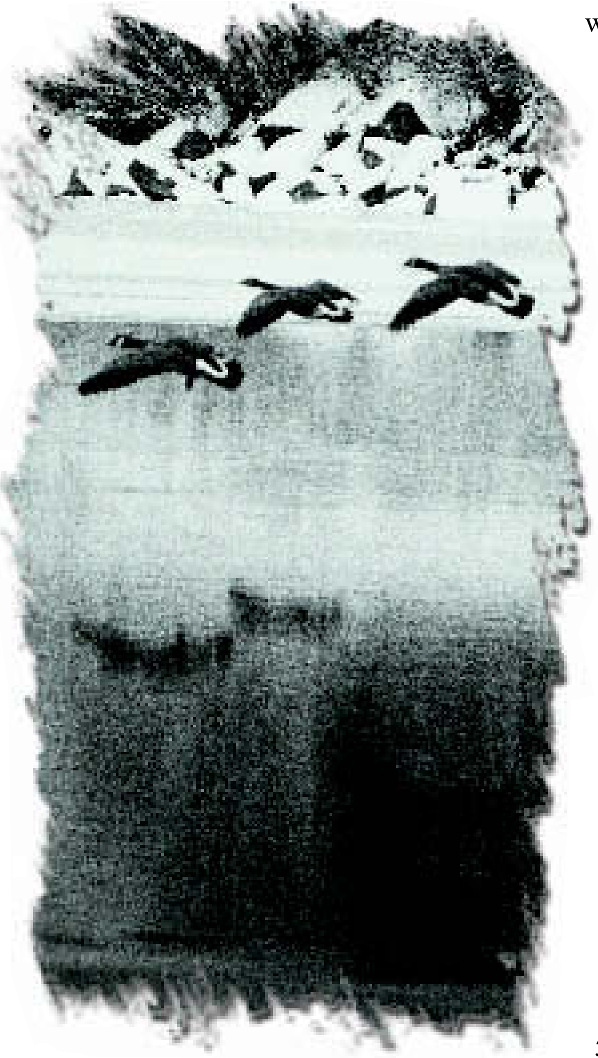
5.2.7 WATER RESOURCES



This section presents potential water resource impacts from implementing the proposed waste processing alternatives described in Chapter 3. Section 5.2.14 discusses potential impacts to INEEL water resources from accidents or unusual natural phenomena such as earthquakes. Appendix C.9 discusses potential long-term impacts to INEEL water resources from facility closure.

Because the Minimum INEEL Processing ***Alternative*** would involve shipment of mixed HLW to the Hanford Site for treatment, possible impacts to water resources at Hanford were also evaluated (see Appendix C.8). Unless otherwise noted, however, the discussion of impacts presented in this section applies specifically to INEEL.

5.2.7.1 Methodology

DOE assessed potential impacts by reviewing project plans for the ***six*** proposed alternatives to determine (1) water use by alternative, (2) liquid effluents that could affect local water resources, and (3) the potential for impacts from flooding. Each alternative was then evaluated with respect to its impacts on surface and subsurface water quality and water use. Previous groundwater computer modeling of the vadose zone and saturated contaminant transport shows that existing plumes would not greatly affect the regional groundwater quality because contaminants would not migrate offsite in concentrations above the EPA drinking water standards (DOE 1995). A more recent study (Rodriguez et al. 1997) predicts that without remediation, chromium, mercury, tritium, iodine-129, neptunium-237, and strontium-90 would reach or exceed EPA drinking water standards in the aquifer beneath the INEEL before the year 2095. Iodine-129 was predicted to migrate to the southern border of the INEEL at the concentration of the drinking water standard (1 picocurie per liter). Section 5.4, Cumulative Impacts, discusses potential impacts of these contaminants.

The primary assumption for evaluating consequences to water resources for each alternative was that there would be no future routine discharge of radioactive liquid effluents that would result in offsite radiation doses. Activities proposed for each alternative have been analyzed to identify potential waste streams and water use (see Sections 5.2.12 and 5.2.13). There are no radioactive discharges directly into the Snake River Plain Aquifer from existing operations. Routine deep well injection of radioactive waste at INTEC was discontinued in 1984. The well was permanently closed and sealed in accordance with Idaho Department of Water Resources regulations in 1989. The sewage treatment plant accepts sanitary wastes from INTEC facilities. Liquid effluent discharges from INTEC facilities to the percolation ponds and sewage treatment plant are monitored for compliance with the conditions of their respective wastewater and land application permits (see Section 4.8). It is not known what contaminants may be present in the process effluent; however, it is assumed that under normal operating conditions the radioactive and chemical discharges would not result in off-INTEC impacts and ***would be*** subject to permitting requirements.

5.2.7.2 Construction Impacts

Potential construction impacts evaluated for water resources include water use and impacts to surface water quality from stormwater runoff. Estimated water use during construction by alternative is presented in Table 5.2-28 of Section 5.2.12. Options under the Separations Alternative have the highest water use, followed by ***the Direct Vitrification Alternative,*** the Non-Separations Alternative, the Minimum INEEL Processing Alternative, the Continued Current Operations Alternative, and the No Action Alternative with the lowest water use. ***During fiscal year 2000,*** INEEL activities ***withdrew about 1.1*** billion gallons of water from the Snake River Plain Aquifer (***Fossum 2002***), most of which ***was*** returned. Total use of groundwater from the Snake River Plain Aquifer for all uses (agricultural irrigation, domestic water use, etc.) averages 470 billion gallons each year (DOE 1995). INEEL activities represent 0.4 percent of the total withdrawal from the aquifer. Water use during construction for any alternative represents a minor increase in water withdrawal over current use. ***Total INEEL water use would be well below the consumptive use water rights of 11.4 billion gallons per year (Teel 1993).***

Construction activities at INEEL are managed in accordance with the *INEEL Storm Water Pollution Prevention Plan for Construction Activities* (DOE 1998a). This plan requires the use of best management practices to minimize stormwater runoff and the potential pollution of surface waters. The *INEEL Storm Water Pollution Prevention Plan for Industrial Activities* (DOE 1998b) requires monitoring at INEEL facilities. Stormwater monitoring at INTEC is discussed in Section 4.8.1.4. Stormwater measurements above benchmark levels established in the *LMITCO Storm Water Monitoring Program Plan* (LMITCO 1998) must be investigated and corrected. A temporary increase in sediment loads in stormwater runoff may be expected during construction. Because options under the Separations Alternative have the most construction activities, the highest potential for stormwater pollution is associated with this alternative. This alternative is followed in order of decreasing potential impact by the Non-Separations Alternative, the Minimum INEEL Processing Alternative, the Continued Current Operations Alternative, and the No Action Alternative. However, in every case, because of the construction best management practices, low annual rainfall, small quantities of runoff, and flat ground slopes, DOE expects impact to surface water to be minimal.

As described in Section 4.8.***1.2***, INTEC stormwater runoff is prevented from reaching the Big Lost River by drainage ditches and berms that divert runoff to a borrow pit and depressions scattered around the INTEC area. Water collects in these depressions and infiltrates the ground surface, providing recharge to the aquifer.

5.2.7.3 Operational Impacts

Potential operational impacts evaluated for water resources include water use, impacts to surface water quality from stormwater runoff, and the potential for flooding. As previously discussed, it is assumed there would be no future routine discharge of radioactive liquid effluents that would result in offsite radioactive doses. Under normal operating conditions for all alternatives, there would be no radioactive ***or*** chemical discharges to the soil or directly to the aquifer that would result in offsite impacts. Potential releases from accidents are evaluated in Section 5.2.14.

Water use by alternative is summarized in Table 5.2-29 (Section 5.2.12). As with construction, the increased operational water use would represent a very small increase over the annual water withdrawal of ***1.1*** billion gallons at the INEEL and 470 billion gallons for the entire Snake River Plain Aquifer. The highest operational water use is expected under the Hot Isostatic Pressed Waste Option.

Stormwater runoff from INTEC is monitored in accordance with the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities* (DOE 1998b). This plan includes provisions for spill control and cleanup, facility inspections to identify and correct potential sources of stormwater pollution, and best management practices at each facility to minimize the potential for polluting stormwater. Stormwater measurements above benchmark levels established in the *LMITCO Storm Water Monitoring Program Plan* (LMITCO 1998) must be investigated and corrected. Based on best management practices, monitoring requirements, and historical measurements of contaminants in INTEC stormwater runoff (Section 4.8), operational impacts to surface water are expected to be minimal under every alternative.

As discussed in Section 4.8***.1.3***, flood studies prepared by the U.S. Geological Survey and Bureau of Reclamation conclude that some inundation at INTEC could occur for a 100-year return period flood. For the two independent 100-year flood studies, the results differ ***by more than*** a factor of two ***in estimated flow rates.*** If, as a result of this EIS, DOE decides to build facilities within the flood plain at INTEC, then some form of mitigation ***could*** be necessary to assure that INTEC facilities would not be impacted by localized flooding. A Mitigation Action Plan would be prepared, if necessary, ***pending results of ongoing flood studies.*** However, before such facilities are constructed, future evaluations and comparative analyses regarding the extent of the 100-year flood at INTEC ***will*** be conducted and used by DOE to determine a more accurate ***evaluation of*** potential inundation.

In a previous study (Koslow and Van Haaften 1986), a probable maximum flood combined with an overtopping failure of Mackay Dam resulted in a larger flood than was presented in the ***U.S. Geological Survey study*** (Berenbrock and Kjelstrom 1998) for a 100-year event. The peak water velocity in the INTEC vicinity was estimated at 2.7 feet per second, which would produce minimal erosion. However, as noted in Appendix C.4, the probable maximum flood could affect bin set 1, causing the bin set to lose its integrity. This is a ***conservative*** design basis bounding event and is discussed in Appendix C.4. ***On January 18, 2001, DOE issued a floodplain determination, an estimate of the 100-year flood elevation, for Resource Conservation and Recovery Act (RCRA) permitting purposes at INTEC (Guymon 2001). The determination is based on Koslow and Van Haaften (1986), as is the probable maximum flood described above. The RCRA determination, however, is based on a 100-year flow scenario which involves the overtopping failure of Mackay Dam resulting in a flood elevation of 4,916 feet, whereas the maximum probable flow estimate results in a flood elevation of 4,917 feet at INTEC. Although this is an extremely conservative assumption, exceeding the requirements for a 10 CFR 1022 floodplain determination, the 4,916 feet elevation is consistent with the safety authorization basis for facilities at INTEC.***

5.2.8 ECOLOGICAL RESOURCES

5.2.8.1 Methodology

This section presents the potential impacts on ecological resources from implementing the proposed waste processing alternatives described in Chapter 3. Potential impacts were qualitatively assessed by reviewing project plans for the ***six*** proposed alternatives to determine if: (1) project activities are likely to produce changes in ecological resources and (2) project plans conform to existing major laws, regulations, and DOE Orders related to protection of ecological resources (e.g., protected species, wetlands). Because the Minimum INEEL Processing ***Alternative*** would involve shipment of mixed HLW to the Hanford Site for treatment, possible impacts to Hanford's ecological resources were also evaluated (see Appendix C.8 for a detailed discussion of at-Hanford impacts). Unless otherwise noted, however, the discussion of impacts in this section applies specifically to the INEEL.

Most of the activities associated with HLW management would take place inside the perimeter fence at INTEC, an area that has been dedicated to industrial use for more than 40 years. Potentially-affected areas (sites and facilities to be used or constructed and surrounding habitat where effluents, emissions, light, or noise may be present) were identified in Chapter 3, Alternatives. Ecological resources of the INEEL are discussed in Section 4.9. The assessment of potential effects is based upon an evaluation of the location, scope, and intensity of construction and waste processing activities in relation to ecological resources. In addition, the potential effects associated with the No Action Alternative serve as a basis of comparison for the other alternatives.

5.2.8.2 Construction Impacts

Construction-related disturbances of various types (such as earthmoving and noise) associated with the development of new INTEC facilities would be a primary source of ecological impacts and could result in displacement of individual animals, habitat loss, and habitat degradation. Table 5.2-1 in Section 5.2.1 lists new facilities and acreage that would be disturbed for the ***six*** proposed waste processing alternatives.

Because INTEC is a heavily-developed industrial area with most natural vegetation removed, its value as wildlife habitat is marginal. No state or Federally-listed species are known to occur in the area. With the exception of the intermittent streams and spreading areas and the engineered percolation ponds and waste treatment lagoons described in Section 4.8 (Water Resources), there are no aquatic habitats on the INEEL or near INTEC. None of the alternatives evaluated in this EIS would affect jurisdictional wetlands.

