CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

This chapter describes the impacts that would result from implementing the waste management alternatives described in Chapter 2. As an aid to the reader, this chapter begins with a guide to understanding the human health and transportation analyses (Section 4.1), followed by a summary of the impacts of the alternatives (Section 4.2).

The three alternatives and the sections in which they are fully discussed are:

- No Action Alternative – Continuation of Ongoing Waste Management Activities (Section 4.3);
- Alternative A – Offsite Shipment of HLW, LLW, Mixed LLW, and TRU Waste to Disposal and Ongoing Management of the Waste Storage Tanks – Preferred Alternative (Section 4.4); and
- Alternative B – Offsite Shipment of LLW and Mixed LLW to Disposal, Shipment of HLW and TRU Waste to Interim Storage, and Interim Stabilization of the Waste Storage Tanks (Section 4.5).

The potential for minority and low-income populations to bear a disproportionate share of high and adverse impacts from the proposed activities is discussed in Section 4.6.

The analyses in this chapter are limited to human health and transportation impacts. None of the proposed alternatives would require changes in the workforce or additional facilities at the WVDP premises; therefore, they would not affect the surrounding natural and cultural environments.

Additional information regarding the methodology used to conduct the analyses is contained in Appendices C and D.

As characterized in Chapter 2, the waste management activities assessed in this EIS would occur in the following facilities at the WVDP site: the Process Building; the Tank Farm; the LSB; LSAs 1, 3, and 4; the Chemical Process Cell Waste Storage Area; and the Radwaste Treatment System Drum Cell. This EIS evaluates proposed activities necessary to (1) store or prepare wastes for shipping, including loading containerized wastes onto transportation vehicles; (2) ship wastes to offsite disposal or interim storage; and (3) manage the emptied waste storage tanks until final decommissioning or long-term stewardship decisions can be made in the future.

The waste management actions proposed under all alternatives would be conducted in existing facilities (or in the case of waste transportation, on existing road and rail lines) by the existing work force and would not involve new construction or building demolition. Ongoing facility operations would continue, unaffected by the proposed actions assessed in this EIS. As a result, the scope of potential impacts that could result from the proposed actions is limited. Specifically, because there would be no mechanism for new land disturbance under any alternative, there would be no potential to directly or indirectly impact current land use; biotic communities; cultural, historical, or archaeological resources; visual resources; ambient noise levels; threatened or endangered species or their critical habitats; wetlands; or floodplains. Additionally, because the work force requirements would be the same under all alternatives (for example, there would be no increases or decreases from current employment levels), there would be no potential for socioeconomic impacts. Therefore, these elements of the affected environment would not be impacted by any actions proposed under the three alternatives and will not be discussed further in this chapter.

None of the onsite management activities under any of the alternatives would result in any new criteria air pollutant emissions (nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter). As shown in Section 3.3.2, the ambient air quality in the region of the Center complies with federal and state ambient air quality standards. Impacts of criteria air pollutant emissions resulting from transportation activities are incorporated in the transportation analysis. Radioactive emissions that could result from ongoing management or interim stabilization of the waste storage tanks are addressed under the human health analysis. Therefore, this chapter includes no further discussion of air quality impacts.

Consistent with DOE and Council on Environmental Quality NEPA guidance, the analysis of impacts in the following sections focuses on those limited areas in which impacts may occur from any action proposed by the three alternatives assessed in this EIS. Because of the limited scope of the proposed actions, there would be potential for impacts to only the workers and the public from the proposed onsite waste management actions, ongoing operations, and the offsite shipping of wastes.

4.1 UNDERSTANDING THE ANALYSIS

This section describes how impacts to worker and public human health from onsite waste management and offsite shipping were analyzed. This discussion is intended to help the reader understand the impacts described for each alternative in subsequent sections.

4.1.1 Human Health Impacts

4.1.1.1 Routine Operations

The waste management activities that would be undertaken under each of the three alternatives analyzed would result in the exposure of workers to radiation and exposure of the public to very small quantities of radioactive materials from controlled releases to the environment. Radiation can cause a variety of ill-health effects in people, including cancer.

To determine whether health effects could occur as a result of radiation exposure from a particular activity and the extent of such effects, the radiation dose must be calculated. An individual may be exposed to radiation externally, through a radiation source outside of the body, and/or internally from ingesting or inhaling radioactive material. The dose is a function of the exposure pathway (for example, external exposure, inhalation, or ingestion) and the type and quantity of radionuclides involved.

The unit of radiation dose for an individual is the rem. A millirem (mrem) is 1/1,000 of a rem. The unit of dose for a population is person-rem and is determined by summing the individual doses of an exposed population. Dividing the person-rem estimate by the number of people in the population indicates the average dose that a single individual could receive. The impacts from a small dose to a large number of people can be approximated by the use of population (collective) dose estimates.

After the dose is estimated, the health impact is calculated from current internationally recognized risk factors. The

Exposure Standards

The following radiation protection standards were established by the EPA and DOE.

- *EPA:* 10-mrem radiation dose per year to the maximally exposed individual member of the public from airborne releases (40 CFR Part 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities*)
- *DOE:* 100-mrem dose per year to the maximally exposed individual member of the public through all exposure pathways (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*)
- *DOE*: 5-rem dose per year for workers (10 CFR 835, *Occupational Radiation Protection*)

potential health impact is stated in terms of the probability of a latent cancer fatality (a fatality resulting from a cancer that was originally induced by radiation but which may occur years after the exposure) to an individual or the number of latent cancer fatalities expected in a population.

To estimate the human health impact from radiation dose, a dose-to-risk factor that indicates the potential for a latent cancer fatality is used. The dose-to-risk factor for low (less than 20 rem) annual doses is 5×10^{-4} of a latent cancer fatality per person-rem for the general public, which includes the very young and the very old, and 4×10^{-4} for the worker population (ICRP 1991). For example, a population dose of 2,000 person-rem is estimated to result in 1 additional cancer fatality ($0.0005 \times 2{,}000 = 1$) in the general public.

Calculations of the number of latent cancer fatalities associated with radiation doses often do not yield whole numbers, and the number may be less than 1. For example, if a population of 1,000,000 people each received a radiation dose of 1 mrem (1×10^{-3} rem) per person, the population dose would be 1,000 person-rem. The number of latent cancer fatalities would be 0.5 (1,000,000 persons × 0.001 rem × 0.0005 latent cancer fatalities per person-rem = 0.5 latent cancer fatalities). The value of 0.5 is the average number of latent cancer fatalities that would occur if the same radiation dose were applied to many different groups of 1,000,000 people. Some groups would experience 1 latent cancer fatality from the radiation dose, some groups would experience no latent cancer fatalities from the radiation dose, and the average would be 0.5. In this context, the value of 0.5 is often referred to as the probability of a latent cancer fatality in the exposed population of 1,000,000 people.

For perspective, it is estimated that the average individual in the United States receives a dose of about 300 mrem (0.3 rem) each year from natural sources of radiation. The probability of a latent cancer fatality corresponding to a single individual's exposure over an assumed 72-year lifetime to 300 mrem annually is about 0.01 or about 1 in 100 (1 person × 300 mrem per year × 1 rem per 1,000 mrem × 72 years × 0.0005 latent cancer fatalities per person-rem = 0.01 latent cancer fatality). If 1,000,000 people were exposed to 300 mrem per year over a 72-year lifetime, about 10,000 latent cancer fatalities would be estimated to occur (1,000,000 people x 300 mrem/year x 72 years x 5E-7 latent cancer fatalities/mrem = 11,000 latent cancer fatalities, rounded to 10,000 latent cancer fatalities).

Under all alternatives, people near the WVDP site would be exposed to radionuclides (radioactive atoms) that are released to the atmosphere and to surface water during normal ongoing operations at the site. For this EIS, DOE estimated the radiation doses from those releases using the GENII computer model (Napier et al. 1988). People were assumed to inhale radioactive material and to be exposed to external radiation from the radioactive material released during normal ongoing operations. People were also assumed to ingest radioactive material through foodstuffs such as leafy vegetables, produce, meat, and milk and to be exposed through activities such as swimming and boating; inadvertent soil ingestion; inhaling resuspended radioactive material; drinking water; and consuming fish from Lake Erie.

Ongoing Operations

Under all alternatives, it is assumed that current levels of maintenance, surveillance, heating, ventilation, and other routine operations would continue to be required while the actions proposed under each alternative were performed. For this EIS, these actions are called *ongoing operations*. Although the impacts of these ongoing actions have been assessed in several previous NEPA documents and are characterized in the Annual Site Environmental Reports, the impacts on worker and public health of these ongoing operations have been included in this EIS using actual operational data from 1995 through 1999. Because ongoing operations would not vary among the proposed alternatives, the impacts from these actions would be the same across all alternatives.

DOE analyzed the exposure of members of the public and workers to radiation or radioactive releases as a result of the alternatives. For workers, DOE analyzed the exposure of both involved and noninvolved workers at the site. Involved workers are those who would be undertaking the proposed waste management activities analyzed in this EIS. They would be exposed to radioactive releases from both the waste management activities and the ongoing operations of the site. Noninvolved workers are those workers who would be present on the site but who would not be conducting the proposed waste management activities. These workers would be conducting activities related to the ongoing operations of the WVDP site. Doses to the worker populations and to individual workers were estimated.

For the public, dose estimates were derived for both the maximally exposed individual (a member of the public located nearest to the site) and the collective population within 80 kilometers (50 miles) of the site.

For both the public and workers, DOE then calculated the probability that the maximally exposed individual would suffer a latent cancer fatality if exposed to that radiation dose and the probability that a latent cancer fatality would occur within the exposed population.

Human Health Impacts

DOE estimated radiation doses to:

- Involved workers
  - Worker population
  - Individual workers
- Noninvolved workers
  - Worker population
  - Individual workers
- Members of the public
  - Collective population
  - Maximally exposed individual

Using accepted dose-to-risk conversion factors, DOE calculated the probability that an individual would suffer a latent cancer fatality or that a latent cancer fatality would occur within the exposed population.

Additional information regarding the analysis of human health impacts under routine operations can be found in Appendix C.

4.1.1.2 Accident Conditions

For this EIS, DOE evaluated a wide range of potential facility accidents at the WVDP site that could result from handling mishaps, fires, or spills, or from external events such as high winds or earthquakes. Although a great many accidents could occur at WVDP facilities, only a few accidents could potentially result in an uncontrolled release of radioactive material to the environment.

Of the accidents that were evaluated, DOE selected 14 accidents for further evaluation using the GENII computer model (Napier et al. 1988). These accidents were selected because they could result from operations and activities that were determined to present the greatest risk, based on their accident consequence and probability.

The chance that an accident might occur during the conduct of an activity is called the probability of occurrence. An event that is certain to occur has a probability of 1 (as in 100 percent certainty). The probability of occurrence of an accident is less than 1 because accidents, by definition, are not certain to occur. However, in its accident analysis, when calculating the probability of a latent cancer fatality occurring as a result of exposure to radiation in particular accident situations, DOE did not take into account the probability of occurrence of the accident.

In an accident, radioactive material could be released from ground level or from a stack. Atmospheric conditions at the time of an accident would affect the dose received by workers, the maximally exposed individual, and the public. For that reason, DOE used two types of atmospheric conditions to estimate radiation doses: (1) atmospheric conditions that are not exceeded 50 percent of the time and provide a realistic estimate of the likely atmospheric conditions that would exist during an accident (50-percent atmospheric conditions), and (2) atmospheric conditions that are not exceeded 95 percent of the time and provide an upper bound on the atmospheric conditions that would exist during an accident (95-percent atmospheric conditions). Site-specific meteorological data from 1994 through 1998 (WVNS 2000a) were used to determine 50-percent and 95-percent atmospheric conditions.

After estimating the radiation that could be released as a result of specific postulated accidents at the WVDP site (the dose to workers or the public), DOE estimated the probability of latent cancer fatalities if those accidents were to occur. As with routine operations, DOE provides the probability of latent cancer fatalities under accident conditions for workers and members of the public (the maximally exposed individual and the collective population within 80 kilometers [50 miles] of the site).

Additional information regarding the analysis of human health impacts under accident conditions can be found in Appendix C.

4.1.2 Transportation Impacts

DOE analyzed the potential impacts of shipping radioactive waste from the WVDP site to a storage or disposal site under both incident-free and accident conditions. Representative highway and rail routes from the WVDP site to specific destinations were determined using the WebTRAGIS routing computer code (Johnson and Michelhaugh 2000). The routes conform to current routing practices and applicable routing regulations and guidelines. The populations that might be exposed along these routes were determined using data from the 2000 census.

The total impacts of transportation are the sums of the radiological and nonradiological incident-free and accident impacts. For incident-free transportation, the potential human health impacts were estimated for transportation workers and populations along the route, people sharing the route (in traffic), and people at stops along the route. The impacts from incident-free transportation are the radiological impacts from exposure to low levels of radiation from the radioactive waste containers and the nonradiological impacts from truck or train exhaust. The RADTRAN 5 computer code (Neuhauser et al. 2000) was used to estimate the impacts for transportation workers and populations. Impacts were also estimated for the maximally exposed individual, who may be a worker or a member of the public, using the RISKIND computer code (Yuan et al. 1995). The impacts for the maximally exposed individual are presented separately from the other incident-free transportation impacts.

Human health impacts could result from transportation accidents in which radioactive material could be released from a waste container and from traffic accidents in which no radioactive material would be released. For transportation accidents involving a release of radioactive material, DOE estimated radiological accident risks (probability of occurrence × consequence) expressed as the number of latent cancer fatalities summed over a complete spectrum of accidents. Impacts were evaluated for the population within 80 kilometers (50 miles) of the road or railway using the RADTRAN 5 computer code. DOE assumed that people would be exposed through inhalation, direct external dose from radioactive material that has deposited on the ground after being dispersed from the accident site (referred to as groundshine), and direct external dose from the passing cloud of dispersed radioactive material (referred to as cloudshine). In rural areas, DOE assumed that exposure could also occur through ingestion of agricultural products grown in contaminated soil. Consequences were also estimated for a severe transportation accident, known as the maximum reasonably foreseeable accident. These consequences were estimated using the RISKIND computer code and are presented separately from the other transportation accident impacts.

Additional information regarding the analysis of transportation impacts under both incident-free and accident conditions can be found in Appendix D.

4.2 SUMMARY OF IMPACTS

The actions proposed by the alternatives analyzed in this EIS would have an almost imperceptible impact on the health of the workers and the public, even when combined with the minimal impacts of ongoing operations. Health impacts for all alternatives under normal onsite operating conditions and offsite transportation would result in less than 1 cancer fatality among workers or the public.

