.320E-09	1.087E-09	9.118E-10
WSW	3.421E-08	1.806E-08	1.145E-08	6.019E-09	3.809E-09	2.663E-09	1.984E-09	1.543E-09	1.239E-09	1.019E-09	8.549E-10
W	5.726E-08	3.046E-08	1.942E-08	1.028E-08	6.541E-09	4.592E-09	3.431E-09	2.676E-09	2.153E-09	1.775E-09	1.491E-09
WNW	4.905E-08	2.604E-08	1.658E-08	8.766E-09	5.571E-09	3.908E-09	2.918E-09	2.275E-09	1.830E-09	1.508E-09	1.267E-09
NW	7.211E-08	3.847E-08	2.457E-08	1.305E-08	8.315E-09	5.844E-09	4.371E-09	3.411E-09	2.747E-09	2.266E-09	1.904E-09
NNW	1.115E-07	5.961E-08	3.813E-08	2.029E-08	1.294E-08	9.104E-09	6.813E-09	5.321E-09	4.288E-09	3.538E-09	2.975E-09
N	1.621E-07	8.624E-08	5.498E-08	2.913E-08	1.853E-08	1.302E-08	9.727E-09	7.588E-09	6.108E-09	5.036E-09	4.231E-09
NNE	8.090E-08	4.330E-08	2.773E-08	1.478E-08	9.451E-09	6.661E-09	4.992E-09	3.903E-09	3.148E-09	2.600E-09	2.188E-09
NE	4.762E-08	2.539E-08	1.622E-08	8.621E-09	5.502E-09	3.873E-09	2.900E-09	2.266E-09	1.826E-09	1.507E-09	1.268E-09
ENE	4.515E-08	2.412E-08	1.543E-08	8.213E-09	5.247E-09	3.695E-09	2.768E-09	2.164E-09	1.745E-09	1.441E-09	1.212E-09
E	4.888E-08	2.616E-08	1.675E-08	8.932E-09	5.709E-09	4.023E-09	3.015E-09	2.357E-09	1.901E-09	1.570E-09	1.321E-09
ESE	4.132E-08	2.222E-08	1.428E-08	7.648E-09	4.902E-09	3.461E-09	2.598E-09	2.034E-09	1.643E-09	1.358E-09	1.144E-09
SE	4.835E-08	2.604E-08	1.675E-08	8.987E-09	5.766E-09	4.074E-09	3.060E-09	2.397E-09	1.936E-09	1.602E-09	1.349E-09
SSE	4.935E-08	2.653E-08	1.704E-08	9.120E-09	5.840E-09	4.120E-09	3.091E-09	2.419E-09	1.952E-09	1.613E-09	1.358E-09

Table 4.6-3D Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

******************** RELATIVE DEPOSITION PER UNIT AREA (M**-2) AT FIXED POINTS BY DOWNWIND SECTORS ********************

DIRECTION FROM SITE	DISTANCES IN MILES .25	.50	.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	3.280E-08	1.109E-08	5.695E-09	3.497E-09	1.743E-09	1.057E-09	7.149E-10	5.180E-10	3.939E-10	3.103E-10	2.512E-10
SSW	2.303E-08	7.787E-09	3.998E-09	2.455E-09	1.224E-09	7.424E-10	5.019E-10	3.637E-10	2.766E-10	2.179E-10	1.764E-10
SW	2.839E-08	9.601E-09	4.930E-09	3.027E-09	1.509E-09	9.152E-10	6.188E-10	4.484E-10	3.410E-10	2.686E-10	2.175E-10
WSW	2.815E-08	9.519E-09	4.887E-09	3.001E-09	1.496E-09	9.074E-10	6.135E-10	4.446E-10	3.381E-10	2.663E-10	2.156E-10
W	3.633E-08	1.229E-08	6.309E-09	3.874E-09	1.931E-09	1.171E-09	7.919E-10	5.739E-10	4.364E-10	3.438E-10	2.783E-10
WNW	3.195E-08	1.080E-08	5.547E-09	3.406E-09	1.698E-09	1.030E-09	6.963E-10	5.046E-10	3.837E-10	3.023E-10	2.447E-10
NW	4.353E-08	1.472E-08	7.558E-09	4.641E-09	2.314E-09	1.403E-09	9.488E-10	6.875E-10	5.228E-10	4.119E-10	3.334E-10
NNW	6.280E-08	2.124E-08	1.090E-08	6.696E-09	3.338E-09	2.025E-09	1.369E-09	9.919E-10	7.542E-10	5.942E-10	4.810E-10
N	1.179E-07	3.985E-08	2.046E-08	1.256E-08	6.264E-09	3.799E-09	2.569E-09	1.861E-09	1.415E-09	1.115E-09	9.027E-10
NNE	4.254E-08	1.439E-08	7.387E-09	4.536E-09	2.261E-09	1.371E-09	9.273E-10	6.719E-10	5.109E-10	4.025E-10	3.259E-10
NE	3.160E-08	1.068E-08	5.486E-09	3.369E-09	1.679E-09	1.019E-09	6.887E-10	4.990E-10	3.795E-10	2.990E-10	2.420E-10
ENE	2.710E-08	9.165E-09	4.706E-09	2.889E-09	1.441E-09	8.737E-10	5.907E-10	4.280E-10	3.255E-10	2.564E-10	2.076E-10
E	2.580E-08	8.723E-09	4.479E-09	2.750E-09	1.371E-09	8.316E-10	5.622E-10	4.074E-10	3.098E-10	2.441E-10	1.976E-10
ESE	1.400E-08	4.733E-09	2.430E-09	1.492E-09	7.440E-10	4.512E-10	3.051E-10	2.211E-10	1.681E-10	1.324E-10	1.072E-10
SE	1.552E-08	5.248E-09	2.695E-09	1.655E-09	8.249E-10	5.003E-10	3.383E-10	2.451E-10	1.864E-10	1.468E-10	1.189E-10
SSE	1.761E-08	5.955E-09	3.058E-09	1.877E-09	9.360E-10	5.677E-10	3.838E-10	2.781E-10	2.115E-10	1.666E-10	1.349E-10

Table 4.6-3D Annual Average Atmospheric Dispersion And Deposition Factors From NWS (1987-1991) Data

DIRECTION	DISTANCES IN MILES										
FROM SITE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	2.078E-10	1.018E-10	6.390E-11	3.230E-11	1.955E-11	1.311E-11	9.391E-12	7.052E-12	5.483E-12	4.380E-12	3.575E-12
SSW	1.459E-10	7.150E-11	4.486E-11	2.268E-11	1.372E-11	9.202E-12	6.594E-12	4.951E-12	3.850E-12	3.075E-12	2.510E-12
SW	1.799E-10	8.815E-11	5.531E-11	2.796E-11	1.692E-11	1.135E-11	8.129E-12	6.104E-12	4.746E-12	3.791E-12	3.095E-12
WSW	1.783E-10	8.740E-11	5.484E-11	2.772E-11	1.678E-11	1.125E-11	8.060E-12	6.052E-12	4.706E-12	3.759E-12	3.068E-12
W	2.302E-10	1.128E-10	7.079E-11	3.578E-11	2.166E-11	1.452E-11	1.040E-11	7.812E-12	6.074E-12	4.852E-12	3.960E-12
WNW	2.024E-10	9.919E-11	6.224E-11	3.146E-11	1.904E-11	1.277E-11	9.148E-12	6.869E-12	5.341E-12	4.266E-12	3.482E-12
NW	2.758E-10	1.352E-10	8.481E-11	4.287E-11	2.595E-11	1.740E-11	1.246E-11	9.360E-12	7.277E-12	5.813E-12	4.745E-12
NNW	3.979E-10	1.950E-10	1.223E-10	6.184E-11	3.743E-11	2.510E-11	1.798E-11	1.350E-11	1.050E-11	8.386E-12	6.845E-12
N	7.467E-10	3.659E-10	2.296E-10	1.160E-10	7.024E-11	4.709E-11	3.374E-11	2.534E-11	1.970E-11	1.574E-11	1.285E-11
NNE	2.696E-10	1.321E-10	8.288E-11	4.189E-11	2.536E-11	1.700E-11	1.218E-11	9.147E-12	7.112E-12	5.681E-12	4.637E-12
NE	2.002E-10	9.811E-11	6.156E-11	3.111E-11	1.883E-11	1.263E-11	9.047E-12	6.794E-12	5.282E-12	4.219E-12	3.444E-12
ENE	1.717E-10	8.415E-11	5.280E-11	2.669E-11	1.615E-11	1.083E-11	7.760E-12	5.827E-12	4.531E-12	3.619E-12	2.954E-12
E	1.634E-10	8.009E-11	5.025E-11	2.540E-11	1.537E-11	1.031E-11	7.386E-12	5.546E-12	4.312E-12	3.445E-12	2.812E-12
ESE	8.869E-11	4.346E-11	2.727E-11	1.378E-11	8.342E-12	5.593E-12	4.008E-12	3.009E-12	2.340E-12	1.869E-12	1.526E-12
SE	9.834E-11	4.819E-11	3.024E-11	1.528E-11	9.250E-12	6.202E-12	4.444E-12	3.337E-12	2.595E-12	2.073E-12	1.692E-12
SSE	1.116E-10	5.468E-11	3.431E-11	1.734E-11	1.050E-11	7.037E-12	5.042E-12	3.786E-12	2.944E-12	2.352E-12	1.919E-12

4.7 NOISE IMPACTS

Noise is defined as "unwanted sound". At high levels noise can damage hearing, cause sleep deprivation, interfere with communication, and disrupt concentration. Even at low levels, noise can be a source of irritation, annoyance, and disturbance to people and communities when it significantly exceeds normal background sound levels. In the context of protecting the public health and welfare, noise implies adverse effects on people and the environment. A quantifiable demonstration of the range of noise levels and how they are subjectively perceived by humans is presented in Figure 3.7-2, Sound Level Range Examples.

4.7.1 Predicted Noise Levels

4.7.1.1 Construction Impacts

The construction of the NEF would require equipment for excavation, such as backhoes, front loaders, bulldozers, and dump trucks; materials-handling equipment, such as cement mixers and cranes; and compressors, generators, and pumps. Noise generated from this type of equipment would range from 87 to 99 dBA at approximately 9.1 m (30 ft) (Cowan, 1994), which would be equivalent of 57 to 69 dBA at approximately 305 m (1,000 ft). Most of the construction activities would occur during weekday, daylight hours; however, construction could occur during nights and weekends, if necessary. Large trucks would produce noise levels around 89 dBA at approximately 9.1 m (30 ft) (Cowan, 1994), which is equivalent of 77 dBA approximately 37m (120 ft). Since there is already substantial truck traffic using New Mexico Highway 234 and New Mexico Highway 18, the temporarily increased noise levels due to construction activities are not expected to adversely affect nearby residents. ER Section 4.2, Transportation Impacts, includes further discussion of vehicular traffic.

Due to the temporary and episodic nature of construction, and because of the significant distance to the nearest residence 4.3 km (2.63 mi), and since construction activities largely would be during weekday daylight hours, actual construction noise at the site is not expected to have a significant effect on nearby residents. Vehicle traffic will be the most noticeable cause of construction noise. Receptors located closest to the intersection of New Mexico Highway 18 and New Mexico Highway 234 will be the most aware of the increase in traffic due to proximity to the source.

4.7.1.2 Operational Impacts

The development of the NEF would generally increase noise levels, although the amount of the increase would depend on many factors, including the number of employees, and the amount of increased vehicular traffic. Vehicular traffic will be increased on New Mexico Highway 234 and New Mexico Highway 18 during operation, but due to the considerable truck traffic already present, noise levels should not increase significantly.

An operational noise survey was performed at the Almelo Enrichment Plant in Almelo, Netherlands, at the border of the site boundary during a 24-hour period. The noise results

obtained during the survey ranged from 30 to 47 dBA, with an average of 39.7 dBA. The main sources of operational noise are from the cascade halls, the cooling fans, and the cooling towers. The Almelo Enrichment Plant design is comparable to the design of the NEF and sound level intensities outside both facilities are expected to vary no more than ±4 dB based on the Almelo Enrichment Plant operating experience. The Almelo survey indicates that the majority of the noise sources were vehicle traffic from adjacent roadways, rather than operational noise from the plant itself. Sound contour maps for the Almelo facility are not available because they were not developed as part of the study. Furthermore, the contours would not be applicable to the NEF because the site building layouts are different. These results were expected and strongly suggest that NEF will be in complete compliance with the U.S. Department of Housing and Urban Development (HUD) guidelines and the Environmental Protection Agency (EPA) criteria (65 dBA and 55 dBA, respectively). Although the noise from the plant and the additional traffic would generally be noticeable, the operational noise from the plant is not expected to have significant impact on nearby residents (HUD, 1985; EPA, 1973). For this particular application (land use), the HUD guidelines are more appropriate since the NEF site is industrial with no nearby residents.

If the highest sound level reading (47 dBA) from the operational survey performed at the Almelo Enrichment Plant is used to calculate the effective exposure to the nearest residence located west of the NEF site at a distance of approximately 4.3 km (2.63 mi), the resultant sound level exposure would be below the perception of the human ear. This is because a source of 47 dBA over such a great distance will be dispersed in air and absorbed by natural landscape, vegetation, and buildings to the point of being masked by background ambient noise at the receptor. This is not meant to be a blanket statement to imply that residents will never be able to distinguish any operational noise emanating from the NEF. Certain phases of operation, weather, time of day, wind direction, traffic patterns, season, and the location of the receptor will all impact perceived operational noise levels. It should be noted that the Almelo survey data support previous assumptions that traffic noise will be the main noise contributor to nearby residences. Although the noise from the plant and the additional traffic would generally be noticeable, the operational noise from the plant is not expected to have a significant impact on nearby residents.

4.7.2 Noise Sources

Noise point sources for the plant during operation will include: cascade halls, boilers, coolers, rooftop fans, air conditioners, transformers, and traffic from delivery trucks, employee and site vehicles. Noise line sources for the plant during operation will consist only of site vehicular traffic entering and leaving the site. Ambient background noise sources in the area include vehicular traffic along New Mexico Highway 234, the concrete quarry to the north of the site, the landfill to the south of the site, the waste facility to the east of the site, train traffic along the tracks located on the north border, low flying aircraft traffic from Eunice Airport, birds, cattle and wind gusts.

4.7.3 Sound Level Standards

HUD guidelines, as detailed in Table 3.7-2, U.S. Department of Housing and Urban Development Land Use Compatibility Guidelines, set the acceptable Day-Night Average Sound

Level (L_{dn}) for areas of industrial, manufacturing, and utilities at 80 dBA as acceptable. Additionally, under these guidelines, construction and operation of the facility should not cause the L_{dn} at a nearby residence to exceed 65 dBA (HUD, 1985). The EPA has set a goal of 55 dBA for L_{dn} in outdoor spaces, as detailed in the EPA Levels Document (EPA, 1973). Background measurements and those performed at the Almelo facility were consistent with the guidance in American Society of Testing and Materials (ASTM) Standard Guide E-1686-02 (ASTM, 2002). As indicated in ER Section 4.7.1, Predicted Noise Levels, background noise levels, calculated construction noise levels, and operational noise levels should be well below both the HUD and EPA guidelines. Both the Eunice City Manager and Lea County Manager have informed LES that there are no city, county or New Mexico state ordinances or regulations governing environmental noise. Thus, the NEF site is not subject either to local or state noise regulation. Nonetheless, anticipated NEF noise levels are expected to be below the applicable HUD guidelines and EPA guidelines and are not expected to be harmful to the public's life and health, nor a disturbance of public peace and welfare.

4.7.4 Potential Impacts to Sensitive Receptors

Potential impacts to local schools, churches, hospitals, and residences are not expected to be significant, as supported by the information presented in ER Section 4.7.1. The nearest home is located west of the site at a distance of approximately 4.3 km (2.63 mi) and due to its proximity is not expected to perceive an increase in noise levels due to operational noise levels. The nearest school, hospital, church and other sensitive noise receptors are beyond this distance, thereby allowing the noise to dissipate and be absorbed, helping decrease the sound levels even further. Homes located near the construction traffic at the intersection of New Mexico Highway 234 and New Mexico Highway 18 will be affected by the vehicle noise, but due to existing heavy tractor trailer vehicle traffic, the change should be minimal. No schools or hospitals are located at this intersection.

4.7.5 Mitigation

Mitigation of operational noise sources will occur primarily from the plant design, as cooling systems, valves, transformers, pumps, generators, and other facility equipment, will generally be located inside plant structures. The buildings themselves will absorb the majority of the noise generated within. Natural land contours, vegetation (such as scrub brush and trees), and site buildings and structures will mitigate noise from other equipment located outside of site structures. Distance from the noise source is also a key factor in the control of noise levels to area receptors. It is generally true that the sound pressure level from an outdoor noise source decreases 6 dB per doubling of distance (Cowan, 1994). Thus, a noise that measures 80 dB at 15.2 m (50 ft) away from the source will measure 74 dB at 30.5 m (100 ft), 68 dB at 61 m (200 ft), and 62 dB at 122 m (400 ft). Noise from construction activities will have the highest sound levels, occasionally peaking at 99 dBA at 9.1 m (30 ft) from the source, which would be equivalent to 69 dBA at 305 m (1,000 ft) (Cowan, 1994). As noted above, the nearest home is located west of the site at a distance of approximately 4.3 km (2.63 miles).However, heavy truck and earth moving equipment usage will be restricted after twilight and during early morning hours. All noise suppression systems on construction vehicles shall be kept in proper operation.

4.7.6 Cumulative Impacts

Cumulative impacts from all site noise sources should remain at or below HUD guidelines of 65 dBA L_{dn} and the EPA guidelines of 55 dBA L_{dn} (EPA, 1973) during NEF construction and operation. Residences closest to the site boundary will experience only minor impacts from construction noise, with the majority of the noise sources being from additional construction vehicle traffic. Since phases of construction include a variety of activities, there may be short-term occasions when higher noise levels will be present; examples include the use of backhoes and large generators.

The level of noise anticipated offsite is comparable to noise levels near a busy road and less than noise levels found in most city neighborhoods. Expected noise levels will mostly affect a 1.6-km (1-mi) radius. The cumulative noise of all site activities should have a minor impact and only those receptors closest to the site boundary.

4.7.7 Comparative Noise Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The noise impact would be greater because of electric generation to support the GDP.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The noise impact would be greater in the short term due to operation of electric generation to support GDP and concentration in one location. In the long term, the noise impact would be the same or greater due to concentration of activity at a single location.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The noise impact for continued operation of the USEC GDP would be significantly greater because of increased electric energy demand to support increased GDP capacity.

4.8 HISTORIC AND CULTURAL RESOURCE IMPACTS

4.8.1 Direct Impacts

A pedestrian cultural resource survey of the 220-ha (543-acre) parcel of land where the NEF is to be located was conducted from September 10 through 12, 2003. Seven potential prehistoric archaeological sites (LA 140701 through LA 140707) were recorded during the survey of the study area; three of these (LA 140701, LA 140702, and LA 140705) are located in the Area of Potential Effect (APE). The APE consists of the site and area that includes the building(s) footprints and temporary lay-down areas. Two sites that are considered not to be eligible for the National Register of Historic Places (NRHP) (LA 140701 and LA 140702) will be impacted by the facility. Four of the recorded sites (LA 140704 through LA 140707) are considered potentially eligible to the NRHP. One potentially eligible archaeological site (LA 140705) will be affected by the proposed location of the access road to the facility. Based on surface findings, this site does contain the potential to contribute significant data to the prehistory of the region. This site will either be avoided or a mitigation plan will be developed and implemented if required. (See ER Section 4.8.6, Minimizing Adverse Impacts on mitigative actions.)

Based on recommendation for the New Mexico State Historic Preservation Officer (SHPO) and standard practice, LES has not identified the locations of the seven potential prehistoric archaeological sites on a map so that the sites would not be disturbed by curiosity seekers or vandals.

4.8.2 Indirect Impacts

Based on the survey results as stated in ER Section 4.8.1, one potentially eligible archaeological site and two sites considered not eligible are known to exist within the APE of the proposed NEF. The potentially eligible sites will either be avoided or a mitigation plan will be developed and implemented, if required, to minimize the potential for indirect impacts. LES has no knowledge of any acts of vandalism on historical and cultural artifacts near the NEF site. LES will provide the New Mexico SHPO with the survey report in 2004 in lieu of providing the locations in the ER to further preclude potential for vandalism. (See ER Section 4.8.6 on mitigative actions.)

4.8.3 Agency Consultation

Consultation has been initiated with all appropriate state agencies and affected Native American Tribes. Letters of response are included in ER Appendix A.

4.8.4 Historic Preservation

Site LA 140705, located within the Area of Potential Effect (APE), is potentially eligible for nomination to the NRHP. This site will either be avoided or a mitigation plan will be developed and implemented. The remaining archeological sites located within the NEF will either be avoided or a mitigation plan will be developed and implemented, if required. The results of the

survey will be submitted to the New Mexico SHPO in 2004 for a determination of eligibility. Based on the New Mexico SHPO determination, LES will implement, if necessary, appropriate measures. New Mexico's implementation of the Federal National Historic Preservation Act is contained in NMAC 4.10.2 (NMAC, 2001b). (See ER Section 4.8.6 on mitigative actions.)

4.8.5 Potential For Human Remains

There is low potential for human remains to be present on the NEF site. Based on previous work in the region, burials tend to occur in rockshelters and on sites with structures. Should an inadvertent discovery of such remains be made during construction, LES will stop construction activities immediately in the area of discovery and notify the New Mexico State Historic Preservation Officer (SHPO). The SHPO will determine the appropriate measures to identify, evaluate, and treat these discoveries. If the remains are potentially from Native American sites, LES will, in addition to the above actions, contact the Federal Agency that has primary management authority and the appropriate Native American tribe, if know or readily ascertainable. LES will also make reasonable effort to protect the items discovered before resuming the construction activities in the vicinity at the discovery. The construction activity will resume only after the appropriate consultations and notifications have occurred and guidance received.

4.8.6 Minimizing Adverse Impacts

One potentially eligible historic property (LA 140705) is located within the APE of the proposed location of the NEF. LA 140705 is located within the proposed access road to the facility. This site will either be avoided or a mitigation plan will be developed and implemented, if required. LA 140704, LA 140706, and LA 140707 should not be affected by the construction of the proposed facility given their location outside the construction zone. These three sites will either be avoided or a mitigation plan will be developed and implemented during the construction phase. Mitigation measures will be in place to minimize any potential impact on historical and cultural resources. In the event that any inadvertent discovery of human remains or other item of archeological significance is made during construction, the facility will cease construction activities immediately in the area of discovery and notify the New Mexico State Historic Preservation Officer to make the determination of appropriate measures to identify, evaluate and treat these discoveries.

Mitigation of the impact to eligible sites within the NEF project boundary can take a variety of forms. Avoidance and data collection are the two most common forms for sites considered eligible based on NRHP criterion (d), their data content, which is the basis for the eligibility of these particular sites (USC, 2003c). When possible, avoidance is the preferred alternative because the site is preserved in place and mitigation costs are minimized. When avoidance is not possible, data collection becomes the preferred alternative. Data collection proceeds after the sites have been determined eligible. A treatment plan is submitted to the appropriate regulatory agencies. The plan describes the expected data content of the sites and how data will be collected, analyzed, and reported.

Options to deal with unexpected discoveries are defined. In the case of these sites, a phased approach may be appropriate. This type of approach would define a process of data recovery that begins with the recovery of the significant information present in the site features and the

surface artifact assemblage combined with some level of subsurface exploration to identify the presence of other significant data to be present.

The next phase is predicated upon the results of the subsurface exploration. If other significant remains are located, additional excavation is used to extract this information. Generally, some maximum amount of excavation is specified and the additional excavation does not exceed that amount unless unexpected discoveries are made.

Alternatively, a testing phase can be inserted into the process prior to data collection. In this approach, a testing plan is prepared and submitted for regulatory review. Once approved, the site (in this case, either eligible or potentially eligible) testing plan is implemented. Recovered materials and spatial data are analyzed, and a testing report and treatment plan are prepared and submitted for regulatory review. Upon approval, the treatment plan is then implemented.

The recovered materials include artifacts and samples that include bone, charcoal, sediments, etc. Samples are usually submitted to outside analytical laboratories, these include radiocarbon dates. Artifacts, bones and perhaps some of the remaining samples are then curated. Curation is usually at the Museum of New Mexico. The museum charges a fee for curation in perpetuity.

Given the small number of potential archaeological sites and isolated occurrences located on the site, and LES's ability to avoid or mitigate impacts to those sites, the NEF project will not have a significant impact on historic and cultural resources.

4.8.7 Cumulative Impacts

Given the small number of archaeological sites located in the study area, there will be no cumulatively significant impacts to cultural resources.

4.8.8 Comparative Historical and Cultural Resource Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The historical and cultural impacts would be the same or less because of similar capacity of the new plant.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The historical and cultural impacts would be the same or less because only one plant site would be disturbed.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The historical and cultural impacts are less since no new facility is constructed.

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4.9 VISUAL/SCENIC RESOURCES IMPACTS

4.9.1 Photos

Refer to ER Section 3.9.2, Site Photographs. As shown on the photographs, there are no existing structures on the NEF site.

4.9.2 Aesthetic and Scenic Quality Rating

The visual resource inventory process provides a means for determining visual values (BLM, 1984). The inventory consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. Based on these three factors, lands are placed into one of four visual resource inventory classes. These inventory classes represent the relative value of the visual resources as follows: Classes I and II are considered to have the highest value, Class III represents a moderate value, and Class IV ranked is of least value. The inventory classes provide the basis for considering visual values in the resource management planning (RMP) process. Visual resource management classes are established through the RMP process. The NEF site, as evaluated based on the scenic quality of the site receives a “C” rating and falls into Class IV. Seismic quality is a measure of the visual appeal of a tract of land which is given an A, B or C rating (A-highest, C-lowest) based on the apparent scenic quality. Refer to ER Table 3.9-1, Scenic Quality Inventory and Evaluation Chart. This class is of the least value and allows for manipulation or disturbance. The proposed use of the NEF site is not outside the objectives for Class IV, which is to provide for management activities that require major modifications of the existing character of the landscape. Therefore, land management activities may dominate the view and be the major focus of viewer attention. The level of change to the characteristics of the landscape can be high (BLM,1984; BLM, 1986).

4.9.3 Significant Visual Impacts

4.9.3.1 Physical Facilities Out Of Character With Existing Features

Given that the site is undeveloped, the proposed NEF is out of character with current, onsite conditions. However, considering the neighboring properties have been developed for industrial purposes (WCS facility, county landfill and quarry), the proposed plant structures are similar to existing, architectural features on surrounding land.

4.9.3.2 Structures Obstructing Existing Views

None of the proposed onsite structures will be taller than 40 m (131 ft). Due to the relative flatness of the site and vicinity, the structures will be observable from New Mexico Highway 234 and from nearby properties, partially obstructing views of existing landscape. However, considering that there are no high quality viewing areas (see ER Section 3.9.7, High Quality View Areas) and the many existing, manmade structures (pump jacks, high power lines, industrial buildings, above-ground tanks) near the NEF, the obstruction of existing views due to

proposed structures will be comparable to current conditions. Refer to ER Figures 3.9-1A through 3.9.1H.)

4.9.3.3 Structures Creating Visual Intrusions

Although most proposed NEF structures will be set back a substantial distance from New Mexico Highway 234, due to the relative flatness of the area, taller plant structures will likely be visible from the highway and adjacent properties, creating a visual intrusion. However, considering the existing structures associated with neighboring industrial properties to the north, east and south (quarry, WCS facility and county landfill, respectively) the nearby utility poles along New Mexico Highway 234, the high power utility line to the east that runs parallel to the New Mexico/Texas state line, and the numerous pump jacks dotting the landscape to the north, south and west, the proposed onsite structures will be no more intrusive.

4.9.3.4 Structures Requiring The Removal Of Barriers, Screens Or Buffers

As noted in ER Section 3.9.1, Viewshed Boundaries, a series of small sand dunes on the western portion of the site provide natural screening from areas to the west. Except possibly for a section of the proposed, westernmost, access road, none of the onsite structures will require removal of natural barriers, screens or buffers. Any removal of natural barriers, screens or buffers associated with road construction will be minimized. Additionally natural landscape, using vegetation indigenous to the area, is planned to provide additional aesthetically pleasing screening measures.

4.9.3.5 Altered Historical, Archaeological Or Cultural Properties

Based on discussion with a county historian and as stated in ER Section 3.8, Historic and Cultural Resources, all potential cultural or archaeological sites that were found within the proposed NEF site can either be avoided or successfully mitigated, if required. The results of the LES surveys of the NEF site will be submitted to the New Mexico State Preservation Officer (SHPO) in 2004 for a determination of eligibility. Based on the SHPO determination, LES will implement, if required, appropriate measures. Therefore, no historical, archaeological or cultural properties will be affected by development of the NEF.

4.9.3.6 Structures That Create Visual, Audible Or Atmospheric Elements Out Of Character With The Site

Although the proposed onsite structures are out of character with the natural setting of the site, they are comparable to those existing on the surrounding industrial properties. None of the NEF structures or associated activities will produce significant noise levels audible from offsite (see ER Section 4.7.1, Predicted Noise Levels) or create significant atmospheric elements (such as a large emission plumes) visible from offsite.

4.9.4 Visual Compatibility And Compliance

As noted in ER Section 3.9.9, Regulatory Information, discussions were held between LES and the city of Eunice, New Mexico, and Lea County officials, to coordinate and discuss local area community planning issues. No local or county zoning, land use planning or associated review process requirements were identified. All applicable local ordinances and regulations will be followed during the construction and operation of the NEF. However, development of the site will meet federal and state requirements for nuclear and radioactive material sites regarding design, siting, construction materials, and monitoring.

4.9.5 Potential Mitigation Measures

Mitigation measures will be in place to minimize the impact to visual and scenic resources. These include the following items:

- The use of accepted natural, low-water consumption landscaping techniques to limit any potential visual impacts. These techniques will incorporate, but not be limited to, the use of landscape plantings. As for aesthetically pleasing screening measures, planned landscape plantings will include indigenous vegetation.
- Prompt re-vegetation or covering of bare areas will be used to mitigate visual impacts due to construction activities.

4.9.6 Cumulative Impacts To Visual/Scenic Quality

The cumulative impacts to the visual/scenic quality of the NEF site can be assessed by examining proposed actions associated with construction of the NEF and development of surrounding properties.

Proposed site development potentially impacting the visual/scenic quality of the NEF site includes:

- Several buildings surrounded by chain link fencing;
- Proposed power lines; and
- New access roads

Existing development on surrounding properties impacting the visual/scenic quality of the site and vicinity includes:

- A railroad spur;
- Industrial structures (buildings, aboveground tanks);
- Man-made earthen structures (industrial lagoons, stockpiled soil, landfill cavities);
- Dirt and gravel covered roadways;
- Power poles and a high-voltage utility line;
- Pump jacks; and
- Barbed wire fencing along property perimeters

By considering both proposed onsite and nearby existing developments, modification to the subject site will not add significantly to its visual degradation. Therefore, there will be little cumulative impact on the visual/scenic quality of the NEF site.

