4.3.3.2.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soils resource as related to the construction and operation of the ceramic immobilization facility. A ceramic immobilization facility, at any of the sites analyzed, would involve some ground-disturbing construction activities (28.3 ha [70 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvements (buildings, roads and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. Indirect effects to the soil resource from infrastructure improvements would have a similar impact on the soil profile and erosion potential.

[Text deleted.]

4.3.3.2.1.6 *Biological Resources*

Construction of the ceramic immobilization facility would require 28.3 ha (70 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be considered, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted in conjunction with the site-specific level of NEPA review, as appropriate, to avoid potential impacts to threatened and endangered species.

Hanford Site

It is assumed that the ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush

habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial resources equaling about 0.008 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys before surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species located within the construction area would be lost during land-clearing activities (Table 3.3.6–1). Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.3.2.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

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It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources on the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the site; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the ceramic immobilization facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be likely affected by construction or operation of the ceramic immobilization facility. Although the assumed site has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate before construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.2 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and smaller mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat on the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met. [Text deleted.]

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. [Text deleted.] Land clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the proposed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as

appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that the ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outflows and would involve minor volumes. Construction and operation of the ceramic immobilization facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facility that this species would not be directly affected by this action.

4.3.3.2.1.7 *Cultural and Paleontological Resources*

This section discusses construction and operational impacts to cultural and paleontological resources that may result from the ceramic immobilization facility at each of the representative sites analyzed. The total land disturbed for this facility is 28.3 ha (70 acres) during construction of which 18.2 ha (45 acres) would be used during operation. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans there. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space or ceremonial space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

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The facility would be constructed within the existing ICPP security area. No sites have been identified through surface surveys of the area. Because the ICPP is developed and disturbed, it is unlikely to contain subsurface

cultural deposits. Impacts to NRHP-eligible sites are not anticipated during construction or operation of the facility.

Some Native American resources such as traditional use areas and sacred space may be affected by the construction of the facility. For example, construction and operation could create auditory or visual impacts to important Native American resources in the vicinity. Resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River Floodplain which have produced fossilized remains. Operation would not have an additional effect on these resources.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. [Text deleted.] Archaeological surveys would be conducted on any unsurveyed areas that would be affected by construction prior to ground-breaking activities. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. Recorded prehistoric site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock. Sites are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings as well as World War II and Cold War Era structures. Resources such as these may occur on the land to be disturbed during construction. Operation would not result in any additional impact to prehistoric or historic resources.

DOE has initiated a public outreach program at Pantex to involve Native American groups in decisionmaking related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries near Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not have an additional effect on these resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of the proposed project area on both sides of Bear Creek Road was surveyed in association with the proposed Exxon Nuclear Facility, which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of 20th-century frame houses and mid-to-late 19th century log houses and outbuildings are located within the project area. Survey work would be conducted prior to construction on any unsurveyed lands to be affected by construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops, and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

Some Native American resources may be affected by construction and operation of the facility. These resources, should any exist, would be identified through consultation with the potentially affected tribes. For example, construction could affect traditionally used plant and animal species. Operation may result in reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Fossilized remains occur at ORR. Some of these may exist in areas to be disturbed during construction. However, any impacts would be considered negligible because the fossil assemblages at ORR consist of common invertebrates with low research potential. Operation would not affect paleontological remains.

Savannah River Site

The ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by construction but not operation.

Some Native American resources may be affected by the proposed action. Construction may affect resources such as prehistoric sites, cemeteries, and traditional plants. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from facility construction and operation. Any resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable paleontological resources have been recorded at SRS to date. Facility construction and operation are not expected to have an effect on paleontological resources.

[Text deleted.]

4.3.3.2.1.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would occur at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 to 4.5 percent (Socio 1996a).

A workforce of 900 would be required during full operation at any site. Operating the facility would generate larger socioeconomic changes than would construction, due to the larger, more permanent workforce. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and in the per capita income (about 1 percent). A total of 3,314 new jobs (900 direct and 2,414 indirect) would be created by the operational activities, and regional unemployment would fall to 3.8 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except Pantex and INEL, construction employment requirements would be met by the available resident labor force. Some in-migrating workers would be needed to fill more specialized positions during operation at all of the sites analyzed. Project-related in-migration would produce the largest population increases in the INEL ROI during construction of the facility. Pantex, however, would require the largest number of in-migrating workers for operation. These population increases in either the INEL or Pantex ROI, however would be less than 1 percent above No Action.

Housing units, in excess of existing vacancies, would be required in the INEL and Pantex ROIs during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS, during operation to accommodate the in-migrating population. The greatest increase in housing requirements (less than 1 percent) during construction and operation would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the analyzed sites. (Socio 1996a).

Community Services. During construction, only the Pantex and INEL ROIs would experience an increase in demand for community services. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during operation would be minor at all of the sites analyzed. The following discussion focuses on the INEL and Pantex ROIs which would experience the largest increases in demand for community services.

To maintain the student-to-teacher ratio of 18.5:1 in the INEL ROI, 18 additional teachers would be needed during construction of the facility. In the Pantex ROI, 22 additional teachers would be needed during operation to maintain the No Action student-to-teacher ratio of 16.3:1. These increases in teacher requirements, however, would be distributed over several school districts in the respective ROIs, and no single school district would be significantly affected (Socio 1996a).

To maintain No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI, two additional police officers and three new firefighters would be needed during construction. Two additional police officers and four additional firefighters at Pantex would be needed to maintain No Action levels of service of 2.3 police officers and 2.3 firefighters per 1,000 persons during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels. However, projected capacity would be capable of accommodating these small increases in patient load. Only two additional physicians would be needed in the INEL ROI during construction and four physicians would be needed in the Pantex ROI during operation to maintain the No Action service level of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Traffic generated during construction of the immobilization facility would affect INEL and ORR local road segments. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. Tennessee State Route 62 from Tennessee State Route 95 at Oak Ridge to Tennessee State Route 170 would experience a significant increase in volume-to-capacity ratio and the level of service would remain F.

During the facility operations phase, INEL would experience a drop in level of service on one road segment. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. (Socio 1996a).

4.3.3.2.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the immobilization facility during the assumed 10-year campaign time are presented in Tables 4.3.3.2.1.9–1 and 4.3.3.2.1.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.3.2.1.9–4 through Table 4.3.3.2.1.9–9. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases during the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the ceramic immobilization facility at each of the sites are presented in Table 4.3.3.2.1.9–1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation range from 1.6×10^{-8} mrem at the NTS site to 5.9×10^{-7} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 8.0×10^{-14} to 3.0×10^{-12}. The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range 3.3×10^{-8} person-rem at the NTS site to 1.2×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.7×10^{-10} to 6.0×10^{-8}.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.1×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 2.8×10^{-4} person-rem at Pantex to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.4×10^{-6} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.1.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the ceramic immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 244 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the average

Table 4.3.3.2.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	3.2×10^{-8}	4.4×10^{-3}	1.6×10^{-8}	4.2×10^{-3}	2.0×10^{-8}	0.018	2.5×10^{-7}	6.1×10^{-5}	5.9×10^{-7}	1.5	1.8×10^{-7}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	3.2×10^{-8}	5.3×10^{-3}	1.6×10^{-8}	4.2×10^{-3}	2.0×10^{-8}	0.018	2.5×10^{-7}	6.1×10^{-5}	5.9×10^{-7}	3.2	1.8×10^{-7}	0.79
Percent of natural background[c]	1.1×10^{-8}	1.8×10^{-3}	5.1×10^{-9}	1.3×10^{-3}	5.9×10^{-9}	5.2×10^{-3}	7.5×10^{-8}	1.8×10^{-5}	2.0×10^{-7}	1.1	6.0×10^{-8}	0.27
10-year fatal annual cancer risk	1.6×10^{-13}	2.7×10^{-8}	8.0×10^{-14}	2.1×10^{-8}	1.0×10^{-13}	8.9×10^{-8}	1.3×10^{-12}	3.1×10^{-10}	3.0×10^{-12}	1.6×10^{-5}	9.0×10^{-13}	4.0×10^{-6}
Annual Population Dose Within 80 Kilometers[d]												
Atmospheric release pathway (person-rem)	1.5×10^{-6}	0.46	3.3×10^{-8}	3.7×10^{-3}	2.3×10^{-7}	2.4	6.3×10^{-7}	2.8×10^{-4}	1.1×10^{-5}	29	1.2×10^{-5}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	1.5×10^{-6}	1.6	3.3×10^{-8}	3.7×10^{-3}	2.3×10^{-7}	2.4	6.3×10^{-7}	2.8×10^{-4}	1.1×10^{-5}	34	1.2×10^{-5}	44
Percent of natural background[c]	8.0×10^{-10}	8.4×10^{-4}	3.6×10^{-10}	4.0×10^{-5}	2.5×10^{-10}	2.7×10^{-3}	5.4×10^{-10}	2.4×10^{-7}	2.9×10^{-9}	9.0×10^{-3}	4.5×10^{-9}	0.017
10-year fatal cancers	7.5×10^{-9}	7.8×10^{-3}	1.7×10^{-10}	1.9×10^{-5}	1.2×10^{-9}	0.012	3.2×10^{-9}	1.4×10^{-6}	5.5×10^{-8}	0.17	6.0×10^{-8}	0.22

Table 4.3.3.2.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative—Continued

	Hanford		NTS		INEL		Pantex		ORR		SRS	
Receptor	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[e]												
Atmospheric and liquid release pathways combined (mrem)	2.4×10^{-9}	2.6×10^{-3}	1.1×10^{-9}	1.3×10^{-4}	8.6×10^{-10}	8.9×10^{-3}	1.8×10^{-9}	8.0×10^{-7}	8.6×10^{-9}	0.026	1.3×10^{-8}	0.049
10-year fatal cancer risk	1.2×10^{-14}	1.3×10^{-8}	5.6×10^{-15}	6.3×10^{-10}	4.3×10^{-15}	4.5×10^{-8}	9.0×10^{-15}	4.0×10^{-12}	4.3×10^{-14}	1.3×10^{-7}	6.7×10^{-14}	2.5×10^{-7}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the ceramic immobilization facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are: 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 rem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to be living within 80 km (50 mi) of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

Table 4.3.3.2.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	244	244	244	244	244	244
10-year risk of fatal cancer	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}	9.8×10^{-4}
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
Noninvolved Workforce[c]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
Total Site Workforce[d]						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3

[a] The involved worker is a worker associated with operations of the ceramic immobilization facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at the Hanford site. The annual dose to the total site workforces would range from 113 person-rem at NTS to 360 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation resources, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization without radionuclides facility at each of several sites are presented in Table 4.3.3.2.1.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 2.3×10^{-4} at the NTS site to 9.1×10^{-3} at the ORR site due to the facility operation. The cancer risk from hazardous chemicals to the MEI is zero at all sites. The HI to the onsite worker ranges from 7.2×10^{-2} at Pantex to 0.15 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Facility Accidents. A set of potential accidents have been postulated for a ceramic immobilization without radionuclides facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 6.3×10^{-4} at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding 10 year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.3×10^{-8}, 2.9×10^{-10}, and 1.3×10^{-9}, respectively. The maximum population 10-year facility lifetime risk would be 6.3×10^{-8} (that is, one fatality in over 1 million years) at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 2.9×10^{-10} and 1.3×10^{-9}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE orders require detailed safety analyses to assure that facility designs and operation procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new ceramic immobilization facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

*Table 4.3.3.2.1.9–3. **Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative***

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard Index[c]	1.6×10^{-3}	1.6×10^{-3}	2.3×10^{-4}	2.3×10^{-4}	3.3×10^{-3}	0.019	8.7×10^{-3}	0.014	9.1×10^{-3}	0.049	4.2×10^{-4}	5.6×10^{-3}
Cancer Risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard Index[e]	0.14	0.14	0.074	0.074	0.14	0.37	0.072	0.078	0.15	0.30	0.13	1.3
Cancer Risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, therefore the calculated cancer risk value is 0.

[e] Hazard Index for Workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, there are no Slope Factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–41 through M.3.4–46.

Table 4.3.3.2.1.9–4. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 10 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 10 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 10 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	2.3×10^{-13}	2.3×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	1.6×10^{-11}	1.6×10^{-7}	1.0×10^{-5}
Glovebox fire	2.3×10^{-13}	2.3×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	1.6×10^{-11}	1.6×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	1.4×10^{-10}	1.4×10^{-6}	1.2×10^{-12}	1.2×10^{-8}	1.6×10^{-9}	1.6×10^{-5}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.4×10^{-9}	1.4×10^{-5}	1.2×10^{-11}	1.2×10^{-7}	1.6×10^{-8}	1.6×10^{-4}	1.0×10^{-5}
Ceramic can drop	5.7×10^{-16}	5.7×10^{-14}	5.7×10^{-18}	5.7×10^{-16}	4.1×10^{-14}	4.1×10^{-12}	1.0×10^{-3}
Pellet container breakage	5.7×10^{-18}	5.7×10^{-16}	5.7×10^{-20}	5.7×10^{-18}	4.1×10^{-16}	4.1×10^{-14}	1.0×10^{-3}
Dissolver spill	1.4×10^{-15}	2.7×10^{-15}	1.4×10^{-17}	2.7×10^{-17}	1.0×10^{-13}	2.0×10^{-13}	0.05
Calciner feed spill	4.0×10^{-15}	7.9×10^{-15}	4.0×10^{-17}	7.9×10^{-17}	2.9×10^{-13}	5.8×10^{-13}	0.05
Calciner product spill	1.0×10^{-12}	2.0×10^{-12}	1.0×10^{-14}	2.0×10^{-14}	7.2×10^{-11}	1.4×10^{-10}	0.05
Sintering furnace explosion	3.4×10^{-13}	3.4×10^{-8}	3.4×10^{-15}	3.4×10^{-10}	2.5×10^{-11}	2.5×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	1.6×10^{-14}	1.6×10^{-9}	1.6×10^{-16}	1.6×10^{-11}	1.2×10^{-12}	1.2×10^{-7}	1.0×10^{-6}
Nuclear criticality	1.4×10^{-11}	1.4×10^{-6}	1.2×10^{-13}	1.2×10^{-8}	1.6×10^{-10}	1.6×10^{-5}	1.0×10^{-6}
Expected risk[d]	1.5×10^{-9}	—	1.3×10^{-11}	—	1.8×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–5. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	
Earthquake	$1.6x10^{-13}$	$1.6x10^{-9}$	$3.6x10^{-15}$	$3.6x10^{-11}$	$3.7x10^{-13}$	$3.7x10^{-9}$	$1.0x10^{-5}$
Glovebox fire	$1.6x10^{-13}$	$1.6x10^{-9}$	$3.6x10^{-15}$	$3.6x10^{-11}$	$3.7x10^{-13}$	$3.7x10^{-9}$	$1.0x10^{-5}$
Glovebox nuclear criticality	$1.0x10^{-10}$	$1.0x10^{-6}$	$2.3x10^{-12}$	$2.3x10^{-8}$	$3.3x10^{-11}$	$3.3x10^{-7}$	$1.0x10^{-5}$
Calciner feed tank nuclear criticality	$1.0x10^{-9}$	$1.0x10^{-5}$	$2.3x10^{-11}$	$2.3x10^{-7}$	$3.3x10^{-10}$	$3.3x10^{-6}$	$1.0x10^{-5}$
Ceramic can drop	$3.9x10^{-16}$	$3.9x10^{-14}$	$9.0x10^{-18}$	$9.0x10^{-16}$	$9.3x10^{-16}$	$3.3x10^{-14}$	$1.0x10^{-3}$
Pellet container breakage	$3.9x10^{-18}$	$3.9x10^{-16}$	$9.0x10^{-20}$	$9.0x10^{-18}$	$9.3x10^{-18}$	$9.3x10^{-16}$	$1.0x10^{-3}$
Dissolver spill	$9.3x10^{-16}$	$1.9x10^{-15}$	$2.2x10^{-17}$	$4.3x10^{-17}$	$2.2x10^{-15}$	$4.5x10^{-15}$	0.05
Calciner feed spill	$2.7x10^{-15}$	$5.4x10^{-15}$	$6.3x10^{-17}$	$1.3x10^{-16}$	$6.5x10^{-15}$	$1.3x10^{-14}$	0.05
Calciner product spill	$6.8x10^{-13}$	$1.4x10^{-12}$	$1.6x10^{-14}$	$3.1x10^{-14}$	$1.6x10^{-12}$	$3.3x10^{-12}$	0.05
Sintering furnace explosion	$2.3x10^{-13}$	$2.3x10^{-8}$	$5.4x10^{-15}$	$5.4x10^{-10}$	$5.6x10^{-13}$	$5.6x10^{-8}$	$1.0x10^{-6}$
Uncontrolled chemical reaction	$1.1x10^{-14}$	$1.1x10^{-9}$	$2.5x10^{-16}$	$2.5x10^{-11}$	$2.6x10^{-14}$	$2.6x10^{-9}$	$1.0x10^{-6}$
Nuclear criticality	$1.0x10^{-11}$	$1.0x10^{-6}$	$2.3x10^{-13}$	$2.3x10^{-8}$	$3.3x10^{-12}$	$3.3x10^{-7}$	$1.0x10^{-6}$
Expected risk[d]	$1.1x10^{-9}$	—	$2.5x10^{-11}$	—	$3.6x10^{-10}$	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–6. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality (per 10 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality (per 10 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities (per 10 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Earthquake	2.1×10^{-13}	2.1×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	4.9×10^{-12}	4.9×10^{-8}	1.0×10^{-5}
Glovebox fire	2.1×10^{-13}	2.1×10^{-9}	2.3×10^{-15}	2.3×10^{-11}	4.9×10^{-12}	4.9×10^{-8}	1.0×10^{-5}
Glovebox nuclear criticality	1.4×10^{-10}	1.4×10^{-6}	3.5×10^{-12}	1.3×10^{-8}	4.3×10^{-10}	4.3×10^{-6}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.4×10^{-9}	1.4×10^{-5}	1.3×10^{-11}	1.3×10^{-7}	4.3×10^{-9}	4.3×10^{-5}	1.0×10^{-5}
Ceramic can drop	5.3×10^{-16}	5.3×10^{-14}	5.7×10^{-18}	5.7×10^{-16}	1.2×10^{-14}	1.2×10^{-12}	1.0×10^{-3}
Pellet container breakage	5.3×10^{-18}	5.3×10^{-16}	5.7×10^{-20}	5.7×10^{-18}	1.2×10^{-16}	1.2×10^{-14}	1.0×10^{-3}
Dissolver spill	1.3×10^{-15}	2.5×10^{-15}	1.4×10^{-17}	2.8×10^{-17}	3.0×10^{-14}	5.9×10^{-14}	0.05
Calciner feed spill	3.7×10^{-15}	7.4×10^{-15}	4.0×10^{-17}	8.0×10^{-17}	8.7×10^{-14}	1.7×10^{-13}	0.05
Calciner product spill	9.3×10^{-13}	1.9×10^{-12}	1.0×10^{-14}	2.0×10^{-14}	2.2×10^{-11}	4.3×10^{-11}	0.05
Sintering furnace explosion	3.2×10^{-13}	3.2×10^{-8}	3.4×10^{-15}	3.4×10^{-10}	7.4×10^{-12}	7.4×10^{-7}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-14}	1.5×10^{-9}	1.6×10^{-16}	1.6×10^{-11}	3.5×10^{-13}	3.5×10^{-8}	1.0×10^{-6}
Nuclear criticality	1.4×10^{-11}	1.4×10^{-6}	1.3×10^{-13}	1.3×10^{-8}	4.3×10^{-11}	4.3×10^{-6}	1.0×10^{-6}
Expected risk[d]	1.5×10^{-9}	—	1.5×10^{-11}	—	4.8×10^{-9}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–7. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	$9.1x10^{-14}$	$9.1x10^{-10}$	$2.6x10^{-14}$	$2.6x10^{-10}$	$5.6x10^{-12}$	$5.6x10^{-8}$	$1.0x10^{-5}$
Glovebox fire	$9.1x10^{-14}$	$9.1x10^{-10}$	$2.6x10^{-14}$	$2.6x10^{-10}$	$5.6x10^{-12}$	$5.6x10^{-8}$	$1.0x10^{-5}$
Glovebox nuclear criticality	$6.2x10^{-11}$	$6.2x10^{-7}$	$2.2x10^{-11}$	$2.2x10^{-7}$	$9.5x10^{-10}$	$9.5x10^{-6}$	$1.0x10^{-5}$
Calciner feed tank nuclear criticality	$6.2x10^{-10}$	$6.2x10^{-6}$	$2.2x10^{-10}$	$2.2x10^{-6}$	$9.5x10^{-9}$	$9.5x10^{-5}$	$1.0x10^{-5}$
Ceramic can drop	$2.3x10^{-16}$	$2.3x10^{-14}$	$6.6x10^{-17}$	$6.6x10^{-15}$	$1.4x10^{-14}$	$1.4x10^{-12}$	$1.0x10^{-3}$
Pellet container breakage	$2.3x10^{-18}$	$2.3x10^{-16}$	$6.6x10^{-19}$	$6.6x10^{-17}$	$1.4x10^{-16}$	$1.4x10^{-14}$	$1.0x10^{-3}$
Dissolver spill	$5.5x10^{-16}$	$1.1x10^{-15}$	$1.6x10^{-16}$	$3.2x10^{-16}$	$3.4x10^{-14}$	$6.7x10^{-14}$	0.05
Calciner feed spill	$1.6x10^{-15}$	$3.2x10^{-15}$	$4.6x10^{-16}$	$9.2x10^{-16}$	$9.8x10^{-14}$	$2.0x10^{-13}$	0.05
Calciner product spill	$4.0x10^{-13}$	$8.0x10^{-13}$	$1.2x10^{-13}$	$2.3x10^{-13}$	$2.5x10^{-11}$	$4.9x10^{-11}$	0.05
Sintering furnace explosion	$1.4x10^{-13}$	$1.4x10^{-8}$	$4.0x10^{-14}$	$4.0x10^{-9}$	$8.5x10^{-12}$	$8.5x10^{-7}$	$1.0x10^{-6}$
Uncontrolled chemical reaction	$6.4x10^{-15}$	$6.4x10^{-10}$	$1.9x10^{-15}$	$1.9x10^{-10}$	$3.9x10^{-13}$	$3.9x10^{-8}$	$1.0x10^{-6}$
Nuclear criticality	$6.2x10^{-12}$	$6.2x10^{-7}$	$2.2x10^{-12}$	$2.2x10^{-7}$	$9.5x10^{-11}$	$9.5x10^{-6}$	$1.0x10^{-6}$
Expected risk[d]	$6.9x10^{-10}$	—	$2.4x10^{-10}$	—	$1.1x10^{-8}$	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–8. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality (per 10 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality (per 10 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatality[b]	Population to 80 km: Risk of Cancer Fatalities (per 10 yr)[a]	Population to 80 km: Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7}	1.0×10^{-5}
Glovebox fire	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7}	1.0×10^{-5}
Glovebox nuclear criticality	1.3×10^{-10}	1.3×10^{-6}	2.9×10^{-11}	2.9×10^{-7}	6.3×10^{-9}	6.3×10^{-5}	1.0×10^{-5}
Calciner feed tank nuclear criticality	1.3×10^{-9}	1.3×10^{-5}	2.9×10^{-10}	2.9×10^{-6}	6.3×10^{-8}	6.3×10^{-4}	1.0×10^{-5}
Ceramic can drop	5.3×10^{-16}	5.3×10^{-14}	1.2×10^{-16}	1.2×10^{-14}	1.0×10^{-13}	1.0×10^{-11}	1.0×10^{-3}
Pellet container breakage	5.3×10^{-18}	5.3×10^{-16}	1.2×10^{-18}	1.2×10^{-16}	1.0×10^{-15}	1.0×10^{-13}	1.0×10^{-3}
Dissolver spill	1.3×10^{-15}	2.5×10^{-15}	2.8×10^{-16}	5.5×10^{-16}	2.4×10^{-13}	4.8×10^{-13}	0.05
Calciner feed spill	3.7×10^{-15}	7.3×10^{-15}	8.1×10^{-16}	1.6×10^{-15}	7.0×10^{-13}	1.4×10^{-12}	0.05
Calciner product spill	9.2×10^{-13}	1.8×10^{-12}	2.0×10^{-13}	4.0×10^{-13}	1.7×10^{-10}	3.5×10^{-10}	0.05
Sintering furnace explosion	3.2×10^{-13}	3.2×10^{-8}	6.9×10^{-14}	6.9×10^{-9}	6.0×10^{-11}	6.0×10^{-6}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-14}	1.5×10^{-9}	3.2×10^{-15}	3.2×10^{-10}	2.8×10^{-12}	2.8×10^{-7}	1.0×10^{-6}
Nuclear criticality	1.3×10^{-11}	1.3×10^{-6}	2.9×10^{-12}	2.9×10^{-7}	6.3×10^{-10}	6.3×10^{-5}	1.0×10^{-6}
Expected risk[d]	1.4×10^{-9}	—	3.2×10^{-10}	—	7.0×10^{-8}	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

Table 4.3.3.2.1.9–9. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality (per 10 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatalities (per 10 yr)[a]	Number of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	$1.5x10^{-13}$	$1.5x10^{-9}$	$3.6x10^{-15}$	$3.6x10^{-11}$	$1.8x10^{-11}$	$1.8x10^{-7}$	$1.0x10^{-5}$
Glovebox fire	$1.5x10^{-13}$	$1.5x10^{-9}$	$3.6x10^{-15}$	$3.6x10^{-11}$	$1.8x10^{-11}$	$1.8x10^{-7}$	$1.0x10^{-5}$
Glovebox nuclear criticality	$9.1x10^{-11}$	$9.1x10^{-7}$	$2.0x10^{-12}$	$2.0x10^{-8}$	$2.0x10^{-9}$	$2.0x10^{-5}$	$1.0x10^{-5}$
Calciner feed tank nuclear criticality	$9.1x10^{-10}$	$9.1x10^{-6}$	$2.0x10^{-11}$	$2.0x10^{-7}$	$2.0x10^{-8}$	$2.0x10^{-4}$	$1.0x10^{-5}$
Ceramic can drop	$3.7x10^{-16}$	$3.7x10^{-14}$	$9.1x10^{-18}$	$9.1x10^{-16}$	$4.4x10^{-14}$	$4.4x10^{-12}$	$1.0x10^{-3}$
Pellet container breakage	$3.7x10^{-18}$	$3.7x10^{-16}$	$9.1x10^{-20}$	$9.1x10^{-18}$	$4.4x10^{-16}$	$4.4x10^{-14}$	$1.0x10^{-3}$
Dissolver spill	$8.9x10^{-16}$	$1.8x10^{-15}$	$2.2x10^{-17}$	$4.4x10^{-17}$	$1.1x10^{-13}$	$2.1x10^{-13}$	0.05
Calciner feed spill	$2.6x10^{-15}$	$5.2x10^{-15}$	$6.4x10^{-17}$	$1.3x10^{-16}$	$3.1x10^{-13}$	$6.2x10^{-13}$	0.05
Calciner product spill	$6.5x10^{-13}$	$1.3x10^{-12}$	$1.6x10^{-14}$	$3.2x10^{-14}$	$7.8x10^{-11}$	$1.6x10^{-10}$	0.05
Sintering furnace explosion	$2.2x10^{-13}$	$2.2x10^{-8}$	$5.5x10^{-15}$	$5.5x10^{-10}$	$2.7x10^{-11}$	$2.7x10^{-6}$	$1.0x10^{-6}$
Uncontrolled chemical reaction	$1.0x10^{-14}$	$1.0x10^{-9}$	$2.6x10^{-16}$	$2.6x10^{-11}$	$1.2x10^{-12}$	$1.2x10^{-7}$	$1.0x10^{-6}$
Nuclear criticality	$9.1x10^{-12}$	$9.1x10^{-7}$	$2.0x10^{-13}$	$2.0x10^{-8}$	$2.0x10^{-10}$	$2.0x10^{-5}$	$1.0x10^{-6}$
Expected risk[d]	$1.0x10^{-9}$	—	$2.2x10^{-11}$	—	$2.3x10^{-8}$	—	—

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1–3 and M.5.3.7.1–4 and the MACCS computer code.

An indication of the magnitude of the impacts of an aircraft crash into a ceramic immobilization facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

[Text deleted.]

4.3.3.2.1.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its output product a stabilized coated ceramic pellet form that would require interim storage with final disposal at the deep borehole complex whose impacts are outlined in Section 4.3.3.2.2.10. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until its disposal in the deep borehole complex. Table 4.3.3.2.1.10–1 provides the estimated operational waste volumes projected to be generated as a result of the ceramic immobilization facility at the sites analyzed. Facilities that would support the ceramic immobilization facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste disposed of, onsite or at regionalized or centralized DOE sites. For the purposes of analysis only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.3. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.3.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

The conceptual design of the ceramic immobilization facility using coated pellets includes a radioactive liquid waste treatment facility which would be required to treat the 110 m^3 (30,000 gal) of liquid TRU waste. Approximately 150 m^3 (200 yd^3) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and solidified sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity 1.5 m^3 (2 yd^3) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 18 additional truck shipments per year, or if applicable, 9 regular train shipments per year or 3 dedicated train shipments per year would be required.

The radioactive liquid waste treatment facility would also treat the 10 m^3 (2,700 gal) of liquid LLW from infrequent container decontamination, laboratory solutions, and scrubber solutions from stacks and exhaust systems. Following treatment and volume reduction, approximately 15 m^3 (20 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Except for disposal, all of

Table 4.3.3.2.1.10–1. Estimated Annual Generated Waste Volumes for Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative[a]

Category	New Facility (m^3)	Hanford No Action (m^3)	NTS No Action (m^3)	INEL No Action (m^3)	Pantex No Action (m^3)	ORR No Action (m^3)	SRS No Action (m^3)
Transuranic							
Liquid	110[b]	None	None	None	None	None	None
Solid	150	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	1.5	98	None	Included in TRU	None	None	Included in TRU
Low-level							
Liquid	10[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	23	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.3	1,505	50	170	46	432	7,700
Hazardous							
Liquid	45	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	23	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	43,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	910	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	186,900	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for the ceramic immobilization facility were derived from Table E.3.3.3–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.3–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acres/yr) at Hanford and ORR, 0.003 ha/yr (0.006 acres/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acres/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.3 m^3 [0.4 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 45 m^3 (12,000 gal) of liquid and 23 m^3 (30 yd^3) of solid hazardous wastes would be generated. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous waste would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 43,000 m^3 (11,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and 186,900 m^3 (49,500,000 gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. The 910 m^3 (1,200 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.3.2.2 *Deep Borehole Complex*

The environmental impacts described in the following sections are based on the analysis of the deep borehole complex for the Immobilization Disposition Alternative as described in Section 2.4.3.2.2. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

4.3.3.2.2.1 *Land Resources*

The deep borehole complex would disturb 63 ha (156 acres) of land during construction, of which 57 ha (141 acres) would be used during operation. The facility would be sited within a 1.6-km (1-mi) buffer zone for a total land requirement of 2,041 ha (5,044 acres). However, the potential site could range up to 20,000 ha (49,420 acres) of land area. If the borehole site were located on privately owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of land area. Because no site has been identified for analysis, impacts to land use and visual resources cannot be determined at this time. If this alternative is selected, a siting study would be conducted in support of NEPA tiered documentation.

4.3.3.2.2.2 *Site Infrastructure*

Implementation of the alternative for immobilization of Pu with emplacement into a deep borehole requires construction and operation of both a stand-alone borehole complex and a ceramic immobilization facility. The ceramic immobilization facility impacts are previously shown in Section 4.3.3.2.1.2.

Since no actual sites for a deep borehole complex have been considered, the site infrastructure impact analysis for constructing, operating, and post-closure monitoring of the borehole complex compares the borehole requirements shown in the appendices, with the generic borehole site described in Section 3.9.2. Upon completion of the Pu disposition mission, only a concrete cap would remain on the surface of the borehole.

The region's utility and transportation infrastructure must be extended to support the facilities and operations of this proposed borehole complex. Connection of the borehole complex to the nearest existing electrical utility via high-voltage transmission lines may require construction of additional transmission lines and obtaining rights-of-way. The additional 6,100 MWh electrical requirement for the entire borehole complex would not have a noticeable effect on a sub-regional electrical power pool. Since emergency power would be provided by diesel generators located in the facility utility area, there would be no additional impact to the electrical pool during emergencies.