4.2.1 Human Health Impacts

Waste management activities under each alternative would result in the exposure of workers to radiation and contaminated material and exposure of the public to very small quantities of radioactive materials. Because the proposed waste management actions would involve only the storage, packaging, loading, and shipping of wastes and management options for the waste storage tanks, the proposed activities would result in a statistically insignificant contribution to the historically low impacts of ongoing WVDP operations. As a result, the human health impacts to involved and noninvolved workers and the public are dominated by ongoing WVDP site operations that would continue under all alternatives; therefore, there would be little discernible difference in the impacts that could occur among the three alternatives. The potential human health impacts for onsite waste management actions are summarized below and demonstrate that the impacts of each alternative would result in less than 1 cancer fatality among workers or the public under normal operating conditions.

- Total Involved and Noninvolved Worker Population Dose (in person-rem)
  - No Action Alternative 150
  - Alternative A 210
  - Alternative B 210

- Latent Cancer Fatalities in Involved and Noninvolved Worker Population
  - No Action Alternative less than 1 (0.062)
  - Alternative A less than 1 (0.084)
  - Alternative B less than 1 (0.085)

- Total Public Population Dose (in person-rem)
  - No Action Alternative 2.5
  - Alternative A 2.5
  - Alternative B 2.5

- Latent Cancer Fatalities in Public Population
  - No Action Alternative less than 1 (1.3×10^{-3})
  - Alternative A less than 1 (1.3×10^{-3})
  - Alternative B less than 1 (1.3×10^{-3})

- Total Maximally Exposed Individual Dose (in mrem)
  - No Action Alternative 0.62
  - Alternative A 0.62
  - Alternative B 0.62

- Total Probability of Latent Cancer Fatality to Maximally Exposed Individual
  - No Action Alternative 3.1×10^{-7}
  - Alternative A 3.1×10^{-7}
  - Alternative B 3.1×10^{-7}

Based on the detailed analyses provided later in this chapter and in Appendix C, under all alternatives, neither individual involved workers, the maximally exposed individual, nor the general public near the WVDP site would be expected to incur a latent cancer fatality under any atmospheric conditions if an accident were to occur during waste management activities. Among the accident scenarios evaluated, the projected latent cancer fatalities among the public ranged from a high of 0.070 to a low of 3.8×10^{-6}. The frequencies of these accidents ranged from 0.1 to 10^{-8} per year. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for these accidents was less than 1. Therefore, the radioactive releases from these accidents would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.2.2 Transportation Impacts

Projected impacts from offsite waste transportation were less than 1 latent cancer fatality among workers and the public for all three alternatives. Rail transportation was generally found to be slightly higher than, but similar to, the impacts from truck transportation. Impacts are also projected to be slightly higher for Alternative B due to the increased shipping required to move the TRU and HLW wastes to interim storage prior to ultimate disposal. Although the same number of shipments would be loaded at the WVDP site (2,250 truck or 847 rail), the total number of shipments required to reach disposal destinations would be higher under Alternative B due to the interim storage of TRU waste and HLW (see Table 2-3).

The transportation impacts that could result from transportation are summarized below.

- No Action Alternative
  - 169 truck or 85 rail shipments of Class A LLW
  - 0.030 – 0.037 fatalities expected from truck shipments
  - 0.036 – 0.043 fatalities expected from rail shipments

- Alternative A
  - 2,550 truck or 847 rail shipments of LLW, mixed LLW, TRU waste and HLW canisters
  - 0.69 – 0.72 fatality expected for truck shipments
  - 0.52 – 0.59 fatalities expected for rail shipments

- Alternative B
  - 3,120 truck or 1,079 rail shipments of LLW, mixed LLW, TRU waste, and HLW canisters
  - 0.76 – 0.87 fatality expected for truck shipments;
  - 0.62 – 0.78 fatalities expected for rail shipments

The consequences of the maximum reasonably foreseeable transportation accidents under each alternative would vary slightly among the alternatives and between truck and rail transport. Under the No Action Alternative, the maximum reasonably foreseeable transportation accident would involve Class A LLW. For truck transport, this accident could result in about 1 latent cancer fatality, and for rail about 1 latent cancer fatality, among the exposed population. For Alternatives A and B, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Because one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident would be the same. Among the exposed population, this accident could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for the Class A LLW accidents and the CH-TRU accident was less than 1. Therefore, the radioactive releases from the Class A LLW accidents and the

CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.2.3 Offsite Impacts

Impacts of waste management activities at offsite locations (Envirocare, Hanford, INEEL, NTS, ORNL, SRS, WIPP, and Yucca Mountain) have been addressed in earlier NEPA documents (see Section 1.7.1). For all waste types, WVDP waste represents less than 2 percent of the total DOE waste inventory. Human health impacts at all sites as a result of the management (storage or disposal) of WVDP during the 10-year period of analysis would be very minor (substantially less than 1 latent cancer fatality).

4.3 IMPACTS OF THE NO ACTION ALTERNATIVE – CONTINUATION OF ONGOING WASTE MANAGEMENT ACTIVITIES

As described in Chapter 2, under the **No Action Alternative**, no additional waste management activities would be performed beyond those activities that have already been evaluated under prior NEPA analyses (Section 1.7.1) in accordance with the provisions of the Council on Environmental Quality Implementing Regulations for NEPA (40 CFR Parts 1500-1508). DOE would provide continued operational support and monitoring of the facilities to meet the requirements for safety and hazard management. Waste management activities currently in progress for onsite storage of existing wastes and offsite disposition of a limited quantity of Class A LLW to a facility such as Envirocare (a commercial radioactive waste disposal site in Clive, Utah) or NTS in Mercury, Nevada, would continue. For the purposes of analysis, however, offsite disposal of Class A LLW at Hanford was also considered. The emptied waste storage tanks would continue to be ventilated and maintained in either a wet or dry condition to mitigate corrosion until final decisions are reached in a ROD for the Decommissioning and/or Long-Term Stewardship EIS. Both wet and dry conditions were analyzed in this EIS. Under the No Action Alternative, active hazard management, operational support, surveillance, and oversight would continue at the current levels of activity. The waste management activities evaluated under this alternative would occur over the next 10 years.

4.3.1 Human Health Impacts (No Action Alternative)

This section characterizes the radiological impacts from the No Action Alternative activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material from controlled releases to the environment. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services. The figures shown in the textbox provide the relative probabilities of cancer fatalities from more common sources of risk.

Comparative Risk

<u>**Cause of Death**</u>	**Approximate** <u>**Probability**</u>
Cancer	1 chance in 5
Lung cancer due to smoking	1 chance in 10
Cancer caused by background radiation	1 chance in 100
Second-hand smoke	1 chance in 700
Motor vehicle accident	1 chance in 5,000
Cancer due to CAT scan	1 chance in 20,000
Cancer due to chest x-ray	1 chance in 250,000

Worker Impacts. Under the No Action Alternative, waste management activities currently in progress would continue for onsite storage of existing wastes and offsite disposal of a limited quantity of Class A LLW. Management of the waste storage tanks would also continue as under current operations. Table 4-1 presents the radiological impacts to involved and noninvolved workers for the No Action Alternative. During the 10-year time period, the collective radiation dose to involved workers was

Table 4-1. Radiation Doses for Involved and Noninvolved Workers Under the No Action Alternative

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers[a]	No Action Alternative activities	10	0.41	4.1	1.6×10^{-4}	1.6×10^{-3}
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	15	150	6.0×10^{-3}	6.0×10^{-2}
All workers	Total	10	15	150	6.2×10^{-3}	6.2×10^{-2}
Worker Population	**Activity**	**Time Period (years)**	**Individual Dose**		**Latent Cancer Fatalities**	
			Annual (mrem/yr)	**Total (mrem)**	**Annual**	**Total**
Involved workers[a]	No Action Alternative activities	10	68	680	2.7×10^{-5}	2.7×10^{-4}
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	59	590	2.4×10^{-5}	2.4×10^{-4}

a. Involved workers would be those individuals that actively participate in the No Action Alternative.
b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in the No Action Alternative.

estimated to be about 4.1 person-rem or about 0.41 person-rem per year from activities under the No Action Alternative. Over this same time period, the individual radiation dose to the average involved worker would be about 68 mrem per year.

This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 (2.7×10^{-5}) latent cancer fatality or a chance of about 1 in 37,000 per year.

In addition to radiation doses from No Action Alternative activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both No Action Alternative activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 150 person-rem over the duration of the No Action Alternative or about 15 person-rem per year (Table 4-1). This dose is equivalent to less than 1 (0.062) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under the No Action Alternative, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

Public Impacts. Under the No Action Alternative, waste management activities currently in progress would continue for onsite storage of existing wastes and offsite disposal of a limited quantity of Class A LLW. Management of the waste storage tanks would also continue as under current operations. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP (Table 4-2).

Table 4-2. Radiation Doses to the Public Under the No Action Alternative[a]

Activity	Maximally Exposed Individual: Individual Radiation Dose[b] Annual (mrem/yr)	Total (mrem)	Probability of Latent Cancer Fatality: Annual	Total	Population Around WVDP Site: Collective Radiation Dose[c] Annual (person-rem/yr)	Total (person-rem)	Probability of Latent Cancer Fatality: Annual	Total
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	1.1×10^{-8}	1.1×10^{-7}	0.17	1.7	8.5×10^{-5}	8.5×10^{-4}
Percent of EPA standard (10 mrem per year)	<1	NA[d]	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	2.1×10^{-8}	2.1×10^{-7}	0.083	0.83	4.2×10^{-5}	4.2×10^{-4}
All pathways	0.062	0.62	3.1×10^{-8}	3.1×10^{-7}	0.25	2.5	1.3×10^{-4}	1.3×10^{-3}
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for the No Action Alternative is 10 years.
b. Individual background radiation doses are about 300 mrem per year.
c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.
d. NA = not applicable.

Annual Dose. The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 (1.3×10^{-4}) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*) and would result in less than 1 (3.1×10^{-8}) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

Total Dose. For the duration of the No Action Alternative (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 (1.3×10^{-3}) latent cancer fatality over the duration of the No Action Alternative.

4.3.2 Impacts from Facility Accidents (No Action Alternative)

DOE evaluated the potential impacts that could occur as a result of accidents at the WVDP site during the implementation of the No Action Alternative. Because only Class A LLW would be shipped under the No Action Alternative, these accidents were limited to those involving the handling of Class A LLW in preparation for shipping. In addition, accidents involving the ongoing management of Tanks 8D-1 and 8D-2 were evaluated. Accidents involving ongoing or continuing activities at the WVDP site that were not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

One potential handling accident involved the puncture of a drum containing Class A LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of 7.1×10^{-6} rem. This accident could result in a radiation dose of 2.4×10^{-6} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.0075 person-rem; this is equivalent to a probability of a latent cancer fatality of 3.8×10^{-6}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 6.0×10^{-5} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

A second potential accident involved a drop of a pallet containing six Class A LLW drums, all of which were assumed to rupture. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of 4.2×10^{-5} rem. This accident could result in a radiation dose of 1.4×10^{-5} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.044 person-rem; this is equivalent to a probability of a latent cancer fatality of 2.2×10^{-5}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 3.5×10^{-4} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

A third potential accident involved the puncture of a box containing Class A LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-3. For a worker located at the site, this accident could result in a radiation dose of 8.5×10^{-5} rem. This accident could result in a radiation dose of 2.9×10^{-5} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.090 person-rem; this is equivalent to a probability of a latent cancer fatality of 4.5×10^{-5}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 7.0×10^{-4} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

DOE also analyzed accidents involving the ongoing management of Tanks 8D-1 and 8D-2. These accidents assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. Two accidents were analyzed, one where the contents of the tank were kept wet and another where the contents of the tank were allowed to dry before the collapse. The frequencies of the accidents were estimated to be in the range of 10^{-4} to 10^{-6} per year.

The consequences of the accidents using 50-percent atmospheric conditions are presented in Table 4-3. If the contents of the tanks are kept wet, the accident could result in a radiation dose of 2.4×10^{-3} rem for the worker located at the site. This accident could result in a radiation dose of 8.1×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 2.5 person-rem; this is equivalent to

Table 4-3. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Class A drum puncture[b]	0.1 – 0.01	7.1×10^{-6}	2.8×10^{-9}	2.4×10^{-6}	1.2×10^{-9}	7.5×10^{-3}	3.8×10^{-6}
Class A pallet drop[b]	0.1 – 0.01	4.2×10^{-5}	1.7×10^{-8}	1.4×10^{-5}	7.0×10^{-9}	0.044	2.2×10^{-5}
Class A box puncture[b]	0.1 – 0.01	8.5×10^{-5}	3.4×10^{-8}	2.9×10^{-5}	1.5×10^{-8}	0.090	4.5×10^{-5}
Collapse of Tank 8D-2 (wet)[b]	$10^{-4} – 10^{-6}$	2.4×10^{-3}	9.6×10^{-7}	8.1×10^{-4}	4.1×10^{-7}	2.5	1.3×10^{-3}
Collapse of Tank 8D-2 (dry)[b]	$10^{-4} – 10^{-6}$	2.8×10^{-3}	1.1×10^{-6}	9.5×10^{-4}	4.8×10^{-7}	3.0	1.5×10^{-3}

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.

Table 4-4. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Class A drum puncture[b]	0.1 – 0.01	7.0×10^{-5}	2.8×10^{-8}	2.6×10^{-5}	1.3×10^{-8}	0.12	6.0×10^{-5}
Class A pallet drop[b]	0.1 – 0.01	4.2×10^{-4}	1.7×10^{-7}	1.5×10^{-4}	7.5×10^{-8}	0.69	3.5×10^{-4}
Class A box puncture[b]	0.1 – 0.01	8.4×10^{-4}	3.4×10^{-7}	3.2×10^{-4}	1.6×10^{-7}	1.4	7.0×10^{-4}
Collapse of Tank 8D-2 (wet)[b]	$10^{-4} – 10^{-6}$	0.024	9.6×10^{-6}	8.9×10^{-3}	4.5×10^{-6}	39	0.020
Collapse of Tank 8D-2 (dry)[b]	$10^{-4} – 10^{-6}$	0.028	1.1×10^{-5}	0.010	5.0×10^{-6}	46	0.023

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.

a probability of a latent cancer fatality of 1.3×10^{-3}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.020 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

If the contents of the tanks are kept dry, this accident could result in a radiation dose of 2.8×10^{-3} rem for the worker located at the site (Table 4-3). This accident could result in a radiation dose of 9.5×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 3.0 person-rem; this is equivalent to a probability of a latent cancer fatality of 1.5×10^{-3}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.023 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-4).