4.9.7 Comparative Visual/Scenic Resources Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of “no action,” i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for the three “no action” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The visual/scenic resources impact would be less because only one of two centrifuge plants would be built.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The visual/scenic resources impact would be the same or less because although only one plant is to be constructed, the capacity would be larger.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The visual/scenic resources impact would be less since no new facility is constructed.

4.10 SOCIOECONOMIC IMPACTS

This section describes the socioeconomic impacts to the community surrounding the NEF, including the impacts from the influx of the construction and operation work force to schools and housing as well as on social services. Transportation impacts are described in ER Section 4.2, Transportation Impacts.

4.10.1 Facility Construction

4.10.1.1 Worker Population

Groundbreaking at the NEF site is scheduled for 2006, with construction continuing for eight years through 2013. Table 4.10-1, Estimated Number of Construction Workers by Annual Pay, lists the estimated average annual number of construction employees working on the NEF during construction and the estimated salary range. As shown in that table, a peak construction force of about 800 workers is anticipated during the period 2008-2009.

During early construction stages of the project, the work force is expected to consist primarily of structural crafts, which should benefit the local area since this workforce is expected to come from the local area. As construction progresses, there will be a transition to predominantly mechanical and electrical crafts in the later stages. The bulk of this labor force is expected to come from the surrounding 112-km (70-mi) region due to the relatively low population of the local site area (Table 3.10-3, Civilian Employment Data, 2000). The available labor pool is expected to correlate with the required education and skill levels for the construction work force.

The southeast New Mexico area's ability to supply ample labor is enhanced by an excellent rural road system and warm climate. These factors allow an employer to draw from a wide geographic area labor force, which is characterized by an eagerness to learn, willingness to work, and a high level of productivity.

4.10.1.2 Impacts on Human Activities

The major impact of facility construction on human activities is expected to be a result of the influx of labor into the area on a daily or semi-permanent basis. LES estimates approximately 15% of the construction work force (120 workers) is expected to move into the vicinity as new residents. Previous experience regarding construction for the nuclear industry projects suggests that of those who move, approximately 65% will bring their families, which on average consist of the worker, a spouse, and one school-aged child (NRC, 1994a). The likely increase in area population during peak construction, therefore, will total 360. This is less than 1% of the total Lea, New Mexico-Andrews, Texas Counties' 2000 population (Table 3.10-1, Population and Population Projections).

The increase in jobs and population would lead to a need for additional housing and an increased level of community services, such as schools, fire and police protection, and medical services. However, since the growth in jobs and population would occur over a period of several years, providers of these services should be able to accommodate the growth. For example, the estimated peak increase in school-age children is 120, or less than 1% of the total

Lea, New Mexico-Andrews, Texas Counties' 2000 enrollment (Table 3.10-7, Educational Information in the Lea, New Mexico-Andrews, Texas County Vicinity). Based on the local area teacher-student ratio of approximately 1:17 (Table 3.10-6, Educational Facilities Near the NEF), and assuming an even distribution of students among all grade levels, the increase in students represents seven classrooms. This impact should be manageable, however, considering that Lea County, New Mexico has experienced a far greater temporary population growth due to petroleum industry work in the mid-1980s (Table 3.10-1). The overall change in population density and population characteristics in Lea County, New Mexico and Andrews County, Texas, due to construction of the NEF, will be insignificant.

Similarly, LES has estimated 120 housing units would be needed to accommodate the new NEF construction workforce. The percentage of vacant housing units in the Lea, New Mexico-Andrews, Texas County area in 2000 was about 16% and 15%, respectively, meaning that more than 4,000 housing units were available (Table 3.10-5, Housing Information in the Lea, New Mexico – Andrews, Texas County Vicinity). Accordingly, there should be no measurable impact related to the need for additional housing.

While some additional investment in facilities and equipment may be necessary, local government revenues would also increase (see ER Section 7.1, Cost Benefits Analysis, and discussion in ER Section 4.10.2.2, Community Characteristic Impacts, concerning LES' anticipated payments to the State of New Mexico and to Lea County, New Mexico, under the Lea County Industrial Revenue Bond business incentive program during the construction and operation of the facility). These benefits and payments will provide the source for additional government investment in facilities and equipment. That revenue increase may lag somewhat behind the need for new investment more easily, but the incremental nature of the growth should allow local governments to more easily accommodate the increase. Consequently, insignificant negative impacts on community services would be expected.

4.10.2 Facility Operation

4.10.2.1 Jobs, Income, and Population

Operation of the proposed NEF would lead to a permanent increase in employment, income, and population in the area. Employment at the NEF during operation will be 210 workers. This is a 0.7% increase in total employment in Lea and Andrews Counties and a 18% increase in manufacturing employment in the two counties, as compared to the 2000 estimate of jobs (Table 3.10-3). A significant number of operational jobs are likely to be filled by residents in the region since most of its populace has completed school attainment at or below the high school grade level (Table 3.10-7, Educational Information in the Lea, New Mexico – Andrews, Texas County Vicinity).

The NEF annual operating payroll will be approximately $10.5 million for a workforce of 210. The resultant average salary is approximately three times the individual per capita income in the Lea New Mexico-Andrews, Texas County area and approximately 60% and 40% above the median household income for those counties, respectively (Table 3.10-4, Area Income Data).

An increase in the number of jobs would also lead to a population increase in the surrounding areas. Lea and Andrews Counties probably would experience the most noticeable population increases. However, these increases would be less than during facility construction and,

accordingly, have commensurate lesser impacts. In particular, the region would avoid a boomtown effect, which generally describes the consequence of rapid increases in population (at least 5 to 10% per year) in small (populations of a few thousand to a few tens of thousands), rural 48 to 80 km (30 to 50 mi) or more from a major city communities undergoing rapid increases in economic activity (NRC, 1994a). The overall change in population density and population characteristics in Lea County, New Mexico and Andrews County, Texas due to operation of the NEF will be insignificant.

4.10.2.2 Community Characteristic Impacts

The increase in population due to NEF operation, as stated above, will be less than during construction. Based on the housing vacancy rate in the area, which is about 3% to 6% higher than the respective states in general (Table 3.10-5, Housing Information in the Lea, New Mexico – Andrews, Texas County Vicinity), the relatively small need for housing units is not anticipated to burden or raise prices within the local real estate market.

Similarly, a smaller increase in local elementary and secondary school enrollment will be expected as compared to than during construction. Area medical, fire, and law enforcement services should be minimally affected as well. Agreements exist among the cities in Lea County, New Mexico, for emergency services if personnel in Eunice, New Mexico are not available. Otherwise, available services should be able to absorb the needs of new workers and residents. To allow provision of services, the development of new fire departments or police departments, for example, should not be necessary because the NEF will be equipped with its own Fire Protection System and Security Force.

LES anticipates the following payments to the State of New Mexico and to Lea County under the Lea County Industrial Revenue Bond business incentive program during the construction and operation of the facility:

- Gross receipts/compensating tax to the State of $14.5 million (during construction).
- Gross receipts/compensating tax to Lea County, New Mexico of $750,000 (during construction).
- Payment in lieu of taxes program that will result in yearly payments based on the value of the property on the site increasing to approximately $1 million per year and slowly dropping over time.

4.10.3 Comparative Socioeconomic Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of “no action,” i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three “no action” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The socioeconomic impact would be less positive since only one centrifuge plant would be built versus two.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The socioeconomic impact would be the same or less positive because of building only one centrifuge plant, but increasing the capacity.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The socioeconomic impact would be less positive since no new plants would be built.

TABLES

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Table 4.10-1 Estimated Number Of Construction Workers By Annual Pay

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		Annual Worker Salary			Workers
Year	**$0-16,000**	**$17,000-33,000**	**$34,000-49,000**	**$50,000-82,000**	**Average No./Yr.**
2006	100	100	50	5	255
2007	50	75	350	45	520
2008	50	100	500	50	700
2009	50	100	600	50	800
2010	50	25	300	50	425
2011	10	25	100	60	195
2012	10	15	75	40	140
2013	10	15	75	40	140

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4.11 ENVIRONMENTAL JUSTICE

This section examines whether there are disproportionately high minority or low-income populations residing within a 6.4-km (4-mi) radius of the NEF for which further examination of environmental impacts, to determine the potential for environmental justice concerns, is warranted. The evaluation was performed using the most recent population and economic data available from the U. S. Census Bureau for that area, and was done in accordance with the procedures contained in NUREG-1748 (NRC, 2003a). This guidance was endorsed by the NRC's recently issued draft Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (FR, 2003). As discussed below, no minority or low-income populations were identified that would require further analysis of environmental justice concerns under the criteria established by the NRC.

4.11.1 Procedure and Evaluation Criteria

The determination of whether the potential for environmental justice concerns exists was made in accordance with the detailed procedures set forth in Appendix C to NUREG-1748 (NRC, 2003a). Census data from the 2000 decennial census were obtained from the U. S. Census Bureau on the minority and low-income populations residing within a 6.4-km (4-mi) radius (i.e., 130 km^2 or 50 mi^2) of the center of the NEF site. These data were obtained by census block group (CBG), and include (for minority populations) percentage totals within each census block group for both each individual minority population group (i.e., African-American, Hispanic, Native American) and for the aggregate minority population. For low-income households (defined in NUREG-1748 as those households falling below the U.S. Census Bureau-specified poverty level), only the total percentage of such households within each CBG was obtained. The low income household data used in the evaluation was for 1999. In examining alternative sites for the NEF, LES considered environmental justice as part of the overall site selection process. However, it did not conduct as detailed an analyses for those sites not selected as that performed for the Lea County site.

Once collected, the above-described minority and low-income population percentage data were then compared to their counterparts for their respective county and state. These comparisons were made pursuant to the "20%" and "50%" criteria contained in Appendix C to NUREG-1748, to determine (1) if any individual CBG contained a minority population group, aggregate minority population, or low-income household percentage that exceeded its county or state counterparts by more than 20 percentage points; and (2) if any CBG was comprised of more than 50% minorities (either by individual group or in the aggregate) or low-income households.

Based on its comparison of the relevant CBG data to their county and state counterparts, as discussed below, LES determined that no further evaluation of potential environmental justice concerns is necessary, as no CBG within the 6.4-km (4-mi) radius of the NEF site contained a minority or low-income population exceeding the NUREG-1748 "20%" or "50%" criteria (NRC, 2003a).

4.11.2 Results

The 130-km^2 (50-mi^2) area around the proposed NEF site includes parts of both Lea County, New Mexico and Andrews County, Texas (Figure 4.11-1, 130-km^2 (50-mi^2) Area Around Proposed NEF). Within that area, there are two census tracts (one in each county and one census block group (CBG) in each census tract).

The minority population for each of the individual CBGs, as well as the total corresponding minority population for Lea and Andrews Counties, the states of New Mexico and Texas and the 130 km^2 (50 mi^2) area around the proposed NEF site are enumerated in Table 4.11-1, Minority Population, 2000. The table also lists the percent make up of each minority and the percentage difference between the CBG and the 130-km^2 (50-mi^2) area around the NEF with the parent state and county. Since the 130-km^2 (50-mi^2) area around the NEF covers both states, the comparisons were made to each state and the two counties (Lea County, New Mexico and Andrews County, Texas). A positive difference value means the CBG has a higher percentage of the minority population; a negative difference value means the CBG or the 130-km^2 (50-mi^2) area around the NEF has a lower percentage of the minority population.

As shown in Table 4.11-1, the largest minority group is Hispanic or Latino, accounting for 42.1% of the total population in New Mexico and 32.0% in Texas. In Lea County, New Mexico, the highest percentage of a minority population, at 39.6%, is also Hispanic or Latino. In Andrews County, Texas, Hispanic or Latino is the largest minority group as well at 40.0%..

Table 4.11-1 demonstrates that no individual CBG and the 130-km^2 (50-mi^2) area around the NEF are comprised of more than 50% of any minority population. With respect to the Hispanic or Latino population, the largest minority population in both census tracts, the percentages are as follows: Census Tract 8, CGB 2 – 24.8%; Census Tract 9501, CBG 4 – 19.8%. The largest minority group in the 130-km^2 (50-mi^2) area around the NEF is Hispanic or Latino, accounting for 11.7%. Moreover, none of these percentages exceeds the applicable State or County percentages for this minority population by more than 20 percentage points.

Table 4.11-2, Low Income (Poverty) Population, 1999, demonstrates that no individual CBG is comprised of more than 50% of low-income households. The percentages are as follows: Tract 8, CBG 2 –3.6%; Tract 9501, CBG 4- 9.9%. Neither of these percentages exceeds 50 percent; moreover, neither of these populations significantly exceeds the percentage of low-income households in the applicable State or County. Low income (poverty) data is only compiled down to the CBG level and, therefore, data is not available for only the 130-km^2 (50-mi^2) area around the NEF.

Based on this analysis of the above-described data, performed in accordance with the criteria, guidelines and procedures set forth in NUREG-1748, LES has concluded that no disproportionately high minority or low-income populations exist that would warrant further examination of environmental impacts upon such populations (NRC, 2003a).

4.11.3 Comparative Environmental Justice Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in

this subsection for each of the three “no action” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The environmental justice impact is the same since it is assumed there are no disproportionate impacts associated with the alternative scenario.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The environmental justice impact would be the same since it is assumed there are no disproportionate impacts associated with the alternative scenario.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The environmental justice impact would be the same since it is assumed that there are no disproportionate impacts associated with the alternative scenario.

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TABLES

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Table 4.11-1 Minority Population, 2000

Geographic Area	New Mexico	Lea County	NM Census Tract 8, Blk Grp 2	Within 130 km^2 (50 mi^2) Compared to NM and Lea County	Texas	Andrews County	TX Census Tract 9501, Blk Grp 4	Within 130 km^2 (50 mi^2) Compared to TX and Andrews County
Total:	1,819,046	55,511	618	60	20,851,820	13,004	591	60
Not Hispanic or Latino	1,053,660	33,501	465	53	14,182,154	7,802	474	53
Percent	57.9%	60.4%	75.2%	88.3%	68.0%	60.0%	80.2%	88.3%
White alone	813,495	29,977	452	48	10,933,313	7,322	438	48
Percent	44.7%	54.0%	73.1%	80.0%	52.4%	56.3%	74.1%	80.0%
Black or African American alone	30,654	2,340	3	3	2,364,255	195	3	3
Percent	1.7%	4.2%	.5%	5.0%	11.3%	1.5%	0.5%	5.0%
State percentage difference	0.0%	2.5%	-1.2%	3.3%	0.0%	-9.8%	-10.8%	6.3%
County percentage difference	N/A	0.0%	-3.7%	0.8%	N/A	0.0%	-1.0%	3.5%
American Indian and Alaska Native alone	161,460	356	2	1	68,859	64	2	1
Percent	8.9%	0.6%	0.3%	1.7%	0.3%	0.5%	0.3%	1.7%

Table 4.11-1 Minority Population, 2000

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Geographic Area	New Mexico	Lea County	NM Census Tract 8, Blk Grp 2	Within 130 km^2 (50 mi^2) Compared to NM and Lea County	Texas	Andrews County	TX Census Tract 9501, Blk Grp 4	Within 130 km^2 (50 mi^2) Compared to TX and Andrews County
State percentage difference	0.0%	-8.2%	-8.6%	-7.2%	0.0%	0.2%	0.0%	1.3%
County percentage difference	N/A	0.0%	-0.3%	1.0%	N/A	0.0%	-0.2%	1.2%
Asian alone	18,257	198	0	0	554,445	88	17	0
Percent	1.0%	0.4%	0.0%	0.0%	2.7%	0.7%	2.9%	0.0%
State percentage difference	0.0%	-0.6%	-1.0%	-1.0%	0.0%	-2.0%	0.2%	-2.7%
County percentage difference	N/A	-0.0%	-0.4%	-0.4%	N/A	0.0%	2.2%	-0.7%
Native Hawaiian and Other Pacific Islander alone	992	11	0	0	10,757	2	0	0
Percent	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
State percentage difference	0.0%	0.0%	-0.1%	-0.1%	0.0%	0.0%	-0.1%	-0.1%
County percentage difference	N/A	0.0%	0.0%	0.0%	N/A	0.0%	0.0%	0.0%
Some other race alone	3,009	34	0	0	19,958	13	0	0

Table 4.11-1 Minority Population, 2000

Geographic Area	New Mexico	Lea County	NM Census Tract 8, Blk Grp 2	Within 130 km^2 (50 mi^2) Compared to NM and Lea County	Texas	Andrews County	TX Census Tract 9501, Blk Grp 4	Within 130 km^2 (50 mi^2) Compared to TX and Andrews County
Percent	0.2%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
State percentage difference	0.0%	-0.1%	-0.2%	-0.2%	0.0%	0.0%	-0.1%	-0.1%
County percentage difference	N/A	0.0%	-0.1%	-0.1%	N/A	0.0%	-0.1%	-0.1%
Two or more races	25,793	585	8	1	230,567	118	14	1
Percent	1.4%	1.1%	1.3%	1.7%	1.1%	0.2%	2.4%	1.7%
State percentage difference	0.0%	-0.4%	-0.1%	-0.2%	0.0%	-0.9%	1.3%	0.6%
County percentage difference	N/A	0.0%	0.2%	-0.6%	N/A	0.0%	2.2%	1.5%
Hispanic or Latino:	765,386	22,010	153	7	6,669,666	5,202	117	7
Percent	42.1%	39.6%	24.8%	11.7%	32.0%	40.0%	19.8%	11.7%
State percentage difference	0.0%	-2.4%	-17.3%	-30.4%`	0.0%	8.0%	-12.2%	-20.3%
County percentage difference	N/A	0.0%	-14.9%	-28%	N/A	0.0%	-20.2%	-28.3%
Total Minority	979,758	24,949	158	11	687,940	564	139	11

Table 4.11-1 Minority Population, 2000

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Geographic Area	New Mexico	Lea County	NM Census Tract 8, Blk Grp 2	Within 130 km^2 (50 mi^2) Compared to NM and Lea County	Texas	Andrews County	TX Census Tract 9501, Blk Grp 4	Within 130 km^2 (50 mi^2) Compared to TX and Andrews County
Percent	53.9%	44.9%	25.6%	18.3%	46.5%	42.8%	23.5%	18.3%
State percentage difference	0.0%	-8.9%	-28.3%	-35.5%	0.0%	-3.7%	-22.9%	-28.1%
County percentage difference	N/A	0.0%	-19.4%	-26.0%	N/A	0.0%	-19.3%	-24.5%

Table 4.11-2 Low Income (Poverty) Population, 1999

Geographic Area	New Mexico	Lea County	NM Census Tract 8, Blk Grp 2	Texas	Andrews County	TX Census Tract 9501, Blk Grp 4
Total:	1,783,907	53,682	581	20,287,300	12,892	568
Income in 1999 below poverty level:	328,933	11,317	21	3,117,609	2,117	56
Percent below poverty level:	18.4%	21.1%	3.6%	15.4%	16.4%	9.9%
State percentage difference	0.0%	2.6%	-14.8%	0.0%	1.1%	-5.5%
County percentage difference	NA	0.0%	-17.5%	NA	0.0%	-6.6%

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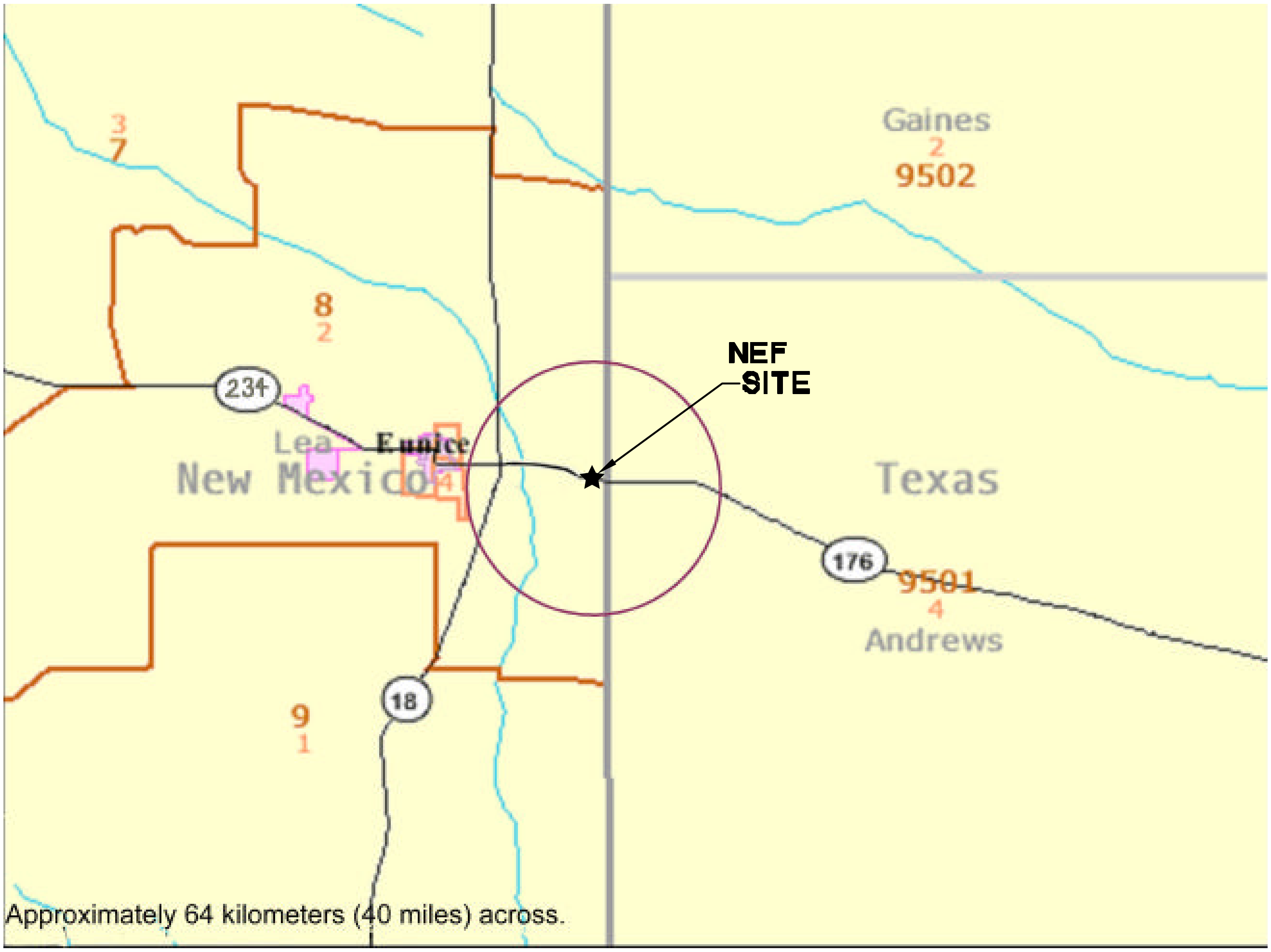
FIGURES



5 0 5 10 15 20 KM

5 0 5 10 MILES

NORTH

MAP SOURCE:
U.S.CENSUS BUREAU

REFERENCE NUMBER
New Mexico Figures.dwg

FIGURE 4.11-1
130–km² (50–mi²) AREA
AROUND PROPOSED NEF
ENVIRONMENTAL REPORT

REVISION DATE: DECEMBER 2003

4.12 PUBLIC AND OCCUPATIONAL HEALTH IMPACTS

4.12.1 Nonradiological Impacts

Sources of nonradiological exposure to the public and to facility workers are characterized below. Nonradiological effluents have been evaluated and do not exceed criteria in 40 CFR 50, 59, 60, 61, 122, 129, or 141 (CFR, 2003w; CFR, 2003x; CFR, 2003y; CFR, 2003g; CFR, 2003z; CFR, 2003s; CFR, 2003h). Radionuclides, hydrogen fluoride, and methylene chloride are governed as a National Emission Standards Hazardous Air Pollutants (NESHAP) (EPA, 2003g). Details of radiological gaseous and liquid effluent impacts and controls are listed in ER Section 4.12.2, Radiological Impacts. A detailed list of the chemicals that will be used at the NEF, by building, is contained in ER Tables 2.1-2 through 2.1-4. ER Figure 2.1-4 indicates where these buildings are located on the NEF site.

4.12.1.1 Routine Gaseous Effluent

Routine gaseous effluents from the plant are listed in Table 3.12-3, Estimated Annual Gaseous Effluent. The primary material in use at the facility is uranium hexafluoride (UF_6). UF_6 is hygroscopic (moisture absorbing) and, in contact with water, will chemically break down into uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF). When released to the atmosphere, gaseous UF_6 combines with humidity to form a cloud of particulate UO_2F_2 and HF fumes. Inhalation of UF_6 typically results in internal exposure to UO_2F_2 and HF. In addition to a potential radiation dose, a worker would be subjected to two other primary toxic effects: (1) the uranium in the uranyl complex acts as a heavy metal poison that can affect the kidneys, and (2) the HF can cause severe irritation to the skin and lungs at high concentrations.

Of primary importance to the NEF is the control of UF_6. The UF_6 readily reacts with air, moisture, and some other materials. The most significant reaction products in this plant are HF, UO_2F_2, and small amounts of uranium tetrafluoride (UF_4). Of these, HF is the most significant hazard, being toxic to humans. Refer to ER Section 3.11.2.2, Public and Occupational Exposure Limits, for public and occupational exposure limits.

It should be noted that the public exposure limits proposed by the State of California (30 $\mu g/m^3$) and the Occupational Safety and Health Administration (OSHA) Permissible Exposure Level (PEL) (2.0 mg/m^3) vastly differ, with the California (CA) value being significantly more conservative. The proposed CA limit is by far the most stringent of all state or federal agencies, yet both are based on allowable exposure for an 8-hr workday. NEF is not obligated to follow California proposed standards; however, for comparative reasons, LES points out that the annual average gaseous effluent release concentration from a 3 million SWU Urenco Centrifuge Enrichment Plant is 3.9 $\mu g/m^3$ at the point of discharge (rooftop). This comparison demonstrates the HF emissions from the plant do not exceed the strictest of regulatory limits at the point of discharge. If standard dispersion modeling techniques are used to estimate the exposure to the nearest residents under normal operating conditions, the concentration at the nearest fence boundary is calculated to be 3.2×10^{-4} $\mu g/m^3$ and the concentration at the nearest residence located west of the site at a distance greater than 4.3 km (2.63 mi) is 6.4×10^{-6} $\mu g/m^3$. The nearest resident to the site is shown in Figure 4.12-1, Nearest Resident. Other sensitive

receptors (e.g., schools and hospitals), as well as the nearest drinking water source, are located further away.

Methylene chloride is used in small bench-top quantities to clean certain components. All chemicals at NEF will be used in accordance with the manufacturers recommendations, health and safety regulations and under formal procedures. LES will investigate the use of alternate solvents and/or apply control technologies as required. The remaining effluents listed in Table 3.12-4, Estimated Annual Liquid Effluent will have no significant impact on the public since they are used in deminimus levels or are nonhazardous by nature. All regulated gaseous effluents will be below regulatory limits as specified in permits issued by the New Mexico Air Quality Bureau.

Worker exposure to in-plant gaseous effluents listed in Table 3.12-3, Estimated Annual Gaseous Effluent, will be minimal. No exposures exceeding 29 CFR 1910, Subpart Z are anticipated (CFR, 2003o). Leaks in UF_6 components and piping would cause air to leak into the system and would not release effluent. All maintenance activities utilize mitigative features including local flexible exhaust hoses connected to the Gaseous Effluent Vent System, thereby minimizing any potential for occupational exposure. Laboratory and maintenance operations activities involving hazardous gaseous or respirable effluents will be conducted with ventilation control (i.e., fume hoods, local exhaust or similar) and/or with the use of respiratory protection as required.

4.12.1.2 Routine Liquid Effluent

Routine liquid effluents are listed in Table 3.12-4, Estimated Annual Liquid Effluent. The facility does not directly discharge any industrial effluents to natural surface waters or grounds onsite, and there is no plant tie-in to a Publicly Owned Treatment Works (POTW). All effluents are contained on the NEF site via collection tanks and retention/detention basins. See ER Section 2.1.2.3.4 for further discussion of the Liquid Effluent Collection and Treatment System. There is no water intake for surface water systems in the region. Water supplies in the region are from distant groundwater sources and are thus protected from any immediate impact due to potential releases. ER Section 3.4 provides further information about water wells in the site area. No public impact is expected from routine liquid effluent discharge.

Worker exposure to liquid in-plant effluents shown in Tables 3,12-2 and 3.12-4 will be minimal. No exposures exceeding 29 CFR 1910 (CFR, 2003o), Subpart Z are anticipated. Additionally, handling of all chemicals and wastes will be conducted in accordance with the site Environment, Health, and Safety Program which will conform to 29 CFR 1910 (CFR, 2003o) and specify the use of appropriate engineered controls, as well as personnel protective equipment, to minimize potential chemical exposures.

4.12.2 Radiological Impacts

Sources of radiation exposure incurred by the public generally fall into one of two major groupings, naturally-occurring radioactivity and man-made radioactivity. Naturally-occurring radioactivity includes primordial radionuclides (nuclides that existed or were created during the formation of the earth and have a sufficiently long half-life to be detected today) and their progeny nuclides, and nuclides that are continually produced by natural processes other than the decay of the primordial nuclides. These nuclides are ubiquitous in nature, and are

responsible for a large fraction of radiation exposure referred to as background exposure. Uranium (U), the material used in the NEF operations, is included in this group. Man-made radioactivity, which includes radioactivity generated by human activities (e.g., fallout from weapons testing, medical treatments, and x-rays), also contributes to background radiation exposure. The combined relative concentrations of naturally-occurring radioactivity and man-made radioactivity in the environment vary extensively around the world, with variations seen between areas in close proximity. The concentration of radionuclides and radiation levels in an area are influenced by such factors as geology, precipitation, runoff, topsoil disturbances, solar activity, barometric pressure, and a host of other variables. The annual total effective dose equivalent from background radiation in the United States varies from 2.0 to 3.0 mSv (200 to 300 mrem) depending on the geographic region or locale and the prevalence of radon and its daughters.

Workers at the NEF are subject to higher potential exposures than members of the public because they are involved directly with handling uranium cylinders, processes for the enrichment of uranium, and decontamination and maintenance of equipment. During routine operations, workers at the plant may potentially be exposed to radiation from uranium via inhalation of airborne particles and direct exposure to equipment and components containing uranic materials. The radiation protection program at the NEF requires routine radiation surveys and air sampling to assure that worker exposures are maintained as low as reasonably achievable (ALARA). In addition, exposure-monitoring techniques at the plant include use of personal dosimeters by workers, personnel breathing zone air sampling, and annual whole-body counting.

