Appendix F
Impact Assessment Methods

This appendix briefly describes the methods used to evaluate the potential direct, indirect, and cumulative effects of the alternatives for surplus plutonium disposition. The same methodologies were also applied to the assessment of impacts at each of the proposed lead assembly and postirradiation examination sites. Included are impact assessment methods for air quality and noise, geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, infrastructure, waste management, socioeconomics, human health risk and hazardous chemicals, facility accidents, transportation, environmental justice, and cumulative impacts. Each section is organized so that first the affected resource is described and then the impact assessment method is presented. Detailed descriptions of the methods for facility accident and transportation impact analyses are presented as Appendixes K and L, respectively.

Although impacts were generally described as either major or minor, this assignment was made in different ways, depending on the resource. For air quality, for example, estimated pollutant emissions from the proposed surplus plutonium disposition facilities were compared with the appropriate regulatory standards or guidelines. For human health risk, estimated radionuclide exposure to humans from the proposed facilities were compared with applicable dose limits. Comparison with regulatory standards is a commonly used method for benchmarking environmental impact and is done here to provide perspective on the magnitude of identified impacts.

Other indicators of impact were also established to focus the analysis on impacts that could be major. The analysis of waste management impacts, for example, focused on alternatives where additional waste generation would be a large percentage of current site waste generation, although a major impact was suggested only where waste generation would exceed the capacity of existing waste management facilities. Cumulative impacts were also evaluated with a view to ensuring that actions with minor impacts individually could not have major impacts collectively.

Impacts in all resource areas were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, efforts were made to ensure that calculations in all areas used accepted protocols and up-to-date models. Finally, like presentations were developed to facilitate the comparison of alternatives.

The impact assessment methods used to evaluate the effects of irradiating mixed oxide (MOX) fuel at the proposed domestic, commercial reactor sites (see Section 4.28) are generally the same as those applied to assess the impacts of the surplus plutonium disposition alternatives at each of the candidate U.S. Department of Energy (DOE) sites. Where there is a difference in the impact assessment method, the nature of the deviation and a discussion of the impact assessment methods used for the reactor sites are provided. Otherwise, if no specific exception is noted, the impact assessment methods applied to the candidate DOE sites were also applied to the proposed reactor sites.

F.1 AIR QUALITY AND NOISE

F.1.1 Description of Affected Resources

F.1.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. For purposes of the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), only outdoor air pollutants were addressed. They may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents, which may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and State agencies, allowing an adequate margin of safety for protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards, acceptable.

The pollutants of concern are primarily those for which Federal and State ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in 40 CFR 50, *National Primary and Secondary Ambient Air Quality Standards* (EPA 1997a). Hazardous air pollutants and other toxic compounds are those listed in Title I of the 1990 Clean Air Act (CAA) as amended, those regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAPs), and those that have been proposed or adopted for regulation by the respective State or are listed in State guidelines. Also of concern are air pollutant emissions that may contribute to the depletion of stratospheric ozone or global warming. Construction activities, particularly those that involve modification of existing facilities, may be subject to certain NESHAPs requirements, for example, the reporting, training, and work practice requirements for asbestos renovation (EPA 1997b). Provisions of other NESHAPs requirements, such as those for benzene (EPA 1997c), would likely not apply because the amounts stored and used for construction and operation of these facilities would be small. Provisions of NESHAPs for radionuclides are discussed in Chapter 5 and Appendix F.10.

Areas with air quality better than the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants are designated as being in attainment; areas with air quality worse than the NAAQS for such pollutants, as nonattainment areas. Areas may be designated as unclassified when sufficient data for attainment status designation are lacking. Attainment status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof. Air Quality Control Regions designated by the U.S. Environmental Protection Agency (EPA) are listed in 40 CFR 81, *Designation of Areas for Air Quality Planning Purposes*.

For locations that are in an attainment area for criteria air pollutants, prevention of significant deterioration (PSD) regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Three PSD classifications are specified with the criteria established in the CAA amendments. Class I areas include national wilderness areas, memorial parks larger than 2,020 ha (5,000 acres), and national parks larger than 2,430 ha (6,000 acres), and areas that have been redesignated as Class I. Class II areas are all areas not designated as Class I. No Class III areas have been designated.

Designation as a nonattainment area for criteria air pollutants triggers control requirements designated to achieve attainment status by specified dates. In addition, facilities that constitute major new emission sources cannot be constructed in a nonattainment area without permits that impose stringent pollution control requirements to ensure progress toward compliance.

The region of influence (ROI) for air quality is that area around a site potentially affected by air pollutant emissions caused by the surplus plutonium disposition alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria air pollutants would increase more than a significant amount in a Class II area. Significance varies according to the averaging period: 2,000 $\mu g/m^3$ for 1 hr for carbon monoxide; 25 μg/m^3 for 3 hr for sulfur dioxide; 5 μg/m^3 for 24 hr for sulfur dioxide and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}); and 1 μg/m^3 annually for sulfur dioxide, PM_{10}, and nitrogen dioxide (EPA 1997d). Generally, this covers a few kilometers downwind from the source. For sources within 100 km (62 mi) of a Class I area, the air quality impact area evaluated would include the Class I area if the average 24-hr increase in concentration were greater than 1μg/m^3. The size of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For purposes of this analysis, where most of the sites are large, impacts were evaluated at the site boundary, along roads within the sites to which the public has access, and anywhere else the contributions to pollutant concentrations could exceed the established significance levels.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each site and background air pollutant concentrations measured near the sites. For this analysis, concentrations for existing sources were obtained from existing source documents or by modeling recent emissions data. Data from the *Storage and Disposition PEIS* (DOE 1996a) were incorporated where appropriate.

The maximum concentrations of toxic air pollutants at or beyond the site boundary were compared with Federal and State regulations or limits. To determine human health risk (see Appendix F.10), modeling outputs on chemical concentrations in air were weighed against chemical-specific toxicity values. Emissions of radionuclides to the air (see Appendix F.10) were evaluated in terms of a total dosage standard.

F.1.1.2 Noise

Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

Sound-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Sound levels are expressed in decibels, or in the case of A-weighted measurements, decibels A-weighted. The EPA has developed noise-level guidelines for different land-use classifications. Some States and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category.

Noise from facility operations and associated traffic could affect human and animal populations. Because most nontraffic noise associated with construction and operation of the proposed facilities would be distant from offsite noise-sensitive receptors, the contribution to offsite noise levels should be small. Impacts associated with transportation access routes, including noise from increased traffic, could result in small increases in noise along these routes. The ROI for each of the sites includes the site and surrounding areas, including transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Sound-level data representative of site environs were obtained from existing reports and from calculations of the sound levels typical of prevailing traffic volumes along the transportation corridors. The acoustic environment was further described in terms of existing noise sources for each site.

F.1.2 Description of Impact Assessment

F.1.2.1 Air Quality

Potential air quality impacts of pollutant emissions from construction and normal operations were evaluated for each alternative (see Table F–1). That assessment included a comparison of effects of each alternative with applicable Federal and State ambient air quality standards and concentration limits. The more stringent standards, EPA or State, served as the assessment criteria. Criteria for hazardous and toxic air pollutants include those listed in Title III of the 1990 CAA Amendments, NESHAPs, and standards and guidelines adopted by the respective states. The State ambient standards are the same as or more stringent than the Federal ambient standards. The Federal primary ambient standards define levels of air quality that EPA "judges are necessary with an adequate margin of safety, to protect the public health" (EPA 1997a). The Federal secondary ambient standards define levels of air quality that EPA "judges are necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant" (EPA 1997a). The surplus plutonium disposition incremental change in concentrations of pollutants was compared with the PSD Class II allowable increments. Impacts on Class I PSD areas were evaluated where there was a Class I area within 100 km (62 mi) of the site.

Operational air pollutant emissions data for each alternative (other than No Action) were based on engineering design reports; construction emissions data for each alternative, on engineering design reports, emission factors for construction equipment listed in *Compilation of Air Pollutant Emission Factors: Mobile Sources* (EPA 1991:vol. II, 7-1–7-7), and emission factors for fugitive dust from construction listed in *Compilation of Air Pollutant Emission Factors* (EPA 1996a:13.2-1; 13.2-2; 13.2.2-1–13.2.2-8; 13.2.3-1–13.2.3-7; 13.2.4-1–13.2.4-9; 13.2.5-1–13.2.5-21). Traffic emissions were estimated using EPA's MOBILE5b and PART 5 emissions calculation models.

For each alternative, contributions to offsite air pollutant concentrations were modeled on the basis of guidance presented in the *Guideline on Air Quality Models* (EPA 1997e). The EPA-recommended Industrial Source Complex Model, Version 3 (ISC3), was selected as the most appropriate model to perform the air dispersion modeling, because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources and source types. The short-term version of ISC3, ISCST3, was used to calculate concentrations with averaging times of 1 to 24 hours and annual average concentrations. Concentrations for the No Action Alternative were based on information provided in the *Storage and Disposition PEIS* (DOE 1996a).

For each reactor site proposed for irradiation of MOX fuel, the contributions to offsite air pollutant concentrations were modeled using the EPA long-term version of the ISC3 model, ISCLT3, for annual average concentrations, and the SCREEN3 model, for short-term average concentrations. Emissions were based on information provided by Duke Engineering and Services, COGEMA Inc., and Stone and Webster as summarized in the *MOX Fuel Fabrication Facility and Nuclear Power Reactor Data Report* (DOE 1999).