The highest consequence accident in Table 4-3 was the collapse of Tank 8D-2 while the contents of the tank were dry. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases for this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.3.3 Transportation (No Action Alternative)

Under the No Action Alternative analysis, about 4,100 cubic meters (145,000 cubic feet) of Class A LLW would be shipped for disposal either to NTS, Hanford, or a commercial disposal site such as Envirocare, under existing NEPA reviews. These shipments would take place over 10 years. All other newly generated and existing wastes would continue to be stored under this alternative. The waste transportation destinations proposed under the No Action Alternative are shown in Figure 4-1.

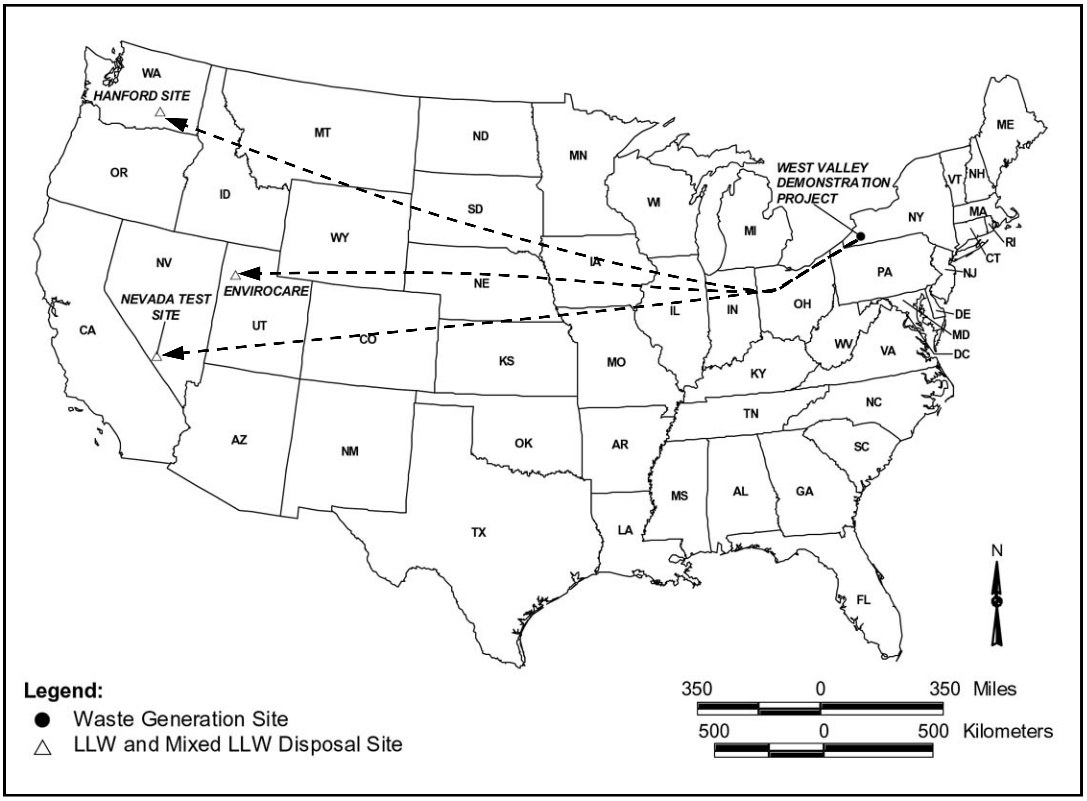

Figure 4-1. Waste Destinations Under the No Action Alternative

Transportation impacts were estimated assuming 100 percent of the Class A LLW would be shipped by truck and 100 percent of the Class A LLW would be shipped by rail. Table 4-5 lists the Class A LLW shipments proposed under the No Action Alternative.

Table 4-5. LLW Waste Shipped Under the No Action Alternative

Waste Type	Container Type	Waste Shipped (cubic feet)[a]	Number of Containers	Number of Shipments
Class A LLW	Boxes[b]	97,649	1,206	87 (truck) 44 (rail)
	Drums[b]	47,351	6,878	82 (truck) 41 (rail)
Total		145,000	8,084	169 (truck) 85 (rail)

a. To convert cubic feet to cubic meters, multiply by 0.028
b. Shipped in Type A shipping container

4.3.3.1 Total Impacts from Transportation Activities

The transportation impacts of shipping radioactive waste would be from two sources: incident-free transportation and transportation accidents. Both radiological impacts and nonradiological impacts are included in the analysis. The total impacts from transportation would be the sum of the impacts from incident-free transportation and transportation accidents. Additional details on these analyses are provided in Appendix D.

Table 4-6 lists the total transportation impacts by waste type and destination under the No Action Alternative. If either trucks or trains were used to ship the radioactive waste, less than 1 fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States over the 10-year time period for the No Action Alternative (U.S. Bureau of the Census 1997).

Table 4-6. Transportation Impacts Under the No Action Alternative

Waste Type	Destination	Incident-Free Public (LCFs)	Incident-Free Worker (LCFs)	Radiological Accident Risk (LCFs)	Pollution Health Effects (Fatalities)	Traffic Fatalities	Total Fatalities
Truck							
Class A LLW	Envirocare	7.7×10^{-3}	9.2×10^{-3}	5.7×10^{-5}	2.1×10^{-3}	1.1×10^{-2}	3.0×10^{-2}
	Hanford Site	9.3×10^{-3}	1.1×10^{-2}	6.2×10^{-5}	2.3×10^{-3}	1.4×10^{-2}	3.7×10^{-2}
	NTS	9.5×10^{-3}	1.1×10^{-2}	7.1×10^{-5}	2.8×10^{-3}	1.3×10^{-2}	3.6×10^{-2}
							Total Truck Fatalities: 0.030 – 0.037
Rail							
Class A LLW	Envirocare	1.4×10^{-2}	9.7×10^{-3}	2.2×10^{-4}	3.0×10^{-3}	9.8×10^{-3}	3.6×10^{-2}
	Hanford Site	1.4×10^{-2}	1.0×10^{-2}	2.5×10^{-4}	3.1×10^{-3}	1.2×10^{-2}	4.0×10^{-2}
	NTS	1.4×10^{-2}	1.3×10^{-2}	2.3×10^{-4}	3.0×10^{-3}	1.2×10^{-2}	4.3×10^{-2}
							Total Rail Fatalities: 0.036 – 0.043

Acronyms: LCFs = latent cancer fatalities; NTS = Nevada Test Site. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

4.3.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

Worker Impacts. If trucks were used to ship the waste, the maximally exposed worker would be a driver who would receive a radiation dose of about 250 mrem per year based on driving a truck containing radioactive waste for about 700 hours per year. This is equivalent to a probability of a latent cancer fatality of about 1.0×10^{-4}. If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 1.9 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 7.6×10^{-7}.

Public Impacts. For truck shipments, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 0.10 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 5.0×10^{-8}.

If shipments were made by rail, the maximally exposed member of the public would be a railyard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 0.35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 1.8×10^{-7}.

4.3.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents

The maximally exposed individual would receive a radiation dose of 4.6 rem from the maximum reasonably foreseeable transportation accident involving a truck shipment of Class A LLW. This is equivalent to a probability of a latent cancer fatality of about 2.3×10^{-3}. The probability of this accident is about 5×10^{-7} per year. The population would receive a collective radiation dose of about 1,300 person-rem from this truck accident involving Class A LLW. This could result in about 1 latent cancer fatality.

For the maximum reasonably foreseeable transportation rail accident involving Class A LLW, the maximally exposed individual would receive a radiation dose of about 9.2 rem. This is equivalent to a probability of a latent cancer fatality of about 4.6×10^{-3}. The probability of this accident is about 2×10^{-6} per year. The population would receive a collective radiation dose of about 2,600 person-rem from this rail accident involving Class A LLW. This could result in about 1 latent cancer fatality.

Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for the Class A LLW accidents was less than 1. Therefore, the radioactive releases from the Class A LLW accidents would not be likely to cause persistent, measurable deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.3.4 Offsite Impacts (No Action Alternative)

Under the No Action Alternative, 4,060 cubic meters (145,000 cubic feet) of Class A LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP Class A LLW were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from 4.8×10^{-3} to 5.4×10^{-3}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between 6.9×10^{-6} and 3×10^{-16}. Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C.10, explains how these impacts were derived.

4.4 IMPACTS OF ALTERNATIVE A – OFFSITE SHIPMENT OF HLW, LLW, MIXED LLW, AND TRU WASTE TO DISPOSAL AND ONGOING MANAGEMENT OF THE WASTE STORAGE TANKS

Under **Alternative A (Preferred Alternative)**, DOE would ship Class A, B, and C LLW and mixed LLW to one of two DOE potential disposal sites (in Washington or Nevada) or to a commercial disposal site (such as the Envirocare facility in Utah); ship TRU waste to WIPP in New Mexico; and ship HLW to the proposed Yucca Mountain HLW Repository. LLW and mixed LLW would be shipped over the next 10 years. TRU waste shipments to WIPP could occur within the next 10 years if the TRU waste were determined to meet all the requirements for disposal in this repository. If some or all of WVDP's TRU waste did not meet these requirements, the Department would need to explore other alternatives for disposal of this waste.

Under DOE's current programmatic decisionmaking, offsite disposal of HLW would occur at the proposed Yucca Mountain HLW Repository sometime after 2025 assuming a license to operate is granted by NRC. Although this period would extend well beyond the 10 years required for all other proposed actions under this alternative, the impacts of transporting the HLW have been included in this EIS to fully inform the decisionmakers should an earlier opportunity to ship HLW present itself. The waste storage tanks would continue to be managed as described under the No Action Alternative.

4.4.1 Human Health Impacts (Alternative A)

This section characterizes the radiological impacts from Alternative A activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services.

Worker Impacts. Under Alternative A, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. Management of the waste storage tanks would continue as under current operations. Table 4-7 presents the radiological impacts to involved and noninvolved workers for Alternative A. During the 10-year time period, the collective radiation dose to involved workers was estimated to be about 61 person-rem or about 6.1 person-rem per year from activities under Alternative A. Over this same time period, the individual radiation dose to the average involved worker would be about 260 mrem per year. This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 (1.0×10^{-4}) latent cancer fatality or a chance of about 1 in 10,000 per year.

Table 4-7. Radiation Doses for Involved and Noninvolved Workers Under Alternative A

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers[a]	Alternative A activities	10	6.1	61	2.4×10^{-3}	0.024
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	15	150	6.0×10^{-3}	0.06
All workers	Total	10	21	210	8.4×10^{-3}	0.084
Worker Population	**Activity**	**Time Period (years)**	**Individual Dose**		**Latent Cancer Fatalities**	
			Annual (mrem/yr)	**Total (mrem)**	**Annual**	**Total**
Involved workers[a]	Alternative A activities	10	260	2,600	1.0×10^{-4}	1.0×10^{-3}
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	59	590	2.4×10^{-5}	2.4×10^{-4}

a. Involved workers would be those individuals that actively participate in Alternative A.
b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in Alternative A.

In addition to radiation doses from Alternative A activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both Alternative A activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 210 person-rem over the duration of Alternative A or about 21 person-rem per year (Table 4-7). This dose is equivalent to less than 1 (0.084) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under Alternative A, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

Public Impacts. Under Alternative A, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. Management of the waste storage tanks would also continue as under current operations. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP and thus would be the same as under the No Action Alternative (Table 4-8).

Table 4-8. Radiation Doses to the Public Under Alternative A[a]

Activity	Maximally Exposed Individual: Individual Radiation Dose[b]: Annual (mrem/yr)	Maximally Exposed Individual: Individual Radiation Dose[b]: Total (mrem)	Maximally Exposed Individual: Probability of Latent Cancer Fatality: Annual	Maximally Exposed Individual: Probability of Latent Cancer Fatality: Total	Population Around WVDP Site: Collective Radiation Dose[c]: Annual (person-rem/yr)	Population Around WVDP Site: Collective Radiation Dose[c]: Total (person-rem)	Population Around WVDP Site: Probability of Latent Cancer Fatality: Annual	Population Around WVDP Site: Probability of Latent Cancer Fatality: Total
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	1.1×10^{-8}	1.1×10^{-7}	0.17	1.7	8.5×10^{-5}	8.5×10^{-4}
Percent of EPA standard (10 mrem per year)	<1	NA[d]	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	2.1×10^{-8}	2.1×10^{-7}	0.083	0.83	4.2×10^{-5}	4.2×10^{-4}
All pathways	0.062	0.62	3.1×10^{-8}	3.1×10^{-7}	0.25	2.5	1.3×10^{-4}	1.3×10^{-3}
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for Alternative A is 10 years.
b. Individual background radiation doses are about 300 mrem per year.
c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.
d. NA = not applicable.

Annual Dose. The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 (1.3×10^{-4}) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the*

Environment) and would result in less than 1 (3.1×10^{-8}) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

Total Dose. For the duration of the Alternative A (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 (1.3×10^{-3}) latent cancer fatality for the duration of the alternative.