In addition to the radiological hazards associated with uranium, workers may be potentially exposed to the chemical hazards associated with uranium. The material, UF_6, is hygroscopic (moisture absorbing) and, in contact with water, will chemically breakdown into UO_2F_2 and HF. When released to the atmosphere, gaseous UF_6 combines with humidity to form a cloud of particulate UO_2F_2 and HF fumes. The reaction is very fast and is dependent on the availability of water vapor. Consequently, an inhalation to UF_6 is typically an internal exposure to HF and UO_2F_2. In addition to the radiation dose, a worker would be subjected to two other primary toxic effects: (1) the uranium in the uranyl complex acts as a heavy metal poison that can affect the kidneys, and (2) the HF can cause acid burns to the skin and lungs if concentrated. Because of low specific activity values, the radiotoxicity of UF_6 and its products are smaller than their chemical toxicity.

Both a radiation protection program and a health and safety program will protect workers at the NEF. The Radiation Protection Program will comply with all applicable NRC requirements established in 10 CFR 20 (CFR, 2003q), Subpart B. Similarly, the Health and Safety Program at the NEF will comply with all applicable OSHA requirements established in 29 CFR 1910 (CFR, 2003o).

The general public and the environment may be impacted by radiation and radioactive material from the NEF in two primary ways. Potential radiological impacts may occur from (1) gaseous and liquid effluent discharges associated with controlled releases from the uranium enrichment process lines during routine operations and from decontamination and maintenance of equipment, and (2) direct radiation exposure associated with transportation and storage of UF_6 feed cylinders, product cylinders, and Uranium Byproduct Cylinders (UBCs).

The potential radiological impacts to the public from operations at the NEF are those associated with chronic exposure to low levels of radiation, not the immediate health effects associated with acute radiation exposure. The major sources of potential radiation exposure are the effluent from the Separations Building, Technical Services Building (TSB) and direct radiation from the UBC Storage Pad. The Centrifuge Assembly Building is a potential minor source of radiation exposure. It is anticipated that the total amount of uranium released to the environment via air effluent discharges from the NEF will be less than 10 g (0.35 ounces) per year (URENCO, 2000; URENCO, 2001, URENCO, 2002a). Due to the anticipated low volume of contaminated liquid waste and the effectiveness of treatment processes, liquid effluent discharges are not expected to have a significant radiological impact to the public or the environment. In addition, the radiological impacts associated with direct radiation from indoor operations are not expected to be a significant contributor because the low-energy gamma-rays associated with the uranium will be absorbed almost completely by the process lines, equipment, cylinders, and building structures at the NEF. However, the UBC Storage Pad may present the highest potential for direct radiation impact to the public at or beyond the plant fence line. The combined potential radiological impacts associated with the small quantity of uranium in effluent discharges and direct radiation exposure due to stored UBCs are expected to be a small fraction of the general public dose limits established in 10 CFR 20 (CFR, 2003q) and within the uranium fuel cycle standards established in 40 CFR 190 (CFR, 2003f). Figure 4.12-1, Nearest Resident and Figure 4.12-2, Site Layout for NEF, show the site layout for the NEF and its relation to the nearest residence.

The principle isotopes of uranium, ^{238}U, ^{236}U, ^{235}U, and ^{234}U, are expected to be the primary nuclides of concern in both gaseous effluent and liquid waste discharged from the plant. However, their concentrations in gaseous and liquid effluents are expected to be very low because of engineered controls and treatment processes prior to discharge. In addition, a combination of the effluent monitoring and environmental monitoring/sampling programs will provide data to identify and assess plant's contribution to environmental uranium at the NEF site. Both monitoring programs have been designed to provide comprehensive data to demonstrate that plant operations have no adverse impact on the environment. ER Section 6.1 provides detailed descriptions of the two monitoring programs.

The enrichment process system operates sub-atmospherically such that any air leaks are into the equipment and not into the building environment. In addition to building HVAC, the plant design includes two separate GEVS for treatment of potentially contaminated gas streams. The enrichment process in the main separations plant includes two parallel trains of exhaust filters (pre-filters, HEPA filters, and activated carbon filters) before gaseous effluent is discharged to the environment. The TSB also has a single train of similar filtration to treat gaseous effluent from laboratories containing process materials and from other rooms within the TSB where decontamination and maintenance works are performed. In addition, gaseous effluent from the GEVS is monitored continuously (refer to ER Section 6.1, Radiological Monitoring, for details regarding the effluent monitoring system).

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System, similar to the TSB GEVS, performs a similar function except it has one set of filters, two fans, and exhausts on the roof of the CAB. Discharges of gaseous effluent from both GEVS and the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System result in ground-level plumes because the release point is at roof top level on the TSB or CAB, as applicable. Consequently, airborne concentrations of uranium present in gaseous effluent continually decrease with distance from

the release point. Therefore, the greatest offsite radiological impact is expected at or near the site boundary locations in each sector. Site boundary distances have been determined for each sector (refer to ER Section 4.6 for details). The nearest resident has been identified at a distance of about 4.3 km (2.63 miles) in the west sector. Other important receptor locations, such as schools, have also been identified within an 8-km (5-mi) radius of the NEF site (refer to ER Section 3.10). With respect to ingestion pathways, there is little in the way of food crops grown within an 8-km (5-mi) radius due to semi-arid nature and minimal development of the local area for agriculture. Cattle grazing across the open range has been observed in the vicinity of the site (refer to ER Section 3.1). The radiological impacts on members of the public and the environment at these potential receptor locations are expected to be only small fractions of the radiological impacts that have been estimated for the site boundary locations because of the low initial concentrations in gaseous effluent and the high degree of dispersion that takes place as the gaseous effluent is transported.

The potential offsite radiological impacts to members of the general public from routine operations at the NEF were assessed through calculations designed to estimate the annual committed effective dose equivalent (CEDE) and annual committed dose equivalent to organs from effluent releases. The calculations also assessed impacts from direct radiation from stored uranium in feed, product and byproduct cylinders. The term "dose equivalent" as described throughout this section refers to a 50-year committed dose equivalent. The addition of the effluent related doses and direct dose equivalent from fixed sources provides an estimate of the total effective dose equivalent (TEDE) associated with plant operations. The calculated annual dose equivalents were then compared to regulatory (NRC and EPA) radiation exposure standards as a way of illustrating the magnitude of potential impacts.

4.12.2.1 Pathway Assessment

4.12.2.1.1 Routine Gaseous Effluent

Most of the airborne uranium is removed through filtration prior to the discharge of gaseous effluent to the atmosphere. However, the release of uranium in extremely low concentrations is expected and raises the potential for radiological impacts to the general public and the environment. The total annual discharge of uranium in routine gaseous effluent from a similar designed 1.5 million SWU uranium enrichment facility (half the size of the NEF) was estimated to be less than 30 g (1.1 oz) (NRC, 1994a). The uranium source term applied in the assessment of radiological impacts for routine gaseous effluent from that plant was 4.4×10^6 Bq (120 μCi) per year. It was noted that actual uranium discharges in gaseous effluent for European facilities with similar design and throughput are significantly lower (i.e., < 1×10^6 Bq (28 μCi) per year) (NRC, 1994a). In contrast, the NEF is a 3 million SWU facility. The annual discharge of uranium in routine gaseous effluent discharged from the NEF is expected to be less than 10 g (0.35 ounces) (URENCO, 2000; URENCO, 2001, URENCO, 2002a). As a conservative assumption for assessment of potential radiological impacts to the general public, the uranium source term used in the assessment of radiological impacts for routine gaseous effluent releases from the NEF was taken as 8.9 MBq (240 μCi) per year, which is equal to twice the source term applied to the 1.5 million SWU plant described in NUREG-1484 (NRC, 1994a). In comparison, the operating history of gaseous emissions from the Urenco Capenhurst facility in the United Kingdom averaged over a four-year period (1999 to 2002) indicates an average annual release

to the atmosphere of uranium of about only 0.1 MBq (2.8 μCi) (URENCO, 2001; URENCO, 2002a). Since the Capenhurst facility is less than half the size of the NEF, scaling their annual release by a conservative factor of 3 suggests that the expected annual releases could be about 0.31 MBq (8.4 μCi) of uranium, or about 28 times smaller than the 8.9 MBq (240 μCi) bounding condition that is used in this assessment.

There are three primary exposure pathways associated with plant effluent: (1) direct radiation due to deposited radioactivity on the ground surface (ground plane exposure), (2) inhalation of airborne radioactivity in a passing effluent plume, and (3) ingestion of food that was contaminated by plant effluent radioactivity. Of these three exposure pathways, inhalation exposures are expected to be the predominant pathways at site boundary locations and also at offsite locations that are relatively close to the site boundary. The reason for this is that the discharge point for gaseous effluent, roof-top stacks, result in ground level effluent plumes. For ground level plume, the airborne concentration(s) within the plume decrease with the distance from the discharge point. Consequently, for gaseous effluent from the NEF, the highest offsite airborne concentrations (and, hence, the greatest radiological impacts) are expected at locations close to the site boundary. Beyond those locations, the concentrations of airborne radioactive material decreases continually as it is transported because of dispersion and depletion processes. For example, based on a comparison of the atmospheric dispersion factors for a ground level effluent release from the NEF calculated for the site boundary, 769 m (2,522 ft), and for the 1.6-km (1-mi) distance in the west sector, the concentration at the 1.6 km (1.0-mi) distance is approximately 3.6 times lower than at the site boundary. Although radiological impacts via the ingestion exposure pathways come into play for distances beyond the site boundary, the concentrations of radioactive material will have been greatly reduced by the time effluent plumes reach those locations.

The radiological impacts from routine gaseous effluents were estimated for four exposure pathways which included inhalation and immersion in the effluent plume, direct dose from ground plane deposition, and ingestion of food products (stored and fresh vegetables, milk and meat) assumed to be grown or raised at the nearest resident location. For both the inhalation and ingestion exposure pathways, the Exposure-to-Dose conversion factors (DCF) were taken from Federal Guidance Report 11 (EPA, 1988) and were applied for both the committed organ equivalent dose and the committed effective equivalent dose. No assumption on the chemical form of the uranic material deposited in the environment is made due to the extended time that effluents will persist in the open environment and the unknown change in chemical form that might take place over time. As a consequence, the most restrictive clearance class for inhalation and fractional uptake condition for ingestion is assumed (for conservatism) in the selection of dose factors from Federal Guidance Report 11 (EPA, 1988). For ingestion and inhalation pathways, dose equivalent were calculated for seven organs (gonads, breast, lung, red bone marrow, bone surface, thyroid, and a remainder for all other organs) as well as effective dose equivalent.

For direct dose from material deposited on the ground plane or from the passing cloud, the DCF from Federal Guidance Report No. 12 (EPA, 1993a) have been applied. For ground plane exposures, it is assumed that the material deposited from the passing cloud remains on the ground surface as an infinite source plane (i.e., no mixing with any soil depth). This provides the most conservative assumption for direct ground plane exposure. The dose from ground plane deposition was evaluated after 30 years (end of expected license period) to account for the maximum buildup of released activity, including the in-growth of radionuclide progeny from

the primary uranium isotopes that make up the expected release from the plant. This provides the upper bound on any single year of projected plant impacts. For external exposures from plume immersion and ground plane exposure, the skin is added to those organs that were evaluated for internal exposures (inhalation and ingestion).

The dose factors in the Federal Guidance Report (FGR)-11 (EPA, 1988) are derived for adults. In order to estimate the impact to other age groups, the doses calculated to adults were adjusted for difference in food consumption or inhalation rates as taken from NRC Regulatory Guide 1.109 (NRC, 1977c) and then multiplied by the relative age dependent dose factor for the effective dose equivalent as found for the different ages in the International Commission of Radiological Protection (ICRP) Report No. 72 (ICRP, 1995). With respect to the DCF's for adults, the relative ingestion dose commitment multiplier by age group for the four isotopes of uranium of concern averaged 1.0 (adults), 1.5 (teens), 1.8 (children) and 7.5 (infants). For the inhalation pathway, these relative dose commitment multipliers are 1.0 (adult), 1.2 (teens), 2.02 (children) and 4.25 (infants).

The ingestion pathway models for locally grown or raised food products were taken from NRC Regulatory Guide 1.109 (NRC, 1977c). The models projected isotopic concentrations in vegetation, milk and meat products based on the annual quantity of uranium material assumed to be released to the air and the atmospheric dispersion and deposition factors at key receptor locations of interest. These food product concentrations were then used to determine the ingestion committed effective dose equivalent and organ doses by multiplying the individual organ and effective dose conversion factors by the food product concentrations and the annual individual usage factors from the NRC Regulatory Guide 1.109 (NRC, 1977c).

The key receptor locations (critical populations) for determining dose impacts included the nearest public access point to the site boundary with the most restrictive atmospheric dispersion factors as well as boundary locations where direct doses from fixed sources are predicted to be the highest. Also included as key locations of interest are nearby private businesses and the location of the nearest resident. Figure 4.12-1, Nearest Resident, indicates the location of the nearest resident.

The atmospheric dispersion factors used in the radiological impacts assessment were calculated as described in ER Section 4.6, Air Quality Impacts and are provided in Table 4.6-3A, Annual Average Atmospheric Dispersion and Deposition Factors from NWS (1987-1991) Data. The meteorological data was taken from the National Weather Service station for Midland – Odessa, Texas covering the years from 1987 through 1991.

Three groups of individuals (members of the public) or exposure scenarios were evaluated for both potential and real receptors located at or beyond the site boundary. For the first group, the dose impact to the nearest (and highest potentially impacted) residence was evaluated for all exposure pathways (inhalation and plume immersion, direct dose from ground plane deposition, and ingestion of food products which include fresh and stored vegetables, milk and meat postulated to be grown or raised at this location). The analysis included dose equivalent assessments for all four age groups (adults, teens, children and infants) for these pathways. The location of this residence is identified to be approximately 4.3 km (2.63 mi) west of the NEF site in the W sector as measured from the main plant vent systems situated on top of the TSB (see Figures 4.12-1 and 6.1-2). The occupancy time was assumed to be continuous for a full year, along with a residential shielding factor of 0.7 (NRC, 1977c). This location provides for an assessment of doses to real members of the public.

The second group of individuals (critical populations) are those associated with local businesses situated near the plant site in the SE and N-NNW sectors about the plant (see Figure 6.1-2, Modified Site Features With Proposed Sampling Stations and Monitoring Locations). Two locations were evaluated for impact assessment based on the most limiting offsite atmospheric dispersion factors, or where the combination of direct dose from fixed sources and plant effluents would maximize the projected total dose. The location of most limiting dispersion is for a small landfill site situated 0.93 km (0.57 mile) from the TSB in the SE sector. The second business location is a quarry operation located approximately 1.8 km (1.1 mi) in the N-NNW sectors around the NEF. The combination of effluents and direct (including scatter) dose from fixed sources is potentially highest here for actually occupied locations. Since these two locations reflect outdoor businesses, the annual occupancy time is taken as the standard 2,000 hours for work environments. Also, the residential shielding factor of 0.7 was replaced with 1.0 (no shielding credit) since the nature of both operations is mainly outdoor work. In addition, only the inhalation and plume immersion pathways along with direct dose equivalent from ground plane deposition are applied since no food products (gardens or animals) are associated with these types of businesses. As these are work locations, the age group of interest, adults (>17 years), is the only significant group assumed to spend substantial time at these places.

The third group of postulated individuals (critical populations) is associated with transient populations who come right up to the site boundary, and for some reason, stay for the equivalent of a standard work year (2,000 hours). This high occupancy time maximizes the dose impacts for future activity that could be associated with such operations as oil well drilling or mineral extraction from land bordering the site boundary. This also provides an estimate for onsite dose equivalents (NEF occupational dose equivalents) for that portion of the NEF staff whose jobs take them in the general area of the plant property away from the buildings. As with the group of local area businesses noted above, the residential shielding factor is set at 1.0 (no shielding credit) since any activity is assumed to take place outdoors. In addition, only the inhalation and plume immersion pathways along with direct dose equivalent from ground plane deposition are applied (no food product ingestion pathways are expected to exist along the site boundary line). As assumed work locations,, the age group of interest is taken as adults.

Transit time for an accident gaseous release (involving uranic or HF concentrations) would be a few minutes (at boundary) to hours (nearest resident) for the critical populations discussed above. The nearest known location from which a member of the public can obtain aquatic food and/or drinking water is the Wallach Quarry, where transit times for gaseous releases are on the order of tens of minutes. The Wallach Quarry is located in the N-NNW sector approximately 1.8 km (1.1 mi) away. There are no recreational, schools or hospitals within 8 km (5 mi) of the NEF.

4.12.2.1.2 Routine Liquid Effluent

The design of the NEF includes liquid waste processing to concentrate and filter out the majority of uranic materials that are collected as part of liquid waste treatment of various process streams. ER Section 2.1.2, Proposed Action, provides an overview of the liquid waste treatment systems. From an effluent standpoint, the main feature of the liquid waste treatment is that there is no direct liquid effluents discharged offsite. The primary liquid waste effluents that could contain residual uranic waste include (1) decontamination, laboratory and miscellaneous waste streams, (2) hand wash and shower effluents, and (3) laundry effluents. Liquids discharged from these paths are collected and sent to an onsite basin (the Treated Effluent Evaporative Basin) that allows for natural evaporation of the liquid with the residual uranic material left

behind in the bottom of the basin. The waste treatment system's design annual liquid uranic waste discharge to the basin is estimated to be 570 g (1.3 lb) of uranium, or approximately 14.4 MBq (390 μCi) of radioactivity. As with the gaseous waste effluents, the major radionuclides in the liquid waste stream are the four isotopes of uranium, ^{238}U, ^{236}U, ^{235}U and ^{234}U. Of these, ^{238}U and ^{234}U account for about 97% of the total uranic radioactivity and dominate the dose contribution resulting from offsite releases. Similar to the treated liquid waste stream, water from other sources, such as site area rain runoff, are also collected on site in separate collection basins which allow for evaporation instead of liquid discharges across the site boundary.

The Treated Effluent Evaporative Basin employs a dual membrane system to prevent the intrusion of collected wastewater into the ground layers below the basin, thereby limiting the potential for soil and groundwater contamination. A leak detection system is also part of the basin design features to provide early indication of any failure of the basin barriers to restrict liquid effluent waste from entering the soil or groundwater regime below the site. ER Section 3.4.1, Surface Hydrology, also describes the site's groundwater investigations which indicates the depth to the nearest groundwater aquifer (Santa Rosa) is approximately 244 m (800 ft) which is separated from the surface by a thick Chinle clay unit. This aquifer is considered not potable. These site features negate any significant potential that the drinking water exposure pathway could be impacted by routine liquid waste releases.

Since there are no offsite releases to any surface waters or POTW, the remaining release pathway assumed for this evaluation is the airborne resuspension of particulate activity from the bottom of the basin after the waste water evaporates off.

As initial operating parameters, the Treated Effluent Evaporative Basin is assumed to be dry no more than 10% of the time. The resuspension rate is taken as 4.0×10^{-6}/hr based on information from a Department of Energy handbook (DOE, 1994) on various release scenarios of radioactivity to the atmosphere. The selected resuspension rate was taken from a very similar set of conditions to the NEF evaporative basin that addressed large pools of liquids outdoors that deposited uranic waste content into a soil layer that subsequently evaporated with a resulting resuspension of contaminants into the atmosphere. This resuspension rate was applied as a constant over the entire 30-year operating period of liquid waste buildup in the basin. The use of the 4×10^{-6}/hr resuspension rate over this entire period is conservative according to a DOE handbook (DOE, 1994) on various release scenarios of radioactivity to the atmosphere, the resuspension rate was assessed only for freshly deposited contaminants that is not heavily intermingled with the overall soil or waste matrix. A review of resuspension literature (NRC, 1975a) also noted that resuspension factors for deposited material in soils reduces over time as the waste becomes fixed within the soil matrix. This reference (NRC, 1975a) provides an algorithm to correct for this time dependent reduction in the resuspension factor which would reduce the amount of resuspended material from the buildup of solid particles deposited over time. The end of plant license period release rates are thereby limited. For conservatism, no time-dependent reduction in the effective resuspension rate over the 30 years of waste deposits has been applied to the calculated offsite releases to the atmosphere. The actual long-term resuspension rate is a site-specific value that depends on environmental factors such as soil type, duration of dry conditions in the basin, and local weather conditions. The site's radiological monitoring program will include measurements of observed resuspension rates from the Treated Effluent Evaporative Basin over time in order to assess the site specific airborne releases from the basin for both the immediate onsite area around the basin and for offsite releases. This information will provide a basis to determine any specific control means

needed to ensure that the buildup of radioactivity in the basin over time will not cause unexpected airborne levels of radioactive materials.

Since the liquid effluent scenario assumes airborne particle releases from the Treated Effluent Evaporative Basin as the offsite transport mode, the same exposure pathways and receptor locations as evaluated for the gaseous release pathways discussed above were also applied to resuspended particles from dried liquid waste. Dose equivalent impacts to the critical receptors are evaluated for the projected 30th year of operations, thereby evaluating the end buildup of uranic material in the basin. In the assessment of the overall radiological impact, the dose equivalent contribution from resuspended airborne material is added to the gas release assessments for the nearest resident location, nearby businesses and site boundary locations.

4.12.2.1.3 Direct Radiation Impacts

Storage of feed, product and UBCs at the NEF may have an impact due to direct and scatter (sky shine) radiation to the site boundary, and to lesser extents, offsite locations. The UBC Storage Pad is the most significant portion of the total direct dose equivalent.

The direct dose equivalent from the accumulation of 30 years of UBC generation (15,727 cylinders) was calculated with the MCNP4C2 computer code (ORNL, 2000a). The layout of the UBC Storage Pad is shown in Figure 4.12-3, UBC Pad Dose Equivalent Isopleths (2,000 Hours Per Year Occupancy). Included in the total was the expected number of empty feed cylinders (354). These cylinders were included because they contain decaying residual material and produce a higher dose equivalent than full UBCs due to the absence of self-shielding. Direct dose from cylinders stored in the Cylinder Receipt and Dispatch Building (CRDB) was also included in the calculations.

The photon source intensity and spectrum were calculated using the ORIGEN-2 computer code (ORNL, 2000b). The generation of photons in UF_6 from beta particles emitted by the decay of uranium (i.e., Bremsstrahlung) is estimated at 60% of that calculated by ORIGEN-2 for UO_2 due to the higher density of UF_6.

In addition to the photon source term, there is a two-component neutron source term. The first component of the neutron source term is due to spontaneous fission by uranium. For this component a Watt fission spectrum for ^{252}Cf, as taken from the Monte Carlo N-particle (MCNP) manual (Briesmeister, 2000), is assumed. The second component is due to neutron emission by fluorine after alpha particle capture. In these calculations, this neutron source is assigned the spectrum from an ^{241}Am-fluoride neutron source since no information is available on the spectrum from UF_6. As a consequence, conservatism is added to the calculation since the neutrons from UF_6 have a lower maximum energy than those from ^{241}Am-fluoride.

The regulatory dose equivalent limit for areas beyond the NEF fence boundary is 0.25 mSv (25 mrem) per year (including direct and effluent contributions) (including the contribution from cylinders stored in the CRDB to a member of the public (CFR, 2003q; CFR, 2003f). The evaluation of the UBC Storage Pad contribution to the offsite dose equivalent was based on a site design criteria of 0.20 mSv (20 mrem) at the site boundary to account for uncertainties in the calculation and to provide conservatism.

The annual offsite dose equivalent was calculated at the NEF fence line assuming 2,000 hours per year occupancy. Implicit in the use of 2,000 hours is the assumption that the dose

equivalent is to a non-resident (i.e., a worker at an unrelated business). The annual dose equivalents for the actual nearest worksite and at the nearest residence were also calculated.

The dose equivalent at the NEF fence line is 0.189 mSv/yr (18.9 mrem/yr) assuming 2,000 hours per year occupancy. The dose equivalent at the nearest actual worksite NNW, 1.9 km (1.17 mi) is 6.0×10^{-5} mSv/yr (0.006 mrem/yr). The dose equivalent at the nearest actual residence west, 4.3 km (2.63 mi) is 8×10^{-12} mSv/yr (8×10^{-10} mrem/yr). In the latter case, full-time occupancy (i.e., 8,760 hours per year) is assumed. Figure 4.12-3, UBC Pad Dose Equivalent Isopleths (2,000 Hours per Year Occupancy) shows the dose equivalent contours for the summed contributions from the UBC Storage Pad and the CRDB for 2,000 hours/year occupancy. Figure 4.12-4, UBC Pad Dose Equivalent Isopleths (8,760 Hours per Year Occupancy), indicates the dose equivalent contours assuming full-time occupancy. Table 4.12-1, Direct Radiation Annual Dose Equivalent by Source, summarizes the annual dose equivalents by source (UBC Storage Pad and CRDB) at different locations.

4.12.2.1.4 Population Dose Equivalents

The local area population distribution was derived from U.S. Census Bureau 2000 data for counties in New Mexico and Texas (DOC, 2000a; DOC, 2000b; DOC, 2000c; DOC, 2000d) that fall all or in part of a 80-km (50-mi) radius of the NEF site. A standard 16-sector compass rose was centered on the NEF site and divided into annular rings at selected distances. Population counts from census data that located significant population groups for towns or cities within the 80-km (50-mi) area were then distributed into those sectors that covered the groupings. After accounting for these significant population locations, the balance of the population for the different counties persons per square kilometer (square mile) was distributed by equal area allocation based on the land area in the sector. For the first 8 km (5 mi), site area observations provided information on the nearest resident within 8 km (5 mi) in all sectors, which indicated that most of the 16 sectors had no resident population near the site. The resulting population for the 2000 is shown on Table 4.12-2, Population Data for the Year 2000. Census data for the year 2000 also provided information on the breakdown of the seven counties within 80 km (50 mi) by age (DOC, 2000d). From this data, age groups as a fraction of the total population were determined for infants under one year of age (1.54%), children ages 1-11 (17.90%), teens ages 12 –17 (10.93%) and adults ages greater than 17 (69.64%). This breakdown was applied to the total population distribution for all exposure pathways including the determination of annual committed dose equivalent from ingestion and inhalation where age also affects the amount of annual intake (air and food).

The collective dose equivalent from gaseous effluents from the Separations Building GEVS, the TSB GEVS and the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System, along with resuspended airborne particles from dried liquid waste deposits on the bottom of the Treated Effluent Evaporative Basin (assuming 30-years of buildup of waste inventory) are calculated for the 80-km (50-mi) population based on all pathways calculated for the nearest resident applying to the general population. For the ingestion of food products, it was assumed that the area produced sufficient volume to supply the entire population with their needs. Annual average usage factors for the general population (NRC, 1977c) were used as the individual consumption rates. Individual total effective dose equivalents were calculated for each age group by sector and then multiplied by the estimated age-dependent population for that sector to get the collective dose equivalent. The collective dose equivalents for each age group were then added to provide the total population collective dose equivalents. Table 4.12-3,

Collective Dose Equivalents to All Ages Population (Person-Seiverts) and Table 4.12-4, Collective Dose Equivalents to All Ages Population (Person-rem) indicate the total collective dose for the entire population within the 80-km (50-mi) radius of the NEF site in units of Person-Sieverts and Person-rem, respectively.

4.12.2.1.5 Mitigation Measures

Although routine operations at the NEF create the potential for radiological and nonradiological impacts on the environment and members of the public, plant design has incorporated features to minimize gaseous and liquid effluent releases and to keep them well below regulatory limits. These features include:

- Process systems that handle UF_6 operate at sub-atmospheric pressure, which minimizes outward leakage of UF_6.
- UF_6 cylinders are moved only when cool and when UF_6 is in solid form, which minimizes the risk of inadvertent release due to mishandling.
- Process off-gas from UF_6 purification and other operations passes through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases pass through high-efficiency filters and chemical absorbers, which remove HF and uranium compounds.
- Waste generated by decontamination of equipment and systems are subjected to processes that separate uranium compounds and various other heavy metals in the waste material.
- Liquid and solid waste handling systems and techniques are used to control wastes and effluent concentrations.
- Gaseous effluent passes through prefilters, HEPA filters, and activated carbon filters, all of which greatly reduce the radioactivity in the final discharged effluent to very low concentrations.
- Liquid waste is routed to collection tanks, and treated through a combination of precipitation, evaporation, and ion exchange to remove most of the radioactivity prior to release of the onsite Treated Effluent Evaporative Basin.
- Effluent paths are monitored and sampled to assure compliance with regulatory discharge limits.

Under routine operations, the potential that radioactivity from the UBC Storage Pad may impact the public is low because the UBCs are surveyed for external contamination before they are placed on the storage pad. Therefore, rainfall runoff from the pad is not expected to be a significant exposure pathway. Runoff water from the UBC Storage Pad is directed from the UBC Storage Pad to an onsite retention basin for evaporation of the collected water. Periodic sampling of the soil from the basin is performed to identify accumulation or buildup of any residual UBC surface contamination washed off by rainwater to the basin (see ER Section 6.1, Radiological Monitoring). No liquids from the retention basin are discharged directly offsite. In addition, direct radiation from the UBC Storage Pad is monitored on a quarterly basis using thermo-luminescent dosimeters (TLDs) and pressurized ion chamber measurements.

4.12.2.2 Public and Occupational Exposure Impacts

The assessment of the dose impacts resulting from the annual liquid and gaseous effluents for the NEF site indicate that the principal radionuclides with respect to the dose equivalent contribution to individuals are ^{234}U and ^{238}U. Each of these nuclides contributes about the same level of committed dose. The critical organ for all receptor locations was found to be the lung as a result of the pathway. This committed dose equivalent dominated all other exposure pathways by a few orders of magnitude.

For gaseous effluents, the location of highest calculated offsite dose is the South site boundary with an annual effective dose equivalent of $1.7x10^{-4}$ mSv ($1.7x10^{-2}$ mrem), with a maximum annual organ (lung) committed dose of $1.4x10^{-3}$ mSv ($1.5x10^{-2}$ mrem). The nearest resident location had maximum annual effective dose equivalents of (teenager) $1.7x10^{-5}$ mSv ($1.7x10^{-3}$ mrem), or about a factor of 10 lower than the site boundary. The maximum annual organ (lung) at the nearest resident was estimated to be $1.3x10^{-4}$ mSv ($1.2x10^{-2}$ mrem) and was to the teenager age group. The nearest business, which exhibited the highest calculated annual effective dose equivalent, was at a location southeast, approximately 925 m (0.57 mi) from the TSB release point. The annual effective dose equivalent for this location from liquid releases is $2.8x10^{-5}$ mSv ($2.8x10^{-3}$ mrem). The maximum organ (lung) committed dose for this receptor was estimated at $2.3x10^{-4}$ mSv ($2.3x10^{-2}$ mrem) from one year's exposure and intake. Tables 4.12-5 through 4.12-7 provide a breakdown of organ and effective doses by exposure pathway for gaseous effluents.