The modeling analysis incorporated conservative assumptions, which tend to overestimate the pollutant concentrations. The "highest-high" concentration for each pollutant and averaging time was selected for comparison with the applicable assessment criterion, instead of the less conservative EPA-recommended "highest-high" and "highest second-highest" concentration for long-term and short-term averaging times, respectively. The concentrations evaluated were the maximum occurring at or beyond the site boundary or a public access road, and included the contribution of the alternative and that of existing onsite sources. Available monitoring data, which reflect both onsite and offsite sources, were also taken into consideration. Concentrations of the criteria air pollutants, hazardous air pollutants, and toxic air compounds were presented for each alternative. Construction equipment activity emissions were evaluated as a volume source for each

Table F–1. Impact Assessment Protocol for Air Quality and Noise

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Air quality			
Criteria air pollutants and other regulated pollutants[a]	Ambient concentration (μg/m^3) of air pollutants, and concentrations of pollutants from existing sources at site	Emission (kg/yr) of air pollutants from facility and facility construction or modification; source characteristics (e.g., stack height and diameter, exit temperature and velocity); shipments and workforce estimates	Contribution of proposed alternative to concentrations of each pollutant at or beyond site boundary; total concentration of each pollutant at or beyond site boundary; percent of applicable standard
Toxic/hazardous air pollutants[b]	Ambient concentrations (μg/m^3) of toxic air pollutants; concentrations of pollutants from existing sources at site	Emission rate (kg/yr) of toxic air pollutants from facility; source characteristics (e.g., stack height and diameter, exit temperature and velocity)	Contribution of proposed alternative to concentrations of each pollutant at or beyond the site boundary; total concentration of each pollutant at or beyond site boundary; percent of applicable standard
Noise	Sound levels at sensitive offsite receptors (e.g., at nearby residences, along major access routes); sound levels at noise-sensitive wildlife habitat (nearby threatened and endangered wildlife habitat)	Descriptions of major construction and operation sources; shipment and workforce estimates	Increase in day/night average sound level at sensitive receptors

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter with an aerodynamic diameter less than or equal to 10 μg; sulfur dioxide; total suspended particulates.
[b] Title III pollutants, pollutants regulated under the National Emissions Standard for Hazardous Air Pollutants, and other State-regulated pollutants.

alternative using the ISC3 model. The total concentration, including the contribution from each alternative and the percent of the applicable standard, were presented. This percentage reflects the variability of the No Action concentrations, the standards and guidelines among sites and the differences among the alternatives.

The effects of traffic related to construction and operation for each alternative were evaluated by calculating the emissions of criteria pollutants from worker vehicles and shipping activities.

One year of sequential hourly onsite meteorological data from the sites and upper-air data for appropriate locations from the National Climactic Data Center were used in the air quality modeling. For consistency, the data were for the same year considered in the *Storage and Disposition PEIS* (DOE 1996a).

Additional assumptions were incorporated in the air quality modeling at each site. For example, to model emissions from a generic process stack for MOX fuel fabrication, a single source within the facility was used, assuming a stack height of 8 m (26 ft), a stack diameter of 0.3 m (1 ft), a stack exit temperature equal to the ambient temperature, and a stack exit velocity of 0.03 m/s (0.1 ft/s). Where they could be obtained, however, actual stack locations and stack parameters were used to model pollutant concentrations.

The analysis tends to overestimate pollutant concentrations, since the location of the maximum site boundary concentrations due to surplus plutonium disposition facilities was assumed to be the same as the location of maximum concentrations of other pollutant sources at the site.

Ozone is typically formed as a secondary pollutant in the ambient air (troposphere). It is formed from such primary pollutants as nitrogen oxides and volatile organic compounds, which emanate from vehicular (mobile), natural, and other stationary sources. It is not emitted directly as a pollutant from the sites. Although ozone may thus be regarded appropriately as a regional issue, specific ozone precursors, notably nitrogen dioxide and volatile organic compounds, were analyzed as applicable to the alternatives under consideration.

The CAA, as amended, required that Federal actions conform to the host State's "State Implementation Plan." A State Implementation Plan provides for the implementation, maintenance, and enforcement of NAAQS for the six criteria pollutants: sulfur dioxide; PM_{10}; carbon monoxide; ozone; nitrogen dioxide; and lead. Its purpose is to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of these standards. No department, agency, or instrumentality of the Federal Government shall engage in or support in any way (i.e., provide financial assistance for, license or permit, or approve) any activity that does not conform to an applicable implementation plan. The final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* (EPA 1993) took effect on January 31, 1994. Hanford, Pantex, the Idaho National Engineering and Environmental Laboratory, the Savannah River Site, and Los Alamos National Laboratory are within areas currently designated as attainment for criteria air pollutants. Therefore, the surplus plutonium disposition alternatives being considered at these sites are not affected by the provisions of the conformity rule. Rocky Flats Environmental Technology Site (RFETS) is in an area designated nonattainment for ozone, PM_{10}, and carbon monoxide. Lawrence Livermore National Laboratory is in an area designated nonattaining for ozone. Applicability of the conformity rule to the RFETS is discussed in Section 4.2.1.7 on No Action.

Emissions of potential stratospheric ozone-depleting compounds such as chlorofluorocarbons were not evaluated because no emissions of these pollutants were identified in the engineering design reports.

Emissions of pollutants that are potential contributors to global warming (e.g., carbon dioxide, nitrous oxide chlorofluorocarbons, and methane) were evaluated using emission data in the engineering design reports. These emissions were compared with annual releases of these pollutants from other sources (EPA 1997f).

F.1.2.2 Noise

Also addressed in the SPD EIS assessment were the onsite and offsite acoustic impacts of construction and operation of the proposed facilities (see Table F–1). That analysis drew from available information (e.g., engineering design reports) on the types of noise sources and the locations of the proposed facilities relative to the site boundary and noise-sensitive locations. Its focus was the degree of change in noise levels at sensitive receptors (e.g., residences near the site boundary and along access routes, and schools along access routes) with respect to ambient conditions. (A change in noise level of less than 3 decibels is generally not detectable by the human ear. An increase of 10 decibels is roughly equivalent to a doubling of the perceived sound.) Most nontraffic noise sources associated with construction and operation of the surplus plutonium disposition facilities are far enough from offsite noise-sensitive receptors that the contribution to offsite noise levels should be small. Projections of traffic noise during construction and operations were based on the employment and shipment projections provided in the engineering design reports.

F.2 GEOLOGY AND SOILS

F.2.1 Description of Affected Resources

Geologic resources include consolidated and unconsolidated earth materials, including mineral assets such as ore and aggregate materials, and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, and land subsidence. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts.

The ROI for geology and soils includes all areas subject to disturbance by construction and operation of surplus plutonium disposition facilities, and those areas beneath these facilities that would remain inaccessible for the life of the facilities.

Geology and soils were considered with respect to natural conditions that could affect the alternative, as well as those portions of the resource that could be affected by the alternative. Geology and soil conditions that could affect the integrity and safety of the surplus plutonium disposition alternatives include large-scale geologic hazards and attributes of the soil beneath the proposed facility. Geology and soil resources that could be affected by the surplus plutonium disposition alternatives include economically valuable mineral resources and prime farmland soils.

F.2.2 Description of Impact Assessment

Facility construction and operations for the surplus plutonium disposition alternatives were considered from the perspective of impacts on specific geologic resources and soil attributes. Construction impacts would predominate in effects on geologic and soil resources; hence, key factors in the analysis were the land area to be disturbed during construction and occupied during operations (see Table F–2). The main objective was avoidance of the siting of facilities over unstable soils (i.e., soils prone to liquefaction, shrink-swell, or erosion).

Table F–2. Impact Assessment Protocol for Geology and Soils

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Soil attributes	Presence of any unstable soils at proposed facility location	Location of proposed facility on the site	Location of facility on unstable soils
Valuable mineral and energy resources	Presence of any valuable mineral or energy resources at proposed facility location	Location of proposed facility on the site	Destruction or rendering inaccessible of valuable mineral or energy resources
Prime farmland soils	Presence of prime farmland soils at proposed facility location	Location of proposed facility on the site	Conversion of prime farmland soils to nonagricultural use

Included in the geology and soil impact analysis was consideration of the risks to the proposed facilities of large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, sinkholes, and salt dissolution (i.e., conditions that tend to affect broad expanses of land). In the *Storage and Disposition PEIS* (DOE 1996a:4-45–47, 4-148–150, 4-204–206, 4-309–311), hazards from the large-scale geologic conditions at each candidate site were assessed for proposed long-term storage facilities. The supporting data and findings of that analysis, which focused on the presence of the hazard and the distance of the facilities from it, were reviewed and accepted as generally applicable to the surplus plutonium disposition facilities and therefore are incorporated by reference. Efforts were also made to determine if locating the surplus plutonium disposition facilities at a specific site could destroy, or preclude the use of, valuable mineral or energy resources.

Pursuant to the Farmland Protection Policy Act (FPPA) (7 USC 4201 et seq.), and the regulations (7 CFR 658) promulgated as result thereof, the presence of prime farmland was also evaluated. This act requires agencies to make FPPA evaluations part of the National Environmental Policy Act (NEPA) process, the main purpose being to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. Prime farmland, as defined in 7 CFR 657, is land that contains the best combination of physical and chemical characteristics for producing crops. It includes cropland, pasture land, rangeland, and forest land. Potential prime farmlands not acquired prior to June 22, 1982, the effective date of the FPPA, are exempt from its provisions (DOE 1996b:4-22).