4.4.2 Impacts from Facility Accidents (Alternative A)

DOE evaluated the potential impacts that could occur as result of accidents at the WVDP site during the implementation of Alternative A. Because all waste types (Class A, B, C, LLW, mixed LLW, RH-TRU, CH-TRU, and HLW) would be shipped under Alternative A, accidents involving the handling of all waste types were evaluated. As with the No Action Alternative, accidents involving the ongoing management of Tanks 8D-1 and 8D-2 were evaluated. Accidents involving ongoing or continuing activities at the WVDP site that were not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

One potential accident involved dropping two drums containing solidified Class C LLW from the Drum Cell. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 4.7×10^{-5} rem. This accident could result in a radiation dose of 1.6×10^{-5} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.050 person-rem; this is equivalent to a probability of a latent cancer fatality of 2.5×10^{-5}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 4.0×10^{-4} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A second potential accident involved the puncture of a drum containing Class C LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 1.2×10^{-4} rem. This accident could result in a radiation dose of 3.9×10^{-5} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.12 person-rem; this is equivalent to a probability of a latent cancer fatality of 6.0×10^{-5}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 9.5×10^{-4} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A third potential accident involved a drop of a pallet containing six Class C LLW drums, all of which were assumed to rupture. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 6.9×10^{-4} rem. This accident could result in a radiation dose of 2.4×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 0.74 person-rem; this is equivalent to a probability of a latent cancer

Table 4-9. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Drum cell drop	0.1 – 0.01	4.7×10^{-5}	1.9×10^{-8}	1.6×10^{-5}	8.0×10^{-9}	0.050	2.5×10^{-5}
Class C drum puncture[b]	0.1 – 0.01	1.2×10^{-4}	4.8×10^{-8}	3.9×10^{-5}	2.0×10^{-8}	0.12	6.0×10^{-5}
Class C pallet drop[b]	0.1 – 0.01	6.9×10^{-4}	2.8×10^{-7}	2.4×10^{-4}	1.2×10^{-7}	0.74	3.7×10^{-4}
Class C box puncture[b]	0.1 – 0.01	1.2×10^{-3}	4.8×10^{-7}	3.9×10^{-4}	2.0×10^{-7}	1.2	6.0×10^{-4}
HIC[c] drop	0.1 – 0.01	1.5×10^{-3}	6.0×10^{-7}	5.2×10^{-4}	2.6×10^{-7}	1.6	8.0×10^{-4}
CH-TRU drum puncture	0.1 – 0.01	0.038	1.5×10^{-5}	0.013	6.5×10^{-6}	41	0.021
RHWF[d] fire	$10^{-4} – 10^{-6}$	0.13	5.2×10^{-5}	0.044	2.2×10^{-5}	140	0.070
Collapse of Tank 8D-2 (wet)[b]	$10^{-4} – 10^{-6}$	2.4×10^{-3}	9.6×10^{-7}	8.1×10^{-4}	4.1×10^{-7}	2.5	1.3×10^{-3}
Collapse of Tank 8D-2 (dry)[b]	$10^{-4} – 10^{-6}$	2.8×10^{-3}	1.1×10^{-6}	9.5×10^{-4}	4.8×10^{-7}	3.0	1.5×10^{-3}

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.
c. HIC= High integrity container.
d. RHWF= Remote-Handled Waste Facility.

Table 4-10. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Drum cell drop	0.1 – 0.01	4.7×10^{-4}	1.9×10^{-7}	1.8×10^{-4}	9.0×10^{-8}	0.79	4.0×10^{-4}
Class C drum puncture[b]	0.1 – 0.01	1.2×10^{-3}	4.8×10^{-7}	4.3×10^{-4}	2.2×10^{-7}	1.9	9.5×10^{-4}
Class C pallet drop[b]	0.1 – 0.01	6.8×10^{-3}	2.7×10^{-6}	2.6×10^{-3}	1.3×10^{-6}	12	6.0×10^{-3}
Class C box puncture[b]	0.1 – 0.01	0.012	4.8×10^{-6}	4.3×10^{-3}	2.2×10^{-6}	19	9.5×10^{-3}
HIC[c] drop	0.1 – 0.01	0.015	6.0×10^{-6}	5.6×10^{-3}	2.8×10^{-6}	25	0.013
CH-TRU drum puncture	0.1 – 0.01	0.38	1.5×10^{-4}	0.14	7.0×10^{-5}	630	0.32
RHWF[d] fire	$10^{-4} – 10^{-6}$	1.3	5.2×10^{-4}	0.47	2.4×10^{-4}	2,100	1.1
Collapse of Tank 8D-2 (wet)[b]	$10^{-4} – 10^{-6}$	0.024	9.6×10^{-6}	8.9×10^{-3}	4.5×10^{-6}	39	0.020
Collapse of Tank 8D-2 (dry)[b]	$10^{-4} – 10^{-6}$	0.028	1.1×10^{-5}	0.010	5.0×10^{-6}	46	0.023

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.
c. HIC= High integrity container.
d. RHWF= Remote-Handled Waste Facility.

fatality of 3.7×10^{-4}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 6.0×10^{-3} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A fourth potential accident involved the puncture of a box containing Class C LLW. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 1.2×10^{-3} rem. This accident could result in a radiation dose of 3.9×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.2 person-rem; this is equivalent to a probability of a latent cancer fatality of 6.0×10^{-4}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 9.5×10^{-3} for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A fifth potential accident involved dropping a high integrity container containing radioactive sludge and resin. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 1.5×10^{-3} rem. This accident could result in a radiation dose of 5.2×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.6 person-rem; this is equivalent to a probability of a latent cancer fatality of 8.0×10^{-4}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.013 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A sixth potential accident involved the puncture of a drum containing CH-TRU waste. The frequency of this accident was estimated to be in the range of 0.1 to 0.01 per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 0.038 rem. This accident could result in a radiation dose of 0.013 rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 41 person-rem; this is equivalent to a probability of a latent cancer fatality of 0.021. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.32 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

A seventh potential accident involved a diesel fuel fire in the RHWF as a result of a leak in the fuel tank or fuel line of a truck. This fire would involve CH-TRU and RH-TRU waste. The frequency of this accident was estimated to be in the range of 10^{-4} to 10^{-6} per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-9. For a worker located at the site, this accident could result in a radiation dose of 0.13 rem. This accident could result in a radiation dose of 0.044 rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 140 person-rem; this is equivalent to a probability of a latent cancer fatality of 0.070. Using 95-percent atmospheric conditions, this accident could result in about 1 latent cancer fatality for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

Although an accident involving dropping a HLW canister while loading a shipping cask could occur, the canisters are designed to resist breaching and tested to withstand a 7-meter (23-foot) drop onto an unyielding surface and it is unlikely that a canister would rupture if it were dropped during loading. Therefore, Tables 4-9 and 4-10 do not include analysis of this type of accident.

As in the No Action Alternative, DOE also analyzed accidents involving the ongoing management of Tanks 8D-1 and 8D-2, and determined that the consequences would be the same under both alternatives. These accidents assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. Two accidents were analyzed, one where the contents of the tank were kept wet, and another were the contents of the tank were allowed to dry. The frequencies of the accidents were estimated to be in the range of 10^{-4} to 10^{-6} per year.

The consequences of the accidents using 50-percent atmospheric conditions are presented in Table 4-9. If the contents of the tanks are kept wet, the accident could result in a radiation dose of 2.4×10^{-3} rem for the worker located at the site. This accident could result in a radiation dose of 8.1×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 2.5 person-rem; this is equivalent to a probability of a latent cancer fatality of 1.3×10^{-3}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.020 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

If the contents of the tanks are kept dry, this accident could result in a radiation dose of 2.8×10^{-3} rem for the worker located at the site (Table 4-9). This accident could result in a radiation dose of 9.5×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 3.0 person-rem; this is equivalent to a probability of a latent cancer fatality of 1.5×10^{-3}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.023 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-10).

The highest consequence accident in Table 4-9 was the fire at the RHWF. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of the fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases for this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.4.3 Transportation (Alternative A)

Under Alternative A, about 21,000 cubic meters (742,000 cubic feet) of radioactive waste would be shipped for disposal. These shipments would take place over 10 years. Although HLW would not be shipped to a geologic repository until sometime after 2025, HLW transportation impacts were included in Alternative A. Class A LLW would be shipped either to NTS, Hanford, or a commercial disposal site such as Envirocare. Class B and Class C LLW would be shipped either to the NTS or the Hanford Site. Mixed LLW, meeting disposal site waste acceptance criteria, would be shipped to Hanford, NTS, or a commercial disposal site such as Envirocare. TRU waste would be shipped to the WIPP site for disposal. HLW would be shipped to a geologic repository (assumed to be the proposed Yucca Mountain Repository for the purposes of evaluation in this EIS). The waste transportation destinations proposed under Alternative A are shown in Figure 4-2.

Transportation impacts were estimated assuming 100 percent of the waste would be shipped by truck and 100 percent of the waste would be shipped by rail. Table 4-11 lists the waste shipments associated with Alternative A. These shipments would take place over 10 years.

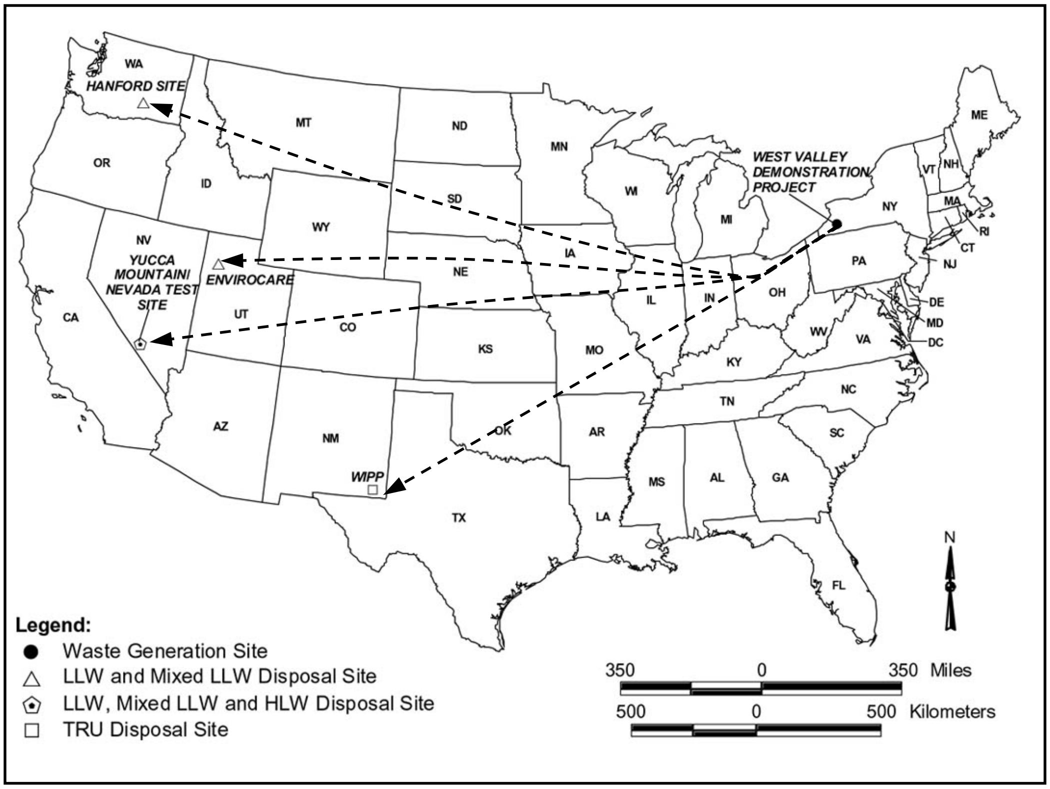

Figure 4-2. Waste Destinations Under Alternative A

4.4.3.1 Total Impacts from Transportation Activities

The transportation impacts of shipping radioactive waste would be from two sources: incident-free transportation and transportation accidents. Both radiological impacts and nonradiological impacts are included in the analysis. The total impacts from transportation would be the sum of the impacts from incident-free transportation and transportation accidents. Additional details on these analyses are provided in Appendix D.

Table 4-12 lists the total transportation impacts by waste type and destination expected under Alternative A. If either trucks or trains were used to ship the radioactive waste, less than 1 fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States over the 10-year time period under Alternative A (U.S. Bureau of the Census 1997).

4.4.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

Worker Impacts. If trucks were used to ship the waste, the maximally exposed worker would be the truck driver. This worker would receive a radiation dose of about 2,000 mrem per year based on driving the truck containing radioactive waste for 1,000 hours per year. This is equivalent to a probability of a latent cancer fatality of about 8.0×10^{-4}.

If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 190 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 7.6×10^{-5}.

Table 4-11. Waste Shipped Under Alternatives A or B

Waste Type	Container Type	Waste Shipped (cubic feet)[a]	Number of Containers	Alternative A Shipments	Alternative B Shipments
Class A LLW	Boxes[b]	351,586	4,341	311 (truck) 156 (rail)	311 (truck) 156 (rail)
	Drums[b]	83,014	12,058	144 (truck) 72 (rail)	144 (truck) 72 (rail)
Class B LLW	HIC[c]	38,500	428	428 (truck) 107 (rail)	428 (truck) 107 (rail)
	Drums[b]	194	29	1 (truck) 1 (rail)	1 (truck) 1 (rail)
Class C LLW	HIC[c]	12,618	141	141 (truck) 36 (rail)	141 (truck) 36 (rail)
	55-gallon drums[c]	6,198	901	91 (truck) 23 (rail)	91 (truck) 23 (rail)
	71-gallon drums[b]	193,405	20,377	850 (truck) 213 (rail)	850 (truck) 213 (rail)
CH-TRU	Drums[c]	40,000	5,810	139 (truck) 139 (rail)	278 (truck)[d] 278 (rail)[d]
RH-TRU	Drums[c]	9,000	1,308	131 (truck) 33 (rail)	262 (truck)[e] 66 (rail)[f]
MLLW	Drums[b]	7,889	1,146	14 (truck) 7 (rail)	14 (truck) 7 (rail)
HLW	Canisters[c]		300[g]	300 (truck) 60 (rail)	600 (truck)[h] 120 (rail)[i]
Total		742,404	46,839	2,550 (truck) 847 (rail)	3,120 (truck)[j] 1,079 (rail)[k]

Acronyms: LLW = low-level radioactive waste; HIC = high-integrity container; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste

a. To convert cubic feet to cubic meters, multiply by 0.028.
b. Shipped in Type A shipping container.
c. Shipped in Type B shipping container.
d. 139 CH-TRU shipments from WVDP to interim storage, 139 CH-TRU shipments from interim storage to disposal.
e. 131 RH-TRU shipments from WVDP to interim storage, 131 RH-TRU shipments from interim storage to disposal.
f. 33 RH-TRU shipments from WVDP to interim storage, 33 RH-TRU shipments from interim storage to disposal.
g. Assumed to be 300 for purposes of analysis; actual number of canisters is 275.
h. 300 HLW shipments from WVDP to interim storage, 300 HLW shipments from interim storage to disposal.
i. 60 HLW shipments from WVDP to interim storage, 60 HLW shipments from interim storage to disposal.
j. Includes 270 TRU waste, and 300 HLW, truck shipments from interim storage to disposal. Alternative B would load the same number of truck shipments (2,550) at WVDP for shipment offsite as Alternative A.
k. Includes 172 TRU waste, and 60 HLW, rail shipments from interim storage to disposal. Alternative B would load the same number of rail shipments (847) at WVDP for shipment offsite as Alternative A.

Public Impacts. If trucks were used to ship the waste, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 19 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 9.5×10^{-6}.

If trains were used to ship the waste, the maximally exposed member of the public would be a railyard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 1.8×10^{-5}.