Because options under the Separations Alternative ***and the Vitrification with Calcine Separations Option*** would have the most construction activity, this alternative ***and option*** would have the greatest potential for construction-related disturbances to plant and animal communities in areas adjacent to INTEC. ***The No Action Alternative would have the least impact.***

Under two of the alternatives, the Separations Alternative and the Minimum INEEL Processing Alternative, DOE could elect to dispose of the grouted low-level waste fraction in a new Low-Activity Waste Disposal Facility ***described in Section 5.2.1.3.*** Although undisturbed, this site is adjacent to INTEC, thus its development would not require the conversion of high-quality wildlife habitat to industrial use. Further, the site's proximity to INTEC would mean that minimal expansion of infrastructure and utilities would be required (Kiser et al. 1998).

Potential construction impacts would be related to activities such as excavating, loading, and hauling soils from the Low-Activity Waste Disposal Facility; grading excavated areas; developing access roads; and building reinforced concrete disposal facilities. The potential effects of clearing approximately 22 acres of shrub-steppe vegetation (see Section 4.9.1) could include a local reduction in plant productivity and invasion by non-native annual plants such as Russian thistle and cheatgrass.

Construction of the Low-Activity Waste Disposal Facility could result in loss of nesting habitat for ground-nesting birds. Small mammals (ground squirrels) and reptiles (snakes and lizards) that live in burrows for much of the year would be subjected to displacement or mortality. Noise, night lights, and increased vehicle activity during the construction phase could disturb wildlife within sight or sound of construction activities and transportation routes. This could result in displacement of some animals and abandonment of nest or burrow sites. Because the area proposed for the Low-Activity Waste Disposal Facility is adjacent to INTEC, it has minimal value as wildlife habitat. This would reduce the extent of animal displacement and mortality.

Once filled to capacity, the Low-Activity Waste Disposal Facility would be equipped with an engineered cap sloping from centerline to ground level with a four percent grade (Kiser et al. 1998). The cap would be revegetated with selected native plants to prevent erosion and improve the appearance of the closed facility.

Under the Minimum INEEL Processing Alternative, two new facilities would be built within the 200-East Area of the Hanford Site. These facilities would be located in a previously-undisturbed area with little value as wildlife habitat due to its proximity to existing waste management facilities. The required acreage would be relatively small (52 acres) and would not result in significant habitat fragmentation. Impacts to biodiversity would be small and local in scope. See Appendix C.8 for a more detailed analysis of impacts at the Hanford site.

5.2.8.3 Operational Impacts

The operation of HLW facilities at INTEC could, depending on the waste processing alternative selected, result in increased levels of human activity (movement of personnel and vehicles, noise, night lighting) and increased emissions of hazardous and radioactive air pollutants over the period of waste processing.

Because operations-phase disturbances to wildlife would be directly related operational employment levels, direct employment levels under the various wastes processing alternatives (see Section 5.2.2) were assumed to reflect the relative amount of disturbance. Direct employment would be highest under the Direct Cement Waste Option. However, as noted in the discussion of socioeconomic impacts, none of the waste processing alternatives is expected to generate significant numbers of new jobs at INTEC, so there would be no marked increase in operational employment levels at INTEC. As a result, operations-related disturbances to wildlife using shrub-steppe habitat adjacent to INTEC would not increase over the period of analysis.

Waste processing and related activities would result in emissions of nonradiological and radiological air pollutants to the atmosphere at INTEC. These emissions are discussed in detail in Section 5.2.6 and discussed here in the context of potential exposures of plants and animals. As noted in Section 5.2.6, minor increases in ambient concentrations of criteria pollutants (e.g., sulfur dioxide and nitrogen dioxide) would be expected, particularly under the Separations Alternative options, but no impacts to local soils or vegetation, including the native sagebrush community, would be expected. The National Park Service has issued interim guidelines for protection of sensitive resources relative to air quality concerns (DOI 1994). For sulfur dioxide, the Park Service recommendation to maximize protection of all plant species is to maintain levels below 40 to 50 parts per billion (ppb) for a 24-hour averaging time, and 8 to 12 ppb for annual average levels. The lower ends of these ranges correspond to about 100 and 20 micrograms per cubic meter, respectively. The guideline for annual average nitrogen dioxide is less than 15 ppb, which corresponds to about 28 micrograms per cubic meter.

The highest projected levels of sulfur dioxide and nitrogen dioxide at ambient air locations from any of the waste processing alternatives would be well below these guidelines under any of the alternatives. When the combined effects of baseline and alternative impacts are considered (see Table C.2-14), the maximum 24-hour sulfur dioxide level would be about 28 micrograms per cubic meter (5 percent of the guideline) along public roads and about half that (less than 3 percent of the guideline) at the INEEL boundary. The maximum annual average sulfur dioxide level would not exceed about 3 percent of the guideline along public roads and would be less than 1 percent at any offsite location. For nitrogen dioxide, the highest public road level would be about 1.8 micrograms per cubic meter, or roughly 2 percent of the guideline. These maximum concentrations would occur under the Planning Basis Option (Separations Alternative), and would be somewhat less for other alternatives. Levels of both pollutants at Craters of the Moon Wilderness Area - the nearest area at which the Park Service guidelines are intended to apply - would be roughly one-seventh to one-tenth of the maximum offsite levels cited above.

A number of toxic air pollutants would be produced by waste processing operations and fossil fuel combustion. These pollutants ***could*** be transported to downwind locations and deposited on surface soils. Plant and animal communities on INEEL could be at risk from the accumulation of these chemical contaminants in surface soils. Animals can be exposed directly to contaminants in surface soils (e.g., incidental ingestion of soils) or indirectly through foodchain exposure (e.g., ingestion of contaminated prey). Plants can be exposed via root contact and subsequent uptake of contaminants in soils or deposition onto the plants themselves. Hence, DOE assessed the impacts of aerial deposition of chemical contaminants from INTEC emissions on ecological receptors in areas surrounding the facility.

DOE assessed the potential impacts to ecological receptors from air emissions associated with waste processing alternatives. A conservative screening approach was used to assess the maximum concentrations of contaminants of potential concern in surface soils that could result from airborne releases and deposition of these substances. Contaminants of potential concern include radionuclides released from waste treatment operations, and toxic air pollutants produced by both fossil fuel combustion and waste treatment operations. The specific contaminants are the same as those assessed for air resources impacts, as described in Section 5.2.6 and Appendix C.2. The assessment involved identifying the area (within the INEEL) of highest predicted impact and estimating the annual deposition rates and total deposition for contaminants of potential concern.

Ibrahim and Morris (1997) found plutonium in detectable concentration to a soil depth of 21 centimeters at the Radioactive Waste Management Complex on the INEEL. However, 50 percent of the plutonium was in the first 3 centimeters, 75 percent was in the first 10 centimeters, and about 88 percent was in the first 15 centimeters. This is a fairly typical pattern for fallout radionuclides, with most radioactivity occurring in the first few centimeters of soil and an exponential decrease below that. For analysis purposes in this EIS, it was assumed that all contaminants would be uniformly distributed through the first 5 centimeters of soil after an operational period ending in 2035. In general, radionuclides adhere or bind to soil particles, and these soil particles are distributed throughout the soil by means of frost heave, penetration of the soil by vertebrate and invertebrate animals, plant roots, and through snow melt and rain. It was also assumed that there would be no loss of contaminants due to radioactive decay, chemical breakdown, weathering, or plant uptake over the period of deposition.

To determine if the predicted concentrations of nonradiological chemical contaminants in surface soils pose a potential risk to plant and animal communities, soil concentrations were compared to ecologically-based screening levels (Table 5.2-***11***). These screening levels represent concentrations of chemicals in surface soils above which adverse effects to plants and animals could occur. These include the lowest ecologically-based screening levels used in the Waste Area Group 3 ecological risk assessment (Rodriquez et al. 1997); screening benchmarks for surface soils developed by Oak Ridge National Laboratory (ORNL) (Efroymson et al. 1997a,b); U.S. Fish and Wildlife Service "A" screening levels (Beyer 1990); and Dutch Ministry of Housing, Spatial Planning and the Environment (MHSP&E 1994) "Target" values. No screening levels were exceeded for any chemical under any waste processing alternative. In general, predicted surface soil concentrations were several orders of magnitude lower than their screening levels, suggesting that plant and animal communities would not be at risk.

Nonradiological chemical contaminant deposition rates would be low under all waste processing alternatives, limiting direct exposure to above-ground plant structures. Most native plants have deep roots to survive desert conditions, which would reduce root exposure to chemicals in shallow surface soils and limit their uptake. Direct contact with contaminants in surface soils is a possible exposure route for animals but would probably be limited because fur, feathers, and chitinous skeletons provide a barrier against dermal exposure. The scarcity of surface water in the area would reduce exposure from ingestion of contaminants in drinking water, and the low airborne concentrations would result in minimal inhalation exposure. Incidental ingestion of contaminants in surface soils and exposure through the foodchain are likely exposure routes. However, the low concentrations predicted in surface soils would minimize potential risks from these exposure routes. For these reasons, potential risks to plant and animal communities on the INEEL from airborne deposition of INTEC chemical contaminants would be low under any waste processing alternative.

Potential radionuclide exposure of plants and animals in areas surrounding INTEC may increase slightly due to waste processing activities; however, potential radionuclide emissions from INTEC facilities would result in doses to humans that are well below regulatory limits (Section 5.2.6) and are not expected to affect biotic populations and communities in the area. The long-term exposure and intake by plants and animals in areas adjacent to INTEC are surveyed and reported annually in the INEEL Site Environmental Report in accordance with DOE Order 5400.1. Any measurable change in exposure or uptake due to waste processing activities would be identified by the environmental surveillance program and assessed to determine possible long-term impacts.

For potential radiological impacts, DOE estimated the deposition and resulting soil concentration of the principal radionuclides that would be released from the waste processing alternatives. The specific radionuclides considered are those which either (a) are emitted in greatest quantities or (b) have the greatest potential for radiological impacts (see Section 5.2.6).

Table 5.2-11. Maximum concentrations of contaminants in soils outside of INTEC compared to ecologically-based screening levels (in milligrams per kilogram).

Contaminant	Highest predicted concentration	Option or alternative	Minimum WAG 3 EBSL[a]	ORNL soil phytotoxicity benchmark[b]	ORNL micro-organisms benchmark[c]	ORNL earthworm benchmark[c]	USFWS "A" screening value[d]	Dutch Ministry target screening value[e]
Antimony	7.9×10^{-3}	Planning Basis	0.767	5	NA	NA	NA	NA
Arsenic	2.0×10^{-3}	Planning Basis	0.901	10	100	60	20	29
Barium compounds	***4.4×10^{-3}***	***Vitrification with Calcine Separations***	0.108	500	3.0×10^{3}	NA	200	200
Beryllium	4.2×10^{-5}	Planning Basis	0.734	10	NA	NA	NA	NA
Cadmium compounds	6.0×10^{-4}	Planning Basis	2.63×10^{-3}	4	20	20	1	0.8
Chromium (hexavalent)	3.7×10^{-4}	Planning Basis	0.167	1	NA	0.4	NA	NA
Chromium (as Cr)	1.3×10^{-3}	Planning Basis	3.25	NA	NA	NA	100	100
Cobalt	9.0×10^{-3}	Planning Basis	0.467	20	1.0×10^{3}	NA	20	20
Copper	2.6×10^{-3}	Planning Basis***/Vitrification with Calcine Separations***	2.17	100	100	50	50	36
Lead	2.3×10^{-3}	Planning Basis	0.072	50	900	500	50	85
Manganese (as Mn)	4.5×10^{-3}	Planning Basis***/Vitrification with Calcine Separations***	14.4	500	100	NA	NA	NA
Mercury	***2.3×10^{-4}***	***Vitrification with Calcine Separations***	6.3×10^{-3}	0.3	30	0.1	0.5	0.3
Molybdenum	1.2×10^{-3}	Planning Basis	5.57	2	200	NA	10	10
Nickel	0.13	Planning Basis	2.77	30	90	200	50	35
Selenium	1.0×10^{-3}	Planning Basis	0.083	1	100	70	NA	NA
Silver	2.8×10^{-10}	Transuranic Separations	1.39	2	50	NA	NA	NA
Thallium	8.5×10^{-10}	Transuranic Separations/Early Vitrification	0.117	1	NA	NA	NA	NA
Vanadium	0.048	Planning Basis	0.255	2	20	NA	NA	NA
Zinc	0.044	Planning Basis	6.37	50	100	200	200	140

a. From WAG 3 RI/BRA/FS (Rodriguez et al. 1997).

b. From Efroymson et al. (1997a).

c. From Efroymson et al. (1997b).

d. From Beyer (1990).

e. From MHSP&E (1994).