Impacts from construction of the deep borehole facility using standard construction practices for the surface facilities and transportation links are similar to those of the deep borehole complex for Direct Disposition Alternative shown in Section 4.3.3.1.2. As in Section 4.3.3.1.2, the greatest surface effects from subsurface borehole construction/drilling would be caused by the surface retention areas, which would contain all material removed during drilling operations. The total amount of utility and material resources consumed during the construction period, assuming 1.6 km (1 mi) of roads, is shown in Table 4.3.3.2.2.2–1.

Table 4.3.3.2.2.2–1. Additional Site Infrastructure Needed for the Construction of the Deep Borehole Complex—Immobilized Disposition Alternative (Annual)

Resource	Construction Requirement	Range of Resource Availability
Electrical	567 MWh	6,500 to 12,000 MWh
Oil	2,000,000 l	0 to 100 million l
Natural gas	0	0 to 5 million m^3
Coal	0	0 to 200,000 t

Source: LLNL 1996h.

Since the lower end of the range of resources available generally exceeds the annualized construction requirement, there would be minimal impact due to construction of the borehole complex.

Operations at the surface processing facilities require electrical power, compressed air, and water. Emplacing-borehole sealing and drilling facilities require process water, process water waste treatment, and electrical power. The resulting site infrastructure changes required to operate the deep borehole complex for disposal of immobilized forms during normal operations are shown in Table 4.3.3.2.2.2–2. The range of available resources was previously described in Section 3.9.2. The additional 6,100 MWh electrical requirement to operate the entire borehole complex for a year would have no measurable impact on any of the sub-regional power pools in the contiguous 48 states. Fuel and transportation requirements present no measurable impacts. Since oil and natural gas availability is governed by usage, the additional oil and natural gas could be procured.

During the post-closure period, the borehole array area of 25 ha (62 acres) would be declared a limited access area indefinitely, and a 1.6-km (1-mi) buffer zone of 1,358 ha (3,355 acres) may also be declared off-limits. The disturbed area remaining after decommissioning would be the 15x15 m (50x50 ft) concrete security and water anti-infiltration caps installed above the borehole array, assumed to be four holes. Even though the borehole

Table 4.3.3.2.2.2–2. Additional Site Infrastructure Needed for the Operation of the Deep Borehole Complex—Immobilized Disposition Alternative (Annual)

	Transportation		**Electrical**		**Fuel**		
	Roads (km)	**Railroads (km)**	**Energy (MWh/yr)**	**Peak Load (MWe)**	**Oil (l/yr)**	**Natural Gas (m^3/yr)**	**Coal (t/yr)**
Facility Requirement	1.6	1.6	6,100	2	773,280	4,810,000	0
Range of resource availability	0 to 60	0 to 20	6,500 to 12,000	2 to 1,000	0 to 100 million	0 to 5 million	0 to 200,000
Amount required in excess to low-end range of available resources	1.6	1.6	0	0	773,280	4,810,000	0

Source: LLNL 1996h.

would be designated as limited access, there are minimal continuing requirements or effects above ground. These minimal requirements include surveillance and groundwater monitoring. Surveillance could be accomplished from a remote location without impact at the site. Groundwater monitoring could be done from locations at various distances from the site. There would be a continuing infrastructure impact directly at the site in that any future land use requiring excavation or mining operations would be restricted in perpetuity. Such restrictions could be institutionalized through construction of drilling barriers and installing a variety of permanent markers.

4.3.3.2.2.3 *Air Quality and Noise*

Construction and operation of the deep borehole complex would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.3.2.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants for the generic sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the deep borehole complex are presented in Table F.1.3–8. Air pollutant emissions sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

During operation, impacts with respect to the concentrations of criteria and toxic/hazardous air pollutants are expected to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.3.2.2.3–1.

NOISE

The location of the facilities associated with the deep borehole complex relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, material handling equipment, drilling rigs, pumps, and generators. These noise sources are assumed

Table 4.3.3.2.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Deep Borehole Complex and No Action Alternative—Immobilized Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline[a] (μg/m³)	Generic Site (μg/m³)[b]
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	72.20
	1-hour	40,000	103.10
Lead	Calendar Quarter	1.5	[c]
Nitrogen dioxide	Annual	100	28.78
Ozone	1-hour	235	[d]
Particulate matter less than or equal to 10 microns in diameter	Annual	50	10.41
	24-hour	150	41.64
Sulfur dioxide	Annual	80	2.57
	24-hour	365	10.28
	3-hour	1,300	23.13
Hazardous and Other Toxic Compounds[e]			
[Text deleted.]			

[a] The Federal standards are presented.

[b] The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

[c] No sources of this pollutant have been identified.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[e] Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; LLNL 1996h.

be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. It is assumed that due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

4.3.3.2.2.4 *Water Resources*

Water usage and wastewater generated differ slightly between the two deep borehole alternatives. However, these differences should not cause any additional impacts to those described in Section 4.3.3.1.4. Water resource data for immobilization to a deep borehole facility are slightly less than the impacts shown in Table 4.3.3.1.4–1.

In general, ceramic immobilization would aid in preventing/delaying the emplaced materials from interacting with the subsurface environment (that is, being dissolved by the brine at depth). These interactions were described in Section 4.3.3.1.4.

[Text deleted.]

4.3.3.2.2.5 *Geology and Soils*

The deep borehole complex area disturbed during construction activities for this alternative would be 63 ha (156 acres). The deep borehole complex represents an irreversible commitment because wastes in below-ground area could not be completely removed, nor could the site be feasibly used for any other purposes following closure of the facility. This land would be perpetually unusable because the substrata would not be suitable for potentially intrusive facilities such as mining, utilities, or building foundations. Because no site has been identified for analysis, impacts to geologic and soil resources cannot be determined at this time.

The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, isolation from the biosphere, would be met. A site study would be conducted in support of the tiered NEPA documentation.

4.3.3.2.2.6 *Biological Resources*

Potential impacts to biological resources described for direct disposition in a deep borehole complex described in Section 4.3.3.1.6 would also apply to the disposal of immobilized Pu in a deep borehole complex. Both borehole complexes would require the same amount of land and would be subject to the same siting criteria.

4.3.3.2.2.7 *Cultural and Paleontological Resources*

The construction of the deep borehole complex would disturb approximately 63 ha (156 acres) of land. The operational land requirement is 2,041 ha (5,044 acres), which includes a 1.6-km (1-mile) buffer zone. The actual facility requires 57 ha (141 acres) during operation. In addition, approximately 1.6 km (1 mi) each of road or railway would also be constructed. No specific site has been proposed for this alternative. Impacts to cultural and paleontological resources would be addressed in tiered NEPA documents as appropriate. A siting study would be conducted in support of tiered NEPA documentation.

Prehistoric and historic resources that may be NRHP-eligible would be identified through additional surveys. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with the NHPA, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*. Therefore, it is not possible to determine potential effects on cultural and paleontological resources.

4.3.3.2.2.8 *Socioeconomics*

The deep borehole complex for the Immobilized Disposition Alternative is similar to the deep borehole complex for the Direct Disposition Alternative. The only difference between the two alternatives with respect to socioeconomic effects is in the number of construction and operation workers required. The Immobilization Disposition Alternative would require 810 construction and 280 operation workers versus 870 construction and 342 operation workers needed for the Direct Disposition Alternative. Thus, the socioeconomics effects for this alternative would be slightly less than the Direct Disposition Alternative because fewer workers would be required and any population growth resulting from in-migrating workers and associated effects on the ROI would be smaller. For a detailed discussion of the socioeconomic effects of constructing and operating a deep borehole complex, see Section 4.3.3.1.8.

4.3.3.2.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with disposal of immobilized Pu in a deep borehole complex. The section first describes the impacts from normal operation at the generic site, followed by a description of impacts from facility accidents.

For the public, the analysis includes an annual dose and cumulative risk to the maximally exposed individual, population, and average individual within 80 km (50 mi). For workers, the analysis includes an annual dose and cumulative risk to an average individual worker and total involved and noninvolved workforce. The health effects were derived from data for representative DOE sites described in Sections 3.2 through 3.7. Data for the representative DOE sites were used to allow qultification of impacts, but do not necessarily capture the entire range of potential deep borehole complex sites. This approach to the radiological risk assessment differs from the analysis of other resources, which are analyzed based on a generic deep borehole site. Because the analysis of radiological dose impacts requires site-specific conditions, such as meteorology and surrounding populations, a generic site analysis would not be possible because of the infinite number of site-specific conditions.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the deep borehole complex during the assumed 10-year campaign time are presented in Tables 4.3.3.2.2.9–1 and 4.3.3.2.2.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.2.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.3.2.2.9–4. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of a deep borehole complex. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the deep borehole complex are presented in Table 4.3.3.2.2.9–1. The impacts from all site operations, including the deep borehole complex, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the deep borehole complex would range from 3.4×10^{-9} to 1.2×10^{-7} mrem. From 10 years of operation, the risk of fatal cancer to this individual would range from 1.7×10^{-14} to 6.0×10^{-13}. The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 6.6×10^{-9} to 2.2×10^{-6} person-rem. The number of fatal cancers in the population from 10 years of operation would range from 3.3×10^{-11} to 1.1×10^{-8}.

The upper bounding dose of 3.2 mrem to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The risk of fatal cancer to this individual from 10 years of operation would be 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are as low as reasonably conceivable. As a result of annual total site operations, the upper bound population dose would be within the limit proposed in 10 CFR 834, and would be 44 person-rem. The number of fatal cancers in this population from 10 years of operation would be 0.22.

Table 4.3.3.2.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site[a]	
	Deep Borehole Complex	**Total Site**
Annual Dose to the Maximally Exposed Individual Member of the Public[b]		
Atmospheric release pathway (mrem)	$3.4x10^{-9}$ to $1.2x10^{-7}$	$6.1x10^{-5}$ to 1.5
Drinking water pathway (mrem)	0	0 to 0.10
Total liquid release pathway (mrem)	0	0 to 1.7
Atmospheric and liquid release pathways combined (mrem)	$3.4x10^{-9}$ to $1.2x10^{-7}$	$6.1x10^{-5}$ to 3.2
Percent of natural background[c]	$1.1x10^{-9}$ to $4.1x10^{-8}$	$1.8x10^{-5}$ to 1.1
10-year fatal cancer risk	$1.7x10^{-14}$ to $6.0x10^{-13}$	$3.1x10^{-10}$ to $1.6x10^{-5}$
Annual Population Dose Within 80 Kilometers[d]		
Atmospheric release pathways (mrem)	$6.6x10^{-9}$ to $2.2x10^{-6}$	$2.8x10^{-4}$ to 40
Total liquid release pathways (mrem)	0	0 to 4.7
Atmospheric and liquid release pathways combined (mrem)	$6.6x10^{-9}$ to $2.2x10^{-6}$	$2.8x10^{-4}$ to 44
Percent of natural background[c]	$7.2x10^{-11}$ to $8.3x10^{-10}$	$2.4x10^{-7}$ to 0.017
10-year fatal cancers	$3.3x10^{-11}$ to $1.1x10^{-8}$	$1.4x10^{-6}$ to 0.22
Annual Dose to the Average Individual Within 80 Kilometers[e]		
Atmospheric and liquid release pathways combined (mrem)	$2.2x10^{-10}$ to $2.5x10^{-9}$	$8.0x10^{-7}$ to 0.049
10-year fatal cancer risk	$1.1x10^{-15}$ to $1.2x10^{-14}$	$4.0x10^{-12}$ to $2.5x10^{-7}$.

[a] Ranges for the "Deep Borehole Complex" and "Total Site" doses may not necessarily reflect the same respective sites. The total site values are applicable only if the deep borehole complex were located on DOE sites and would not apply if generic non-DOE sites were selected.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year for the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] Annual natural background radiation levels: the average individual receives a dose that could range from 295 to 338 mrem; the population within 80 km receives a dose that could range from 9,190 to 379,000 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose at a site by the number of people projected to be living within 80 km of that site. The number of people ranges from 29,400 to 1,285,000.

Source: HNUS 1996a. Ranges are based on impacts from the following representative DOE sites: Hanford, NTS, INEL, Pantex, ORR, and SRS.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.2.9–2. Included are involved workers directly associated with the deep borehole complex, workers who are not involved with the deep borehole complex, and the entire workforce at the site. All doses fall within regulatory limits.

Table 4.3.3.2.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	13
10-year risk of fatal cancer	5.2×10^{-5}
Total dose (person rem/yr)	2.2
10-year fatal cancers	8.8×10^{-3}
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	2.6 to 32
10-year risk of fatal cancer	1.0×10^{-5} to 1.3×10^{-4}
Total dose (person rem/yr)	3.0 to 250
10-year fatal cancers	0.012 to 1.0
Total Site Workforce[d]	
Dose (person-rem/yr)	5.2 to 252
10-year fatal cancers	0.021 to 1.0

[a] The involved worker is a worker associated with operations of the deep borehole complex. The estimated number of badged involved workers is 168.

[b] The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker on-site but not associated with operations of the deep borehole complex. The ranges for the noninvolved workers are based on No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS. Noninvolved worker doses are shown for comparison purposes only and would not apply if the deep borehole complex were located at a separate dedicated site. The Noninvolved Workforce is equivalent to the No Action workforce.

[d] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996a for involved workers. For the noninvolved workers see Sections 4.2.1.9, 4.2.2.9, 4.2.3.9, 4.2.4.9, 4.2.5.9, and 4.2.6.9, respectively.

The annual dose to the average deep borehole complex worker would be 13 mrem; the entire deep borehole complex workforce would receive 2.2 person-rem annually. The annual dose to the average noninvolved worker would range from 2.6 to 32 mrem, depending on the borehole site (if an existing DOE site were chosen), and the annual total dose to all noninvolved workers would range from 3.0 to 250 person-rem. The annual dose to the total site workforces would range from 5.2 to 252 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the deep borehole complex at the generic site are presented in Table 4.3.3.2.2.9–3. Included is the impact due only to operation of the deep borehole complex and the sites's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

Table 4.3.3.2.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Deep Borehole Complex Generic Site	
	Facility [a]	Total Site[b]
Maximally Exposed Individual (Public)		
Hazard Index[c]	1.2×10^{-3}	1.2×10^{-3}
Cancer risk[d]	0	0
Worker Onsite		
Hazard Index[e]	0.28	0.28
Cancer risk[f]	0	0

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer risk for MEI=(emission concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, therefore the calculated cancer risk is 0.

[e] Hazard Index for workers=sum of Individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(emission for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, there are no Slope Factors; therefore the calculated cancer risk is 0.

Section M.3, Table M.3.4–47.

The HI to the MEI is 1.2×10^{-3} at the deep borehole complex site. The cancer risk to the MEI is zero (because no carcinogens are released from hazardous chemicals) at the deep borehole complex site. The HI to the onsite worker is 0.28 at the deep borehole complex generic site, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals).

Facility Accidents. A set of potential accidents have been postulated for a deep borehole for disposal of immobilized Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident scenarios considered are: earthquake, Pu storage container breakage, Pu storage container breach, pellet-grout mixing process facility fire, ceramic pellet spill, pellet-grout mix spill, dropped bucket during emplacement, failure of release-open early during emplacement, mixing system breaks pellets during bucket emplacement, pellets break during emplacement release, rupture of delivery pipe during pumped emplacement, mixing system breaks during pumped emplacement, pellets break during pumped emplacement, failure of ventilation filter, uncontrolled chemical reaction, pellet storage criticality, and pellet-grout mixing criticality. The range of consequences and risks for a set of accidents at the generic site are presented in Table 4.3.3.2.2.9–4. The estimated range of environmental data (wet to dry site) and the general public population density data (low to high density) for the generic site envelopes the site characteristics expected for the immobilized Pu disposition site.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.3.3.2.2.9–4. *Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative*

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatalities (per 10 yr)[c]		Number of Cancer Fatalities[b]		Accident Frequency (per yr)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Earthquake	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-14}	2.3×10^{-14}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-14}	5.2×10^{-16}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Pu storage container breakage	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-16}	2.3×10^{-16}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-16}	5.2×10^{-18}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pu storage container breach	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-16}	2.3×10^{-16}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-16}	5.2×10^{-18}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-13}	9.3×10^{-16}	1.0×10^{-3}
Pellet - grout mixing process facility fire	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-14}	2.3×10^{-14}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-14}	5.2×10^{-16}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-5}
Ceramic pellet spill	5.7×10^{-19}	2.3×10^{-19}	5.7×10^{-17}	2.3×10^{-17}	1.2×10^{-19}	5.2×10^{-21}	1.2×10^{-17}	5.2×10^{-19}	1.0×10^{-16}	9.3×10^{-19}	1.0×10^{-14}	9.3×10^{-17}	1.0×10^{-3}
Pellet grout mix spill	1.7×10^{-15}	6.9×10^{-16}	3.4×10^{-15}	1.4×10^{-15}	3.6×10^{-16}	1.6×10^{-17}	7.2×10^{-16}	3.1×10^{-17}	3.0×10^{-13}	2.8×10^{-15}	6.0×10^{-13}	5.5×10^{-15}	6.0×10^{-2}
Bucket dropped during emplacement	5.7×10^{-15}	2.3×10^{-15}	5.7×10^{-11}	2.3×10^{-11}	1.2×10^{-15}	5.2×10^{-17}	1.2×10^{-11}	5.2×10^{-13}	1.0×10^{-12}	9.3×10^{-15}	1.0×10^{-8}	9.3×10^{-11}	1.0×10^{-5}
Failure of release - opens early during bucket emplacement	2.8×10^{-14}	1.1×10^{-14}	2.8×10^{-10}	1.1×10^{-10}	5.9×10^{-15}	2.6×10^{-16}	5.9×10^{-11}	2.6×10^{-12}	4.9×10^{-12}	4.6×10^{-14}	4.9×10^{-8}	4.6×10^{-10}	4.9×10^{-5}
Mixing system breaks pellets during emplacement	5.7×10^{-14}	2.3×10^{-14}	5.7×10^{-12}	2.3×10^{-12}	1.2×10^{-14}	5.2×10^{-16}	1.2×10^{-12}	5.2×10^{-14}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}
Pellets break during bucket emplacement release	5.7×10^{-14}	2.3×10^{-14}	5.7×10^{-12}	2.3×10^{-12}	1.2×10^{-14}	5.2×10^{-16}	1.2×10^{-12}	5.2×10^{-14}	1.0×10^{-11}	9.3×10^{-14}	1.0×10^{-9}	9.3×10^{-12}	1.0×10^{-3}
Rupture of delivering pipe during pumped emplacement	3.4×10^{-15}	1.4×10^{-15}	3.4×10^{-11}	1.4×10^{-11}	7.2×10^{-16}	3.1×10^{-17}	7.2×10^{-12}	3.1×10^{-13}	6.0×10^{-13}	5.5×10^{-15}	6.0×10^{-9}	5.5×10^{-11}	1.0×10^{-5}
Delivering pipe dropped during pumped emplacement	6.8×10^{-16}	2.7×10^{-16}	6.8×10^{-12}	2.7×10^{-12}	1.4×10^{-16}	6.2×10^{-18}	1.4×10^{-12}	6.2×10^{-14}	1.2×10^{-13}	1.1×10^{-15}	1.2×10^{-9}	1.1×10^{-11}	1.0×10^{-5}
Mixing system breaks pellets during pumped emplacement	6.8×10^{-15}	2.7×10^{-15}	6.8×10^{-13}	2.7×10^{-13}	1.4×10^{-15}	6.2×10^{-17}	1.4×10^{-13}	6.2×10^{-15}	1.2×10^{-12}	1.1×10^{-14}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-13}
Pellets break during pumped emplacement release	6.8×10^{-15}	2.7×10^{-15}	6.8×10^{-13}	2.7×10^{-13}	1.4×10^{-15}	6.2×10^{-17}	1.4×10^{-13}	6.2×10^{-15}	1.2×10^{-12}	1.1×10^{-14}	1.2×10^{-10}	1.1×10^{-12}	1.0×10^{-13}
Failure of ventilation filter	3.4×10^{-18}	1.4×10^{-18}	3.4×10^{-13}	1.4×10^{-13}	7.2×10^{-19}	3.1×10^{-20}	7.2×10^{-14}	3.1×10^{-15}	6.0×10^{-16}	5.5×10^{-18}	6.0×10^{-11}	5.5×10^{-13}	1.0×10^{-6}
Uncontrolled chemical reaction	5.7×10^{-18}	2.3×10^{-18}	5.7×10^{-13}	2.3×10^{-13}	1.2×10^{-18}	5.2×10^{-20}	1.2×10^{-13}	5.2×10^{-15}	1.0×10^{-15}	9.3×10^{-18}	1.0×10^{-10}	9.3×10^{-13}	1.0×10^{-6}
Pellet storage criticality	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}	1.0×10^{-6}

Table 4.3.3.2.2.9–4. Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative—Continued

	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				
	Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatality (per 10 yr)[a]		Probability of Cancer Fatality[b]		Risk of Cancer Fatalities (per 10 yr)[c]		Number of Cancer Fatalities[b]		Accident Frequency (per yr)
Accident Scenario	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Pellet-grout mixing criticality	$1.4x10^{-10}$	$6.2x10^{-11}$	$1.4x10^{-5}$	$6.2x10^{-6}$	$2.9x10^{-11}$	$1.0x10^{-12}$	$2.9x10^{-6}$	$1.0x10^{-7}$	$6.3x10^{-9}$	$3.3x10^{-11}$	$6.3x10^{-4}$	$3.3x10^{-6}$	$1.0x10^{-6}$
Expected risk[d]	$2.8x10^{-10}$	$1.2x10^{-10}$			$5.9x10^{-11}$	$2.0x10^{-12}$			$1.3x10^{-8}$	$6.6x10^{-11}$			

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the MEI) or the number of cancer fatalities (for the population within 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks for each accident over the 10-year lifetime of the facility.

Note: The impacts shown are the maximum for the reference sites. All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.8.1–3 and M.5.2.8.1–4 and the MACCS computer code.

4.3.3.2.2.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a deep borehole complex which disposes of the waste form produced by the ceramic immobilization facility outlined in Section 4.3.3.2.1.10. There is no spent nuclear fuel or HLW associated with the operation of the deep borehole facility; however, the product output from the immobilization facility is a stabilized coated ceramic pellet. Table 4.3.3.2.2.10–1 provides the operational waste volumes projected to be generated from the deep borehole facility for immobilized disposal. Facilities that would support the deep borehole facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, waste could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. For purposes of analysis, a pristine site with no waste management infrastructure was assumed for No Action because the deep borehole facility was assumed to be a rural setting where no waste is currently being generated. The incremental waste volumes generated from the deep borehole facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.2. A detailed description of the waste management activities that would be required to support the new deep borehole disposal facility can be found in Section E.3.3.2.

Construction and operation of a deep borehole disposal facility for immobilized disposal would require the construction of waste management facilities to treat and store generated TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with all applicable Federal and State regulations.

Less than 1 m^3 (120 gal) of liquid TRU waste generated per year from equipment decontamination would be treated in a waste handling facility to form grout. In the solids treatment area of the waste handling facility less than 1 m^3 (<1 yd^3) of solid TRU waste from process and facility operations, equipment decontamination, failed equipment, and used tools would be compacted, as appropriate, then packaged, assayed, and certified to the WIPP WAC or alternative treatment level. A small quantity (0.1 m^3 [0.2 yd^3]) of mixed TRU solid waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be principally rubber gloves and leaded gloveboxes. To transport the TRU and mixed TRU wastes to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), one truck shipment every 15 years would be required.

An estimated 3 m^3 (800 gal) of liquid LLW from process wash liquids and excess water from the borehole would be solidified in the waste handling facility. The solidified liquid LLW and solid LLW comprised of sealant residues, contaminated reagent containers, deformed shipping containers, wipes, rags, and paper clothing would result in approximately 5 m^3 (7 yd^3) of LLW that would require disposal at a DOE LLW disposal facility. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.002 ha/yr (0.004 acres/yr) at Hanford and ORR, 0.0008 ha/yr (0.002 acre/yr) at NTS and INEL, and 0.0006 ha/yr (0.002 acres/yr) at SRS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Approximately 141 m^3 (37,400 gal) of liquid hazardous waste consisting of 2 m^3 (600 gal) of chemical makeup and reagents from the surface facility and 139 m^3 (36,800 gal) of decontamination water, oil, antifreeze, and hydraulic fluid from the drilling and emplacing-borehole sealing facilities would be collected in DOT-approved

Table 4.3.3.2.2.10–1. Estimated Annual Generated Waste Volumes for the Deep Borehole Complex[a]—Immobilized Disposition Alternative

Category	New Facility (m^3)	No Action (m^3)
Transuranic		
Liquid	0.5[b]	None
Solid	0.5	None
Mixed Transuranic		
Liquid	0	None
Solid	0.1	None
Low-level		
Liquid	3[b]	None
Solid	6	None
Mixed low-level		
Liquid	0	None
Solid	0	None
Hazardous		
Liquid	141	None
Solid	15	None
Nonhazardous (sanitary)		
Liquid	9,460	None
Solid	291	None
Nonhazardous (other)		
Liquid	6,060	None
Solid	1,250[c]	None

[a] No waste generation was assumed for No Action. Waste generation volumes for deep borehole disposal facility for immobilized disposal are from Table E.3.3.2–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.2–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Includes rock cuttings, bentonite, and polymers from drilling and emplacing borehole sealing facilities.

containers and shipped to RCRA-permitted treatment and disposal facilities. An estimated 15 m^3 (20 yd^3) of solid hazardous waste such as wipes contaminated with oils, lubricants, and cleaning solvents would be compacted, as appropriate, and then packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities.

Approximately 9,460 m^3 (2,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and 6,060 m^3 (1,600,000 gal) of steam plant blowdown and evaporator condensate would require treatment in accordance with standard industrial practices. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling tower. Construction of sanitary, utility, and process wastewater treatment systems would be required. The 291 m^3 (380 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste would be shipped to a permitted landfill. The drilling and emplacing-borehole sealing facilities would generate approximately 1,250 m^3 (1,630 yd^3) of rock cuttings, bentonite, and polymers. As per customary drilling industry practices, these wastes would end up in mud pits and then filled with earth and leveled.

4.3.4 IMMOBILIZATION ALTERNATIVE CATEGORY

These sections describe three immobilization alternatives for the final disposition of Pu: Vitrification Alternative, Ceramic Immobilization Alternative, and Electrometallurgical Treatment Alternative (GBZ). The representative sites are: Hanford, NTS, INEL, Pantex, ORR, and SRS. The sections describe the construction and annual operational impacts of the immobilization alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. The impacts for all of the alternatives in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2). The potential can-in-canister approach at SRS for either vitrification or ceramic immobilization has been described in Appendix O. Should either of these variants be selected, follow-on tiered NEPA documentation will be completed, as appropriate.

4.3.4.1 Vitrification Alternative

The environmental impacts described in the following sections are based on the analysis of a new vitrification facility described in Section 2.4.4.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the vitrification facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the Vitrification Alternative, the analysis in Sections 4.3.4.1.1 to 4.3.4.1.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4–1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of vitrified Pu.

4.3.4.1.1 *Land Resources*

A new facility for the Vitrification Alternative would disturb 24 ha (60 acres) of land during construction, of which 12 ha (30 acres) would be used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. Land use would be less if existing facilities were used for portions of the vitrification operation.

Construction and operation of the vitrification facility would not cause indirect land use impacts at the analysis sites. As discussed in Section 4.3.4.1.8, in-migration of workers should be required only during the operational phase. However, it is expected that housing construction should be sufficient to absorb the increase in population at each site. Therefore, offsite land use at the analysis sites would not be affected. Direct and indirect impacts to land resources during construction and operation are described by representative site.

Hanford Site

Land Use. The vitrification facility site would utilize vacant land in the 200 Areas adjacent to 200 East. Construction would be in conformance with existing and future land use as described in the *Hanford Site Development Plan* and with ongoing discussions in the Comprehensive Land Use Planning Process (HF DOE 1993c:13,14). According to the current *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations which includes radioactive material management, processing, and storage. [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction of the vitrification alternative would be consistent with State and local (Benton, Franklin, and Grant counties and the City of Richland) land use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas and current VRM Class 5 designation. A potential visual impact during operation would be from stack plumes which would be visible from public viewpoints with high sensitivity levels including State Highways 24 and 240 and the City of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the vitrification alternative would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan,* which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked form sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. A new vitrification facility would be located on undeveloped land in the ICPP security area, which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan,* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation during operation from additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The vitrification facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* which designates Zone 4 for weapons and

weapon components staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other site land uses. There would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Construction and operation of the vitrification alternative would be consistent with the industrialized landscape character. The current VRM Class 5 designation of Zone 4 would not change.

Oak Ridge Reservation

Land Use. A new vitrification facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR or offsite land uses. No prime farmlands exist onsite. The vitrification facility would not be in conflict with City of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land-Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operation from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new vitrification facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land use category is Primary Industrial Mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.1.2 *Site Infrastructure*

Implementation of the vitrification alternative for immobilization of Pu with radionuclides requires construction and operation of facilities to conduct the vitrification processes. The potential impacts to the site infrastructure at six representative DOE sites for construction and operation of a vitrification facility are described below. Data for construction and operation are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.1.2–1, and changes from operations in Table 4.3.4.1.2–2.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational requirements would have negligible impact on the site infrastructure.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. Additional oil would be required during the period of construction and for operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Oak Ridge Reservation

Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Savannah River Site

[Text deleted.] If existing facilities were used for part of the operations, the construction impacts would be lower. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Table 4.3.4.1.2–1. Additional Site Infrastructure Needed for the Construction of the Vitrification Facility Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	2,000	5	94,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	347,500	63	9,428,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	126,940	30	5,810,000	0	0
Amount required in excess to site availability	0	0	94,000	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	234,500	47	5,914,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	48,266	15	889,166	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	728,000	115	473,000	95,000,000	16,300
Amount required in excess to site availability	0	0	57,000[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	796,000	121	28,484,500	0	221,352
Amount required in excess to site availability	0	0	94,000[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.4.1.2–2. Additional Site Infrastructure Needed for the Operation of the Vitrification Facility Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	<5	12,000	3	378,500	0	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	357,500	61	9,713,300	21,039,531	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
NTS							
Site availability	1,100[a]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	136,940	28	6,094,000	0	0
Amount required in excess to site availability	0	<5	0	0	378,500[b]	0	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	244,500	45	6,198,500	0	11,340
Amount required in excess to site availability	<5	<5	0	0	0	0	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	58,266	13	1,173,666	7,200,000	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	738,000	113	757,500	95,000,000	16,300
Amount required in excess to site availability	<5	<5	0	0	341,500[b]	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	806,000	119	28,769,000	0	221,352
Amount required in excess to site availability	<5	<5	0	0	378,500[b]	0	0

[a] Includes paved and unpaved roads.

[b] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

4.3.4.1.3 *Air Quality and Noise*

Construction and operation of the vitrification facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant

- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the vitrification facility are presented in Table F.1.3–9. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating

- Operation of diesel generators, diesel driven pumps, and periodic testing of emergency diesel generators

- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require "offsets" (reductions of existing emissions) to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.1.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

Table 4.3.4.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	11.49	2,290	2,299.06	284	312.6	602	712.3	5	7.83	22	119.5
	1-hour	40,000	0.3	90.92	2,748	2,812.03	614	686.5	2,900	3,475	11	16.85	171	630.2
Lead	Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	0.44	b	0.06[d]	4	4.55	2.15	4.42	3	3.09	5.7	7.47
Ozone	1-hour	235	e	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.75	1	1	3	3.01
	24-hour	150	0.02	0.05	106	106.02	80	80.08	88.5	88.81	2	2.01	50.6	50.87
Sulfur dioxide	Annual	52	<0.01	0.02	8.4	8.4	6	6.01	<0.01	0.06	2	2	14.5	14.55
	24-hour	260	<0.01	0.11	94.6	94.68	135	135.27	<0.01	0.99	32	32.02	196	196.9
	3-hour	1,300	0.01	0.78	725	725.55	579	580.2	<0.01	5.49	80	80.09	823	828.7
	1-hour	1,018	0.02	2.34	c	c	c	c	c	c	c	c	c	c
	1-hour	655[f]	0.02	2.34	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	14.74	c	c	c	c
Mandated by State														
Gaseous fluorides (as HF)	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	b	b	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	b	b	c	c	c	c	4.21	4.21	c	c	c	c
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.61
	24-hour	150	<0.02	0.05	c	c	80	80.08	c	c	2	2.01	c	c

Table 4.3.4.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	Hanford No Action (μg/m³)	Hanford Total (μg/m³)	NTS No Action (μg/m³)	NTS Total (μg/m³)	INEL No Action (μg/m³)	INEL Total (μg/m³)	Pantex No Action (μg/m³)	Pantex Total (μg/m³)	ORR No Action (μg/m³)	ORR Total (μg/m³)	SRS No Action (μg/m³)	SRS Total (μg/m³)
Total suspended particulates (continued)	3-hour	200	c	c	c	c	c	c	b	1.70[d]	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	4.58[d]	c	c	c	c
[Text deleted.]														