F.3 WATER RESOURCES

F.3.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption, agricultural purposes, or irrigation or industrial/commercial purposes, and that could be impacted by the proposed action. This analysis involved the review of engineering estimates of expected water use and effluent discharges from proposed construction, operation, maintenance, and decontamination and decommissioning (D&D) of the proposed facilities, and ultimately the impacts of the activities on the local surface water and groundwater.

F.3.2 Description of Impact Assessment

The water resources evaluation for the SPD EIS tiers from the corresponding analysis presented in the *Storage and Disposition PEIS* (DOE 1996a). Its purpose was to evaluate the differences in the impacts where changes would be incurred in the assumed water usage to accommodate the facilities involved in the planned disposition activities. Determination of the impacts of the alternatives on water resources (see Table F–3) consisted of a comparison of field-generated data with regulatory standards, design parameters commonly used in the water and wastewater design industry, and accepted industry standards.

Certain assumptions were integral to this analysis: (1) that all water and sewage treatment facilities would be approved by the appropriate permitting authority, and thus that the impacts of project-specific withdrawals from the water treatment plants and effluent discharges from the sewage treatment plant would be in accordance with established standards; (2) that the sewage treatment facilities would meet the effluent limitations imposed by their respective National Pollutant Discharge Elimination System (NPDES) permits; and (3) that any storm-water runoff from construction or operation activities would be handled in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction, siltation fencing or other erosion control devices would be used to mitigate short-term adverse impacts from siltation, and that, as appropriate, storm-water holding ponds would be constructed to lessen the impacts of rainfall events on the receiving streams.

Table F–3. Impact Assessment Protocol for Water Resources[a]

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Surface water quality	Surface waters near the facilities in terms of stream classifications and changes in water quality	Anticipated effluent quantity and quality	Noncompliance of surface water quality with relevant standards of Clean Water Act or with State regulations
Groundwater quality	Groundwater near the facilities in terms of classification, presence of designated sole source aquifers, and changes in quality of groundwater	Quantity and quality of anticipated withdrawals from, or discharges to, groundwater	Concentrations of contaminants in groundwater exceeding standards established in accordance with Safe Drinking Water Act or State regulations
Surface water availability	Surface waters near the facilities, including average flow; 7-day, 10-year low flow; and numbers of downstream users	Volume of withdrawals from, and discharges to, surface waters	Changes in availability to downstream users of water for drinking, irrigation, or animal feeding[b]
Groundwater availability	Groundwater near the facilities, including numbers of all groundwater users, existing water rights for major water users, and contractual agreements for water supply use within impacted area	Volume of withdrawals and discharges to groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding
Flooding impacts	Locations of 100- and 500-year floodplains	Facility location on the site	Construction of facilities in a floodplain[c]

[a] For flows above the design capacity of existing water and sewage treatment systems.
[b] An impact is assumed if withdrawals exceed 10 percent of the 7-day, 10-year low flow of the receiving stream.
[c] A floodplain assessment is a prerequisite to construction on a floodplain.

Further assumptions regarding water resources impacts were based in part on results of the analysis. The first step in the analysis was to determine whether any revisions in project water and wastewater flows had occurred between the time of the *Storage and Disposition PEIS* (DOE 1996a) and the collection of data for the SPD EIS. If no revisions were necessary, and if no evidence of an impact on water resources was presented in the *Storage and Disposition PEIS* (DOE 1996a), then it was assumed that no such impact would be incurred. If the analysis reflected a revision downward in the assumed water use for a proposed activity, and there was no impact for that activity in the *Storage and Disposition PEIS* (DOE 1996a), then no impact was attributed to that activity. If the analysis reflected an increase in water use, then an evaluation of the design capacity of the water and wastewater treatment facilities was made to determine whether their design capacity would be exceeded by the additional flows. If the combined flow (i.e., the existing flow plus those from the proposed activities) were less than the design capacity of the water and sewage treatment plants, then it was assumed that there would be no impact on water availability for local users or on the receiving stream from sewage treatment plant effluent discharges. If the flows from the proposed facilities were found to exceed the design capacity of the existing water or sewage treatment facilities, then the following extensive analyses of the impact of these flows were conducted.

Surface Water Availability. The analysis of the potential impacts on water availability entailed comparing the rate of surface water use for the specific alternative, the associated effluent discharges, and the use and classification of water in downstream waterways. For facilities intending to use surface water, an evaluation was made of the total use and the 7-day, 10-year low-flow conditions of the receiving stream. Discharges of effluent back into the receiving stream were included in the evaluation. If net losses were found to exceed 10 percent of the 7-day, 10-year low flow, an impact was assumed. Where groundwater was the source of water, discharges to surface water were interpreted as adding to the flow in the receiving stream. If the increases exceeded 200 percent of the 7-day, 10-year low flow, then an impact was assumed.

Surface Water Quality. The evaluation of the surface water quality impacts focused on the quality and quantity of the effluent to be discharged and the quality of the receiving stream upstream and downstream from the proposed facilities. The evaluation of effluent quality featured review of the expected design parameters, such as the design average and maximum flows, as well as the effluent parameters reflected in the existing or expected NPDES permit. Those parameters include biochemical oxygen demand, total suspended solids, metals, coliform bacteria, organic and inorganic chemicals, radionuclides, and any other parameters that affect the local environment. Water quality management practices were reviewed to ensure that NPDES permit limitations would be met. Factors that currently degrade water quality were also identified.

During construction, the receiving stream could be affected by construction site runoff and sedimentation. Such impacts relate to the amount of land disturbed, the type of soil at the site, the topography, and weather conditions. They would be minimized by application of standard management practices for storm-water and erosion control.

During operations, receiving waters could be affected by increased runoff from parking lots, buildings, or other cleared areas. Storm water from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, and process effluents. Impacts of storm-water discharges could be highly specific, and mitigation would depend on management practices, the design of holding facilities, the topography, and adjacent land use. Data from the existing water quality database were compared with expected flows from the new facilities to determine the relative impacts on the quality of the water in the receiving stream.

Groundwater Availability. Effects of the proposed action on groundwater supplies were determined by analyzing potential withdrawal rates for the construction and operation phases of the action. Estimates of withdrawal from the affected aquifers were provided. Additionally, instances in which groundwater use could exceed a large portion of the locally developed groundwater supplies were identified.

Groundwater Quality. Potential groundwater quality impacts associated with effluent discharges during the construction and operation phases were examined. The groundwater quality projections were then weighed against Federal and State groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. Also evaluated were the effects of construction and operation activities on the movement of existing groundwater contamination plumes, and the consequences thereof for groundwater use in the area.

Floodplain Impacts. Once the regional 100- and 500-year floodplains were identified from maps and other existing documents, the likely impacts of proposed surplus plutonium disposition facility construction and operation activities were analyzed. For any facilities proposed for location in a floodplain, a floodplain assessment would be prepared, as necessary. Where possible, the surplus plutonium disposition facilities were sited to ensure compliance with Executive Order 11988, *Floodplain Management*, and 10 CFR 1022, *Compliance With Floodplain/Wetlands Environmental Review Requirements*.

F.4 ECOLOGICAL RESOURCES

F.4.1 Description of Affected Resources

Ecological resources include terrestrial and aquatic resources (plants and animals), wetlands, and threatened and endangered species that could be affected by proposed construction and operations at the proposed surplus plutonium disposition sites. In accordance with the *Storage and Disposition PEIS* (DOE 1996a), the ROI for habitat impacts from facility construction and operations is the area within a 1.6-km (1-mi) radius of the proposed facilities.

F.4.2 Description of Impact Assessment

The proposed alternatives would involve, at a minimum, land disturbance during modifications to existing facilities and may require site clearing for construction of new facilities (see Table F–4). Accordingly, ecological impacts were assessed in terms of potential disturbances or loss of nonsensitive terrestrial and aquatic habitats and the potential effects on nearby sensitive habitats. For purposes of the SPD EIS, sensitive habitats include those areas occupied by threatened and endangered species, State-protected species, and wetlands.

Table F–4. Impact Assessment Protocol for Ecological Resources

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Nonsensitive terrestrial and aquatic habitats	Vegetation and wildlife within a 1.6-km (1-mi) radius of proposed facility locations	Area disturbed by construction of proposed facility	Decrease in acreage of undisturbed local and regional nonsensitive habitats
Sensitive terrestrial and aquatic habitats, including wetlands	Sensitive species habitats within a 1.6-km (1-mi) radius of proposed facility locations	Area disturbed by construction of proposed facility	Decrease in extent of sensitive habitats in ROI Determination by USFWS and State agencies that facility construction could disturb sensitive habitats

Key: ROI, region of influence; USFWS, U.S. Fish and Wildlife Service.

F.4.2.1 Nonsensitive Habitat Impacts

During the construction phase, ecological resources could be affected through disturbance or loss of habitat resulting from site clearing, land disturbance, human intrusion, and noise. Terrestrial resources could be directly affected through changes in vegetative cover important to individual animals of certain species with limited home ranges, such as small mammals and songbirds. Likely impacts include increased direct mortality and susceptibility to predation. Activities associated with the construction and operation of facilities (e.g., human intrusion and noise) could also compel the migration of the wildlife to adjacent areas with similar habitat. If the receiving areas were already supporting the maximum sustainable wildlife, competition for limited resources and habitat degradation could be fatal to some species. Therefore, the analysis of impacts on terrestrial wildlife was based largely on the extent of plant community loss or modification.