Table 4-12. Transportation Impacts Under Alternative A

Waste Type	Destination	Incident-Free Public (LCFs)	Incident-Free Worker (LCFs)	Radiological Accident Risk (LCFs)	Pollution Health Effects (Fatalities)	Traffic Fatalities	Total Fatalities
Truck							
Class A LLW	Envirocare	0.021	0.025	1.1×10^{-4}	5.7×10^{-3}	0.030	0.081
	Hanford Site	0.025	0.029	1.2×10^{-4}	6.3×10^{-3}	0.038	0.098
	NTS	0.026	0.029	1.4×10^{-4}	7.6×10^{-3}	0.036	0.098
Class B LLW	Hanford Site	0.024	0.052	6.9×10^{-7}	5.9×10^{-3}	0.035	0.12
	NTS	0.024	0.050	7.9×10^{-7}	7.1×10^{-3}	0.034	0.11
Class C LLW	Hanford Site	0.072	0.16	4.6×10^{-7}	0.018	0.11	0.36
	NTS	0.074	0.15	5.4×10^{-7}	0.022	0.10	0.35
CH-TRU	WIPP	6.9×10^{-3}	8.0×10^{-3}	6.2×10^{-4}	2.3×10^{-3}	0.012	0.030
RH-TRU	WIPP	5.4×10^{-3}	0.011	6.2×10^{-9}	2.2×10^{-3}	0.011	0.030
MLLW	Envirocare	6.4×10^{-4}	7.6×10^{-4}	8.7×10^{-6}	1.8×10^{-4}	9.2×10^{-4}	2.5×10^{-3}
	Hanford Site	7.7×10^{-4}	9.1×10^{-4}	9.4×10^{-6}	1.9×10^{-4}	1.2×10^{-3}	3.0×10^{-3}
	NTS	7.9×10^{-4}	8.8×10^{-4}	1.1×10^{-5}	2.3×10^{-4}	1.1×10^{-3}	3.0×10^{-3}
HLW	Repository	0.017	0.035	8.1×10^{-7}	5.8×10^{-3}	0.024	0.082
							Total Truck Fatalities: 0.69 – 0.72
Rail							
Class A LLW	Envirocare	0.037	0.026	4.4×10^{-4}	8.0×10^{-3}	0.026	0.097
	Hanford Site	0.037	0.028	4.8×10^{-4}	8.2×10^{-3}	0.034	0.11
	NTS	0.038	0.035	4.4×10^{-4}	8.1×10^{-3}	0.033	0.11
Class B LLW	Hanford Site	0.035	0.026	2.8×10^{-6}	3.9×10^{-3}	0.016	0.081
	NTS	0.036	0.036	2.5×10^{-6}	3.8×10^{-3}	0.017	0.093
Class C LLW	Hanford Site	0.11	0.081	1.0×10^{-6}	0.012	0.049	0.25
	NTS	0.11	0.11	9.1×10^{-7}	0.012	0.053	0.29
CH-TRU	WIPP	6.9×10^{-3}	6.5×10^{-3}	1.6×10^{-4}	3.4×10^{-3}	0.018	0.035
RH-TRU	WIPP	5.5×10^{-3}	5.1×10^{-3}	2.0×10^{-8}	8.0×10^{-4}	4.2×10^{-3}	0.016
MLLW	Envirocare	1.1×10^{-3}	8.0×10^{-4}	3.4×10^{-5}	2.4×10^{-4}	8.1×10^{-4}	3.0×10^{-3}
	Hanford Site	1.1×10^{-3}	8.6×10^{-4}	3.8×10^{-5}	2.5×10^{-4}	1.0×10^{-3}	3.3×10^{-3}
	NTS	1.2×10^{-3}	1.1×10^{-3}	3.4×10^{-5}	2.5×10^{-4}	1.0×10^{-3}	3.5×10^{-3}
HLW	Repository	6.3×10^{-3}	0.011	2.5×10^{-7}	4.2×10^{-3}	0.019	0.041
							Total Rail Fatalities: 0.52 – 0.59

Acronyms: LCFs = latent cancer fatalities; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste; NTS = Nevada Test Site; WIPP = Waste Isolation Pilot Plant. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

4.4.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents

For waste shipped under Alternative A, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Since one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident are the same. The probabilities of the truck and rail accidents are slightly different. The probability of the truck accident was 6×10^{-7} per year. For rail, the probability of the accident was 1×10^{-7} per year. The maximally exposed individual would receive a radiation dose of about 25 rem from this accident, which is equivalent to a latent cancer fatality risk of 0.012. The population would receive a collective radiation dose of approximately 6,600 person-rem from this accident. This could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for the CH-TRU accident was less than 1. Therefore, the radioactive releases from the CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.4.4 Offsite Impacts (Alternative A)

Under Alternative A, 19,200 cubic meters (685,515 cubic feet) of LLW and 221 cubic meters (7,889 cubic feet) of mixed LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP LLW and mixed LLW inventory were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from 3.2×10^{-2} to 3.6×10^{-2}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between 5.1×10^{-5} and 2.1×10^{-15}.

In addition, approximately 1,372 cubic meters (49,000 cubic feet) of TRU waste would be disposed of at WIPP. Disposal of this waste volume at WIPP would result in a probability that a worker would incur a latent cancer fatality of 1.0×10^{-2}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of 3.0×10^{-9}. The population within 80 kilometers (50 miles) of the site would have a probability of incurring a latent cancer fatality of 3.0×10^{-6}.

Disposal of 300 canisters of WVDP HLW[1] at a geologic repository at Yucca Mountain would result in a probability that a worker would incur a latent cancer fatality of 6.8×10^{-2}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of 3.1×10^{-7}. The population within 80 kilometers (50 miles) of the site would have a probability of incurring a latent cancer fatality of 2.0×10^{-2}.

Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C-10, explains how these impacts were derived.

4.5 IMPACTS OF ALTERNATIVE B – OFFSITE SHIPMENT OF LLW AND MIXED LLW TO DISPOSAL, SHIPMENT OF HLW AND TRU WASTE TO INTERIM STORAGE, AND INTERIM STABILIZATION OF THE WASTE STORAGE TANKS

Under **Alternative B**, LLW and mixed LLW would be shipped offsite for disposal at the same locations as Alternative A. TRU wastes would be shipped for interim storage at one of five DOE sites: Hanford Site; INEEL; ORNL; SRS; or WIPP. TRU wastes would subsequently be shipped to WIPP (or would remain at WIPP) for disposal. HLW would be shipped to SRS or Hanford for interim storage, with subsequent shipment to Yucca Mountain for disposal.

It is assumed that the shipment of LLW and mixed LLW to disposal would occur within the next 10 years, and that TRU waste and HLW would be shipped to interim storage during that same 10 years. Ultimate disposal of TRU wastes and HLW wastes would be subject to the same constraints described under Alternative A; however, the impacts of transporting these wastes to their ultimate disposal sites have been included in the impact analyses for this alternative. The waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization.

[1] For purposes of analysis, DOE assumed that vitrification of HLW at WVDP would result in the production of 300 canisters. Vitrification is now complete and has resulted in the production of 275 canisters. Therefore, the impacts associated with the 275 canisters actually produced would be lower than the impacts analyzed.

4.5.1 Human Health Impacts (Alternative B)

This section characterizes the radiological impacts from Alternative B activities that could result from exposure of workers to direct radiation and contaminated material and exposure of the public to small quantities of radioactive material from controlled releases to the environment. Nonradiological injuries and fatalities have also been estimated using Bureau of Labor Statistics on incident rates for construction, manufacturing, and services.

Worker Impacts. Under Alternative B, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, and offsite interim storage of RH-TRU, CH-TRU, and HLW prior to disposal. In addition, the waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization of the tanks. Table 4-13 presents the radiological impacts to involved and noninvolved workers for Alternative B. During the 10-year time period, the collective radiation dose to involved workers was estimated to be about 63 person-rem or about 6.3 person-rem per year from activities under Alternative B. Over this same time period, the individual radiation dose to the average involved worker would be about 260 mrem per year. This radiation dose is well below the limit in 10 CFR 835 of 5 rem (5,000 mrem) per year and the WVDP administrative control level of 500 mrem per year (WVNS 2001), and would result in less than 1 (1.0×10^{-4}) latent cancer fatality or a chance of about 1 in 10,000 per year. These radiation doses include the radiation doses from interim stabilization of the waste storage tanks.

Table 4-13. Radiation Doses for Involved and Noninvolved Workers Under Alternative B

Worker Population	Activity	Time Period (years)	Collective Dose		Latent Cancer Fatalities	
			Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Involved workers[a]	Alternative B activities	10	6.3	63	2.5×10^{-3}	0.025
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	15	150	6.0×10^{-3}	0.060
All workers	Total	10	21	210	8.5×10^{-3}	0.085
Worker Population	**Activity**	**Time Period (years)**	**Individual Dose**		**Latent Cancer Fatalities**	
			Annual (mrem/yr)	**Total (mrem)**	**Annual**	**Total**
Involved workers[a]	Alternative B activities	10	260	2,600	1.0×10^{-4}	1.0×10^{-3}
Noninvolved workers[b]	Ongoing operations of WVDP[b]	10	59	590	2.4×10^{-5}	2.4×10^{-4}

a. Involved workers would be those individuals that actively participate in Alternative B.
b. Noninvolved workers would be those individuals that would be onsite but would not actively participate in Alternative B.

In addition to radiation doses from Alternative B activities, workers would be exposed to radiation doses from the ongoing operations of the WVDP site. When radiation doses are calculated for involved and noninvolved workers for both Alternative B activities and ongoing operations, the total collective radiation dose to the workers was estimated to be about 210 person-rem over the duration of Alternative B or about 21 person-rem per year (Table 4-13). This dose is equivalent to less than 1 (0.085) latent cancer fatality within the worker population.

Nonradiological impacts to workers, based on Bureau of Labor Statistics and the required work effort estimated to complete the actions proposed under Alternative B, are not expected to result in any non-lost workday injuries, lost workday injuries, or fatalities.

Public Impacts. Under Alternative B, waste management activities would involve offsite transportation and disposal of Class A, B, C, mixed LLW, RH-TRU, CH-TRU, and HLW. In addition, the waste storage tanks and their surrounding vaults would be partially filled with a retrievable grout to provide for interim stabilization of the tanks. Radiation doses to the public would be similar to the radiation doses for ongoing operations at the WVDP and thus would be the same as under the No Action Alternative and Alternative A. Annual and total radiation doses to the public (maximally exposed individual and collective population) are listed in Table 4-14.

Table 4-14. Radiation Doses to the Public Under Alternative B[a]

Activity	Maximally Exposed Individual				Population Around WVDP Site			
	Individual Radiation Dose[b]		Probability of Latent Cancer Fatality		Collective Radiation Dose[c]		Probability of Latent Cancer Fatality	
	Annual (mrem/yr)	Total (mrem)	Annual	Total	Annual (person-rem/yr)	Total (person-rem)	Annual	Total
Interim Stabilization of Waste Storage Tanks								
Airborne releases[d]	4.6×10^{-7}	4.6×10^{-7}	2.3×10^{-13}	2.3×10^{-13}	1.2×10^{-5}	1.2×10^{-5}	6.0×10^{-9}	6.0×10^{-9}
Percent of EPA standard (10 mrem per year)	<1	NA[e]	NA	NA	NA	NA	NA	NA
Ongoing operations at WVDP								
Airborne releases	0.021	0.21	1.1×10^{-8}	1.1×10^{-7}	0.17	1.7	8.5×10^{-5}	8.5×10^{-4}
Percent of EPA standard (10 mrem per year)	<1	NA[e]	NA	NA	NA	NA	NA	NA
Waterborne releases	0.041	0.41	2.1×10^{-8}	2.1×10^{-7}	0.083	0.83	4.2×10^{-5}	4.2×10^{-4}
All pathways	0.062	0.62	3.1×10^{-8}	3.1×10^{-7}	0.25	2.5	1.3×10^{-4}	1.3×10^{-3}
Percent of DOE standard (100 mrem per year)	<1	NA	NA	NA	NA	NA	NA	NA
Percent of natural background	<1	NA	NA	NA	<1	NA	NA	NA

a. The time period for Alternative B is 10 years.
b. Individual background radiation doses are about 300 mrem per year.
c. The collective radiation dose to the 1.5-million-person population that surrounds the WVDP site from natural background is about 380,000 person-rem per year.
d. Interim stabilization was assumed to take place in less than 1 year.
e. NA = not applicable.

Annual Dose. The collective radiation dose through all exposure pathways (air and water) to people living within 80 kilometers (50 miles) of the site would be about 0.25 person-rem per year. This is equivalent to less than 1 (1.3×10^{-4}) latent cancer fatality in the exposed population each year. The radiation dose through all exposure pathways to the maximally exposed individual living around the WVDP site would be about 0.062 mrem per year. This radiation dose is 0.062 percent of the DOE standard of 100 mrem per year (DOE Order 5400.5, *Radiation Protection of the Public and the Environment*) and would result in less than 1 (3.1×10^{-8}) latent cancer fatality per year or a chance of about 1 in 32 million for the maximally exposed individual.

The radiation doses from atmospheric releases during interim stabilization of the waste storage tanks were 4.6×10^{-7} mrem for the maximally exposed individual and 1.2×10^{-5} person-rem for the population around the WVDP site. This is equivalent to less than 1 (6.0×10^{-9}) latent cancer fatality during interim stabilization.

Total Dose. For the duration of the No Action Alternative (10 years), the total collective radiation dose through all exposure pathways to the population around the WVDP site would be about 2.5 person-rem. This is equivalent to less than 1 (1.3×10^{-3}) latent cancer fatality over the duration of Alternative B.

Interim stabilization of the waste storage tanks was assumed to take place in less than 1 year. Therefore, the total radiation doses from interim stabilization are the same as the annual radiation doses in Table 4-14.

4.5.2 Impacts from Facility Accidents (Alternative B)

With the exception of interim stabilization of Tanks 8D-1 and 8D-2, the onsite activities proposed under Alternative B would be the same as those proposed under Alternative A. The facility accidents characterized previously in Section 4.4.2 would be representative of Alternative B and would have the same consequences. Therefore, the potential facility accidents characterized in Section 4.4.2 and their consequences will not be repeated here. As with the No Action Alternative and Alternative A, accidents involving ongoing or continuing activities at the WVDP site that were not part of this EIS have been addressed in other documents such as the *Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley Final Environmental Impact Statement* (DOE 1982) and several facility safety analysis reports and environmental assessments. For example, accidents involving the High-Level Waste Vitrification Facility are characterized in the *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage* (WVNS 2000b).