For liquid effluents which result in resuspended airborne particles from the dry out of the Treated Effluent Evaporative Basin, the location of highest calculated offsite dose is also the south site boundary with an annual effective dose equivalent of $1.7x10^{-5}$ mSv ($1.7x10^{-3}$ mrem), with a maximum annual organ (lung) committed dose of $1.5x10^{-4}$ mSv ($1.5x10^{-2}$ mrem). The nearest resident location had maximum annual effective dose equivalents of (teenager) $1.7x10^{-6}$ mSv ($1.7x10^{-4}$ mrem), or about a factor of 10 lower that the site boundary liquid pathway doses, and about a factor of 10 below the equivalent gaseous dose impacts at the same local. The liquid impact assessments assumed that the evaporative basin was dry only 10% of the year, thereby limiting the dose impact. Even if the evaporative basin were assumed to be dry for a full year, the increase in the resuspended material into the air would increase the liquid pathway dose by a factor of 10, making it about the same impact as the gaseous pathway contribution to the total offsite dose. However, even with this assumed ten-fold increase in annual release, the resulting dose would still be well below all regulatory limits. The maximum annual organ (lung) dose equivalent at the nearest resident from liquid effluents was estimated to be $1.3x10^{-5}$ mSv ($1.3x10^{-3}$ mrem) and was to the teenager age group. The nearest business, which exhibited the highest calculated annual effective dose equivalent, was also the southeast location, approximately 925 m (0.57 mi) from the TSB release point. The estimated annual effective dose equivalent for this location from liquid releases is $2.9x10^{-6}$ mSv ($2.9x10^{-4}$ mrem). The maximum organ (lung) committed dose for this receptor was estimated at $2.4x10^{-5}$ mSv ($2.4x10^{-3}$ mrem) from one year's exposure and intake. Tables 4.12-8 through 4.12-10 provide a breakdown of organ and effective doses by exposure pathway for the liquid effluent contribution to the offsite dose.

The combination of both liquid and gaseous related annual effluent dose impacts are summarized in Table 4.12-11, Maximum Annual Liquid and Gas Radiological Impacts.

As can be seen on Table 4.12-12, Annual Effective Total Dose Equivalent (All Sources), the dominant source of offsite radiation exposure is from direct (and scatter) radiation from the UBC Storage Pad (fixed source). The maximum annual dose equivalent was found along the north site boundary with an estimated impact of 0.188 mSv /year (18.8 mrem/year). Table 4.12-12 provides the combined impact from liquid, gases and fixed radiation sources and illustrates that the annual total effective dose equivalent (TEDE) at the maximum exposure point is estimated to be 0.19 mSv (19 mrem) assuming a full UBC Storage Pad. The calculated dose equivalents are all below the 1 mSv (100 mrem/yr) TEDE requirement per 10 CFR 20.1301 (CFR, 2003q), and also within the 0.25 mSv (25 mrem/yr) dose equivalent to the whole body and any organ as indicated in 40 CFR 190 (CFR, 2003f). It is therefore concluded that the operation of the NEF will not exceed the dose equivalent criteria for members of the public as stipulated in Federal regulations.

Table 4.12-3, Collective Dose Equivalents to All Ages Population (Person-Sieverts) and Table 4.12-4, Collective Dose Equivalents to All Ages Population (Person-rem) provide the estimated collective effective dose equivalent to the 80-km (50-mi) population (all age and exposure pathways). The estimated dose is 5.2×10^{-5} Person-Sv (5.2×10^{-3} Person-rem). This is a small fraction of the collective dose from natural background for the same population.

In addition to members of the public along the site boundary and beyond, estimates of annual facility area radiation dose rates have been made along with projections of occupational (NEF worker) personnel exposures during normal operations. Table 4.12-13, Estimated NEF Occupational Dose Equivalent Rates and Table 4.12-14, Estimated NEF Occupational (Individual) Exposures summarize the annual dose equivalent rates and projected dose impact for different areas and compounds (i.e., cylinders) of the plant, and for different work functions for employees. Section 4.1 of the NEF Safety Analysis Report (SAR) provides a detailed description of the NEF radiation protection program for controlling and limiting occupational exposures for plant workers.

4.12.3 Environmental Effects of Accidents

4.12.3.1 Accident Scenarios

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4.12.4 Comparative Public and Occupational Exposure Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action" i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The public and occupational exposure impact would be greater because of greater effluents and operational exposure associated with GDP operation.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The public and occupational exposure impact would be greater in the short term due to more effluents and operational exposure associated with GDP operation. In the long term, the public and occupational exposure would be the same or greater.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The public and occupational exposure impact would be significantly greater since a significant amount of additional effluent and exposure results from operation of the GDP at the increased capacity.

TABLES

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Table 4.12-1 Direct Radiation Annual Dose Equivalent by Source

Location	Annual Occupancy (hours/year)	UBC Storage Pad mSv/yr (mrem/yr)	CRDB mSv/yr (mrem/yr)	Total mSv/yr (mrem/yr)
Site Fence, North* 435 m (1,427 ft)	2,000	0.188 (18.8)	0.001 (0.1)	0.19 (19.0)
Site Fence East* 376 m (1,235 ft)	2,000	0.188 (11.8)	0.003 (0.3)	0.121 (12.1)
Nearest Actual Business, NNW 1.9 km (1.17 mi)**	2,000	$6.0x10^{-5}$ ($6.0x10^{-3}$)	$2.0x10^{-10}$ ($2.0x10^{-8}$)	$6.0x10^{-5}$ ($6.0x10^{-3}$)
Nearest Actual Residence, West 4.3 km (2.63 mi)**	8,760	$8.0x10^{-12}$ ($8.0x10^{-10}$)	$9.0x10^{-20}$ ($9.0x10^{-18}$)	$8.0x10^{-12}$ ($8.0x10^{-10}$)

* Distance from the closest edge of the pad.

**Distance from the center of the site.

Table 4.12-2 Population Data for the Year 2000
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Population (All Ages) Distribution (2000 Census) Within
80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	43	171	275	370	476	1,336
NNE	0	0	0	0	0	61	243	405	568	4,404	5,681
NE	0	0	0	0	0	61	243	405	3,523	3,064	7,296
ENE	0	0	0	0	0	61	188	405	3,523	730	4,906
E	0	0	0	0	0	33	132	220	308	396	1,089
ESE	0	0	0	0	0	33	132	220	9,960	396	10,741
SE	0	0	0	0	0	33	132	220	1,937	7,084	9,406
SSE	0	0	0	0	0	33	132	157	1,321	2,836	4,479
S	0	0	0	0	0	43	171	286	88	6,746	7,334
SSW	0	0	0	0	0	43	171	2,282	167	56	2,719
SW	0	0	0	0	0	43	171	286	400	266	1,166
WSW	0	0	11	6	0	43	171	286	400	537	1,454
W	0	0	11	52	1,286	1,324	171	286	400	537	4,067
WNW	0	0	0	0	0	43	171	286	400	520	1,420

Table 4.12-2 Population Data for the Year 2000

Population (All Ages) Distribution (2000 Census) Within
80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
NW	0	0	0	0	0	43	171	286	400	514	1,414
NNW	0	0	0	0	0	43	7,335	7,450	9,871	514	25,213
Ring Totals=	0	0	22	58	1,286	1,981	9,909	13,754	33,635	29,075	89,720
Cum. Totals =	0	0	22	80	1,366	3,347	13,256	27,009	60,644	89,720	

Table 4.12-3 Collective Dose Equivalents to All Ages Population (Person-Sieverts)

(liquid and gas release pathways)

Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-Sievert)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0.0	0.0	0.0	0.0	0.0	3.3E-07	4.4E-07	3.1E-07	2.5E-07	2.1E-07	1.5E-06
NNE	0.0	0.0	0.0	0.0	0.0	2.3E-07	3.1E-07	2.3E-07	1.9E-07	9.9E-07	2.0E-06
NE	0.0	0.0	0.0	0.0	0.0	1.4E-07	1.8E-07	1.4E-07	7.0E-07	4.0E-07	1.6E-06
ENE	0.0	0.0	0.0	0.0	0.0	1.3E-07	1.3E-07	1.3E-07	6.6E-07	9.1E-08	1.1E-06
E	0.0	0.0	0.0	0.0	0.0	7.5E-08	1.0E-07	7.7E-08	6.3E-08	5.4E-08	3.7E-07
ESE	0.0	0.0	0.0	0.0	0.0	6.3E-08	8.7E-08	6.6E-08	1.7E-06	4.6E-08	2.0E-06
SE	0.0	0.0	0.0	0.0	0.0	7.4E-08	1.0E-07	7.7E-08	4.0E-07	9.7E-07	1.6E-06
SSE	0.0	0.0	0.0	0.0	0.0	7.6E-08	1.0E-07	5.6E-08	2.8E-07	3.9E-07	9.0E-07
S	0.0	0.0	0.0	0.0	0.0	1.5E-07	2.0E-07	1.5E-07	2.7E-08	1.4E-06	1.9E-06
SSW	0.0	0.0	0.0	0.0	0.0	6.9E-08	9.3E-08	5.5E-07	2.3E-08	5.1E-09	7.4E-07
SW	0.0	0.0	0.0	0.0	0.0	7.3E-08	9.7E-08	7.1E-08	5.8E-08	2.5E-08	3.2E-07
WSW	0.0	0.0	1.0E-07	3.2E-08	0.0	6.9E-08	9.1E-08	6.7E-08	5.4E-08	4.8E-08	4.6E-07

(liquid and gas release pathways)

Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-Sievert)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
W	0.0	0.0	1.7E-07	4.6E-07	7.7E-06	3.5E-06	1.5E-07	1.1E-07	9.3E-08	8.3E-08	1.2E-05
WNW	0.0	0.0	0.0	0.0	0.0	9.8E-08	1.3E-07	9.8E-08	7.9E-08	6.8E-08	4.8E-07
NW	0.0	0.0	0.0	0.0	0.0	1.4E-07	2.0E-07	1.5E-07	1.2E-07	1.0E-07	7.1E-07
NNW	0.0	0.0	0.0	0.0	0.0	2.2E-07	1.3E-05	5.9E-06	4.6E-06	1.6E-07	2.4E-05
Ring Totals=	0	0	2.7E-07	5.0E-07	7.7E-06	5.5E-06	1.5E-05	8.2E-06	9.3E-06	5.0E-06	5.2E-05
Cum. Totals =	0	0	2.7E-07	7.6E-07	8.4E-06	1.4E-05	2.9E-05	3.8E-05	4.7E-05	5.2E-05	

Table 4.12-4 Collective Dose Equivalents to All Ages Population (Person-rem)
Page 1 of 2

(liquid and gas release pathways)

Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-rem)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0.0	0.0	0.0	0.0	0.0	3.3E-05	4.4E-05	3.1E-05	2.5E-05	2.1E-05	1.5E-04
NNE	0.0	0.0	0.0	0.0	0.0	2.3E-05	3.1E-05	2.3E-05	1.9E-05	9.9E-05	2.0E-04
NE	0.0	0.0	0.0	0.0	0.0	1.4E-05	1.8E-05	1.4E-05	7.0E-05	4.0E-05	1.6E-04
ENE	0.0	0.0	0.0	0.0	0.0	1.3E-05	1.3E-05	1.3E-05	6.6E-05	9.1E-06	1.1E-04
E	0.0	0.0	0.0	0.0	0.0	7.5E-06	1.0E-05	7.7E-06	6.3E-06	5.4E-06	3.7E-05
ESE	0.0	0.0	0.0	0.0	0.0	6.3E-06	8.7E-06	6.6E-06	1.7E-04	4.6E-06	2.0E-04
SE	0.0	0.0	0.0	0.0	0.0	7.4E-06	1.0E-05	7.7E-06	4.0E-05	9.7E-05	1.6E-04
SSE	0.0	0.0	0.0	0.0	0.0	7.6E-06	1.0E-05	5.6E-06	2.8E-05	3.9E-05	9.0E-05
S	0.0	0.0	0.0	0.0	0.0	1.5E-05	2.0E-05	1.5E-05	2.7E-06	1.4E-04	1.9E-04
SSW	0.0	0.0	0.0	0.0	0.0	6.9E-06	9.3E-06	5.5E-05	2.3E-06	5.1E-07	7.4E-05
SW	0.0	0.0	0.0	0.0	0.0	7.3E-06	9.7E-06	7.1E-06	5.8E-06	2.5E-06	3.2E-05
WSW	0.0	0.0	1.0E-05	3.2E-06	0.0	6.9E-06	9.1E-06	6.7E-06	5.4E-06	4.8E-06	4.6E-05

Table 4.12-4 Collective Dose Equivalents to All Ages Population (Person-Rem)

(liquid and gas release pathways)

Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-rem)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
W	0.0	0.0	1.7E-05	4.6E-05	7.7E-04	3.5E-04	1.5E-05	1.1E-05	9.3E-06	8.3E-06	1.2E-03
WNW	0.0	0.0	0.0	0.0	0.0	9.8E-06	1.3E-05	9.8E-06	7.9E-06	6.8E-06	4.8E-05
NW	0.0	0.0	0.0	0.0	0.0	1.4E-05	2.0E-05	1.5E-05	1.2E-05	1.0E-05	7.1E-05
NNW	0.0	0.0	0.0	0.0	0.0	2.2E-05	1.3E-03	5.9E-04	4.6E-04	1.6E-05	2.4E-03
Ring Totals=	0	0	2.7E-05	5.0E-05	7.7E-04	5.5E-04	1.5E-03	8.2E-04	9.3E-04	5.0E-04	5.2E-03
Cum. Totals =	0	0	2.7E-05	7.6E-05	8.4E-04	1.4E-03	2.9E-03	3.8E-03	4.7E-03	5.2E-03	

Table 4.12-5A Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult from Gaseous Effluent (Nearest Resident)

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Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.3E-13	1.6E-13	1.9E-13	1.5E-13	1.4E-13	4.2E-13	1.6E-13	1.5E-13	1.7E-13
	(mrem)	2.3E-11	1.6E-11	1.9E-11	1.5E-11	1.4E-11	4.2E-11	1.6E-11	1.5E-11	1.7E-11
Inhalation	(mSv)	0.0E+00	9.2E-10	1.0E-09	1.0E-04	2.5E-08	3.9E-07	9.8E-10	3.7E-08	1.2E-05
	(mrem)	0.0E+00	9.2E-08	1.0E-07	1.0E-02	2.5E-06	3.9E-05	9.8E-08	3.7E-06	1.2E-03
Grd. Plane direct	(mSv)	1.9E-05	7.7E-08	7.8E-08	6.2E-08	6.1E-08	1.5E-07	6.5E-08	6.2E-08	7.1E-08
	(mrem)	1.9E-03	7.7E-06	7.8E-06	6.2E-06	6.1E-06	1.5E-05	6.5E-06	6.2E-06	7.1E-06
Ingestion	(mSv)	0.0E+00	4.1E-08	4.1E-08	4.1E-08	1.2E-06	1.8E-05	4.1E-08	1.7E-06	1.2E-06
	(mrem)	0.0E+00	4.1E-06	4.1E-06	4.1E-06	1.2E-04	1.8E-03	4.1E-06	1.7E-04	1.2E-04
Sum Total	(mSv)	1.9E-05	1.2E-07	1.2E-07	1.0E-04	1.3E-06	1.9E-05	1.1E-07	1.8E-06	1.4E-05
	(mrem)	1.9E-03	1.2E-05	1.2E-05	1.0E-02	1.3E-04	1.9E-03	1.1E-05	1.8E-04	1.4E-03

Table 4.12-5B Annual and Committed Dose Equivalents for Exposures in Year 30 to an Teen from Gaseous Effluents (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.3E-13	1.6E-13	1.9E-13	1.5E-13	1.4E-13	4.2E-13	1.6E-13	1.5E-13	1.7E-13
	(mrem)	2.3E-11	1.6E-11	1.9E-11	1.5E-11	1.4E-11	4.2E-11	1.6E-11	1.5E-11	1.7E-11
Inhalation	(mSv)	0.0E+00	1.1E-09	1.2E-09	1.2E-04	3.1E-08	4.6E-07	1.2E-09	4.4E-08	1.5E-05
	(mrem)	0.0E+00	1.1E-07	1.2E-07	1.2E-02	3.1E-06	4.6E-05	1.2E-07	4.4E-06	1.5E-03
Grd. Plane direct	(mSv)	1.9E-05	7.7E-08	7.8E-08	6.2E-08	6.1E-08	1.5E-07	6.5E-08	6.2E-08	7.1E-08
	(mrem)	1.9E-03	7.7E-06	7.8E-06	6.2E-06	6.1E-06	1.5E-05	6.5E-06	6.2E-06	7.1E-06
Ingestion	(mSv)	0.0E+00	7.1E-08	7.0E-08	7.0E-08	2.0E-06	3.1E-05	7.0E-08	3.0E-06	2.1E-06
	(mrem)	0.0E+00	7.1E-06	7.0E-06	7.0E-06	2.0E-04	3.1E-03	7.0E-06	3.0E-04	2.1E-04
Sum Total	(mSv)	1.9E-05	1.5E-07	1.5E-07	1.2E-04	2.1E-06	3.1E-05	1.4E-07	3.1E-06	1.7E-05
	(mrem)	1.9E-03	1.5E-05	1.5E-05	1.2E-02	2.1E-04	3.1E-03	1.4E-05	3.1E-04	1.7E-03

Table 4.12-5C Annual and Committed Dose Equivalents for Exposures in Year 30 to an Child from Gaseous Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.3E-13	1.6E-13	1.9E-13	1.5E-13	1.4E-13	4.2E-13	1.6E-13	1.5E-13	1.7E-13
	(mrem)	2.3E-11	1.6E-11	1.9E-11	1.5E-11	1.4E-11	4.2E-11	1.6E-11	1.5E-11	1.7E-11
Inhalation	(mSv)	0.0E+00	8.6E-10	9.6E-10	9.5E-05	2.4E-08	3.6E-07	9.2E-10	3.4E-08	1.1E-05
	(mrem)	0.0E+00	8.6E-08	9.6E-08	9.5E-03	2.4E-06	3.6E-05	9.2E-08	3.4E-06	1.1E-03
Grd. Plane direct	(mSv)	1.9E-05	7.7E-08	7.8E-08	6.2E-08	6.1E-08	1.5E-07	6.5E-08	6.2E-08	7.1E-08
	(mrem)	1.9E-03	7.7E-06	7.8E-06	6.2E-06	6.1E-06	1.5E-05	6.5E-06	6.2E-06	7.1E-06
Ingestion	(mSv)	0.0E+00	6.8E-08	6.8E-08	6.8E-08	1.9E-06	3.0E-05	6.8E-08	2.9E-06	2.0E-06
	(mrem)	0.0E+00	6.8E-06	6.8E-06	6.8E-06	1.9E-04	3.0E-03	6.8E-06	2.9E-04	2.0E-04
Sum Total	(mSv)	1.9E-05	1.5E-07	1.5E-07	9.5E-05	2.0E-06	3.0E-05	1.3E-07	2.9E-06	1.4E-05
	(mrem)	1.9E-03	1.5E-05	1.5E-05	9.5E-03	2.0E-04	3.0E-03	1.3E-05	2.9E-04	1.4E-03

Table 4.12-5D Annual and Committed Dose Equivalents for Exposures in Year 30 to an Infant from Gaseous Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.3E-13	1.6E-13	1.9E-13	1.5E-13	1.4E-13	4.2E-13	1.6E-13	1.5E-13	1.7E-13
	(mrem)	2.3E-11	1.6E-11	1.9E-11	1.5E-11	1.4E-11	4.2E-11	1.6E-11	1.5E-11	1.7E-11
Inhalation	(mSv)	0.0E+00	6.8E-10	7.7E-10	7.6E-05	1.9E-08	2.9E-07	7.3E-10	2.7E-08	9.1E-06
	(mrem)	0.0E+00	6.8E-08	7.7E-08	7.6E-03	1.9E-06	2.9E-05	7.3E-08	2.7E-06	9.1E-04
Grd. Plane direct	(mSv)	1.9E-05	7.7E-08	7.8E-08	6.2E-08	6.1E-08	1.5E-07	6.5E-08	6.2E-08	7.1E-08
	(mrem)	1.9E-03	7.7E-06	7.8E-06	6.2E-06	6.1E-06	1.5E-05	6.5E-06	6.2E-06	7.1E-06
Ingestion	(mSv)	0.0E+00	1.2E-08	1.2E-08	1.2E-08	3.5E-07	5.3E-06	1.2E-08	5.1E-07	3.6E-07
	(mrem)	0.0E+00	1.2E-06	1.2E-06	1.2E-06	3.5E-05	5.3E-04	1.2E-06	5.1E-05	3.6E-05
Sum Total	(mSv)	1.9E-05	9.0E-08	9.1E-08	7.6E-05	4.3E-07	5.7E-06	7.8E-08	6.0E-07	9.5E-06
	(mrem)	1.9E-03	9.0E-06	9.1E-06	7.6E-03	4.3E-05	5.7E-04	7.8E-06	6.0E-05	9.5E-04

Table 4.12-6A Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult From Gaseous Effluent (Nearby Businesses)

Location: Nearby Business – SE, 925 m (3,035 ft)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	7.4E-13	5.3E-13	6.3E-13	5.0E-13	4.6E-13	1.4E-12	5.3E-13	4.7E-13	5.4E-13
	(mrem)	7.4E-11	5.3E-11	6.3E-11	5.0E-11	4.6E-11	1.4E-10	5.3E-11	4.7E-11	5.4E-11
Inhalation	(mSv)	0.0E+00	2.1E-09	2.4E-09	2.3E-04	5.8E-08	8.8E-07	2.2E-09	8.3E-08	2.8E-05
	(mrem)	0.0E+00	2.1E-07	2.4E-07	2.3E-02	5.8E-06	8.8E-05	2.2E-07	8.3E-06	2.8E-03
Grd. Plane direct	(mSv)	3.6E-05	1.5E-07	1.5E-07	1.2E-07	1.2E-07	2.8E-07	1.2E-07	1.2E-07	1.3E-07
	(mrem)	3.6E-03	1.5E-05	1.5E-05	1.2E-05	1.2E-05	2.8E-05	1.2E-05	1.2E-05	1.3E-05
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	3.6E-05	1.5E-07	1.5E-07	2.3E-04	1.7E-07	1.2E-06	1.3E-07	2.0E-07	2.8E-05
	(mrem)	3.6E-03	1.5E-05	1.5E-05	2.3E-02	1.7E-05	1.2E-04	1.3E-05	2.0E-05	2.8E-03

Table 4.12-6B Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult From Gaseous Effluent (Nearby Businesses)

Location: Nearby Business – NNW, 1,712 m (5,617 ft)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	6.0E-13	4.3E-13	5.1E-13	4.1E-13	3.7E-13	1.1E-12	4.3E-13	3.9E-13	4.4E-13
	(mrem)	6.0E-11	4.3E-11	5.1E-11	4.1E-11	3.7E-11	1.1E-10	4.3E-11	3.9E-11	4.4E-11
Inhalation	(mSv)	0.0E+00	1.7E-09	1.9E-09	1.9E-04	4.7E-08	7.2E-07	1.8E-09	6.8E-08	2.3E-05
	(mrem)	0.0E+00	1.7E-07	1.9E-07	1.9E-02	4.7E-06	7.2E-05	1.8E-07	6.8E-06	2.3E-03
Grd. Plane direct	(mSv)	5.2E-05	2.1E-07	2.1E-07	1.7E-07	1.7E-07	4.1E-07	1.8E-07	1.7E-07	1.9E-07
	(mrem)	5.2E-03	2.1E-05	2.1E-05	1.7E-05	1.7E-05	4.1E-05	1.8E-05	1.7E-05	1.9E-05
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	5.2E-05	2.1E-07	2.1E-07	1.9E-04	2.1E-07	1.1E-06	1.8E-07	2.4E-07	2.3E-05
	(mrem)	5.2E-03	2.1E-05	2.1E-05	1.9E-02	2.1E-05	1.1E-04	1.8E-05	2.4E-05	2.3E-03

Table 4.12-7A Annual and Committed Dose Equivalents for Exposure in Year 30 to an Adult From Gaseous Effluent (Site Boundary)

Location: Maximum Site Boundary – South, 417 m (1,368 ft)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	4.5E-12	3.2E-12	3.8E-12	3.0E-12	2.7E-12	8.3E-12	3.2E-12	2.8E-12	3.3E-12
	(mrem)	4.5E-10	3.2E-10	3.8E-10	3.0E-10	2.7E-10	8.3E-10	3.2E-10	2.8E-10	3.3E-10
Inhalation	(mSv)	0.0E+00	1.3E-08	1.4E-08	1.4E-03	3.5E-07	5.3E-06	1.3E-08	5.0E-07	1.7E-04
	(mrem)	0.0E+00	1.3E-06	1.4E-06	1.4E-01	3.5E-05	5.3E-04	1.3E-06	5.0E-05	1.7E-02
Grd. Plane direct	(mSv)	2.7E-04	1.1E-06	1.1E-06	8.8E-07	8.6E-07	2.1E-06	9.1E-07	8.7E-07	1.0E-06
	(mrem)	2.7E-02	1.1E-04	1.1E-04	8.8E-05	8.6E-05	2.1E-04	9.1E-05	8.7E-05	1.0E-04
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	2.7E-04	1.1E-06	1.1E-06	1.4E-03	1.2E-06	7.4E-06	9.2E-07	1.4E-06	1.7E-04
	(mrem)	2.7E-02	1.1E-04	1.1E-04	1.4E-01	1.2E-04	7.4E-04	9.2E-05	1.4E-04	1.7E-02

Table 4.12-7B Annual and Committed Dose Equivalents for Exposure in Year 30 to an Adult From Gaseous Effluent (Site Boundary)

Location: Maximum Site Boundary – North, 995 m (3,265 ft) Side Next to UBC Storage Pad)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.3E-12	1.7E-12	2.0E-12	1.6E-12	1.4E-12	4.3E-12	1.7E-12	1.5E-12	1.7E-12
	(mrem)	2.3E-10	1.7E-10	2.0E-10	1.6E-10	1.4E-10	4.3E-10	1.7E-10	1.5E-10	1.7E-10
Inhalation	(mSv)	0.0E+00	6.5E-09	7.4E-09	7.3E-04	1.8E-07	2.8E-06	7.0E-09	2.6E-07	8.7E-05
	(mrem)	0.0E+00	6.5E-07	7.4E-07	7.3E-02	1.8E-05	2.8E-04	7.0E-07	2.6E-05	8.7E-03
Grd. Plane direct	(mSv)	2.4E-04	9.7E-07	9.8E-07	7.9E-07	7.8E-07	1.9E-06	8.2E-07	7.9E-07	9.0E-07
	(mrem)	2.4E-02	9.7E-05	9.8E-05	7.9E-05	7.8E-05	1.9E-04	8.2E-05	7.9E-05	9.0E-05
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	2.4E-04	9.8E-07	9.9E-07	7.3E-04	9.6E-07	4.6E-06	8.3E-07	1.0E-06	8.8E-05
	(mrem)	2.4E-02	9.8E-05	9.9E-05	7.3E-02	9.6E-05	4.6E-04	8.3E-05	1.0E-04	8.8E-03

Table 4.12-8A Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult From Liquid Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.8E-12	7.7E-14	8.9E-14	7.3E-14	6.7E-14	1.8E-13	7.6E-14	6.9E-14	7.8E-14
	(mrem)	2.8E-10	7.7E-12	8.9E-12	7.3E-12	6.7E-12	1.8E-11	7.6E-12	6.9E-12	7.8E-12
Inhalation	(mSv)	0.0E+00	9.6E-11	1.1E-10	1.1E-05	2.7E-09	4.0E-08	1.0E-10	3.9E-12	1.3E-06
	(mrem)	0.0E+00	9.6E-09	1.1E-08	1.1E-03	2.7E-07	4.0E-06	1.0E-08	3.9E-10	1.3E-04
Grd. Plane direct	(mSv)	1.2E-06	4.7E-09	4.7E-09	3.8E-09	3.7E-09	9.1E-09	3.9E-09	3.8E-12	4.3E-09
	(mrem)	1.2E-04	4.7E-07	4.7E-07	3.8E-07	3.7E-07	9.1E-07	3.9E-07	3.8E-10	4.3E-07
Ingestion	(mSv)	0.0E+00	4.2E-09	4.2E-09	4.2E-09	1.2E-07	1.8E-06	4.2E-09	1.8E-07	1.3E-07
	(mrem)	0.0E+00	4.2E-07	4.2E-07	4.2E-07	1.2E-05	1.8E-04	4.2E-07	1.8E-05	1.3E-05
Sum Total	(mSv)	1.2E-06	9.0E-09	9.0E-09	1.1E-05	1.3E-07	1.9E-06	8.2E-09	1.8E-07	1.4E-06
	(mrem)	1.2E-04	9.0E-07	9.0E-07	1.1E-03	1.3E-05	1.9E-04	8.2E-07	1.8E-05	1.4E-04

Table 4.12-8B Annual and Committed Dose Equivalents for Exposures in Year 30 to a Teen From Liquid Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.8E-12	7.7E-14	8.9E-14	7.3E-14	6.7E-14	1.8E-13	7.6E-14	6.9E-14	7.8E-14
	(mrem)	2.8E-10	7.7E-12	8.9E-12	7.3E-12	6.7E-12	1.8E-11	7.6E-12	6.9E-12	7.8E-12
Inhalation	(mSv)	0.0E+00	1.2E-10	1.3E-10	1.3E-05	3.2E-09	4.8E-08	1.2E-10	4.7E-12	1.5E-06
	(mrem)	0.0E+00	1.2E-08	1.3E-08	1.3E-03	3.2E-07	4.8E-06	1.2E-08	4.7E-10	1.5E-04
Grd. Plane direct	(mSv)	1.2E-06	4.7E-09	4.7E-09	3.8E-09	3.7E-09	9.1E-09	3.9E-09	3.8E-12	4.3E-09
	(mrem)	1.2E-04	4.7E-07	4.7E-07	3.8E-07	3.7E-07	9.1E-07	3.9E-07	3.8E-10	4.3E-07
Ingestion	(mSv)	0.0E+00	7.2E-09	7.2E-09	7.2E-09	2.1E-07	3.1E-06	7.2E-09	3.0E-07	2.1E-07
	(mrem)	0.0E+00	7.2E-07	7.2E-07	7.2E-07	2.1E-05	3.1E-04	7.2E-07	3.0E-05	2.1E-05
Sum Total	(mSv)	1.2E-06	1.2E-08	1.2E-08	1.3E-05	2.1E-07	3.2E-06	1.1E-08	3.0E-07	1.7E-06
	(mrem)	1.2E-04	1.2E-06	1.2E-06	1.3E-03	2.1E-05	3.2E-04	1.1E-06	3.0E-05	1.7E-04