Construction or modification of facilities, and the operation thereof, could directly affect aquatic resources through increased runoff and sedimentation, increased flows, and the introduction of thermal and chemical changes to the water. However, various mitigation techniques should minimize construction impacts, and discharges of contaminants to surface waters from routine operations are expected to be limited by engineering control practices. Therefore, impacts are expected to be minimal.

F.4.2.2 Sensitive Habitat Impacts

Impacts on threatened and endangered species, State-protected species, and their habitats during construction of the proposed surplus plutonium disposition facilities were determined in a manner similar to that for nonsensitive habitats. A list of sensitive species that could be present at each site was compiled. Informal consultations were initiated with the appropriate U.S. Fish and Wildlife Service (USFWS) offices and State-equivalent agencies as part of the impacts assessment for sensitive species. Plans were developed for preconstruction surveys, as necessary, to determine the presence of any Federal- or State-listed species within the ROI. Those plans call for consulting the USFWS and various State agencies to confirm that potential impacts on sensitive habitats are acceptable or can be mitigated.

Most construction impacts on wetlands are related to the displacement of wetlands by filling, draining, or dredging activities. Operational impacts thereon could result from effluents, surface water or groundwater withdrawals, or the creation of new wetlands. Loss of wetlands resulting from construction and operation of the surplus plutonium disposition facilities was addressed by comparing data on the location and areal extent of wetlands in the ROI with the land area requirements for the proposed facilities.

F.5 CULTURAL AND PALEONTOLOGICAL RESOURCES

F.5.1 Description of Affected Resources

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. For the SPD EIS, the potential impacts of proposed surplus plutonium disposition activities were assessed separately for each of the three general categories of cultural resources: prehistoric, historic, and Native American. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age, and may be sources of information on paleoenvironments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the proposed surplus plutonium disposition activities in much the same manner.

Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with Cold War themes. Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. Such resources may include geographical features, plants, animals, cemeteries, battlefields, trails, and environmental features.

The primary ROI used for the cultural and paleontological resource analyses encompasses the land areas directly disturbed by construction and operation of the proposed facilities. The natural setting of those resources was considered a contextual component thereof.

F.5.2 Description of Impact Assessment

The SPD EIS study addressed the potential direct and indirect impacts on cultural resources at each of the candidate sites from the proposed action and alternatives (see Table F–5). The assessment of direct impacts focused on ground-disturbing activities and alterations to existing resources, particularly those listed or eligible for listing on the National Register of Historic Places (National Register), and those considered important to

Table F–5. Impact Assessment Protocol for Cultural and Paleontological Resources

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Prehistoric resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements	Location of proposed facility on the site Areas to be disturbed	Potential for physical destruction, damage, or alteration; isolation or alteration of the character of the property; introduction of visual, audible, or atmospheric elements out of character; and neglect of resources listed or eligible for listing on the National Register Noncompliance with existing laws, regulations, and programmatic agreements
Historic resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements	Location of proposed facility on the site Areas to be disturbed	Potential for physical destruction, damage, or alteration; isolation or alteration of the character of the property; introduction of visual, audible, or atmospheric elements out of character; and neglect of resources listed or eligible for listing on the National Register Noncompliance with existing laws, regulations, and programmatic agreements
Native American resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements Resources identified through consultations with Native American tribal governments	Location of proposed facility on the site Areas to be disturbed	Potential for disturbance of Native American resources as determined through consultations with potentially affected Native American tribal governments (per DOE Order 1230.2) Noncompliance with existing laws, regulations, and programmatic agreements
Paleontological resources	Site cultural resource inventory/management plan Existing programmatic agreements	Location of proposed facility on the site Areas to be disturbed	Potential for appropriation, excavation, injury, or destruction of resources without permission (per Antiquities Act of 1906) Noncompliance with existing laws, regulations, and programmatic agreements

Native Americans. Potential indirect impacts of surplus plutonium disposition activities were also assessed—impacts associated with reduced access to a resource site, as well as impacts associated with increased traffic and visitation in sensitive areas.

For specific sites, depending on the alternative, more detailed information was required (e.g., file investigations, Native American consultations, implementation of the Native American policy of DOE, predictive modeling) to determine the types, numbers, and locations, as well as the National Register eligibility or importance in other respects of resources in the proposed project area.

Plans were drawn up for consultation with each State Historic Preservation Officer and reviews of existing DOE site cultural resource surveys and management plans to determine the National Register eligibility and importance of the resources, and to assess measures designed to mitigate the impacts of the proposed actions.

The measure of impact on a particular resource will depend largely on specific cultural resource management agreements with the candidate sites, the consultations with State Historic Preservation Officers and affected Native American tribes, and overall compliance with Section 106 of the National Historic Preservation Act.

F.6 LAND RESOURCES

F.6.1 Description of Affected Resources

Land resources include the land on and contiguous to each candidate site; the physical features that influence current or proposed uses; local urban and rural population density; pertinent State, county, and municipal land-use plans and regulations; land ownership and availability; and the aesthetic characteristics of the site and surrounding areas.

Land resources analysis for the SPD EIS determined the potential beneficial or adverse impacts on land use and visual resources for the defined ROI. The ROI for land use at each candidate site varies due to disparities in population density and growth trends, the extent of Federal land ownership, adjacent land-use patterns and trends, and other geographic or safety considerations. The ROI for visual resources includes those lands within the viewshed of the proposed action and alternatives.

F.6.2 Description of Impact Assessment

F.6.2.1 Land-Use Analysis

Requirements for the SPD EIS included estimating the impacts of the alternatives on land use within each DOE site, adjacent Federal or State lands, adjacent communities, and wildlife or resource areas. At issue were the net land area affected; its relationship to conforming and nonconforming land uses; current growth trends, land values, and other socioeconomic factors pertaining to land use; and the projected modifications to other facility activities and missions consistent with the proposed alternatives (see Table F–6). Land-use impacts could vary considerably from site to site, depending on existing facility land-use configurations, adjoining land uses, plans for transportation security, proximity to residential areas, and other environmental and containment factors.

Evaluation of existing land uses at each of the potentially affected sites required review of existing and future facility land-use plans. Where land adjacent to the proposed site is managed by local government, applicable community general plans, zoning ordinances, and population growth trend data were reviewed. Where such land is managed or under the jurisdiction of a Federal or State land management agency, the respective agency resource management plans and policies were reviewed. Total land area requirements include those areas to be occupied by the footprint of each building and nonbuilding support area in conjunction with all paved roads, parking areas, graveled areas, and construction laydown areas, and any land graded and cleared of vegetation. Land area requirements were identified using proposed facility data reports.

Table F–6. Impact Assessment Protocol for Land Resources

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Land use; area used	Total site acreage; available acreage	Location of proposed facility on the site; total land area requirements	Facility land requirements greater than 30% of available acreage
Compatibility with existing or future land-use plans, policies, or regulations	Existing facility and regional land-use configurations; applicable plans, policies, or regulations	Location of proposed facility on the site; facility D&D procedures; expected modifications of other facility activities and missions to accommodate proposed alternatives	Incompatibility with existing facility or adjacent land use; encroachment by disturbed area onto sensitive lands protected by existing management plans or policies; significant long-term or permanent loss of land use resulting from facility construction, operation, or D&D
Visual resources	Delineation of nearby visual resources and viewsheds, including Class I areas	Location of proposed facility on the site; facility dimensions and appearance	Significant reduction of assigned VRM classification for a notable viewshed

Key: D&D, decontamination and decommissioning; VRM, Visual Resource Management.

F.6.2.2 Visual Resources Analysis

Visual resource impacts are changes in the physical features of the landscape attributable to the proposed action. Visual resource assessment was based on the Bureau of Land Management Visual Resource Management (VRM) classification scheme (DOI 1986a, 1986b). Impacts on scenic or visual resources were analyzed by identifying existing VRM classifications and documenting any potential reductions therein at each of the alternative locations as a result of the proposed action or alternatives (see Table F–6). Existing class designation was derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas. The elements of scenic quality are landforms, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. Scenic value is determined by the variety and harmonious composition of the elements of scenic quality. Sensitivity levels are determined by user volumes and user attention. Distance zones concern the visibility from travel routes or observation points.

Important concerns of the visual resources analysis were the degree of contrast between the proposed action and the surrounding landscape, the location and sensitivity levels of public vantage points, and the visibility of the proposed action from the vantage points. The distance from a vantage point to the affected area and atmospheric conditions were also taken into consideration, as distance and haze can diminish the degree of contrast and visibility. A qualitative assessment of the degree of contrast between the proposed facilities or activities and the existing visual landscape was also presented. Reduction of an assigned VRM classification could result if the affected area could be seen from the vantage point with a high sensitivity level.

F.7 INFRASTRUCTURE

F.7.1 Description of Affected Resources

Site infrastructure includes physical resources required to support the construction and operation of facilities. It includes the capacities of the onsite road and rail transportation networks; electric power and electrical load capacities; natural gas, coal, and fuel oil capacities; and water supply system capacities.

The ROI is generally limited to the boundaries of DOE sites. However, should infrastructure requirements exceed site capacities, the ROI would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, then the ROI would be expanded to include the likely source of additional power: the power pool currently supplying the site.

F.7.2 Description of Impact Assessment

In general, infrastructure impacts were assessed by evaluating the requirements of each alternative against the site capacities. An impact assessment was made for each resource (road networks, rail interfaces, electricity, fuel, and water) for the various alternatives (see Table F–7). Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from reports describing the existing infrastructure at the sites, and from the data reports for each facility. If necessary, design mitigation considerations conducive to reduction of the infrastructure demand were also identified.