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[b] No sources for this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996c; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

NOISE

The location of the facilities associated with the vitrification facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction materials and workers to the site.

Nontraffic noise associated with operation of these facilities would include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas, so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emission from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.1.4 *Water Resources*

The construction and operation of a vitrification facility would affect surface water and groundwater resources. Water resource requirements and discharges provided in Table C.1.1.3–4, Table C.2.1.3–4, and Table E.3.3.4–1 were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.1.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the vitrification facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the vitrification facility. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the expected annual surface water withdrawal. This additional withdrawal would not affect surface water availability. During operation, the total annual water requirement would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the existing surface water withdrawal and approximately 0.0002 percent of the average annual flow of the Columbia River and would cause negligible impacts.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]), would be generated, treated, and discharged to evaporation/percolation ponds. [Text deleted.] During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to either recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The vitrification facility would be located in the 200 Area which is above the 100-year, 500-year and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the vitrification facility; therefore, there would be no impact to groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater would be discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

Table 4.3.4.1.4–1. ***Potential Changes to Water Resources Resulting From the Vitrification Alternative***

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action						
No Action water requirements (millions l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharges (millions l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	10.6	10.6	10.6	10.6	10.6	10.6
Percent increase in project water use[a]	0.08	0.4	0.1	4.3	0.07	0.08
Water Quality						
Total wastewater discharge (million l/yr)	4.6	4.6	4.6	4.6	4.6	4.6
Percent change in wastewater discharge[b]	1.9	5.6	0.9	2.5	0.2	0.7
Percent change in streamflow	neg	NA	NA	NA	0.01[c]	0.09[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	250	250	250	250	250	250
Percent increase in projected water use[e]	1.9	10.4	3.3	100.4	1.7	1.9
Water Quality						
Wastewater discharge (million l/yr)	197	197	197	197	197	197
Percent change in wastewater discharge[f]	80.1	240	36.5	139.7	8.7	28.1
Percent change in streamflow	neg	NA	NA	NA	0.4[c]	3.9[d]
Floodplain						
Action in 100-year floodplain	No	No	No	No	No	No
Critical action in 500-year floodplain	No	Uncertain	Uncertain	No	Uncertain	Unlikely

[a] Percent increases in water requirements during construction of the vitrification facility are calculated by dividing water requirements for the facility (10.6 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction of the vitrification facility are calculated by dividing wastewater discharges for the facility (4.6 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the vitrification facility are calculated by dividing water requirements (250 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent changes in wastewater discharged during operation of the vitrification facility are calculated by dividing wastewater discharge rate for the new facility (197 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater 4.6 million l/yr (1.2 million gal/yr), would be generated. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycling.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning, and other distillates; fire sprinkler water; and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycling or discharge to natural drainage channels.

There have been no studies to assess the 500-year floodplain boundaries at NTS. Information on the 500-year floodplain could be developed in future environmental studies. Studies have shown the 100-year floodplain to be confined to the Jackass Flats and Frenchman Lake areas. The proposed sites for the vitrification facility are not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required for construction and operation and the percent increase in projected water use are shown in Table 4.3.4.1.4–1. Annual construction water requirements for the facilities (10.6 million l/yr [2.8 million gal/yr]), would represent less than 0.03 percent of the minimum estimated annual recharge to the regional aquifer under the NTS (38 billion l [10 billion gal]) and a 0.4-percent increase over the projected groundwater usage. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which would be approximately 10.4 percent of the projected groundwater usage and 0.7 percent of the minimum estimated annual recharge. This additional amount would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or would be available for recycling. All discharges would be monitored to comply with discharge limits. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be either treated and discharged to

evaporation/percolation ponds or available for recycling. This amount would increase wastewater discharges by 36.5 percent. All discharges would be monitored to comply with discharge limit.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site for the vitrification facility is not located in an area historically prone to flooding, but is within the flood zone which would occur as a result of the failure of the MacKay Dam during a maximum probable flood, which would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Water requirements for operation of the vitrification facility would fall within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). As shown in Table 4.3.4.1.4–1, construction water requirements (10.6 million l/yr [2.8 million gal/yr]) for the proposed facilities, which are small relative to INEL's total usage, would represent a 0.1-percent increase over the projected annual groundwater usage. Minimal impacts to groundwater availability would occur. During operation, the water requirements for the facility would be 250 million l/yr (66 million gal/yr), which represents a 3.3-percent increase over the projected No Action annual groundwater usage. INEL would still be well within the total groundwater allotment.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Because no new groundwater supply wells would be installed, the vitrification facility is not expected to affect existing groundwater contamination in the ICPP area.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated and would be discharged to the existing wastewater treatment systems north of Zone 12. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the playas in 1994 and is expecting this quantity to decrease in the future, the estimated quantity of additional wastewater that would be discharged to the playas (approximately 539,700 l/day [142,600 gal/day]) should not cause any exceedances of the monthly average limit of 2.46 million l/day (650,000 gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The proposed location for the vitrification facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the vitrification facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.1.4–1, construction of the facilities would require 10.6 million l/yr (2.8 million gal/yr) of water, which would represent approximately a 4.3-percent increase over the No Action annual groundwater usage and 0.6 percent of the capacity of groundwater system (1,900 million l/yr [502 million gal/yr]). [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed vitrification facilities at Pantex would require 250 million l/yr (66 million gal/yr), resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The water requirements would be approximately 13.1 percent of the capacity of the groundwater system and about a 100-percent increase in projected No Action water usage. The total site groundwater withdrawal including this facility would be 499 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the vitrification facilities would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged to the playas until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the vitrification facility would be obtained from the Clinch River and its tributaries. [Text deleted.]

During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/ yr), which would represent a 0.07-percent increase over the projected annual surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr), which would represent a 1.7-percent increase over the projected No Action annual surface water withdrawal and would be 0.006 percent

of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). Minimal impacts to surface water availability would occur.

During construction of the vitrification facility, sanitary wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 197 million l/yr (52 million gal/yr) of sanitary wastewater would be generated by the new facility. This quantity would represent less than 0.4 percent of the average flow of East Fork Poplar Creek and would be a 8.7-percent increase in wastewater discharges. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to natural drainage channels. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. Groundwater would be used for construction and operation of a new vitrification facility. No surface water withdrawals would be made. [Text deleted.] During construction of the vitrification facility, sanitary and other nonhazardous wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 0.7-percent increase in the wastewater discharge from this facility. If existing facilities were used there would be less water used and wastewater discharged during construction. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 28.1-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 3.9-percent of the minimum flow of this stream. All discharges would be monitored to comply with discharge requirements. [Text deleted.] Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain. Although information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the vitrification facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because facility would be is located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the

vitrification buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the projected No Action annual groundwater withdrawal. This additional withdrawal would cause minimal impacts to groundwater availability.

During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. The total annual water requirements of 250 million l/yr (66 million gal/yr) shown in Table 4.3.4.1.4–1 represent a 1.9-percent increase in the projected groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 100 times greater than that required for the vitrification facility from the Cretaceous Aquifer indicate drawdown of almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be less in overlying aquifers and not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the facility would cause a slight drawdown at the well head and would not affect any aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the vitrification facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (24 ha [60 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the vitrification process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. [Text deleted.]

4.3.4.1.6 *Biological Resources*

Construction of the vitrification facility would require 24 ha (60 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the vitrification operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new vitrification facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the vitrification facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the vitrification facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a vitrification facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location to be affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the vitrification facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the vitrification facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are described below.

Terrestrial Resources. Construction and operation of the vitrification facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.007 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the vitrification facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitats nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the vitrification facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the vitrification facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The

USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the vitrification facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the vitrification facility (Section 4.3.4.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the vitrification facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the vitrification facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the vitrification facility would be located within Zone 4, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since Zone 4 does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the vitrification facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the vitrification facility. Although the assumed facility location has been disturbed, the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the vitrification facility would be located about 3 km (5 miles) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility at ORR would result in the disturbance of about 0.2 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas that would be revegetated following construction.

Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest. While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys were most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated in accordance with 10 CFR 1022.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the vitrification facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river. During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would provide minimal impacts to aquatic resources during either construction or operation.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the vitrification facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that a new vitrification facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES permitted outfalls and would involve minor volumes. Impacts from construction and operation of the vitrification facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by this action.

4.3.4.1.7 *Cultural and Paleontological Resources*

This section discusses the potential impacts to cultural and paleontological resources that may result from the construction and operation of the vitrification facility at each of the representative sites analyzed. The total land disturbed during the construction of this facility is 24 ha (60 acres), of which 12 ha (30 acres) would be used during operation. [Text deleted.] If existing facilities were used for a portion of the vitrification operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The vitrification facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the proposed facility.

The CGTO conducted surveys over portions of Frenchman Flat and identified at least 20 significant plant species. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Impacts could include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The vitrification facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP-listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The vitrification facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. This area has not been systematically surveyed for archaeological resources. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. In compliance with the standing Programmatic Agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded prehistoric resources at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock and are located predominantly near the playas (PX MH 1981a:58). Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Construction, but not operation, may have an effect on any identified resources.

DOE has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of

these resources may be affected by facility construction. Additional sites may occur on unsurveyed lands to be disturbed.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as cemeteries and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological remains may be encountered on the acreage to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected, so there would be no additional impact to resources.

Savannah River Site

The vitrification facility would be located on open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Site types known to occur at SRS include remains of prehistoric base camps, and lithic quarries and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by the proposed action. Operation would not have an additional impact on archaeological resources.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from the proposed alternative. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts would be considered negligible because the fossil assemblages known to occur at SRS are of low research value. During operation, no additional ground disturbance would be expected, so there would be no additional impact to resources.

[Text deleted.]

4.3.4.1.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the vitrification facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the vitrification operation. The effects at all of the candidate sites are found in the supplemental socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a vitrification facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 382 workers in the peak year of construction at any site. The largest increases in regional employment (less than 1 percent) and regional per capita income (much less than 1 percent) among the sites analyzed would be at INEL. A total of 776 new jobs (382 direct and 394 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.9 percent (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 768 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (almost 2 percent) and per capita income (less than 1 percent). A total of 2,828 new jobs (768 direct and 2,060 indirect) would be generated by the operational activities and regional unemployment would fall to 4.0 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill specialized positions during operation. Project-related increases in population would be greatest if the facility is located at Pantex. However, this increase would be less than 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the in-migrating population during operation. The greatest increase in housing requirements would be in the INEL ROI but this would be much less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be no increased demand for community services at any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during construction or operations would be minor. The following discussion focuses on the Pantex ROI which is expected to experience the largest increase in demand for community services.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 15 new teachers would be needed during operation of the proposed facility. However, the increase in teacher requirements would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

Only three additional police officers and three firefighters would need to be added in the Pantex ROI to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action estimates. However, projected hospital capacities would be capable of accommodating the small increase in patient load. To maintain the No Action service level of 2.0 physicians per 1,000 persons, only 2 additional physicians would be needed in the Pantex ROI (Socio 1996a).

Local Transportation. Traffic generated during the construction of the vitrification facility would not affect the level of service on the local road segments analyzed at any of the sites. However traffic would have the greatest

effect on local transportation at INEL. U.S. 20/26 from U.S. 26 East to Idaho State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.4.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the vitrification facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.1.9–1 and 4.3.4.1.9–2, respectively, are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.1.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.4.1.9–4 through 4.3.4.1.9–9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The vitrification facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilized facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a vitrification facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the vitrification facility at each of the sites are presented in Table 4.3.4.1.9–1. The impacts from all site operations, including the vitrification facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual vitrification facility operation range from 7.2×10^{-6} mrem at the NTS site to 2.5×10^{-4} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 3.6×10^{-11} to 1.3×10^{-9}. The impacts to the average individual would be less. As a result of annual operations, the population doses would range from 1.4×10^{-5} person-rem at the NTS site to 5.0×10^{-3} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 7.0×10^{-8} to 2.5×10^{-5}.

The dose to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range

Table 4.3.4.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Vitrification Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public [b]												
Atmospheric release pathway (mrem)	1.4×10^{-5}	4.4×10^{-3}	7.2×10^{-6}	4.2×10^{-3}	8.9×10^{-6}	0.018	1.1×10^{-4}	1.3×10^{-4}	2.5×10^{-4}	1.5	7.7×10^{-5}	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	1.4×10^{-5}	5.3×10^{-3}	7.2×10^{-6}	4.2×10^{-3}	8.9×10^{-6}	0.018	1.1×10^{-4}	1.3×10^{-4}	2.5×10^{-4}	3.2	7.7×10^{-5}	0.79
Percent of natural background[c]	4.7×10^{-6}	1.8×10^{-3}	2.3×10^{-6}	1.3×10^{-3}	2.6×10^{-6}	5.2×10^{-3}	3.3×10^{-5}	3.9×10^{-5}	8.5×10^{-5}	1.1	2.6×10^{-5}	0.27
10-year fatal cancer risk	7.0×10^{-11}	2.7×10^{-8}	3.6×10^{-11}	2.1×10^{-8}	4.5×10^{-11}	8.8×10^{-8}	5.5×10^{-10}	6.4×10^{-10}	1.3×10^{-9}	1.6×10^{-5}	3.9×10^{-10}	4.0×10^{-6}
3.5-year fatal cancer risk[d]	2.5×10^{-11}	9.5×10^{-9}	1.3×10^{-11}	7.4×10^{-9}	1.6×10^{-11}	3.1×10^{-8}	1.9×10^{-10}	2.2×10^{-10}	4.6×10^{-10}	5.6×10^{-6}	1.4×10^{-10}	1.4×10^{-6}
Annual Population Dose Within 80 Kilometers [e]												
Atmospheric release pathway (person-rem)	7.9×10^{-4}	0.46	1.4×10^{-5}	3.7×10^{-3}	1.6×10^{-4}	2.4	3.4×10^{-4}	6.2×10^{-4}	4.4×10^{-3}	29	5.0×10^{-3}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	7.9×10^{-4}	1.6	1.4×10^{-5}	3.7×10^{-3}	1.6×10^{-4}	2.4	3.4×10^{-4}	6.2×10^{-4}	4.4×10^{-3}	34	5.0×10^{-3}	44
Percent of natural background[c]	4.2×10^{-7}	8.4×10^{-4}	1.5×10^{-7}	4.1×10^{-5}	1.8×10^{-7}	2.7×10^{-3}	2.9×10^{-7}	5.3×10^{-7}	1.2×10^{-6}	9.0×10^{-3}	1.9×10^{-6}	0.017
10-year fatal cancers	4.0×10^{-6}	7.8×10^{-3}	7.0×10^{-8}	1.9×10^{-5}	8.0×10^{-7}	0.012	1.7×10^{-6}	3.1×10^{-6}	2.2×10^{-5}	0.17	2.5×10^{-5}	0.22
3.5-year fatal cancers[d]	1.4×10^{-6}	2.7×10^{-3}	2.5×10^{-8}	6.7×10^{-6}	2.8×10^{-7}	4.2×10^{-3}	6.0×10^{-7}	1.1×10^{-6}	7.7×10^{-6}	0.060	8.8×10^{-6}	0.077

Table 4.3.4.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Vitrification Alternative—Continued

Receptor	Hanford Facility	Hanford Total Site[a]	NTS Facility	NTS Total Site[a]	INEL Facility	INEL Total Site[a]	Pantex Facility	Pantex Total Site[a]	ORR Facility	ORR Total Site[a]	SRS Facility	SRS Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers [f]												
Atmospheric and liquid release pathways combined (mrem)	$1.3x10^{-6}$	$2.6x10^{-3}$	$4.8x10^{-7}$	$1.3x10^{-4}$	$5.9x10^{-7}$	$8.9x10^{-3}$	$9.7x10^{-7}$	$1.8x10^{-6}$	$3.4x10^{-6}$	0.026	$5.6x10^{-6}$	0.049
10-year fatal cancer risk	$6.4x10^{-12}$	$1.3x10^{-8}$	$2.4x10^{-12}$	$6.3x10^{-10}$	$3.0x10^{-12}$	$4.5x10^{-8}$	$4.9x10^{-12}$	$8.9x10^{-12}$	$1.7x10^{-11}$	$1.3x10^{-7}$	$2.8x10^{-11}$	$2.5x10^{-7}$
3.5-year fatal cancer risk[d]	$2.2x10^{-12}$	$4.6x10^{-9}$	$8.4x10^{-13}$	$2.2x10^{-10}$	$1.1x10^{-12}$	$1.6x10^{-8}$	$1.7x10^{-12}$	$3.1x10^{-12}$	$6.0x10^{-12}$	$4.6x10^{-8}$	$9.8x10^{-12}$	$8.8x10^{-8}$

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the vitrification facility.Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by the NESHAPs (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

[d] For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

[e] For DOE activities proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS.)

Source: Section M.2.

from 1.3x10^{-4} mrem at Pantex to 3.2 mrem at the ORR site. From 10 years of operation, the corresponding risk of fatal cancer to this individual would range from 6.4x10^{-10} to 1.6x10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834, and would range from 6.2x10^{-4} person-rem at Pantex to 44 person-rem at the SRS site. The corresponding number of fatal cancers in these populations from 10 years of operation would be range from 3.1x10^{-6} to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected in this table for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.1.9–2. Included are involved workers directly associated with the vitrification facility, workers who are not involved with the vitrification facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to vitrification facility workers is site-independent and would be 200 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforce would range from 113-person-rem at the NTS site to 360 person-rem at the Hanford site. The risks and numbers of fatal cancer among the different workers from 10 years of operation are included in Table 4.3.4.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the vitrification facility at each of several sites are presented in Table 4.3.4.1.9–3. Included is the impact due only to operation of the vitrification facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 1.0x10^{-4} at the NTS site to 3.9x10^{-3} at the ORR site due to the new facility operation. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 0.019 at the Pantex site to 0.040 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites. [Text deleted.]

Facility Accidents. A set of potential accidents has been postulated for the vitrification facility, where releases of Pu may occur that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.3.4.1.9–4 through 4.3.4.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 9.9x10^{-3} at ORR for the Cs fire accident scenario with a probability of 1.0x10^{-6} per year. The corresponding 10 year cancer facility lifetime risk from the same accident scenarios for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 9.9x10^{-8}, 7.7x10^{-11} and 3.8x10^{-10}, respectively. The maximum population 10-year facility lifetime risk would be 1.8x10^{-5} (that is, one fatality in over 600,000 years) at ORR for the Cs ion processing fire accident scenario with a probability of 1.0x10^{-6} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 1.4x10^{-8} and 6.8x10^{-8}, respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionally reduced.

Table 4.3.4.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Vitrification Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	200	200	200	200	200	200
10-year risk of fatal cancer	$8.0x10^{-4}$	$8.0x10^{-4}$	$8.0x10^{-4}$	$8.0x10^{-4}$	$8.0x10^{-4}$	$8.0x10^{-4}$
3.5-year risk of fatal cancer[c]	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
3.5-year risk of fatal cancer[c]	0.15	0.15	0.15	0.15	0.15	0.15
Noninvolved Workforce[d]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	$1.1x10^{-4}$	$2.0x10^{-5}$	$1.2x10^{-4}$	$4.0x10^{-5}$	$1.0x10^{-5}$	$1.3x10^{-4}$
3.5-year risk of fatal cancer[c]	$3.9x10^{-5}$	$7.0x10^{-6}$	$4.2x10^{-5}$	$1.4x10^{-5}$	$3.5x10^{-6}$	$4.6x10^{-5}$
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5 year fatal cancers[c]	0.35	$4.2x10^{-3}$	0.31	0.020	0.063	0.32
Total Site Workforce[e]						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3
3.5 year fatal cancers[c]	0.49	0.16	0.46	0.18	0.22	0.46

[a] The involved worker is associated with operations of the vitrification facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

[d] The noninvolved worker is onsite but not associated with operations of the vitrification facility. The Noninvolved Workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.4.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Vitrification Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]	Facility[b]	Total Site[c]	Facility[a]	Total Site[b]	Facility[a]	Total Site[b]
Maximally Exposed Individual (Public)												
Hazard Index[c]	6.7×10^{-4}	7.3×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	1.4×10^{-3}	0.017	3.7×10^{-3}	9.4×10^{-3}	3.9×10^{-3}	0.043	1.8×10^{-4}	5.3×10^{-3}
Cancer Risk[d]	0	0	0	0	0	3.6×10^{-6}	0	1.1×10^{-8}	0	0	0	1.3×10^{-7}
Worker Onsite												
Hazard Index[e]	0.038	0.042	0.020	0.020	0.038	0.26	0.019	0.025	0.040	0.19	0.034	1.2
Cancer Risk[f]	0	0	0	0	0	7.7×10^{-4}	0	4.5×10^{-7}	0	0	0	1.9×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(Emissions concentration) x (0.286 [converts concentrations to doses]) x (Slope Factor).

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Where there are no known carcinogens among chemicals emitted, there are no Slope Factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–48 through M.3.4–53.

Table 4.3.4.1.9–4. Vitrification Alternative Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	$9.1x10^{-10}$ ($3.2x10^{-10}$)	$1.8x10^{-9}$	$8.6x10^{-12}$ ($3.0x10^{-12}$)	$1.7x10^{-11}$	$7.6x10^{-8}$ ($2.7x10^{-8}$)	$1.5x10^{-7}$	0.05
Melter spill	$9.1x10^{-13}$ ($3.2x10^{-13}$)	$9.1x10^{-10}$	$8.6x10^{-15}$ ($3.0x10^{-15}$)	$8.6x10^{-13}$	$7.6x10^{-11}$ ($2.7x10^{-11}$)	$7.6x10^{-9}$	$1.0x10^{-3}$
Cs capsule drop	$5.3x10^{-12}$ ($1.8x10^{-12}$)	$5.3x10^{-11}$	$4.0x10^{-14}$ ($1.4x10^{-14}$)	$4.0x10^{-12}$	$6.4x10^{-10}$ ($2.2x10^{-10}$)	$6.4x10^{-8}$	$1.0x10^{-3}$
Canister drop	$9.0x10^{-12}$ ($3.1x10^{-12}$)	$9.0x10^{-10}$	$8.5x10^{-14}$ ($3.0x10^{-14}$)	$8.5x10^{-12}$	$7.5x10^{-10}$ ($2.6x10^{-10}$)	$7.5x10^{-8}$	$1.0x10^{-3}$
CPC ion column fire	$6.9x10^{-8}$ ($2.4x10^{-8}$)	$6.9x10^{-6}$	$5.3x10^{-10}$ ($1.9x10^{-10}$)	$5.3x10^{-8}$	$8.4x10^{-6}$ ($2.9x10^{-6}$)	$8.4x10^{-4}$	$1.0x10^{-3}$
Pu oxide oven solids fire	$1.7x10^{-14}$ ($5.9x10^{-15}$)	$1.7x10^{-12}$	$1.7x10^{-16}$ ($6.0x10^{-17}$)	$1.7x10^{-14}$	$1.2x10^{-13}$ ($4.2x10^{-11}$)	$1.2x10^{-10}$	$1.0x10^{-3}$
Earthquake	$4.4x10^{-12}$ ($1.5x10^{-12}$)	$4.4x10^{-8}$	$4.4x10^{-14}$ ($1.5x10^{-14}$)	$4.4x10^{-10}$	$3.2x10^{-10}$ ($1.1x10^{-10}$)	$3.2x10^{-6}$	$1.0x10^{-5}$ $1.0x10^{-5}$
Cs fire	$3.9x10^{-10}$ ($1.4x10^{-10}$)	$3.9x10^{-5}$	$3.0x10^{-12}$ ($1.0x10^{-12}$)	$3.0x10^{-7}$	$4.7x10^{-8}$ ($1.6x10^{-8}$)	$4.7x10^{-3}$	$1.0x10^{-6}$ $1.0x10^{-6}$
Blender fire	$7.0x10^{-11}$ ($2.5x10^{-11}$)	$7.0x10^{-6}$	$5.3x10^{-13}$ ($1.9x10^{-13}$)	$5.3x10^{-8}$	$8.4x10^{-9}$ ($2.9x10^{-9}$)	$8.4x10^{-4}$	$1.0x10^{-6}$ $1.0x10^{-6}$
Nuclear criticality in Pu oxide furnace	$4.2x10^{-12}$ ($1.5x10^{-12}$)	$4.2x10^{-7}$	$3.3x10^{-14}$ ($1.2x10^{-14}$)	$3.3x10^{-9}$	$3.5x10^{-11}$ ($1.2x10^{-11}$)	$3.5x10^{-6}$	$1.0x10^{-6}$
Expected risk[d]	$7.1x10^{-8}$ ($2.5x10^{-8}$)	– –	$5.4x10^{-10}$ ($1.9x10^{-10}$)	– –	$8.5x10^{-6}$ ($3.0x10^{-6}$)	– –	– –

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–5. Vitrification Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	$6.2x10^{-10}$ ($2.2x10^{-10}$)	$1.2x10^{-9}$	$1.4x10^{-11}$ ($4.9x10^{-12}$)	$2.7x10^{-11}$	$1.7x10^{-9}$ ($5.9x10^{-10}$)	$3.5x10^{-9}$	0.05
Melter spill	$6.2x10^{-13}$ ($2.2x10^{-13}$)	$6.2x10^{-11}$	$1.4x10^{-14}$ ($4.9x10^{-15}$)	$1.4x10^{-12}$	$1.7x10^{-12}$ ($5.9x10^{-13}$)	$1.7x10^{-10}$	$1.0x10^{-3}$
Cs capsule drop	$3.6x10^{-12}$ ($1.3x10^{-12}$)	$3.6x10^{-10}$	$6.6x10^{-14}$ ($2.3x10^{-14}$)	$6.6x10^{-12}$	$1.5x10^{-11}$ ($5.2x10^{-12}$)	$1.5x10^{-9}$	$1.0x10^{-3}$
Canister drop	$6.1x10^{-12}$ ($2.1x10^{-12}$)	$6.1x10^{-10}$	$1.4x10^{-13}$ ($4.9x10^{-14}$)	$1.4x10^{-11}$	$1.7x10^{-11}$ ($5.9x10^{-12}$)	$1.7x10^{-9}$	$1.0x10^{-3}$
CPC ion column fire	$4.7x10^{-8}$ ($1.6x10^{-8}$)	$4.7x10^{-6}$	$8.7x10^{-10}$ ($3.0x10^{-10}$)	$8.7x10^{-8}$	$1.9x10^{-7}$ ($6.6x10^{-8}$)	$1.9x10^{-5}$	$1.0x10^{-3}$
Pu oxide oven solids fire	$1.2x10^{-14}$ ($4.2x10^{-15}$)	$1.1x10^{-12}$	$2.7x10^{-16}$ ($9.4x10^{-17}$)	$2.7x10^{-14}$	$2.8x10^{-14}$ ($9.8x10^{-15}$)	$2.8x10^{-12}$	$1.0x10^{-3}$
Earthquake	$3.0x10^{-12}$ ($1.0x10^{-12}$)	$3.0x10^{-8}$	$7.0x10^{-14}$ ($2.4x10^{-14}$)	$7.0x10^{-10}$	$7.2x10^{-12}$ ($2.5x10^{-12}$)	$7.2x10^{-8}$	$1.0x10^{-5}$
Cs fire	$2.6x10^{-10}$ ($9.1x10^{-11}$)	$2.6x10^{-5}$	$4.9x10^{-12}$ ($1.7x10^{-12}$)	$4.9x10^{-7}$	$1.1x10^{-9}$ ($3.8x10^{-10}$)	$1.1x10^{-4}$	$1.0x10^{-6}$
Blender fire	$4.7x10^{-11}$ ($1.6x10^{-11}$)	$4.7x10^{-6}$	$8.7x10^{-13}$ ($2.3x10^{-14}$)	$8.7x10^{-8}$	$2.0x10^{-10}$ ($7.0x10^{-11}$)	$2.0x10^{-5}$	$1.0x10^{-6}$
Nuclear criticality in Pu oxide furnace	$3.1x10^{-12}$ ($1.1x10^{-12}$)	$3.1x10^{-7}$	$6.5x10^{-14}$ ($2.3x10^{-14}$)	$6.5x10^{-9}$	$6.9x10^{-13}$ ($2.4x10^{-13}$)	$6.9x10^{-8}$	$1.0x10^{-6}$
Expected risk[d]	4.8x10-8 (1.7x10-8)	–	$8.9x10^{-10}$ ($3.1x10^{-10}$)	–	$2.0x10^{-7}$ ($7.0x10^{-8}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–6. Vitrification Alternative Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	$8.4x10^{-10}$ ($2.9x10^{-10}$)	$1.7x10^{-9}$	$8.6x10^{-12}$ ($3.0x10^{-12}$)	$1.7x10^{-11}$	$2.3x10^{-8}$ ($8.0x10^{-9}$)	$4.7x10^{-8}$	0.05
Melter spill	$8.4x10^{-13}$ ($2.9x10^{-13}$)	$8.4x10^{-11}$	$8.7x10^{-15}$ ($3.0x10^{-15}$)	$8.7x10^{-13}$	$2.3x10^{-11}$ ($8.0x10^{-12}$)	$2.3x10^{-9}$	$1.0x10^{-3}$
Cs capsule drop	$4.6x10^{-12}$ ($1.6x10^{-12}$)	$4.6x10^{-10}$	$3.8x10^{-14}$ ($1.3x10^{-14}$)	$3.8x10^{-12}$	$2.0x10^{-10}$ ($7.0x10^{-11}$)	$2.0x10^{-8}$	$1.0x10^{-3}$
Canister drop	$8.3x10^{-12}$ ($2.9x10^{-12}$)	$8.3x10^{-10}$	$8.5x10^{-14}$ ($3.0x10^{-14}$)	$8.5x10^{-12}$	$2.3x10^{-10}$ ($8.0x10^{-11}$)	$2.3x10^{-8}$	$1.0x10^{-3}$
CPC ion column fire	$6.1x10^{-8}$ ($2.1x10^{-8}$)	$6.1x10^{-6}$	$5.0x10^{-10}$ ($1.7x10^{-10}$)	$5.0x10^{-8}$	$2.6x10^{-6}$ ($9.1x10^{-7}$)	$2.6x10^{-4}$	$1.0x10^{-3}$
Pu oxide oven solids fire	$1.6x10^{-14}$ ($5.6x10^{-15}$)	$1.6x10^{-12}$	$1.7x10^{-16}$ ($5.9x10^{-17}$)	$1.7x10^{-14}$	$3.7x10^{-13}$ ($1.3x10^{-13}$)	$3.7x10^{-11}$	$1.0x10^{-3}$
Earthquake	$4.1x10^{-12}$ ($1.4x10^{-12}$)	$4.1x10^{-8}$	$4.4x10^{-14}$ ($1.5x10^{-4}$)	$4.4x10^{-10}$	$9.6x10^{-11}$ ($3.3x10^{-11}$)	$9.6x10^{-7}$	$1.0x10^{-5}$
Cs fire	$3.4x10^{-10}$ ($1.2x10^{-10}$)	$3.4x10^{-5}$	$2.9x10^{-12}$ ($1.0x10^{-12}$)	$2.9x10^{-7}$	$1.5x10^{-8}$ ($5.2x10^{-9}$)	$1.5x10^{-3}$	$1.0x10^{-6}$
Blender fire	$6.1x10^{-11}$ ($2.1x10^{-11}$)	$6.1x10^{-6}$	$5.1x10^{-13}$ ($1.8x10^{-13}$)	$5.1x10^{-8}$	$2.7x10^{-9}$ ($9.4x10^{-10}$)	$2.7x10^{-4}$	$1.0x10^{-6}$
Nuclear criticality in Pu oxide furnace	$4.0x10^{-12}$ ($1.4x10^{-12}$)	$4.0x10^{-7}$	$3.9x10^{-14}$ ($1.4x10^{-14}$)	$3.9x10^{-9}$	$9.0x10^{-12}$ ($3.1x10^{-12}$)	$9.0x10^{-7}$	$1.0x10^{-6}$
Expected risk[d]	$6.2x10^{-8}$ ($2.2x10^{-8}$)	–	$5.2x10^{-10}$ ($1.8x10^{-10}$)	–	$2.7x10^{-6}$ ($9.4x10^{-7}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–7. Vitrification Alternative Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Blender spill	$3.7x10^{-10}$ ($1.3x10^{-10}$)	$7.5x10^{-10}$	$1.1x10^{-10}$ ($3.8x10^{-11}$)	$2.1x10^{-10}$	$2.5x10^{-8}$ ($8.7x10^{-9}$)	$5.0x10^{-8}$	0.05
Melter spill	$3.7x10^{-13}$ ($1.3x10^{-13}$)	$3.7x10^{-11}$	$1.0x10^{-13}$ ($3.5x10^{-14}$)	$1.0x10^{-11}$	$2.5x10^{-11}$ ($8.7x10^{-12}$)	$2.5x10^{-9}$	$1.0x10^{-3}$
Cs capsule drop	$2.2x10^{-12}$ ($7.7x10^{-13}$)	$2.2x10^{-10}$	$5.9x10^{-13}$ ($2.1x10^{-13}$)	$5.9x10^{-11}$	$1.9x10^{-10}$ ($6.6x10^{-11}$)	$1.9x10^{-8}$	$1.0x10^{-3}$
Canister drop	$3.7x10^{-12}$ ($1.3x10^{-12}$)	$3.7x10^{-10}$	$1.0x10^{-12}$ ($3.5x10^{-13}$)	$1.0x10^{-10}$	$2.5x10^{-10}$ ($8.7x10^{-11}$)	$2.5x10^{-8}$	$1.0x10^{-3}$
CPC ion column fire	$3.0x10^{-8}$ ($1.0x10^{-8}$)	$3.0x10^{-6}$	$7.7x10^{-9}$ ($2.7x10^{-9}$)	$7.7x10^{-7}$	$2.5x10^{-6}$ ($8.7x10^{-7}$)	$2.5x10^{-4}$	$1.0x10^{-3}$
Pu oxide oven solids fire	$6.9x10^{-15}$ ($2.4x10^{-15}$)	$6.9x10^{-13}$	$2.0x10^{-15}$ ($7.0x10^{-16}$)	$2.0x10^{-13}$	$4.2x10^{-13}$ ($1.5x10^{-13}$)	$4.2x10^{-11}$	$1.0x10^{-3}$
Earthquake	$1.8x10^{-12}$ ($6.3x10^{-13}$)	$1.8x10^{-8}$	$5.1x10^{-13}$ ($1.8x10^{-13}$)	$5.1x10^{-9}$	$1.1x10^{-10}$ ($3.8x10^{-11}$)	$1.1x10^{-6}$	$1.0x10^{-5}$
Cs fire	$1.7x10^{-10}$ ($5.9x10^{-11}$)	$1.7x10^{-5}$	$4.4x10^{-11}$ ($1.5x10^{-11}$)	$4.4x10^{-6}$	$1.4x10^{-8}$ ($4.9x10^{-9}$)	$1.4x10^{-3}$	$1.0x10^{-6}$
Blender fire	$3.0x10^{-11}$ ($1.0x10^{-11}$)	$3.0x10^{-6}$	$7.8x10^{-12}$ ($2.7x10^{-12}$)	$7.8x10^{-7}$	$2.5x10^{-9}$ ($8.7x10^{-10}$)	$2.5x10^{-4}$	$1.0x10^{-6}$
Nuclear criticality in Pu oxide furnace	$1.9x10^{-12}$ ($6.6x10^{-13}$)	$1.9x10^{-7}$	$7.0x10^{-13}$ ($2.4x10^{-13}$)	$7.0x10^{-8}$	$2.2x10^{-11}$ ($7.7x10^{-12}$)	$2.2x10^{-6}$	$1.0x10^{-6}$
Expected risk[d]	$3.0x10^{-8}$ ($1.0x10^{-8}$)	–	$7.9x10^{-9}$ ($7.8x10^{-9}$)	–	$2.6x10^{-6}$ ($9.1x10^{-7}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–8. Vitrification Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Blender spill	$8.5x10^{-10}$ ($3.0x10^{-10}$)	$1.7x10^{-9}$	$1.8x10^{-10}$ ($6.3x10^{-11}$)	$3.7x10^{-10}$	$1.8x10^{-7}$ ($6.3x10^{-8}$)	$3.5x10^{-7}$	0.05
Melter spill	$8.6x10^{-13}$ ($3.0x10^{-13}$)	$8.6x10^{-11}$	$1.8x10^{-13}$ ($6.3x10^{-14}$)	$1.8x10^{-11}$	$1.8x10^{-10}$ ($6.3x10^{-11}$)	$1.8x10^{-8}$	$1.0x10^{-3}$
Cs capsule drop	$5.2x10^{-12}$ ($1.8x10^{-12}$)	$5.2x10^{-10}$	$1.0x10^{-12}$ ($3.5x10^{-13}$)	$1.0x10^{-10}$	$1.3x10^{-9}$ ($4.5x10^{-10}$)	$1.3x10^{-7}$	$1.0x10^{-3}$
Canister drop	$8.4x10^{-12}$ ($2.9x10^{-12}$)	$8.4x10^{-10}$	$1.8x10^{-12}$ ($6.3x10^{-13}$)	$1.8x10^{-10}$	$1.7x10^{-9}$ ($5.9x10^{-10}$)	$1.7x10^{-7}$	$1.0x10^{-3}$
CPC ion column fire	$6.8x10^{-8}$ ($2.4x10^{-8}$)	$6.8x10^{-6}$	$1.4x10^{-8}$ ($4.9x10^{-9}$)	$1.4x10^{-6}$	$1.8x10^{-5}$ ($6.3x10^{-6}$)	$1.8x10^{-3}$	$1.0x10^{-3}$
Pu oxide oven solids fire	$1.6x10^{-14}$ ($5.6x10^{-15}$)	$1.6x10^{-12}$	$3.5x10^{-15}$ ($1.2x10^{-15}$)	$3.5x10^{-13}$	$3.0x10^{-12}$ ($1.0x10^{-12}$)	$3.0x10^{-10}$	$1.0x10^{-3}$
Earthquake	$4.1x10^{-12}$ ($1.4x10^{-12}$)	$4.1x10^{-8}$	$8.9x10^{-13}$ ($3.1x10^{-13}$)	$8.9x10^{-9}$	$7.7x10^{-10}$ ($2.7x10^{-10}$)	$7.7x10^{-6}$	$1.0x10^{-5}$
Cs fire	$3.8x10^{-10}$ ($1.3x10^{-11}$)	$3.8x10^{-5}$	$7.7x10^{-11}$ ($2.7x10^{-11}$)	$7.7x10^{-6}$	$9.9x10^{-8}$ ($3.5x10^{-8}$)	$9.9x10^{-3}$	$1.0x10^{-6}$
Blender fire	$6.8x10^{-11}$ ($2.4x10^{-11}$)	$6.8x10^{-6}$	$1.4x10^{-11}$ ($4.9x10^{-12}$)	$1.4x10^{-6}$	$1.8x10^{-8}$ ($6.3x10^{-9}$)	$1.8x10^{-3}$	$1.0x10^{-6}$
Nuclear criticality in Pu oxide furnace	$3.8x10^{-12}$ ($1.3x10^{-12}$)	$3.8x10^{-7}$	$8.5x10^{-13}$ ($3.0x10^{-13}$)	$8.5x10^{-8}$	$1.6x10^{-10}$ ($5.6x10^{-11}$)	$1.6x10^{-5}$	$1.0x10^{-6}$
Expected risk[d]	$6.9x10^{-8}$ ($2.4x10^{-8}$)	–	$1.4x10^{-8}$ ($4.9x10^{-9}$)	–	$1.8x10^{-5}$ ($6.3x10^{-6}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–9. ***Vitrification Alternative Accident Impacts at Savannah River Site***