EBSL = ecologically-based screening level; NA = Not available; ORNL = Oak Ridge National Laboratory; USFWS = U.S. Fish and Wildlife Service; WAG = Waste Area Group.

Predicted soil concentrations, shown in Table 5.2-***12***, are within historical ranges of concentrations in soils around INTEC (Morris 1993; Rodriguez et al. 1997) and below ecologically-based screening levels for radionuclides developed for the Waste Area Group 3 Remedial Investigation/Feasibility Study (Rodriquez et al. 1997).

Because INTEC is a heavily-developed industrial area with most natural vegetation removed, its value as wildlife habitat is marginal. No state or Federally-listed species is known to occur in the area. No currently listed threatened and endangered species or critical habitat would be affected by the alternatives evaluated in this EIS. In November 1997, as part of an informal consultation under Section 7 of the Endangered Species Act, DOE requested assistance from the U.S. Fish and Wildlife Service in identifying any threatened or endangered species or critical habitat that might be affected by the actions analyzed in this EIS. In a letter dated December 16, 1997, the U.S. Fish and Wildlife Service replied that it was their preliminary determination that the proposed action was unlikely to impact any species listed under the Endangered Species Act. In January 1999, DOE sent a second letter to the U.S. Fish and Wildlife Service asking if any conditions had changed with respect to threatened or endangered species or critical habitats that might occur in the general vicinity of INTEC. In a letter dated February 11, 1999, the U.S. Fish and Wildlife Service reiterated that it was their preliminary determination that, given the general nature of the proposal, the project would be unlikely to impact any listed species. Based upon the analyses conducted for this EIS, DOE has determined that the activities analyzed for this EIS are not likely to adversely affect listed species or critical habitat, and, accordingly no further action is necessary.

With the exception of intermittent streams, spreading areas, playas, engineered percolation and evaporation ponds, and waste treatment lagoons there are no aquatic habitats on the INEEL or in the vicinity of INTEC. Before any of these potential wetlands is altered, a wetland determination would be completed to determine if mitigation is required.

5.2.9 TRAFFIC AND TRANSPORTATION

This section presents the estimated impacts of transporting radioactive materials for each of the waste processing alternatives described in Chapter 3. Transportation of hazardous and radioactive materials on highways and railways outside the boundaries of ***the*** INEEL is an integral component of HLW management and affects decisions to be made within the scope of this EIS. The different waste forms that are analyzed include vitrified HLW, vitrified low-level waste, vitrified transuranic waste, grouted low-level waste, grouted transuranic waste, hot isostatic pressed HLW, cementitious HLW, calcine, ***steam reformed SBW***, solidified HLW fraction, and solidified transuranic waste fraction.

Although transportation of road-ready HLW to a geologic repository is beyond the scope of DOE's Proposed Action (see Chapter 1), DOE has, in this EIS, analyzed HLW transportation for two reasons. First, transporting HLW for disposal is an action that logically follows the Proposed Action (40 CFR 1508.25). Second, waste processing alternatives would result in large differences in the number of shipments, resulting in transportation impacts that would have to be considered by the decision-maker.

DOE has assumed that all HLW will ultimately be disposed of in a geologic repository. The Government has not yet ***approved*** a geologic repository for HLW disposal. However, only one site, Yucca Mountain in Nevada, is currently under consideration. Therefore, for purposes of analysis, the transportation impacts for HLW shipment are based on the assumption that Yucca Mountain is the destination. The routes between the INEEL and Yucca Mountain selected in this EIS are ***representative of*** those that DOE may ultimately select. DOE has not yet determined when it would make decisions concerning the transportation of spent nuclear fuel and HLW to the Yucca Mountain site. The Yucca Mountain EIS includes information, such as the comparative impacts of heavy-haul truck and rail transportation, alternative intermodel (rail to truck) transfer station locations associated with heavy-haul truck routes, and alternative rail transport corridors in Nevada. It is uncertain at this time when DOE would make transportation-related

Table 5.2-12. Maximum concentrations of radionuclides in soils outside of INTEC compared to background and ecologically-based screening levels (in picocuries per gram).[a]

					Separations Alternative			Non-Separations Alternative					***Direct Vitrification Alternative***	
Radionuclides	Background concentration[b]	WAG 3 EBSL[b]	No Action Alternative	Continued Current Operations Alternative	Full Separations Option	Planning Basis Option	Transuranic Separations Option	Hot Isostatic Pressed Waste Option	Direct Cement Waste Option	Early Vitrification Option	***Steam Reforming Option***	Minimum INEEL Processing Alternative at INEEL	***Vitrification without Calcine Separations Option***	***Vitrification with Calcine Separations Option***
Americium-241	0.011	355	ND	ND	1.3×10^{-9}	6.1×10^{-10}	2.2×10^{-9}	ND	ND	ND	***ND***	2.7×10^{-6}	***ND***	***ND***
Antimony-125	NA	6,020	5.7×10^{-8}	4.5×10^{-7}	***5.8×10^{-8}***	4.7×10^{-7}	7.3×10^{-8}	4.5×10^{-7}	4.5×10^{-7}	1.8×10^{-7}	***1.8×10^{-7}***	7.1×10^{-7}	***1.2×10^{-7}***	***1.8×10^{-7}***
Cesium-134	NA	1,950	3.1×10^{-9}	2.4×10^{-7}	2.9×10^{-10}	2.4×10^{-7}	***6.4×10^{-9}***	2.4×10^{-7}	2.4×10^{-7}	1.1×10^{-8}	***1.8×10^{-8}***	1.4×10^{-8}	***7.4×10^{-9}***	***7.4×10^{-9}***
Cesium-137	0.82	4,950	9.1×10^{-6}	1.0×10^{-4}	1.8×10^{-4}	1.9×10^{-4}	3.0×10^{-4}	3.6×10^{-3}	***1.8×10^{-4}***	2.9×10^{-4}	***2.9×10^{-4}***	3.3×10^{-4}	***1.9×10^{-4}***	***2.0×10^{-4}***
Cobalt-60	NA	1,180	4.9×10^{-9}	4.6×10^{-8}	2.3×10^{-9}	4.8×10^{-8}	1.1×10^{-9}	4.6×10^{-8}	4.6×10^{-8}	1.5×10^{-8}	***1.5×10^{-8}***	1.3×10^{-6}	***1.0×10^{-8}***	***1.3×10^{-8}***
Europium-154	NA	2,480	7.5×10^{-9}	4.3×10^{-8}	8.6×10^{-11}	4.3×10^{-8}	1.4×10^{-10}	4.3×10^{-8}	4.3×10^{-8}	2.3×10^{-8}	***2.4×10^{-8}***	1.3×10^{-6}	***1.6×10^{-8}***	***1.6×10^{-8}***
Europium-155	NA	32,500	ND	ND	3.9×10^{-11}	1.9×10^{-11}	6.5×10^{-11}	ND	ND	ND	***ND***	2.4×10^{-10}	***ND***	***ND***
Iodine-129	NA	47,600	0.012	0.033	1.2×10^{-3}	0.034	5.6×10^{-4}	0.033	0.033	0.037	***0.035***	0.041	***0.025***	***0.026***
Nickel-63	NA	NA	ND	ND	5.4×10^{-13}	2.6×10^{-13}	9.1×10^{-13}	ND	ND	ND	***ND***	3.5×10^{-11}	***ND***	***ND***
Plutonium-238	0.049	355	2.3×10^{-7}	4.2×10^{-7}	2.6×10^{-6}	1.6×10^{-6}	4.3×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	4.4×10^{-6}	***4.5×10^{-6}***	1.2×10^{-5}	***3.0×10^{-6}***	***3.0×10^{-6}***
Plutonium-239	0.10	379	3.9×10^{-9}	2.5×10^{-8}	1.9×10^{-11}	2.5×10^{-8}	2.9×10^{-11}	2.5×10^{-8}	2.5×10^{-8}	1.2×10^{-8}	***1.3×10^{-8}***	4.3×10^{-7}	***8.3×10^{-9}***	***8.3×10^{-9}***
Plutonium-241	NA	373,000	ND	ND	4.4×10^{-9}	2.1×10^{-9}	7.4×10^{-9}	ND	ND	ND	***ND***	3.1×10^{-10}	***ND***	***ND***
Promethium-147	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	***ND***	6.9×10^{-6}	***ND***	***ND***
Ruthenium-106	NA	194,000	8.9×10^{-8}	2.5×10^{-6}	1.3×10^{-7}	2.5×10^{-6}	6.2×10^{-8}	2.9×10^{-6}	2.5×10^{-6}	2.9×10^{-7}	***2.7×10^{-7}***	3.1×10^{-7}	***2.0×10^{-7}***	***3.2×10^{-7}***
Samarium-151	NA	NA	ND	ND	1.6×10^{-8}	7.6×10^{-9}	2.7×10^{-8}	ND	ND	ND	***ND***	3.3×10^{-6}	***ND***	***ND***
Strontium-90	0.49	3,340	7.8×10^{-7}	1.3×10^{-5}	4.6×10^{-4}	2.3×10^{-4}	7.8×10^{-4}	2.3×10^{-4}	2.3×10^{-4}	6.8×10^{-4}	***6.8×10^{-4}***	9.9×10^{-4}	***4.6×10^{-4}***	***4.6×10^{-4}***
Technetium-99	NA	487	ND	ND	1.4×10^{-6}	6.9×10^{-7}	2.4×10^{-6}	6.4×10^{-6}	ND	ND	***ND***	1.1×10^{-7}	***ND***	***ND***

a. Concentrations for the alternatives assume uniform distribution through a 5-centimeter thick soil layer.

b. From WAG 3 RI/BRA/FS (Rodriguez et al. 1997).

EBSL = ecologically-based screening level; NA = Not available; ND = Not detectable; WAG = Waste Area Group.

decisions. Therefore, the Idaho HLW & FD EIS uses a bounding rail distance analysis for Idaho HLW to a repository for purposes of illustration of impacts and to demonstrate that impacts were considered.

In addition to transportation of HLW for ultimate disposal, this EIS analyzes waste that could be transported to DOE's Hanford Site in Richland, Washington; DOE's Waste Isolation Pilot Plant in New Mexico; a commercial radioactive disposal site operated by Envirocare of Utah, Inc.; and a commercial radioactive waste disposal site operated by Chem-Nuclear Systems. The Envirocare site is located 80 miles west of Salt Lake City, Utah. The Chem-Nuclear Systems site is in Barnwell County, South Carolina. There would be no waste shipped offsite in the No Action Alternative; therefore, this alternative is not explicitly discussed in this section.

This section summarizes the methods of analysis and potential impacts related to the transportation of these materials and traffic from construction and operations under normal (incident-free) and accident conditions. The impacts are presented by alternative and include accident numbers, fatality numbers, radiation doses, and health effects. This section also presents the impacts of changes in the level of traffic on roads near the INEEL from the waste processing alternatives. Because the Minimum INEEL Processing ***Alternative*** involves shipment of mixed HLW to the Hanford Site for treatment, possible traffic and transportation changes at the Hanford Site are presented in Appendix C.8.

5.2.9.1 Methodology

This section summarizes the methods of analysis used in determining the environmental risks and consequences of transporting wastes. Data on the total number of shipments and inventory information were taken from project data sheets identified in Appendix C.6 and other INEEL documents. Details of the analysis can be found in Appendix C.5.

Methodology for Traffic Impact Analysis - DOE assessed potential traffic impacts based on changes in INEEL employment (numbers of employees) associated with each alternative (see Section 5.2.2). The impacts associated with each alternative were evaluated relative to baseline or historic traffic volumes. Changes in traffic volume under the various alternatives were also used to assess potential changes in level of service to the major roads.

The level-of-service impact is a qualitative measure of operational conditions within a traffic stream as perceived by motorists and passengers. A level of service is defined for each roadway or section of roadway in terms of speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety (TRB 1985).

For purposes of evaluating impacts of increased or decreased traffic and usage, the capacity of the roadway in terms of vehicles per hour for a given level of service is first established using the procedure in TRB (1985). The level of service based on existing traffic flow is then established. A new level of service is then calculated based on the changes in traffic associated with each alternative. These levels of service are then compared to determine if the capacity of the highway is exceeded or if the level of service has changed.