Table F–7. Impact Assessment Protocol for Infrastructure

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Transportation Roads (km) Railroads (km)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Electricity Energy consumption (MWh/yr) Peak load (MW)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Fuel Natural gas (m^3/yr) Oil (l/yr) Coal (t/yr)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Water (l/yr)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of environmental impact. Whenever projected demand approaches or exceeds capacity, further analysis for that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility, provided the potential for impact is identified early. Similarly, a dramatic "spike" in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

F.8 WASTE MANAGEMENT

F.8.1 Description of Affected Resources

The operation of surplus plutonium disposition support facilities would generate several types of waste, depending on the alternative. Such wastes include the following:

- **Transuranic:** Waste containing more than 100 nCi of alpha-emitting transuranic (TRU) isotopes with half-lives greater than 20 year per gram of waste, except for (1) high-level waste; (2) waste that DOE has determined, with the concurrence of EPA, does not need the degree of isolation required by 40 CFR 191, and (3) waste that the U.S. Nuclear Regulatory Commission (NRC) has approved for disposal, case by case in accordance with 10 CFR 61. Mixed transuranic waste contains hazardous components regulated under the Resource Conservation and Recovery Act (RCRA).

- **Low-level:** Waste that contains radioactivity and is not classified as high-level waste, TRU waste, or spent nuclear fuel,[1] or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the TRU concentration is less than 100 nCi/g of waste.

- **Mixed low-level:** Low-level waste that also contains hazardous components regulated under RCRA.

- **Hazardous:** Under RCRA, a solid waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special EPA lists or possess at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act.

- **Nonhazardous:** Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act.

The alternatives for surplus plutonium disposition could have an impact on existing site facilities devoted to the treatment, storage, and disposal of these categories of waste.

For new facilities, construction wastes would be similar to those generated by any construction project of comparable scale. Wastes generated during the modification of existing nuclear facilities, however, could produce additional radioactive or hazardous demolition debris.

For all but nonhazardous wastes, DOE chose to combine the liquid and solid waste generation estimates into one waste generation rate for ease of comparison to site waste generation rates. Liquid waste was converted from liters to cubic meters using a conversion factor of 1,000 liters per cubic meter. This is likely to be conservative because it includes the volume of the liquid waste before treatment.

Waste management activities in support of the disposition of surplus plutonium would be contingent on Records of Decision (RODs) issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a). Depending on future waste-type-specific RODs, in accordance with that EIS, wastes could be treated and disposed of on the site or at regionally or centrally located waste management centers. The ROD for hazardous waste issued on August 5, 1998, states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of nonwastewater hazardous waste, with the Oak Ridge Reservation and SRS continuing to treat some of their own hazardous waste on the site in existing facilities where this is economically favorable. According to the TRU Waste ROD issued on January 20, 1998, TRU and TRU mixed waste would be treated on the site according to the current planning-basis Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria and shipped to WIPP for disposal. The impacts of disposing of TRU waste at WIPP are

[1] Fuel withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

described in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, it is assumed TRU waste would be stored on the site until 2016.

F.8.2 Description of Impact Assessment

As shown in Table F–8, impacts were assessed by comparing the projected waste stream volumes generated from the proposed activities at each site with current site waste generation rates and storage volumes.[2] Furthermore, projected waste generation rates for the proposed activities were compared with processing rates and capacities of those existing treatment, storage, and disposal facilities likely to be involved in managing the additional waste. Most likely, each waste type would be managed at many different facilities; for simplicity, however, it was assumed that the entire waste volume would be managed at one treatment facility, one storage facility, and one disposal facility.

Table F–8. Impact Assessment Protocol for Waste Management

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Waste management capacity TRU waste Low-level waste Mixed low-level waste Hazardous waste Nonhazardous waste	Site generation rates (m^3/yr) for each waste type Site management capacities (m^3) or rates (m^3/yr) for potentially affected treatment, storage, and disposal facilities for each waste type	Construction and operation generation rates (m^3/yr) for each waste type	SPD facility waste generation rates are a large percentage of existing site generation rates and a large percentage of capacities of applicable waste management facilities
Disposal capacity for transuranic waste (including mixed TRU waste)	TRU waste volume (m^3) expected to be disposed of at WIPP Capacity at WIPP (m^3)	Total TRU waste generated (m^3) for SPD facilities	Combination of SPD facility TRU waste generation and existing TRU waste generation exceeds capacity of WIPP

Key: SPD, surplus plutonium disposition; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

F.9 SOCIOECONOMICS

F.9.1 Description of Affected Resources

Socioeconomic impacts may be defined as the environmental consequences of a proposed action in terms of demographic and economic changes. Two types of jobs would be created as a result of DOE's adopting any of the surplus plutonium disposition alternatives: (1) construction-related jobs, transient in nature and short in duration, and thus less likely to impact public services; and (2) jobs related to plant operations, required for a decade or more and thus possibly creating additional service requirements in the ROI.

[2] For the SPD EIS, only the impacts relative to the capacities of waste management facilities were considered. Environmental impacts of waste management facility operation are evaluated in other facility-specific or sitewide NEPA documents.

F.9.2 Description of Impact Assessment

Before the socioeconomic analyses could begin, the socioeconomic environment had to be defined for two geographic regions, the regional economic area (REA) and ROI. The REA is used to assess potential effects of an action on the regional economy. REAs are the broad markets defined by the economic linkages among and between the regional industrial and service sectors and the communities within a region. These linkages determine the nature and magnitude of any multiplier effect associated with a change in economic activity.

For example, as work expands at a given site, the money spent on accomplishing this work flows into the local economy; it is spent on additional jobs, goods, and services within the REA. Using the Regional Input-Output Modeling System developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, the regional economic impacts of a proposed project can be estimated over the life of the project.

Similarly, potential demographic impacts were assessed for the ROI. The ROI could represent a smaller geographic area—one in which only the housing market and local community services would be significantly affected by a given alternative. Site-specific ROIs were identified as those counties in which at least 90 percent of the site's workforce reside. This distribution reflects existing residential preferences for people currently employed at the sites and was used to estimate the distribution of new workers required to support the alternatives.

For each REA, data were compiled on the current socioeconomic conditions, including unemployment rates, economic sector activities, and the civilian labor force. For each ROI, statistics were compiled on the housing demand and community services. These data were combined with population forecasts developed using Census Bureau data to project changes to reflect the various siting alternatives being considered. Site-specific data were then used to help determine whether the overall workforce would be increased by the alternatives being considered (see Table F–9).

In some cases, a site's overall workforce was projected to decrease at the same time additional workers would be needed to support an alternative under consideration in the SPD EIS. In these cases, there would be little change in the site's overall workforce from current levels, and thus very little change in requirements for community services would be expected from a particular alternative. In the alternative, where the projected increases in the site workforce were greater than current levels, the impacts on community services were assessed by determining the increase in community services required to maintain the current status.

F.10 HUMAN HEALTH RISK DURING NORMAL OPERATIONS

F.10.1 Description of Affected Resources

Assessments for the SPD EIS aimed in part at enhancing public understanding of the potential impacts of each of the alternatives on their own health and that of workers. Included was a description of the radiological and chemical releases resulting from construction activities and normal operations for each alternative, including No Action, and the impacts on public and occupational health.

The risks from radiation were not added to those from hazardous chemicals, given the considerable uncertainty as to their combined effects. Impacts of some chemicals are enhanced by radiation, while those of others are not affected or can even be reduced. The reverse also holds true: chemicals can increase, decrease, or not influence radiological effects.

For the public, impacts on individuals (maximally exposed and average exposed) and on the population within 80 km (50 mi) of the site were evaluated; for workers, the focus was impacts on individuals and on the total

Table F–9. Impact Assessment Protocol for Socioeconomics

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Workforce requirements	Site workforce projections from DOE sites	Estimated construction and operating staff requirements and timeframes	Workforce requirements added to sites' workforce projections
REA civilian labor force	Labor force projections based on State population projections	Estimated construction and operating staff requirements and timeframes	Workforce requirements as a percentage of the civilian labor force
Unemployment rate	1996 unemployment rates in counties surrounding sites and in host States	Estimated construction and operating staff requirements	Projected change in unemployment rates
Health care services: Number of hospital beds per 100,000 residents	Latest available rates based on telephone interviews with area hospitals and State hospital associations	Estimated influx of new health care facilities to meet construction and operating staff requirements	Projected change in numbers to maintain current rates
Number of physicians per 100,000 residents	Latest available rates based on AMA data	Estimated influx of new health care employees to meet construction and operating staff requirements	Projected change in numbers to maintain current rates
Housing—Percent of occupied housing units	Latest available rates from the Census Bureau	Estimated influx of new housing units needed for influx of construction and operating staff requirements	Projected change in numbers to maintain current rates
Schools: Percent operating capacity for school districts in ROI	Latest available rates based on telephone interviews with school districts	Estimated influx of new students generated by movement of employees and their families into ROI	Projected change in operating capacity for school districts in ROI
Teacher-to-student ratio	Latest available rates based on telephone interviews with school districts	Estimated influx of new students generated by movement of employees and their families into ROI	Projected change in number of teachers to maintain current teacher-to-student ratio
Community services: Ratio of police to 100,000 residents	Latest number of sworn officers based on telephone interviews with police departments	Estimated influx of new officers to meet construction and operating staff requirements	Projected change in number of officers to maintain current police-to-resident ratio
Ratio of firefighters to 100,000 residents	Latest number of firefighters based on telephone interviews with fire departments	Estimated influx of new firefighters to meet construction and operating requirements	Projected change in number of firefighters to maintain current firefighter-to-resident ratio

Key: AMA, American Medical Association; REA, regional economic area; ROI, region of influence.

facility workforce. The basic health risk issue addressed was whether any of the alternatives would result in undue numbers of health effects (e.g., cancers among workers or the public). Because protection of human health is regulated by DOE, EPA, NRC, and the Occupational Safety and Health Administration (OSHA), estimates of public and worker doses and associated health risks are also necessary to demonstrate that surplus plutonium disposition facilities are being designed in compliance with the applicable standards issued by these agencies.