As described in Chapter 2, under Alternative B interim stabilization, Tanks 8D-1 and 8D-2 would be filled with approximately 102 centimeters (40 inches) of grout. An accident involving a containment system failure during interim stabilization would have a frequency in the range of 10^{-6} to 10^{-8} per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-15. For an onsite worker, this accident could result in a radiation dose of 0.015 rem. This accident could result in a radiation dose of 4.9×10^{-3} to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the WVDP site, this accident could result in a collective radiation dose of 15 person-rem; this is equivalent to a probability of a latent cancer fatality of 7.5×10^{-3}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.12 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-16). After the completion of interim stabilization, the risk from this accident would be eliminated.

DOE also analyzed the impacts of an accident involving Tanks 8D-1 and 8D-2 after they had been stabilized. This accident assumed that a severe earthquake occurred at the WVDP site, causing the roof of the vault and Tank 8D-2 to collapse into the tank. The frequency of this accident was estimated to be in the range of 10^{-4} to 10^{-6} per year. The consequences of this accident using 50-percent atmospheric conditions are presented in Table 4-15.

Table 4-15. Radiological Consequences of Accidents Using 50-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Containment system failure during interim stabilization of Tank 8D-2[b]	$10^{-6} – 10^{-8}$	0.015	6.0×10^{-6}	4.9×10^{-3}	2.5×10^{-6}	15	7.5×10^{-3}
Collapse of Tank 8D-2 (grouted)[b]	$10^{-4} – 10^{-6}$	1.3×10^{-3}	5.2×10^{-7}	4.5×10^{-4}	2.3×10^{-7}	1.4	7.0×10^{-4}

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.

Table 4-16. Radiological Consequences of Accidents Using 95-Percent Atmospheric Conditions

Accident	Frequency (per year)	Worker		Maximally Exposed Individual		Population[a]	
		Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (rem)	Latent Cancer Fatality	Radiation Dose (person-rem)	Latent Cancer Fatality
Containment system failure during interim stabilization of Tank 8D-2[b]	$10^{-6} – 10^{-8}$	0.14	5.6×10^{-5}	0.054	2.7×10^{-5}	240	0.12
Collapse of Tank 8D-2 (grouted)[b]	$10^{-4} – 10^{-6}$	0.013	5.2×10^{-6}	4.9×10^{-3}	2.5×10^{-6}	22	0.011

a. Collective dose to the 1.5 million people living within 80 kilometers (50 miles) of the WVDP site.
b. Ground-level release.

For a worker located at the site, this accident could result in a radiation dose of 1.3×10^{-3} rem. This accident could result in a radiation dose of 4.5×10^{-4} rem to the maximally exposed individual living near the WVDP site. For the population living within 80 kilometers (50 miles) of the site, this accident could result in a radiation dose of 1.4 person-rem; this is equivalent to a probability of a latent cancer fatality of 7.0×10^{-4}. Using 95-percent atmospheric conditions, this accident could result in a probability of a latent cancer fatality of 0.011 for the population living within 80 kilometers (50 miles) of the WVDP site (Table 4-16).

The highest consequence accident in Table 4-15 was the accident involving a containment system failure during interim stabilization. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for this accident was less than 1. Therefore, the radioactive releases from this accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.5.3 Transportation (Alternative B)

Under Alternative B, about 21,000 cubic meters (742,000 cubic feet) of radioactive waste would be shipped for disposal. These are the same volumes that would be shipped under Alternative A. These shipments would take place over 10 years. Although HLW would not be shipped to a geologic repository until sometime after 2025, HLW transportation impacts were included in Alternative B. As was the case for Alternative A, under Alternative B Class A LLW would be shipped either to NTS, Hanford, or a commercial disposal site such as Envirocare; Class B and Class C LLW would be shipped either to the NTS or the Hanford Site; and mixed LLW would be shipped to Hanford, NTS, or a commercial disposal site such as Envirocare. In contrast to Alternative A, TRU waste would be shipped first to Hanford, INEEL, ORNL or SRS for storage, then to WIPP for disposal. TRU waste could also be shipped to WIPP for interim storage prior to disposal there. HLW would be shipped first to the SRS or Hanford for storage, then to a geologic repository for disposal (again, assumed to be the proposed Yucca Mountain Repository for the purposes of evaluation in this EIS). The waste transportation destinations proposed under Alternative B are shown in Figure 4-3.

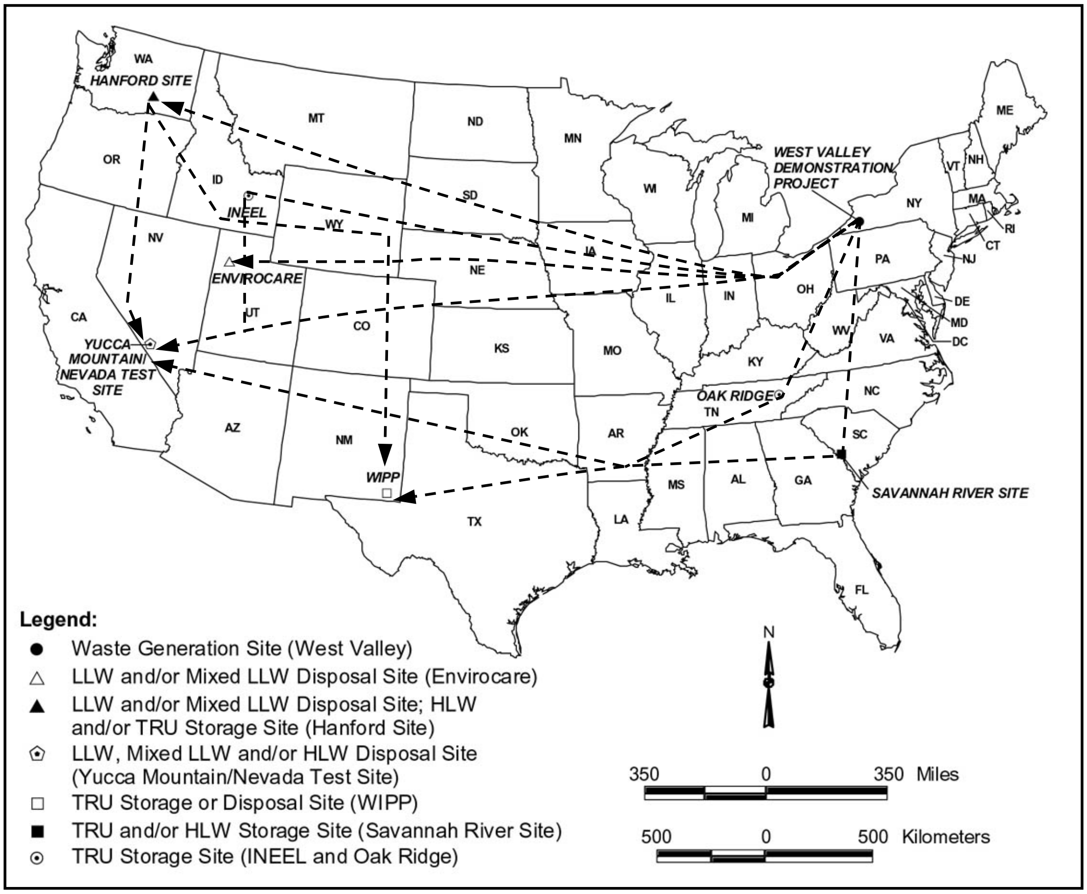

Figure 4-3. Waste Destinations Under Alternative B

Transportation impacts were estimated assuming that 100 percent of the waste would be shipped by truck and that 100 percent of the waste would be shipped by rail. Table 4-11 lists the waste shipments associated with Alternative B. Because only the destinations for TRU waste and HLW vary between Alternatives A and B, the reader will see very little difference among the impacts to workers or the public for these alternatives.

4.5.3.1 Total Impacts from Transportation Activities

Table 4-17 lists the total transportation impacts by waste type and destination expected under Alternative B. If either trucks or trains were used to ship the radioactive waste, less than one fatality would occur. For perspective, there would be about 400,000 traffic fatalities in the United States during the 10-year time period under Alternative B (U.S. Bureau of the Census 1997).

Table 4-17. Transportation Impacts Under Alternative B

Waste Type	Destination	Incident-Free Public (LCFs)	Incident-Free Worker (LCFs)	Radiological Accident Risk (LCFs)	Pollution Health Effects	Traffic Fatalities	Total Fatalities
Truck							
Class A LLW	Envirocare	0.021	0.025	1.1×10^{-4}	5.7×10^{-3}	0.030	0.081
	Hanford Site	0.025	0.029	1.2×10^{-4}	6.3×10^{-3}	0.038	0.098
	NTS	0.026	0.029	1.4×10^{-4}	7.6×10^{-3}	0.036	0.098
Class B LLW	Hanford Site	0.024	0.052	6.9×10^{-7}	5.9×10^{-3}	0.035	0.12
	NTS	0.024	0.050	7.9×10^{-7}	7.1×10^{-3}	0.034	0.11
Class C LLW	Hanford Site	0.072	0.16	4.6×10^{-7}	0.018	0.11	0.36
	NTS	0.074	0.15	5.4×10^{-7}	0.022	0.10	0.35
CH-TRU	SRS → WIPP	0.010	0.014	1.8×10^{-3}	3.8×10^{-3}	0.022	0.052
	INEEL → WIPP	0.014	0.020	1.5×10^{-3}	4.2×10^{-3}	0.025	0.065
	ORNL → WIPP	8.9×10^{-3}	0.013	1.1×10^{-3}	3.1×10^{-3}	0.017	0.043
	Hanford → WIPP	0.017	0.023	1.7×10^{-3}	4.9×10^{-3}	0.032	0.079
RH-TRU	SRS → WIPP	8.1×10^{-3}	0.017	1.8×10^{-8}	3.6×10^{-3}	0.021	0.050
	INEEL → WIPP	0.011	0.026	1.7×10^{-8}	4.0×10^{-3}	0.024	0.065
	ORNL → WIPP	7.0×10^{-3}	0.016	1.1×10^{-8}	2.9×10^{-3}	0.016	0.042
	Hanford → WIPP	0.014	0.031	1.9×10^{-8}	4.6×10^{-3}	0.030	0.080
MLLW	Envirocare	6.4×10^{-4}	7.6×10^{-4}	8.7×10^{-6}	1.8×10^{-4}	9.2×10^{-4}	2.5×10^{-3}
	Hanford Site	7.7×10^{-4}	9.1×10^{-4}	9.4×10^{-6}	1.9×10^{-4}	1.2×10^{-3}	3.0×10^{-3}
	NTS	7.9×10^{-4}	8.8×10^{-4}	1.1×10^{-5}	2.3×10^{-4}	1.1×10^{-3}	3.0×10^{-3}
HLW	SRS → Repository	0.027	0.054	2.2×10^{-6}	9.6×10^{-3}	0.047	0.14
	Hanford Site → Repository	0.025	0.055	1.2×10^{-6}	8.0×10^{-3}	0.037	0.12
						Total Truck Fatalities:	0.76 – 0.87

Table 4-17. Transportation Impacts Under Alternative B (cont)

Waste Type	Destination	Incident-Free Public (LCFs)	Incident-Free Worker (LCFs)	Radiological Accident Risk (LCFs)	Pollution Health Effects	Traffic Fatalities	Total Fatalities
Rail							
Class A LLW	Envirocare	0.037	0.026	4.4×10^{-4}	8.0×10^{-3}	0.026	0.097
	Hanford Site	0.037	0.028	4.8×10^{-4}	8.2×10^{-3}	0.034	0.11
	NTS	0.038	0.035	4.4×10^{-4}	8.1×10^{-3}	0.033	0.11
Class B LLW	Hanford Site	0.035	0.026	2.8×10^{-6}	3.9×10^{-3}	0.016	0.081
	NTS	0.036	0.036	2.5×10^{-6}	3.8×10^{-3}	0.017	0.093
Class C LLW	Hanford Site	0.11	0.081	1.0×10^{-6}	0.012	0.049	0.25
	NTS	0.11	0.11	9.1×10^{-7}	0.012	0.053	0.29
CH-TRU	SRS → WIPP	0.018	0.018	6.9×10^{-4}	8.9×10^{-3}	0.057	0.10
	INEEL → WIPP	0.020	0.020	1.0×10^{-3}	0.010	0.038	0.089
	ORNL → WIPP	0.016	0.017	6.2×10^{-4}	8.0×10^{-3}	0.031	0.073
	Hanford → WIPP	0.023	0.021	1.3×10^{-3}	0.012	0.053	0.11
RH-TRU	SRS → WIPP	0.014	0.014	7.3×10^{-8}	2.1×10^{-3}	0.013	0.044
	INEEL → WIPP	0.016	0.015	1.2×10^{-7}	9.7×10^{-3}	0.036	0.077
	ORNL → WIPP	0.013	0.013	6.8×10^{-8}	7.5×10^{-3}	0.030	0.063
	Hanford → WIPP	0.018	0.017	1.5×10^{-7}	0.011	0.050	0.096
MLLW	Envirocare	1.1×10^{-3}	8.0×10^{-4}	3.4×10^{-5}	2.4×10^{-4}	8.1×10^{-4}	3.0×10^{-3}
	Hanford Site	1.1×10^{-3}	8.6×10^{-4}	3.8×10^{-5}	2.5×10^{-4}	1.0×10^{-3}	3.3×10^{-3}
	NTS	1.2×10^{-3}	1.1×10^{-3}	3.4×10^{-5}	2.5×10^{-4}	1.0×10^{-3}	3.5×10^{-3}
HLW	SRS → Repository	9.9×10^{-3}	0.019	2.5×10^{-7}	6.1×10^{-3}	0.038	0.074
	Hanford Site → Repository	9.4×10^{-3}	0.019	3.3×10^{-7}	5.3×10^{-3}	0.034	0.067
Total Rail Fatalities: 0.62 – 0.78							

Acronyms: LCFs = latent cancer fatalities; CH-TRU = contact-handled transuranic waste; RH-TRU = remote-handled transuranic waste; MLLW = mixed low-level waste; HLW = high-level radioactive waste; SRS = Savannah River Site; NTS = Nevada Test Site; WIPP = Waste Isolation Pilot Plant; INEEL = Idaho National Engineering and Environmental Laboratory; ORNL = Oak Ridge National Laboratory. The range of total fatalities is based on the minimum and maximum total fatalities for each waste type.

4.5.3.2 Incident-Free Impacts for the Maximally Exposed Individual from Transportation Activities

Worker Impacts. If trucks were used to ship the waste, the maximally exposed worker would be the truck driver. This worker would receive a radiation dose of about 2,000 mrem per year based on driving the truck containing radioactive waste for 1,000 hours per year. This is equivalent to a probability of a latent cancer fatality of about 8.0×10^{-4}.