Methodology for Vehicle-Related Transportation Analysis - DOE's analysis of potential vehicle-related impacts included expected accidents, expected fatalities from accidents, and impacts from vehicle emissions. Vehicle-related accidents are accidents not related to transportation of waste or materials but simply related to number of miles traveled by vehicles and the risk of accidents occurring based on the increase in miles traveled. Mileage through states along a given route were multiplied by state-specific accident and fatality rates (Saricks and Tompkins 1999) to determine the potential numbers of route-specific accidents and fatalities.

DOE estimated impacts from vehicle emissions using an impact factor for particulate and sulfur dioxide truck emissions (Rao et al. 1982). The impact factor, 1.0×10^{-7} latent fatalities per kilometer, estimates the expected number of latent fatalities per urban kilometer traveled. No impact factors are available for suburban or rural zones; therefore, expected latent fatalities based on vehicle emissions are presented for urban areas only.

The analysis assumes that vehicle-related transportation impacts are independent of the cargo that is being hauled. All vehicle-related transportation impacts were calculated assuming round-trip distances to account for the return trip.

Methodology for Cargo-Related Incident-Free Transportation Analysis - DOE determined radiological impacts for workers and the general public during normal, incident-free transportation. For truck shipments, the occupational receptors were the drivers of the shipment. For rail shipments, the occupational receptors were workers in close proximity to the shipping containers during the inspection or classification of railcars. The general population included persons along the route within 800 meters of the transport link (off-link), persons sharing the transport link (on-link), and persons at stops. All radiological impacts were calculated using the RADTRAN 4 computer code (Neuhauser and Kanipe 1992).

A dose rate of 10 millirem per hour at a distance of 2 meters from the transport vehicle was assumed for all waste shipments. This dose rate is the maximum permitted under 49 CFR 173.441 for exclusive use shipments.

DOE based the calculation of impacts on the development of unit risk factors. Unit risk factors provide an estimate of the dose to an exposure group from transporting one shipment of a specific material over a specific route. The unit risk factors have units of person-rem per shipment and may be combined with the total number of shipments to determine the dose for a series of shipments between a given origin and destination. RADTRAN 4 was used to develop new unit risk factors for all waste types. Truck routes were determined using the HIGHWAY computer code (Johnson et al. 1993a), and train routes were determined using the INTERLINE computer code (Johnson et al. 1993b).

Methodology for Cargo-Related Transportation Accident Analysis - For radioactive waste transportation accidents, accident risk assessment was performed using methodology developed by the U.S. Nuclear Regulatory Commission for calculating the probabilities and consequences from a range of unlikely accidents. Although it is not possible to predict where along the transport route such accidents might occur, the accident risk assessment used route-specific information for accident rates and population densities. Radiation doses for population zones (rural, suburban, and urban) were weighted by the accident probabilities to yield accident risk using the RADTRAN 4 computer code. Using this methodology, a high-consequence accident would not necessarily have significant risk if the probability of that accident is very low.

Differences in waste types translate into different radioactive material release characteristics under accident conditions; thus, analyses were performed for each waste type. Characterization data for the representative waste types were developed based on project data sheets identified in Appendix C.6.

Accident severity categories for radioactive waste transportation accidents are described in NUREG/CR-4829 (Fischer et al. 1987) and NUREG-0170 (NRC 1977). Severity is a function of the magnitudes of the mechanical forces (impact) and thermal forces (fire) to which a cask may be subjected during an accident. The accident severity scheme takes into account all reasonably-foreseeable transportation accidents. Transportation accidents are grouped into accident severity categories, ranging from high-probability events with low consequences to low-probability events with high consequences. Each accident severity category is assigned a conditional probability, which is the probability, given that an accident occurs, that the accident will be of the indicated severity.

Radioactive material releases from transportation accidents were calculated by assigning release fractions (the fraction of the radioactivity in the shipment that could be released in a given severity of accident) to each accident severity. Representative release fractions were identified for each of the representative waste types based on the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997), and those release fractions used for vitrified HLW in the Yucca Mountain EIS (McSweeney 1999).

Radioactive material released to the atmosphere is transported by wind. The amount of dispersion, or dilution, of the radioactive material concentrations in air depends on the meteorological conditions at the time of the accident. Neutral meteorological conditions are the most frequently occurring atmospheric stability condi-

Assessment of the Health Effects of Ionizing Radiation

This EIS presents the consequences of exposure to radiation even though the effects of radiation exposure under most of the circumstances evaluated in this EIS are small. This section explains basic concepts used in the evaluation of radiation effects in order to provide the background for later discussions of impacts.

The effects on people of radiation that is emitted during disintegration (decay) of a radioactive substance depend on the kind of radiation (alpha and beta particles, and gamma and x-rays) and the total amount of radiation energy absorbed by the body. The total energy absorbed per unit quantity of tissue is referred to as "absorbed dose." The absorbed dose, when multiplied by certain quality factors and factors that take into account different sensitivities of various tissues, is referred to as "effective dose equivalent," or where the context is clear, simply "dose." The common unit of effective dose equivalent is the rem.

An individual may be exposed to ionizing radiation externally, from a radioactive source outside the body, and/or internally, from ingesting or inhaling radioactive material. An external dose is delivered only during the actual time of exposure to the external radiation source. An internal dose, however, continues to be delivered as long as the radioactive source is in the body, although both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time. The dose from internal exposure is calculated over 50 years following the initial exposure.

The maximum annual allowable radiation dose to the members of the public from DOE-operated nuclear facilities is 100 millirem per year, as stated in DOE Order 5400.5. All DOE facilities covered by this EIS operate well below this limit. It is estimated that the average individual in the United States receives a dose of about 360 millirem per year from all sources combined, including natural and medical sources of radiation. For perspective, a chest x-ray results in an approximate dose of 8 millirem, while a diagnostic hip x-ray results in an approximate dose of 83 millirem.

Radiation can also cause a variety of ill-health effects in people. The most significant ill-health effect from environmental and occupational radiation exposures is induction of latent cancer fatalities (LCFs). This effect is referred to as latent cancer fatalities because it may take many years for cancer to develop and for death to occur, and cancer may never actually be the cause of death.

The collective dose to an exposed population (or population dose) is calculated by summing the estimated doses received by each member of the exposed population. The total dose received by the exposed population over a given period of time is measured in person-rem. For

Assessment of the Health Effects of Ionizing Radiation (continued)

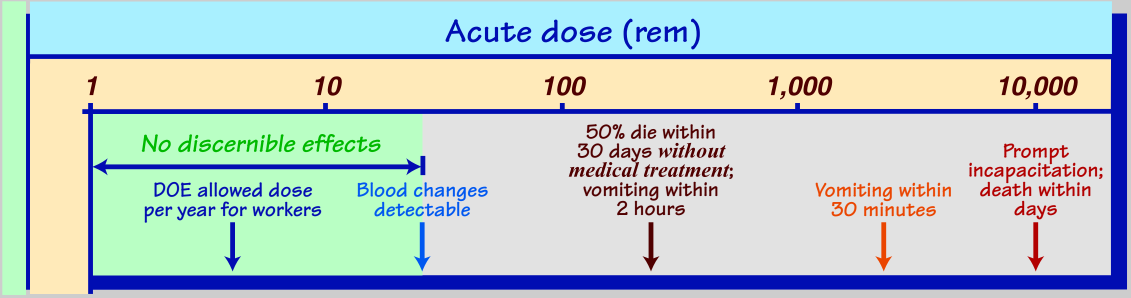
example, if 1,000 people each received a dose of 1 millirem (0.001 rem), the collective dose would be 1,000 persons × 0.001 rem = 1.0 person-rem. Alternatively, the same collective dose (1.0 person-rem) would result from 500 people each of whom received a dose of 2 millirem.

DOE calculated latent cancer fatalities by multiplying the collective radiation dose values by the dose-to-risk conversion factors from the International Commission on Radiological Protection (ICRP 1991). DOE has adopted these risk factors of 0.0005 and 0.0004 latent cancer fatality for each person-rem of radiation exposure to the general public and worker population respectively for doses less than 20 rem. The factor for the population is slightly higher due to the presence of infants and children who are more sensitive to radiation than the adult worker population.

Sometimes, calculations of the number of latent cancer fatalities associated with radiation exposure do not yield whole numbers, and, especially in environmental applications, may yield numbers less than 1.0. For example, if a population of 100,000 were exposed to a total dose per individual of 0.001 rem (1 millirem), the collective dose would be 100 person-rem, and the corresponding estimated number of latent cancer fatalities would be 0.05 (100,000 persons × 0.001 rem × 0.0005 latent cancer fatality per person-rem = 0.05 latent cancer fatality).

How should one interpret a number of latent cancer fatalities **less than 1**, such as 0.05? The answer is to interpret the result as a statistical estimate. That is, 0.05 is the average number of deaths that would be expected if the same exposure situation were applied to many different groups of 100,000 people. In most groups, nobody (0 people) would incur a latent cancer fatality from the 0.001 rem dose each member would have received. In a small fraction of the groups, one latent fatal cancer would result; in exceptionally few groups, two or more latent fatal cancers would occur. The average number of deaths over all the groups would be 0.05 latent fatal cancer (just as the average of 0, 0, 0, and 1 is ¼, or 0.25). The most likely outcome is zero latent cancer fatalities.

Large radiation doses (i.e., at levels substantially greater than the DOE worker dose limit) may cause acute (or immediate) health effects. The figure below shows a diagram of these acute radiation effects on human health.



tions in the United States and, therefore, are most likely to be present in the event of an accident involving a radioactive waste shipment. For accident risk assessment, DOE assumed neutral weather conditions (Pasquill Stability Class D) (Doty et al. 1976).

Collective doses were calculated for populations within 80 kilometers of an accident. Three population density zones (rural, suburban, and urban) were assessed. Dose calculations considered a variety of exposure pathways, including inhalation and direct exposure (cloudshine from the passing cloud), direct exposure (groundshine) from radioactivity deposited on the ground, and inhalation of resuspended radioactive particles from the ground. Human health effects that could result from the radiation doses received were estimated using standard risk factors recommended by the International Commission on Radiological Protection (ICRP 1991).

As a complementary analysis to RADTRAN 4, DOE used the RISKIND (Yuan et al. 1995) computer program developed by Argonne National Laboratory to estimate the radiological consequences to exposed individuals under hypothetical transportation accident conditions. The RISKIND program was originally developed for the DOE Office of Civilian Radioactive Waste Management to analyze the potential radiological health consequences to individuals or specific population subgroups exposed to spent nuclear fuel shipments. In its current configuration, RISKIND supports transportation analysis of radioactive waste forms other than spent nuclear fuel.

The Nuclear Regulatory Commission (Fischer et al. 1987) has estimated that because of the rigorous design specifications for the shipping packages used by DOE, the packages will withstand at least 99.4 percent of the truck or rail accidents analyzed in this EIS without sustaining damage sufficient to have any radiological significance. The remaining 0.6 percent of accidents that could potentially breach the shipping package are represented by a spectrum of accident severities and radioactive release conditions. The RISKIND consequence assessment deals strictly with this small fraction of accidents that could cause the shipping packages to release some or all of their radioactive contents.

Whereas the RADTRAN 4 accident risk assessment considers the entire range of accident severities and their probabilities, the RISKIND assessment is intended to provide an estimate of the potential impacts posed by two transportation accidents differing only in the amount of radioactive material released. Because the RISKIND assessment was performed in a consequence-only mode (i.e., independent of accident probability), uncertainties regarding the severity, occurrence, or location of an accident were removed from the analysis. Thus, the consequence results provide information addressing public concern about the magnitude of an accident impact by assuming that an accident was to occur near them. Information about the configuration and use of RISKIND for this analysis can be found in Appendix C.5.

5.2.9.2 Construction Impacts

As noted in ***Section 4.10.1.1***, the existing principal highway (Highway 20) between Idaho Falls and the INEEL is designated as Level-of-Service A, which represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Based on predicted employment levels during the construction phase (see Section 5.2.2) for the alternatives described in Chapter 3, DOE would not expect the level of service designation for Highway 20 to change. DOE analyzed the impacts of increased traffic in the INEEL area in the SNF & INEL EIS (DOE 1995). The SNF & INEL EIS, which analyzed larger traffic increases as compared to this EIS, also concluded there would be no change in level of service.