Table 4.12-8C Annual and Committed Dose Equivalents for Exposures in Year 30 to a Child From Liquid Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.8E-12	7.7E-14	8.9E-14	7.3E-14	6.7E-14	1.8E-13	7.6E-14	6.9E-14	7.8E-14
	(mrem)	2.8E-10	7.7E-12	8.9E-12	7.3E-12	6.7E-12	1.8E-11	7.6E-12	6.9E-12	7.8E-12
Inhalation	(mSv)	0.0E+00	9.0E-11	1.0E-10	9.9E-06	2.5E-09	3.8E-08	9.6E-11	3.6E-12	1.2E-06
	(mrem)	0.0E+00	9.0E-09	1.0E-08	9.9E-04	2.5E-07	3.8E-06	9.6E-09	3.6E-10	1.2E-04
Grd. Plane direct	(mSv)	1.2E-06	4.7E-09	4.7E-09	3.8E-09	3.7E-09	9.1E-09	3.9E-09	3.8E-12	4.3E-09
	(mrem)	1.2E-04	4.7E-07	4.7E-07	3.8E-07	3.7E-07	9.1E-07	3.9E-07	3.8E-10	4.3E-07
Ingestion	(mSv)	0.0E+00	6.9E-09	6.9E-09	6.9E-09	2.0E-07	3.0E-06	6.9E-09	2.9E-07	2.1E-07
	(mrem)	0.0E+00	6.9E-07	6.9E-07	6.9E-07	2.0E-05	3.0E-04	6.9E-07	2.9E-05	2.1E-05
Sum Total	(mSv)	1.2E-06	1.2E-08	1.2E-08	9.9E-06	2.0E-07	3.1E-06	1.1E-08	2.9E-07	1.4E-06
	(mrem)	1.2E-04	1.2E-06	1.2E-06	9.9E-04	2.0E-05	3.1E-04	1.1E-06	2.9E-05	1.4E-04

Table 4.12-8D Annual and Committed Dose Equivalents for Exposures in Year 30 to an Infant From Liquid Effluent (Nearest Resident)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.8E-12	7.7E-14	8.9E-14	7.3E-14	6.7E-14	1.8E-13	7.6E-14	6.9E-14	7.8E-14
	(mrem)	2.8E-10	7.7E-12	8.9E-12	7.3E-12	6.7E-12	1.8E-11	7.6E-12	6.9E-12	7.8E-12
Inhalation	(mSv)	0.0E+00	7.1E-11	8.0E-11	7.9E-06	2.0E-09	3.0E-08	7.6E-11	2.9E-12	9.5E-07
	(mrem)	0.0E+00	7.1E-09	8.0E-09	7.9E-04	2.0E-07	3.0E-06	7.6E-09	2.9E-10	9.5E-05
Grd. Plane direct	(mSv)	1.2E-06	4.7E-09	4.7E-09	3.8E-09	3.7E-09	9.1E-09	3.9E-09	3.8E-12	4.3E-09
	(mrem)	1.2E-04	4.7E-07	4.7E-07	3.8E-07	3.7E-07	9.1E-07	3.9E-07	3.8E-10	4.3E-07
Ingestion	(mSv)	0.0E+00	1.3E-09	1.2E-09	1.2E-09	3.6E-08	5.5E-07	1.2E-09	5.3E-08	3.7E-08
	(mrem)	0.0E+00	1.3E-07	1.2E-07	1.2E-07	3.6E-06	5.5E-05	1.2E-07	5.3E-06	3.7E-06
Sum Total	(mSv)	1.2E-06	6.0E-09	6.1E-09	7.9E-06	4.1E-08	5.9E-07	5.3E-09	5.3E-08	9.9E-07
	(mrem)	1.2E-04	6.0E-07	6.1E-07	7.9E-04	4.1E-06	5.9E-05	5.3E-07	5.3E-06	9.9E-05

Table 4.12-9A Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult from Liquid Effluent (Nearby Businesses)

Location: Nearby Business – SE, 925 m (3,035 ft)

Page 1 of 1

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	9.2E-12	2.5E-13	2.9E-13	2.4E-13	2.2E-13	5.7E-13	2.5E-13	2.3E-13	2.5E-13
	(mrem)	9.2E-10	2.5E-11	2.9E-11	2.4E-11	2.2E-11	5.7E-11	2.5E-11	2.3E-11	2.5E-11
Inhalation	(mSv)	0.0E+00	2.2E-10	2.5E-10	2.4E-05	6.1E-09	9.2E-08	2.3E-10	8.9E-12	2.9E-06
	(mrem)	0.0E+00	2.2E-08	2.5E-08	2.4E-03	6.1E-07	9.2E-06	2.3E-08	8.9E-10	2.9E-04
Grd. Plane direct	(mSv)	2.2E-06	8.9E-09	9.0E-09	7.2E-09	7.1E-09	1.7E-08	7.5E-09	7.2E-12	8.2E-09
	(mrem)	2.2E-04	8.9E-07	9.0E-07	7.2E-07	7.1E-07	1.7E-06	7.5E-07	7.2E-10	8.2E-07
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	2.2E-06	9.1E-09	9.2E-09	2.4E-05	1.3E-08	1.1E-07	7.7E-09	1.6E-11	2.9E-06
	(mrem)	2.2E-04	9.1E-07	9.2E-07	2.4E-03	1.3E-06	1.1E-05	7.7E-07	1.6E-09	2.9E-04

Table 4.12-9B Annual and Committed Dose Equivalents for Exposures in Year 30 to an Adult from Liquid Effluent (Nearby Businesses)

Location: Nearby Business – NNW, 1,712 m (5,617 ft)

Page 1 of 1

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	7.5E-12	2.0E-13	2.4E-13	1.9E-13	1.8E-13	4.7E-13	2.0E-13	1.8E-13	2.1E-13
	(mrem)	7.5E-10	2.0E-11	2.4E-11	1.9E-11	1.8E-11	4.7E-11	2.0E-11	1.8E-11	2.1E-11
Inhalation	(mSv)	0.0E+00	1.8E-10	2.0E-10	2.0E-05	4.9E-09	7.5E-08	1.9E-10	7.2E-12	2.4E-06
	(mrem)	0.0E+00	1.8E-08	2.0E-08	2.0E-03	4.9E-07	7.5E-06	1.9E-08	7.2E-10	2.4E-04
Grd. Plane direct	(mSv)	3.2E-06	1.3E-08	1.3E-08	1.0E-08	1.0E-08	2.5E-08	1.1E-08	1.0E-11	1.2E-08
	(mrem)	3.2E-04	1.3E-06	1.3E-06	1.0E-06	1.0E-06	2.5E-06	1.1E-06	1.0E-09	1.2E-06
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	3.2E-06	1.3E-08	1.3E-08	2.0E-05	1.5E-08	9.9E-08	1.1E-08	1.8E-11	2.4E-06
	(mrem)	3.2E-04	1.3E-06	1.3E-06	2.0E-03	1.5E-06	9.9E-06	1.1E-06	1.8E-09	2.4E-04

Table 4.12-10A Annual and Committed Dose Equivalents for Exposure in Year 30 to an Adult From Liquid Effluent (Site Boundary)

Location: Maximum Site Boundary – South, 417 m (1,368 ft)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	5.5E-11	1.5E-12	1.7E-12	1.4E-12	1.3E-12	3.4E-12	1.5E-12	1.4E-12	1.5E-12
	(mrem)	5.5E-09	1.5E-10	1.7E-10	1.4E-10	1.3E-10	3.4E-10	1.5E-10	1.4E-10	1.5E-10
Inhalation	(mSv)	0.0E+00	1.3E-09	1.5E-09	1.4E-04	3.6E-08	5.5E-07	1.4E-09	5.3E-11	1.7E-05
	(mrem)	0.0E+00	1.3E-07	1.5E-07	1.4E-02	3.6E-06	5.5E-05	1.4E-07	5.3E-09	1.7E-03
Grd. Plane direct	(mSv)	1.6E-05	6.6E-08	6.6E-08	5.3E-08	5.2E-08	1.3E-07	5.5E-08	5.3E-11	6.1E-08
	(mrem)	1.6E-03	6.6E-06	6.6E-06	5.3E-06	5.2E-06	1.3E-05	5.5E-06	5.3E-09	6.1E-06
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	1.6E-05	6.7E-08	6.8E-08	1.5E-04	8.9E-08	6.8E-07	5.7E-08	1.1E-10	1.7E-05
	(mrem)	1.6E-03	6.7E-06	6.8E-06	1.5E-02	8.9E-06	6.8E-05	5.7E-06	1.1E-08	1.7E-03

Table 4.12-10B Annual and Committed Dose Equivalents for Exposure in Year 30 to an Adult From Liquid Effluent (Site Boundary)

Location: Maximum Site Boundary – North, 995 m (3,264 ft) (Side Next to UBC Storage Pad)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Remainder	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.9E-11	7.8E-13	9.1E-13	7.4E-13	6.9E-13	1.8E-12	7.8E-13	7.0E-13	7.9E-13
	(mrem)	2.9E-09	7.8E-11	9.1E-11	7.4E-11	6.9E-11	1.8E-10	7.8E-11	7.0E-11	7.9E-11
Inhalation	(mSv)	0.0E+00	6.8E-10	7.7E-10	7.6E-05	1.9E-08	2.9E-07	7.3E-10	2.8E-11	9.1E-06
	(mrem)	0.0E+00	6.8E-08	7.7E-08	7.6E-03	1.9E-06	2.9E-05	7.3E-08	2.8E-09	9.1E-04
Grd. Plane direct	(mSv)	1.5E-05	5.9E-08	6.0E-08	4.8E-08	4.7E-08	1.2E-07	5.0E-08	4.8E-11	5.5E-08
	(mrem)	1.5E-03	5.9E-06	6.0E-06	4.8E-06	4.7E-06	1.2E-05	5.0E-06	4.8E-09	5.5E-06
Ingestion	(mSv)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	(mrem)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Total	(mSv)	1.5E-05	6.0E-08	6.1E-08	7.6E-05	6.6E-08	4.0E-07	5.1E-08	7.6E-11	9.1E-06
	(mrem)	1.5E-03	6.0E-06	6.1E-06	7.6E-03	6.6E-06	4.0E-05	5.1E-06	7.6E-09	9.1E-04

Table 4.12-11 Maximum Annual Liquid and Gas Radiological Impacts

Category	Dose Equivalent	Location
Maximum Effective Dose Equivalent	(mSv) 1.9E-04 (mrem) 1.9E-02	Site Boundary (South, 417 m (1,368 ft))
Maximum Thyroid Committed Dose Equivalent	(mSv) 9.8E-07 (mrem) 9.8E-05	Site Boundary (South, 417 m (1,368 ft))
Maximum Organ Committed Dose Equivalent	(mSv) 1.5E-03 (mrem) 1.5E-01	Site Boundary (South 417 m (1,368 ft))

Table 4.12-12 Annual Total Effective Dose Equivalent (All Sources)
Page 1 of 1

Location		Fixed Sources	Gas & Liquid Effluents	TEDE
Site Boundary (North)	(mSv)	1.9E-01	9.7E-05	1.9E-01
	(mrem)	1.9E+01	9.7E-03	1.9E+01
Nearest Business	(mSv)	6.0E-05	2.5E-05	8.5E-05
(NNW, 1.7 km (1.1 mi))	(mrem)	6.0E-03	2.5E-03	8.5E-03
Nearest Resident (W, 4.3 km (2.63 mi))	(mSv)	8.0E-12	1.9E-05	1.9E-05
	(mrem)	8.0E-10	1.9E-03	1.9E-03

Table 4.12-13 Estimated NEF Occupational Dose Equivalent Rates

Area or Component	Dose Rate, mSv/hr (mrem/hr)
Plant general area (excluding Separations Building Modules)	< 0.0001 (< 0.01)
Separations Building Module – Cascade Halls	0.0005 (0.05)
Separations Building Module – UF_6 Handling Area and Process Services Area	0.001 (0.1)
Empty used UF_6 shipping cylinder	0.1 on contact (10.0) 0.010 at 1 m (3.3 ft) (1.0)
Full UF_6 Shipping cylinder	0.05 on contact (5.0) 0.002 at 1 m (3.3 ft) (0.2)

Table 4.12-14 Estimated NEF Occupational (Individual) Exposures

Page 1 of 1

Position	Annual Dose Equivalent*
General Office Staff	< 0.05 mSv (< 5.0 mrem)
Typical Operations & Maintenance Technician	1 mSv (100 mrem)
Typical Cylinder Handler	3 mSv (300 mrem)

*The average worker exposure at the Urenco Capenhurst facility during the years 1998 through 2002 was approximately 0.2 mSv (20 mrem) (URENCO, 2000; URENCO, 2001; URENCO, 2002a).

Table 4.12-15 Accident Criteria Chemical Exposure Limits by Category

	High Consequence (Category 3)	**Intermediate Consequence (Category 2)**
Worker (5-min averages)	> 175 mg HF/m^3	> 98 mg HF/m^3
Outside Controlled Area (30-min averages)	> 28 mg HF/m^3	> 1.6 mg HF/m^3
Outside Controlled Area (8-hr averages)	> 7.0 mg HF/m^3	> 0.8 mg HF/m^3

Category 3, High Consequence (workers): Chemical Dose greater than AEGL-3 and ERPG-3.

Category 2, Intermediate Consequence (workers): Chemical Dose greater than AEGL-2 and ERGP-2, and less than or equal to AEGL-3 and ERPG-3.

Category 1, Low Consequence (workers): Accident of lower radiological or chemical exposures than those listed above.

Definitions

ERPG (Emergency Response Planning Guideline): Values intended to provide estimates of concentration ranges above which one could not be responsibly anticipate observing health effects.

ERPG-1: The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.

ERPG-2: The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

ERPG-3: The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

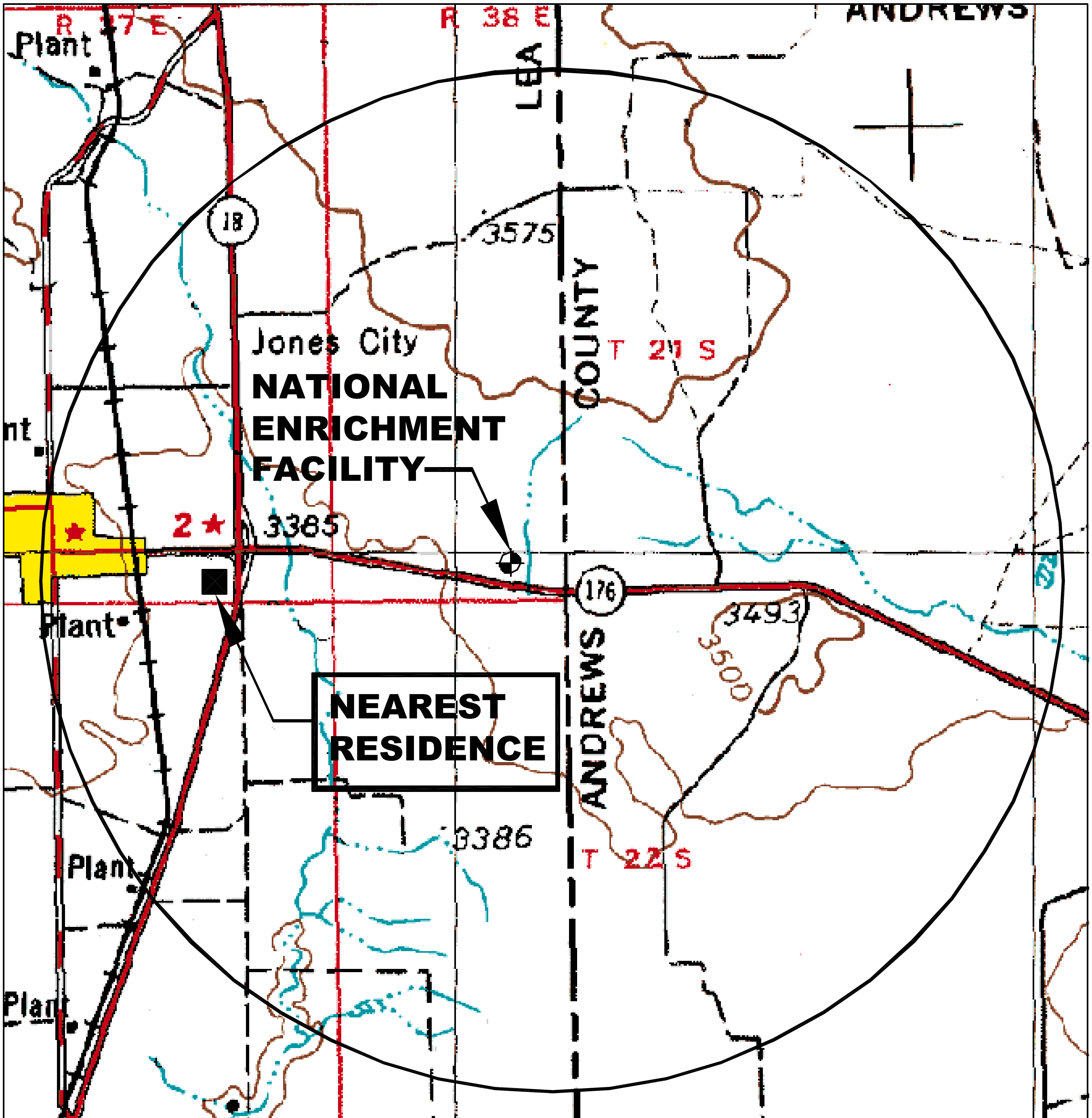
AEGL (Acute Exposure Guideline Level): Threshold exposure limits for the protection of the general public, which are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. It is believed that the recommended exposure levels are applicable to the general population including infants and children, and other individuals who may be sensitive and susceptible.

AEGL-1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects, or an impaired ability to escape.

AEGL-3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

FIGURES



1 0 1 2 3 4 5 KM

1 0 1 2 3 MILES

NORTH

MAP SOURCE:
USGS 1:100,000 30 MIN. X 60 MIN. MAPS
HOBBS, NEW MEXICO – TEXAS
CONTOUR INTERVAL: 100 FEET

LEGEND:

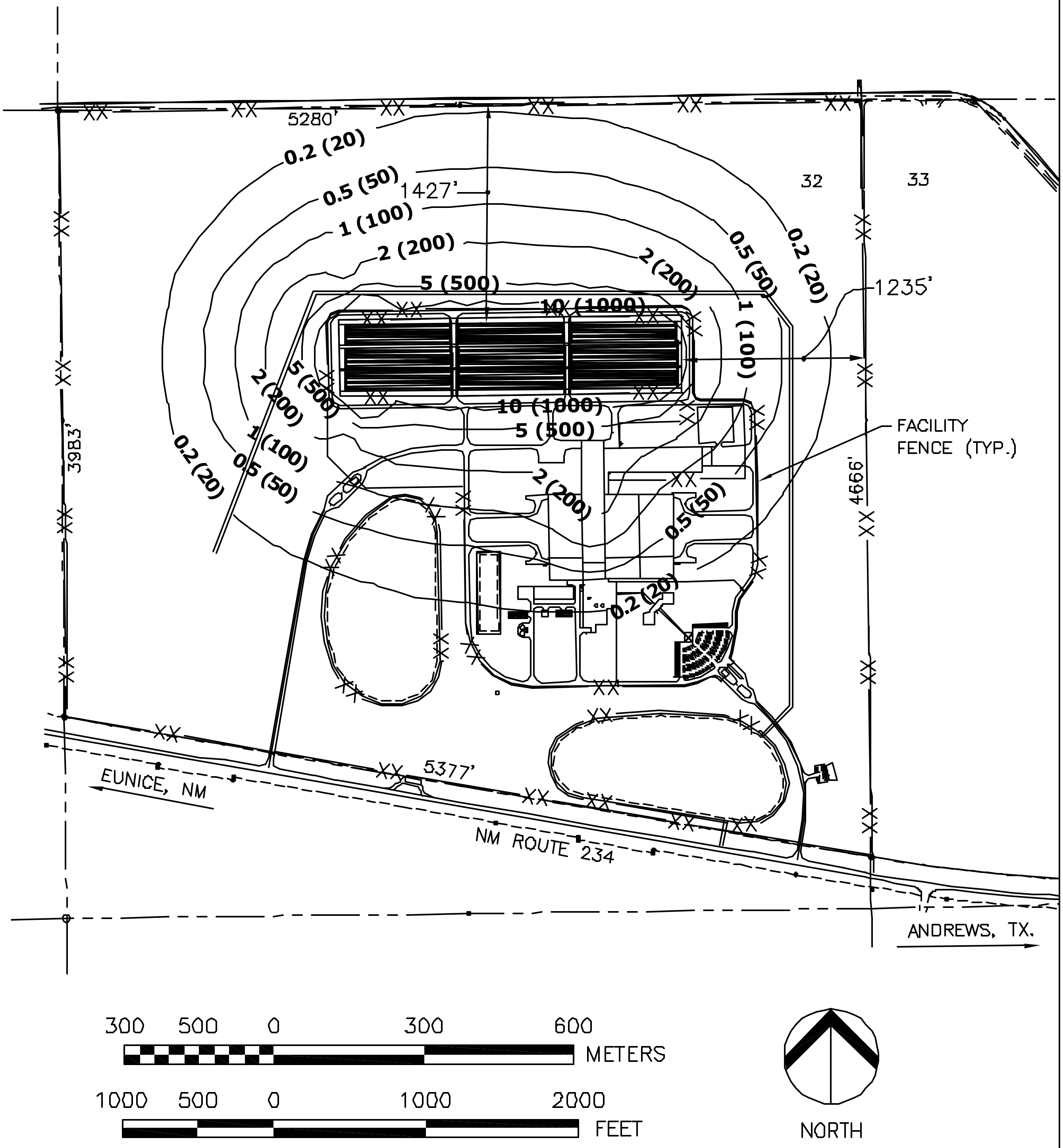
■ RESIDENT LOCATION

REFERENCE NUMBER
15Min Figures.dwg

FIGURE 4.12-1
NEAREST RESIDENT

ENVIRONMENTAL REPORT
REVISION DATE: DECEMBER 2003

Figure removed under 10 CFR 2.390.



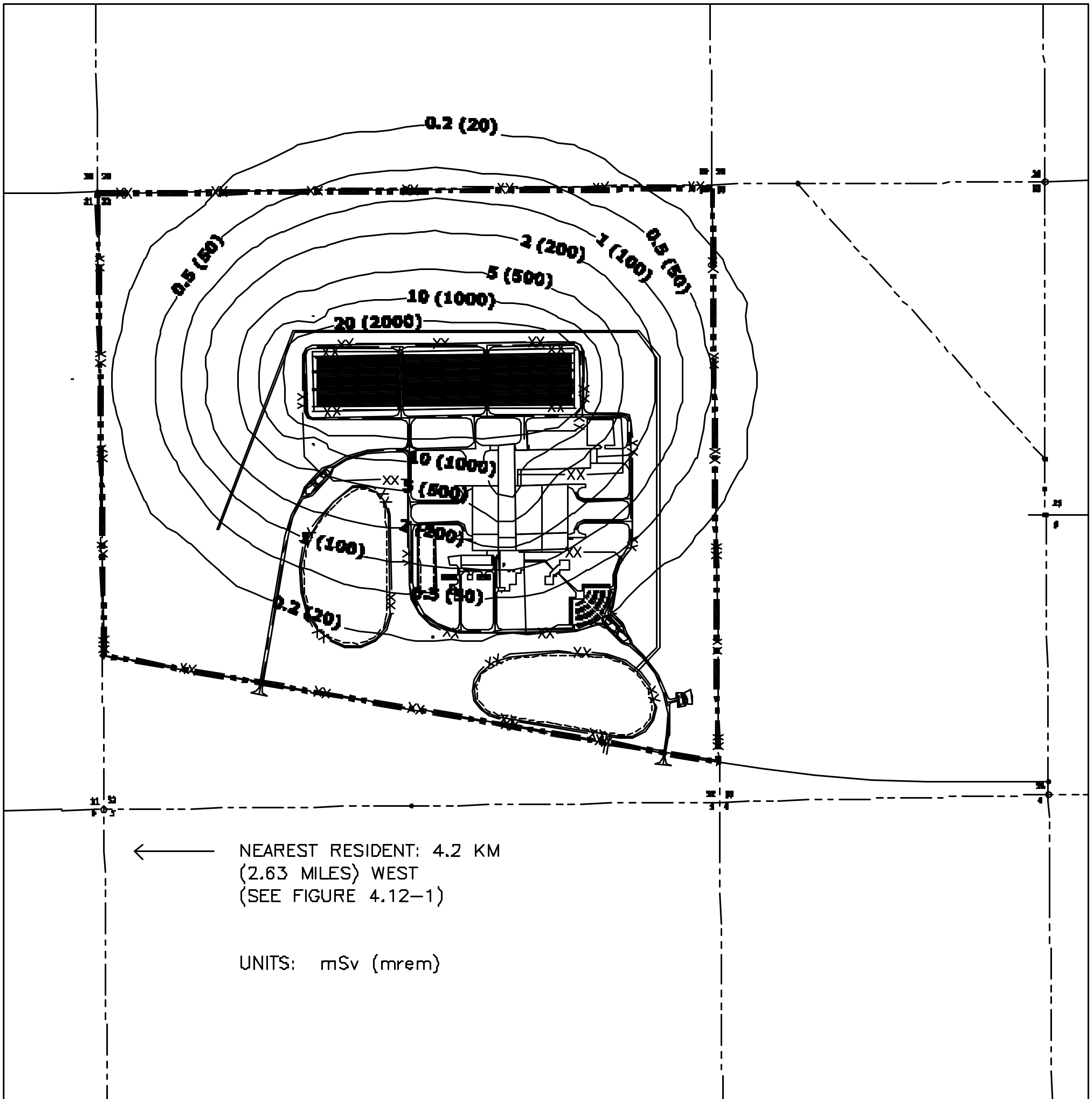
* ISOPLETHS INCLUDE CONTRIBUTION FROM CRDB.

REFERENCE NUMBER
Figure4.12–3.dwg

FIGURE 4.12-3

UBC STORAGE PAD ANNUAL DOSE EQUIVALENT ISOPLETHS (2,000 HOURS PER YEAR OCCUPANCY) ENVIRONMENTAL REPORT

REVISION DATE: DECEMBER 2003



300 0 300 600 900 METERS

1000 0 1000 2000 3000 FEET

NORTH

MAP SOURCE:
USGS 7.5 MINUTE
EUNICE NE QUADRANGLE
TEX.-N. MEX. 1:24000
CONTOUR INTERVAL: 5 FEET

* ISOPLETHS INCLUDE CONTRIBUTION FROM THE CRDB.

REFERENCE NUMBER
Figure4.12-4.dwg

FIGURE 4.12-4

UBC STORAGE PAD ANNUAL DOSE EQUIVALENT ISOPLETHS (8,760 HOURS PER YEAR OCCUPANCY)
ENVIRONMENTAL REPORT

REVISION DATE: DECEMBER 2003

4.13 WASTE MANAGEMENT IMPACTS

Solid waste generated at the NEF will be disposed of at licensed facilities designed to accept the various waste types. Industrial waste, including miscellaneous trash, filters, resins and paper will be shipped offsite for compaction and then sent to a licensed waste landfill. Radioactive waste will be collected in labeled containers in each Restricted Area and transferred to the Solid Waste Collection Room for inspection. Suitable waste will be volume-reduced and all radioactive waste disposed of at a licensed LLW disposal facility. Hazardous and some mixed wastes will be collected at the point of generation, transferred to the Solid Waste Collection Room, inspected, and classified. Any mixed waste that may be processed to meet land disposal requirements may be treated in its original collection container and shipped as LLW for disposal. There will be no onsite disposal of solid waste at the NEF. Waste Management Impacts for onsite disposal, therefore, need not be evaluated. Onsite storage of UBCs will minimally impact the environment. A detailed pathway assessment for the UBC Storage Pad is provided in ER Section 4.13.3.1.1, UBC Storage.

NEF will generate approximately 1,770 kg (3,932 lbs) of Resource Conservation and Recovery Act (RCRA) hazardous wastes per year and 50 kg (110 lbs) of mixed waste. This is an average of 147 kg (325 lbs) per month. Under New Mexico regulations, a facility that generates less than 100 kg (220 lbs) per month is conditionally exempt. In New Mexico, hazardous waste generators are classified by the actual monthly generation rate, not the annual average. Given that the average is over 100 kg/mo (220 lbs/mo), NEF would be considered a small quantity generator and would not be conditionally exempt from the New Mexico Hazardous Waste Bureau (NMHWB) hazardous waste regulations. Within 90 days after the generation of any new waste stream, NEF will need to determine if it is classified as a hazardous waste. If so, the NEF will need to notify the NMHWB within that time period. As a small quantity generator, the NEF will be required to file an annual report to the NMHWB and to pay an annual fee The NEF plans to ship all hazardous wastes offsite within the allowed timeframe, therefore, no further permitting should be necessary. Without the appropriate Treatment Storage and Disposal Permit, NEF will not treat, store or dispose of hazardous wastes onsite; therefore the impacts for such systems need not be evaluated.

4.13.1 Waste Descriptions

Descriptions of the sources, types and quantities of solid, hazardous, radioactive and mixed wastes generated by NEF construction and operation are provided in ER Section 3.12, Waste Management.

4.13.2 Waste Management System Description

Descriptions of the proposed NEF waste management systems are provided in ER Section 3.12.

4.13.3 Waste Disposal Plans

4.13.3.1 Radioactive and Mixed Waste Disposal Plans

Solid radioactive wastes are produced in a number of plant activities and require a variety of methods for treatment and disposal. These wastes, as well as the generation and handling systems, are described in detail in ER Section 3.12, Waste Management.

All radioactive and mixed wastes will be disposed of at offsite, licensed facilities. The impacts on the environment due to these offsite facilities are not addressed in this report. Table 4.13-1, Possible Radioactive Waste Processing/Disposal Facilities, summarizes the facilities that may be used to process or dispose of NEF radioactive or mixed waste.

Radioactive waste will be shipped to any of the three listed radioactive waste processing / disposal sites. Other offsite processing or disposal facilities may be used if appropriately licensed to accept NEF waste types. Depleted UF_6 will most likely be shipped to one of the UF_6 Conversion Facilities subsequent to temporary onsite storage. The remaining mixed waste will either be pretreated in its collection container onsite prior to offsite disposal, or shipped directly to a mixed waste processor for ultimate disposal.

The Barnwell site, located in Barnwell, South Carolina, is a low-level radioactive waste disposal facility licensed in an agreement state in association with 10 CFR 61, (CFR, 2003r). This facility is licensed to accept NEF low-level waste either directly from the NEF site or as processed waste from offsite waste processing vendors. The disposal site is approximately 2,320 km (1,441 mi) from the NEF.

The Clive site, located in South Clive, Utah, is owned and operated privately by Envirocare of Utah. This low-level waste disposal site is also licensed in an agreement state in association with 10 CFR 61 (CFR, 2003r), and 40 CFR 264 (CFR, 2003v). Currently, the license allows acceptance of Class A waste only. In addition to accepting radioactive waste, the Clive facility may accept some mixed wastes. This facility is licensed to accept NEF low-level waste either directly from the NEF site or as processed waste from offsite waste processing vendors. The disposal site is approximately 1,636 km (1,016 mi) from the NEF.