If trains were used to ship the waste, the maximally exposed worker would be an inspector. This worker would receive a radiation dose of about 190 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 7.6×10^{-5}.

Public Impacts. If trucks were used to ship the waste, the maximally exposed member of the public would be a person working at a service station who would receive a radiation dose of about 19 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 9.5×10^{-6}.

If trains were used to ship the waste, the maximally exposed member of the public would be a rail yard worker who was not directly involved with handling the railcars. This person would receive a radiation dose of about 35 mrem per year. This is equivalent to a probability of a latent cancer fatality of about 1.8×10^{-5}.

4.5.3.3 Impacts from the Maximum Reasonably Foreseeable Transportation Accidents

As is the case for Alternative A, for waste shipped under Alternative B, the maximum reasonably foreseeable truck or rail transportation accident with the highest consequences would involve CH-TRU waste. Because one TRUPACT-II shipping container was assumed to be involved in either the truck or rail accident, the consequences for the truck or rail accident are the same. However, the probability of the truck and rail accidents are slightly different. The probability of the truck accident was 1×10^{-6} per year. For rail, the probability of the accident was 5×10^{-7} per year. The maximally exposed individual would receive a radiation dose of about 25 rem from this accident, which is equivalent to a latent cancer fatality risk of 0.012. The population would receive a collective radiation dose of approximately 6,600 person-rem from this accident. This could result in about 3 latent cancer fatalities. Using the screening procedure in *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000a), the sum of fractions of the biota concentration guides for the CH-TRU accident was less than 1. Therefore, the radioactive releases from the CH-TRU accident would not be likely to cause persistent, measurable, deleterious changes in populations or communities of terrestrial or aquatic plants or animals.

4.5.4 Offsite Impacts (Alternative B)

Under Alternative B, LLW and mixed LLW would be disposed of at Hanford, NTS, or a commercial disposal site such as Envirocare. If the entire volume of WVDP LLW and mixed LLW inventory were sent to one of these sites, the probability that a worker would incur a latent cancer fatality would range from 3.2×10^{-2} to 3.6×10^{-2}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between 5.1×10^{-5} and 2.1×10^{-15}.

In addition, approximately 1,372 cubic meters (49,000 cubic feet) of TRU waste would be stored at Hanford, INEEL, ORNL, SRS, or WIPP. Interim storage of this waste volume would result in a probability that a worker would incur a latent cancer fatality of between 2.5×10^{-3} and 1.6×10^{-4}. The maximally exposed individual member of the public would have a probability of incurring a latent cancer fatality of between 6.9×10^{-7} and 2.1×10^{-10}. The populations within 80 kilometers (50 miles) of the sites would have a probability of incurring a latent cancer fatality of between 2.6×10^{-3} and 2.3×10^{-5}.

HLW currently stored at WVDP would be stored at Hanford or SRS. Interim storage of 300 canisters of WVDP HLW at these sites would result in a probability that a worker would incur a latent cancer fatality of between 2.0×10^{-2} and 3.6×10^{-2}.

Table 2-6 provides offsite human health impacts in detail; Appendix C, Section C-10, explains how these impacts were derived.

4.6 ENVIRONMENTAL JUSTICE IMPACTS

In February 1994, the President issued Executive Order 12898, titled *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* [59 Fed. Reg. 7629-7633 (1994)]. This Order directs federal agencies to incorporate environmental justice as part of their missions. As such, federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Council on Environmental Quality has issued guidance (CEQ 1997) to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed. In this guidance, the Council encouraged federal agencies to supplement the guidance with their own specific procedures tailored to particular programs or activities of an agency. DOE has prepared the *Draft Guidance on Incorporating Environmental Justice Considerations into the Department of Energy's National Environmental Policy Act Process* (DOE 2000b) based on Executive Order 12898 and the Council on Environmental Quality environmental justice guidance.

Among other things, the DOE draft guidance states that even for actions that are at the low end of the sliding scale with respect to the significance of environmental impacts, some consideration (which could be qualitative) is needed to show that DOE considered environmental justice concerns. DOE needs to demonstrate that it considered apparent pathways or uses of resources that are unique to a minority or low-income community before determining whether, even in light of these special pathways or practices, there are disproportionately high and adverse impacts on the minority or low-income population. The DOE draft guidance also defines "minority population" as a populace where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

For this Waste Management EIS, DOE applied the environmental justice guidance to determine whether there could be any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the WVDP site as a result of the implementation of any of the alternatives analyzed. Analysis of environmental justice concerns was based on an assessment of the impacts reported in Sections 4.3 through 4.5. Although no high and adverse impacts were identified to any receptor from either the proposed onsite waste management actions or the offsite shipments of wastes, DOE considered whether minority or low-income populations would be disproportionately affected by the ongoing management of the WVDP site, particularly taking into account subsistence fishing on the part of some residents of the Cattaraugus Reservation of the Seneca Nation of Indians.

Subsistence Consumption of Fish. Consumption of food and water is a major source of exposure to potentially hazardous substances for U.S. residents. These pathways are also expected to be the primary routes through which a resident of the Cattaraugus Reservation of the Seneca Nation could be exposed to releases from the WVDP site. Because a member of the Seneca Nation may consume more fish from local waters than other members of the population around the WVDP site, DOE performed an additional dose assessment for increased fish consumption.

Specifically, DOE evaluated the potential human health impacts that could occur from the consumption by one individual of up to 62 kilograms (137 pounds) of game fish per year, compared to 21 kilograms (46 pounds) of game fish assumed for the maximally exposed individual in the WVDP Annual Site Environmental Reports. The 62-kilogram consumption rate represents the 95th percentile fish consumption rate for Native Americans from the *Exposure Factors Handbook* (EPA 1997).

Over the period 1995 through 1999, the average radiation dose from fish consumption reported in the WVDP Annual Site Environmental Reports (WVNS 1996, 1997, 1998, 1999, 2000c) was 0.016 mrem per year, based on eating 21 kilograms (46 pounds) of fish per year. The radiation dose from eating 62 kilograms (137 pounds) of fish per year was 0.05 mrem per year. These radiation doses are less than 0.1 percent of the DOE standard of 100 mrem per year from DOE Order 5400.5 and would result in less than 1 (2.5×10^{-8}) latent cancer fatality. Based on this analysis, DOE concludes that implementation of any of the alternatives would not result in disproportionately high and adverse impacts on the minority or low-income population in the region, even in light of possible increased exposure through subsistence fishing. Additional information concerning the assessment of human health impacts is provided in Appendix C.

Transportation. The transportation of radioactive waste would use the nation's existing highways and railroads. As described in previous sections, the total impacts from transportation would be very low (less than 1 fatality over 10 years) and therefore would not present a large health or safety risk to the population as a whole, or to workers or individuals along transportation routes. Based on this analysis, DOE concludes that implementation of any of the alternatives would not result in disproportionately high and adverse impacts on the minority or low-income populations along transportation routes.

Only a severe accident that resulted in a considerable release of radioactive material could cause high and adverse impacts in the affected populations. Because the risk of these accidents applies to the entire population along transportation routes, it would not apply disproportionately to any minority or low-income populations along the routes.

Additional information concerning the assessment of transportation impacts is provided in Appendix D.

Offsite Activities. The potential that low-income or minority populations could experience disproportionately high and adverse environmental consequences at sites where waste management activities would occur was addressed in earlier NEPA documents (see Section 1.7.1). No such potential impacts were identified for any site. For LLW, mixed LLW, and HLW, the potential for adverse human health impacts as a result of waste management activities is low, and no disproportionately high and adverse health effects would be expected for any particular segment of the population, including low-income or minority populations.

With respect to TRU waste, the WM PEIS concluded that the potential for disproportionately high and adverse human health effects as a result of TRU waste treatment operations was low for all sites except INEEL and WIPP (WM PEIS, Section 8.10.1). At those sites, the maximally exposed individual member of the public would be located in a census tract that contained a low-income or minority population. WVDP TRU waste, however, would be stored on these sites on an interim basis and would not be treated. Therefore, DOE does not anticipate that the interim storage of WVDP TRU waste at either of these sites would pose disproportionately high and adverse impacts on low-income or minority populations.

4.7 REFERENCES

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CHAPTER 5
CUMULATIVE IMPACTS

This chapter addresses the potential for cumulative environmental impacts resulting from the implementation of Alternatives A or B and other past, present, and reasonably foreseeable future actions in the region around the West Valley Demonstration Project site.

Council on Environmental Quality regulations implementing the procedural provisions of NEPA require federal agencies to consider the cumulative impacts of a proposal (40 CFR 1508.25(c)). A cumulative impact on the environment is the impact that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). This type of an assessment is important because significant cumulative impacts can result from several smaller actions that by themselves do not have significant impacts.

The Western New York Nuclear Service Center is located in a rural area with no other major industrial or commercial centers surrounding it. Land use within 8 kilometers (5 miles) of the site is predominantly agricultural (active and inactive) and forestry uses. The industries near the site are light industrial and commercial (either retail or service-oriented). A field review of an 8-kilometer (5-mile) radius did not indicate the presence of any industrial facilities that would present a hazard in terms of safe operation of the site or would have any potential to impact the environment around WVDP (see Section 3.5). Thus, there is no potential for cumulative impacts from other present or reasonably foreseeable future actions, other than from activities at the site.

The WVDP site and the surrounding area in Cattaraugus County are in attainment with the National Primary and Secondary Ambient Air Quality Standards and New York State air quality standards. WVDP's current emissions of criteria pollutants are well below the New York State Department of Environmental Conservation's annual emission. The estimate of future emissions of criteria pollutants under all alternatives demonstrates that the site will continue to operate within its permit limits, with emissions that, even when conservatively combine with Buffalo background levels, would all be below federal and New York State standards (see Section 3.3.2).

Past fuel processing and radioactive waste disposal operations at the Center have resulted in airborne and liquid releases, some soil and groundwater contamination, limited sediment contamination in the creeks, and some detectible contamination off the site. The net impact from past operations to the regional population near the Center has been estimated to be approximately 13 person-rem. During reprocessing operations, the estimated cumulative exposure to the workforce was about 4,200 person-rem (JAI 1980). As demonstrated in Section 4.0, the potential radiation dose to workers and the public, within 80 kilometers (50 miles), from the implementation of the No Action Alternative, Alternatives A or B, would be far lower than that experienced in the past (2.5 person-rem), and the resulting cumulative impact would be very small (less than one projected latent cancer fatality). There are ongoing operations at the WVDP site. These activities are those included in the No Action Alternative and Alternatives A and B and involve active hazardous waste management, operational support, surveillance, and oversight and other routine operations. These activities result in exposure of workers and the public to very low doses of radiation above background levels each year (0.1 percent of natural background annual exposure for the maximally exposed member of the public). The dose from ongoing operations, when added to the expected dose from the implementation of Alternatives A or B, would remain very low.

All ongoing operations that would contribute to potential impacts have been incorporated into the impact analyses provided in this EIS that demonstrate very small impacts. There are no other ongoing or currently planned activities at the WVDP site that would contribute to site cumulative impacts. In the future, DOE or the New York State Energy Research and Development Authority may propose decommissioning and/or long-term stewardship activities that could impose environmental impacts at the site. However, at this time it is not known what, if any, contributions future decontamination and/or long-term stewardship actions may make to cumulative impacts.

The shipment of radioactive wastes from the WVDP site to the disposal sites has the potential to affect people nationwide located along the highway and rail corridors between the site and the offsite disposal facilities. These potential impacts include the direct effect of radiation exposure to people using, working, and residing along the selected corridors and traffic accidents. Transportation workers and the general public using, working, and residing along the selected transportation corridors could also be affected by shipments of radioactive waste or materials from other sites. This situation would be particularly true for individuals residing along the major interstate highways used as access routes to the waste disposal sites. However, the potential cumulative impacts would be small, less than one projected latent cancer fatality in the affected population for the 10-year duration of the proposed actions (see Section 4.0). Further, there would be relatively few shipments of radioactive waste, (average of 25 trucks and/or 8 railcars per year) from the WVDP site, in comparison to other radioactive waste and materials shipments and truck shipments. Additionally, the actions contemplated in this EIS are also addressed in other NEPA documents such as the WM PEIS (DOE 1997a) and WIPP Supplemental EIS II (DOE 1997b) as listed in Section 1.7. These documents include analyses of impacts associated with transportation of waste to the receiving sites identified in this EIS and potential cumulative impacts at those sites.

REFERENCES

DOE (U.S. Department of Energy), 1997a. *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Volumes 1 through 5)*, DOE/EIS-0200-F, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement,* DOE/EIS-0026-S-2, Washington, DC, September.

JAI (E.R. Johnson Associates, Inc.), 1980. *Review of the Operating History of the Nuclear Fuel Service, Inc., West Valley, New York Irradiated Fuel Processing Plant*, JAI-161, Reston, Virginia, December 26.

CHAPTER 6

UNAVOIDABLE IMPACTS, SHORT-TERM USES AND LONG-TERM PRODUCTIVITY, AND IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

In addition to a discussion of the environmental impacts of the proposed action and a discussion of alternatives, NEPA requires that an EIS contain information on any adverse environmental effects that could not be avoided if the proposed action were implemented, the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposed action should it be implemented (NEPA, Section 102(2)(C); 42 U.S.C. 4332(C)). This chapter provides this information for Alternatives A and B.

6.1 UNAVOIDABLE ADVERSE IMPACTS

Under Alternative A or B, there would be a very slight increase in radiation doses to the public and workers as a result of waste management activities, which could result in a very slight increase in excess cancer risk. The highest *total* risk of a latent cancer fatality for the maximally exposed member of the public would be very low at 3.1×10^{-7} (about 3 chances in 10 million) under all alternatives, including the No Action Alternative. Offsite transportation of waste under Alternatives A or B could result in slight worker and public radiation exposure and the potential for traffic accident fatalities. The total estimate of fatalities from waste shipments is less than one for all alternatives.

6.2 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Implementation of Alternative A or B would not create a conflict between the local, short-term uses of the environment and long-term productivity. All activities would occur in existing or planned facilities or would use existing or planned infrastructure resources such as roads and railways. Environmental resources such as land use, plants and animals, and wetlands would not be affected by implementation of either of the action alternatives.