5.2.9.3 Operational Impacts

This section describes for each alternative the potential impacts from traffic and transportation during the operational phase. It considers the baseline INEEL employment, current levels of service for onsite and offsite roads in the region of influence, and data from previous DOE analyses, the types and quantities of materials and waste generated, and the method of transportation for each. The analysis presents a comparison between the traffic accidents and deaths, occupational exposures, the maximum individual risk and collective radiation dose. Transportation of waste would occur by truck or rail depending on alternative, waste form, and destination. DOE analyzed the impacts of both incident-free and accident conditions.

Traffic Impacts - As noted previously, the highway (Highway 20) between Idaho Falls and the INEEL is designated as Level-of-Service A, which represents free flow.

Based on predicted operational employment levels under the alternatives described in Chapter 3 and results in the SNF & INEL EIS, DOE does not expect the level of service designation for Highway 20 to change.

Vehicle-Related Transportation Impacts - This section describes the transportation impacts that are not related to radioactive material being shipped but to the movement of the vehicles on the highway or railroad. The three types of impacts addressed are impacts from vehicle emissions, estimated number of traffic accidents, and estimated number of traffic and air emissions fatalities from the waste shipments.

Tables 5.2-1*3* and 5.2-1*4* present the total vehicle-related impacts for each option over the project campaign. Table 5.2-1*3* presents information based on shipments by truck, and Table 5.2-1*4* presents information based on shipments by rail. These numbers are a function of total round trip distances, number of shipments, and state-specific accident and fatality rates.

For truck shipments, DOE ***estimates*** the Transuranic Separations Option to result in the highest number of accidents and fatalities, 25 and 0.98, respectively. This option is also ***estimated*** to produce the highest number of accident and fatalities for rail shipments, 0.69 and 0.13. The maximum values associated with this option are due to the long distances both truck and rail shipments of low-level waste Class C type grout must move between the INEEL and Barnwell, South Carolina.

Impacts from emissions were only evaluated for truck shipments and are shown in Table 5.2-1*3*. The Direct Cement Waste Option would result in the greatest ***predicted*** latent fatalities from emissions (***0.099***). The large number of trips through urban areas required between INTEC and the geologic repository for transporting the cementitious HLW accounts for the maximum number of latent fatalities under this option. See Appendix C.5 for more details on route mileage and shipment numbers.

Incident-Free Transportation Impacts - The impacts of incident-free transport of radioactive waste are summarized in Tables 5.2-1*5* for truck and 5.2-1*6* for rail. These tables present the collective dose to workers and public individuals.

For truck shipments, the Direct Cement Waste Option yielded the largest collective doses. This option was estimated to cause a total of 2.9×10^{3} person-rem to members of the public, from which ***1.4*** latent fatalities were predicted. As with the latent fatalities due to emissions, the maximum doses are due to the large number of shipments required for the cementitious HLW. The minimum impact would result from the Continued Current Operations Alternative, which was estimated to produce a total dose of 25 person-rem to members of the public, from which 0.013 latent cancer fatality would be expected. This option would provide the smallest impact because a relatively small amount of waste would be shipped offsite. The highest worker impacts would occur under the Direct Cement Waste Option (***520*** person-rem).

For rail shipments, the Transuranic Separations Option would yield the largest collective dose of 15 person-rem to members of the public, from which 7.6×10^{-3} latent cancer fatality were predicted. The Continued Current Operations Alternative would result in the smallest impact with a total dose of 0.18 person-rem from which 9.1×10^{-5} latent cancer fatality would be expected. The highest worker impacts would occur under the Direct Cement Waste Option (160 person-rem).

Table 5.2-13. Estimated fatalities from truck emissions and accidents (vehicle-related impacts).

Waste form	Origin	Destination	Number of accidents	Number of fatalities	LFs from emissions[a]
Continued Current Operations Alternative					
RH-TRU ***Solids***	INTEC	WIPP	0.23	8.9×10^{-3}	6.8×10^{-4}
Full Separations Option					
Class A Type Grout	INTEC	Envirocare	1.5	0.075	7.7×10^{-3}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	0.60	0.027	4.3×10^{-3}
Total			2.1	***0.10***	0.012
Solidified ***HAW***[b]	INTEC	Hanford	0.048	3.3×10^{-3}	8.2×10^{-5}
Vitrified HLW (at Hanford)[b]	***Hanford***	***INTEC***	***1.9***	***0.13***	***3.2×10^{-3}***
Planning Basis Option					
Class A Type Grout	INTEC	Envirocare	1.6	0.084	8.6×10^{-3}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	0.60	0.027	4.3×10^{-3}
RH-TRU ***Solids***	INTEC	WIPP	0.23	8.9×10^{-3}	6.8×10^{-4}
Total			***2.4***	0.12	0.014
Transuranic Separations Option					
RH-TRU ***Fraction***	INTEC	WIPP	0.47	0.018	1.4×10^{-3}
Class C Type Grout	INTEC	Barnwell	25	0.96	0.093
Total			25	0.98	0.094
Hot Isostatic Pressed Waste Option					
HIP HLW	INTEC	NGR	4.4	0.20	0.031
RH-TRU ***Solids***	INTEC	WIPP	0.23	8.9×10^{-3}	6.8×10^{-4}
Total			4.6	0.21	0.032
Direct Cement Waste Option					
Cementitious HLW	INTEC	NGR	14	***0.62***	***0.098***
RH-TRU ***Solids***	INTEC	WIPP	0.23	8.9×10^{-3}	6.8×10^{-4}
Total			14	***0.63***	***0.099***
Early Vitrification Option					
Early Vitrified HLW	INTEC	NGR	9.0	0.41	0.065
Early Vitrified RH-TRU	INTEC	WIPP	0.76	0.029	2.2×10^{-3}
Total			9.8	0.44	0.067
Steam Reforming Option					
Steam Reformed SBW	***INTEC***	***WIPP***	***2.8***	***0.10***	***8.1×10^{-3}***
Calcine	***INTEC***	***NGR***	***4.7***	***0.21***	***0.033***
NGLW Grout	***INTEC***	***WIPP***	***2.7***	***0.10***	***8.0×10^{-3}***
Total			***10***	***0.42***	***0.049***
Minimum INEEL Processing Alternative					
Calcine and Cs resin	INTEC	Hanford	2.3	0.16	4.0×10^{-3}
Grouted CH-TRU	INTEC	WIPP	2.3	0.086	6.6×10^{-3}
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	***1.9***	***0.13***	***3.2×10^{-3}***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	***2.3***	***0.10***	***0.016***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	0.39	0.026	***6.7×10^{-4}***
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	0.21	0.011	1.1×10^{-3}
Total			***9.4***	***0.51***	***0.032***

Table 5.2-1*3*. Estimated fatalities from truck emissions and accidents (vehicle-related impacts) (continued).

Waste form	Origin	Destination	Number of accidents	Number of fatalities	LFs from emissions[a]
Vitrification without Calcine Separations Option					
Vitrified Calcine	***INTEC***	***NGR***	***9.0***	***0.41***	***0.065***
Vitrified SBW	***INTEC***	***NGR***	***0.47***	***0.021***	***3.4×10^{-3}***
Vitrified SBW	***INTEC***	***WIPP***	***1.0***	***0.040***	***3.0×10^{-3}***
Total (with SBW to NGR)			***9.5***	***0.43***	***0.068***
Total (with SBW to WIPP)			***10***	***0.45***	***0.068***
NGLW Grout[b]			***2.7***	***0.10***	***8.0×10^{-3}***
Vitrification with Calcine Separations Option					
Class A Type Grout	***INTEC***	***Envirocare***	***1.3***	***0.066***	***6.8×10^{-3}***
Vitrified Calcine (separated)	***INTEC***	***NGR***	***0.50***	***0.023***	***3.6×10^{-3}***
Vitrified SBW	***INTEC***	***NGR***	***0.47***	***0.021***	***3.4×10^{-3}***
Vitrified SBW	***INTEC***	***WIPP***	***1.0***	***0.040***	***3.0×10^{-3}***
Total (with SBW to NGR)			***2.2***	***0.11***	***0.014***
Total (with SBW to WIPP)			***2.8***	***0.13***	***0.013***
NGLW Grout[b]	***INTEC***	***WIPP***	***2.7***	***0.10***	***8.0×10^{-3}***

a. Calculated for travel through urban areas only.
b. Stand-alone project.
CH-TRU = contact-handled transuranic waste; Cs = cesium; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LLW = low-level waste; LF = latent fatality; ***NGLW = newly generated liquid waste;*** NGR = national geologic repository; RH-TRU = remote-handled transuranic waste; WIPP = Waste Isolation Pilot Plant.

Transportation Accident Impacts - The impacts from the transportation impact analysis are shown in Table 5.2-1***7*** for truck shipments and Table 5.2-1***8*** for rail shipments. Each value in the tables (except the maximum individual dose) represents the sum of consequence (population dose or latent cancer fatalities) times probability for a range of possible accidents. The maximum individual dose impacts are consequence values obtained from the RISKIND code.

For truck shipments, the Transuranic Separations Option would result in the highest doses. This option would result in ***200*** person-rem (***0.10*** latent cancer fatality) for truck shipments. For rail shipments, the highest dose of ***75*** person-rem (***0.038*** latent cancer fatality) would result from the Transuranic Separations Option.

Transportation Accident Radiological Consequences - The results of the RISKIND consequence analyses are included in the last column of Tables 5.2-1***7*** and 5.2-1***8*** for moderate severity truck and rail accidents, respectively, under neutral atmospheric stability conditions. Consequence results for extreme severity truck and rail accidents may be found in Appendix C.5 along with the results under stable atmospheric stability conditions.

Under moderate truck accident severity conditions, the maximum individual effective dose ranges from 7.7×10^{-6} rem (contact-handled transuranic waste ***and NGLW grout***) to ***0.18*** rem (solidified ***high-activity waste***). For moderate severity rail accidents, the effective dose ranges from ***7.7×10^{-6}*** rem (***steam reformed SBW and NGLW grout***) to ***0.36*** rem (solidified ***high-activity waste***).

5.2.9.4 Traffic Noise

As noted in Section 4.10.***6***, noise generated by INEEL operations is not propagated at detectable levels offsite, because all major facility areas are at least 3 miles away from the site boundary. INEEL-related noise that affects the public is dominated by transportation noise sources, such as buses, private vehicles, delivery trucks, construction trucks, aircraft, and freight trains.

Table 5.2-14. Estimated fatalities from rail accidents (vehicle-related impacts).

Waste form	Origin	Destination	Number of accidents	Number of fatalities
Continued Current Operations Alternative				
RH-TRU ***Solids***	INTEC	WIPP	0.011	2.1×10^{-3}
Full Separations Option				
Class A Type Grout	INTEC	Envirocare	0.074	2.1×10^{-3}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	0.016	4.8×10^{-3}
Total			0.090	0.026
Solidified ***HAW*** [a]	INTEC	Hanford	6.5×10^{-3}	8.6×10^{-4}
Vitrified HLW (at Hanford) [a]	***Hanford***	***INTEC***	***0.13***	***0.017***
Planning Basis Option				
Class A Type Grout	INTEC	Envirocare	0.083	0.024
Vitrified HLW ***(at INEEL)***	INTEC	NGR	0.016	4.8×10^{-3}
RH-TRU ***Solids***	INTEC	WIPP	0.011	2.1×10^{-3}
Total			0.11	0.030
Transuranic Separations Option				
RH-TRU ***Fraction***	INTEC	WIPP	0.022	4.3×10^{-3}
Class C Type Grout	INTEC	Barnwell	0.67	0.13
Total			0.69	0.13
Hot Isostatic Pressed Waste Option				
HIP HLW	INTEC	NGR	0.12	0.035
RH-TRU ***Solids***	INTEC	WIPP	0.011	2.1×10^{-3}
Total			0.13	0.038
Direct Cement Waste Option				
Cementitious HLW	INTEC	NGR	***0.36***	0.11
RH-TRU ***Solids***	INTEC	WIPP	0.011	2.1×10^{-3}
Total			***0.37***	0.11
Early Vitrification Option				
Early Vitrified HLW	INTEC	NGR	0.24	0.073
Early Vitrified RH-TRU	INTEC	WIPP	0.036	7.0×10^{-3}
Total			0.28	0.080
Steam Reforming Option				
Steam Reformed SBW	***INTEC***	***WIPP***	***0.13***	***0.025***
Calcine	***INTEC***	***NGR***	***0.12***	***0.038***
NGLW Grout	***INTEC***	***WIPP***	***0.13***	***0.025***
Total			***0.39***	***0.088***
Minimum INEEL Processing Alternative				
Calcine and Cs resin	INTEC	Hanford	0.16	0.021
CH-TRU	INTEC	WIPP	0.11	0.021
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	***0.13***	***0.017***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	***0.076***	***0.023***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	0.052	7.0×10^{-3}
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	0.018	5.2×10^{-3}
Total			***0.54***	***0.094***

Table 5.2-14. Estimated fatalities from rail accidents (vehicle-related impacts) (continued).