Waste processors such as GTS Duratek, primarily located in Oak Ridge, Tennessee, have the ability to volume reduce most Class A low level wastes. GTS Duratek also has the capability to process contaminated oils and some mixed wastes. The NEF may send wastes that are candidates for volume reduction, recycling, or treatment to the GTS Duratek facilities. Other processing vendors may be used to process NEF waste depending on future availability. The processing facilities are approximately 1,993 km (1,238 mi).

With regard to depleted UF_6 disposal, DOE has recently contracted for the construction and operation of depleted UF_6 conversion facilities in Paducah, Kentucky, and Portsmouth, Ohio. This action was taken following the earlier enactment of Section 3113 of the USEC Privatization Act, which requires the Secretary of Energy to “accept” for disposal depleted UF_6 generated by an NRC-licensed facility such as the NEF, and related subsequent legislation. DOE facilities for conversion and ultimate offsite disposal of LES generated depleted UF_6 is one of the options available for the disposition of depleted UF_6. Such disposal will be accomplished either by sale of converted depleted UF_6 for reuse or by shipment of the depleted UF_6 to a licensed disposal

facility for burial. As described later in this chapter, other options are available for depleted UF_6 disposal.

4.13.3.1.1 Uranium Byproduct Cylinder (UBC) Storage

The NEF yields a depleted UF_6 stream that will be temporarily stored onsite in containers before transfer to the conversion facility and subsequent reuse or disposal. The storage containers are referred to as Uranium Byproduct Cylinders (UBC). The storage location is designated the UBC Storage Pad. The UBC Storage Pad will have minimal environmental impacts.

The NEF's preferred option for disposition of the UBCs includes temporary onsite storage of cylinders. See ER Section 4.13.3.1.3. There will be no disposal onsite. The NEF will pursue economically viable disposal paths for the UBCs as soon as they become available. In addition, the NEF will look to private deconversion facilities to render the UF_6 into U_3O_8.

LES is committed to the following storage and disposition of UBCs on the NEF site (LES, 2003b):

- Only temporary onsite storage will be utilized.
- No long-term storage beyond the life of the plant.
- Aggressively pursue economically viable disposal paths.
- Setting up a financial surety bonding mechanism to assure adequate funding is in place to dispose of all UBCs.

Since UBCs will be stored for a time on the pad, the potential impact of this preferred option is the remote possibility of stormwater runoff from the UBC Storage Pad becoming contaminated with UF_6 or its derivatives. Cylinders placed on the UBC Storage Pad normally have no surface contamination due to restrictions placed on surface contamination levels by plant operating procedures . Because of the remote possibility of contamination, the runoff water will be directed to an onsite lined retention basin, designed to minimize ground infiltration. The site soil characteristics greatly minimize the migration of materials into the soil over the life of the plant. However, the basin is sampled under the site's environmental monitoring plan. The sources of the potential water runoff contamination (albeit unlikely) would be either residual contamination on the cylinders from routine handling, or accidental releases of UF_6 and its derivatives resulting from a leaking cylinder or cylinder valve (caused by corrosion, transportation or handling accidents, or other factors). Operational evidence suggests that breaches in cylinders and the resulting leaks are "self-sealing." (See ER Section 4.13.3.1.2.)

The chemical and physical properties of UF_6 can pose potential health risks, and the material is handled accordingly. Uranium and its decay products emit low-levels of alpha, beta, gamma and neutron radiation. If UF_6 is released to the atmosphere, it reacts with water vapor in the air to form hydrogen fluoride (HF) and the uranium oxyfluoride compound called uranyl fluoride (UO_2F_2). These products are chemically toxic. Uranium is a heavy metal that, in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it enters the bloodstream by means of ingestion or inhalation. HF is an extremely corrosive gas that can damage the lungs and cause death if inhaled in high concentrations.

The NEA/IAEA (NEA, 2002) reports that there is widespread experience with the storage of UF_6 in steel cylinders in open-air storage yards. It is reported that even without routine treatment of localized corrosion, containers have maintained structural integrity for more than 50 years. The

most extreme conditions experienced were in Russian Siberia where temperatures ranged from +40°C to -40°C (+104°F to –40°F), and from deep snow to full sun.

Depleted UF_6 can be safely stored for decades in painted steel cylinders in open-air storage yards. Internal corrosion does not represent a problem. A reaction between the UF_6 and inner surface of the cylinder forms a complex uranium oxifluoride layer between the UF_6 and cylinder wall that limits access of water moisture to the inside of the cylinder, thus further inhibiting internal corrosion. Moreover, while limiting factors are the external corrosion of the steel containers and the integrity of the “connection” seals, their impact can be minimized with an adequate preventive maintenance program. The three primary causes of external corrosion, all of which are preventable, are: (1) standing water on metal surfaces, (2) handling damaged cylinders and (3) the aging of cylinder paint.

Standing water problems can be minimized through proper yard drainage, use of support saddles, and periodic inspection. Handling damage can be minimized by appropriate labor training and yard access design. Aging can be minimized through the use of periodic inspection and repainting and the use of quality paint. At the NEF UBCs are placed on an outdoor storage pad of reinforced concrete. The pad is provided with a UBC Storage Pad Stormwater Retention Basin, concrete saddles on which the cylinders rest, and a mobile cylinder transporter. The stormwater collection system has sampling capabilities. The mobile transporter transfers cylinders from the UF_6 Handling Area of the Separations Building to the UBC Storage Pad where they rest on concrete saddles for storage. UBC transport between the Separations Building and the storage area is discussed in greater detail in the Safety Analysis Report Section 3.4.11, Material Handling Processes.

The Depleted Uranium Hexafluoride Management Study (LES, 1991b) provides a plan for the storage of UBCs in a safe and cost-effective manner in accordance with all applicable regulations to protect the environment. The NEF will maintain an active cylinder management program to improve storage conditions in the cylinder yard, to monitor cylinder integrity by conducting routine inspections for breaches, and to perform cylinder maintenance and repairs to cylinders and the Storage Pad, as needed. The UBC Storage Pad has been sited to minimize the potential environmental impact from external radiation exposure to the public at the site boundary. The concrete pad to be initially constructed onsite for the storage of UBCs will only be of a size necessary to hold a few years worth of UBCs. It will be expanded, only if necessary. The dose equivalent rate from the UBC Storage Pad at the site boundary will be below the regulatory limits of 10 CFR 20 (CFR 2003q) and 40 CFR 190 (CFR, 2003f). The direct dose equivalent comes from the gamma-emitting progeny within the uranium decay chain. In addition, neutrons are produced by spontaneous fission in uranium and by the $^{19}_{9}F$ (alpha, n)$^{22}_{11}Na$ reaction. Thermoluminescent Dosimeters (TLDs) will be distributed along the site boundary fence line to monitor this impact due to photons (see ER Section 6.1), and ensure that the estimated dose equivalent is not exceeded. See ER Section 4.12.2.1.3 for more detailed information on the impact of external dose equivalents from UBC Storage Pad.

The overall impact of the preferred UBC Storage Pad option is believed to be small given the comprehensive cylinder maintenance and inspection programs that have been instituted in Europe over the past 30 years. This experience has shown that outdoor UF_6 cylinder storage will have little or no adverse environmental impact when it is coupled with an effective and protective cylinder management program. In more than 30 years of operation at three different enrichment plants, the European cylinder management program has not resulted in any

significant releases of UF_6 to the environment (see ER Section 3.11.2.2, Public and Occupational Exposure Limits, for information of the types of releases that have occurred at Urenco plants).

4.13.3.1.2 Mitigation for Depleted UF_6 Storage

Since UF_6 is a solid at ambient temperatures and pressures, it is not readily released from a cylinder following a leak or breach. When a cylinder is breached, moist air reacts with the exposed UF_6 solid and iron, resulting in the formation of a dense plug of solid uranium and iron compounds and a small amount of HF gas. This "self-healing" plug limits the amount of material released from a breached cylinder. When a cylinder breach is identified, the cylinder is typically repaired or its contents are transferred to a new cylinder.

LES will maintain an active cylinder management program to maintain optimum storage conditions in the cylinder yard, to monitor cylinder integrity by conducting routine inspections for breaches, and to perform cylinder maintenance and repairs to cylinders and the storage yard, as needed. The following handling and storage procedures and practices shall be adopted at the NEF to mitigate adverse events, by either reducing the probability of an adverse event or reducing the consequence should an adverse event occur (LES, 1991b).

- All filled UBCs will be stored in designated areas of the storage yard on concrete saddles (or saddles comprised of other material) that do not cause cylinder corrosion. These saddles shall be placed on a stable concrete surface.
- The storage array shall permit easy visual inspection of all cylinders.
- The UBCs shall be surveyed for external contamination (wipe tested) prior to being placed on the UBC Storage Pad or transported offsite. The maximum level of removable surface contamination allowed on the external surface of the cylinder shall be no greater than 0.4 Bq/cm^2 (22 dpm/cm^2) (beta, gamma, alpha) on accessible surfaces averaged over 300 cm^2.
- UBC valves shall be fitted with valve guards to protect the cylinder valve during transfer and storage.
- Provisions are in place to ensure that UBCs do not have the defective valves (identified in NRC Bulletin 2003-03, "Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders" (NRC, 2003e) installed.
- All UBCs shall be abrasive-blasted and coated with a minimum of one coat of zinc chromate primer plus one zinc-rich topcoat or equivalent anti-corrosion treatment.
- Only designated vehicles with less than 280 L (74 gal) of fuel shall be allowed in the UBC Storage Pad area.
- Only trained and qualified personnel shall be allowed to operate vehicles on the UBC Storage Pad area.
- UBCs shall be inspected for damage prior to placing a filled cylinder on the Storage Pad.
- UBCs shall be re-inspected annually for damage or surface coating defects. These inspections shall verify that:
  - Lifting points are free from distortion and cracking.
  - Cylinder skirts and stiffener rings are free from distortion and cracking.
  - Cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion.

- o Cylinder valves are fitted with the correct protector and cap, the valve is straight and not distorted, 2 to 6 threads are visible, and the square head of the valve stem is undamaged.
  - o Cylinder plugs are undamaged and not leaking.
  - o If inspection of a UBC reveals significant deterioration (i.e., leakage, cracks, excessive, distortion, bent or broken valves or plugs, broken or torn stiffening rings or skirts, or other conditions that may affect the safe use of the cylinder), the contents of the affected cylinder shall be transferred to another undamaged cylinder and the defective cylinder shall be discarded. The root cause of any significant deterioration shall be determined and, if necessary, additional inspections of cylinders shall be made.
  - o Proper documentation on the status of each UBC shall be available on site, including content and inspection dates.
  - o Cylinders containing liquid depleted UF_6 shall not be transported.
- Site stormwater runoff from the UBC Storage Pad is directed to a lined retention basin, which will be included in the site environmental monitoring plan. (See ER Section 6.1.)

4.13.3.1.3 Depleted UF_6 Disposition Alternatives

LES is committed to the temporary storage of UBCs on the NEF site as described in ER Section 4.13.3.1.1, Uranium Byproduct Cylinder (UBC) Storage. The preferred option and a “plausible strategy” for disposition of the UBCs is private sector conversion and disposal as described below. The disposition of UBCs by DOE conversion and disposal is described below since it is also a “plausible strategy,” but is not considered the preferred option.

On April 24, 2002, LES submitted to the NRC information addressing depleted uranium disposition (LES, 2002). LES recommended that the NRC consider that the Section 3113 requirements of the U.S. Enrichment Corporation Privatization Act mandate, in LES’s view, that DOE dispose of depleted uranium from a uranium enrichment facility licensed by the NRC. LES’s position is that this approach constitutes a “plausible strategy” for dispositioning these materials. Subsequently, the NRC in its response to the LES submittal (NRC, 2003b) dated March 24, 2003, stated that the NRC “[c]onsiders that Section 3113 would be a “plausible strategy” for dispositioning depleted uranium tails if the NRC staff determines the depleted uranium is a low-level radioactive waste.”

The NRC March 24, 2003 letter (NRC, 2003b) stated that the NRC expects LES to indicate in its NEF license application whether the depleted uranium tails will be treated as a waste or a resource. LES will make a determination as to whether the depleted uranium is a resource or a waste and notify the NRC.

The NRC also noted in its letter to LES (NRC, 2003b), that the NEF license application should demonstrate that, given the expected constituents of the LES depleted uranium, the material meets the definition of low-level radioactive waste given in 10 CFR Part 61 (CFR, 2003r). The definition of low-level waste in 10 CFR 61 (CFR, 2003r) is radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste), 10 CFR 30 (CFR, 2003c), and 10 CFR 40 (CFR, 2003d).

High-level radioactive waste (HLW) is primarily in the form of spent fuel discharged from commercial nuclear power reactors. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride. No spent fuel is used in the NEF. Therefore, the LES depleted uranium is not high-level waste nor does it contain any high-level waste.

A transuranic element is an artificially made, radioactive element that has an atomic number higher than uranium in the Periodic Table of Elements such as neptunium, plutonium, americium, and others. Transuranic waste is material contaminated with transuranic elements. It is produced primarily from reprocessing spent fuel and from the use of plutonium in the fabrication of nuclear weapons. Since the LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride, it contains no transuranic waste.

Spent nuclear fuel is fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride. Therefore, the LES depleted uranium is not nuclear fuel.

Section 11e.(2) of the Atomic Energy Act classifies tailings produced from uranium ore as byproduct material. Tailings are the waste left after ore has been extracted from rock. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride, not from uranium ore or rock tailings. Therefore, the NEF depleted uranium is not byproduct material per section 11e.(2) of the Atomic Energy Act.

10 CFR 30 (CFR, 2003c) states that byproduct material is any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the process of producing or utilizing special nuclear material. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride and is not made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material.

10 CFR 40 (CFR, 2003c) states that byproduct material is the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute “byproduct material” within this definition. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride and is not produced by extraction or concentration of uranium or thorium from ore.

The NEF depleted uranium is not high-level radioactive waste, contains no transuranic waste, spent nuclear fuel, or byproduct material as defined in Section 11e.(2) of the Atomic Energy Act, 10 CFR 30 (CFR, 2003c) and 10 CFR 40 (CFR, 2003d); therefore, once NEF depleted uranium is determined by LES to be a waste and not a resource, it meets the 10 CFR 61 definition of low-level radioactive waste.

Disposition of the UBCs has several potential impacts that depend on the particular approach taken. Currently, the preferred options are short-term onsite storage followed by conversion and underground burial (Option 2 below) or transportation of the UBCs to a DOE conversion facility (Option 1 below). LES considered several other options in addition to the preferred options that could have implications on the number of UBCs stored at the NEF and the length of storage for the cylinders. All of these options are discussed below along with some of their

impacts. However, at this time, LES considers only Options 1 and 2 below to represent plausible strategies for the disposition of its UBCs.

Option 1 –U.S. Private Sector Conversion and Disposal (Preferred Plausible Strategy)

Transporting depleted UF_6 from the NEF to a private sector conversion facility and depleted U_3O_8 permanent disposal in a western U.S. exhausted underground uranium mine is the preferred “plausible strategy” disposition option. The NRC repeatedly affirmed its acceptance of this option during its licensing review of the previous LES license application. In Section 4.2.2.8 of its final environmental impact statement (FEIS) for that application, the NRC staff noted that “it is plausible to assume that depleted UF_6 converted into U_3O_8 may be disposed by emplacement in near surface or deep geological disposal units” (NRC, 1994a). And during the subsequent adjudicatory hearing on that application, an NRC Atomic Safety and Licensing Board held that “[LES] has presented a plausible disposal strategy. [Its] plan to convert depleted UF_6 to U_3O_8 at an offsite facility in the United States and then ship that material as waste to a final site for deeper than surface burial is a reasonable and credible plan for depleted UF_6 disposal (NRC, 1997).

LES has committed to the Governor of New Mexico (LES, 2003b) that: (1) there will be no long-term disposal or long-term storage (beyond the life of the plant) of UBCs in the State of New Mexico; (2) a disposal path outside the State of New Mexico is utilized as soon as possible; (3) LES will aggressively pursue economically viable paths for UBCs as soon as they become available; (4) LES will work with qualified vendors pursuing construction of private deconversion facilities by entering in good faith discussions to provide such vendor long-term UBC contracts to assist them in their financing efforts; and (5) LES will put in place as part of the NRC license a financial surety bonding mechanism that assures funding will be available in the event of any default by LES.

ConverDyn, a company that is engaged in converting U_3O_8 material to UF_6 for enrichment, has the technical capability to construct and operate a depleted UF_6 to depleted U_3O_8 facility at its facility in Metropolis, Illinois in the future if there is an assured market. One of the two ConverDyn partners, General Atomics, may have access to an exhausted uranium mine (the Cotter Mines in Colorado) where depleted U_3O_8 could be disposed. Furthermore, discussions have recently been held with Cogema concerning a private conversion facility. Cogema has experience with such a facility currently processing depleted UF_6 in France. These factors support LES’s position that this option is the preferred “plausible strategy” option.

Option 2 – DOE Conversion and Disposal (Plausible Strategy)

Transporting depleted UF_6 from the NEF to DOE conversion facilities for ultimate disposition is a plausible disposition option. Pursuant to Section 3113 of the USEC Privatization Act, DOE is instructed to “accept for disposal” depleted UF_6, such as those that will be generated by the NRC-licensed NEF. To that end, DOE has recently contracted for the construction and operation of two UF_6 conversion facilities to be located in Paducah, Kentucky and Portsmouth, Ohio.

DOE has recently reaffirmed the plausibility of this option. In a July 25, 2002 letter to Martin Virgilio, Director of the NRC Office of Nuclear Material Safety and Safeguards, William Magwood IV, Director of DOE’s Office of Nuclear Energy, Science and Technology, unequivocally stated that “in view of [DOE’s] plans to build depleted uranium disposition facilities and the critical importance [DOE] places on maintaining a viable domestic uranium enrichment

industry, [DOE] acknowledges that Section 3113 may constitute a "plausible strategy" for the disposal of depleted uranium from the private sector domestic uranium enrichment plant license applicants and operators." (DOE, 2002a)

Moreover, this plausible strategy is virtually identical to one considered by LES during its earlier licensing efforts before the NRC. During the adjudicatory hearing on LES's application, an NRC Atomic Safety and Licensing Board noted that "all parties apparently agree that LES's actual disposal method will be to transfer the tails to DOE and pay DOE's disposal charges" (footnote omitted) (NRC, 1997). LES considers that given the NRC's earlier acceptance of this option, DOE's current acceptance, and DOE's existing contractual commitment to ensure construction and operation of two depleted UF_6 conversion plants, this option to disposition its depleted UF_6 by way of DOE conversion and disposal remains plausible.

Option 3 - Foreign Re-Enrichment or Conversion and Disposal

The shipment of depleted UF_6 to either Canada, Europe or the Confederation of Independent States (CIS) (the former Soviet Union) for either re-enrichment or conversion and disposal would require that a bilateral agreement for cooperation exist between the U.S. and the subject foreign country so long as the depleted UF_6 continues to be classified as source material.

Option 3A – Russian Re-Enrichment

Because the U.S. does not yet have a bilateral agreement for cooperation with Russia, U.S. depleted UF_6, as source material, cannot be shipped to Russia for re-enrichment. However, once there is a bilateral agreement in effect, source material could be re-enriched in Russia to about 0.7 $^{w}/_{o}$ and returned to the U.S. or elsewhere, with the re-enrichment depleted UF_6 remaining in Russia.

Option 3B – French Conversion or Re-Enrichment

The shipment of depleted UF_6 to France for conversion to depleted U_3O_8 by Cogema and its return to the U.S. for disposal is a possible, though unlikely, option. However, the viability of this option would depend on Cogema's available capacity, the economics of transportation back and forward across the Atlantic, and the willingness of Areva, Cogema's parent company, to participate in a Urenco-sponsored venture.

There may be a French interest in re-enriching depleted UF_6, for a price, and keeping the depleted UF_6 just as it would for a regular utility customer. Though Eurodif has excess capacity, its use would be electricity cost-dependent. This option is less likely to be implemented than either option or Option 2 above.

Option 3C – Kazakhstan Conversion and Disposal

While there may be an interest in Kazakhstan in converting depleted UF_6 to depleted U_3O_8 and disposing of it there, such interest is only speculative at this time. One way transportation economics costs could be a factor weighing against this option's employment.

4.13.3.1.4 Converted Depleted UF_6 Disposal Options

The following provides a brief summary of the different disposal options considered in the Programmatic Environmental Impact Statement (PEIS) for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride (DOE, 1999). Appendix I of the

PEIS assessed disposal impacts of converted depleted UF_6. The information is based on pre-conceptual design data provided in the engineering analysis report (LLNL, 1997a).

The PEIS was completed in April 1999 and identified conversion of depleted UF_6 to another chemical form for use or long-term storage as part of a preferred management alternative. In the corresponding Record of Decision (ROD) for the Long-Term Management and Use of Depleted Uranium Hexafluoride (FR, 1999), DOE decided to promptly convert the depleted UF_6 inventory to depleted uranium oxide, depleted uranium metal, or a combination of both.

Under the uranium oxide disposal alternative, depleted UF6 would be chemically converted to a stable oxide form and disposed of below ground as LLW. The ROD further explained that depleted uranium oxide will be used as much as possible, and the remaining depleted uranium oxide will be stored for potential future uses or disposal, as necessary. In addition, according to the ROD, conversion to depleted uranium metal will occur only if uses for such metal are available. Disposal is defined as the emplacement of material in a manner designed to ensure isolation for the foreseeable future. Compared with long-term storage, disposal is considered to be permanent, with no intent to retrieve the material for future use. In fact, considerable and deliberate effort would be required to regain access to the material following disposal.

The PEIS considered several disposal options, including disposal in shallow earthen structures, below-ground vaults, and an underground mine. In addition, two physical waste forms were considered in the PEIS: ungrouted waste and grouted waste. Ungrouted waste refers to U_3O_8 or UO_2 in the powder or pellet form produced during the deconversion process. This bulk material would be disposed of in drums. Grouted waste refers to the solid material obtained by mixing the uranium oxide with cement and repackaging it in drums. Grouting is intended to increase structural strength and stability of the waste and to reduce the solubility of the waste in water. However, because cement would be added to the uranium oxide, grouting would increase the total volume of material requiring disposal. Grouting of waste was assumed to occur at the disposal facility. For each option, the U_3O_8 and UO_2 would be packaged for disposal as follows:

- U_3O_8 would be disposed of in 208 L (55-gal) drums. If ungrouted, approximately 714,000 drums would be required; if grouted, approximately 1,500,000 drums would be required.
- UO_2 would be disposed of in 110 L (30-gal) drums. These small drums would be used because of the greater density of UO_2, a filled 110-L (30-gal) drum would weigh about 605 kg (1,330 lbs). If ungrouted, approximately 740,000 drums would be required; if grouted, approximately 1,110,000 drums would be required.

All disposal options would include a central waste-form facility where drums of uranium oxide would be received from the deconversion facility and prepared for disposal. The waste-form facility would include an administration building, a receiving warehouse, and cementing/curing/ short-term storage buildings (if necessary). Grouting of waste would be performed by mechanically mixing the uranium oxide with cement in large tanks and then pouring the mixture into drums. Once prepared for disposal (if necessary), drums would be moved into disposal units. For the grouted U_3O_8 option, the area of the waste-form facility would be approximately 3.6 ha (9 acres); for the grouted UO_2 option, the area would be about 4.5 ha (11 acres). For ungrouted disposal options, only about 3 ha (7 acres) would be required because the facilities for grouting, curing, and additional short-term storage would not be needed. The unique features of each disposal option are described below.

4.13.3.1.4.1 Disposal in Shallow Earthen Structures

Shallow earthen structures, commonly referred to as engineered trenches, are among the most commonly used forms of low-level waste disposal, especially in dry climates. Shallow earthen structures would be excavated to a depth of about 8 m (26 ft), with the length and width determined by site conditions and the annual volume of waste to be disposed of. Disposal in shallow earthen structures would consist of placing waste on a stable structural pad with barrier walls constructed of compacted clay. Clay would be used because it prevents the walls from collapsing or caving in, and it presents a relatively impermeable barrier to waste migration. The waste containers (i.e., drums) would be tightly stacked three pallets high in the bottom of the structure with forklifts. Any open space between containers would be filled with earth, sand, gravel, or other similar material as each layer of drums was placed. After the structure was filled, a 2-m (6-ft) thick cap composed of engineered fill dirt and clay would be placed on top and compacted. The cap would be mounded at least 1 m (3 ft) above the local grade and sloped to minimize the potential for water infiltration. Disposal would require about 30 ha (74 acres).

4.13.3.1.4.2 Disposal in Vaults

Concrete vaults for disposal would be divided into five sections, each section approximately 20 m (66 ft) long by 8 m (26 ft) wide and 4 m (13 ft) tall. As opposed to shallow earthen structures, the walls and floor of a vault would be constructed of reinforced concrete. A crane would be used to place the depleted U_3O_8 within each section. Once a vault was full, any open space between containers would be filled with earth, sand, gravel, or other similar material. A permanent roof slab of reinforced concrete that completely covers the vault would be installed after all five sections were filled. A cap of engineered fill dirt and clay would be placed on top of the concrete cover and compacted. The cap would be mounded above the local grade and sloped to minimize the potential for water infiltration. Disposal would require about 51 ha (125 acres).

4.13.3.1.4.3 Disposal in a Mine

An underground mine disposal facility would be a repository for permanent deep geological disposal. A mined disposal facility could possibly use a previously existing mine, or be constructed for the sole purpose of waste disposal. For purposes of comparing alternatives, the conservative assumption of constructing a new mine was assessed in the PEIS. A mine disposal facility would consist of surface facilities that provide space for waste receiving and inspection (the waste-form facility), and shafts and ramps for access to and ventilation of the underground portion of the repository. The underground portion would consist of tunnels (called “drifts”) for the transport and disposal of waste underground. The dimensions of the drifts would be similar to those described previously for the storage options, except that each drift would have a width of 6.5 m (21 ft). Waste containers would be placed in drifts and back-filled. Disposal of ungrouted and grouted U_3O_8 would require about 91 ha (228 acres) and 185 ha (462 acres) of underground disposal space, respectively. Disposal of ungrouted and grouted UO_2 would require about 70 ha (172 acres) and 102 ha (252 acres), respectively.

4.13.3.1.5 Potential Impacts of Each Disposal Option

This section provides a summary of the potential environmental impacts associated with the disposal of depleted uranium oxides in shallow earthen structures, vaults, and a mine during two distinct phases: (1) the operational phase and (2) the post-closure phase. Analysis of the operational phase included facility construction and the time during which waste would be actively placed in disposal units. Analysis of the post-closure phase considered potential impacts 1,000 years after the disposal units fail (i.e., release uranium material to the environment). For each phase, impacts were estimated for both generic wet and dry environmental settings. The following is presented as a general summary of potential environmental impacts during the operational phase:

- ***Potential Adverse Impacts.*** Potential adverse impacts during the operational phase would be small and generally similar for all options. Minor to moderate impacts would occur during construction activities, although these impacts would be temporary and easily mitigated by common engineering and good construction practices. Impacts during waste emplacement activities also would be small and limited to workers.
- ***Wet or Dry Environmental Setting.*** In general, potential impacts would be similar for generic wet and dry environmental settings during the operational phase.
- ***U_3O_8 or UO_2.*** The potential disposal impacts tend to be slightly larger for U_3O_8 than for UO_2 because the volume of U_3O_8 would be greater and most environmental impacts tend to be proportional to the volume.
- ***Grouted or Ungrouted Waste.*** For both U_3O_8 and UO_2, the disposal of grouted waste would result in larger impacts than disposal of ungrouted waste during the operational phase for two reasons: (1) grouting increases the volume of waste requiring disposal (by about 50%) and (2) grouting operations result in small emissions of uranium material to the air and water.
- ***Shallow Earthen Structure, Vault, or Mine.*** The potential impacts are essentially similar for disposal in a shallow earthen structure, vault, or mine. However, disposal in a mine could create slightly larger potential impacts if excavation of the mine was required (use of an existing mine would minimize impacts).

For the post-closure phase, impacts from disposal of U_3O_8 and UO_2, were calculated for a post-failure time of 1,000 years. The potential impacts estimated for the post-closure phase are subject to a great deal of uncertainty because of the extremely long time period considered and the dependence of predictions on the behavior of the waste material as it interacts with soil and water in a distant future environment. The post-closure impacts would depend greatly on the specific disposal facility design and site-specific characteristics. Because of these uncertainties, the assessment assumptions are generally selected to produce conservative estimates of impact, i.e., they tend to overestimate the expected impact. Changes in key disposal assumptions could yield significantly different results.

The following is presented as a general summary of potential environmental impacts during the post-closure phase:

- ***Potential Adverse Impacts.*** For all disposal options, potentially large impacts to human health and groundwater quality could occur within 1,000 years after failure of a facility in a wet setting, whereas essentially no impacts would occur from a dry setting in the same time frame. Potential impacts would result primarily from the contamination of groundwater. The

maximum dose to an individual assumed to live at the edge of the disposal site and use the contaminated water was estimated to be about 1.1 mSv/yr (110 mrem/yr), which would exceed the 0.25 mSv/yr (25-mrem/yr) limit specified in 10 CFR 61 (CFR, 2003r) and DOE Order 5820.2A (DOE, 1988). (For comparison, the average dose equivalent to an individual from background radiation is about 2 to 3 mSv/yr (200 to 300 mrem/yr). Possible exposures (on the order of 0.1 Sv/yr (10 rem/yr) could occur for shallow earthen structures and vaults if the cover material were to erode and expose the uranium material; however, this would not arise until several thousand years later, and such exposure could be eliminated by adding new cover material to the top of the waste area.

- ***Wet or Dry Environmental Setting.*** The potential impacts would be significantly greater in a wet setting than in a dry setting. Specifically virtually no impacts would be expected in a dry setting for more than 1,000 years due to the low water infiltration rate and greater depth to the water table.
- ***U_3O_8 or UO_2.*** Overall, the potential environmental impacts tend to be slightly larger for U_3O_8 than for UO_2 because the volume of U_3O_8 requiring disposal would be greater than that of UO_2. A larger volume of waste essentially exposes a greater area of it to infiltrating water.
- ***Grouted or Ungrouted Waste.*** For both U_3O_8 and UO_2, the disposal of grouted waste would have larger environmental impacts than disposal of ungrouted waste, once the waste was exposed to the environment, because grouting would increase the waste volume. However, further studies using site-specific soil characteristics are necessary to determine the effect of grouting on long-term waste mobility. Grouting might reduce the dissolution rate of the waste and subsequent leaching of uranium into the groundwater in the first several hundred years after failure. However, over longer periods the grouted form would be expected to deteriorate and, because of the long half-life of uranium, the performance of grouted and ungrouted waste would be essentially the same. Depending on soil properties and characteristics of the grout material, it is also possible that grouting could increase the solubility of the uranium material by providing a carbonate-rich environment.
- ***Shallow Earthen Structure, Vault, or Mine.*** Because of the long time periods considered and the fact that the calculations were performed to characterize a time of 1,000 years after each facility was assumed to fail, the potential impacts are very similar among the options of for disposal in a shallow earthen structure, vault, or mine. However, shallow earthen structures would be expected to contain the waste material for a period of at least several hundred years before failure, whereas vaults and a mine would be expected to last even longer — from several hundred years to a thousand years or more. Therefore, vault and mine disposal would provide greater protection of waste in a wet environment. In addition, both vault and a mine would be expected to provide additional protection against erosion of the cover material (and possible resultant surface exposure of the waste material) as compared to shallow earthen structures. The exact time that any disposal facility would perform as designed would depend on the specific facility design and site characteristics.