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Blender spill	6.1×10^{-10} (2.1×10^{-10})	1.2×10^{-9}	1.5×10^{-13} (5.2×10^{-14})	2.9×10^{-11}	8.0×10^{-8} (2.8×10^{-8})	1.6×10^{-7}	0.05
Melter spill	6.1×10^{-13} (2.1×10^{-13})	6.1×10^{-11}	1.5×10^{-14} (5.2×10^{-15})	1.5×10^{-12}	8.0×10^{-11} (2.8×10^{-11})	8.0×10^{-9}	1.0×10^{-3}
Cs capsule drop	3.7×10^{-12} (1.3×10^{-12})	3.7×10^{-10}	8.2×10^{-14} (2.9×10^{-14})	8.2×10^{-12}	6.4×10^{-10} (2.2×10^{-10})	6.4×10^{-8}	1.0×10^{-3}
Canister drop	6.0×10^{-12} (2.1×10^{-12})	6.0×10^{-10}	1.4×10^{-13} (4.9×10^{-14})	1.4×10^{-11}	7.9×10^{-10} (2.8×10^{-10})	7.9×10^{-8}	1.0×10^{-3}
CPC ion column fire	4.8×10^{-8} (1.7×10^{-8})	4.8×10^{-6}	1.1×10^{-9} (3.8×10^{-10})	1.1×10^{-7}	8.4×10^{-6} (2.9×10^{-6})	8.4×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	1.1×10^{-14} (3.8×10^{-15})	1.1×10^{-12}	2.7×10^{-16} (9.4×10^{-17})	2.7×10^{-14}	1.3×10^{-12} (4.5×10^{-13})	1.3×10^{-10}	1.0×10^{-3}
Earthquake	2.9×10^{-12} (1.0×10^{-12})	2.9×10^{-8}	7.1×10^{-14} (2.5×10^{-14})	7.1×10^{-10}	3.4×10^{-10} (1.2×10^{-10})	3.4×10^{-6}	1.0×10^{-5}
Cs fire	2.7×10^{-10} (9.4×10^{-11})	2.7×10^{-5}	6.1×10^{-12} (2.1×10^{-12})	6.1×10^{-7}	4.7×10^{-8} (1.6×10^{-8})	4.7×10^{-3}	1.0×10^{-6}
Blender fire	4.8×10^{-11} (1.7×10^{-11})	4.8×10^{-6}	1.1×10^{-12} (3.8×10^{-13})	1.1×10^{-7}	8.4×10^{-9} (2.9×10^{-9})	8.4×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	2.8×10^{-12} (9.8×10^{-13})	2.8×10^{-7}	5.7×10^{-14} (2.0×10^{-14})	5.7×10^{-9}	4.7×10^{-11} (1.6×10^{-11})	4.7×10^{-6}	1.0×10^{-6}
Expected risk[d]	4.9×10^{-8} (1.7×10^{-8})	– –	1.1×10^{-9} (3.8×10^{-10})	– –	8.5×10^{-6} (3.0×10^{-6})	– –	– –

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.1.9–4 through 4.3.4.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas to minimize the risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major structural damage and the release of Pu directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal impacts.

4.3.4.1.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a vitrification facility. There is no spent nuclear fuel or HLW associated with the operation of the vitrification facility; however, the facility does generate as its product output a glass log. The vitrification facility would provide interim storage of the glass log until entry into the Federal Waste Management System for final disposition. Table 4.3.4.1.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the vitrification facility. Facilities that would support the vitrification facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the vitrification facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.4. A detailed description of the waste management activities that would be required to support the vitrification facility can also be found in Section E.3.3.4.

Construction and operation of a vitrification facility would impact existing waste management activities at each of the sites analyzed by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Approximately 99 m^3 (130 yd^3) of solid TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the vitrification facility if sited at ORR, Pantex, or NTS. A small quantity (0.7 m^3 [0.9 yd^3]) of solid mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Following treatment and volume reduction, approximately 14 m^3 (18 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acre/yr) at Hanford and ORR, 0.002 ha/yr (0.006 acre/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acre/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m^3 [0.2 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that has been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party

Table 4.3.4.1.10–1. Estimated Annual Generated Waste Volumes for the Vitrification Alternative[a]

Category	New Facility (m³)	Hanford No Action (m³)	NTS No Action (m³)	INEL No Action (m³)	Pantex No Action (m³)	ORR No Action (m³)	SRS No Action (m³)
Transuranic							
Liquid	0.8[b]	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700
Hazardous							
Liquid	19	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	269,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for vitrification facility are from Table E.3.3.4–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.4–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

Agreement for Hanford or the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 19 m^3 (5,000 gals) of liquid and 19 m^3 (25 yd^3) of solid hazardous wastes would be generated annually. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 34,000 m^3 (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and 269,000 m^3 (71 million gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. For the Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be vitrified. The construction of these treatment systems would be determined in further tiered NEPA documentation. The 920 m^3 (1,200 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.2 Ceramic Immobilization Alternative

The environmental impacts described in the following sections are based on the analysis of the ceramic immobilization facility described in Section 2.4.4.2. The highly radioactive isotope Cs-137, would be included into the ceramic matrix to serve as a radiation barrier to theft and diversion. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the ceramic immobilization, the analysis in Section 4.3.4.2.1 to 4.3.4.2.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4–1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of immobilized Pu.

4.3.4.2.1 *Land Resources*

A new ceramic immobilization facility would disturb 20 ha (49 acres) of land during construction of which 12 ha (30 acres) is used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. This section describes the impacts to land resources from construction and operation of the facility for each representative site. Land use would be less if existing facilities were used for portions of the ceramic immobilization operation.

Construction and operation of the ceramic immobilization facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.4.2.8, in-migration of workers would be required during construction at INEL and Pantex and at all sites analyzed during operations. It is expected that historic housing construction rates would be sufficient to accommodate the in-migrating population at each site. Therefore, offsite land use at the analysis sites would not be affected.

Hanford Site

Land Use. The potential site for a new ceramic immobilization facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the ceramic immobilization alternative would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with State and local (Benton, Franklin, and Grant counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Area and current VRM Class 5 designation. A potential source of visual impact during operations would be from the stack plumes which could be visible from public viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. [Text deleted.] Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertakes land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The proposed ceramic immobilization facility would be located on undeveloped land in the ICPP security area which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation from the additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial character of the ICPP.

Pantex Plant

Land Use. A new ceramic immobilization facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* master plan which designates Zone 4 for weapons and weapon components for staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the additional stack plumes; however, the visual environment would be consistent with the existing industrialized landscape character, and VRM Class 5 designation of Zone 4.

Oak Ridge Reservation

Land Use. A new ceramic immobilization facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan*, which designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR and offsite land uses. No prime farmlands exist onsite. A new ceramic immobilization facility would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operations from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new ceramic immobilization facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated Industrial Operations, while the future land-use category is primary industrial mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:2,11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with local land use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.2.2 Site Infrastructure

Implementation of the alternative for ceramic immobilization requires construction and operation of facilities to conduct the ceramic immobilization processes. Data for annual construction and operations are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.2.2–1 and changes from operations in Table 4.3.4.2.2–2 for six representative sites.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Hanford would require additional natural gas supplies to operate the ceramic immobilization facility. Since natural gas availability is governed by usage and not by storage capacity onsite, the additional natural gas required for operations could be procured through normal contractual means.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Since NTS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure during operations. The final facility design could be converted to use fuel oil. Construction and operation of this facility could require construction of transportation links to the existing road and rail networks, of less than 5 km (3 mi). Since NTS does not use natural gas, this facility would be designed to burn fuel oil if NTS were selected as the site.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the ceramic immobilization facility site.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required for construction could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Oak Ridge Reservation

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Construction and operation of this facility would require construction of transportation

Table 4.3.4.2.2–1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	8,000	1.5	2,200,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	353,500	59.5	11,534,800	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	132,940	26.5	7,916,000	0	0
Amount required in excess of site availability	0	0	2,200,000[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	240,500	43.5	8,020,000	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	54,266	11.5	2,995,166	7,200,000	0
Amount required in excess of site availability	0	0	1,219,446[a]	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	734,000	111.5	2,579,000	95,000,000	16,300
Amount required in excess of site availability	0	0	2,163,000[a]	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	802,000	118	30,590,500	0	221,352
Amount required in excess of site availability	0	0	2,200,000[a]	0	0

[a] Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.4.2.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	< 5	< 5	25,000	3	190,000	3,500,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	370,500	61	9,524,800	24,539,531	0
Amount required in excess of site availability	< 5	<5	0	0	0	3,500,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	149,940	28	5,906,000	3,500,000	0
Amount required in excess of site availability	0	<5	0	0	190,000[c]	3,500,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	257,500	45	6,010,000	3,500,000	11,340
Amount required in excess of site availability	< 5	< 5	0	0	0	3,500,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	71,266	13	985,166	10,700,000	0
Amount required in excess of site availability	< 5	< 5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	751,000	113	569,000	98,500,000	16,300
Amount required in excess of site availability	< 5	< 5	0	0	153,000[c]	0	0

Table 4.3.4.2.2–2. ***Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)—Continued***

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	819,000	119	28,580,500	3,500,000	221,352
Amount required in excess of site availability	< 5	< 5	0	0	190,000[c]	3,500,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes paved and unpaved roads.

[c] Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible.

Savannah River Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to the existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contracts, or the construction companies could provide for this additional oil from local suppliers. Because SRS does not use natural gas, this facility would be designed to burn fuel oil if SRS were selected as the ceramic immobilization facility site.

4.3.4.2.3 *Air Quality and Noise*

Construction and operation of the ceramic immobilization facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the ceramic immobilization facility are presented in Table F.1.3–10. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.2.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the facilities associated with the ceramic immobilization facility relative to the site boundary and sensitive receptors was examined for each site to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include

Table 4.3.4.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	Hanford No Action (μg/m³)	Hanford Total (μg/m³)	NTS No Action (μg/m³)	NTS Total (μg/m³)	INEL No Action (μg/m³)	INEL Total (μg/m³)	Pantex No Action (μg/m³)	Pantex Total (μg/m³)	ORR No Action (μg/m³)	ORR Total (μg/m³)	SRS No Action (μg/m³)	SRS Total (μg/m³)
Criteria Pollutant														
Carbon monoxide	8-hour	10,000	0.08	39.68	2,290	2,321.46	284	383.5	602	984.8	5	14.81	22	360.7
	1-hour	40,000	0.3	314.95	2,748	2,970.3	614	865.9	2,900	4,897	11	31.31	171	1,765
Lead	Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	3.75	b	0.56[d]	4	9.08	2.15	22.95	3	3.84	5.7	21.91
Ozone[c]	1-hour	235	e	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5.01	8.73	8.75	1	1	3	3.02
	24-hour	150	0.02	0.06	106	106	80	80.11	88.5	88.91	2	2.01	50.6	50.97
Sulfur dioxide	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	<0.01	2	2	14.5	14.5
	24-hour	260	<0.01	<0.01	94.6	94.6	135	135	<0.01	0.05	32	32	196	196.03
	3-hour	1,300	0.01	0.04	725	725	579	579	<0.01	0.21	80	80	823	823.21
	1-hour[f]	1,018	0.02	0.11	c	c	c	c	c	c	c	c	c	c
	1-hour	655[f]	0.02	0.11	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	0.54	c	c	c	c
Mandated by State														
Gaseous fluoride (as HF)	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6[g]	0.6[g]	1.04	1.04
	12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6[g]	0.6[g]	1.99	1.99
	8-hour	250	c	c	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	c	c	c	c	c	c	4.21	4.21	c	c	c	c

Table 4.3.4.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative—Continued

			Hanford		NTS		INEL		Pantex		ORR		SRS	
Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)	No Action (μg/m³)	Total (μg/m³)
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5.01	c	c	c	c	12.6	12.62
	24-hour	150	0.02	0.06	c	c	80	80.11	c	c	2	2.01	c	c
	3-hour	200	c	c	c	c	c	c	b	2.29[d]	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	6.15[d]	c	c	c	c
[Text deleted.]														

[a] The more stringent of the Federal and State standards is presented for the averaging time.

[Text deleted.]

[b] No sources of this pollutant have been identified.

[c] No State standard for indicated averaging time.

[d] The concentration represents the alternative contribution only.

[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

[f] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

[g] 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations from other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996d; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

heavy-construction equipment and increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.2.4 *Water Resources*

The construction and operation of a ceramic immobilization facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.3–5 and C.2.1.3–5 and Table E.3.3.5–1, were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.2.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the ceramic immobilization facility to a HLW repository.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the ceramic immobilization facility. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual surface water withdrawal (13,511 million l/yr [3,569 million gal/yr]). During operation, the total annual water requirement for the ceramic immobilization facility would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the projected surface water annual withdrawal and would increase Hanford's total withdrawals to 0.04-percent of the minimum average flow of the Columbia River. These additional withdrawals would have a negligible impact on surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds. This amount would represent a 11.7-percent increase in the annual amount being discharged. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. This amount would represent a 39.8-percent increase in the amount being discharged. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The ceramic immobilization facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the facility; therefore there would be no impact to groundwater availability. Construction and operation of the facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.4.2.4–1. Potential Changes to Water Resources Resulting From the Ceramic Immobilization Alternative

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	38	38	38	38	38	38
Percent increase in projected water use[a]	0.3	1.6	0.5	15.3	0.3	0.3
Water Quality						
Total wastewater discharge (million l/yr)	28.8	28.8	28.8	28.8	28.8	28.8
Percent change in wastewater discharge[b]	11.7	35.1	5.3	20.4	1.3	4.1
Percent change in streamflow	neg	NA	NA	NA	0.06[c]	0.6[d]
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	250	250	250	250	250	250
Percent increase in projected water use[e]	1.9	10.4	3.3	100	1.7	1.9
Water Quality						
Total wastewater discharge (million l/yr)	98	98	98	98	98	98
Percent change in wastewater discharge[f]	39.8	119.5	18.1	69.5	4.3	14.0
Percent change in streamflow	neg	NA	NA	NA	0.2[c]	1.9[d]
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	Uncertain	Unlikely

[a] Percent increases in water requirements during construction of the ceramic immobilization facility are calculated by dividing water requirements for the facility (38 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[b] Percent changes in wastewater discharged during construction for the new ceramic immobilization facility are calculated by dividing wastewater discharges for the facility (28.8 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr]), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the ceramic immobilization facility are calculated by dividing water requirements (250 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

[f] Percent changes in wastewater discharged during operation of the ceramic immobilization facility are calculated by dividing wastewater discharge rate for the new facility (98 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only through the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater, and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]), would be generated. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility will be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning and other distillates, fire sprinkler water and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycle or discharge to natural drainage channels.

No studies to assess the 500-year floodplain boundaries at NTS have been conducted. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the ceramic immobilization facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding. Information on the location of the 500-year floodplain could be developed in future environmental studies.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required and the percent increase in projected water use are shown in Table 4.3.4.2.4–1. Construction water requirements for the facilities (38 million l/yr [10 million gal/yr]) would represent approximately 0.1 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under the entire NTS. As shown in Table 4.3.4.2.4–1, the quantity of water required for construction of the proposed facility would represent a 1.6-percent increase over the projected No Action groundwater use. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which is approximately 10.4 percent of the projected groundwater use. This additional withdrawal would represent 0.7 percent of the estimated minimum annual recharge, and would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or be available for recycle. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other nonhazardous liquids (including industrial wastewater, cooling water, blowdown, and stormwater runoff) would be treated and discharged to evaporation/percolation ponds, or be available for recycle. All discharges would be monitored to comply with discharge limits.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated, if necessary, prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The candidate site for the ceramic immobilization facility is not located in an area historically prone to flooding, but is within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.4.2.4–1, construction water requirements for the facility (38 million l/yr [10.0 million gal/yr]), would represent a 0.5-percent increase over the projected annual groundwater usage and would be within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr) has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). No impacts to groundwater availability would occur. During operation, the water requirements for the facilities would be 250 million l/yr (66 million gal/yr). This would represent a 3.3-percent increase over the projected annual groundwater usage; INEL would still be well within the total groundwater allotment.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged to the disposal ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the

playas in 1994 and since this quantity is expected to decrease in the future, the expected quantity of additional wastewater potentially discharged to the playas should not cause any exceedance of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The proposed location for the ceramic immobilization facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the ceramic immobilization facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.2.4–1, construction of the proposed consolidated facilities would require 38 million l/yr (10 million gal/yr) of water, which would represent approximately a 15.3-percent increase over the projected annual No Action groundwater usage and 2-percent of the capacity of the groundwater wells. [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the ceramic immobilization facilities at Pantex would require 250 million l/yr (66 million gal/yr) resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The total site groundwater withdrawal including this facility would be 449 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered includes decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the ceramic immobilization facility would be obtained from the Clinch River and its tributaries. [Text deleted.] During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.7-percent increase over the projected annual No Action surface water withdrawal. Total ORR withdrawals would be 0.4-percent of the

average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). Minimal impacts to surface water availability would occur.

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 98 million l/yr (25.9 million gal/yr) of wastewater would be generated by the facility. This quantity would represent about 0.2-percent of the minimum flow of East Fork Poplar Creek and a 4.3-percent increase in annual discharge amounts. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharged to natural drainage channels. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site location of the ceramic immobilization facility is located outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for all construction and operation needs of a new ceramic immobilization facility. During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 4.1-percent increase in the effluent from this facility. If existing facilities were used, there would be less water used and wastewater discharged during construction. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 14.0-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 1.9 percent of the minimum flow of this stream; no impacts are expected. All discharges would be monitored to comply with discharge requirements. Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential location for a new ceramic immobilization facility is outside the 100-year floodplain. Although, information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the ceramic immobilization facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because the facility would be is located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m^3/s (2,040 ft^3/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 63 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m^3/s (186 ft^3/s), and an elevation of about 61 m (199 ft) above MSL

(SR USGS 1996a:1). Elevations of the buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. Water requirements during operations (250 million l/yr [66 million gal/yr]), as shown in Table 4.3.4.2.4–1, represent a 1.9-percent increase in the projected No Action groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals from the Cretaceous Aquifer of eight times greater than that required for the ceramic immobilization facility indicate that drawdown could be almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the ceramic immobilization facility would cause a small drawdown at the well head and should not affect any aquifers in the area.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.2.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the ceramic immobilization facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (20 ha [49 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the immobilization process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.4.2.6 *Biological Resources*

Construction of the ceramic immobilization facility would require 20 ha (49 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the ceramic immobilization operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.01 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location so as to be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure. Since the volume of water included represents a small percentage of the flow of the river, impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.01 percent of NTS. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in

use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.4.2.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the facility. Although the facility location has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K–25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.1 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of

forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES discharge requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily,

and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

[Text deleted.]

Savannah River Site

It is assumed that a new ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outfalls and would involve minor volumes. Construction and operation of the ceramic immobilization facility is not expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site so that this species would not be directly affected by this action.

4.3.4.2.7 *Cultural and Paleontological Resources*

This section discusses potential impacts to cultural and paleontological resources that may result from construction and operation of the ceramic immobilization facility at each of the representative sites analyzed. The land to be disturbed during construction totals 20 ha (49 acres) of which 12 ha (30 acres) would be used during operation. If existing facilities were used for a portion of the ceramic immobilization operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through pre-construction surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. However, additional unsurveyed lands necessary for the proposed facility may contain prehistoric or historic resources. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Impacts to any prehistoric or historic resources would occur during construction, but not operation, of the proposed facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The ceramic immobilization facility would be constructed within the existing developed and disturbed ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there is considered NRHP-eligible on that basis. Zone 4 has not been systematically surveyed for archaeological sites. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. The area is a developed industrial zone and the probability of archaeological sites there is low. In compliance with the standing programmatic agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock, and are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Operation would not have an additional impact on archaeological sites.

The Department has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological remains.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road, north of Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of these resources may be affected by facility construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops,

and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as ancestral sites, cemeteries, and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological resources may occur in the area to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected so, there would be no impact to paleontological resources.

Savannah River Site

A new ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites that are considered potentially eligible for the NRHP. Additional surveys would be conducted in areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by facility construction but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from facility construction or operation. These resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossilized remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.4.2.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Data Report (Socio 1996a). Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the ceramic immobilization operation.

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would be at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.5 percent in the INEL REA (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 860 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and per capita income (less than 1 percent). A total 3,167 new jobs (860 direct and 2,307 indirect) would be created by the operational activities, and regional unemployment would fall to 3.9 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL and Pantex, construction employment requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill more specialized positions during operation. Project-related population increases would be the largest at INEL during construction of the facility. Pantex would require the largest number of in-migrating workers for operations; however, population increases in either ROI would be less than 1 percent over No Action projects.

Housing units, in excess of existing vacancies, would be required in the Pantex and INEL ROIs during construction of the project. Additional housing construction would also be required during operation at all sites analyzed, except NTS, to accommodate the in-migrating population. The greatest increase in housing requirement during both phases would be in the INEL ROI, but this would be less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the ceramic immobilization facility would increase demand for community services at Pantex and INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operations on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services would occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 in the INEL ROI, 17 new teachers would be needed during construction. The Pantex ROI would need 22 teachers to maintain the No Action student-to-teacher ratio of 16.3:1 during operation. These increases in teacher requirements, however, would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

During construction, 2 police officers and 3 firefighters would be needed to maintain the No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI. Three additional police officers and 5 new firefighters would be needed to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels at all of the sites analyzed during operations. However projected capacities would be capable of accommodating these small increases in patient load. Two additional physicians would be needed in the INEL ROI during construction and 3 additional physicians during operation in the Pantex ROI to maintain the No Action service levels of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Construction of the ceramic immobilization facility would have the greatest relative effect on local transportation at INEL. A total of 1,920 vehicle trips per day would be generated during the construction of the ceramic immobilization facility. This increase would cause a drop in the level of service to two road segments in the INEL ROI. U.S. 20 from U.S. 26/91 at Idaho Falls to U.S. 26 East would change from D to E; U.S. 20/26 from U.S. 26 East to State Route 22/33 would change form B to C.

Operations at INEL would generate 1,651 vehicle trips per day. The impacts would be the same as described for the construction phase of the ceramic immobilization facility.

4.3.4.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents. The impacts associated with the ultimate disposal of the immobilized form in an HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.2.9–1 and 4.3.4.2.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.2.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The ceramic immobilization facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilization facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed member of the public resulting from the normal operation of a ceramic immobilization facility at each of the sites are presented in Table 4.3.4.2.9–1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation would range from 1.2×10^{-7} mrem at NTS to 4.2×10^{-6} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 6.0×10^{-13} to 2.1×10^{-11}. The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range from 1.7×10^{-7} person-rem at the NTS site to 6.7×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 8.5×10^{-10} to 3.4×10^{-7}.

Table 4.3.4.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]												
Atmospheric release pathway (mrem)	2.3×10^{-7}	4.4×10^{-3}	1.2×10^{-7}	4.2×10^{-3}	1.5×10^{-7}	0.018	1.8×10^{-6}	6.2×10^{-5}	4.2×10^{-6}	1.5	1.3×10^{-6}	0.42
Drinking water pathway	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5×10^{-4}	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	2.3×10^{-7}	5.3×10^{-3}	1.2×10^{-7}	4.2×10^{-3}	1.5×10^{-7}	0.018	1.8×10^{-6}	6.2×10^{-5}	4.2×10^{-6}	3.2	1.3×10^{-6}	0.79
Percent of natural background[c]	7.7×10^{-8}	1.8×10^{-3}	3.8×10^{-8}	1.3×10^{-3}	4.4×10^{-8}	5.2×10^{-3}	5.4×10^{-7}	1.9×10^{-5}	1.4×10^{-6}	1.1	4.4×10^{-7}	0.27
10-year fatal cancer risk	1.2×10^{-12}	2.7×10^{-8}	6.0×10^{-13}	2.1×10^{-8}	7.5×10^{-13}	8.9×10^{-8}	9.0×10^{-12}	3.1×10^{-10}	2.1×10^{-11}	1.6×10^{-5}	6.5×10^{-12}	4.0×10^{-6}
3.5-year fatal cancer risk[d]	4.2×10^{-13}	9.5×10^{-9}	2.1×10^{-13}	7.4×10^{-9}	2.6×10^{-13}	3.1×10^{-8}	3.2×10^{-12}	1.1×10^{-10}	7.4×10^{-12}	5.6×10^{-6}	2.3×10^{-12}	1.4×10^{-6}
Annual Population Dose Within 80 Kilometers[e]												
Atmospheric release pathway (person-rem)	3.9×10^{-5}	0.46	1.7×10^{-7}	3.7×10^{-3}	1.4×10^{-5}	2.4	1.9×10^{-5}	3.0×10^{-4}	3.2×10^{-5}	29	6.7×10^{-5}	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	3.9×10^{-5}	1.6	1.7×10^{-7}	3.7×10^{-3}	1.4×10^{-5}	2.4	1.9×10^{-5}	3.0×10^{-4}	3.2×10^{-5}	34	6.7×10^{-5}	44
Percent of natural background[c]	2.1×10^{-8}	8.4×10^{-4}	1.8×10^{-9}	4.0×10^{-5}	1.5×10^{-8}	2.7×10^{-3}	1.6×10^{-8}	2.6×10^{-7}	8.4×10^{-9}	9.0×10^{-3}	2.5×10^{-8}	0.017
10-year fatal cancers	2.0×10^{-7}	7.8×10^{-3}	8.5×10^{-10}	1.9×10^{-5}	7.0×10^{-8}	0.012	9.5×10^{-8}	1.5×10^{-6}	1.6×10^{-7}	0.17	3.4×10^{-7}	0.22
3.5-year fatal cancers[d]	7.0×10^{-8}	2.7×10^{-3}	3.0×10^{-10}	6.7×10^{-6}	2.5×10^{-8}	4.2×10^{-3}	3.3×10^{-8}	5.3×10^{-7}	5.6×10^{-8}	0.060	1.2×10^{-7}	0.077

Table 4.3.4.2.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]
Annual Dose to the Average Individual Within 80 Kilometers[f]												
Atmospheric and liquid release pathways combined (mrem)	6.3×10^{-8}	2.6×10^{-3}	5.8×10^{-9}	1.3×10^{-4}	5.2×10^{-8}	8.9×10^{-3}	5.4×10^{-8}	8.6×10^{-7}	2.5×10^{-8}	0.026	7.5×10^{-8}	0.049
10-year fatal cancer risk	3.1×10^{-13}	1.3×10^{-8}	2.9×10^{-14}	6.3×10^{-10}	2.6×10^{-13}	4.5×10^{-8}	2.7×10^{-13}	4.3×10^{-12}	1.2×10^{-13}	1.3×10^{-7}	3.8×10^{-13}	2.5×10^{-7}
3.5 year fatal cancer risk[d]	1.1×10^{-13}	4.6×10^{-9}	1.0×10^{-14}	2.2×10^{-10}	9.1×10^{-14}	1.6×10^{-8}	9.5×10^{-14}	1.5×10^{-12}	4.2×10^{-14}	4.6×10^{-8}	1.3×10^{-14}	8.8×10^{-8}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of ceramic facility. Therefore, the impacts may not be directly additive.