6.3 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Utilization of utilities such as electricity, natural gas, and water would continue at the same rates as current operations under all alternatives. The only additional irreversible or irretrievable commitment of resources that would occur if Alternative A or B were implemented is the use of fossil fuels in the shipment of waste off the site and the use of land for the disposal of radioactive wastes. Approximately 2,550 truck or 847 rail shipments would be required to ship all LLW, mixed LLW, TRU waste and HLW off the site under Alternative A or B. Both rail and truck shipments would require the consumption of diesel fuel and other fossil fuels such as gasoline and lubricants.

Implementation of Alternatives A or B would also involve the use of offsite land previously committed for radioactive waste disposal facilities. As described in Section 1.7, the land use requirements for the offsite disposal of LLW, mixed LLW, and TRU waste have been addressed in the WM PEIS (DOE 1997a) and the WIPP Supplemental EIS II (DOE 1997b). Land use requirements for the offsite disposal of HLW are addressed in the *Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002).

6.4 REFERENCES

DOE (U.S. Department of Energy), 1997a. *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Volumes 1 through 5)*, DOE/EIS-0200-F, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Washington, DC, September.

DOE (U.S. Department of Energy), 2002. *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS–0250, Office of Civilian Radioactive Waste Management, Washington, DC, February.

CHAPTER 7
LIST OF PREPARERS AND DISCLOSURE STATEMENT

This chapter identifies the individuals who were principal preparers of this document. Daniel Sullivan directed its preparation. Thomas L. Anderson managed the project and provided technical support. Lucinda Swartz served as technical reviewer for conformity to the National Environmental Policy Act, the Council on Environmental Quality, and U.S. Department of Energy regulations and guidance. Following the list of preparers is the "NEPA Disclosure Statement for Preparation of the West Valley Demonstration Project Waste Management Environmental Impact Statement."

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NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE WEST VALLEY DEMONSTRATION PROJECT WASTE MANAGEMENT ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, **Battelle Memorial Institute** hereby certifies as follows: check either (a) or (b).

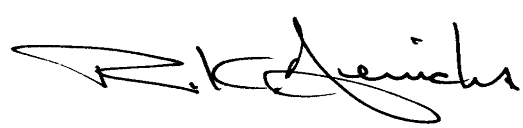
(a) **X** **Battelle Memorial Institute** has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ ____________________________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:



Signature

Ralph K. Henricks
Name

Contracting Officer
Title
25 October 2000
Date

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CHAPTER 8

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Betty Nolan, Congressional
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Joe Patti
John Pfeffer
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Larry Rubin
Pete Scherer
Warren Schmidt
Tim Siepel
Ray Vaughan
Eric Wohlers
Pete Cooney, alternate
Gayla Gray, alternate
Mark Mitskovski, alternate
Bob Potter, alternate
CTF General Mailing Distribution

OTHER
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Janet Anderson
Jay Beech
Willis Bixby
Tom Blackburn
Wesley Churchill
Cristin Clarke
Ron Cook
Captain Scott M. Crosier
Leonard Davis
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Charles Pfeffer
Mary Seeley
Paul Stansbury
Bill Tetley
Stefan Wawrzynski
John C. Wright, Jr.

CHAPTER 9
GLOSSARY

50 percent atmospheric conditions	Atmospheric conditions that are not exceeded 50 percent of the time and provide a realistic estimate of the likely atmospheric conditions that would exist during an accident.
95 percent atmospheric conditions	Atmospheric conditions that are not exceeded 95 percent of the time and provide an upper bound on the atmospheric conditions that would exist during an accident.
air quality	The cleanliness of the air as measured by the levels of pollutants relative to standards or guideline levels established to protect human health and welfare. Air quality is often expressed in terms of the pollutant for which concentrations are the highest percentage of a standard (e.g., air quality may be unacceptable if the level of one pollutant is 150 percent of its standard, even if levels of other pollutants are well below their respective standards).
air-quality standards	The legally prescribed level of constituents in the outside air that cannot be exceeded during a specified time in a specified area.
background radiation	Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices).
Center	The Western New York Nuclear Service Center; the site abbreviation as used in this EIS.
characterization	The determination of waste composition and properties, whether by review of process knowledge, nondestructive examination or assay, or sampling and analysis, generally done for the purpose of determining appropriate storage, treatment, handling, transport, and disposal practices to meet regulatory requirements.
cloudshine	Direct external dose from the passing cloud of dispersed radioactive material.
collective dose	The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sievert.
concentration	The quantity of a substance in a unit quantity of a sample (for example, milligrams per liter or micrograms per kilogram).

contact-handled waste Radioactive waste or waste packages whose external dose rate is low enough to permit handling by humans during normal waste management activities. Also defined as transuranic waste with a surface dose rate not greater than 200 millirem per hour.

contamination Unwanted chemical elements, compounds, or radioactive material on structures, areas, environmental media, objects, or personnel.

criteria pollutant An air pollutant that is regulated by National Ambient Air Quality Standards (NAAQS). The Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants currently are: sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (less than 10 micrometers [0.0004 inch] in diameter and less than 2.5 micrometers [0.0001 inch] in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. *Note: Sometimes pollutants regulated by state laws are also called criteria pollutants.*

cumulative impacts Impacts on the environment that result when the incremental impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

decommissioning Removing facilities such as processing plants, waste tanks, and burial grounds from service and reducing or stabilizing radioactive contamination. Includes the following concepts: the decontamination, dismantling, and return of an area to its original condition without restrictions on use or occupancy; partial decontamination, isolation of remaining residues, and continued surveillance and restrictions on use or occupancy.

decontamination The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive contamination from facilities, soil, or equipment by washing, chemical action, mechanical cleaning, or other techniques.

dermal Relating to the skin.

disposal Emplacement of waste so as to ensure isolation from the biosphere without maintenance and with no intent of retrieval, and requiring deliberate action to gain access after emplacement.

disposal area A place for burying unwanted (that is, radioactive) materials in which the earth acts as a receptacle to prevent the dispersion of wastes in the environment and the escape of radiation.

disposal facility A man-made structure in which waste is disposed.

DOE orders Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose (radiological) A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or committed equivalent dose, as defined in the *Glossary of Terms Used in DOE NEPA Documents* (September 1998).

endangered species Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424). *Note: Some states also list species as endangered. Thus, in certain cases, a state definition would also be appropriate.*

environmental impact statement (EIS) The detailed written statement that is required by section 102(2)(C) of the National Environmental Policy Act (NEPA) for a proposed major federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable regulations in 40 CFR 1500-1508, and the Department of Energy NEPA regulations in 10 CFR Part 1021.

The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives, adverse environmental effects that can not be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and Tribal programs and policies. Executive Order 12898 directs federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

exposure — The condition of being subject to the effects or acquiring a dose of a potential stressor such as a hazardous chemical agent or ionizing radiation; also, the process by which an organism acquires a dose of a chemical such as mercury or a physical agent such as ionizing radiation. Exposure can be quantified as the amount of the agent available at various boundaries of the organism (e.g., skin, lungs, gut) and available for absorption.

FONSI (Finding of no significant impact) — A public document issued by a federal agency briefly presenting the reasons why an action for which the agency has prepared an environmental assessment has no potential to have a significant effect on the human environment and, thus, will not require preparation of an environmental impact statement. [See environmental impact statement.]

geologic repository — A system that is intended to be used for, or may be used for, the disposal of radioactive waste or spent nuclear fuel in excavated geologic media. A geologic repository includes (a) the geologic repository operations area, and (b) the portion of the geologic setting that provides isolation. A near-surface disposal area is not a geologic repository.

groundwater — Water below the ground surface in a zone of saturation.

Subsurface water is all water that exists in the interstices of soil, rocks, and sediment below the land surface, including soil moisture, capillary fringe water, and groundwater. That part of subsurface water in interstices completely saturated with water is called groundwater.

groundshine — Direct external dose from radioactive material that has deposited on the ground after being dispersed from the accident site.

hazardous waste — A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33.

Source, special nuclear, or by-product materials as defined by the Atomic Energy Act are not hazardous waste because they are not solid waste under RCRA. (See Resource Conservation and Recovery Act and waste characterization.)

high-efficiency particulate air filter (HEPA) — An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inch) in diameter. These filers include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

high-level (radioactive) waste (HLW)	Defined by statute (the Nuclear Waste Policy Act) to mean the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products nuclides in sufficient concentrations; and other highly radioactive material that the U.S. Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule requires permanent isolation. The NRC has not defined "sufficient concentrations" of fission products or identified "other highly radioactive material that requires permanent isolation." The NRC defines high-level radioactive waste (HLW) to mean irradiated (spent) reactor fuel, as well as liquid waste resulting from the operation of the first cycle solvent extraction system, the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted.
involved worker	Worker who would participate in a proposed action.
latent cancer fatality (LCF)	Deaths from cancer resulting from, and occurring some time after, exposure to ionizing radiation or other carcinogens.
Low-income population	Low-income populations, defined in terms of Bureau of the Census annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. (See environmental justice.)
low-level (radioactive) waste (LLW)	Radioactive waste that is not high-level waste, transuranic waste, spent nuclear fuel, or by-product tailings from processing of uranium or thorium ore. (See radioactive waste.)
maximally exposed individual (MEI)	A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).
millirem	One-thousandth of a rem (Also see *rem*).
mitigative measures	Those actions that avoid impacts altogether, minimized impacts, rectify impacts, reduce or eliminate impacts, or compensate for the impact.
mixed waste	Waste that contains both hazardous waste, as defined under the Resource Conservation and Recovery Act, and source, special nuclear, or by-product material subject to the Atomic Energy Act.

NAAQS (National Ambient Air Quality Standards)	Standards defining the highest allowable levels of certain pollutants in the ambient air (i.e., the outdoor air to which the public has access). Because the Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in diameter, and less than 2.5 micrometers (0.0001 inch) in diameter. Primary standards are established to protect public health; secondary standards are established to protect public welfare (e.g., visibility, crops, animals, buildings). (See criteria pollutant.)
NEPA (National Environmental Policy Act of 1969)	NEPA is the basic national charter for protection of the environment. It establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. Section 102(2) contains "action-enforcing" provisions to ensure that federal agencies follow the letter and spirit of the Act. For major federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of NEPA requires federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.
NESHAPs (National Emissions Standards for Hazardous Air Pollutants)	Emissions standards set by the Environmental Protection Agency for air pollutants which are not covered by the Nation Ambient Air Quality Standards (NAAQS) and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63. NESHAPs are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, dry cleaning facilities, petroleum refineries).
noninvolved worker	A worker who would be on the site of an action but would not participate in the action. (See involved worker.)
occupational dose	Whole-body radiation dose received by workers participating in a given task.
person-rem	The unit of collective radiation dose applied to populations or groups of individuals (see collective dose); that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-sieverts.
probability of occurrence	The chance that an accident might occur during the conduct of an activity.

radioactive waste In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or by-product material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radionuclide An unstable isotope that undergoes spontaneous transformation, emitting radiation.

Record of Decision (ROD) A concise public document that records a federal agency's decision(s) concerning a proposed action for which the agency has prepared an environmental impact statement (EIS). The ROD is prepared in accordance with the requirements of the Council on Environmental Quality NEPA regulations (40 CFR 1505.2). A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternatives(s), factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. [See environmental impact statement (EIS).]

release fraction The fraction of the radioactivity that could be released to the atmosphere in a given accident.

rem A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rads in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from "roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as one roentgen of X-ray or gamma-ray exposure. One rem equals 0.01 sievert.

remote-handled waste Packaged waste whose external surface dose rate exceeds 200 millirem per hour.

repository A permanent deep geologic disposal facility for high-level or transuranic wastes and spent nuclear fuel.

Resource Conservation and Recovery Act (RCRA) A law that gives the Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (i.e., from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. RCRA also sets forth a framework for the management of non-hazardous solid wastes. (See hazardous waste.)

retrievable grout For this EIS, retrievable grout refers to a controlled low-strength material that provides for interim stabilization of the waste tanks. The grout material would be formulated to be sufficiently flexible to provide shielding and removable should DOE decide to remove the tanks in the future. The grout material would also provide sufficient structural stability and radionuclide retention should DOE decide to close the tanks in place. The exact formulation of this low-strength grout material would need to be developed and would be the subject of additional regulatory reviews before the interim stabilization action could be implemented.

risk The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors). However, separate presentation of probability and consequence is often more informative.

scientific notation A notation adopted by the scientific community to deal with very large and very small numbers by moving the decimal point to the right or left so that only one number above zero is to the left of the decimal point. Scientific notation uses a number times 10 and either a positive or negative exponent to show how many places to the left or right the decimal places has been moved. For example, in scientific notation, 120,000 would be written as 1.2×10^{5}, and 0.000012 would be written as 1.2×10^{-5}.

scoping An early and open process for determining the scope of issues to be addressed in an environmental impact statement (EIS) and for identifying the significant issues related to a proposed action.

The scoping period begins after publication in the Federal Register of a Notice of Intent (NOI) to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. DOE also conducts an early internal scoping process for environmental assessments or EISs. For EISs, this internal scoping process precedes the public scoping process. DOE's scoping procedures are found in 10 CFR 1021.311.

source term The amount of a specific pollutant (e.g., chemical, radonuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (i.e., amount per unit time).

stabilization Treatment of waste or a waste site to protect the biosphere from contamination.

storage (waste) The collection and containment of waste in a retrievable manner, requiring surveillance and institutional control, as not to constitute disposal.

surface water — All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

thalweg — The line joining the deepest points of a stream channel, often used as a synonym for valley profile.

threatened species — Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR 424). (See endangered species.)

transuranic (TRU) waste — Radioactive waste that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

TRUPACT-II — TRUPACT-II is the package designed to transport contact-handled transuranic waste to the Waste Isolation Pilot Plant site. It is a cylinder with a flat bottom and a domed top that is transported in the upright position. The major components of the TRUPACT-II are an inner, sealed, stainless steel containment vessel within an outer, sealed, stainless steel containment vessel. Each containment vessel is nonvented and capable of withstanding 345 kilopascals (50 pounds per square inch) of pressure. The inner containment vessel cavity is 1.8 meters (6 feet) in diameter and 2 meters (6.75 feet) tall, with a capability of transporting fourteen 0.21-cubic-meter (55-gallon) drums, two standard waste boxes, or one 10-drum overpack.

waste characterization — The identification of waste composition and properties by reviewing process knowledge, nondestructive examination, nondestructive assay, or sampling and analysis. Characterization provides the basis for determining appropriate storage, treatment, handling, transportation, and disposal methods to meet regulatory requirements.

worker — Any worker whose day-to-day activities are controlled by process safety management programs and a common emergency response plan associated with a facility or facility area. This definition includes any individual within a facility/facility area who would participate or support activities required for implementation of the alternatives.

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