In NUREG-1484 (NRC, 1994a), Section 4.2.2.8, the NRC provided a generic evaluation of the impacts of disposal of depleted uranium oxides. This generic evaluation was done since there are no actual disposal facilities for large quantities of depleted UF_6. The depleted UF_6 disposal impact analysis method included selection of assumed generic disposal sites, development of undisturbed performance and deep well water use exposure scenarios, and estimation of potential doses.

Exposure pathways used for the near-surface disposal case included drinking shallow well water and consuming crops irrigated with shallow well water. Evaluation of the deep disposal case included undisturbed performance and deep well water exposure scenarios. In the undisturbed performance scenario, groundwater flows into a river that serves as a source of drinking water and fish. For the well water use exposure scenario, an individual drills a well into an aquifer down gradient from the disposal facility and uses groundwater for drinking and irrigation.

The release of uranium isotopes and their daughter nuclides from the disposal facility is limited by their solubility in water. Using the environmental characteristics of a humid southeastern U.S. site and the methods of the EIS, drinking water and agricultural doses were conservatively estimated, for a near surface disposal facility, to exceed 10 CFR 61 limits (CFR, 2003r).

In order to compensate for the lack of knowledge of a specific deep disposal site, two representative sites whose geological structures have previously been characterized were selected for the NRC analysis. Potential consequences of emplacement of U_3O_8 in a geological disposal unit include intake of radionuclides from drinking water, irrigated crops, and fish. Under the assumed conditions for the undisturbed performance scenario, groundwater would be discharged to a river. Under conditions not expected to occur, an individual would obtain groundwater by drilling a well down gradient from the disposal unit.

The estimated impacts for a deep disposal facility were less than the 0.25 mSv/yr (25 mrem/yr) level adopted from 10 CFR 61 (CFR, 2003r) as a basis for comparison. The assumptions used in the analysis, included neglect of potential engineered barriers, mass transfer limitations in releases, and decay and retardation during vertical transfer contribute to a conservative analysis.

The evaluation also concluded that UBCs can be stored indefinitely in a retrievable surface facility with minimal environmental impacts. The environmental impacts associated with such storage would be commitment of the land for a storage area, and a small offsite radiation dose.

4.13.3.1.6 Costs Associated with Depleted UF_6 Conversion and Disposal

This section presents cost estimates for the conversion of depleted uranium hexafluoride (depleted UF_6) and the disposal of the depleted triuranium octoxide (depleted U_3O_8) produced during deconversion. It also presents cost estimates for the associated transportation of depleted UF_6 to the conversion plant and the transportation of depleted U_3O_8 to the disposal site. The cost estimates were obtained from analyses of four sources: a 1997 study by the Lawrence Livermore National Laboratory (LLNL), the Uranium Disposition Services, LLC (UDS) contract with the Department of Energy (DOE) dated August 29, 2002, information from Urenco related to depleted UF_6 disposition costs including conversion, and the costs submitted to the Nuclear Regulatory Commission (NRC) by LES as part of the Claiborne Energy Center (CEC) license application in the early 1990s (LES, 1993). The estimated cost to dispose of depleted U_3O_8 in an exhausted uranium mine was also assessed.

This section reviews cost estimates developed by LLNL for the interim storage of the current very large United States (U.S.) inventory of depleted UF_6 at DOE conversion facilities, the DOE preferred option of conversion of depleted UF_6 to depleted U_3O_8 at DOE facilities, the ultimate disposal of depleted U_3O_8 at DOE sites, and the transportation of depleted UF_6 and depleted U_3O_8 (LLNL, 1997a). While cost estimates for other disposition alternatives (e.g. conversion to

uranium oxide (UO_2)) were reviewed they are not addressed in this section since they were not considered as being applicable to LES. It is noted that the LLNL study estimates are reported in 1996 discounted dollars.

This section reviews the UDS-DOE contract since it is regarded as being more credible than an estimate because it represents actual U.S. cost data (DOE, 2002b). Unfortunately the UDS contract does not provide a breakdown of the conversion and disposal cost components.

This section also reflects information on depleted UF_6 disposition cost by European fuel cycle supplier, Urenco. The disposal costs submitted to the NRC in support of the Claiborne Energy Center license application to the NRC in the early 1990s were also reviewed (LES, 1993).

This section is based on an analysis of reports and literature in the public domain as well as information provided by Urenco and the experience of expert consultants.

In August 2001 the DOE reported that it had an inventory of depleted UF_6 enrichment tails material amounting to 55,000 (60,627), 193,000 (212,746) and 449,000 (494,938) metric tons (tons) stored at its enrichment sites at Oak Ridge in Tennessee, at Portsmouth in Ohio, and at Paducah in Kentucky, respectively (DOE, 2001d). This total of approximately 700,000 MT (771,617 tons) of depleted UF_6 corresponds to about 470,000 MT (518,086 tons) of uranium (MTU) as UF_6, a figure that is obtained by multiplying the mass of depleted UF_6 by the mass fraction of U to UF_6; i.e., 0.676. The depleted UF_6 is stored in approximately 60,000 steel cylinders, some dating back to about 1947 (DOE, 2001e). On October 31, 2000, the DOE issued a Request for Proposal (RFP) to construct depleted UF_6 to depleted U_3O_8 conversion facilities at the Portsmouth and Paducah sites in order to begin management and disposition of the UBCs accumulated at its three sites (DOE, 2000a). The DOE plans to ship the depleted UF_6 stored at the East Tennessee Technology Park (ETTP) at Oak Ridge to Portsmouth for conversion.

Since the 1950s, the government has stored depleted UF_6 in an array of large steel cylinders at Oak Ridge, Paducah, and Portsmouth. Several different cylinder types, including 137 nominal 19-ton cylinders (Paducah) made of former UF_6 gaseous diffusion conversion shells, are in use, although the vast majority of cylinders have a 12 MT (14 ton) capacity. The cylinders are typically 3.7 m (12 ft) long by 1.2 m (4 ft) in diameter, with most having a thin wall thickness of 0.79 cm (5/16 in) of steel. Similar but smaller cylinders are also in use. Thick-walled cylinders, 48Ys that have a 1.6 cm (5/8 in) wall thickness, will be used by LES for storage and transport. The cylinders managed by DOE at the three sites are typically stacked two cylinders high in large areas called yards.

The DOE and USEC Inc. cylinders considered acceptable for UF_6 handling and shipping are referred to as conforming cylinders in the LLNL study. LLNL notes that the old or corroded cylinders that will not meet the American National Standards Institute (ANSI) specifications (ANSI, applicable version), non-conforming cylinders, will require either special handling and special over-packs or transfer of contents to approved cylinders, and approval by regulatory agencies such as the Department of Transportation (DOE, 2001d). The LLNL report estimated high costs for the management and transporting of 29,083 non-conforming cylinders in the study's reference case, approximately 63% of the total of 46,422 cylinders in the study. There are approximately 4,683 cylinders at the Oak Ridge ETTP that the DOE has determined should be transported to the Portsmouth site for disposition. The LLNL report estimated that the life-cycle cost of developing special over-packs and constructing and operating a transfer facility for

the DOE's non-conforming cylinders could be as much as $604 million, in discounted 1996 dollars (LLNL, 1997a).

On August 29, 2002, the DOE announced the competitive selection of UDS to design, construct, and operate conversion facilities near the Paducah and Portsmouth gaseous diffusion plants. UDS will operate these facilities for the first five years, beginning in 2005. The UDS contract runs from August 29, 2002 to August 3, 2010. UDS will also be responsible for maintaining the depleted uranium and product inventories and transporting depleted uranium from ETTP to the Portsmouth for conversion. The DOE-UDS contract scope includes packaging, transporting and disposing of the conversion product depleted U_3O_8 at a government waste disposal site such as the Nevada Test Site (NTS) (DOE, 2002b).

UDS is a consortium formed by Framatome ANP, Inc., Duratek Federal Services, Inc., and Burns and Roe Enterprises, Inc. The estimated value of the cost reimbursement contract is $558 million (DOE, 2002c). Design, construction and operation of the facilities will be subject to appropriations of funds from Congress. On December 19, 2002, the White House confirmed that funding for both conversion facilities will be included in President Bush's 2004 budget. President Bush signed the Energy and Water Appropriations Bill on December 1, 2003 which included funding for both conversion facilities.

The NEF UBCs will all be thick-walled conforming 48Y cylinders. The 48Y cylinders have a gross weight of about 14.9 MT (16.4 tons), and when filled, will normally contain 12.5 MT (13.8 tons) of UF_6 or about 8.5 MTU (9.4 tons). The management and transporting of the LES UBCs will not involve unusual costs such as those that will be required for the majority of the DOE-managed cylinders currently stored at the three government sites.

In May 1997, LLNL published a cost analysis report for the long-term management of depleted uranium hexafluoride (LLNL, 1997a). The report was prepared to provide comparative life-cycle cost data for the Department of Energy's (DOE) Draft 1997 Programmatic Environmental Impact Statement (PEIS) on alternative strategies for management and disposition of depleted UF_6 (DOE, 1997a). The LLNL report appears to be the most comprehensive recent assessment of depleted UF_6 disposition costs available in the public domain. The technical data on which the LLNL cost analysis report is based, is principally the May 1997 Engineering Analysis Report, also by LLNL (LLNL, 1997b). The April 1999 Final PEIS identified as soon as practicable conversion of DUF_6 to another stable chemical form, uranium oxide (or metal if there is a use for it), the DOE-preferred management alternative (DOE, 1999).

The LLNL costs, which are reported in discounted 1996 dollars (first quarter), were undiscounted and adjusted upward by 11% to 2002 dollars using the U.S. Gross Domestic Product (GDP) Implicit Price Deflator (IPD).

When the LLNL report was prepared in 1997, more than five years ago, the cost estimates in it were based on an inventory of 560,000 MT (617,294 tons) of depleted UF_6, or 378,600 MTU (417,335 tons uranium) after applying the 0.676 mass fraction multiplier. This inventory equates over the 20 years of the study to an annual throughput rate of 28,000 MT (30,865 tons) of UF_6 or about 19,000 MT (20,943 tons) of depleted uranium, which is approximately 3.6 times the expected annual UBC output of the proposed NEF. The costs in the LLNL report are based on the life-cycle quantity of 378,600 MTU (417,335 tons uranium), beginning in 2009.

The LLNL cost analyses assumed that the depleted UF_6 would be converted to depleted U_3O_8, the DOE's preferred disposal form, using one of two dry process conversion alternatives. The first alternative, the AHF option, upgrades the hydrogen fluoride (HF) product to anhydrous HF

(<1.0% water). In the second option, the HF neutralization alternative, the HF would be neutralized with lime to produce calcium fluoride (CaF_2). The LLNL cost analyses assumed that the AHF and CaF_2 conversion products' would have negligible uranium contamination and could be sold for unrestricted use.

Table 4.13-2, LLNL Estimated Life-Cycle Costs for DOE Depleted UF_6 to Depleted U_3O_8 Conversion, presents the LLNL-estimated life-cycle capital, operating, and regulatory discounted costs in 1996 dollars, for conversion of 378,600 MTU (417,335 tons uranium) over 20 years, of depleted UF_6 to depleted U_3O_8 by anhydrous hydrogen fluoride (AHF) and HF neutralization processing. The costs were extracted from Table 4.8 in the LLNL report. The discounted LLNL life-cycle costs in 1996 dollars were undiscounted and converted to per kg unit costs and adjusted to 2002 dollars using the Gross Domestic Product (GDP) Implicit Price Deflator (IPD), as shown in the table. The escalation adjustment resulted in the 1996 costs being increased by 11%.

The anhydrous hydrogen fluoride (AHF) conversion option for which LLNL provides a cost estimate assumes that the AHF by-product is saleable, and that total sales revenues over the 20 years of operation would amount to $77.32 million, in discounted dollars. LLNL also assumed that the life-cycle sale of CaF_2 obtained from neutralizing HF with lime would result in discounted revenues of $11.02 million.

The cost estimates for the conversion facility assumed that all major buildings are to be structural steel frame construction, except for the process building which is a two story reinforced concrete structure. Most of this building is assumed to be "special construction" with 0.3-m (1-ft) thick concrete perimeter walls and ceilings, 8-in concrete interior walls, and 0.6-m (2-ft) thick concrete floor mat. The "standard construction" area walls were taken to be 8-in thick concrete with 15-cm (6-in) elevated floors and 20 cm (8-in) concrete floors slabs on grade.

Table 4.13-3, Summary of LLNL Estimated Capital, Operating and Regulatory Unit Costs for DOE depleted UF_6 to Depleted U_3O_8 Conversion, presents a summary of estimated capital, operating and regulatory costs for depleted UF_6 to depleted U_3O_8 conversion on a dollars per kgU basis, in both 1996 and 2002 dollars, undiscounted. It can be seen that in either case the conversion process is operations and maintenance intensive.

Table 4.13-4, LLNL Estimated Life Cycle Costs for DOE Depleted UF_6 Disposal Alternatives, presents LLNL-estimated life-cycle costs for the waste form preparation and disposal of DOE depleted U_3O_8 produced by conversion of depleted UF_6. The table presents estimated costs for two depleted U_3O_8 disposal alternatives: shallow earthen structures (engineered "trenches") and concrete vaults. The waste form preparation for each alternative consists primarily of loading, compacting, and sealing the depleted U_3O_8 into 208-L (55-gal) steel drums.

The LLNL-estimated life-cycle costs for depleted U_3O_8 disposal range from $86 million, in discounted 1996 dollars, for the engineered trench alternative to $180 million for depleted U_3O_8 disposal in a concrete vault. The disposal unit costs range from $1.46 per kgU to $2.17 per kgU, in 2002 dollars. As discussed later in this section, the LLNL-estimated concrete vault costs are higher than those that would be required to either sink a new underground mine or to refurbish and operate an existing exhausted mine, an alternative that the NRC has indicated to be acceptable (ORNL, 1995). For example, the capital cost for the concrete vault alternative of $130.75 million in discounted 1996 dollars or $349.7 million in undiscounted 2002 dollars is far greater than the $12.4 million cost of a new 200 MT (220 tons) per day underground mine, as shown later in this section.

Table 4.13-5, Summary of Total Estimated Conversion and Disposal Costs presents the depleted UF_6 conversion and depleted U_3O_8 disposal costs already discussed on a dollar per kgU basis, in undiscounted 2002 dollars. In addition it also includes the LLNL-estimated cost to DOE of rail transportation (including loading and unloading) of conforming depleted UF_6 cylinders to the conversion facility site and drummed depleted U_3O_8 to the disposal sites. It does not include interim storage costs since it may reasonably be assumed that LES UBCs may be shipped directly to the deconversion facility. The table indicates that the total costs for depleted UF_6 disposal in, in 2002 dollars, based on the LLNL study estimates, is likely to range from about $5.06 to $5.81 per kgU.

On August 29, 2002, the DOE announced the competitive selection of UDS to design and construct conversion facilities near the DOE enrichment plants at Paducah, Kentucky and Portsmouth, Ohio, and to operate these facilities from 2006 to 2010. UDS will also be responsible for maintaining the depleted uranium and conversion product inventories and transporting depleted uranium from Oak Ridge East Tennessee Technology Park (ETTP) to the Portsmouth site for conversion. The contract scope includes packaging, transporting and disposing of the conversion product depleted U_3O_8. Table 4.13-6, DOE UDS August 29, 2002 Contract Quantities and Costs presents a summary of the UDS contract quantities and costs.

The DOE-estimated value of the cost reimbursement incentive fee contract, which runs from August 29, 2002 to August 3, 2010, is $558 million (DOE, 2002c). Design, construction and operation of the facilities will be subject to appropriations of funds from Congress. On December 19, 2002, the White House confirmed that funding for both conversion facilities will be included in President Bush's 2004 budget. However, the Office of Management and Budget has not yet indicated how much funding will be allocated. Framatome is a subsidiary of Areva, the French company whose subsidiary Cogema has operated the world's only existing commercial depleted UF_6 conversion plant since 1984.

The table shows the target deconversion quantities and the estimated fee. The contract calls for the construction of a 12,200 MTU (13,448 tons uranium) per year conversion plant at Paducah and a 9,100 MTU (10,031 tons uranium) per year conversion plant at Portsmouth, for an annual nominal total capacity of 21.3 million kgU (23,479 tons uranium), which is also the target conversion rate per year. Based on the target conversion rate the UDS contract total unit capital cost is estimated to be $0.77 per kgU ($0.35 per lb U). This unit cost is based on plant operation over 25 years and 6% government cost of money. The conversion, disposal and material management total operating cost during the first five years of operation corresponds to $3.15 per kgU. The total unit capital and operating cost is $3.92 per kgU. As noted earlier in this section, the DOE has indicated that the disposal of the depleted U_3O_8 may take place at the Nevada Test Site. The cost to DOE of depleted U_3O_8 disposal at NTS is currently estimated at $7.50 per ft^3 or about $0.11 per kgU ($.0.05 per lb U). In 1994 it was reported that the NTS charge to the DOE of $10 per ft^3 ($0.15 per kgU) was not a full cost recovery rate (EGG, 1994).

It is of interest to note that USEC entered into an agreement with the DOE on June 30, 1998, wherein it agreed to pay the DOE $50,021,940 immediately prior to privatization for a commitment by the DOE "for storage, management and disposition of the transferred depleted uranium…" generated by USEC during the FY 1999 to FY 2004 time period (DOE, 1998). Under the terms of the agreement, the DOE also committed to perform "…research and development into the beneficial use of depleted uranium, and related activities and support services for depleted uranium-related activities". The agreement specifies that USEC will transfer to the DOE title to and possession of 2,026 48G cylinders containing approximately

16,673,980 kgU (18,380 tons of uranium). Under this agreement, DOE effectively committed to dispose of the USEC DUF_6 at an average rate of approximately 3.0 million kgU per year between the middle of calendar 1998 and the end of 2003 at a cost of exactly $3.00 per kgU ($1.36 per lb U), in 1998 dollars.

According to Urenco its depleted UF_6 disposal will be similar to those that will be generated by LES at the NEF. Urenco contracts with a supplier for depleted UF_6 to depleted U_3O_8 conversion. The supplier has been converting depleted UF_6 to depleted U_3O_8 on an industrial scale since 1984.

The Claiborne Energy Center costs given in Table 4.13-7, Summary of Depleted UF_6 Disposal Costs from Four Sources are based upon those presented to John Hickey of the NRC in the LES letter of June 30, 1993 (LES, 1993) as adjusted for changes in units and escalated to 2002. A conversion cost of $4.00 per kgU was provided to LES by Cogema at that time. A value of $1.00 per kgU U_3O_8 ($0.45 lb U_3O_8) depleted U_3O_8 disposal cost was based on information provided by Urenco at the time.

As indicated earlier in this section, the NRC has noted that an existing exhausted underground uranium mine would be a suitable repository for depleted U_3O_8 (NRC, 1995). For purposes of comparing alternatives, the conservative assumption of constructing a new mine was assessed. A mine disposal facility would consist of surface facilities for waste receiving and inspection (the waste-form facility), and shafts and ramps for access to and ventilation of the underground portion of the repository, and appropriate underground transport and handling equipment. The mine underground would consist of tunnels (called "drifts") and cross-cuts for the transport and storage of stacked 208-L (55-gal) steel drums which are then back-filled. A great many features of a typical underground mine would be applicable to this disposal alternative.

The NEF, when operating at its nominal full capacity of 3.0 million Separative Work Units (SWUs) per year will produce 7,800 MT (8.598 tons) of depleted UF_6 A typical U.S. underground mine, operating for five days per week over fifty weeks of the year, excepting ten holiday days per year, would operate for 240 days per year. Thus, if LES UBCs were disposed uniformly over the year, the average disposal rate would be 32.5 MT (35.8 tons) of depleted UF_6 per day. This is much less than the rate of ore production in even a typical small under ground mine. However, it may reasonably assumed that the rate of emplacement of the drummed depleted U_3O_8 would be less than the rate of ore removal from a typical underground mine.

The estimated capital and operating costs for a 200 MT per day underground metal mine in a U.S. setting was provided by a U.S. mining engineering company, Western Mine Engineering, Inc. The costs are for a vein type mine accessed by a 160-m (524-ft) deep vertical shaft with rail type underground haulage transport. The operating costs for the 200 MT per day mine is estimated to be $0.07 per kg ($0.03 per lb) of ore and the capital cost is estimated to be approximately $0.04 per kg ($0.02 per lb) of ore, for a total cost of $0.11 per kg ($0.05 per lb) of ore. The capital cost of the mine is $12.4 million 2002 dollars. In the case of an existing exhausted mine the capital costs could be much less.

The mine cost estimates presented indicate that the assumption of the much higher costs presented in Table 4.13-4, LLNL Estimated Life Cycle Costs for DOE Depleted UF_6 Disposal Alternatives for the concrete vault alternative, represents an upper bound cost estimate for depleted U_3O_8 disposal. For example, the capital cost of the concrete vault alternative, which may be obtained by discounting the LLNL estimate costs presented in Table 4.13-4, is $350

million in 2002 dollars, or 28 times the capital cost of the 200 MT (220 tons) mine discussed above.

The four sets of cost estimates obtained are presented in Table 4.13-7 in 2002 dollars per kgU. Note that the Claiborne Enrichment Center cost had a greater uncertainty associated with it. The UDS contract does not allow the component costs for conversion, disposal and transportation to be estimated. The costs in the table indicate that $5.50 per kgU ($2.50 per lb U) is a conservative and, therefore, prudent estimate of total depleted UF_6 disposition cost for the LES NEF. Urenco has reviewed this estimate and, based on its current cost for UBC disposal, finds this figure to be prudent.

4.13.3.2 Water Quality Limits

All plant effluents are contained on the NEF site. A series of evaporation retention/detention basins, and septic systems are used to contain the plant effluents. There will be no discharges to a Publicly Owned Treatment Works (POTW). Contaminated water is treated to the limits in 10 CFR 20.2003, 10 CFR 20, Appendix B, Table 3 and to administrative levels recommended by Regulatory Guide 8.37 (CFR, 2003q; NRC, 1993). Refer to ER Section 4.4, Water Resource Impacts, for additional water quality standards and permits for the NEF. ER Section 3.12, Waste Management, also contains information on the NEF systems and procedures to ensure water quality.

4.13.4 Waste Minimization

The highest priority has been assigned to minimizing the generation of waste through reduction, reuse or recycling. The NEF incorporates several waste minimization systems in its operational procedures that aim at conserving materials and recycling important compounds. For example, all Fomblin Oil will be recovered where practical. Fomblin Oil is an expensive, highly fluorinated, inert oil selected specifically for use in UF_6 systems to avoid reactions with UF_6. The NEF will also have in place a Decontamination Workshop designed to remove radioactive contamination from equipment and allow some equipment to be reused rather than treated as waste.

In addition, the NEF process systems that handle UF_6, other than the Product Liquid Sampling System, will operate entirely at subatmospheric pressure to prevent outward leakage of UF_6. Cylinders, initially containing liquid UF_6, will be transported only after being cooled, so that the UF_6 is in solid form, to minimize the potential risk of accidental releases due to mishandling.

The NEF is designed to minimize the usage of natural and depletable resources. Closed-loop cooling systems have been incorporated in the designs to reduce water usage. Power usage will be minimized by efficient design of lighting systems, selection of high-efficiency motors, and use of proper insulation materials.

ALARA controls will be maintained during facility operation to account for standard waste minimization practices as directed in 10 CFR 20 (CFR, 2003q). The outer packaging associated with consumables will be removed prior to use in a contaminated area. The use of glove boxes will minimize the spread of contamination and waste generation.

Collected waste such as trash, compressible dry waste, scrap metals, and other candidate wastes will be volume reduced at a centralized waste processing facility. This facility could be

operated by a commercial vendor such as GTS Duratek. This facility would further reduce generated waste to a minimum quantity prior to final disposal at a land disposal facility or potential reuse.

4.13.4.1 Control and Conservation

The features and systems described below serve to limit, collect, confine, and treat wastes and effluents that result from the UF_6 enrichment process. A number of chemicals and processes are used in fulfilling these functions. As with any chemical/industrial facility, a wide variety of waste types will be produced. Waste and effluent control is addressed below as well as the features and systems used to conserve resources.

4.13.4.1.1 Mitigating Effluent Releases

The equipment and design features incorporated in the NEF are selected to keep the release of gaseous and liquid effluent contaminants as low as practicable, and within regulatory limits. They are also selected to minimize the use of depletable resources. Equipment and design features for limiting effluent releases during normal operation are described below:

The process systems that handle UF_6 operate almost entirely at sub-atmospheric pressures. Such operation results in no outward leakage of UF_6 to any effluent stream.

- The one location where UF_6 pressure is raised above atmospheric pressure is in the piping and cylinders inside the sampling autoclave. The piping and cylinders inside the autoclave confine the UF_6. In the event of leakage, the sampling autoclave provides secondary containment of UF_6.
- Cylinders of UF_6 are transported only when cool and when the UF_6 is in solid form. This minimizes risk of inadvertent releases due to mishandling.
- Process off-gas, from UF_6 purification and other operations, is discharged through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases are discharged through high-efficiency filters and chemical adsorbent beds. The filters and adsorbents remove HF and uranium compounds left in the gaseous effluent stream.
- Liquids and solids in the process systems collect uranium compounds. When these liquids and solids (e.g., oils, damaged piping, or equipment) are removed for cleaning or maintenance, portions end up in wastes and effluent. Different processes are employed to separate uranium compounds and other materials (such as various heavy metals) from the resulting wastes and effluent. These processes are described in ER Section 4.13.4.2 below.
- Processes used to clean up wastes and effluent create their own wastes and effluent as well. Control of these is also accomplished by liquid and solid waste handling systems and techniques, which are described in detail in the Sections below. In general, careful applications of basic principles for waste handling are followed in all of the systems and processes. Different waste types are collected in separate containers to minimize contamination of one waste type with another. Materials that can cause airborne contamination are carefully packaged; ventilation and filtration of the air in the area is provided as necessary. Liquid wastes are confined to piping, tanks, and other containers; curbing, pits, and sumps are used to collect and contain leaks and spills. Hazardous wastes are stored in designated areas in carefully labeled containers; mixed wastes are also

contained and stored separately. Strong acids and caustics are neutralized before entering an effluent stream. Radioactively contaminated wastes are decontaminated insofar as possible to reduce waste volume.

- Following handling and treatment processes to limit wastes and effluent, sampling and monitoring is performed to assure regulatory and administrative limits are met. Gaseous effluent is monitored for HF and is sampled for radioactive contamination before release; liquid effluent is sampled and/or monitored in liquid waste systems; solid wastes are sampled and/or monitored prior to offsite treatment and disposal. Samples are returned to their source where feasible to minimize input to waste streams.

4.13.4.1.2 Conserving Depletable Resources

The NEF design serves to minimize the use of depletable resources. Water is the primary depletable resource used at the facility. Electric power usage also depletes fuel sources used in the production of the power. Other depletable resources are used only in small quantities. Chemical usage is minimized not only to conserve resources, but also to preclude excessive waste production. Recyclable materials are used and recycled wherever practicable.

The main feature incorporated in the NEF to limit water consumption is the use of closed-loop cooling systems. Refer to SAR Section 3.5.5 for details concerning the NEF cooling water systems.

The NEF is designed to minimize the usage of natural and depletable resources as shown by the following measures:

- The use of low-water consumption landscaping versus conventional landscaping reduces water usage.
- The installation of low flow toilets, sinks and showers reduces water usage when compared to standard flow fixtures.
- Localized floor washing using mops and self-contained cleaning machines reduces water usage compared to conventional washing with a hose twice per week.
- The use of high efficiency washing machines compared to standard machines reduces water usage.
- The use of high efficiency closed cell cooling towers (water/air cooling) versus open cell design reduces water usage.
- Closed-loop cooling systems have been incorporated to reduce water usage.

Power usage is minimized by efficient design of lighting systems, selection of high-efficiency motors, use of appropriate building insulation materials, and other good engineering practices. The demand for power in the process systems is a major portion of plant operating cost; efficient design of components is incorporated throughout process systems.

4.13.4.1.3 Prevention and Control of Oil Spills

The NEF will implement a spill control program for accidental oil spills. The purpose of the spill control program will be to reduce the potential for the occurrence of spills, reduce the risk of injury in case of a spill occurs, minimize the impact of a spill, and provide a procedure for the cleanup and reporting of spills. The oil spill control program will be established to comply with

the requirements of 40 CFR 112 (CFR, 2003aa), Oil Pollution Prevention. As required by Part 112 , a Spill Prevention, Control, and Countermeasure (SPCC) plan will be prepared prior to either the start of facility operation of the facility or prior to the storage of oil onsite in excess of the de minimis quantities established in 40 CFR 112.1(d) (CFR, 2003aa). The SPCC Plan will be reviewed and certified by a Professional Engineer and will be maintained onsite.

As a minimum the SPCC Plan will contain the following information:

- Identification of potential significant sources of spills and a prediction of the direction and quantity of flow that would result from a spill from each such source;
- Identification the use of containment or diversionary structures such as dikes, berms, culverts, booms, sumps, and diversion ponds to be used at the facility where appropriate to prevent discharged oil from reaching navigable waters;
- Procedures for inspection of potential sources of spills and spill containment/diversion structures; and
- Assigned responsibilities for implementing the plan, inspections, and reporting.

In addition to preparation and implementation of the SPCC Plan, the facility will comply with the specific spill prevention and control guidelines contained in 40 CFR 112.7(e) (CFR, 2003aa), such as drainage of rain water from diked areas, containment of oil in bulk storage tanks, above ground tank integrity testing, and oil transfer operational safeguards.

4.13.4.2 Reprocessing and Recovery Systems

Systems used to allow recovery or reuse of materials are described below.

4.13.4.2.1 Fomblin Oil Recovery System

Fomblin oil is an expensive, highly fluorinated, inert oil selected specifically for use in UF_6 systems to avoid reaction with UF_6. The Fomblin Oil Recovery System recovers used Fomblin oil from pumps used in UF_6 systems. All Fomblin oil is recovered; none is normally released as waste or effluent.