Waste form	Origin	Destination	Number of accidents	Number of fatalities
Vitrification without Calcine Separations Option				
Vitrified Calcine	***INTEC***	***NGR***	***0.24***	***0.073***
Vitrified SBW	***INTEC***	***NGR***	***0.012***	3.8×10^{-3}
Vitrified SBW	***INTEC***	***WIPP***	***0.020***	3.8×10^{-3}
Total (with SBW to NGR)			***0.25***	***0.077***
Total (with SBW to WIPP)			***0.26***	***0.077***
NGLW Grout [a]	***INTEC***	***WIPP***	***0.13***	***0.025***
Vitrification with Calcine Separations Option				
Class A Type Grout	***INTEC***	***Envirocare***	***0.066***	***0.019***
Vitrified Calcine (separated)	***INTEC***	***NGR***	***0.013***	4.1×10^{-3}
Vitrified SBW	***INTEC***	***NGR***	***0.012***	3.8×10^{-3}
Vitrified SBW	***INTEC***	***WIPP***	***0.020***	3.8×10^{-3}
Total (with SBW to NGR)			***0.091***	***0.027***
Total (with SBW to WIPP)			***0.099***	***0.027***
NGLW Grout [a]	***INTEC***	***WIPP***	***0.13***	***0.025***

[a] Stand-alone project.

CH-TRU = contact-handled transuranic waste; Cs = cesium; MHLW = mixed high-level waste; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LLW = low-level waste; ***NGLW = newly generated liquid waste;*** NGR = national geologic repository; RH-TRU = remote-handled transuranic waste; WIPP = Waste Isolation Pilot Plant.

The SNF & INEL EIS (DOE 1995) noted that (barring mission changes) baseline INEEL employment was expected to decline over the 1995 to 2005 period. Direct construction phase and operations phase employment resulting from implementation of the various waste processing alternatives (Section 5.2.2) is expected to offset these job losses to some extent but is not expected to result in significant numbers of new jobs. Therefore, the overall noise level resulting from site transportation during construction and operations for all waste processing alternatives is expected to be lower than the baseline. The number of trucks carrying waste and spent nuclear fuel under any alternative is expected to be, at most, a few per day (see Appendix C.5, Traffic and Transportation). Noise from these trucks would represent a small addition to the existing noise from several hundred buses (about 300 routes) that travel to and from the INEEL each day. In summary, no environmental impact due to noise traffic is expected from any of the waste processing alternatives being considered.

Table 5.2-15. Estimated cargo-related incident-free transportation impacts – truck.

					Public							
			Workers[a]		Stops[b]		Sharing route		Along route		Total public effects	
Waste form	Origin	Destination	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
Continued Current Operations Alternative												
RH-TRU ***Solids***	INTEC	WIPP	4.5	1.8×10^{-3}	24	0.012	1.1	5.7×10^{-4}	0.27	1.3×10^{-4}	25	0.013
Full Separations Alternative												
Class A Type Grout	INTEC	Envirocare	34	0.013	16	8.1×10^{-3}	11	5.3×10^{-3}	2.9	1.5×10^{-3}	30	0.015
Vitrified HLW ***(at INEEL)***	INTEC	NGR	23	9.1×10^{-3}	110	0.057	7.6	3.8×10^{-3}	2.0	1.0×10^{-3}	120	0.062
Total			56	***0.022***	130	0.065	18	9.1×10^{-3}	5.0	2.5×10^{-3}	150	0.077
Solidified ***HAW***[c]	INTEC	Hanford	11	4.4×10^{-3}	60	0.030	2.4	1.2×10^{-3}	0.62	3.1×10^{-4}	63	0.032
Vitrified HLW (at Hanford)[c]	***Hanford***	***INTEC***	***100***	***0.04***	***550***	***0.27***	***21***	***0.011***	***5.7***	***2.8×10^{-3}***	***570***	***0.29***
Planning Basis Option												
Class A Type Grout	INTEC	Envirocare	37	0.015	18	9.0×10^{-3}	12	5.9×10^{-3}	3.3	1.6×10^{-3}	33	0.017
Vitrified HLW ***(at INEEL)***	INTEC	NGR	23	9.1×10^{-3}	110	0.057	7.6	3.8×10^{-3}	2.0	1.0×10^{-3}	120	0.062
RH-TRU ***Solids***	INTEC	WIPP	4.5	1.8×10^{-3}	24	0.012	1.1	5.7×10^{-4}	0.27	1.3×10^{-4}	25	0.013
Total			64	0.026	160	0.078	***20***	0.010	***5.5***	2.8×10^{-3}	180	0.091
Transuranic Separations Option												
RH-TRU ***Fraction***	INTEC	WIPP	8.9	3.6×10^{-3}	48	0.024	2.3	1.1×10^{-3}	0.53	2.7×10^{-4}	50	0.025
Class C Type Grout	INTEC	Barnwell	78	0.031	380	0.19	***25***	0.013	***7.3***	3.7×10^{-3}	410	0.21
Total			87	0.035	430	0.21	28	0.014	7.9	3.9×10^{-3}	460	0.23
Hot Isostatic Pressed Waste Option												
HIP HLW	INTEC	NGR	170	0.066	840	0.42	***55***	0.028	15	7.4×10^{-3}	910	0.45
RH-TRU ***Solids***	INTEC	WIPP	4.5	1.8×10^{-3}	24	0.012	1.1	5.7×10^{-4}	0.27	1.3×10^{-4}	25	0.013
Total			170	0.068	860	0.43	***57***	0.028	15	7.5×10^{-3}	930	0.47
Direct Cement Waste Option												
Cementitious HLW	INTEC	NGR	520	0.21	***2.6×10^{3}***	1.3	***170***	***0.087***	***46***	0.023	***2.8×10^{3}***	1.4
RH-TRU ***Solids***	INTEC	WIPP	4.5	1.8×10^{-3}	24	0.012	1.1	5.7×10^{-4}	0.27	1.3×10^{-4}	25	0.013
Total			***520***	0.21	***2.6×10^{3}***	1.3	***170***	***0.087***	***46***	0.023	2.9×10^{3}	***1.4***

Table 5.2-15. Estimated cargo-related incident-free transportation impacts – truck (continued).

Waste form	Origin	Destination	Workers[a]		Public							
					Stops[b]		Sharing route		Along route		Total effects	
			Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
Early Vitrification Option												
Early Vitrified HLW	INTEC	NGR	340	0.14	1.7×10^{3}	0.87	***110***	0.057	***30***	0.015	1.9×10^{3}	0.94
Early Vitrified RH-TRU	INTEC	WIPP	15	5.8×10^{-3}	78	0.039	3.7	***1.8×10^{-3}***	0.87	***4.3×10^{-4}***	82	0.041
Total			360	0.14	1.8×10^{3}	0.90	***120***	0.059	31	0.016	2.0×10^{3}	0.98
Steam Reforming Option												
Steam Reformed SBW	***INTEC***	***WIPP***	***53***	***0.021***	***280***	***0.14***	***13***	***6.7×10^{-3}***	***3.1***	***1.6×10^{-3}***	***300***	***0.15***
Calcine	***INTEC***	***NGR***	***180***	***0.071***	***890***	***0.45***	***59***	***0.03***	***16***	***7.9×10^{-3}***	***970***	***0.48***
NGLW Grout	***INTEC***	***WIPP***	***52***	***0.021***	***280***	***0.14***	***13***	***6.6×10^{-3}***	***3.1***	***1.6×10^{-3}***	***290***	***0.15***
Total			***280***	***0.11***	***1.5×10^{3}***	***0.73***	***86***	***0.043***	***22***	***0.011***	***1.6×10^{3}***	***0.78***
Minimum INEEL Processing Alternative												
Calcine and Cs resin	INTEC	Hanford	120	0.049	670	0.34	26	0.013	7.0	3.5×10^{-3}	710	0.35
CH-TRU	INTEC	WIPP	***27***	0.011	91	0.046	4.4	2.2×10^{-3}	1.0	5.1×10^{-4}	96	0.048
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	***100***	***0.04***	***550***	***0.27***	***21***	***0.011***	***5.7***	***2.8×10^{-3}***	***570***	***0.29***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	***130***	***0.052***	***650***	***0.32***	***43***	***0.022***	***11***	***5.7×10^{-3}***	***700***	***0.35***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	***5.1***	2.1×10^{-3}	28	0.014	1.1	5.5×10^{-4}	0.29	1.5×10^{-4}	29	0.015
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	2.6	***1.0×10^{-3}***	1.3	6.3×10^{-4}	0.83	4.1×10^{-4}	0.23	1.1×10^{-4}	2.3	1.2×10^{-3}
Total			***390***	***0.16***	***2.0×10^{3}***	***1.0***	***98***	***0.049***	***26***	***0.013***	***2.1×10^{3}***	***1.1***
Vitrification without Calcine Separations Option												
Vitrified Calcine	***INTEC***	***NGR***	***340***	***0.14***	***1.7×10^{3}***	***0.87***	***110***	***0.057***	***30***	***0.015***	***1.9×10^{3}***	***0.94***
Vitrified SBW	***INTEC***	***NGR***	***9.7***	***3.9×10^{-3}***	***49***	***0.024***	***3.2***	***1.6×10^{-3}***	***0.86***	***4.3×10^{-4}***	***53***	***0.027***
Vitrified SBW	***INTEC***	***WIPP***	***20***	***7.9×10^{-3}***	***110***	***0.053***	***5.0***	***2.5×10^{-3}***	***1.2***	***5.9×10^{-4}***	***110***	***0.056***
Total (with SBW to NGR)			***350***	***0.14***	***1.8×10^{3}***	***0.89***	***120***	***0.059***	***31***	***0.016***	***1.9×10^{3}***	***0.96***
Total (with SBW to WIPP)			***360***	***0.15***	***1.8×10^{3}***	***0.92***	***120***	***0.060***	***32***	***0.016***	***2.0×10^{3}***	***0.99***
NGLW Grout [c]	***INTEC***	***WIPP***	***52***	***0.021***	***280***	***0.14***	***13***	***6.6×10^{-3}***	***3.1***	***1.6×10^{-3}***	***290***	***0.15***

Table 5.2-15. Estimated cargo-related incident-free transportation impacts – truck (continued).

			Workers[a]		Public							
					Stops[b]		Sharing route		Along route		Total effects	
Waste form	Origin	Destination	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
Vitrification with Calcine Separations Option												
Class A Type Grout	***INTEC***	***Envirocare***	***30***	***0.012***	***14***	7.1×10^{-3}	***9.3***	4.7×10^{-3}	***2.6***	1.3×10^{-3}	***26***	***0.013***
Vitrified Calcine (separated)	***INTEC***	***NGR***	***19***	7.6×10^{-3}	***96***	***0.048***	***6.4***	3.2×10^{-3}	***1.7***	8.4×10^{-4}	***100***	***0.052***
Vitrified SBW	***INTEC***	***NGR***	***9.7***	3.9×10^{-3}	***49***	***0.024***	***3.2***	1.6×10^{-3}	***0.86***	4.3×10^{-4}	***53***	***0.027***
Vitrified SBW	***INTEC***	***WIPP***	***20***	7.9×10^{-3}	***110***	***0.053***	***5.0***	2.5×10^{-3}	***1.2***	5.9×10^{-4}	***110***	***0.056***
Total (with SBW to NGR)			***58***	***0.023***	***160***	***0.079***	***19***	9.5×10^{-3}	***5.1***	2.6×10^{-3}	***180***	***0.091***
Total (with SBW to WIPP)			***68***	***0.027***	***220***	***0.11***	***21***	***0.010***	***5.5***	2.7×10^{-3}	***240***	***0.12***
NGLW Grout[c]	***INTEC***	***WIPP***	***52***	***0.021***	***280***	***0.14***	***13***	6.6×10^{-3}	***3.1***	1.6×10^{-3}	***290***	***0.15***

a. Occupational Exposure: Exposure to waste transportation crews (2 individuals at 10 meters).
b. Stops: Exposure to individuals while shipments are at rest stops (50 individuals at 20 meters).
c. Stand-alone project.