F.10.2 Description of Impact Assessment

F.10.2.1 Public Health Risks

The health risks to the general public were determined in the following ways: (1) for present operations, doses stated in the most recent environmental or safety reports were used to calculate health risks; and (2) for operations of the proposed facilities, incremental radiological and chemical doses were modeled using specific facility data and site-dependent parameters and converted into their associated health risks.

Radiological and chemical impacts associated with the No Action Alternative were estimated from projected releases from all site facilities that are expected to be operating at the time the actions assessed in the SPD EIS are under way. For each of the other alternatives, radiological and chemical effluents were obtained from facility data reports specific to each surplus plutonium disposition process.

F.10.2.1.1 Radiological Risks

Public health risk assessments from radiological releases during normal operations of the proposed facilities at the candidate sites were performed using the Generation II computer code, to calculate doses from inhalation, ingestion of terrestrial foods, drinking water, fish, and direct exposure to radiation in plumes or on the ground. This type of assessment uses site-dependent factors, including meteorology, population distributions, agricultural production, and facility locations on a given site. As reflected in Table F–10, doses were calculated for the maximally exposed individual (MEI) member of the public, for the average exposed member of the public, and for the total population living within 80 km (50 mi) of a given release location (NRC 1977:1.109.30).

Total site doses were compared with regulatory limits and, for perspective, with background radiation levels in the vicinity of the site. These doses were also converted into a projected number of fatal cancers using a risk estimator of 500 fatal cancers per 1 million person-rem derived from data prepared by the National Research Council's Committees on the Biological Effects of Ionizing Radiations and by the International Commission on Radiological Protection (ICRP 1991). The calculated health effects were compared with those arising among the same population groups from other causes.

[Text deleted.]

F.10.2.1.2 Chemical Risks

The potential impacts on the offsite public from exposure to hazardous chemicals released to the atmosphere as a result of the construction or routine operation of the proposed facilities were evaluated. The receptor considered in these evaluations was the MEI member of the offsite population at each candidate site. The MEI is the hypothetical individual in the population who has the highest potential exposure.

Table F–10. Impact Assessment Protocol for Human Health Risk

	Required Data		
Risk	**Affected Environment**	**Facility Design**	**Measure of Impact**
Radiation: public			
Offsite MEI dose via airborne pathways	Current annual dose (mrem) to MEI via all airborne pathways at site	Annual radionuclide release rates (Ci) to air from proposed facility. Stack height. Location of proposed facility on the site.	Annual dose greater than 10 mrem via airborne releases (NESHAPs limit), and 5 mrem (airborne external [10 CFR 50]).
Offsite MEI dose via liquid pathways	Current annual dose (mrem) to MEI via all liquid pathways at site	Annual radionuclide release rates (Ci) to liquid pathways.	Annual dose via liquid releases greater than 4 mrem (SDWA) and 3 mrem (10 CFR 50).
Offsite MEI dose via all pathways, including air, water, and others (e.g., direct radiation)	Current annual dose (mrem) to MEI via all pathways at site Annual radionuclide release rates to air and water from site release locations Joint frequency meteorological data Water dilution factors Distances from radionuclide release points to site boundary for 16 cardinal directions Exposure information associated with other potential pathways (e.g., direct radiation from each site area)	Annual radionuclide releases to air and via any other pathway (e.g., direct radiation) from proposed facility. Stack height. Location of proposed facility on the site. Exposure information associated with other potential pathways (e.g., direct radiation).	Annual dose greater than 100 mrem via all pathways (DOE 5400.5 and 10 CFR 20)
Dose to population within 80 km (50 mi) of site via all pathways	Current annual population dose (person-rem) via all pathways at site Projected population distribution within an 80-km (50-mi) radius from radionuclide release points Latest available milk, meat, and vegetable distributions within an 80-km (50-mi) radius from radionuclide release points Joint frequency meteorological data Water usage values (e.g., fish harvest, number of water drinkers) Water dilution factors	Annual radionuclide release rates (Ci) to air and liquid from proposed facility. Stack height. Location of proposed facility on the site.	Annual population dose greater than 100 person-rem via all pathways (proposed 10 CFR 834).

Table F–10. Impact Assessment Protocol for Human Health Risk (Continued)

Risk	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Radiation: occupational			
Average dose to involved (facility) worker[a]	Not applicable	Annual average dose (mrem) to the facility worker.	Annual dose of more than 750 mrem. This value represents 15% of 10 CFR 835 and 10 CFR 20 limit of 5,000 mrem/yr and 37.5% of DOE administrative control level of 2,000 mrem/yr, and has been chosen to ensure that dose received by average worker is well below dose limits and administrative control level. Annual dose of more than 5,000 mrem/yr for commercial plants (10 CFR 20).
Average dose to noninvolved (site) worker[a]	Current annual average dose (mrem) among all noninvolved workers at site	Not applicable.	Annual dose of more than 250 mrem. This value represents 5% of 10 CFR 835 limit of 5,000 mrem/yr and 12.5% of the DOE administrative control level of 2,000 mrem/yr, and has been chosen to ensure that dose received by average worker is well below dose limits and administrative control level.
Total dose to involved (facility) workers	Not applicable	Annual total dose (person-rem) among all facility workers. Number of facility workers.	Annual dose of more than 750 mrem times number of involved workers. Annual dose of more than 5,000 mrem/yr for commercial plants (10 CFR 20).
Total dose to noninvolved (site) workers	Current annual total dose (person-rem) among all workers at site Number of noninvolved workers	Not applicable.	Annual dose of more than 250 mrem times number of noninvolved workers at site.
Radiation: construction workers			
Average dose to construction worker[a]	Level of existing contamination and dose expected from working in that area of site	Annual average and total dose to construction worker.	For average worker, 50% of values given above for public's MEI. This is based on interpretation of a construction worker as a member of the public and application of a reduction factor of 2 in going to an average rather than a maximally exposed worker.
Total dose to construction workers		Numbers of construction workers.	For total workforce, number of workers in workforce times doses for an average worker.

Table F–10. Impact Assessment Protocol for Human Health Risk (Continued)

Risk	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Hazardous chemicals: public			
Offsite MEI latent cancer incidence risk	Distribution of population in ROI Joint frequency meteorological data	Airborne release (kg/yr) of hazardous chemicals.	Probability of latent cancer incidence for MEI.
[Text deleted.]			

[a] More meaningful in determining health risk than dose to maximally exposed worker, which varies significantly each year. Monitoring, however, will ensure that dose to the maximally exposed worker remains within regulatory limits.

Key: CFR, Code of Federal Regulations; MEI, maximally exposed individual; NESHAPs, National Emission Standards for Hazardous Air Pollutants; ROI, region of influence; SDWA, Safe Drinking Water Act.

As a result of releases from construction and routine operation of facilities, receptors are expected to be potentially exposed to concentrations of hazardous chemicals that are below those that could cause acutely toxic health effects. Acutely toxic health effects result from short-term exposure to relatively high concentrations of contaminants, such as those that may be encountered during facility accidents. Long-term exposure to relatively lower concentrations of hazardous chemicals can produce adverse chronic health effects that may include both carcinogenic and noncarcinogenic effects. However, the health effect endpoint evaluated in this analysis is limited to the probability of an excess latent cancer incidence for the offsite population MEI because only carcinogenic chemicals are expected to be released from the proposed actions.

Estimates of airborne concentrations of hazardous chemicals were developed using the ISC air dispersion model. This model was developed by EPA for regulatory air-dispersion-modeling applications (EPA 1996b). ISC3 is the most recent version of the model and is approved for use for a wide variety of emission sources and conditions. The ISC model estimates atmospheric concentrations based on the airborne emissions from the facility for each block in a circular grid comprising 16 directional sectors (e.g., north, north-northeast, northeast) at radial distances out to 80 km (50 mi) from the point of release, producing a distribution of atmospheric concentrations. The offsite population MEI is located in the block with the highest estimated concentration.

For carcinogenic chemicals, risk is estimated by the following equation:

$$\text{Risk} = \text{CA} \times \text{URF}$$

where

Risk = unitless probability of cancer incidence
CA = contaminant concentration in air (in $\mu g/m^3$)
URF = cancer inhalation unit risk factor (in units of cancers per $\mu g/m^3$)

Cancer unit risk factors are used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular concentration of a potential carcinogen.

For the proposed actions, benzene is the only potential carcinogen that may be released to the atmosphere during facility construction activities (UC 1998a, 1998b, 1998c, and 1998d). EPA considers benzene to be a human carcinogen based on several studies that show increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and increases in chromosomal aberrations of bone marrow cells and peripheral lymphocytes in workers exposed to benzene and in laboratory studies with rabbits and rats (EPA 1997g).

F.10.2.2 Occupational Health Risks

F.10.2.2.1 Radiological Risks

Health risks from radiological exposure were determined for two types of workers: the facility worker, (i.e., the worker inside one of the plutonium-processing facilities or one of the commercial plants); and the site worker (i.e., the worker elsewhere on the site but not involved in plutonium processing). Health risks to individual workers and to total workforces were assessed.