Used Fomblin oil is recovered by removing impurities that inhibit the oil's lubrication properties. The impurities collected are primarily uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4) particles. The recovery process also removes trace amounts of hydrocarbons, which if left in the oil would react with UF_6. The Fomblin Oil Recovery System components are located in the Decontaminated Workshop in the Technical Services Building (TSB). The total annual volume of oil to be processed in this system is approximately 535 L (141 gal).

The Fomblin oil recovery process consists of oil collection, uranium precipitation, trace hydrocarbon removal, oil sampling, and storage of cleaned oil for reuse. Each step is performed manually.

Fomblin oil is collected in the Vacuum Pump Rebuild Workshop as part of the pump disassembly process. The oil is the transferred for processing to the Decontamination Workshop in plastic containers. The containers are labeled so each can be tracked through the process. Used oil awaiting processing is stored in the used oil storage receipt array to eliminate the possibility of accidental criticality.

Uranium compounds are removed from the Fomblin oil in the Fomblin oil fume hood to minimize personnel exposure to airborne contamination. Dissolved uranium compounds are removed by the addition of anhydrous sodium carbonate (Na_2CO_3) to the oil container which causes the uranium compounds to precipitate into sodium uranyl carbonate $Na_4UO_2(CO_3)_3$. The mixture is agitated and then filtered through a coarse screen to remove metal particles and small parts such as screws and nuts. These are transferred to the Solid Waste Collection System. The oil is then heated to 90°C (194°F) and stirred for 90 minutes to speed the reaction. The oil is then centrifuged to remove UF_4, sodium uranyl carbonate, and various metallic fluorides. The particulate removed from the oil is collected and transferred to the Solid Waste Collection Room for disposal.

Trace amounts of hydrocarbons are next removed in the Fomblin oil fume hood next by adding activated carbon to the Fomblin oil and heating the mixture at 100°C (212°F) for two hours. The activated carbon absorbs the hydrocarbons, and the carbon in turn is removed by filtration through a bed celite. The resulting sludge is transferred to the Solid Waste Disposal Collection Room for disposal.

Recovered Fomblin oil is sampled. Oil that meets the criteria can be reused in the system while oil that does not meet the criteria will be reprocessed. The following limits have been set for evaluating recovered Fomblin oil purity for reuse in the plant:

- Uranium - 50 ppm by volume
- Hydrocarbons - 3 ppm by volume

Recovered Fomblin oil is stored in plastic containers in the Chemical Storage Area.

Failure of this system will not endanger the health and safety of the public. Nevertheless, design and operating features are included that contribute to the safety of plant workers. Containment of waste is provided by components, designated containers, and air filtration systems. Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. To minimize worker exposure, airborne radiological contamination resulting from dismantling is extracted. Where necessary, air suits and portable ventilation units are available for further worker protection.

4.13.4.2.2 Decontamination System

The Contaminated Workshop and Decontamination System are located in the same room in the TSB. This room is called the Decontamination Workshop. The Decontamination Workshop in the TSB will contain the area to break down and strip contaminated equipment and to decontaminate that equipment and its components. The decontamination systems in the workshop are designed to remove radioactive contamination from contaminated materials and equipment. The only significant forms of radioactive contamination found in the plant are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4) and uranyl fluoride (UO_2F_2).

One of the functions of the Decontamination Workshop is to provide a maintenance facility for both UF_6 pumps and vacuum pumps. The workshop will be used for the temporary storage and subsequent dismantling of failed pumps. The dismantling area will be in physical proximity to the decontamination train, in which the dismantled pump components will be processed. Full maintenance records for each pump will be kept.

The process carried out within the Decontamination Workshop begins with receipt and storage of contaminated pumps, out-gassing, Fomblin oil removal and storage, and pump stripping. Activities for the dismantling and maintenance of other plant components are also carried out. Other components commonly decontaminated besides pumps include valves, piping, instruments, sample bottles, tools, and scrap metal. Personnel entry into the facility will be via a sub-change facility. This area has the required contamination controls, washing and monitoring facilities.

The decontamination part of the process consists of a series of steps following equipment disassembly including degreasing, decontamination, drying, and inspection. Items from uranium hexafluoride systems, waste handling systems, and miscellaneous other items are decontaminated in this system. The decontamination process for most plant components is described below, with a typical cycle time of one hour. For smaller components the decontamination process time is slightly less, about 50 minutes. Sample bottles and flexible hoses are handled under special procedures due to the difficulty of handling the specific shapes. Sample bottle decontamination and decontamination of flexible hoses are addressed separately below.

Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. Administrative measures are applied to uranium concentrations in the Citric Acid Tank and Degreaser Tank to maintain these controls. To minimize worker exposure, airborne radiological contamination resulting from dismantling is extracted. Air suits and portable ventilation units are available for further worker protection.

Containment of chemicals and wastes is provided by components, designated containers, and air filtration systems. All pipe work and vessels in the Decontamination Workshop are provided with design measures to protect against spillage or leakage. Hazardous wastes and materials are contained in tanks and other appropriate containers, and are strictly controlled by administrative procedures. Chemical reaction accidents are prevented by strict control on chemical handling.

4.13.4.2.3 General Decontamination

Prior to removal from the plant, the pump goes through an isolation and de-gas process. This removes the majority of UF_6 from the pump. The pump flanges are then sealed prior to movement to the Decontamination Workshop. The pumps are labeled so each can be tracked through the process. Pumps enter the Decontamination Workshop through airlock doors. The internal and external doors are electrically interlocked such that only one door can be opened at a given time. Pumps may enter the workshop individually or in pairs. Valves, pipework, flexible hoses, and general plant components are accepted into the room either within plastic bags or with the ends blinded.

Pumps waiting to be processed are stored in the pump storage array to eliminate the possibility of accidental criticality. The array maintains a minimum edge spacing of 600 mm (2 ft). Pumps are not accepted if there are no vacancies in the array.

Before being broken down and stripped, all pumps are placed in the Outgas Area and the local ventilation hose is positioned close to the pump flange. The flange cover is then removed. HF and UF_6 fumes from the pump are extracted via the exhaust hose, typically over a period of several hours. While in the Outgas Area, the oil will be drained from the pumps and the first

stage roots pumps will be separated from the second stage roots pumps. The oil is drained into 5-L (1.3 gal) plastic containers that are labeled so each can be tracked through the process.

Prior to dispatch from the Outgas Area, the outside of the bins, the pump frames, and the oil bottles are all monitored for radiological contamination. The various items will then be taken to the decontamination system or Fomblin oil storage array as appropriate.

Oil waiting to be processed is stored in the Fomblin oil storage array to eliminate the possibility of accidental criticality. The array maintains a minimum edge spacing of about 600 mm (2 ft) between containers. When ready for processing, the oil is transferred to the Fomblin Oil Recovery System where the uranics and hydrocarbon contaminants can be separated prior to reuse of the oil.

After out-gassing, individual pumps are removed from the Outgas Area and placed on either of the two hydraulic stripping tables. An overhead crane is utilized to aid the movement of pumps and tools over the stripping table. The tables can be height-adjusted and the pump can be moved and positioned on the table. Hydraulic stripping tools are then placed on the stripping tables using the overhead crane or mobile jig truck. The pump and motor are stripped to component level using various hydraulic and hand tools. Using the overhead crane or mobile jig truck, the components are placed in bins ready for transportation to the General Decontamination Cabinet.

Degreasing is performed following disassembly of equipment. Degreasing takes place in the hot water Degreaser Tank of the decontamination facility system. The degreased components are inspected and then transferred to the next decontamination tank. .

Following disassembly and degreasing, decontamination is accomplished by immersing the contaminated component in a citric acid bath with ultrasonic agitation. After 15 minutes, the component is removed, and is rinsed with water to remove the citric acid.

The tanks are sampled periodically to determine the condition of the solution and any sludge present. The Citric Acid Tank contents are analyzed for uranium concentration and citric acid concentration. A limit on ^{235}U of 0.2 g/L (0.02 ounces/gal) of bath has been established to prevent criticality. Additional citric acid is added as necessary to keep the citric acid concentration between 5% and 7%. Spent solutions, consisting of citric acid and various uranyl and metallic citrates, are transferred to a citric acid collection tank. The Rinse Water Tanks are checked for satisfactory pH levels; unusable water is transferred to an effluent collection tank.

All components are dried after decontamination. This is performed manually using compressed air.

The decontaminated components are inspected prior to release. The quantity of contamination remaining shall be “as-low-as-reasonably practicable." Components released for unrestricted use do not have contamination exceeding 83.3 Bq/100 cm^2 (5,000 dpm/100 cm^2) for average fixed alpha or beta/gamma contamination and 16 Bq/100 cm^2 (1,000 dpm/100 cm^2) removable alpha or beta/gamma contamination. However, if all the component surfaces cannot be monitored then the consignment will be disposed of as a low-level waste.

4.13.4.2.4 Sample Bottle Decontamination

Sample bottle decontamination is handled somewhat differently than the general decontamination process. The Decontamination Workshop has a separate area dedicated to

sample bottle storage, disassembly, and decontamination. Used sample bottles are weighed to confirm the bottles are empty. The valves are loosened, and the remainder of the decontamination process is performed in the sample bottle decontamination hood. The valves are removed inside the fume hood. Any loose material inside the bottle or valve is dissolved in a citric acid solution. Spent citric acid is transferred to the Spent Citric Acid Collection Tank in the Liquid Effluent Collection and Treatment System.

Initially, sample bottles and valves are flushed with a 10% citric acid solution and then rinsed with deionized water. In the case of sample bottles, these are filled with deionized water and left to stand for an hour, while the valves are grouped together and citric acid is recirculated in a closed loop for an hour. These used solutions are collected and taken to the Citric Acid Collection Tank in the General Decontamination Cabinet. Any liquid spillages / drips are soaked away with paper tissues that are disposed of in the Solid Waste Collection Room. Bottles and valves are then rinsed again with deionized water. This used solution is collected in a small plastic beaker, and then poured into the Citric Acid Tank in the decontamination train. Both the bottles and valves are dried manually, using compressed air, and inspected for contamination and rust. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. The bottles are then put into an electric oven to ensure total dryness, and on removal are ready for reuse. The cleaned components are transferred to the clean workshop for reassembly and pressure and vacuum testing.

4.13.4.2.5 Flexible Hose Decontamination

The decontamination of flexible hoses is handled somewhat differently than the general process and has a separate area. The decontamination process is performed in a Flexible Hose Decontamination Cabinet. This decontamination cabinet is designed to process only one flexible hose at a time and is comprised of a supply of citric acid, deionized water and compressed air.

Initially, the flexible hose is flushed with a 10% citric acid solution at 60°C (140°F) and then rinsed with deionized water (also at 60°C) (140°F) in a closed loop recirculation system. The used solutions (citric acid and deionized water) are transferred into the contaminated Citric Acid Tank for disposal. Interlocks are provided in the recirculation loop to prevent such that the recirculation pumps from starting if the flexible hose has not been connected correctly at both ends. Both the citric acid and deionized water recirculation pumps are equipped with a 15-minute timer device. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. Spill from the drip tray are routed to either the Citric Acid Tank or the hot water recirculation tank, depending upon the decontamination cycle. Each flexible hose is then dried in the decontamination cupboard using hot compressed air at 60°C (140°F). to ensure complete dryness. The cleaned dry flexible hose is then transferred to the Vacuum Pump Rebuild Workshop for reassembly and pressure testing prior to reuse in the plant.

4.13.4.2.6 Decontamination Equipment

The following major components are included in the Decontamination System:

- Citric Acid Baths: An open top Citric Acid Tank with a sloping bottom in hastelloy is provided for the primary means of removing radioactive contamination. The sloping-bottom construction is provided for ease of emptying and draining the tank completely. The tank has

a liquid capacity of 800 L (211 gal). The tank is located in a cabinet and is furnished with ultrasonic agitation, a thermostatically controlled electric heater to maintain the content's temperature at 60°C (140°F), and a recirculation pump. Mixing is provided to accommodate sampling for criticality prevention. Level control with a local alarm is provided to maintain the acid level. The tank has a ring header and a manual hose to rinse out residual solids/sludge with deionized water after the batch has been pumped to the Liquid Effluent Collection and Treatment System. In order to minimize uranium concentration, the rinse water from the Rinse Water Tank that receives deionized water directly is pumped into the other Rinse Water Tank, which in turn is pumped into the Citric Acid Tank. The counter-current system eliminates a waste product stream by concentrating the uranics only in the Citric Acid Tank. The rinse water transfer pump is linked with the level controller of the Citric Acid Tank, which prevents overfilling of this tank during transfer of the rinse water. During transfer, the rinse water transfer pump trips at a high tank level resulting in a local alarm. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to assure airborne contamination is controlled. The Citric Acid Tank contents are monitored and then emptied by an air-driven double diaphragm pump into the Spent Citric Acid Collection Tank in the Liquid Effluent Collection and Treatment System.

- Rinse Water Baths: Two open top Rinse Water Tanks with stainless steel sloping bottoms are provided to rinse excess citric acid from decontaminated components. Each of the tanks has a liquid capacity of 800 L (211 gal). Both tanks are located in an enclosure, and each tank is furnished with ultrasonic agitation, a thermostatically controlled electric heater to maintain the contents temperature at 60°C (140°F), and a recirculation pump to accommodate sampling for criticality prevention. The sloping-bottom is provided of emptying and draining the tank completely. Fresh deionized water is added to the tank. In order to minimize uranium concentration, the rinse water from the tank that receives deionized water directly is pumped into the other Rinse Water Tank, which in turn is pumped into the Citric Acid Tank. Level control is provided to maintain the deionized (rinse) water level. During transfer, the rinse water transfer pump trips at tank high level resulting in a local alarm. The Rinse Water Tank that directly receives deionized water is topped up manually with the water as necessary. The extracted air exhausts to the GEVS to assure airborne contamination is controlled. A manual spray hose is available for rinsing the tank after it has been emptied.
- Decontamination Degreasing Unit: An open top Degreaser Tank with a sloping bottom in hastelloy is provided for the primary means of removing the Fomblin oil and greases that may inhibit the decontamination process. Components requiring degreasing are cleaned manually and then immersed into the Degreaser Tank. The sloping-bottom construction is provided for ease of emptying and draining the tank completely. During the decontamination process, the tank contents are continuously recirculated using a pump. Recirculation is provided to accommodate sampling for criticality prevention. The tank has a capacity of 800 L (211 gal) and is located in a cabinet. It is furnished with an ultrasonic agitation facility, and a thermostatically-controlled electric heater to maintain the temperature at 60°C (140°F). The tank has a ring header and a manual hose to rinse out residual solids/sludge with deionized water after the batch has been pumped to the Liquid Effluent Collection and Treatment System. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. Level control with a local alarm is provided to maintain the liquid level. The Degreaser Tank contents are monitored and then emptied by

an air-driven double diaphragm pump into the Degreaser Water Collection Tank in the Liquid Effluent Collection and Treatment System.

- The activities carried out in the Decontamination Workshop may create potentially contaminated gaseous streams, which would require treatment before discharging to the atmosphere. These streams consist of air with traces of UF_6, HF, and uranium particulates (mainly UO_2F_2). The Gaseous Effluent Vent System is designed to route these streams to a filter system and to monitor, on a continuous basis, the resultant exhaust stream discharged to the atmosphere. Air exhausted from the General Decontamination Cabinet, the Sample Bottle Decontamination Cabinet, and the Flexible Hose Decontamination Cabinet is vented to the GEVS. There will be local ventilation ports in the stripping area and Outgas Area that operate under vacuum with all air discharging through the GEVS. The room itself will have other HVAC ventilation.
- Vapor Recovery Unit and distillation still.
- Drying Cabinet: One drying cabinet is provided to dry components after decontamination.
- Decontamination System for Sample Bottles (in a cabinet) - a small, fresh citric acid tank; a small, deionized water tank; and 5 L (1.3 gal) containers for citric acid/uranic waste
- Decontamination System for Flexible Hoses (in a cabinet) - a small citric acid tank for fresh and waste citric acid, an air diaphragm pump and associated equipment
- Various tools for moving equipment (e.g., cranes)
- Various tools for stripping equipment
- An integral monorail hoist with a lifting capacity of one ton, located within the decontamination enclosure, is provided to lift the basket and its components into and out of the Degreaser Tank, Citric Acid Tank, and the two Rinse Water Tanks as part of the decontamination activity sequence.
- Citric Acid Tank and Degreaser Tank clean-up ancillary items, comprised for each tank, a portable air driven transfer pump and associated equipment
- Radiation monitors.

4.13.4.2.7 Laundry System

The Laundry System cleans contaminated and soiled clothing and other articles which have been used throughout the plant. It contains the resulting solid and liquid wastes for transfer to appropriate treatment and disposal facilities. The Laundry System receives the clothing and articles from the plant in plastic bin bags, taken from containers strategically positioned within the plant. Clean clothing and articles are delivered to storage areas located within the plant. The Contaminated Laundry System components are located in the Laundry room of the TSB.

The Laundry System collects, sorts, cleans, dries, and inspects clothing and articles used throughout the plant in the various Restricted Areas. The laundry system does not handle any articles from outside the radiological zones. Laundry collection is divided into two main groups: articles with a low probability of contamination and articles with a high probability of contamination. Those articles unlikely to have been contaminated are further sorted into lightly soiled and heavily soiled groups. The sorting is done on a table underneath a vent hood that is connected to the TSB Gaseous Effluent Vent System (GEVS). All lightly soiled articles are cleaned in the laundry. Heavily soiled articles are inspected and any considered to be difficult to

clean (i.e., those with significant amounts of grease or oil on them) are transferred to the Solid Waste Collection Room without cleaning. Special containers and procedures are used for collection, storage, and transfer of these items as described in the Solid Waste Disposal System section. Articles from one plant department are not cleaned with articles from another plant department.

Special water-absorbent bags are used to collect the articles that are more likely to be contaminated. These articles may include pressure suits and items worn when, for example, it is required to disconnect or “open up” an existing plant system. These articles that are more likely to be contaminated are cleaned separately. Expected contaminants on the laundry include slight amounts of uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4).

Clothing processed by this system normally includes overalls, laboratory coats, shirts, towels and miscellaneous items. Approximately 113 kg (248 lbs) of clothing is washed each day. Upon completion of a cycle, the washer discharges to one of three Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment System.

The washed laundry is dried in the hot air dryers. The exhaust air passes through a lint drawer to the atmosphere. Upon completion of a drying cycle, the dried laundry is inspected for excessive wear. Usable laundry is folded and returned to storage for reuse. Unusable laundry is handled as solid waste as described in the Solid Waste Disposal System section.

When sorting is completed, the articles are placed into the front-loading washing machine in batches. The cleaning process uses 80°C (176°F) minimum water, detergents, and non-chlorine bleach for dirt and odor removal, and disinfection of the laundry. Detergents and non-chlorine bleach are added by vendor-supplied automatic dispensing systems. No “dry cleaning” solvents are used. Wastewater from the washing machine is discharged to one of three Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment System. The laundry effluent is then sampled, analyzed, and transferred to the double-lined Treated Effluent Evaporative Basin with leak detection for disposal (if uncontaminated) or to the Precipitation Treatment Tank for treatment as necessary.

When the washing cycle is complete, the wet laundry is placed in a front-loading, electrically heated dryer. The dryer has variable temperature settings, and the hot wet air is exhausted to the atmosphere through a lint drawer that is built into the dryer. The lint from the drawer is then sent to the Solid Waste Disposal System as combustible waste.

Dry laundry is removed from the dryer and placed on the laundry inspection table for inspection and folding. Folded laundry is returned to storage areas in the plant.

The following major components are included in this system:

- Washers: Two industrial quality washing machines are provided to clean contaminated and soiled laundry. One machine is operating and one is a spare for standby. Each machine has an equal capacity that is capable of washing the daily batches.
- Dryers: Two industrial quality dryers are provided to dry the laundry cleaned in the washing machine. One dryer is operating and one is a spare for standby. Each machine has an equal capacity that is capable of drying the daily batches. The dryer has a lint drawer that filters out the majority of the lint.

- Air Hood: One exhaust hood mounted over the sorting table and connected to the TSB GEVS. The hood is to draw potentially contaminated air away as laundry is sorted prior to washing.
- Sorting Table: One table to sort laundry prior to washing.
- Laundry Inspection Table: One table to inspect laundry for excessive wear after washing and drying.

The Laundry System interfaces with the following other plant systems:

- Liquid Effluent Collection and Treatment System: The wastewater generated during the laundry process is pumped to one of three Laundry Effluent Monitor Tanks.
- Solid Waste Disposal System: The Solid Waste Disposal System receives clothing that has been laundered but is not acceptable for further use. It also receives clothing rejected from the laundry system due to excess quantities of oil or hazardous liquids.
- TSB GEVS: Air from the sorting hood is sent to the TSB GEVS.
- Process Water System: The Process Water System supplies hot and cold water to the washer.
- Compressed Air System: Compressed air will be supplied as required to support options selected for the Laundry washers and dryers.
- Electrical System: The washing machines and dryers consume power.

Piping, piping components, and a laundry room sump provide containment of any liquid radiological waste. Small leaks and spills from the washer are mopped up and sent to the Liquid Effluent Collection and Treatment System. A rarely occurring large leak is captured in the laundry room sump. Any effluent captured in the sump is transferred to the Liquid Effluent Collection and Treatment System by a portable pump.

Liquid effluents from the washers are collected in the Liquid Effluent Collection and Treatment System and monitored prior to discharge to the Treated Effluent Evaporative Basin. Clothing containing hazardous wastes is segregated prior to washing to avoid introduction into this system. The exhaust air blows to atmosphere because there is little chance of any contaminant being in it.

The washer and dryer are equipped with electronic controls to monitor the operation. The dryer has a fire protection system that initiates an isolated sprinkler inside the dryer basket if a fire is detected in the dryer.

4.13.5 Comparative Waste Management Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of “no action” i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three “no action,” alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The waste management impact would be greater since a greater amount of waste results from GDP operation.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The waste management impact would be greater in the short term because the GDP produces a larger waste stream. In the long term, the waste management impact would be the same once the GDP production is terminated.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The waste management impact would be significantly greater because a significant amount of additional waste results from GDP operation at the increased capacity.

TABLES

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Table 4.13-1 Possible Radioactive Waste Processing / Disposal Facilities

Radioactive Waste Processing / Disposal Facility	Acceptable Wastes	Approximate Distance km (miles)
Barnwell Disposal Site Barnwell, SC	Radioactive Class A, B, C Processed Mixed	2,320 (1,441)
Envirocare of Utah South Clive, UT	Radioactive Class A Mixed	1,636 (1016)
GTS Duratek[1] Oak Ridge, TN	Radioactive Class A Some Mixed	1,993 (1,238)
Depleted UF_6 Conversion Facility[2] Paducah, Kentucky	Depleted UF_6	1,670 (1037)
Depleted UF_6 Conversion Facility[2] Portsmouth, Ohio	Depleted UF_6	2,243 (1,393)

[1]Other offsite waste processors may also be used.

[2]Per DOE-UDS contract, to begin operation in 2005.

Table 4.13-2 LLNL-Estimated Life-Cycle Costs for DOE Depleted UF_6 to Depleted U_3O_8 Conversion

LLNL-ESTIMATED LIFE-CYCLE COSTS FOR DOE DEPLETED UF_6 TO DEPLETED U_3O_8 CONVERSION (A) (MILLION DOLLARS FOR 378,600 MTU OF DEPLETED UF_6 OVER 20 YEARS; DISCOUNTED 1996 DOLLARS)		
Conversion Capital & Operating Activities	AHF Conversion Alternative	HF Neutralization Conversion Alternative
Technology Department	9.84	5.74
Process Equipment	22.36	20.88
Process Facilities	46.33	45.53
Balance of Plant	29.20	30.25
Regulatory Compliance	22.70	22.70
Operations & Maintenance	134.76	198.40
Decontamination & Decommissioning	1.76	1.73
Total Discounted Costs (1996 Dollars):	266.95	325.23
Total Undiscounted Costs (1996 Dollars):	902.6	1,160.1
Undiscounted Unit Costs ($/kgU):		
TOTAL (1996 Dollars)	2.38	3.05
TOTAL (2002 Dollars per GDP IPD)	2.64	3.39
(a) Source: (LLNL, 1997a)		
AHF: Assumes sale of anhydrous hydrogen fluoride; $77.32 million credit assumed. HF: Assumes sale of calcium fluoride (CAF_2) produced from hydrogen fluoride (HF); $11.02 million credit assumed.		

Table 4.13-3 Summary of LLNL-Estimated Capital, Operating and Regulatory Unit Costs for DOE Depleted UF_6 to Depleted U_3O_8 Conversion

SUMMARY OF LLNL-ESTIMATED CAPITAL, OPERATING, AND REGULATORY UNIT COSTS FOR DOE DEPLETED UF_6 TO DEPLETED U_3O_8 CONVERSION (A)
(UNDISCOUNTED DOLLARS PER KILOGRAMS OF U AS DEPLETED UF_6)

Cost Breakdown	AHF Alternative		HF Neutralization Alternative	
	1996$	2002$	1996$	2002$
Capital (b)	0.72	0.80	0.69	0.76
Operating & Maintenance	1.51	1.67	2.22	2.46
Regulatory Compliance	0.14	0.16	0.14	0.16
Total:	2.38	2.64	3.05	3.39

(a) Unit costs based on Table 4.13-2 costs.

(b) Technology development, process equipment, process facilities, balance of plant and decontamination and decommissioning.

Source: (LLNL, 1997a)

Note: Summation may be affected by rounding.

Table 4.13-4 LLNL-Estimated Life-Cycle Costs for DOE Depleted UF_6 Disposal Alternatives

LLNL-ESTIMATED LIFE-CYCLE COSTS FOR DOE DEPLETED U_3O_8 DISPOSAL ALTERNATIVES (MILLION DOLLARS FOR 378,600 MTU OF DEPLETED UF_6 OVER 20 YEARS; UNDISCOUNTED 1996 DOLLARS)		
	Depleted U_3O_8 Disposal Alternatives	
Depleted U_3O_8 Disposal Capital & Operating Activities	Engineered Trench	Concrete Vault
Waste Form Preparation:		
Technology Development	6.56	6.56
Balance of Plant	26.43	26.43
Regulatory Compliance	2.02	2.02
Operations & Maintenance	33.23	33.23
Decontamination & Decommissioning	0.60	0.60
Subtotal (1996 Discounted Dollars)	68.84	68.84
Waste Disposal:		
Facility Engineering & Construction	12.22	96.08
Site Preparation & Restoration	0.89	1.68
Emplacement & Closure	30.61	39.2
Regulatory Compliance	40.35	40.35
Surveillance & Maintenance	2.29	2.86
Subtotal (1996 Discounted Dollars)	86.36	180.17
Preparation & Disposal Discounted Total Costs (1996 Dollars):	155.20	249.01
Preparation & Disposal Undiscounted Total Costs (1996 Dollars):	499.60	742.50
Undiscounted Unit Costs ($/kgU):		
TOTAL (1996 Dollars)	1.31	1.95
TOTAL (2002 Dollars per GDP IPD)	1.46	2.17
Source: (LLNL, 1997a)		

Table 4.13-5 Summary of Total Estimated Conversion and Disposal Costs

SUMMARY OF TOTAL ESTIMATED CONVERSION AND DISPOSAL COSTS (UNDISCOUNTED 2002 DOLLARS PER KGU OF DEPLETED UF_6)				
	AHF Alternative		HF Neutralization Alternative	
Cost Items	Engineered Trench	Concrete Vault	Engineered Trench	Concrete Vault
Depleted UF_6 Conversion to Depleted U_3O_8	2.64	2.64	3.39	3.39
Waste Preparation & Disposal	1.46	2.17	1.46	2.17
Depleted UF_6 & Depleted U_3O_8 Transportation	0.25	0.25	0.25	0.25
Total Cost:	4.35	5.06	5.1	5.81

Table 4.13-6 DOE-UDS August 29, 2002 Contract Quantities and Costs

DOE-UDS AUGUST 29, 2002, CONTRACT QUANTITIES & COSTS		
	Target Million kgU	
UDS Conversion & Disposal Quantities:	Depleted UF_6 (a)	U (b)
FY 2005 (Aug. – Sept.)	1.050	0.710
FY 2006	27.825	18.8
FY 2007	31.500	21.294
FY 2008	31.500	21.294
FY 2009	31.500	21.294
FY 2010 (Oct.-July)	26.250	17.745
Total:	149.625	101.147
Nominal Conversion Capacity (c) and Target Conversion Rate (Million kgU/yr)		21.3
UDS Contract Workscope Costs (d):		Million $
Design, Permitting, Project Management, etc.		27.99
Construct Paducah Conversion Facility		93.96
Construct Portsmouth Conversion Facility		90.40
Operations for First 5 Years Depleted UF_6 & Depleted U_3O_8 (e)		283.23
Contract Estimated Total Cost w/o Fee		495.58
Contract Estimated Value per DOE PR, August 29, 2003		558.00
Difference Between Cost & Value is the Estimated Fee of 12.6%		62.42
Capital Cost without Fee		212.35
Capital Cost with Fee		239.10
First 5 Years Operating Cost with Fee		318.92
Estimated Unit Conversion & Disposal Costs:		
Unit Capital Cost (f)		$0.77/kgU
2005-2010 Unit Operating Costs in 2002$		$3.15/kgU
Total Estimated Unit Cost		$3.92kgU

(a) As on page B-10 of the UDS contract.
(b) Depleted UF_6 weight multiplied by the uranium atomic mass fraction, 0.676.
(c) Based on page H-34 of the UDS contract.
(d) Workscope costs on an UDS contract pages B-2 and B-3.
(e) Does not include any potential off-set credit for HF sales.
(f) Assumed operation over 25 years, 6% government cost of money, and no taxes.

Table 4.13-7 Summary of Depleted UF_6 Disposal Costs From Four Sources

SUMMARY OF Depleted UF_6 DISPOSAL COSTS FROM FOUR SOURCES				
	Costs in 2002 Dollars per kgU			
Source	Conversion	Disposal	Transportation	Total
LLNL (UCRL-AR-127650 (a)	2.64	2.17	0.25	5.06
UDS Contract (b)	(d)	(d)	(d)	3.92
URENCO (e)	(d)	(d)	(d)	(d)
CEC Cost Estimate (c)	4.93	1.47	0.34	6.74

(a) 1997 Lawrence Livermore National Laboratory cost estimate study for DOE; discounted costs in 1996 dollars were undiscounted and escalated to 2002 by ERI.

(b) Uranium Disposition Services (UDS) contract with DOE for capital and operating costs for first five years of Depleted UF_6 conversion and Depleted U_3O_8 conversion product disposition.

(c) Based upon depleted UF_6 and depleted U_3O_8 disposition costs provided to the NRC during Claiborne Energy Center license application in 1993.

(d) Cost component proprietary or not made available.

(e) The average of the three costs is $5.24/lg U. LES has selected $5.50/kgU as the disposal cost for the National Enrichment Facility. Urenco has reviewed this cost estimate, and based on its current experience with UF_6 disposal, finds this figure to be prudent..