CH-TRU = contact-handled transuranic waste; Cs = cesium; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LLW = low-level waste; LCF = latent cancer fatality (public: 5.0×10^{-4} LCF/person-rem; worker: 4.0×10^{-4} LCF/person-rem); ***NGLW = newly generated liquid waste;*** NGR = national geologic repository; RH-TRU = remote-handled transuranic waste; WIPP = Waste Isolation Pilot Plant.

Table 5.2-16. Estimated cargo-related incident-free transportation impacts – rail.

					Public							
			Workers[a]		Stops[b]		Sharing route		Along route		Total effects	
Waste form	Origin	Destination	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
Continued Current Operations Alternative												
RH-TRU ***Solids***	INTEC	WIPP	3.3	1.3×10^{-3}	0.023	1.1×10^{-5}	***0.011***	***5.3×10^{-6}***	0.15	7.4×10^{-5}	0.18	9.1×10^{-5}
Full Separations Option												
Class A Type Grout	INTEC	Envirocare	31	0.012	8.8×10^{-3}	4.4×10^{-6}	0.051	2.5×10^{-5}	0.70	3.5×10^{-4}	0.76	3.8×10^{-4}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	7.0	2.8×10^{-3}	0.028	1.4×10^{-5}	0.017	8.4×10^{-6}	0.19	9.4×10^{-5}	0.23	1.2×10^{-4}
Total			38	0.015	0.037	1.8×10^{-5}	0.067	3.4×10^{-5}	0.89	4.4×10^{-4}	0.99	5.0×10^{-4}
Solidified ***HAW***[c]	INTEC	Hanford	4.0	1.6×10^{-3}	9.1×10^{-3}	4.5×10^{-6}	5.4×10^{-3}	2.7×10^{-6}	0.062	3.1×10^{-5}	0.076	3.8×10^{-5}
Vitrified HLW (at Hanford)[c]	***Hanford***	***INTEC***	***40***	***0.016***	***0.20***	***9.8×10^{-5}***	***0.12***	***5.8×10^{-5}***	***1.3***	***6.6×10^{-4}***	***1.6***	***8.2×10^{-4}***
Planning Basis Option												
Class A Type Grout	INTEC	Envirocare	35	0.014	9.8×10^{-3}	4.9×10^{-6}	0.056	2.8×10^{-5}	0.78	3.9×10^{-4}	0.84	4.2×10^{-4}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	7.0	2.8×10^{-3}	0.028	1.4×10^{-5}	0.017	8.4×10^{-6}	0.19	9.4×10^{-5}	0.23	1.2×10^{-4}
RH-TRU ***Solids***	INTEC	WIPP	3.3	1.3×10^{-3}	0.023	1.1×10^{-5}	***0.011***	***5.3×10^{-6}***	0.15	7.4×10^{-5}	0.18	9.1×10^{-5}
Total			45	0.018	0.060	3.0×10^{-5}	***0.084***	4.2×10^{-5}	1.1	5.6×10^{-4}	1.3	6.3×10^{-4}
Transuranic Separations Option												
RH-TRU ***Fraction***	INTEC	WIPP	6.6	2.6×10^{-3}	0.046	2.3×10^{-5}	***0.021***	***1.1×10^{-5}***	0.30	1.5×10^{-4}	0.36	1.8×10^{-4}
Class C Type Grout	INTEC	Barnwell	130	***0.052***	1.8	9.2×10^{-4}	0.79	4.0×10^{-4}	12	6.1×10^{-3}	15	7.4×10^{-3}
Total			140	0.055	1.9	9.4×10^{-4}	***0.81***	4.1×10^{-4}	12	6.2×10^{-3}	15	7.6×10^{-3}
Hot Isostatic Pressed Waste Option												
HIP HLW	INTEC	NGR	51	0.020	0.20	1.0×10^{-4}	0.12	6.1×10^{-5}	1.4	6.8×10^{-4}	1.7	8.5×10^{-4}
RH-TRU ***Solids***	INTEC	WIPP	3.3	1.3×10^{-3}	0.023	1.1×10^{-5}	***0.011***	***5.3×10^{-6}***	0.15	7.4×10^{-5}	0.18	9.1×10^{-5}
Total			54	0.022	0.23	1.1×10^{-4}	0.13	6.7×10^{-5}	1.5	7.6×10^{-4}	1.9	9.4×10^{-4}
Direct Cement Waste Option												
Cementitious HLW	INTEC	NGR	160	***0.064***	0.64	3.2×10^{-4}	***0.38***	1.9×10^{-4}	4.3	***2.1×10^{-3}***	***5.3***	2.7×10^{-3}
RH-TRU ***Solids***	INTEC	WIPP	3.3	1.3×10^{-3}	0.023	1.1×10^{-5}	***0.011***	***5.3×10^{-6}***	0.15	7.4×10^{-5}	0.18	9.1×10^{-5}
Total			160	***0.065***	***0.66***	3.3×10^{-4}	***0.39***	2.0×10^{-4}	***4.4***	2.2×10^{-3}	***5.5***	***2.7×10^{-3}***

Table 5.2-16. Estimated cargo-related incident-free transportation impacts – rail (continued).

					Public							
			Workers[a]		Stops[b]		Sharing route		Along route		Total effects	
Waste form	Origin	Destination	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
					Early Vitrification Option							
Early Vitrified HLW	INTEC	NGR	110	0.042	0.42	2.1×10^{-4}	0.25	1.3×10^{-4}	2.8	1.4×10^{-3}	3.5	1.8×10^{-3}
Early Vitrified RH-TRU	INTEC	WIPP	11	4.3×10^{-3}	0.074	3.7×10^{-5}	***0.035***	***1.7×10^{-5}***	0.48	2.4×10^{-4}	0.59	3.0×10^{-4}
Total			120	***0.046***	***0.49***	2.5×10^{-4}	0.29	***1.4×10^{-4}***	3.3	1.7×10^{-3}	4.1	***2.0×10^{-3}***
					Steam Reforming Option							
Steam Reformed SBW	***INTEC***	***WIPP***	***39***	***0.015***	***0.27***	***1.3×10^{-4}***	***0.13***	***6.3×10^{-5}***	***1.7***	***8.7×10^{-4}***	***2.1***	***1.1×10^{-3}***
Calcine	***INTEC***	***NGR***	***54***	***0.022***	***0.22***	***1.1×10^{-4}***	***0.13***	***6.5×10^{-5}***	***1.5***	***7.3×10^{-4}***	***1.8***	***9.1×10^{-4}***
NGLW Grout	***INTEC***	***WIPP***	***38***	***0.015***	***0.26***	***1.3×10^{-4}***	***0.12***	***6.2×10^{-5}***	***1.7***	***8.6×10^{-4}***	***2.1***	***1.1×10^{-3}***
Total			***130***	***0.053***	***0.75***	***3.8×10^{-4}***	***0.38***	***1.9×10^{-4}***	***4.9***	***2.5×10^{-3}***	***6.1***	***3.0×10^{-3}***
					Minimum INEEL Processing Alternative							
Calcine and Cs resin	INTEC	Hanford	49	0.020	0.24	1.2×10^{-4}	0.14	7.2×10^{-5}	1.6	8.1×10^{-4}	2.0	1.0×10^{-3}
CH-TRU	INTEC	WIPP	8.3	3.3×10^{-3}	0.044	2.2×10^{-5}	0.020	1.0×10^{-5}	0.28	1.4×10^{-4}	0.35	1.7×10^{-4}
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	***40***	***0.016***	***0.20***	***9.8×10^{-5}***	***0.12***	***5.8×10^{-5}***	***1.3***	***6.6×10^{-4}***	***1.6***	***8.2×10^{-4}***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	***39***	***0.016***	***0.20***	***9.9×10^{-5}***	***0.12***	***6.0×10^{-5}***	***1.3***	***6.6×10^{-4}***	***1.6***	***8.2×10^{-4}***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	9.3	3.7×10^{-3}	0.024	1.2×10^{-5}	0.015	7.3×10^{-6}	0.17	8.3×10^{-5}	0.21	1.0×10^{-4}
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	8.0	3.2×10^{-3}	1.9×10^{-3}	9.4×10^{-7}	0.011	5.4×10^{-6}	0.15	7.5×10^{-5}	0.16	8.1×10^{-5}
Total			***150***	***0.062***	***0.70***	***3.5×10^{-4}***	***0.43***	***2.1×10^{-4}***	***4.9***	***2.4×10^{-3}***	***6.0***	***3.0×10^{-3}***
					Vitrification without Calcine Separations Option							
Vitrified Calcine	***INTEC***	***NGR***	***110***	***0.042***	***0.42***	***2.1×10^{-4}***	***0.25***	***1.3×10^{-4}***	***2.8***	***1.4×10^{-3}***	***3.5***	***1.8×10^{-3}***
Vitrified SBW	***INTEC***	***NGR***	***7.5***	***3.0×10^{-3}***	***0.030***	***1.5×10^{-5}***	***0.018***	***9.0×10^{-6}***	***0.20***	***1.0×10^{-4}***	***0.25***	***1.2×10^{-4}***
Vitrified SBW	***INTEC***	***WIPP***	***5.9***	***2.3×10^{-3}***	***0.041***	***2.0×10^{-5}***	***0.019***	***9.5×10^{-6}***	***0.26***	***1.3×10^{-4}***	***0.32***	***1.6×10^{-4}***
Total (with SBW to NGR)			***110***	***0.045***	***0.45***	***2.3×10^{-4}***	***0.27***	***1.4×10^{-4}***	***3.0***	***1.5×10^{-3}***	***3.8***	***1.9×10^{-3}***
Total (with SBW to WIPP)			***110***	***0.045***	***0.46***	***2.3×10^{-4}***	***0.27***	***1.4×10^{-4}***	***3.1***	***1.5×10^{-3}***	***3.8***	***1.9×10^{-3}***
NGLW Grout[c]	***INTEC***	***WIPP***	***38***	***0.015***	***0.26***	***1.3×10^{-4}***	***0.12***	***6.2×10^{-5}***	***1.7***	***8.6×10^{-4}***	***2.1***	***1.1×10^{-3}***

Table 5.2-16. Estimated cargo-related incident-free transportation impacts – rail (continued).

			Workers[a]		Public							
					Stops[b]		Sharing route		Along route		Total effects	
Waste form	Origin	Destination	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF	Person-rem	LCF
Vitrification with Calcine Separations Option												
Class A Grout	***INTEC***	***Envirocare***	***27***	***0.011***	***7.8×10^{-3}***	***3.9×10^{-6}***	***0.045***	***2.2×10^{-5}***	***0.62***	***3.1×10^{-4}***	***0.67***	***3.3×10^{-4}***
Vitrified Calcine (separated)	***INTEC***	***NGR***	***5.8***	***2.3×10^{-3}***	***0.023***	***1.2×10^{-5}***	***0.014***	***7.0×10^{-6}***	***0.16***	***7.9×10^{-5}***	***0.19***	***9.7×10^{-5}***
Vitrified SBW	***INTEC***	***NGR***	***7.5***	***3.0×10^{-3}***	***0.030***	***1.5×10^{-5}***	***0.018***	***9.0×10^{-6}***	***0.20***	***1.0×10^{-4}***	***0.25***	***1.2×10^{-4}***
Vitrified SBW	***INTEC***	***WIPP***	***5.9***	***2.3×10^{-3}***	***0.041***	***2.0×10^{-5}***	***0.019***	***9.5×10^{-6}***	***0.26***	***1.3×10^{-4}***	***0.32***	***1.6×10^{-4}***
Total (with SBW to NGR)			***41***	***0.016***	***0.061***	***3.0×10^{-5}***	***0.077***	***3.8×10^{-5}***	***0.97***	***4.9×10^{-4}***	***1.1***	***5.6×10^{-4}***
Total (with SBW to WIPP)			***39***	***0.016***	***0.072***	***3.6×10^{-5}***	***0.078***	***3.9×10^{-5}***	***1.0***	***5.2×10^{-4}***	***1.2***	***5.9×10^{-4}***
NGLW Grout[c]	***INTEC***	***WIPP***	***38***	***0.015***	***0.26***	***1.3×10^{-4}***	***0.12***	***6.2×10^{-5}***	***1.7***	***8.6×10^{-4}***	***2.1***	***1.1×10^{-3}***

a. Occupational Exposure: Exposure to waste transportation crews (5 individuals at 152 meters).

b. Stops: Exposure to individuals while shipments are at rest stops (100 individuals at 20 meters).

c. Stand-alone project.