[b] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

[d] Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced.

[e] For DOE activity proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of site in 2030 (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.2×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834 and would range from 3.0×10^{-4} person-rem at Pantex to 44 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.5×10^{-6} to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.2.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 279 mrem to the average facility worker and 120 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 123 person-rem at NTS to 370 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.2.9–2.

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce[a]						
Average worker dose (mrem/yr)[b]	279	279	279	279	279	279
10-year risk of fatal cancer	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
3.5-year risk of fatal cancer[c]	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}
Total dose (person-rem/yr)	120	120	120	120	120	120
10-year fatal cancers	0.46	0.46	0.46	0.46	0.46	0.46
3.5-year fatal cancers[c]	0.16	0.16	0.16	0.16	0.16	0.16
Noninvolved Workforce[d]						
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
3.5-year risk of fatal cancer[c]	3.9×10^{-5}	7.0×10^{-6}	4.2×10^{-5}	1.4×10^{-5}	3.5×10^{-6}	4.6×10^{-5}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5-year fatal cancers[c]	0.35	4.2×10^{-3}	0.31	0.020	0.063	0.32

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Total Site Workforce[e]						
Dose (person-rem/yr)	370	123	340	134	164	346
10-year fatal cancers	1.5	0.50	1.4	0.54	0.66	1.4
3.5-year fatal cancers[c]	0.53	0.18	0.49	0.19	0.23	0.49

[a] The involved worker is associated with operations of the ceramic immobilization facility.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced to 3.5-year campaign.

[d] The noninvolved worker is onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

[e] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization facility at each of several sites are presented in Table 4.3.4.2.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 3.9×10^{-4} at NTS to 1.5×10^{-2} at ORR due to the new facility operation. The incremental cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 8.1×10^{-2} at Pantex to 0.17 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Table 4.3.4.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Alternative

	Hanford		NTS		INEL		Pantex		ORR		SRS	
Receptor	**Facility**[a]	**Total Site**[b]	**Facility**[a]	**Total Site**[b]	**Facility**[a]	**Total Site**[b]	**Facility**[a]	**Total Site**[b]	**Facility**[a]	**Total Site**[b]	**Facility**[a]	**Total Site**[b]
Maximally Exposed Individual (Public)												
Hazard index[c]	$2.6x10^{-3}$	$2.7x10^{-3}$	$3.9x10^{-4}$	$3.9x10^{-4}$	$5.6x10^{-3}$	0.021	0.015	0.020	0.015	0.055	$7.1x10^{-4}$	$5.9x10^{-3}$
Cancer Risk[d]	0	0	0	0	0	$3.6x10^{-6}$	0	$1.1x10^{-8}$	0	0	0	$1.3x10^{-7}$
Worker onsite												
Hazard index[e]	0.16	0.16	0.083	0.083	0.16	0.39	0.081	0.087	0.17	0.32	0.14	1.3
Cancer Risk[f]	0	0	0	0	0	$7.7x10^{-4}$	0	$4.5x10^{-7}$	0	0	0	$1.9x10^{-4}$

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(emissions concentration) x (0.286 [converts concentrations to doses]) x Slope Factor. Where there are no known carcinogens among chemicals emitted, therefore, the calculated cancer risk is 0.

[e] Hazard Index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no Slope Factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–54 through M.3.4–59.

Facility Accidents. A set of potential accidents has been postulated for the ceramic immobilization facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9 form the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.019 at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding 10-year cancer facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.9×10^{-7}, 8.6×10^{-10}, and 3.8×10^{-9}, respectively. The maximum population 10-year facility lifetime risk would be 2.6×10^{-7} (that is, one fatality in over one million years) at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding maximum offsite individual and worker 10-year facility lifetime risks would be 1.2×10^{-9} and 512×10^{-9}, respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly into the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

Table 4.3.4.2.9–4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Earthquake	$7.9x10^{-14}$ ($2.8x10^{-14}$)	$7.9x10^{-10}$	$7.9x10^{-16}$ ($2.8x10^{-16}$)	$7.9x10^{-12}$	$5.8x10^{-12}$ ($2.0x10^{-12}$)	$5.8x10^{-8}$	$1.0x10^{-5}$
Glovebox fire	$7.9x10^{-14}$ ($2.8x10^{-14}$)	$7.9x10^{-10}$	$7.9x10^{-16}$ ($2.8x10^{-16}$)	$7.9x10^{-12}$	$5.8x10^{-12}$ ($2.0x10^{-12}$)	$5.8x10^{-8}$	$1.0x10^{-5}$
Glovebox criticality	$1.4x10^{-10}$ ($4.9x10^{-11}$)	$1.4x10^{-6}$	$1.1x10^{-12}$ ($3.8x10^{-15}$)	$1.2x10^{-8}$	$1.6x10^{-9}$ ($5.6x10^{-10}$)	$1.6x10^{-5}$	$1.0x10^{-5}$
Mixing tank criticality	$1.4x10^{-9}$ ($4.9x10^{-10}$)	$1.4x10^{-5}$	$1.1x10^{-11}$ ($3.8x10^{-12}$)	$1.2x10^{-7}$	$1.6x10^{-8}$ ($5.6x10^{-9}$)	$1.6x10^{-4}$	$1.0x10^{-5}$
Bellows drop	$5.8x10^{-15}$ ($2.0x10^{-15}$)	$5.8x10^{-13}$	$5.5x10^{-17}$ ($1.9x10^{-17}$)	$5.5x10^{-15}$	$4.9x10^{-13}$ ($1.7x10^{-13}$)	$4.9x10^{-11}$	$1.0x10^{-3}$
Cesium capsule drop	$1.2x10^{-11}$ ($4.2x10^{-12}$)	$1.2x10^{-9}$	$9.2x10^{-14}$ ($3.2x10^{-14}$)	$9.2x10^{-12}$	$1.5x10^{-9}$ ($5.2x10^{-10}$)	$1.5x10^{-7}$	$1.0x10^{-3}$
Plutonyl nitrate dissolver spill	$1.4x10^{-15}$ ($4.9x10^{-16}$)	$2.7x10^{-15}$	$1.4x10^{-17}$ ($4.9x10^{-18}$)	$2.7x10^{-17}$	$9.9x10^{-14}$ ($3.5x10^{-14}$)	$2.0x10^{-13}$	0.05
Calciner feed spill	$9.2x10^{-15}$ ($3.2x10^{-15}$)	$1.8x10^{-14}$	$8.7x10^{-17}$ ($3.0x10^{-17}$)	$1.7x10^{-16}$	$7.7x10^{-13}$ ($2.7x10^{-13}$)	$1.5x10^{-12}$	0.05

Table 4.3.4.2.9–4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	
Calciner product spill	2.6×10^{-12} (9.1×10^{-13})	5.1×10^{-12}	2.4×10^{-14} (8.4×10^{-15})	4.8×10^{-14}	2.1×10^{-10} (7.3×10^{-11})	4.3×10^{-10}	0.05
Cesium fire	3.9×10^{-15} (1.4×10^{-15})	3.9×10^{-10}	3.0×10^{-17} (1.1×10^{-17})	3.0×10^{-12}	4.7×10^{-13} (1.6×10^{-13})	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	5.7×10^{-16} (2.0×10^{-16})	5.7×10^{-11}	5.7×10^{-18} (2.0×10^{-18})	5.7×10^{-13}	4.1×10^{-14} (1.4×10^{-18})	4.1×10^{-9}	1.0×10^{-6}
Criticality	4.2×10^{-9} (1.5×10^{-9})	4.2×10^{-4}	4.5×10^{-11} (1.6×10^{-11})	3.5×10^{-6}	4.8×10^{-8} (1.7×10^{-8})	4.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	3.7×10^{-16} (1.3×10^{-16})	3.7×10^{-11}	3.5×10^{-18} (1.2×10^{-18})	3.5×10^{-13}	3.1×10^{-14} (1.1×10^{-14})	3.1×10^{-9}	1.0×10^{-6}
Expected risk[d]	5.7×10^{-9} (2.0×10^{-9})	–	4.7×10^{-11} (1.6×10^{-11})	–	6.7×10^{-8} (2.3×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Earthquake	5.4×10^{-14} (1.9×10^{-14})	5.4×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	1.3×10^{-13} (4.5×10^{-14})	1.3×10^{-9}	1.0×10^{-5}
Glovebox fire	5.4×10^{-14} (1.9×10^{-14})	5.4×10^{-10}	1.3×10^{-15} (4.5×10^{-16})	1.3×10^{-11}	1.3×10^{-13} (4.5×10^{-14})	1.3×10^{-9}	1.0×10^{-5}
Glovebox criticality	1.0×10^{-10} (3.5×10^{-11})	1.0×10^{-6}	2.3×10^{-12} (8.0×10^{-13})	2.3×10^{-8}	3.3×10^{-11} (1.1×10^{-11})	3.3×10^{-7}	1.0×10^{-5}
Mixing tank criticality	1.0×10^{-9} (3.5×10^{-10})	1.0×10^{-5}	2.3×10^{-11} (8.0×10^{-12})	2.3×10^{-7}	3.3×10^{-10} (1.1×10^{-10})	3.3×10^{-6}	1.0×10^{-5}
Bellows drop	4.0×10^{-15} (1.4×10^{-15})	4.0×10^{-13}	8.8×10^{-17} (8.1×10^{-17})	8.8×10^{-15}	1.1×10^{-14} (3.8×10^{-15})	1.1×10^{-12}	1.0×10^{-3}
Cesium capsule drop	8.1×10^{-12} (2.8×10^{-12})	8.1×10^{-10}	1.5×10^{-13} (5.2×10^{-14})	1.5×10^{-11}	3.4×10^{-11} (1.2×10^{-11})	3.4×10^{-9}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	9.3×10^{-16} (3.2×10^{-16})	1.9×10^{-15}	2.2×10^{-17} (7.7×10^{-18})	4.3×10^{-17}	2.2×10^{-15} (7.7×10^{-16})	4.5×10^{-15}	0.05
Calciner feed spill	6.2×10^{-15} (2.2×10^{-15})	1.2×10^{-14}	1.4×10^{-16} (4.9×10^{-17})	2.8×10^{-16}	1.7×10^{-14} (5.9×10^{-15})	3.5×10^{-14}	0.05

Table 4.3.4.2.9–5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	$1.7x10^{-12}$ ($5.9x10^{-13}$)	$3.5x10^{-12}$	$3.9x10^{-14}$ ($1.4x10^{-14}$)	$7.7x10^{-14}$	$4.9x10^{-12}$ ($1.7x10^{-12}$)	$9.7x10^{-12}$	0.05
Cesium fire	$2.6x10^{-15}$ ($9.1x10^{-16}$)	$2.6x10^{-10}$	$4.9x10^{-17}$ ($1.7x10^{-17}$)	$4.9x10^{-12}$	$1.1x10^{-14}$ ($3.8x10^{-15}$)	$1.1x10^{-9}$	$1.0x10^{-6}$
Process cell fire	$3.9x10^{-16}$ ($1.4x10^{-16}$)	$3.9x10^{-11}$	$9.0x10^{-18}$ ($3.1x10^{-18}$)	$9.0x10^{-13}$	$9.3x10^{-16}$ ($3.2x10^{-16}$)	$9.3x10^{-11}$	$1.0x10^{-6}$
Criticality	$3.0x10^{-9}$ ($1.0x10^{-9}$)	$3.0x10^{-4}$	$6.8x10^{-11}$ ($2.4x10^{-11}$)	$6.8x10^{-6}$	$9.7x10^{-10}$ ($3.4x10^{-10}$)	$9.7x10^{-5}$	$1.0x10^{-6}$
Uncontrolled chemical reaction	$2.5x10^{-16}$ ($8.7x10^{-17}$)	$2.5x10^{-11}$	$5.5x10^{-18}$ ($1.9x10^{-18}$)	$5.5x10^{-13}$	$7.0x10^{-16}$ ($2.4x10^{-16}$)	$7.0x10^{-11}$	$1.0x10^{-6}$
Expected risk[d]	$4.2x10^{-9}$ ($1.5x10^{-9}$)	–	$9.3x10^{-12}$ ($3.2x10^{-12}$)	–	$1.4x10^{-9}$ ($4.9x10^{-10}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Earthquake	$7.4x10^{-14}$ ($2.6x10^{-14}$)	$7.4x10^{-10}$	$8.0x10^{-16}$ ($2.8x10^{-16}$)	$8.0x10^{-12}$	$1.7x10^{-12}$ ($6.0x10^{-13}$)	$1.7x10^{-8}$	$1.0x10^{-5}$
Glovebox fire	$7.4x10^{-14}$ ($2.6x10^{-14}$)	$7.4x10^{-10}$	$8.0x10^{-16}$ ($2.8x10^{-16}$)	$8.0x10^{-12}$	$1.7x10^{-12}$ ($6.0x10^{-13}$)	$1.7x10^{-8}$	$1.0x10^{-5}$
Glovebox criticality	$1.4x10^{-10}$ ($4.9x10^{-11}$)	$1.4x10^{-6}$	$1.3x10^{-12}$ ($4.5x10^{-13}$)	$1.3x10^{-8}$	$4.3x10^{-10}$ ($1.5x10^{-10}$)	$4.3x10^{-6}$	$1.0x10^{-5}$
Mixing tank criticality	$1.4x10^{-9}$ ($4.9x10^{-10}$)	$1.4x10^{-5}$	$1.3x10^{-11}$ ($4.5x10^{-12}$)	$1.3x10^{-7}$	$4.3x10^{-9}$ ($1.5x10^{-9}$)	$4.3x10^{-5}$	$1.0x10^{-5}$
Bellows drop	$5.4x10^{-15}$ ($1.9x10^{-15}$)	$5.4x10^{-13}$	$5.5x10^{-17}$ ($1.9x10^{-17}$)	$5.5x10^{-15}$	$1.5x10^{-13}$ ($5.2x10^{-14}$)	$1.5x10^{-11}$	$1.0x10^{-3}$
Cesium capsule drop	$1.1x10^{-11}$ ($3.8x10^{-12}$)	$1.1x10^{-9}$	$8.8x10^{-14}$ ($3.1x10^{-14}$)	$8.8x10^{-12}$	$4.6x10^{-10}$ ($1.6x10^{-10}$)	$4.6x10^{-8}$	$1.0x10^{-3}$
Plutonyl nitrate dissolver spill	$1.3x10^{-15}$ ($4.5x10^{-16}$)	$2.5x10^{-15}$	$1.4x10^{-17}$ ($4.9x10^{-18}$)	$2.8x10^{-17}$	$3.0x10^{-14}$ ($1.0x10^{-14}$)	$5.9x10^{-14}$	0.05
Calciner feed spill	$8.4x10^{-15}$ ($2.9x10^{-13}$)	$1.7x10^{-14}$	$8.7x10^{-17}$ ($3.0x10^{-17}$)	$1.7x10^{-16}$	$2.3x10^{-13}$ ($8.0x10^{-14}$)	$4.7x10^{-13}$	0.05

Table 4.3.4.2.9–6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory—Continued

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Calciner product spill	2.4×10^{-12} (8.4×10^{-13})	4.7×10^{-12}	2.4×10^{-14} (8.4×10^{-15})	4.8×10^{-14}	6.5×10^{-11} (2.3×10^{-11})	1.3×10^{-10}	0.05
Cesium fire	3.4×10^{-15} (1.2×10^{-15})	3.4×10^{-10}	2.9×10^{-17} (1.0×10^{-17})	2.9×10^{-12}	1.5×10^{-13} (5.2×10^{-14})	1.5×10^{-8}	1.0×10^{-6}
Process cell fire	5.3×10^{-16} (1.8×10^{-16})	5.3×10^{-11}	5.7×10^{-18} (2.0×10^{-18})	5.7×10^{-13}	1.2×10^{-14} (4.2×10^{-15})	1.2×10^{-9}	1.0×10^{-6}
Criticality	4.0×10^{-9} (1.4×10^{-9})	4.0×10^{-4}	4.0×10^{-11} (1.4×10^{-11})	4.0×10^{-6}	1.3×10^{-8} (4.5×10^{-9})	1.3×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	3.4×10^{-16} (1.2×10^{-16})	3.4×10^{-11}	3.5×10^{-18} (1.2×10^{-18})	3.5×10^{-13}	9.3×10^{-15} (3.2×10^{-15})	9.3×10^{-10}	1.0×10^{-6}
Expected risk[d]	5.6×10^{-9} (2.0×10^{-9})	–	5.5×10^{-11} (1.9×10^{-11})	–	1.8×10^{-9} (6.3×10^{-10})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	$3.2x10^{-14}$ ($1.1x10^{-14}$)	$3.2x10^{-10}$	$9.2x10^{-15}$ ($3.2x10^{-15}$)	$9.2x10^{-11}$	$2.0x10^{-12}$ ($7.0x10^{-13}$)	$2.0x10^{-8}$	$1.0x10^{-5}$
Glovebox fire	$3.2x10^{-14}$ ($1.1x10^{-14}$)	$3.2x10^{-10}$	$9.2x10^{-15}$ ($3.2x10^{-15}$)	$9.2x10^{-11}$	$2.0x10^{-12}$ ($7.0x10^{-13}$)	$2.0x10^{-8}$	$1.0x10^{-5}$
Glovebox criticality	$6.2x10^{-11}$ ($2.2x10^{-11}$)	$6.2x10^{-7}$	$2.2x10^{-11}$ ($7.7x10^{-12}$)	$2.2x10^{-7}$	$9.5x10^{-10}$ ($3.3x10^{-10}$)	$9.5x10^{-6}$	$1.0x10^{-5}$
Mixing tank criticality	$6.2x10^{-10}$ ($2.2x10^{-10}$)	$6.2x10^{-6}$	$2.2x10^{-10}$ ($7.7x10^{-11}$)	$2.2x10^{-6}$	$9.5x10^{-9}$ ($3.3x10^{-9}$)	$9.5x10^{-5}$	$1.0x10^{-5}$
Bellows drop	$2.4x10^{-15}$ ($8.4x10^{-16}$)	$2.4x10^{-13}$	$6.7x10^{-16}$ ($2.3x10^{-16}$)	$6.7x10^{-14}$	$1.6x10^{-13}$ ($5.6x10^{-14}$)	$1.6x10^{-11}$	$1.0x10^{-3}$
Cesium capsule drop	$5.1x10^{-12}$ ($1.8x10^{-12}$)	$5.1x10^{-10}$	$1.3x10^{-12}$ ($4.5x10^{-13}$)	$1.3x10^{-10}$	$4.4x10^{-10}$ ($1.5x10^{-10}$)	$4.4x10^{-8}$	$1.0x10^{-3}$
Plutonyl nitrate dissolver spill	$5.5x10^{-16}$ ($1.9x10^{-16}$)	$1.1x10^{-15}$	$1.6x10^{-16}$ ($5.6x10^{-17}$)	$3.2x10^{-16}$	$3.4x10^{-14}$ ($1.2x10^{-14}$)	$6.7x10^{-14}$	0.05
Calciner feed spill	$3.7x10^{-15}$ ($1.3x10^{-15}$)	$7.5x10^{-15}$	$1.1x10^{-15}$ ($3.8x10^{-16}$)	$2.1x10^{-15}$	$2.5x10^{-13}$ ($8.7x10^{-14}$)	$5.0x10^{-13}$	0.05

Table 4.3.4.2.9–7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatality[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[b]	Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Probability of Cancer Fatalities[c]	
Calciner product spill	1.0×10^{-12} (3.5×10^{-13})	2.1×10^{-12}	3.0×10^{-13} (1.0×10^{-13})	5.9×10^{-13}	7.0×10^{-11} (2.4×10^{-11})	1.4×10^{-10}	0.05
Cesium fire	1.7×10^{-15} (5.9×10^{-16})	1.7×10^{-10}	4.4×10^{-16} (1.5×10^{-16})	4.4×10^{-11}	1.4×10^{-13} (4.9×10^{-14})	1.4×10^{-8}	1.0×10^{-6}
Process cell fire	2.3×10^{-16} (8.0×10^{-17})	2.3×10^{-11}	6.6×10^{-17} (2.3×10^{-17})	6.6×10^{-12}	1.4×10^{-14} (4.9×10^{-15})	1.4×10^{-9}	1.0×10^{-6}
Criticality	1.9×10^{-9} (6.6×10^{-10})	1.9×10^{-4}	6.5×10^{-10} (2.3×10^{-10})	6.5×10^{-5}	2.8×10^{-8} (9.8×10^{-9})	2.8×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-16} (5.2×10^{-17})	1.5×10^{-11}	4.2×10^{-17} (1.5×10^{-17})	4.2×10^{-12}	1.0×10^{-14} (3.5×10^{-15})	1.0×10^{-9}	1.0×10^{-6}
Expected risk[d]	2.5×10^{-9} (8.7×10^{-10})	–	8.9×10^{-10} (3.1×10^{-10})	–	3.9×10^{-8} (1.4×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Earthquake	7.3×10^{-14} (2.5×10^{-14})	7.3×10^{-10}	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-10}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-7}	1.0×10^{-5}
Glovebox fire	7.3×10^{-14} (2.5×10^{-14})	7.3×10^{-10}	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-10}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-7}	1.0×10^{-5}
Glovebox criticality	1.3×10^{-10} (4.5×10^{-11})	1.3×10^{-6}	2.9×10^{-11} (1.0×10^{-11})	2.9×10^{-7}	6.3×10^{-9} (2.2×10^{-9})	6.3×10^{-5}	1.0×10^{-5}
Mixing tank criticality	1.3×10^{-9} (4.5×10^{-10})	1.3×10^{-5}	2.9×10^{-10} (1.0×10^{-10})	2.9×10^{-6}	6.3×10^{-8} (2.2×10^{-8})	6.3×10^{-4}	1.0×10^{-5}
Bellows drop	5.5×10^{-15} (1.9×10^{-15})	5.5×10^{-13}	1.2×10^{-15} (4.2×10^{-16})	1.2×10^{-13}	1.1×10^{-12} (3.8×10^{-13})	1.1×10^{-10}	1.0×10^{-3}
Cesium capsule drop	1.2×10^{-11} (4.2×10^{-12})	1.2×10^{-9}	2.4×10^{-12} (8.4×10^{-13})	2.4×10^{-10}	3.1×10^{-9} (1.1×10^{-9})	3.1×10^{7}	1.0×10^{-3}
Plutonyl nitrate dissolver spill	1.3×10^{-15} (4.5×10^{-16})	2.5×10^{-15}	2.8×10^{-16} (9.8×10^{-17})	5.7×10^{-16}	2.4×10^{-13} (8.4×10^{-14})	4.8×10^{-13}	0.05
Calciner feed spill	8.6×10^{-15} (3.0×10^{-15})	1.7×10^{-14}	1.8×10^{-15} (6.3×10^{-16})	3.7×10^{-15}	1.8×10^{-12} (6.3×10^{-13})	3.5×10^{-12}	0.05

Table 4.3.4.2.9–8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	$2.4x10^{-12}$ ($8.4x10^{-13}$)	$4.8x10^{-12}$	$5.2x10^{-13}$ ($1.8x10^{-13}$)	$1.0x10^{-12}$	$4.9x10^{-10}$ ($1.7x10^{-10}$)	$9.9x10^{-10}$	0.05
Cesium fire	$3.8x10^{-15}$ ($1.3x10^{-15}$)	$3.8x10^{-10}$	$7.7x10^{-16}$ ($2.7x10^{-16}$)	$7.7x10^{-11}$	$9.9x10^{-13}$ ($3.5x10^{-13}$)	$9.9x10^{-8}$	$1.0x10^{-6}$
Process cell fire	$5.3x10^{-16}$ ($1.8x10^{-16}$)	$5.3x10^{-11}$	$1.2x10^{-16}$ ($4.2x10^{-17}$)	$1.2x10^{-11}$	$1.0x10^{-13}$ ($3.5x10^{-14}$)	$1.0x10^{-8}$	$1.0x10^{-6}$
Criticality	$3.8x10^{-9}$ ($1.3x10^{-9}$)	$3.8x10^{-4}$	$8.6x10^{-10}$ ($3.0x10^{-10}$)	$8.6x10^{-5}$	$1.9x10^{-7}$ ($6.6x10^{-8}$)	0.019	$1.0x10^{-6}$
Uncontrolled chemical reaction	$3.4x10^{-16}$ ($1.2x10^{-16}$)	$3.4x10^{-11}$	$7.4x10^{-17}$ ($2.6x10^{-17}$)	$7.4x10^{-12}$	$7.1x10^{-14}$ ($2.5x10^{-14}$)	$7.1x10^{-9}$	$1.0x10^{-6}$
Expected risk[d]	$5.2x10^{-9}$ ($1.8x10^{-9}$)	–	$1.2x10^{-9}$ ($4.2x10^{-10}$)	–	$2.6x10^{-7}$ ($9.1x10^{-8}$)	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

Table 4.3.4.2.9–9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[b]**	**Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]**	**Probability of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Earthquake	$5.2x10^{-14}$ $(1.8x10^{-14})$	$5.2x10^{-10}$	$1.3x10^{-15}$ $(4.5x10^{-16})$	$1.3x10^{-11}$	$6.2x10^{-12}$ $(2.2x10^{-12})$	$6.2x10^{-8}$	$1.0x10^{-5}$
Glovebox fire	$5.2x10^{-14}$ $(1.8x10^{-14})$	$5.2x10^{-10}$	$1.3x10^{-15}$ $(4.5x10^{-16})$	$1.3x10^{-11}$	$6.2x10^{-12}$ $(2.2x10^{-12})$	$6.2x10^{-8}$	$1.0x10^{-5}$
Glovebox criticality	$9.1x10^{-11}$ $(3.2x10^{-11})$	$9.1x10^{-7}$	$2.0x10^{-12}$ $(7.0x10^{-13})$	$2.0x10^{-8}$	$2.0x10^{-9}$ $(7.0x10^{-10})$	$2.0x10^{-5}$	$1.0x10^{-5}$
Mixing tank criticality	$9.1x10^{-10}$ $(3.2x10^{-10})$	$9.1x10^{-6}$	$2.0x10^{-11}$ $(7.0x10^{-12})$	$2.0x10^{-7}$	$2.0x10^{-8}$ $(7.0x10^{-9})$	$2.0x10^{-4}$	$1.0x10^{-5}$
Bellows drop	$3.9x10^{-15}$ $(1.4x10^{-15})$	$3.9x10^{-13}$	$9.3x10^{-17}$ $(3.2x10^{-17})$	$9.3x10^{-15}$	$5.1x10^{-13}$ $(1.8x10^{-13})$	$5.1x10^{-11}$	$1.0x10^{-3}$
Cesium capsule drop	$8.4x10^{-12}$ $(2.9x10^{-12})$	$8.4x10^{-10}$	$1.9x10^{-13}$ $(6.6x10^{-14})$	$1.9x10^{-11}$	$1.5x10^{-9}$ $(5.2x10^{-10})$	$1.5x10^{7}$	$1.0x10^{-3}$
Plutonyl nitrate dissolver spill	$8.9x10^{-16}$ $(3.1x10^{-16})$	$1.8x10^{-15}$	$2.2x10^{-17}$ $(7.7x10^{-18})$	$4.4x10^{-17}$	$1.1x10^{-13}$ $(3.8x10^{-14})$	$2.1x10^{-13}$	0.05
Calciner feed spill	$6.1x10^{-15}$ $(2.1x10^{-15})$	$1.2x10^{-14}$	$1.5x10^{-16}$ $(5.2x10^{-17})$	$2.9x10^{-16}$	$8.1x10^{-13}$ $(2.8x10^{-13})$	$1.6x10^{-12}$	0.05

Table 4.3.4.2.9–9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site—Continued

Accident Description	Worker at 1,000 m: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Worker at 1,000 m: Probability of Cancer Fatality[b]	Maximum Offsite Individual: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Maximum Offsite Individual: Probability of Cancer Fatalities[b]	Population to 80 km: Risk of Cancer Fatality per 10 yr (per 3.5 yr)[a]	Population to 80 km: Probability of Cancer Fatalities[c]	Accident Frequency (per yr)
Calciner product spill	1.7×10^{-12} (5.9×10^{-13})	3.4×10^{-12}	4.1×10^{-14} (1.4×10^{-14})	8.2×10^{-14}	2.2×10^{-10} (7.7×10^{-11})	4.5×10^{-10}	0.05
Cesium fire	2.7×10^{-15} (9.4×10^{-16})	2.7×10^{-10}	6.1×10^{-18} (2.1×10^{-18})	6.1×10^{-12}	4.7×10^{-13} (1.6×10^{-13})	4.7×10^{-8}	1.0×10^{-6}
Process cell fire	3.7×10^{-16} (1.3×10^{-16})	3.7×10^{-11}	9.1×10^{-18} (3.2×10^{-18})	9.1×10^{-13}	4.4×10^{-14} (1.5×10^{-14})	4.4×10^{-9}	1.0×10^{-6}
Criticality	2.7×10^{-9} (9.4×10^{-10})	2.7×10^{-4}	6.0×10^{-11} (2.1×10^{-11})	6.0×10^{-6}	6.1×10^{-8} (2.1×10^{-8})	6.1×10^{-3}	1.0×10^{-6}
Uncontrolled chemical reaction	2.4×10^{-16} (8.4×10^{-17})	2.4×10^{-11}	5.9×10^{-18} (2.1×10^{-18})	5.9×10^{-13}	3.2×10^{-14} (1.1×10^{-14})	3.2×10^{-9}	1.0×10^{-6}
Expected risk[d]	3.7×10^{-9} (1.3×10^{-9})	–	8.3×10^{-11} (2.9×10^{-11})	–	8.5×10^{-8} (3.0×10^{-8})	–	–

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1–3, M.5.3.6.1–4 and the MACCS computer code.

4.3.4.2.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its product output a stabilized ceramic form spiked with cesium radionuclides that would require interim storage. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until entry into the Federal Waste Management System for final disposition. Table 4.3.4.2.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the ceramic immobilization facility. Facilities that would support the ceramic immobilization facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.5. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.5.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. No soil contaminated with hazardous or radioactive constituents is expected to be generated

Table 4.3.4.2.10–1. *Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative*[a]

		Hanford	NTS	INEL	Pantex	ORR	SRS
Category	New Facility (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)	No Action (m^3)
Transuranic							
Liquid	75[b]	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7[b]	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700

Table 4.3.4.2.10–1. Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative[a]—Continued

		Hanford	NTS	INEL	Pantex	ORR	SRS
Category	**New Facility (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**	**No Action (m^3)**
Hazardous							
Liquid	38	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	170,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for ceramic immobilization facility are from Table E.3.3.5–1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.5–1.

[b] Liquid TRU and LLW would be treated and solidified prior to disposal.