The facility worker's dose was based on data from design reports on specific surplus plutonium disposition facilities or from the commercial plant historical data. It was assumed that the noninvolved site worker only receives a dose that results from his or her primary onsite activities. No additional dose to these workers would be expected from surplus plutonium disposition facility operation.

Worker doses were converted into the number of projected fatal cancers using the risk estimator of 400 fatal cancers per 1 million person-rem given in the International Commission on Radiological Protection Publication 60 (ICRP 1991). This risk estimator, compared with that for members of the public, reflects the absence of the most radiosensitive age groups (i.e., infants and children) in the workforce.

F.10.2.2.2 Hazardous Chemical Risks

Impacts of exposures to hazardous chemicals for workers directly involved in the proposed actions were not quantitatively evaluated. The use of personal protective equipment by the workers, as well as the use of engineering process controls, will limit worker exposure to levels within OSHA *Permissible Exposure Limits* (in 29 CFR 1910) or American Conference of Governmental Industrial Hygienists *Threshold Limit Values.*

F.11 FACILITY ACCIDENTS

F.11.1 Description of Affected Resources

Processing any hazardous material poses a risk of accidents impacting involved workers (workers directly involved in facility processes), noninvolved workers (workers on the site but not directly involved in facility processes), and members of the public. The consequences of such accidents could involve the release of radioactive or chemical material or the release of hazardous (e.g., explosive) energy, beyond the intended confines of the process. Risk is determined by the development of a representative spectrum of accidents, each of which is conservatively characterized by a likelihood (i.e., expected frequency of occurrence) and a consequence.

For the purpose of this analysis, involved workers were defined as workers in the immediate vicinity of the process involved in the accident; noninvolved workers, as workers located at the closer of 1,000 m (3,281 ft) from the accident (emission) source or the site boundary; and members of the public, as persons residing outside the site boundary and within 80 km (50 mi) of the facility.

F.11.2 Description of Impact Assessment

To avoid duplication, the analysis of potential accidents performed for the SPD EIS took full cognizance of the corresponding analyses in the *Storage and Disposition PEIS* (DOE 1996a), including accident sequence development, source term definition, and consequence analysis. The analysis focused on the likelihoods and consequences of a variety of a bounding spectrum of accidents postulated for each alternative, from high-consequence, low-frequency accidents to low-consequence, high-frequency accidents.

One objective of the accident analysis, a follow-on to a hazard analysis, was to translate each source term into a probabilistic distribution of consequences based on site-specific modeling of meteorological dispersion of the hazardous material and resulting uptake of that material by members of the human population. To predict the impacts of postulated accidents on the health of workers and the public, source terms were translated into consequences using the Melcor Accident Consequence Code System (MACCS2).

Metrics used to measure the impact of each accident include the accident frequency, the mean and 95th percentile doses for the noninvolved worker at the closer of 1,000 m (3,281 ft) or the site boundary, the mean and 95th percentile doses for the MEI at the site boundary, and the mean and 95th percentile doses for members of the general public within 80 km (50 mi) of the facility. Additionally, the individual doses were translated into the probability of latent cancer fatality, and the dose to the general public into the expected number of latent cancer fatalities (see Table F–11). Additional information on the development of accident sequences, source term definition, and consequence analysis can be found in Appendix K.

Table F–11. Impact Assessment Protocol for Facility Accidents

	Required Data		
Accident	**Affected Environment**	**Facility Design**	**Measure of Impact**
Operational events External events NPH events	Meteorological data Data on population within 80 km (50 mi) of facility Site boundary data	Accident source terms Accident frequencies Facility location	Radiological dose at 1,000 m (3,281 ft) from accident source Probability of latent cancer fatality given dose at 1,000 m (3,281 ft) Radiological dose to offsite MEI Probability of latent cancer fatality given dose at site boundary Dose to general public within 80 km (50 mi) of facility Latent cancer fatalities among general public within 80 km (50 mi) of facility

Key: MEI, maximally exposed individual; NPH, natural phenomena hazard.

F.12 TRANSPORTATION

F.12.1 Description of Affected Resources

Overland transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of cargo. The transportation of plutonium, radioactive waste, or other nuclear materials can pose additional risks owing to the unique properties of the material.

Accordingly, DOE, NRC, and the U.S. Department of Transportation have instituted strict policies and regulations governing the transport of such materials. The requirements are applicable throughout a shipment's ROI, which encompasses the onsite roadways, as well as the public roads between DOE sites and between DOE sites and commercial sites. For site-to-site transport, for example, shippers are required to use interstate highways predominantly.

F.12.2 Description of Impact Assessment

The risk from incident-free transportation was assessed for persons living within 0.8 km (0.5 mi) of the route; the risk from hypothetical accidents, for persons living within 80 km (50 mi) of the route. Assessment of the human health risks of overland transportation is crucial to a complete appraisal of the environment impacts of transportation associated with the surplus plutonium disposition alternatives.

The impacts associated with overland transportation were calculated per shipment, and then multiplied by the number of shipments. This approach allowed for maximum flexibility in determining the risk for a variety of alternatives (see Table F–12).

Fundamental assumptions of this analysis were consistent with those of the *Storage and Disposition PEIS* (DOE 1996a), and the same computer codes, release data, and accident scenarios were used. The HIGHWAY computer program was used for selecting highway routes for transporting radioactive materials by truck. The HIGHWAY database is a computerized road atlas that currently describes approximately 386,242 km (240,000 mi) of roads. A complete description of the interstate system and all U.S. highways is included in the database. Most of the principal State highways and many local and community roadways are also identified. The code is updated periodically to reflect current road conditions, and has been benchmarked against the reported mileages and observations of commercial trucking firms.

The first analytic step in the ground transportation analysis was to determine the incident-free and accident risk factors per shipment for transportation of the various types of hazardous materials. As with any risk estimate, the risk factors were calculated as the product of the probability and the magnitude of the exposure. Accident risk factors were calculated for radiological and nonradiological traffic accidents. The probabilities (much lower than unity [i.e., 1]) and the magnitudes of exposure were multiplied, yielding risk numbers. Incident-free risk factors were calculated for crew and public exposure to radiation emanating from the package and for public exposure to the chemical toxicity of the transportation vehicle exhaust. The probability of incident-free exposure is unity.

The RADTRAN 4 computer code (Neuhauser and Kanipe 1995) was used for the incident-free and accident risk assessments to estimate the impacts on collective populations. RADTRAN 4 was developed by Sandia National Laboratories to calculate population risk associated with the transportation of radioactive materials by a variety of modes: truck, rail, air, ship, and barge. Calculations are in terms of the probabilities and consequences of potential exposure events.

The RISKIND computer code (Yuan et al. 1995) was used to estimate the incident-free doses to MEIs and to develop impact estimates for use in the accident consequence assessment. This code was developed for DOE's Office of Civilian Radioactive Waste Management to analyze the exposure of individuals during incident-free transportation. It also allows for a detailed assessment of the consequences for individuals and population subgroups of severe transportation accidents in various environmental settings.

RISKIND calculations supplemented the collective risk results achieved with RADTRAN 4; they addressed areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses answered the "what if" questions, such as, "What if I live next to a site access road?" or "What if an accident happens near my town?"

Radiological doses, expressed in units of rem, were multiplied by the ICRP 60 (ICRP 1991) conversion factors and the estimated numbers of shipments to produce risk estimates in units of latent cancer fatalities. The vehicle emission risk factors were calculated in terms of latent fatalities; the vehicle accident risk factors, in fatalities. The nonradiological risk factors were multiplied by the number of shipments.

For each alternative, risks of both incident-free and accident conditions were assessed. For the incident-free assessment, risks were calculated for "collective populations" of potentially exposed individuals and for MEIs. (The collective population risk is a measure of the radiological risk posed to society as a whole by the

Table F–12. Impact Assessment Protocol for Transportation

	Required Data		
Risk	**Affected Environment**	**Facility Design**	**Measure of Impact**
Incident-free transportation			
Radiation dose to crew		Origin and destination of shipments Characterization of vehicles and material shipped	Dose and latent cancer fatalities to crew
Radiation dose to public On-link Off-link During stops	Population within 0.8 km (0.5 mi) of route Number of persons using a highway Traffic conditions along route	Origin and destination of shipments Characterization of vehicles and material shipped	Dose and latent cancer fatalities to public
Maximally exposed crew member		Origin and destination of shipments Characterization of vehicles and material shipped Location of workers	Radiation doses compared with 10 CFR 20 limits (2 mrem/hr and 100 mrem/yr)
Maximally exposed member of public		Origin and destination of shipments Characterization of vehicles and material shipped	Radiation doses compared with 10 CFR 20 limits (2 mrem/hr and 100 mrem/yr)
Health risks from vehicle emissions		Origin and destination of shipments Characterization of vehicles	Fatalities
Transportation accidents			
Radiological risk to public	Population within 80 km (50 mi) of route	Origin and destination of shipments Characterization of vehicles and material shipped	Doses and latent cancer fatalities
Nonradiological risk to public (nonradiological)	Traffic conditions along route	Origin and destination of shipments	Fatalities
Maximally exposed individual		Origin and destination of shipments Characterization of vehicles and material shipped	Doses and latent cancer fatalities

Key: CFR, Code of Federal Regulations.

alternative being considered. It was the primary means of comparing the various alternatives.) The accident assessment had two components: (1) a probabilistic risk assessment, which addressed the probabilities and consequences of a range of possible transportation accident environments, including low-probability accidents with high consequences and high-probability accidents with low consequences; and (2) an accident consequence assessment, which concerned only the consequences of the most severe transportation accidents postulated.