[c] Recyclable wastes.

during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Following treatment and volume reduction, approximately 99 m^3 (130 yd^3) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity (0.7 m^3 [0.9 yd^3]) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC of alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. After treatment and volume reduction, approximately 11 m^3 (14 yd^3) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.003 ha/yr (0.008 acres/yr) at Hanford and ORR, 0.002 ha/yr (0.004 acres/yr) at NTS and INEL, and 0.001 ha/year (0.003 acres/yr) at SRS. With no onsite LLW disposal

capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m^3 [0.2 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 38 m^3 (10,000 gal) of liquid and 19 m^3 (25 yd^3) of solid hazardous wastes would be generated annually. Hazardous wastes would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 34,000 m^3 (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant blowdown and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. The Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be immobilized. The construction of these treatments systems would be determined in further tiered NEPA documentation. The 920 m^3 (1,200 yd^3) of solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.3 Electrometallurgical Treatment Alternative

The environmental impacts described in the following sections are based on the analysis of the electrometallurgical treatment facility described in Section 2.4.4.3. The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD and if a different site were ultimately selected, the impacts described in this section could be different. With respect to public and occupational health and safety, and waste, these impacts are not anticipated to differ significantly from those discussed in this section. DOE would analyze such different impacts in subsequent tiered, site-specific NEPA documentation if this alternative were selected.

4.3.4.3.1 *Land Resources*

Land Use. As discussed in Section 4.3.4.3.2, the Pu disposition effort would require the installation of additional equipment within existing buildings, however, no major modifications are anticipated. Therefore, no additional land area would be disturbed, used during operations, or required for a buffer zone. Utilization of existing facilities would not change land use and the alternative would likely be consistent with existing site use. Therefore, there would be no direct land use impacts during operations.

Operation of the facility would likely be consistent with Federal and local land-use plans, policies, and controls. Other onsite or offsite land uses would not be affected. Prime farmlands would not be affected. As discussed in Section 4.3.4.3.8, no in-migration would be anticipated during operations. Therefore, no indirect impacts to offsite land use would occur.

Visual Resources. There would be no new impacts to visual resources caused by operations. The visual environment would be consistent with the existing industrialized landscape character. The alternative would be anticipated to be consistent with the current VRM designation of the developed area of the site, likely a Class 5.

4.3.4.3.2 *Site Infrastructure*

The existing site infrastructure resources at the INEL site, and in particular the ANL-W facilities, are considered adequate to accommodate Pu disposition. The Pu disposition effort would require the use of some equipment that is not currently installed in existing buildings. The power and fuel resources that would be required to install this equipment are shown in Appendix C. No major modifications to existing facilities are anticipated due the addition of Pu disposition activities.

The site infrastructure resources to be utilized during operation of the electrometallurgical treatment process are presented in Appendix C. As shown in Table 4.3.4.3.2–1, the effect of this added resource consumption would be within the capacity available at INEL.

Table 4.3.4.3.2–1. Additional Site Infrastructure Needed for the Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory (Annual)[a]

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	0	0	2,400	0.008	0	0	0
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	445	48	234,900	42	5,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0	0	0

[a] Values in this table represent the incremental site infrastructure values allocated to operating this alternative at INEL.
Source: INEL 1995a:1; LLNL 1996b.

4.3.4.3.3 *Air Quality and Noise*

Air quality or noise effects from the required facility modifications for electrometallurgical treatment would be localized, short-term, and minor. Operation of this facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are discussed in Section 4.3.4.3.9.

Due to the limited additional equipment required for Pu disposition activities, incremental noise impacts during operation are expected to be low relative to sitewide baseline operations for INEL. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

The electrometallurgical treatment would result in the emission of some criteria pollutants. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

Emission rates for operation of the electrometallurgical treatment facility are presented in Table F.1.3–11. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers or operation of new boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility processes and laboratories

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.4.3.3–1. Pollutant concentrations, combined with No Action, would be in compliance with Federal and State standards.VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the ANL-W facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during facility modifications and operations may include slightly increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring materials, equipment and workers to the site.

Nontraffic noise sources associated with operation of this alternative facility include ventilation systems, diesel generators and other sources. These noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from equipment and other site operations would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

Table 4.3.4.3.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Electrometallurgical Treatment Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	INEL No Action (μg/m³)	INEL Total (μg/m³)
Criteria Pollutants				
Carbon monoxide	8-hour	10,000	284	284
	1-hour	40,000	614	614
Lead	Calendar Quarter	1.5	0.001	0.001
Nitrogen dioxide	Annual	100	4	4
Ozone	1-hour	235	b	b
Particulate matter less than or equal to 10 microns in diameter	Annual	50	5	5
	24-hour	150	80	80
Sulfur dioxide	Annual	80	6	6
	24-hour	365	135	135
	3-hour	1,300	579	579
Mandated by Idaho				
Total suspended particulates	Annual	60	5	5
	24-hour	150	80	80
Hazardous and Other Toxic Compounds [c]	-	-	-	-

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.

[b] Ozone, as a criteria pollutant is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[c] Emissions of volatile organic compounds were not modeled.

[Text deleted.]

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996b.

4.3.4.3.4 *Water Resources*

Water resource requirements and discharges provided in Tables C.1.1.3–6 and C.2.1.3–6 and Table E.3.3.6–1 were used to assess impacts to surface water and groundwater.

Surface Water. No surface water would be withdrawn for any facility modifications or operational activities associated with the electrometallurgical facility; consequently, no impacts to surface water availability or surface water quality are expected. [Text deleted.]

During operation, no effluent would be discharged to natural surface waters. Sanitary wastewater from the facility would be treated prior to discharge to lined evaporation ponds. However, cooling system blowdown and nonhazardous industrial wastewater would be discharged to the industrial waste pond. Treated effluents would be monitored to comply with discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

The facility for the proposed electrometallurgical demonstration is located outside the flood zone of the Big Lost River that could develop as a result of the failure of MacKay Dam during a probable maximum flood. The flood event would be more critical than either the 100- or 500-year floodplain.

Groundwater. Groundwater required to support site activities during facility modifications (15 million l/yr [4 million gal/yr]) would represent approximately a 0.02-percent maximum increase over the projected groundwater withdrawal, and would be less than 0.003-percent of INEL current allotment. Thus, no additional allotments or permits would be required; it would not cause depletion of the aquifer or affect recharge. Groundwater required during operation of the facility (17.4 million l/yr [4.6 million gal/yr]) would be less than 0.04-percent of INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment, not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). Operating an electrometallurgical facility would not exceed current groundwater allotments.

During construction, no water would be discharged directly to the environment and thus would not be expected to contribute to existing near-surface contamination. During operation, sanitary wastewater would be treated and discharged to evaporation ponds. Therefore, no impacts to ground water quality would be anticipated.

4.3.4.3.5 *Geology and Soils*

The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD, construction would be required for any site other than INEL. Additional tiered NEPA documentation would be completed, as appropriate.

As discussed in Section 4.3.4.3.2, the Electrometallurgical Treatment Alternative could be implemented at INEL utilizing existing site infrastructure. The Pu disposition effort would require the installation of additional equipment within existing buildings; however, no major modifications are anticipated. As a result, no new ground-breaking construction activities would be associated for this alternative. Therefore, no construction or operational impacts to geologic and soil resources are anticipated and no direct or indirect impacts to geologic or soil resources are anticipated.

4.3.4.3.6 *Biological Resources*

For analytical purposes it is assumed that immobilization of surplus Pu through electrometallurgical treatment would take place within existing facilities at ANL-W. Since existing facilities would be used, including those for wastewater treatment, no additional disturbance of land area or habitat would occur, and impacts to biological resources at INEL would not be expected.

4.3.4.3.7 *Cultural and Paleontological Resources*

No new construction would be required for the electrometallurgical treatment alternative and only minor modifications would be required for the HFEF and the ZPPR. Both of these structures were built in the 1970s, and the FCF was refurbished and upgraded in 1994. None of these facilities are NRHP eligible. No acreage would be disturbed if this alternative is chosen. Therefore, no cultural or paleontological resources would be affected.

4.3.4.3.8 *Socioeconomics*

This section analyzes the socioeconomic effects of the electrometallurgical facility for INEL. The effects at INEL are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Construction is not required for this alternative. The electrometallurgical facility's operation would require an additional 83 workers. Operating this facility would generate an additional 223 indirect jobs in the INEL REA. Unemployment would drop to 5.2 percent from the No Action projection of 5.4 percent during operation. These new jobs would be filled by workers from within the region. Operation of the electrometallurgical facility at INEL would very slightly increase regional per capita income above the No Action projection.

Population and Housing, Community Services, and Local Transportation. The new jobs would be filled by the existing regional labor force, and there would be no project-related population impacts on housing, community services, or local transportation beyond the No Action projections.

4.3.4.3.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated health and safety impacts resulting from either normal operations or accidents involved with the immobilization of Pu using the electrometallurgical treatment. The section first describes the impacts from normal facility operation at the INEL site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.3.9–1 and 4.3.4.3.9–2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.3.9–3. Additional information is provided in Appendix M.

Normal Operation. There would be no radiological releases associated with modifying the facility for the treatment of Pu. Workers involved with the modifications would be limited in their exposure to material potentially contaminated with radioactivity. This would assure that their doses are maintained as low as reasonably achievable. Towards this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as the result of activities associated with the installation of additional equipment. Onsite and offsite concentrations resulting from releases would be within the regulated exposure limits.

During the normal operation of the treatment process to immobilize the Pu, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the treatment process to immobilize Pu are presented in Table 4.3.4.3.9–1. The impacts from all site operations, including the treatment process, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the electrometallurgical treatment process would be 7.6×10^{-4} mrem. The associated fatal cancer risk to this individual from 10 years of operation would be 3.8×10^{-9}. The impacts to the average individual would be even smaller. The annual dose to the population within 80 km (50 mi) would be 0.016 person-rem, which could result in 8.0×10^{-5} fatal cancers in this population from 10 years of operation.

The dose to the maximally exposed member of the public from annual total site operations would be maintained within the radiological limits specified by NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.019 mrem. From 10 years of operation, the corresponding risk of fatal cancers to this individual would be 9.5×10^{-8}. The impacts to the average individual would be even smaller. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations, the annual population dose would be within the limit in proposed 10 CFR 834, and would be 2.4 person-rem. The corresponding number of potential fatal cancers in this population from 10 years of operation would be 0.012.

Doses to onsite workers from normal operations are given in Table 4.3.4.3.9–2. Included are involved workers directly associated with the electrometallurgical treatment of Pu, noninvolved workers, and the entire workforce at INEL. All doses fall within regulatory limits.

The annual dose to the average worker involved with the electrometallurgical treatment of Pu would be 40 mrem; the dose to the entire Pu treatment workforce would be 2.9 person-rem. The annual dose to the total

Table 4.3.4.3.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

Receptor	Electrometallurgical Treatment Facility	Total Site[a]
Annual Dose to the Maximally Exposed Individual Member of the Public[b]		
Atmospheric release pathway (mrem)	$7.6x10^{-4}$	0.019
Drinking water pathway (mrem)	0	0
Total liquid release pathway (mrem)	0	0
Atmospheric and liquid release pathways combined (mrem)	$7.6x10^{-4}$	0.019
Percent of natural background[c]	$2.2x10^{-4}$	$5.6x10^{-3}$
10-year fatal cancer risk	$3.8x10^{-9}$	$9.5x10^{-8}$
Annual Population Dose Within 80 Kilometers[d]		
Atmospheric release pathway (person-rem)	0.016	2.4
Total liquid release pathway (person-rem)	0	0
Atmospheric and liquid release pathways combined (person-rem)	0.016	2.4
Percent of natural background[c]	$3.1x10^{-5}$	$4.7x10^{-3}$
10-year fatal cancers	$8.0x10^{-5}$	0.012
Annual Dose to the Average Individual Within 80 Kilometers[e]		
Atmospheric and liquid release pathways combined (mrem)	$1.1x10^{-4}$	0.016
10-year fatal cancer risk	$5.5x10^{-10}$	$8.0x10^{-8}$

[a] Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for operation of the electrometallurgical treatment process. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operation are 10 mrem from the air pathways, as required by the NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation level at INEL is 338 for the average individual; the population within 80 km receives 90,800 person-rem.

[d] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[e] Obtained by dividing the population dose by the number of people projected to live within 80 km of INEL (269,000).

Note: Impacts from the electrometallurgical treatment are assumed to be 20 percent of the impacts associated with ANL-W. This is based on an estimate of the additional amount of material that would have to be processed by the electrometallurgical treatment facility to accommodate the immobilization of the Pu under this alternative.

Source: LLNL 1996b and model results (refer to Section M.2).

site workforce would be 223 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.3.9–2.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the electrometallurgical treatment subalternative at INEL are presented in Table 4.3.4.3.9–3. Included are the impacts due to operation of the electrometallurgical treatment facility only to immobilize Pu, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation would be $1.8x10^{-6}$ at INEL. The cancer risk from hazardous chemicals to the MEI would be zero (because no carcinogens are released from hazardous chemicals) at INEL.

Table 4.3.4.3.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Electrometallurgical Treatment at Idaho National Engineering Laboratory

Receptor	Impact
Involved Workforce[a]	
Average worker dose (mrem/yr)[b]	40
10-year risk of fatal cancer	1.6×10^{-4}
Total dose (person-rem/yr)	2.9
10-year fatal cancers	0.012
Noninvolved Workforce[c]	
Average worker dose (mrem/yr)[b]	30
10-year risk of fatal cancer	1.2×10^{-4}
Total dose (person-rem/yr)	220
10-year fatal cancers	0.88
Total Site Workforce[d]	
Dose (person-rem/yr)	223
10-year fatal cancers	0.89

[a] The involved worker is a worker associated with operations of the electrometallurgical treatment process to immobilize Pu.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] The noninvolved worker is a worker onsite but not associated with electrometallurgical treatment operations. The noninvolved workforce is equivalent to the No Action workforce.

[d] The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996b.

Table 4.3.4.3.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

Receptor	INEL	
	Facility[a]	**Total Site**[b]
Maximally Exposed Individual (Public)		
Hazard index[c]	1.8×10^{-6}	0.015
Cancer risk[d]	0	3.6×10^{-6}
Worker Onsite		
Hazard index[e]	1.6×10^{-5}	0.22
Cancer risk[f]	0	7.7×10^{-4}

[a] Facility=Contribution from the proposed new facility operation only.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation.

[c] Hazard Index for MEI=Sum of Individual Hazard Quotients (noncancer health effects) for MEI.

[d] Cancer Risk for MEI=(Emissions Concentrations) x (0.286[converts concentrations to doses]) x (Slope Factor (SF)). Where there are no known carcinogens among chemicals emitted, the cancer risk value is 0.

[e] Hazard Index for Workers=Sum of Individual Hazard Quotients (noncancer health effects) for workers.

[f] Cancer Risk for Workers=(Emissions for 8-hr) x (0.286[converts concentrations to doses]) x (0.237[Fraction of year exposed]) x (0.571[Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Table M.3.4-60.

The HI to the onsite worker would be $1.6x10^{-5}$ at INEL, and the cancer risk to the onsite worker would be zero (because no carcinogens are released from hazardous chemicals) at INEL. The total HI to the MEI is $1.5x10^{-2}$ and to the workers is 0.22. The total cancer risk to the MEI is $3.6x10^{-6}$ and to the workers is $7.7x10^{-4}$.

Facility Accidents. Potential accidents associated with electrometallurgical treatment at the FCF at INEL have been analyzed and documented in an Environmental Assessment (IN DOE 1996c:83-94). The analysis includes both design-basis and beyond design-basis accidents associated with the treatment of spent nuclear fuels but does not explicitly analyze the effects of integrating plutonium in with the spent fuel being processed. Since the FCF is used for the treatment of a variety of DOE reactor fuels, many process uncertainties exist; these include the types and quantities of materials at risk within the argon cell. As a result, the safety analyses are based on conservative assumptions that are expected to bound any campaign that may be conducted during the DOE spent fuel treatment program. For comparison, the materials-at-risk considered for the FCF SAR (IN ANL 1995a:Ch 9) and addressed in the EA and another study on the immobilization of surplus fissile material through electrometallurgical treatment of spent fuel (LLNL 1996b:8-1) are based on a process for the treatment of EBR-II fuel. This provides a basis for extrapolation of the accident consequences for the proposed surplus plutonium immobilization program since the electrometallurgical processes are essentially the same and the bounding accidents evolve in the same way. The processes to produce metal immobilization forms (bounding case) are considered in theses analyses, because they result in the largest accident impacts attributable to immobilization operations (LLNL 1996b:8-1).

The accidents analyzed in the FCF SAR were screened using three criteria (LLNL 1996b:8-3) to select a subset of accidents that would reflect the additional risk associated with surplus Pu immobilization program. The accident in the subset with the highest impacts is a breach in the argon cell that would be initiated by a design-basis earthquake. This accident has an estimated probability in the range $1.0x10^{-6}$ to $1.0x10^{-4}$ per year and, if it were to occur, would result in a $5.2x10^{-7}$ increased likelihood of latent cancer fatality to an uninvolved worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a $3.5x10^{-8}$ increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of $3.5x10^{-11}$. The estimated number of latent cancer fatalities in the offset population within 80 km (50 mi) would be $3.7x10^{-6}$ and the corresponding risk of latent cancer fatalities over a 10-year campaign would be $3.7x10^{-9}$ (IN DOE 1996c:89-90).

The beyond design-basis accident with the highest impacts would be a metal fire due to an earthquake induced breach in the argon cell concurrent with HEPA filter failure and an unfiltered release. This scenario is similar to the design-basis accident with the highest impacts except in this more severe accident, the release to the environment is unfiltered. This accident has an estimated probability of $1.0x10^{-6}$ per year or less and, if it occurred, would result in a $5.2x10^{-3}$ increased likelihood of latent cancer fatality to a worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a $3.5x10^{-4}$ increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of $3.5x10^{-9}$. The estimated number of latent cancer fatalities in the offsite population within 80 km (50 mi) would be 0.037 and the corresponding risk of latent cancer fatalities over a 10-year campaign would be $3.7x10^{-7}$ (IN DOE 1996c:91-93).

4.3.4.3.10 *Waste Management*

This section summarizes the waste management impacts for the construction and operation of electrometallurgical treatment for the immobilization of surplus fissile material in existing ANL-W facilities at INEL. Table 4.3.4.3.10–1 provides the estimated operational waste volumes projected to be generated at INEL, as a result of the electrometallurgical treatment of surplus fissile material. Facilities that would support the electrometallurgical treatment facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the electrometallurgical treatment facility

Table 4.3.4.3.10–1. Estimated Annual Generated Waste Volumes for the Electrometallurgical Treatment Alternative

Category	INEL	
	No Action[a] (m^3)	Pu Disposition (m^3)
Transuranic		
Liquid	0	None
Solid	3.5	6
Mixed Transuranic		
Liquid	0	None
Solid	Included in TRU	0.8
Low-Level		
Liquid	0	2
Solid	7,200	55
Mixed Low-Level		
Liquid	4	None
Solid	170	0.8
Hazardous		
Liquid	Included in solid	None
Solid	1,200	0.8
Nonhazardous (Sanitary)		
Liquid	Not reported separately, included in solid	1,550
Solid	52,000	1,500
Nonhazardous (Other)		
Liquid	0	2,990[b]
Solid	Included in sanitary	0.8[c]

[a] The No Action volumes are from Table 4.2.3.10–1. Incremental waste generation volumes for electrometallurgical treatment facility are from Table E.3.3.6–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.6–1.

[b] Includes recyclable wastes.

[c] Recyclable wastes.

and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.6. A detailed description of the waste management facilities that would be required to support the electrometallurgical treatment facility can also be found in Section E.3.3.6.

Operation of an electrometallurgical treatment facility would impact existing waste management activities at INEL, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during modifications to existing facilities would consist of approximately 2,780 m^3 (735,000 gal) of sanitary wastewater, 2,840 m^3 (750,000 gal) of other wastewater and 5,730 m^3 (7,500 yd^3) of solid sanitary wastes. These wastes would have minimal impact and can be easily handled within existing facilities.

The Electrometallurgical Treatment Facility would not generate any high-level waste as a waste stream from processing Pu. However, the Electrometallurgical Treatment Facility would produce an immobilized GBZ product that would require acceptance at a HLW repository. Electrometallurgical treatment for Pu disposition would annually produce an additional 37 m^3 (49 yd^3) of immobilized GBZ product (LLNL 1996b:7-3). This immobilized GBZ product would require interim storage onsite until acceptance at a HLW repository.

For Pu disposition, approximately 6 m^3 (8 yd^3) of additional TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging in a radwaste facility to meet the WIPP WAC or alternative treatment level. INEL has existing and planned TRU waste facilities that could be utilized. A small quantity (0.8 m^3 [1 yd^3]) of mixed TRU solid waste would require treatment and packaging to meet the WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), one additional truck shipment per year or, if applicable, one regular train shipment every other year, or one dedicated train shipment every 8 years, would be required. [Text deleted.]

INEL has existing facilities that could manage the small quantities of LLW. As a result of Pu disposition, approximately 55 m^3 (72 yd^3) of additional LLW from solidified liquid LLW, protective clothing, and small equipment would require disposal. Using the land usage factor from Section E.1.4, the area required for LLW disposal at INEL would be 0.009 ha/yr (0.02 acres/yr). The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

For Pu disposition, a small quantity (0.8 m^3 [1 yd^3]) of additional mixed LLW consisting of solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the INEL Site Treatment Plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous wastes would consist primarily of analytical solutions and solvent rags. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

As a result of Pu disposition, approximately 1,550 m^3 (410,000 gal) of additional liquid nonhazardous sanitary and 2,990 m^3 (790,000 gal) of additional cooling tower blowdown and industrial wastewater would require treatment in accordance with INEL site practice and discharge permits. The 1,500 m^3 (2,000 yd^3) of additional solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practices at INEL.

4.3.5 REACTOR CATEGORY

The following sections describe four reactor alternatives for the disposition of surplus Pu: Existing LWR Alternative, Partially Completed LWR Alternative, Evolutionary LWR Alternative, and the CANDU Reactor Alternative. A common activity for each reactor alternative is the MOX fuel fabrication facility, which is also described. The impacts for each reactor alternative would need to include those shown for the MOX fuel fabrication activity. Depending on the alternative, impacts on the following representative DOE sites may be described: Hanford, NTS, INEL, Pantex, ORR, SRS, and a generic range of site conditions within the United States. The sections describe the construction and operational impacts of the Reactor Alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. For the CANDU reactor, effects within the United States and Canada are analyzed. Impacts described in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2).

4.3.5.1 Mixed Oxide Fuel Fabrication Facility

The environmental impacts described in the following sections are based on the analysis of the MOX fuel fabrication facility for the Reactor Category of Alternatives and is described in Section 2.4.5.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. Environmental impacts for a representative commercial facility are also described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, the MOX fuel fabrication facility could be located at either Hanford, INEL, Pantex, or SRS. As a result of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus Pu would be fabricated into MOX fuel. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities, at these four sites should the Preferred Alternative be selected at the ROD.

4.3.5.1.1 *Land Resources*

The MOX fuel fabrication facility may be located at Hanford, NTS, INEL, Pantex, ORR, SRS, or a commercial MOX fuel fabrication site. At all sites, the MOX fuel fabrication facility would disturb 121 ha (300 acres) of land during construction of which 81 ha (200 acres) would be used during operations. At any of these sites, the MOX fuel fabrication facility would be a stand-alone operation. The facility would be sited in a 1.6-km (1-mi) buffer zone for a total land area of 890 ha (2,200 acres). The buffer zone would be contained within the boundary of all analysis sites except at ORR, where the buffer zone would be less than 1.6 km (1 mi).

Construction and operation of the MOX fuel fabrication facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.5.1.8, in-migration of workers would be required at INEL only during the construction phase and at all analysis sites except ORR during the operational phase. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at each site. Therefore, offsite land use at the representative sites would not be affected.

Hanford Site

Land Use. The potential site for the MOX fuel fabrication facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction of the MOX fuel fabrication facility would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operations would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. The proposal would be consistent with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction would be consistent with the industrialized landscape character of the 200 Area and Hanford VRM Class 5 designation of the potential site. A potential visual impact during operation would be from the new stack plumes which could be visible from viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the MOX fuel fabrication facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as nonnuclear test area. However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The MOX fuel fabrication facility would be located in or adjacent to the ICPP security area. New construction would be required. Construction and operation of the facility would be in conformance with the current *Idaho National Engineering Laboratory Site Development Plan,* which designates the ICPP as situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with local land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur from the additional stack plumes; however, the proposal would be consistent with the existing VRM Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11. The master plan of the current *Pantex Site Development Plan* designates Zone 11 for applied technology (PX DOE 1995g:16). However, Pantex could revise the site development plan should DOE decide to construct a MOX fuel fabrication facility in Zone 11.

Construction would not affect other site land uses. As discussed in Section 3.5.1, there would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential impacts could occur during operations from the additional stack plumes; however, the visual environment would be consistent with the industrialized landscape character and current VRM Class 5 designation of Zone 11.

Oak Ridge Reservation

Land Use. The MOX fuel fabrication facility would be located on undeveloped land at or adjacent to Y-12. Weapons component manufacturing and development is among the future land uses designated for Y-12 by the future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6,5-7). However, ORR could revise the site development plan should DOE decide to construct the facility at ORR.

The MOX fuel fabrication facility would not affect other ORR or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the *Oak Ridge Area Land Use Plan* designates the potential site for industrial and/or Public use (depending upon the exact location chosen).

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the new stack plumes; however, the visual environment would be consistent with the industrialized landscape character and existing VRM Class 5 designation of Y-12.

Savannah River Site

Land Use. The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. Facility construction and operation would be in conformance with future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, the future land-use category for the proposed development site is primary industrial mission (SR DOE 1994d:11,12). However, construction of the facility would convert undeveloped, forested land, and a very small portion of NERP lands.

Construction would not affect other SRS or offsite land uses at SRS. There are no prime farmland on SRS. Construction and operation would not be in conflict with the land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation to Class 5. Potential visual impacts could occur during operation from additional stack plumes. However, because of hilly terrain, impacts to State Highway 125 and SRS Route 1 would not occur.

Generic Site

Land Use. The site chosen for the commercial facility would likely contain adequate land area to accommodate MOX fuel fabrication facility and surrounding undeveloped land area. Construction of the facility could change existing land use. It is anticipated that the facility would be in conformance with site development/facility utilizations plans as well as land use plans, policies, and controls at the Federal, State, and local levels. If site development is not in conformance, it could be possible for land use plans, policies, and controls to be revised. Revisions could include a change in zoning classification of the site. The use of special status lands and prime farmland could be affected.

Visual Resources. It is anticipated that the facility would be relatively visually unobtrusive to adjacent lands due to sensitive site design, earthwork, and landscaping. However, the existing VRM classification could change due to facility construction and operations. It is likely that the existing VRM classification would be Class 4 or 5. Visual impacts to adjacent lands with high sensitivity levels, such as public roads, residential areas, and recreational/scenic areas could be reduced by the 1.6-km (1-mi) buffer zone.

[Text deleted.]

4.3.5.1.2 Site Infrastructure

A MOX fuel fabrication facility is required to support the various reactor alternatives for Pu disposition. The environmental consequences of this MOX fuel fabrication activity is additive to the consequences for each of the reactor alternatives discussed in Sections 4.3.5.2 through 4.3.5.5.

The options considered for the production of MOX fuel include the construction of a facility at a representative site (Hanford, NTS, INEL, Pantex, ORR, or SRS) and the production of MOX fuel assemblies by a commercial nuclear fuel vendor at a generic domestic facility.

Changes to the existing infrastructure at representative sites due to the construction and operation of a facility for the production of MOX fuel are presented in Tables 4.3.5.1.2–1 and 4.3.5.1.2–2, respectively. Construction is estimated to require 6 years to complete.

Table 4.3.5.1.2–1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	**Peak Load (MWe)**	**Oil (l/yr)**	**Natural Gas (m^3/yr)**	**Coal (t/yr)**
Facility Requirement	833	1	126,180	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Project usage with facility	346,333	59	9,460,980	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Project usage with facility	125,773	26	5,842,180	0	0
Amount required in excess of site availability	0	0	126,180[a]	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Project usage with facility	233,333	43	5,946,180	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Project usage with facility	47,099	11	921,346	7,200,000	0
Amount required in excess of site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Project usage with facility	726,833	111	505,180	95,000,000	16,300
Amount required in excess of site availability	0	0	89,180[a]	0	0

Table 4.3.5.1.2–1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Project usage with facility	795,700	119	28,516,680	0	221,352
Amount required in excess of site availability	0	0	126,180[a]	0	0
Generic Site					
Range of resource availability	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	0	0.5	126,180[a]	0	0

[a] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Table 4.3.5.1.2–2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	<5	0	13,000	5	20,000	2,350,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Project usage with facility	425	204	358,500	63	4,354,800	23,389,531	0
Amount required in excess of site availability	<5	0	0	0	0	2,350,000[a]	0
NTS							
Site availability	1,100[b]	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Project usage with facility	650	0	137,940	30	5,736,000	2,350,000	0
Amount required in excess of site availability	0	0	0	0	20,000[c]	2,350,000[a]	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Project usage with facility	450	48	245,500	47	5,840,000	2,350,000	11,340
Amount required in excess of site availability	<5	0	0	0	0	2,350,000[a]	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Project usage with facility	81	27	59,266	15	815,166	9,550,000	0
Amount required in excess of site availability	<5	0	0	0	0	0	0

Table 4.3.5.1.2–2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Project usage with facility	76	27	739,000	115	399,000	97,350,000	16,300
Amount required in excess of site availability	<5	0	0	0	0	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Project usage with facility	235	103	807,000	121	28,410,500	2,350,000	221,352
Amount required in excess of site availability	<5	0	0	0	20,000[c]	2,350,000[a]	0
Generic Site							
Range of availability	3-9	0-4.3	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	<2	0	0	4.5	20,000[c]	2,350,000[a]	0

[a] Facility would be adapted to use fuel oil instead of natural gas.

[b] Includes paved and unpaved roads.

[c] Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995 a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Hanford Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirements during construction would be within site availability. Impacts during operation would be greatest for natural gas which would require a 2,350,000 m^3/yr (82,990,250 ft^3/yr) increase over availability. This natural gas could be procured through normal contractual means. Total requirements for electrical energy, peak load, and oil would be less than that already available at the site.

Nevada Test Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total electrical energy required at NTS during the 6-year construction period would be less than site availability, and total oil requirements would be above site availability. Additional oil required could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at NTS; however, oil-based utilities could be used to meet the need in lieu of natural gas. Peak electrical power load would be higher than projected usage without the facility but under current site availability. Projected total electrical energy usage with the facility would be more than projected usage without the facility, but would be less than site availability. Oil consumption would increase slightly above site availability and would be procured through normal contractual means.

Idaho National Engineering Laboratory

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Impacts during operation would be greatest for natural gas which is not currently

used at INEL; however, oil based utilities could be modified to meet the need. Total requirement for electrical energy would be within site availability, and the total requirement for oil would be within current site availability.

Pantex Plant

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for both electrical energy and oil would be less than current site availability. Requirements during operation for natural gas would be more than projected usage without the facility but less than site availability. The total electrical energy requirement and the total oil requirement would be less than current availability. Adequate electrical energy is available from the regional power grid.

Oak Ridge Reservation

Available reserves would accommodate the additional electrical energy requirement for construction of the MOX fuel fabrication facility. The requirement for oil would be more than current site availability but could be procured through normal contractual means. Site infrastructure impacts during operation would be minor compared with available resources. Onsite access to the MOX facilities would require less than 5 km (3 mi) of new roadway. Peak electrical power load would be greater than projected peak load without the facility, but would be less than current availability. The total requirement for oil with the MOX fuel fabrication facility would be slightly less than site availability. The total requirement for natural gas would be well within site availability.

Savannah River Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for oil would be slightly higher than site availability but could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at SRS; however, fuel oil based utilities could be modified to meet the need. Peak electrical power load would be slightly greater than projected peak load without the facility, but well under availability. The total requirement for electrical energy with the facility would be well under site availability, and the total requirement for oil would be slightly above site availability but would be handled as stated above.