F.13 ENVIRONMENTAL JUSTICE

F.13.1 Description of Affected Resources

Constituting the affected environment are the low-income and minority populations residing in the potentially affected area. For the analysis of environmental justice relative to incident-free transportation, that area was defined as a corridor 1.6 km (1 mi) wide centered on rail or truck routes. For analyses pertaining to transportation accidents and evaluations of environmental justice in facility environs, it consisted of the geographical area within an 80 km (50 mi) distance of the accident site or facility.

Minority populations were split among four groups: Asians, Blacks, Hispanics, and Native Americans. The population group designated as Hispanic includes all persons who identified themselves as having Hispanic origins, regardless of race. For example, a person self-identified as Asian and of Hispanic origin was included among Hispanics. Persons self-identified as Asian and not of Hispanic origin were included in the Asian population.

Block group spatial resolution was used throughout the analysis (see Table F–13). The Census Bureau defines block group to include 250–500 housing units with 400 being typical. The minority population residing in the affected area was determined from data contained in Table P12 of Standard Tape File 3A published by the Census Bureau (DOC 1992). Low-income populations were estimated from data in Table P121 (DOC 1992:B-28, B-29), which provides statistical data characterizing income status relative to the poverty threshold for each block group.

F.13.2 Description of Impact Assessment

Formal requirements for inclusion of environmental justice concerns in environmental documentation were initiated by Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, issued in February 1994. The Council on Environmental Quality has oversight responsibility for implementation of the Executive order in documentation prepared under the provisions of NEPA. The Council issued draft guidance for environmental justice in May 1996 (CEQ 1997). These guidelines provide the foundation for evaluation of environmental justice in the SPD EIS.

Analysis of environmental justice for the SPD EIS focused on the "block group," one of the geographical aggregations of demographic data typically provided by the Census Bureau (DOC 1992). Block groups provide the finest spatial resolution available for evaluation of low-income populations. It is rare, however, that the boundaries of block groups coincide with those of affected areas. Uniform population distribution within block groups is also uncommon. Such uniformity was assumed, however, for purposes of SPD EIS population estimates. Thus, for each block group, the percentage of the population included in the population count equaled the percentage of the geographical area of the block group that lay within the affected area. An upper bound for the potentially affected population was obtained by including the total population of partially included block groups in the population count; a lower bound, by excluding the total population of such block groups from the count.

The following definitions were used in the evaluation:

- **Minority individuals:** Persons who are members of any of the following population groups: Asian or Pacific Islander, Black, Hispanic, or Native Americans (American Indian, Eskimo, or Aleut). This definition includes all persons except those self-designated as not of Hispanic origin and as either White or "Other Race" (one of the classifications used by the Census Bureau in the 1990 census).

Table F–13. Impact Assessment Protocol for Environmental Justice

	Required Data		
Resource	**Affected Environment**	**Health Effects**	**Measure of Impact**
Minority population	Minority population data at block group spatial resolution from Table P12 of STF3A (DOC 1992)		Disproportionately high annual population dose to minority population (CEQ 1997:app. A)
	Distribution within 80 km (50 mi) of each candidate site	Population dose for sectors within 80-km (50-mi) radius of candidate site	
	Distribution within 1.6 km (1 mi) of transportation corridors	Population dose for areas within 1.6-km (1-mi) radius of transportation corridor	
Low-income population	Low-income population data at block group spatial resolution from Table P121 of STF3A (DOC 1992)		Disproportionately high annual population dose to low-income population (CEQ 1997:app. A)
	Distribution within 80 km (50 mi) of each candidate site	Population dose for sectors within 80-km (50-mi) radius of candidate site	
	Distribution within 1.6 km (1 mi) of transportation corridor	Population dose for areas within 1.6-km (1-mi) radius of transportation corridor	

Key: CEQ, Council on Environmental Quality; DOC, U.S. Department of Commerce; STF, Standard Tape File.

- **Minority population:** The total number of minority individuals residing within a potentially affected area.

- **Low-income individuals:** All persons whose self-reported income is below the poverty threshold as adopted by the Census Bureau (DOC 1992:app. B, B-28).

- **Low-income population:** The total number of low-income individuals residing within a potentially affected area.

If the analysis of health or other environmental effects showed that the actions consistent with the proposed alternatives would have significant impacts on the general population, then additional analysis of impacts on the minority and low-income populations was conducted. The analysis method was identical to that described for the evaluation of radiological impacts on the general population. Given the impracticality of extrapolating block level population and income data, minority and low-income populations within each block group were assumed to increase in direct proportion to the increase in general population from the year 1990 to the year of interest.

F.14 CUMULATIVE IMPACTS

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis for the SPD EIS involved combining the impacts of the SPD EIS alternatives (including No Action) with the impacts of other past, present, and reasonably foreseeable activities.

[Text deleted.]

In general, cumulative impacts were calculated by adding the values for the baseline,[3] the maximum impacts from the proposed activities at the candidate sites, and other future actions. This cumulative value was then weighed against the appropriate impact indicators to determine the potential for impact. Table F–14 shows the selected indicators of cumulative impacts evaluated in the SPD EIS. The analysis focused on the potential for cumulative impacts at each candidate site from DOE actions under detailed consideration at the time of the SPD EIS (see Table F–15). Non-DOE actions were also considered where information was readily available. Public documents prepared by agencies of Federal, State, and local government were the primary sources of information for the non-DOE actions.

Table F–14. Selected Indicators of Cumulative Impact

Category	Indicator
Resource use	Land occupied
	Electricity use
	Water use
	Workers required
[Text deleted.]	
Air quality	Percent of NAAQS for criteria pollutants
Human health	Offsite population
	MEI dose
	Total dose
	Latent cancer fatalities
	Workers
	Average dose
	Total dose
	Latent cancer fatalities
Waste generation	Site waste generation rate versus capacity
	TRU waste
	LLW
	Mixed LLW
	Hazardous waste
	Nonhazardous waste
Transportation	Number of offsite trips
	MEI dose
	Risk of latent cancer fatality

Key: LLW, low-level waste; MEI, maximally exposed individual; NAAQS, National Ambient Air Quality Standards; TRU, transuranic.

It is assumed that construction impacts would not be cumulative because such construction is typically of short duration and construction impacts are generally temporary. However, waste created during construction as well as any radiation doses received by construction workers have been added to the cumulative totals for all

[3] The conditions attributable to actions, past and present, by DOE and other public and private entities.

Table F–15. Other Past, Present, and Reasonably Foreseeable Actions Considered in the Cumulative Impact Assessment for Candidate DOE Sites

Activities	Hanford	INEEL	Pantex	SRS	LLNL	LANL	ORNL
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X	X			X
Disposition of Surplus Highly Enriched Uranium				X			X
Interim Management of Nuclear Materials at SRS				X			
[Text deleted.]							
Tritium Supply and Recycling				X			
Waste Management	X	X	X	X		X	X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management	X	X		X			
Foreign Research Reactor Spent Nuclear Fuel	X	X		X			
Tank Waste Remediation System	X						
Shutdown of the River Water System at SRS				X			
Radioactive releases from nuclear power plant sites, Vogtle and WNP	X			X			
Hanford Reach of the Columbia River Comprehensive River Conservation Study	X						
FEIS and Environmental Information Report for Continued Operation of LLNL and SNL					X		
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components			X				
Stockpile Stewardship and Management			X	X	X		X
[Text deleted.]							
Management of Plutonium Residues and Scrub Alloy at Rocky Flats				X			
Spent Nuclear Fuel Management (SRS)				X			
DWPF Final Supplemental				X			
Supplemental EIS for In-Tank Precipitation Process Alternatives				X			
Construction and Operation of a Tritium Extraction Facility at SRS				X			
Supplement Analysis for Storing Plutonium in the Actinide Packaging and Storage Facility and Building 105–K at SRS				X			
Los Alamos Site-Wide EIS						X	
Hanford Remedial Action and Comprehensive Land Use Plan	X						
Advanced Mixed Waste Treatment Project		X					
Construction and Operation of the Spallation Neutron Source							X
Long-Term Management and Use of Depleted Uranium Hexafluoride							X

Key: DWPF, Defense Waste Processing Facility; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; ORNL, Oak Ridge National Laboratory; SNL, Sandia National Laboratories; WNP, Washington Nuclear Power.

proposed surplus plutonium disposition activities. D&D of the proposed facilities was not addressed in the cumulative impact estimates. Given the uncertainty regarding the timing of D&D, any impact estimate at this time would be highly speculative. A detailed evaluation of D&D will be provided in follow-on NEPA documentation closer to the actual time of those actions.

Recent sitewide NEPA documents (see Table F–16) provide the latest comprehensive evaluation of cumulative impacts for the sites.

Table F–16. Recent Comprehensive National Environmental Policy Act Documents for the DOE Sites

Site	Document	Year	ROD Issued[a]
Hanford	*Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*	1996	February 1997
INEEL	*DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*	1995	March 1996
Pantex	*Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*	1996	January 1997
SRS	*Savannah River Site Waste Management Final Environmental Impact Statement*	1995	October 1995
LLNL	*Final Site-Wide Environmental Impact Statement for Continued Operation of the Lawrence Livermore National Laboratory*	1992	January 1993
LANL	*Final Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*	1999	Pending

[a] Date of the first ROD issued.

Key: ROD, Record of Decision.

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