Generic Site

Since no domestic site exists for the fabrication of MOX fuel, the site infrastructure impact analysis for construction and operation of the facility compares the requirements shown in the appendices with the generic fuel fabrication facility site described in Section 3.10.2. It is possible that construction requirements for peak electric load and oil would exceed availability for an actual domestic site at the low-end range of available resources. Site infrastructure resources required for operation of a MOX fuel fabrication facility would exceed availability of peak electric load, oil, and natural gas at the low-end range of available resources at a generic domestic site. These additional resource requirements could require new electrical transmission lines, oil storage tanks, and gas transfer pipelines. The generic regional power pool (Table 3.10.2–2) shows that there is sufficient reserve capacity to support the additional load. Oil could be obtained from existing commercial sources. Natural gas may not be available, but oil-based utilities could substitute.

4.3.5.1.3 *Air Quality and Noise*

Construction and operation of the MOX fuel fabrication facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.5.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM_{10} and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

The MOX fuel fabrication process involves pure Pu materials that would require minimal chemical processing. The emissions estimates for the facility are based on operational experience at European MOX facilities, the glovebox ventilation system design, and the actual process. Feed material preparation and fabrication of fuel pellets would be done in gloveboxes to control contamination for normal operations. The ventilation system for the MOX fuel fabrication facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. There would be essentially four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.5.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters for further filtration before release to the environment. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutant releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits. VOC emissions of 1,000 kg/yr (2,200 lbs/yr), are shown in Table F.1.3–6, and would give trace concentrations at the site boundaries.

NOISE

The location of the facilities associated with the MOX fuel fabrication facility relative to the site boundary and sensitive receptors was examined for each of the seven sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of a MOX fuel fabrication facility include ventilation systems, cooling systems, and diesel generators. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the analyzed sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.5.1.4 *Water Resources*

The construction and operation of a MOX fuel fabrication facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.2–3 and C.2.1.2–3 and Table E.3.2.3–1, were used to assess impacts to surface and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.5.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of a MOX fuel fabrication facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the MOX fuel fabrication facility. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected annual surface water withdrawal. During operation, the total annual water requirement for the facility would be approximately 56.8 million l/yr (15 million gal/yr), which would represent a 0.4-percent increase over the existing surface water withdrawal and approximately 0.00005 percent of the annual average flow rate of the Columbia River (3,360 m^3/s [118,642 ft^3/s]). These additional withdrawals would have minimal affects on surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary and other nonhazardous wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to an existing wastewater treatment system. During operation, approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This would represent a 17.7-percent increase in the wastewater discharged annually at Hanford. All discharges would be monitored to comply with discharge requirements. Negligible impacts are expected.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be collected, monitored for radioactivity, and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels.

The MOX fuel fabrication facility would be located outside of the Columbia River floodplain and the area of the probable maximum flood. The maximum probable flood is greater than the 500-year flood.

Groundwater. No groundwater would be used during construction or operation of the MOX fuel fabrication facility; therefore, there would be no impacts to groundwater availability. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected. Treated wastewater discharged to evaporation/infiltration ponds that does not evaporate, however, would percolate downward toward the groundwater. This wastewater would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.5.1.4–1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Water Source	Surface	Ground	Ground	Ground	Surface	Ground	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247	0
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700	0
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent increase in projected water use[a]	0.01	0.08	0.03	0.8	0.01	0.01	NA
Water Quality							
Total wastewater discharge (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent change in wastewater discharge[b]	0.8	2.3	0.4	1.3	0.08	0.3	NA
Percent change in streamflow	neg	NA	NA	NA	0.004[c]	0.04[d]	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	56.8	56.8	56.8	56.8	56.8	56.8	56.8
Percent increase in projected water use[e]	0.4	2.4	0.8	5.1	0.4	0.4	NA
Water Quality							
Total wastewater discharge (million l/yr)	43.5	43.5	43.5	43.5	43.5	43.5	43.5
Percent change in wastewater discharge[f]	17.7	53	8.1	30.9	1.9	6.2	NA
Percent change in streamflow	neg	NA	NA	NA	0.02[c]	0.9[d]	NA

Table 4.3.5.1.4-1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Floodplain							
Is actions in 100-year floodplain?	No	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Uncertain	Uncertain

[a] Percent increases in water requirements during construction MOX fuel fabrication facility are calculated by dividing water requirements for the facility (1.9 million l/yr) with that for No Action water requirements each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr).

[b] Percent changes in wastewater discharged during construction for the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (1.9 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr).

[c] Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m^3/s) and East Fork Poplar Creek (1.5 m^3/s). The comparison for the East Fork Poplar Creek is shown in the table.

[d] Percent changes in stream flow from wastewater discharge are calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).

[e] Percent increases in water requirements during operation of the MOX fuel fabrication facility are calculated by dividing water requirements for the Facility (56.8 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr).

[f] Percent changes in wastewater discharged during operation of the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (43.5 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1991a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, recycled or discharged to natural drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to natural drainage channels or be available to recycle.

No studies have been conducted to assess the 500-year floodplain boundaries at NTS. An assessment of the 500-year floodplain at NTS could be developed in future environmental studies. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the MOX fuel fabrication facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs from locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Annual construction water requirements for the facilities (1.9 million l/yr [0.5 million gal/yr]) represent approximately 0.005 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under NTS. As shown in Table 4.3.5.1.4–1, the quantity of water required for construction of the facility would represent approximately a 0.08-percent increase over the projected No Action groundwater usage. Withdrawal of this additional quantity should not impact groundwater availability. Operating the facility at NTS would require 56.8 million l/yr (15 million gal/yr), which is approximately 2.4 percent of the projected No Action groundwater usage. This additional withdrawal represents less than 0.2 percent of the estimated annual recharge. Minimal impacts to groundwater availability are expected.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored prior to discharge and would not be discharged until contaminant levels were within the limits specified in the State of Nevada permit. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for a MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system at the ICPP Area. This amount would represent a 0.4-percent increase in the effluent discharged at INEL. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This amount represents a 8.1-percent increase in INEL's annual effluent. After treatment, all wastewater generated during construction and operation would be available to recycle or would then be allowed to evaporate to the atmosphere, and/or infiltrate to the subsurface. All discharges would be monitored to comply with discharge requirements.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to infiltration/evaporation ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or evaporation/ infiltration ponds.

The potential location for a MOX fuel fabrication facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.5.1.4–1, construction and operation water requirements for the facility (1.9 million l/yr [0.5 million gal/yr]), and 56.8 million l/yr (15 million gal/yr), respectively, would represent 0.03- and 0.8-percent increases over the projected annual groundwater usage. These withdrawals would increase the total projected amount to be pumped at INEL to 17.6 percent of the total allotment during construction and 17.7 percent of the allotment during operation. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). These additional withdrawals would not impact groundwater availability.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater that is discharged to disposal ponds but does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be available for

recycle. In 1994, Pantex averaged approximately 1.4 million l/day (370,000 gal/day) of wastewater discharged to the playas. This quantity is expected to decrease in the future. The expected quantity of additional wastewater potentially discharged to the playas during operation (0.12 million l/day [31,704 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or the playas. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, available for recycle or discharged to local drainage channels or the playas.

The potential site for the MOX fuel fabrication facility would be located in Zone 11. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 11, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala aquifer or possibly from the Hollywood Road Wastewater Treatment Plant. Construction water requirements for a MOX fuel fabrication facility would be small relative to the recoverable water in aquifer storage which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.5.1.4–1, construction of the facility would require 1.9 million l/yr (0.5 million gal/yr) of water, which represents approximately a 0.8-percent increase over Pantex's projected annual groundwater usage and would be approximately 0.1 percent of the capacity of the groundwater system (1,900 million l/yr [502 million gal/yr]). Water required for operations would increase projected water requirements for Pantex by 5.1 percent. Previous studies have shown that, when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the facility at Pantex would require 56.8 million l/yr (15 million gal/yr), resulting in a small drawdown representing approximately 2.9 percent of the available groundwater. Although this additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer, the estimated degree is not substantial. The total groundwater withdrawal including this facility would be 305 million l/yr (80.9 million gal/yr) which, because of expected cutbacks in other programs, would be 63 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from wells at Pantex.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operational of a MOX fuel fabrication facility would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected no action annual surface water withdrawal. During operation, water requirements would be approximately 56.8 million l (15 million gal) annually. This represents a 0.4-percent increase in the projected annual surface water withdrawal for ORR. These additional water withdrawals from the Clinch River should cause minimal impacts to surface water availability.

During construction of the MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y–12 area. This would cause a less than 1-percent increase in the effluent from the Y–12 area. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility. This would cause a 1.9-percent increase in the effluent discharged from the Y–12 area. All discharges would be monitored to comply with discharge requirements. No impacts would be expected. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

Since the MOX fuel fabrication facility would be located outside both the 500- and 100-year floodplains no impact to floodplains is expected.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for construction and operation of a MOX fuel fabrication facility. During construction of a MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modification. This amount would represent a 0.3-percent increase in the estimated annual flow to this system and could be handled within the existing capacity. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility, representing a 6.2-percent increase for SRS. This additional quantity would represent approximately 0.9 percent of the Fourmile Branch's minimum flow. [Text deleted.]

Cooling system blowdown is another non-hazardous wastewater stream generated by this facility. The facility would release approximately 0.04 million l (11,200 gal) of treated blowdown water over an 8-hour period, 250 days/yr. All discharges to surface waters would be monitored to comply with discharge requirements.

Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

The potential location of a MOX fuel fabrication facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain boundary could be developed in future environmental studies.

Groundwater. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the existing projected annual groundwater withdrawal. During operation, water requirements would be approximately 56.8 million l/yr

(15 million gal/yr) and would represent a 0.4-percent increase in groundwater withdrawals. Minimal impacts to groundwater availability are expected. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected.

Generic Site

Utilizing an existing fuel fabrication facility should not cause any impacts to water resources outside of those identified in the site-specific environmental impact statements which have been prepared for these facilities. There would be no noticeable changes to current use of water resources. The facilities would continue to obtain raw water from either surface or groundwater sources which have an adequate supply to support them. Wastewater would continue to be treated, monitored, and discharged under permit requirements.

[Text deleted.]

4.3.5.1.5 *Geology and Soils*

This section discusses the environmental impacts to the geologic and soil resource as related to the construction and operation of the MOX fuel fabrication facility proposed for the Hanford, INEL, Pantex, SRS, NTS, ORR, and at an existing commercial uranium fuel fabrication facility, generic environment. A MOX fuel fabrication facility, at any of the representative sites, will involve some ground-disturbing construction activities (121 ha [300 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. Specifically, the relative annual amount of precipitation is greater at many eastern areas relative to most western areas. Specifically, ORR and SRS receive a greater relative amount of precipitation than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on geologic resources are anticipated. Neither facility construction and operational activities or site infrastructure improvements will restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is relatively low for many western areas, including Pantex, Hanford, INEL, and NTS. The soil erosion potential for many eastern areas including ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. The generic MOX fabrication facility could be located in either a low precipitation area or an area with a greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.5.1.6 *Biological Resources*

Construction of the MOX fuel fabrication facility would require 121 ha (300 acres) of land at each of the DOE sites analyzed and at the generic site. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

For analytical purposes it is assumed that the MOX facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.08 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX facility. These disturbance may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a MOX facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location that would be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharge to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would likely be affected by construction and operation of the MOX facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-

listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the MOX facility would be located in the Frenchman Flat area of the NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at NTS would result in the disturbance of terrestrial resources equaling about 0.03 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed project area, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise could cause larger mammals and birds in construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the MOX facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The desert tortoise is a federally listed threatened species that could be affected by construction of the MOX facility at NTS. Construction activities such as land-clearing operations, trenches, and excavation could pose a threat to the tortoise. Measures from previous projects at NTS designed to avoid impacts to the desert tortoise have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the MOX facility.

[Text deleted.]

Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the MOX facility (Section 4.3.5.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the MOX fuel fabrication facility would be located adjacent to the ICPP. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX fuel fabrication facility would result in the disturbance of terrestrial habitat equaling about 0.05 percent of INEL. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the MOX fuel fabrication facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they move was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. The closest pronghorn wintering area is located 4.8 km (3 mi) from the assumed site, therefore, wintering pronghorn should not be affected (IN DOE 1978a:222). Nests and young animals living within the project area could be lost during construction. The assumed site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX fuel fabrication facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX fuel fabrication facility would not affect wetlands since there are no wetlands on the assumed site. Wetlands associated with the Big Lost River are located about 1.6 km (1 mi) from the facility location; therefore, impacts to these wetlands are not expected.

Aquatic Resources. Construction and operation of the MOX fuel fabrication facility would not impact aquatic resources since there are no surface water bodies on the assumed site. The nearest surface water body is in the Big Lost River which is located 1.6 km (1 mi) from the facility location.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the MOX fuel fabrication facility on INEL, but several State-listed status species may be affected. [Text deleted.] Burrows and foraging habitat for the pygmy rabbit would be lost. Bat

species such as the Townsend's western big-eared bat may roost in caves and forage throughout the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant

It is assumed that the MOX facility would be located within Zone 11, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the MOX facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional water could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the MOX facility. Although the site has already been disturbed, it is possible that the State-listed Texas horned lizard could still be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the MOX fabrication facility would be located adjacent to the Y–12 Area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.9 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas used for constructing laydown. Vegetation within the area to be developed would be destroyed during land clearing. The area immediately adjacent to Y–12 is largely grassland or disturbed land; it is in turn bordered by oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While grassland and disturbed land would be affected most by construction, both forest types could also be impacted. None of the community types that could be disturbed are considered rare within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals with the proposed project area, such as amphibians, reptiles, and smaller mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site could be lost during construction. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediments control

measures would control secondary impacts. Since existing intake and discharge structures would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River or East Fork Poplar Creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impacts on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the MOX facility could cause water quality changes (primarily sediments leading and resulting turbidity) to Bear Creek or East Fork Poplar Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since existing intake and discharge structures would be used, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharge to West Fork Poplar Creek. The small volume of wastewater discharged to the stream would be expected to have negligible impacts on aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the MOX facility. The Tennessee dace is sensitive to sedimentation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

Savannah River Site

It is assumed that the MOX fuel fabrication facility would be located about 1.6 km (1 mi) north of the P–Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.15 percent of SRS. Vegetation within the assumed facility location, which would be lost during land-clearing activities, consists of loblolly, longleaf, and slash pine. This community type is common on SRS and throughout the region.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Since the majority of the assumed site is upland, the facility could be located to avoid direct impacts to wetlands. Implementation of soil erosion and sediment control measures would control secondary impacts. Due to the relatively small amount of water required during both construction and operation, existing intake and discharge structures would be used. It would not be necessary to disturb wetlands along site streams. Any unavoidable impacts to wetlands would be mitigated. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. All wastewater discharges would be treated as necessary to comply with NPDES-permit requirements.

Aquatic Resources. Stormwater runoff during construction of a MOX fuel fabrication facility at SRS could cause temporary water quality changes in local tributaries to Par Pond. Water requirements during construction would be met by existing site sources. Since new intake and discharge structures would not be required, direct disturbance to aquatic resources in site water bodies would not occur. Wastewater discharges during construction would be minimal and would not be expected to affect aquatic resources.

Operation of the MOX fuel fabrication facility would necessitate water withdrawal from the Savannah River. Water would be withdrawn through existing intake structures. The small volume of water required would not affect the river's flow (Section 4.3.5.1.4), nor increase the entrainment and impingement of fish; thus, fish populations should not be affected. In compliance with the *Anadromous Fish Conservation Act* (16 USC 757a), populations of anadromous fish species on or near SRS would be sustained and their movement unobstructed by project construction and operation. During operation, nonhazardous wastewater would be discharged to local drainage channels. Flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES-permit requirements.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species are expected to be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by the MOX facility. Preactivity surveys would be conducted as appropriate before construction to determine the presence of any special status species on the proposed site.

Generic Site

For analytical purposes it is assumed that a MOX fuel fabrication facility could be located at an unspecified location within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of a MOX fuel fabrication facility would result in the direct disturbance of terrestrial resources. Surrounding areas could be indirectly affected by erosion and sedimentation. Construction of the facility would affect animal populations. Specific impacts would vary with the particular site chosen; however, certain general types of impacts could be expected regardless of location. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed facility location may not survive. The

location will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Disturbances associated with both construction and operation, such as noise and human presence, could affect wildlife living adjacent to the facility. These disturbances could cause some species to move form the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

It is not possible to identify the particular vegetative communities to be disturbed since the location of the facility is not known; however, development could take place within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type (Section 3.11.6). Due to previous disturbance, vegetation found at a particular location could vary considerably from that which may have once occurred. In fact, the presence of natural climax communities in certain areas could be considered uncommon and, thus, sensitive to development. For example, little native grassland exists due to the extensive conversion of this community to agriculture use. Tiered NEPA documentation will address site-specific impacts.

Wetlands. Wetlands could be affected either directly or indirectly by construction of a MOX fuel fabrication facility. Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct impact is unavoidable, mitigation measures would be developed consistent with 10 CFR 1022 and in accordance with the conditions of a COE permit, if applicable. This would limit the disturbance to the smallest possible area, and mitigation measures would offset wetland loss.

Indirect impacts to wetlands from a MOX fuel fabrication facility could occur as a result of stormwater runoff carrying sediments to wetlands adjacent to disturbed areas. Changes in hydrology and soils could occur as a result of alterations in water levels and the buildup of sediments. These changes could, in turn, change the vegetative composition of the wetland.

The potential to affect wetlands would depend on where the facility was located. Although wetlands occur in each of the principal vegetation types within which a MOX fuel fabrication facility could be located, they are most prevalent in the southeastern evergreen forest, southwestern and northwestern portions of the deciduous forest, and the northern portion of grassland community regions of the site area. Thus, if the commercial MOX fuel fabrication facility were constructed in one of these areas, there would be a greater potential to impact wetlands. However, even within these regions, wetlands could be largely avoided during the siting process. Site-specific impacts will be addressed in tiered NEPA documentation.

Aquatic Resources. During construction of a MOX fuel fabrication facility, potential impacts to aquatic resources could result from stormwater runoff. Runoff could alter flow rates, increase turbidity, and result in sedimentation of stream beds. These impacts could, in turn, cause temporary and permanent changes in species composition and density, and could alter breeding habitats. Operational impacts to aquatic resources would be expected to be minimal since wastewater volumes would be minimal and would be discharged through an NPDES-permitted outfall. As discussed in Section 3.11.6, a wide variety of aquatic resources occur within the principal vegetation types within which this facility could be located. Since a site has not been selected for the commercial MOX fuel fabrication facility, it is not possible to determine which aquatic resources would be affected. Site-specific impacts will be determined in tiered NEPA documentation.

Threatened and Endangered Species. Construction and operation of the MOX fuel fabrication facility would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those discussed above for terrestrial resources, wetlands, and species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development. During the siting process, concern for

these species would be a primary consideration. Further, once a site was chosen, consultation with the USFWS and the appropriate State agency(s) would take place to ensure that threatened and endangered species would be protected. Potential impacts to individual species, necessary consultation, and protective measures will be addressed in site-specific NEPA documentation.

4.3.5.1.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources that may result from construction and operation of the MOX fuel fabrication facility at each of the representative sites analyzed, and a generic site. The land to be disturbed during construction would be 121 ha (300 acres) of which 81 ha (200 acres) would be used during operations. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility at all sites except ORR, where the buffer zone would be smaller. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. If sites were identified, efforts would be made to avoid them. Operations would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The MOX fuel fabrication facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction of the proposed facility. Operation would not result in additional impact as it does not involve ground disturbance or increased activity.

The CGTO has conducted surveys over portions of Frenchman Flat and identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The facility would be constructed adjacent to the existing ICPP security area. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites are located adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources can be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The MOX fuel fabrication facility would be constructed in Zone 11 of Pantex. Areas to be disturbed by development have not been systematically surveyed for archaeological or paleontological resources. Prior to construction, additional survey work may be necessary. Because Zone 11 is disturbed, it is unlikely to contain intact subsurface prehistoric or historic remains. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operation would not have additional impact to archaeological resources as it does not result in additional ground disturbance.

Facility construction may have an impact on historic structures at Pantex. The original buildings at Pantex were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features which clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

DOE has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zone 11. Some resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within the land to be disturbed by development. Burials are considered important Native American resources. Also, construction and operation may have an impact on traditionally used plant and animal species.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains. The land to be disturbed during construction may contain some paleontological remains. Operation would not have an additional effect on paleontological remains.

Oak Ridge Reservation

The MOX fuel fabrication facility would be constructed adjacent to Y–12. This area has not been systematically surveyed. Although some of the land is disturbed, it may contain prehistoric or historic resources. Recorded prehistoric sites at ORR include villages, burial mounds, lithic workshops, and quarries. Historic sites recorded at ORR include both archaeological remains and standing structures. One prehistoric site, (40AN6), a lithic scatter, has been identified to the east of the Y–12 fences, near Scarboro Road. Additional prehistoric or historic

resources may occur in the project area, and these could be affected by construction. Operation, because it does not involve additional ground disturbance, is not expected to affect any prehistoric or historic resources.

Although none have been identified near Y–12 to date, facility construction and operation could have an impact on some Native American resources. For example, archaeological sites, which can be affected by construction, are sometimes considered Native American resources. In addition, the presence of a facility may create a visual intrusion into sacred or ceremonial space.

Fossilized remains occurring at ORR have little research value, so impacts to paleontological remains would be considered negligible.

Savannah River Site

The MOX fuel fabrication facility would be located approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources such as remains of villages, traditional plant gathering areas, cemeteries, and isolated burials may be affected by construction and operation of the facility.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

Generic Site

This facility involves the use of an area adjacent to an existing fuel fabrication facility. No impacts to prehistoric, historic, or paleontological resources are anticipated because construction would occur on previously disturbed ground. Operation could affect some Native American resources. For example, the facility could create auditory intrusion into important Native American ceremonial or sacred sites. Increased security may result in reduced access to traditional use areas. Native American resources can be identified through project-specific consultation with potentially affected tribes.

[Text deleted.]

4.3.5.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the MOX Fuel Facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a MOX fuel facility at any of the DOE sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 475 workers in the peak year of construction at any site. The largest increase in regional employment (less than 1 percent) among the sites analyzed would be at INEL. A total of 964 new jobs (475 direct and 489 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.8 percent (Socio 1996a). The largest increase in per capita income would occur if the facility is constructed at INEL, but the increase would be much less than 1 percent.

A workforce of 500 would be required for fuel operation at any site. Operating the facility at INEL would generate the largest changes in regional employment (about 1 percent) while the largest increase in per capita income (less than 1 percent) would also occur at INEL. A total of 1,841 new jobs (500 direct and 1,341 indirect) would be generated the operational activities, and regional unemployment would fall to 4.4 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL, construction requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill specialized positions during operation at all of the sites analyzed. Increases to the population from in-migration during construction or operation would be less than 1 percent over No Action projections. Housing units, in excess of existing vacancies, would be required in the INEL ROI during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS and ORR, during operation to accommodate the in-migrating population. During both phases, the greatest increase in housing requirements (much less than 1 percent) would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the MOX fuel facility would increase demand for community services at INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operation on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services is expected to occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 at INEL, only one new teacher would be needed during construction. Nine additional teachers would be needed during operation in the Pantex ROI to maintain the No Action student-to-teacher ratio of 16.3:1 (Socio 1996a).

No additional police officers or firefighters would be needed to maintain No Action service levels at any of the sites analyzed during construction. One additional police officer and 3 additional firefighters would be necessary during operation to maintain the No Action level of service of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels at each site analyzed. Projected capacities would be capable of accommodating these small increases in patient load. No additional physicians would be needed at any of the sites analyzed during construction, however, 1 additional physician would be needed at INEL during operation to maintain the No Action service level of 1.2 physicians per 1,000 persons (Socio 1996a).

Local Transportation. There would be minor effects to the road networks due to construction and operation of a MOX fuel fabrication facility, but no drop in level of service. No new roads or improvements to existing roads would be needed (Socio 1996a).

Generic Site

Regional Economy Characteristics. The commercial site would require 475 and 500 workers for construction and operation of the facility, respectively. Project-related increases in per capita income and employment would be relatively small when compared to the regional economies in each REA. An analysis of the resident labor force in the REA surrounding each of the representative sites indicates that sufficient labor is available to fill these newly created positions.

Population and Housing, Community Services, and Local Transportation. There would be little or no population growth from in-migrating workers related to this project. Effects on housing, community services, and local transportation are expected to be similar to No Action projections.

4.3.5.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the MOX fuel fabrication facility, whose activities are associated with Pu disposition alternatives that utilize nuclear reactors. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.5.1.9–1 and 4.3.5.1.9–2, respectively; impacts associated with the longer of the two assumed campaign times (17 years) are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.5.1.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.5.1.9–4 through Table 4.3.5.1.9–9. Detailed results are presented in Appendix M.

The Preferred Alternative for disposition of surplus Pu is a dual technology strategy including immobilization and burning Pu as MOX fuel in existing reactors. For analysis purposes, approximately 70 percent of the surplus Pu was identified to be in forms suitable for MOX fuel fabrication. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents in this section are presented for an assumed 17-year operational campaign for the disposition of 50 t (55.1 tons) of surplus Pu and for an assumed 11-year operational campaign for the analyzed case (70 percent).

The Preferred Alternative for disposition through the utilization of existing reactors would require a shorter reactor campaign to dispose of less material with the utilization of additional reactors. The impacts and risks associated with MOX fuel fabrication would therefore be reduced since the duration of operations would coincide with the reactor campaign.

Normal Operation. There would be no radiological releases associated with the construction of a MOX fuel fabrication facility at any of the sites. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the MOX fuel fabrication facility at each of the sites are presented in Table 4.3.5.1.9–1. The impacts from all site operations, including the MOX fuel fabrication facility, are also given in the table. Comparisons with natural background radiation doses are included. Health effect values for operational periods of 11 and 17 years are presented in the table.

The doses to the MEI due to annual MOX facility operation at the identified DOE sites would range from 6.8×10^{-5} mrem at the NTS site to 6.8×10^{-3} mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 5.8×10^{-10} to 5.8×10^{-8}. The impacts to the average individual would be less. As a result of annual facility operation, the population doses would range from 1.4×10^{-4} person-rem at the NTS site to 0.048 person-rem at the ORR site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 1.2×10^{-6} to 4.1×10^{-4}. For the generic site, the dose to the maximally exposed member of the public would be 0.015 mrem. From 17 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-7}. The annual population dose would

Table 4.3.5.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
Receptor	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site
Annual Dose to the Maximally Exposed Individual Member of the Public[b]														
Atmospheric release pathway (mrem)	$1.4x10^{-4}$	$4.4x10^{-3}$	$6.8x10^{-5}$	$4.2x10^{-3}$	$8.8x10^{-5}$	0.018	$5.2x10^{-4}$	$5.3x10^{-4}$	$6.8x10^{-3}$	1.5	$1.5x10^{-3}$	0.42	0.015	0.073 to 0.52
Drinking water pathway	0	0	0	0	0	0	0	0	0	0.10	0	0.081	0	<1.0
Total liquid release pathway (mrem)	0	$9.5x10^{-4}$	0	0	0	0	0	0	0	1.7	0	0.37	0	0.002 to 1.0
Atmospheric and liquid release pathways combined (mrem)	$1.4x10^{-4}$	$5.4x10^{-3}$	$6.8x10^{-5}$	$4.2x10^{-3}$	$8.8x10^{-5}$	0.018	$5.2x10^{-4}$	$5.3x10^{-4}$	$6.8x10^{-3}$	3.2	$1.5x10^{-3}$	0.79	0.015	0.52 to 1.1
Percent of natural background[c]	$4.7x10^{-5}$	$1.8x10^{-3}$	$2.2x10^{-5}$	$1.3x10^{-3}$	$2.6x10^{-5}$	$5.3x10^{-3}$	$1.6x10^{-4}$	$1.6x10^{-4}$	$2.3x10^{-3}$	1.1	$5.0x10^{-4}$	0.27	$4.9x10^{-3}$	0.18 to 0.37
17-year fatal cancer risk	$1.2x10^{-9}$	$4.6x10^{-8}$	$5.8x10^{-10}$	$3.6x10^{-8}$	$7.5x10^{-10}$	$1.5x10^{-7}$	$4.4x10^{-9}$	$4.5x10^{-9}$	$5.8x10^{-8}$	$2.8x10^{-5}$	$1.3x10^{-8}$	$6.7x10^{-6}$	$1.3x10^{-7}$	$4.4x10^{-6}$ to $9.5x10^{-6}$
11-year fatal cancer risk[d]	$7.8x10^{-10}$	$3.0x10^{-8}$	$3.8x10^{-10}$	$2.3x10^{-8}$	$4.9x10^{-10}$	$9.7x10^{-8}$	$2.8x10^{-9}$	$2.9x10^{-9}$	$3.8x10^{-8}$	$1.8x10^{-5}$	$8.4x10^{-8}$	$4.3x10^{-6}$	$8.4x10^{-8}$	$2.8x10^{-6}$ to $6.1x10^{-6}$
Annual Population Dose Within 80 Kilometers[e]														
Atmospheric release pathway (person-rem)	$6.2x10^{-3}$	0.47	$1.4x10^{-4}$	$3.9x10^{-3}$	$9.7x10^{-4}$	2.4	$2.8x10^{-3}$	$3.1x10^{-3}$	0.048	29	0.044	41	0.14	0.44 to 11.2
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6	0	0.050 to 0.48
Atmospheric and liquid release pathways combined (person-rem)	$6.2x10^{-3}$	1.6	$1.4x10^{-4}$	$3.9x10^{-3}$	$9.7x10^{-4}$	2.4	$2.8x10^{-3}$	$3.1x10^{-3}$	0.048	34	0.044	44	0.14	0.49 to 11.7
Percent of natural background[c]	$3.3x10^{-6}$	$8.4x10^{-4}$	$1.5x10^{-6}$	$4.2x10^{-5}$	$1.1x10^{-6}$	$2.7x10^{-3}$	$2.4x10^{-6}$	$2.6x10^{-6}$	$1.3x10^{-5}$	$9.0x10^{-3}$	$1.7x10^{-5}$	0.017	$6.7x10^{-5}$	$2.3x10^{-4}$ to $5.6x10^{-3}$
17-year fatal cancers	$5.3x10^{-5}$	0.014	$1.2x10^{-6}$	$3.3x10^{-5}$	$8.3x10^{-6}$	0.020	$2.4x10^{-5}$	$2.6x10^{-5}$	$4.1x10^{-4}$	0.29	$3.7x10^{-4}$	0.37	$1.2x10^{-3}$	$4.1x10^{-3}$ to 0.095
11-year fatal cancers[d]	$3.4x10^{-5}$	$9.0x10^{-3}$	$7.8x10^{-7}$	$2.1x10^{-5}$	$5.4x10^{-6}$	0.013	$1.6x10^{-5}$	$1.7x10^{-5}$	$2.7x10^{-4}$	0.19	$2.4x10^{-4}$	0.24	$7.8x10^{-3}$	$2.7x10^{-3}$ to 0.061

Table 4.3.5.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel Fabrication Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site[a]	Facility	Total Site
Annual Dose to the Average Individual Within 80 Kilometers[f]														
Atmospheric and liquid release pathways combined (mrem)	1.0×10^{-5}	2.6×10^{-3}	4.8×10^{-6}	1.3×10^{-4}	3.6×10^{-6}	8.9×10^{-3}	8.0×10^{-6}	8.9×10^{-6}	3.7×10^{-5}	0.026	4.9×10^{-5}	0.049	2.1×10^{-4}	8.9×10^{-4} to 0.014
17-year fatal cancer risk	8.5×10^{-11}	2.2×10^{-8}	4.0×10^{-11}	1.1×10^{-9}	3.1×10^{-11}	7.6×10^{-8}	6.8×10^{-11}	7.5×10^{-11}	3.2×10^{-10}	2.2×10^{-7}	4.2×10^{-10}	4.2×10^{-7}	1.8×10^{-9}	7.6×10^{-9} to 1.2×10^{-7}
11-year fatal cancer risk[d]	5.5×10^{-11}	1.4×10^{-8}	2.6×10^{-11}	7.1×10^{-10}	2.0×10^{-11}	4.9×10^{-8}	4.4×10^{-11}	4.9×10^{-11}	2.1×10^{-10}	1.4×10^{-7}	2.7×10^{-10}	2.7×10^{-7}	1.2×10^{-9}	4.9×10^{-9} to 7.7×10^{-8}

[a] Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9 for the DOE sites and Section 3.10.9 for the generic site). The location of the MEI may be different under No Action than for operation of the MOX fuel fabrication facility. Therefore, the impacts may not be directly additive.

[b] The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR Part 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

[c] The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem, (7) Generic Site: the average individual receives a dose that could range from 281 to 311 mrem; the population within 80 km receives 155,000 to 251,000 person-rem.

[d] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[e] For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

[f] Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; 893,000 at SRS; and a range of 550,000 to 807,000 at the generic site).

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: Section M.2 for DOE sites. Refer to Section 3.10.9 for ranges associated with the generic site.

be 0.14 person-rem. The corresponding number of fatal cancers in this population from 17 years of operation would be 1.2×10^{-3}.

The doses to the MEI due to annual total site operations at the identified DOE sites are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The doses would range from 4.2×10^{-3} mrem at the NTS site to 3.2 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.6×10^{-8} to 2.8×10^{-5}. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 3.1×10^{-3} person-rem at the Pantex site to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.6×10^{-5} to 0.37. For the generic site, the doses to the maximally exposed member of the public from annual total site operations are within radiological limits and would range from 0.52 to 1.1 mrem. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 4.4×10^{-6} to 9.5×10^{-6}. As a result of annual total site operation, the population doses are within the proposed reporting limit and would range from 0.49 to 11.7 person-rem. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 4.1×10^{-3} to 0.095.

The radiological impacts to the public that are associated with the generic site are included in Table 4.3.5.1.9–1.

Doses to onsite workers from normal operations are given in Table 4.3.5.1.9–2. Included are involved workers directly associated with the MOX fuel fabrication facility, workers who are not involved with the MOX fuel fabrication facility and the entire workforce at each site. All doses fall within regulatory limits. Health effects are given for 11 and 17 years of facility operations.

The annual dose to MOX fuel fabrication facility workers is site-independent and would be 250 mrem to the average facility worker and 31 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at the ORR site to 159 mrem at the generic site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 34 person-rem at the NTS site to 281 person-rem at the Hanford site. The risks and numbers of fatal cancers among the different workers from 11 and 17 years of operations are included in Table 4.3.5.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these litigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the MOX fuel fabrication facility at several sites and a generic commercial site are presented in Table 4.3.5.1.9–3. Included are the impacts due to operation of the MOX fuel fabrication facility only, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation ranges from 4.9×10^{-6} at the NTS site to 1.9×10^{-4} at the Pantex, ORR, and generic sites. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released) at all sites. The HI to the onsite worker ranges from 8.0×10^{-4} at Pantex to 1.7×10^{-3} at the ORR and generic sites, and the cancer risk to the onsite worker is zero (because no carcinogens are released hazardous chemicals) at all sites.

Table 4.3.5.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic Site
Involved Workforce[a]							
Average worker dose (mrem/yr)[b]	250	250	250	250	250	250	250
17-year fatal cancer risk	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
11-year fatal cancer risk[c]	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
Total dose (person-rem/yr)	31	31	31	31	31	31	31
17-year fatal cancers	0.21	0.21	0.21	0.21	0.21	0.21	0.21
11-year fatal cancers[c]	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Noninvolved Workforce[d]							
Average worker dose (mrem/yr)[b]	27	5.0	30	10	2.6	32	33 to 159
17-year fatal cancer risk	1.8×10^{-4}	3.4×10^{-5}	2.0×10^{-4}	6.8×10^{-5}	1.8×10^{-5}	2.2×10^{-4}	2.2×10^{-4} to 1.1×10^{-3}
11-year fatal cancer risk[c]	1.2×10^{-4}	2.2×10^{-5}	1.3×10^{-4}	4.4×10^{-5}	1.2×10^{-5}	1.4×10^{-4}	1.4×10^{-4} to 7.1×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226	7.0 to 98
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5	0.048 to 0.67
11-year fatal cancers	1.1	0.013	0.97	0.061	0.19	0.97	0.031 to 0.43
Total Site Workforce[e]							
Dose (person-rem/yr)	281	34	251	45	75	257	38 to 129
17-year fatal cancers	1.9	0.23	1.7	0.31	0.51	1.7	0.26 to 0.88
11-year fatal cancers[c]	1.2	0.15	1.1	0.20	0.33	1.1	0.17 to 0.57

[a] The involved worker is a worker associated with operations of the proposed action.

[b] The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

[c] For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[d] The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

[e] The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: NRC 1995b; Section M.2.

Table 4.3.5.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
Receptor	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**	**Facility[a]**	**Total Site[b]**
Maximally Exposed Individual (Public)														
Hazard Index[c]	$3.3x10^{-5}$	$9.5x10^{-5}$	$4.9x10^{-6}$	$4.9x10^{-6}$	$7.1x10^{-5}$	0.015	$1.9x10^{-4}$	$5.8x10^{-3}$	$1.9x10^{-4}$	0.040	$9.0x10^{-6}$	$5.2x10^{-3}$	$1.9x10^{-4}$	$1.9x10^{-4}$
Cancer risk[d]	0	0	0	0	0	$3.6x10^{-6}$	0	$1.1x10^{-8}$	0	0	0	$1.3x10^{-7}$	0	0
Worker Onsite														
Hazard Index[e]	$1.6x10^{-3}$	$5.6x10^{-3}$	$8.2x10^{-4}$	$8.2x10^{-4}$	$1.6x10^{-3}$	0.22	$8.0x10^{-4}$	$6.9x10^{-3}$	$1.7x10^{-3}$	0.16	$1.4x10^{-3}$	1.2	$1.7x10^{-3}$	$1.7x10^{-3}$
Cancer risk[f]	0	0	0	0	0	$7.7x10^{-4}$	0	$4.5x10^{-7}$	0	0	0	$1.9x10^{-4}$	0	0

[a] Facility=Contribution from the proposed new facility operation only. For the generic site, the data from the DOE site with maximum emissions and exposure was chosen.

[b] Total=Includes the contributions from the No Action and the proposed new facility operation. For generic site, no hazardous chemical emission is assumed.

[c] Hazard Index for MEI=sum of individual Hazard Quotients (noncancerous health effects) for MEI.

[d] Cancer risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, therefore the calculated cancer risk value is 0.

[e] Hazard Index for workers=sum of individual Hazard Quotients (noncancerous health effects) for workers.

[f] Cancer risk for workers: (emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4–61 through M.3.4–67.

Facility Accidents. A set of potential accidents have been postulated for a MOX fuel fabrication facility for which there may be releases of radioactivity that may impact onsite workers and the offsite population.

The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 for Hanford, NTS, Pantex, ORR, INEL, and SRS. For a generic site, the accident impacts and risk at DOE sites are presented in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 and would be representative of a generic site due to the range of meteorological conditions and population densities across the analyzed DOE sites. In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 2.3 at ORR for the beyond design basis explosion accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 17-year facility lifetime risk form the same accident scenario for the population, maximum offsite individual, and worker at 801 m (2,630 ft), would be 3.9×10^{-6}, 2.3×10^{-8}, and 1.8×10^{-8}, respectively. The maximum population 17-year facility lifetime risk would be 3.2×10^{-4} (that is, one fatality in over 50,000 years) at ORR for the design basis fire accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 17-year facility lifetime risks would be 1.6×10^{-6} and 1.3×10^{-6}, respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9. [Text deleted.] The 17-year facility lifetime risks would range from 4.4×10^{-7} to 1.3×10^{-6} for noninvolved workers, 1.1×10^{-8} to 1.6×10^{-6} for the maximally exposed individual, and 1.8×10^{-6} to 3.2×10^{-4} for the population within 80 km, respectively. The disposition of approximately 70 percent of the surplus Pu using MOX-fueled existing LWRs would decrease the operational campaign length. As a result, the impacts for 50 t (55.1 tons) for the assumed 17-year existing LWR campaign would be proportionately reduced.

[Text deleted.]

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a MOX fuel fabrication facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal injuries.

Table 4.3.5.1.9–4. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Hanford Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	$1.1x10^{-6}$ ($7.1x10^{-7}$)	$1.3x10^{-4}$	$4.4x10^{-8}$ ($2.9x10^{-8}$)	$5.1x10^{-6}$	$8.1x10^{-5}$ ($5.3x10^{-5}$)	$9.3x10^{-3}$	$5.0x10^{-4}$
Fire in a process cell	$1.3x10^{-12}$ ($8.4x10^{-13}$)	$7.6x10^{-10}$	$5.2x10^{-14}$ ($3.4x10^{-14}$)	$3.0x10^{-11}$	$9.6x10^{-11}$ ($6.2x10^{-11}$)	$5.5x10^{-8}$	$1.0x10^{-4}$
Impact-induced spill	$2.1x10^{-16}$ ($1.4x10^{-16}$)	$2.7x10^{-13}$	$8.1x10^{-17}$ ($5.3x10^{-17}$)	$1.1x10^{-14}$	$1.5x10^{-14}$ ($9.7x10^{-15}$)	$1.9x10^{-11}$	$4.5x10^{-5}$
Deflagration inside a glovebox	$2.7x10^{-10}$ ($1.7x10^{-10}$)	$1.6x10^{-7}$	$1.1x10^{-11}$ ($7.1x10^{-12}$)	$6.4x10^{-9}$	$2.0x10^{-8}$ ($1.3x10^{-8}$)	$1.2x10^{-5}$	$1.0x10^{-4}$
Nuclear criticality	$3.5x10^{-13}$ ($2.3x10^{-13}$)	$2.1x10^{-7}$	$1.4x10^{-14}$ ($9.1x10^{-15}$)	$8.4x10^{-9}$	$2.9x10^{-12}$ ($1.9x10^{-12}$)	$1.7x10^{-6}$	$1.0x10^{-7}$
Beyond evaluation basis fire in a process cell	$8.9x10^{-12}$ ($5.8x10^{-12}$)	$5.4x10^{-6}$	$3.7x10^{-13}$ ($2.4x10^{-13}$)	$2.2x10^{-7}$	$6.7x10^{-10}$ ($4.3x10^{-10}$)	$3.9x10^{-4}$	$1.0x10^{-7}$
Oxyacetylene explosion in a process cell	$1.6x10^{-8}$ ($1.0x10^{-8}$)	$9.4x10^{-3}$	$5.4x10^{-10}$ ($3.5x10^{-10}$)	$1.7x10^{-4}$	$9.6x10^{-7}$ ($6.2x10^{-7}$)	0.58	$1.0x10^{-7}$
Beyond evaluation basis earthquake	$7.0x10^{-9}$ ($4.5x10^{-9}$)	$4.1x10^{-3}$	$2.7x10^{-10}$ ($1.7x10^{-10}$)	$1.6x10^{-4}$	$4.9x10^{-7}$ ($3.2x10^{-7}$)	0.29	$1.0x10^{-7}$
Expected risk[d]	$1.1x10^{-6}$ ($7.1x10^{-7}$)	-	$4.4x10^{-8}$ ($2.9x10^{-8}$)	-	$8.1x10^{-5}$ ($5.3x10^{-5}$)	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–5. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Nevada Test Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	7.4×10^{-7} (4.8×10^{-7})	8.7×10^{-5}	1.7×10^{-8} (1.1×10^{-8})	2.0×10^{-6}	1.8×10^{-6} (1.2×10^{-6})	2.1×10^{-4}	5.0×10^{-4}
Fire in a process cell	8.9×10^{-13} (5.8×10^{-13})	5.2×10^{-10}	2.1×10^{-14} (1.4×10^{-14})	1.2×10^{-11}	2.1×10^{-12} (1.4×10^{-12})	1.3×10^{-9}	1.0×10^{-4}
Impact-induced spill	1.4×10^{-16} (9.1×10^{-17})	1.9×10^{-13}	3.3×10^{-18} (2.1×10^{-18})	4.3×10^{-15}	3.4×10^{-16} (2.2×10^{-16})	4.5×10^{-13}	4.5×10^{-5}
Deflagration inside a glovebox	1.8×10^{-10} (1.2×10^{-10})	1.1×10^{-7}	4.3×10^{-12} (2.8×10^{-12})	2.5×10^{-9}	4.4×10^{-10} (2.9×10^{-10})	2.6×10^{-7}	1.0×10^{-4}
Nuclear criticality	2.7×10^{-13} (1.7×10^{-13})	1.5×10^{-7}	5.5×10^{-15} (3.6×10^{-15})	3.3×10^{-9}	5.6×10^{-14} (3.6×10^{-14})	3.3×10^{-8}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	6.3×10^{-12} (4.1×10^{-12})	3.7×10^{-6}	1.5×10^{-13} (9.8×10^{-14})	8.6×10^{-8}	1.5×10^{-11} (9.7×10^{-12})	8.9×10^{-6}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.0×10^{-8} (6.5×10^{-9})	6.3×10^{-3}	2.1×10^{-10} (1.4×10^{-10})	1.3×10^{-4}	2.2×10^{-8} (1.4×10^{-8})	0.013	1.0×10^{-7}
Beyond evaluation basis earthquake	4.6×10^{-9} (3.0×10^{-9})	2.7×10^{-3}	1.0×10^{-10} (6.5×10^{-11})	6.3×10^{-5}	1.1×10^{-8} (7.1×10^{-9})	6.5×10^{-3}	1.0×10^{-7}
Expected risk[d]	7.4×10^{-7} (4.8×10^{-7})	-	1.8×10^{-8} (1.2×10^{-8})	-	1.8×10^{-6} (1.2×10^{-6})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–6. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Idaho National Engineering Laboratory

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	1.0×10^{-6} (6.5×10^{-7})	1.2×10^{-4}	1.1×10^{-8} (7.1×10^{-9})	1.3×10^{-6}	2.4×10^{-5} (1.6×10^{-5})	2.8×10^{-3}	5.0×10^{-4}
Fire in a process cell	1.2×10^{-12} (7.8×10^{-13})	7.1×10^{-10}	1.3×10^{-14} (8.4×10^{-15})	7.7×10^{-12}	2.8×10^{-11} (1.8×10^{-11})	1.7×10^{-8}	1.0×10^{-4}
Impact-induced spill	1.9×10^{-16} (1.2×10^{-16})	2.5×10^{-13}	2.1×10^{-8} (1.4×10^{-8})	2.7×10^{-15}	4.5×10^{-15} (2.9×10^{-15})	5.9×10^{-12}	4.5×10^{-5}
Deflagration inside a glovebox	2.5×10^{-10} (1.6×10^{-10})	1.5×10^{-7}	2.7×10^{-12} (1.7×10^{-12})	1.6×10^{-9}	5.9×10^{-9} (3.8×10^{-9})	3.5×10^{-6}	1.0×10^{-4}
Nuclear criticality	3.4×10^{-13} (2.2×10^{-13})	2.0×10^{-7}	3.3×10^{-15} (2.1×10^{-15})	1.9×10^{-9}	7.2×10^{-13} (4.7×10^{-13})	4.3×10^{-7}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	8.9×10^{-11} (5.8×10^{-11})	5.1×10^{-6}	9.6×10^{-14} (6.2×10^{-14})	5.5×10^{-8}	2.0×10^{-10} (1.3×10^{-10})	1.2×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.6×10^{-8} (1.0×10^{-8})	9.2×10^{-3}	1.3×10^{-10} (8.4×10^{-11})	8.0×10^{-5}	3.0×10^{-7} (1.9×10^{-7})	0.17	1.0×10^{-7}
Beyond evaluation basis earthquake	6.3×10^{-9} (4.1×10^{-9})	3.7×10^{-3}	6.8×10^{-11} (4.4×10^{-11})	4.0×10^{-5}	1.5×10^{-7} (9.7×10^{-8})	0.086	1.0×10^{-7}
Expected risk[d]	1.0×10^{-6} (6.5×10^{-7})	-	1.1×10^{-8} (7.1×10^{-9})	-	2.4×10^{-5} (1.6×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–7. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Pantex Plant

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	4.4×10^{-7} (2.9×10^{-7})	5.1×10^{-5}	1.7×10^{-7} (1.1×10^{-7})	2.0×10^{-5}	2.7×10^{-5} (1.7×10^{-5})	3.2×10^{-3}	5.0×10^{-4}
Fire in a process cell	5.2×10^{-13} (3.4×10^{-13})	3.1×10^{-10}	1.8×10^{-13} (1.8×10^{-13})	1.2×10^{-10}	3.2×10^{-11} (2.1×10^{-11})	1.9×10^{-8}	1.0×10^{-4}
Impact-induced spill	8.1×10^{-17} (5.3×10^{-17})	1.1×10^{-13}	3.3×10^{-17} (2.1×10^{-17})	4.3×10^{-14}	5.1×10^{-15} (3.3×10^{-15})	6.7×10^{-12}	4.5×10^{-5}
Deflagration inside a glovebox	1.1×10^{-10} (7.1×10^{-11})	6.4×10^{-8}	4.4×10^{-11} (2.9×10^{-11})	2.6×10^{-8}	6.7×10^{-9} (4.3×10^{-9})	3.9×10^{-6}	1.0×10^{-4}
Nuclear criticality	1.6×10^{-13} (1.0×10^{-13})	9.7×10^{-8}	8.1×10^{-14} (5.3×10^{-14})	4.6×10^{-8}	1.9×10^{-12} (1.2×10^{-12})	1.1×10^{-6}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	3.7×10^{-12} (2.4×10^{-12})	2.2×10^{-6}	1.5×10^{-12} (9.7×10^{-13})	8.7×10^{-7}	2.3×10^{-10} (1.5×10^{-10})	1.3×10^{-4}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	5.6×10^{-9} (3.6×10^{-9})	3.3×10^{-3}	2.1×10^{-9} (1.4×10^{-9})	1.3×10^{-3}	3.3×10^{-7} (2.1×10^{-7})	0.20	1.0×10^{-7}
Beyond evaluation basis earthquake	2.7×10^{-9} (1.7×10^{-9})	1.6×10^{-3}	1.1×10^{-9} (7.1×10^{-10})	6.4×10^{-4}	1.6×10^{-7} (1.0×10^{-7})	0.098	1.0×10^{-7}
Expected risk[d]	4.4×10^{-7} (2.9×10^{-7})	-	1.8×10^{-7} (1.2×10^{-7})	-	2.7×10^{-5} (1.7×10^{-5})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–8. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Oak Ridge Reservation

	Worker at 801 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	1.3×10^{-6} (8.4×10^{-7})	1.4×10^{-4}	1.6×10^{-6} (1.0×10^{-6})	1.8×10^{-4}	3.2×10^{-4} (2.1×10^{-4})	0.037	5.0×10^{-4}
Fire in a process cell	1.5×10^{-12} (9.7×10^{-13})	8.7×10^{-10}	1.8×10^{-12} (1.2×10^{-12})	1.1×10^{-9}	3.8×10^{-10} (2.5×10^{-10})	2.2×10^{-7}	1.0×10^{-4}
Impact-induced spill	2.4×10^{-16} (1.6×10^{-16})	3.1×10^{-13}	3.0×10^{-16} (1.9×10^{-16})	3.8×10^{-13}	6.0×10^{-14} (3.9×10^{-14})	7.9×10^{-11}	4.5×10^{-5}
Deflagration inside a glovebox	3.1×10^{-10} (2.0×10^{-10})	1.8×10^{-7}	3.8×10^{-10} (2.5×10^{-10})	2.3×10^{-7}	8.1×10^{-8} (5.3×10^{-8})	4.6×10^{-5}	1.0×10^{-4}
Nuclear criticality	3.9×10^{-10} (2.5×10^{-10})	2.3×10^{-7}	4.9×10^{-13} (3.2×10^{-13})	2.9×10^{-7}	3.4×10^{-11} (2.2×10^{-11})	2.0×10^{-5}	1.0×10^{-7}
Beyond evaluation basis fire in a process cell	1.0×10^{-11} (6.5×10^{-12})	6.2×10^{-6}	1.3×10^{-11} (8.4×10^{-12})	7.7×10^{-6}	2.7×10^{-9} (1.7×10^{-9})	1.6×10^{-3}	1.0×10^{-7}
Oxyacetylene explosion in a process cell	1.8×10^{-8} (1.2×10^{-8})	0.011	2.3×10^{-8} (1.5×10^{-8})	0.013	3.9×10^{-6} (2.5×10^{-6})	2.3	1.0×10^{-7}
Beyond evaluation basis earthquake	7.4×10^{-9} (4.8×10^{-9})	4.5×10^{-3}	9.6×10^{-9} (6.2×10^{-9})	5.6×10^{-3}	1.9×10^{-6} (1.2×10^{-6})	1.2	1.0×10^{-7}
Expected risk[d]	1.3×10^{-6} (8.4×10^{-7})	-	1.6×10^{-6} (1.0×10^{-6})	-	3.2×10^{-4} (2.1×10^{-4})	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 801 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [801 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1–5 and the MACCS computer code.

Table 4.3.5.1.9–9. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
Accident Description	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatality per 17 yr (per 11 yr)[a]**	**Probability of Cancer Fatality[b]**	**Risk of Cancer Fatalities per 17 yr (per 11 yr)[a]**	**Number of Cancer Fatalities[c]**	**Accident Frequency (per yr)**
Fire on the loading dock	$7.1x10^{-7}$ ($4.6x10^{-7}$)	$8.4x10^{-5}$	$2.5x10^{-8}$ ($1.6x10^{-8}$)	$2.9x10^{-6}$	$8.1x10^{-5}$ ($5.3x10^{-5}$)	$9.9x10^{-3}$	$5.0x10^{-4}$
Fire in a process cell	$8.9x10^{-13}$ ($5.8x10^{-13}$)	$5.0x10^{-10}$	$3.0x10^{-14}$ ($1.9x10^{-14}$)	$1.8x10^{-11}$	$1.0x10^{-10}$ ($6.5x10^{-11}$)	$5.9x10^{-8}$	$1.0x10^{-4}$
Impact-induced spill	$1.3x10^{-16}$ ($8.4x10^{-17}$)	$1.8x10^{-13}$	$4.7x10^{-18}$ ($3.0x10^{-18}$)	$6.2x10^{-15}$	$1.6x10^{-14}$ ($1.0x10^{-14}$)	$2.1x10^{-11}$	$4.5x10^{-5}$
Deflagration inside a glovebox	$1.8x10^{-10}$ ($1.8x10^{-10}$)	$1.0x10^{-7}$	$6.2x10^{-12}$ ($4.0x10^{-12}$)	$3.7x10^{-9}$	$2.1x10^{-8}$ ($1.4x10^{-8}$)	$1.2x10^{-5}$	$1.0x10^{-4}$
Nuclear criticality	$2.4x10^{-13}$ ($1.5x10^{-13}$)	$1.4x10^{-7}$	$7.4x10^{-15}$ ($4.8x10^{-15}$)	$4.5x10^{-9}$	$3.8x10^{-12}$ ($2.5x10^{-12}$)	$2.3x10^{-6}$	$1.0x10^{-7}$
Beyond evaluation basis fire in a process cell	$6.1x10^{-12}$ ($4.0x10^{-12}$)	$3.6x10^{-6}$	$2.1x10^{-13}$ ($1.4x10^{-13}$)	$1.2x10^{-7}$	$7.2x10^{-10}$ ($4.7x10^{-10}$)	$4.2x10^{-4}$	$1.0x10^{-7}$
Oxyacetylene explosion in a process cell	$9.6x10^{-9}$ ($6.2x10^{-9}$)	$5.8x10^{-3}$	$3.1x10^{-10}$ ($2.0x10^{-10}$)	$1.8x10^{-4}$	$1.0x10^{-6}$ ($6.5x10^{-7}$)	0.62	$1.0x10^{-7}$
Beyond evaluation basis earthquake	$4.7x10^{-9}$ ($3.0x10^{-9}$)	$2.8x10^{-3}$	$1.6x10^{-10}$ ($1.0x10^{-10}$)	$9.1x10^{-5}$	$5.2x10^{-7}$ ($3.4x10^{-7}$)	0.31	$1.0x10^{-7}$
Expected risk[d]	$7.2x10^{-7}$ ($4.7x10^{-7}$)	-	$2.5x10^{-8}$ ($1.6x10^{-8}$)	-	$8.9x10^{-5}$ ($5.8x10^{-5}$)	-	-

[a] The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual)) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

[d] Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1–4 and M.5.3.2.1-5 and the MACCS computer code.

4.3.5.1.10 *Waste Management*

This section summarizes the impacts for the construction and operation of a MOX fuel fabrication facility. There is no spent nuclear fuel or HLW associated with a MOX fuel fabrication facility. Table 4.3.5.1.10–1 provides the estimated operational waste volumes projected to be generated at the DOE sites analyzed and a generic site as a result of the MOX fuel fabrication facility. Facilities that would support the MOX fuel fabrication facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes at DOE sites could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed on in accordance with current site practice. The projected incremental waste volumes generated from a MOX fuel fabrication facility and the resultant waste effluent that was used for the waste impact analysis can be found in Section E.3.2.3. A detailed description of the waste management activities that would be required to support the MOX fuel fabrication facility can also be found in Section E.3.2.3.

Construction and operation of a MOX fuel fabrication facility would impact existing waste management activities at each of the DOE sites analyzed and a generic commercial site, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and liquid hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Transuranic and mixed TRU wastes would be generated from Pu oxide purification, fuel fabrication, and material recycle. Following treatment and volume reduction, approximately 306 m^3 (400 yd^3) of TRU and 4 m^3 (5 yd^3) mixed TRU wastes consisting of filters, resins, job control waste, process equipment, and sweepings would require treatment and packaging to meet the current planning-basis WIPP WAC. This waste would be treated and packaged in a facility constructed with the MOX plant at ORR, NTS, Pantex, and the commercial MOX facility, or in an expanded central facility at the Hanford, INEL, or SRS sites. This waste would also require storage facilities where it could be staged until it would be shipped to WIPP or an alternate facility for disposal. To transport TRU waste to WIPP or an alternate facility, 36 additional truck shipments per year or, if applicable, 18 regular train shipments or 6 dedicated train shipments per year would be required.

All the sites analyzed have facilities to handle LLW. The approximately 153 m^3 (200 yd^3) of LLW generated in materials purification, uranium and Pu oxide processing and preparation, and rod pressing and processing would consist of contaminated job control waste, filters, and process equipment. This waste quantity is small in comparison to the No Action waste volumes disposed of at Hanford, INEL, NTS, ORR, and SRS. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.05 ha/yr (0.1 acre/yr) at Hanford and ORR, 0.03 ha/yr (0.06 acre/yr) at INEL and NTS, and 0.02 ha/yr (0.04 acre/yr) at SRS. Pantex and the generic commercial MOX facility would require nine LLW shipments per year to NTS or a commercial disposal facility, respectively. A commercial LLW disposal facility would require approximately 0.01 ha/yr (0.02 acre/yr) to dispose of this waste. For DOE sites, the ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Less than 1 m^3 (200 gal) of liquid and 38 m^3 (50 yd^3) of solid mixed LLW is estimated to be generated in the MOX fuel fabrication facility. Mixed LLW would consist of radioactively-contaminated solvents, lead, and scintillation vials. All the sites analyzed have the capacity to treat mixed LLW. [Text deleted.] Mixed LLW

Table 4.3.5.1.10–1. Estimated Annual Generated Waste Volumes for the Mixed Oxide Fuel Fabrication Facility[a]

Category	New Facility (m³)	Hanford No Action (m³)	NTS No Action (m³)	INEL No Action (m³)	Pantex No Action (m³)	ORR No Action (m³)	SRS No Action (m³)	Generic Site No Action (m³)
Transuranic								
Liquid	0	None	None	None	None	None	None	None
Solid	306	271	None	3.5	None	119	338	None
Mixed Transuranic								
Liquid	0	None	None	None	None	None	None	None
Solid	4	98	None	Included in TRU	None	None	Included in TRU	None
Low-Level								
Liquid	4[b]	None	Dependent on restoration activities	None	8	2,970	74,000	4
Solid	153	3,390	15,000	7,200	32	7,320	16,400	41
Mixed Low-Level								
Liquid	0.8	3,760	None	4	4	87,600	1,330	0.8
Solid	38	1,505	50	170	46	432	7,700	2
Hazardous								
Liquid	4	Included in solid	Included in solid	Included in solid	2	6,460	1,260	4
Solid	153	560	212	1,200	31	26	15,100	153
Nonhazardous (Sanitary)								
Liquid	43,300	414,000	Not reported separately; included in solid	Not reported separately; included in solid	141,000	550,000	703,000	6,910
Solid	76	5,107	2,120	52,000	339	53,100	61,200	246
Nonhazardous (Other)								
Liquid	227	Included in sanitary	None	None	Included in sanitary	650,000	Included in sanitary	264
Solid	84[c]	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary	84[c]

[a] The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1, and Section 3.10.10. Incremental waste generation volumes for MOX Fuel Fabrication facility are from Table E.3.2.3–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.2.3–1.

[b] Liquid LLW would be treated and solidified prior to disposal.

[c] Includes recyclable wastes.

would be managed in accordance with the Tri-Party Agreement for Hanford, and the respective site treatment plans that were developed to comply with the *Federal Facility Compliance Act* for the remainder of the DOE sites. Mixed LLW would be managed in accordance with the NRC license conditions and other applicable requirements for the generic commercial site.

Approximately 4 m^3 (1,000 gal) of liquid and 153 m^3 (200 yd^3) of solid hazardous waste would be generated in the MOX fuel fabrication facility from the use of chemical and organic lubricants, coolants, solvents, and paints. Accommodation in existing facilities is feasible at Hanford, INEL, and ORR, though expansion may be required. Additional RCRA-permitted staging facilities would be required at NTS, Pantex, SRS, and the generic facility, where the hazardous waste would be stored pending onsite or offsite treatment at a RCRA-permitted facility.

Approximately 43,500 m^3 (11.5 million gal) of liquid nonhazardous sanitary, industrial, and other wastewater would require treatment in accordance with site practice and discharge permits. This waste would require a separate treatment facility at Hanford, INEL, and NTS, since these sites do not have centralized nonhazardous wastewater treatment facilities. At ORR, Pantex, and SRS, the plant or central wastewater facilities have the capacity to accommodate this increased flow. The generic MOX fuel fabrication facility may require expansion of the wastewater treatment facilities to handle this flow, or it may be possible to accommodate the increase in a public treatment facility. The approximately 76 m^3 (100 yd^3) of solid sanitary and industrial nonhazardous waste, and 84 m^3 (110 yd^3) of other nonhazardous waste generated by the MOX fuel fabrication facility is a small fraction of the solid nonhazardous wastes normally handled at any of the sites analyzed for this action, and would be recycled or shipped to onsite or offsite disposal facilities in accordance with site-specific practice.

4.3.5.2 Existing Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the existing LWR facility for the Existing LWR Alternative described in Section 2.4.5.2. This alternative would require the operation of a minimum of three LWRs, which could be located at the same or different sites. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, three to five existing LWRs could be selected to disposition the surplus Pu. As a results of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus would be used as MOX fuel in existing LWRs. As many as five sites with one reactor each or as few as one site with three reactors could be used for Pu disposition. If there are multiple reactors at a site, the impacts in the Sections 4.3.5.2.1 through 4.3.5.2.10 would be approximately doubled for two reactors or tripled for three reactors.

4.3.5.2.1 *Land Resources*

Land Use. No additional direct impacts to land use would occur from operations. As discussed in Section 4.3.5.2.2, a small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle MOX fuel. If required, this addition would be a minor change to the plant profile and would be anticipated to utilize land area previously disturbed. Therefore, any new construction would be inconsequential. Additional land area would not be required for a buffer zone and there would be no change in land use. Site development would be in conformance with site development/facility utilization plans as well as land-use plans, policies, and controls at the Federal, State, and local levels.

The use of MOX fuel in an existing LWR would not affect the use of other onsite lands (for example, buffer/undeveloped land areas would not be encroached upon). Site land use would be compatible with offsite land uses, including the use of special status land. Prime farmland would also not be affected. As discussed in Section 4.3.5.2.8, no in-migration of workers would occur during operations. Therefore, no indirect impacts to offsite lands would occur.

Visual Resources. No additional impacts to visual resources would occur from operations. Current VRM classification of the developed area of the site would be maintained and would likely be a Class 5. Facility operations, such as stack plumes, could continue to be visible from lands with high sensitivity levels, such as public roadways, urbanized areas, and recreational/scenic areas. However, this would not represent a change (that is, increase in magnitude or extent) from the existing condition.

4.3.5.2.2 *Site Infrastructure*

The existing LWR site infrastructure would remain essentially unchanged from the conditions described in Section 3.11.2 (see Table 4.3.5.2.2–1). A small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle the MOX fuel. However, because this is only a minor change to the plant profile, existing LWR site infrastructure would not be impacted by the change to MOX fuel. The site is served with water and an existing power distribution system that would adequately support the power demands of plant equipment and employee facilities.

Table 4.3.5.2.2–1. Additional Site Infrastructure Needed for the Operation of One Existing Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)	Coal (t/yr)
Facility Requirement	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Range of resource availability[a]	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Amount required in excess of low-end range of available resources	0	0	0	0	0	0	0

[a] The existing site infrastructure would remain essentially unchanged.

Source: ORNL 1995b.