CH-TRU = contact-handled transuranic waste; Cs = cesium; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LCF = latent cancer fatality (public: 5.0×10^{-4} LCF/person-rem; worker: 4.0×10^{-4} LCF/person-rem); LLW = low-level waste; ***NGLW = newly generated liquid waste;*** NGR = national geologic repository; RH-TRU = remote-handled transuranic waste; WIPP = Waste Isolation Pilot Plant.

Table 5.2-17. Cargo-related impacts from truck transportation accidents.

			Population Risk[a]		
Waste form	Origin	Destination	Dose (person-rem)	Latent cancer fatalities	Maximum Individual Dose (rem)[b]
Continued Current Operations Alternative					
RH-TRU ***Solids***	INTEC	WIPP	***1.1***	***5.7×10^{-4}***	***9.8×10^{-6}***
Full Separations Option					
Class A Type Grout	INTEC	Envirocare	0.18	8.8×10^{-5}	2.4×10^{-5}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	3.0×10^{-3}	1.5×10^{-6}	***5.8×10^{-5}***
Total[c]			0.18	8.9×10^{-5}	***8.2×10^{-5}***
Solidified ***HAW***[d]	INTEC	Hanford	***6.7***	***3.3×10^{-3}***	0.18
Vitrified HLW (at Hanford)[d]	***Hanford***	***INTEC***	***1.1×10^{-3}***	***5.6×10^{-7}***	***2.2×10^{-5}***
Planning Basis Option					
Class A Type Grout	INTEC	Envirocare	0.19	9.7×10^{-5}	2.4×10^{-5}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	3.0×10^{-3}	1.5×10^{-6}	***5.8×10^{-5}***
RH-TRU ***Solids***	INTEC	WIPP	***1.1***	***5.7×10^{-4}***	***9.8×10^{-6}***
Total[c]			***1.3***	***6.7×10^{-4}***	***9.2×10^{-5}***
Transuranic Separations Option					
RH-TRU ***Fraction***	INTEC	WIPP	***17***	***8.6×10^{-3}***	6.1×10^{-5}
Class C Type Grout	INTEC	Barnwell	190	0.093	2.3×10^{-3}
Total[c]			***200***	***0.10***	***2.4×10^{-3}***
Hot Isostatic Pressed Waste Option					
HIP HLW	INTEC	NGR	3.0×10^{-3}	1.5×10^{-6}	1.6×10^{-5}
RH-TRU ***Solids***	INTEC	WIPP	***1.1***	***5.7×10^{-4}***	***9.8×10^{-6}***
Total[c]			***1.1***	***5.7×10^{-4}***	***2.6×10^{-5}***
Direct Cement Waste Option					
Cementitious HLW	INTEC	NGR	46	0.023	8.8×10^{-3}
RH-TRU ***Solids***	INTEC	WIPP	***1.1***	***5.7×10^{-4}***	***9.8×10^{-6}***
Total[c]			***47***	0.023	8.8×10^{-3}
Early Vitrification Option					
Early Vitrified HLW	INTEC	NGR	2.9×10^{-3}	1.5×10^{-6}	***1.3×10^{-5}***
Early Vitrified RH-TRU	INTEC	WIPP	6.5×10^{-5}	3.2×10^{-8}	8.3×10^{-6}
Total[c]			3.0×10^{-3}	1.5×10^{-6}	***2.1×10^{-5}***
Steam Reforming Option					
Steam Reformed SBW	***INTEC***	***WIPP***	***2.3***	***1.1×10^{-3}***	***7.9×10^{-6}***
Calcine	***INTEC***	***NGR***	***74***	***0.037***	***1.5×10^{-5}***
NGLW grout	***INTEC***	***WIPP***	***0.78***	***3.9×10^{-4}***	***7.7×10^{-6}***
Total[c]			77	***0.039***	***3.1×10^{-5}***
Minimum INEEL Processing Alternative					
Calcine and Cs resin	INTEC	Hanford	36	0.018	0.095
Grouted CH-TRU	INTEC	WIPP	***0.60***	***3.0×10^{-4}***	7.7×10^{-6}
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	1.1×10^{-3}	5.6×10^{-7}	***2.2×10^{-5}***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	***2.8×10^{-3}***	1.4×10^{-6}	***2.2×10^{-5}***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	4.4×10^{-5}	2.2×10^{-8}	1.1×10^{-5}
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	***4.6×10^{-5}***	***2.3×10^{-8}***	1.1×10^{-5}
Total[c]			***36***	0.018	0.095

Table 5.2-17. Cargo-related impacts from truck transportation accidents (continued).

			Population Risk[a]		
Waste form	Origin	Destination	Dose (person-rem)	Latent cancer fatalities	Maximum Individual Dose (rem)[b]
Vitrification without Calcine Separations Option					
Vitrified Calcine	***INTEC***	***NGR***	2.9×10^{-3}	1.5×10^{-6}	5.8×10^{-5}
Vitrified SBW	***INTEC***	***NGR***	1.9×10^{-5}	9.6×10^{-9}	9.5×10^{-6}
Vitrified SBW	***INTEC***	***WIPP***	5.0×10^{-5}	2.5×10^{-8}	9.5×10^{-6}
Total[c] (with SBW to NGR)			3.0×10^{-3}	1.5×10^{-6}	6.8×10^{-5}
Total[c] (with SBW to WIPP)			3.0×10^{-3}	1.5×10^{-6}	6.8×10^{-5}
NGLW Grout[d]	***INTEC***	***WIPP***	0.78	3.9×10^{-4}	7.7×10^{-6}
Vitrification with Calcine Separations Option					
Class A Type Grout	***INTEC***	***Envirocare***	0.15	7.7×10^{-5}	2.4×10^{-5}
Vitrified Calcine (separated)	***INTEC***	***NGR***	2.9×10^{-3}	1.5×10^{-6}	7.7×10^{-5}
Vitrified SBW	***INTEC***	***NGR***	1.9×10^{-5}	9.6×10^{-9}	9.5×10^{-6}
Vitrified SBW	***INTEC***	***WIPP***	5.0×10^{-5}	2.5×10^{-8}	9.5×10^{-6}
Total[c] (with SBW to NGR)			0.16	7.9×10^{-5}	1.1×10^{-4}
Total[c] (with SBW to WIPP)			0.16	7.9×10^{-5}	1.1×10^{-4}
NGLW Grout[d]	***INTEC***	***WIPP***	0.78	3.9×10^{-4}	7.7×10^{-6}

a. Each population risk value is the sum of the consequence (population dose or latent cancer fatalities) times the probability for a range of possible accidents.

b. The maximum individual dose total is the highest value in the group of results.

c. Maximum Individual Dose is not additive. The totals are presented only for comparison between options.

d. Stand-alone project.

CH-TRU = contact handled transuranic waste; Cs = cesium; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LLW = low-level waste; ***NGLW = newly generated liquid waste; NGR = national geologic repository***; RH-TRU = remote handled transuranic waste; WIPP = Waste Isolation Pilot Plant.

Table 5.2-18. Cargo-related impacts from rail transportation accidents.

			Population Risk[a]		
Waste form	Origin	Destination	Dose (person-rem)	Latent cancer fatalities	Maximum Individual Dose (rem)[b]
Continued Current Operations Alternative					
RH-TRU ***Solids***	INTEC	WIPP	***0.092***	***4.6×10^{-5}***	***1.2×10^{-5}***
Full Separations Option					
Class A Type Grout	INTEC	Envirocare	0.035	1.8×10^{-5}	4.6×10^{-5}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	1.5×10^{-4}	7.5×10^{-8}	***1.2×10^{-4}***
Total[c]			0.035	1.8×10^{-5}	***1.7×10^{-4}***
Solidified ***HAW*** [d]	INTEC	Hanford	***1.4***	***6.8×10^{-4}***	0.36
Vitrified HLW (at Hanford) [d]	***Hanford***	***INTEC***	***2.1×10^{-4}***	***1.0×10^{-7}***	***3.5×10^{-5}***
Planning Basis Option					
Class A Type Grout	INTEC	Envirocare	0.039	2.0×10^{-5}	4.6×10^{-5}
Vitrified HLW ***(at INEEL)***	INTEC	NGR	1.5×10^{-4}	7.5×10^{-8}	***1.2×10^{-4}***
RH-TRU ***Solids***	INTEC	WIPP	***0.092***	***4.6×10^{-5}***	***1.2×10^{-5}***
Total[c]			***0.13***	***6.6×10^{-5}***	***1.8×10^{-4}***
Transuranic Separations Option					
RH-TRU ***Fraction***	INTEC	WIPP	***1.4***	***6.8×10^{-4}***	1.2×10^{-4}
Class C Type Grout	INTEC	Barnwell	74	0.037	6.7×10^{-3}
Total[c]			***75***	***0.038***	***6.8×10^{-3}***
Hot Isostatic Pressed Waste Option					
HIP HLW	INTEC	NGR	1.6×10^{-4}	7.8×10^{-8}	2.4×10^{-5}
RH-TRU ***Solids***	INTEC	WIPP	***0.092***	***4.6×10^{-5}***	***1.2×10^{-5}***
Total[c]			***0.092***	***4.6×10^{-5}***	***3.6×10^{-5}***
Direct Cement Waste Option					
Cementitious HLW	INTEC	NGR	2.5	***1.2×10^{-3}***	0.018
RH-TRU ***Solids***	INTEC	WIPP	***0.092***	***4.6×10^{-5}***	***1.2×10^{-5}***
Total[c]			***2.6***	1.3×10^{-3}	0.018
Early Vitrification Option					
Early Vitrified HLW	INTEC	NGR	1.5×10^{-4}	7.6×10^{-8}	***1.8×10^{-5}***
Early Vitrified RH-TRU	INTEC	WIPP	4.3×10^{-6}	***2.1×10^{-9}***	9.1×10^{-6}
Total[c]			1.6×10^{-4}	7.8×10^{-8}	***2.7×10^{-5}***
Steam Reforming Option					
Steam Reformed SBW	***INTEC***	***WIPP***	***0.17***	***8.3×10^{-5}***	***7.7×10^{-6}***
Calcine	***INTEC***	***NGR***	***3.8***	***1.9×10^{-3}***	***2.3×10^{-5}***
NGLW grout	***INTEC***	***WIPP***	***0.062***	***3.1×10^{-5}***	***7.7×10^{-6}***
Total [c]			***4.0***	***2.0×10^{-3}***	***3.8×10^{-5}***
Minimum INEEL Processing Alternative					
Calcine and Cs resin	INTEC	Hanford	5.7	2.8×10^{-3}	0.18
CH-TRU	INTEC	WIPP	***0.047***	***2.3×10^{-5}***	8.2×10^{-6}
Vitrified HLW ***(at Hanford)***	Hanford	INTEC	***2.1×10^{-4}***	1.0×10^{-7}	***3.5×10^{-5}***
Vitrified HLW ***(at Hanford)***	INTEC	NGR	1.4×10^{-4}	***7.1×10^{-8}***	***3.5×10^{-5}***
Vitrified LLW fraction ***(at Hanford)***	Hanford	INTEC	8.1×10^{-6}	4.0×10^{-9}	1.2×10^{-5}
Vitrified LLW fraction ***(at Hanford)***	INTEC	Envirocare	6.7×10^{-6}	3.3×10^{-9}	1.2×10^{-5}
Total[c]			5.7	***2.9×10^{-3}***	0.18

Table 5.2-18. Cargo-related impacts from rail transportation accidents (continued).

			Population Risk[a]		
Waste form	Origin	Destination	Dose (person-rem)	Latent cancer fatalities	Maximum Individual Dose (rem)[b]
Vitrification without Calcine Separations Option					
Vitrified Calcine	***INTEC***	***NGR***	1.5×10^{-4}	7.6×10^{-8}	1.2×10^{-4}
Vitrified SBW	***INTEC***	***NGR***	3.5×10^{-5}	1.8×10^{-8}	1.1×10^{-5}
Vitrified SBW	***INTEC***	***WIPP***	4.7×10^{-5}	2.4×10^{-8}	1.1×10^{-5}
Total[c] (with SBW to NGR)			1.9×10^{-4}	9.3×10^{-8}	1.3×10^{-4}
Total[c] (with SBW to WIPP)			2.0×10^{-4}	9.9×10^{-8}	1.3×10^{-4}
NGLW Grout[d]	***INTEC***	***WIPP***	***0.062***	3.1×10^{-5}	7.7×10^{-6}
Vitrification with Calcine Separations Option					
Class A Type Grout	***INTEC***	***Envirocare***	***0.023***	1.2×10^{-5}	4.6×10^{-5}
Vitrified Calcine (separated)	***INTEC***	***NGR***	1.5×10^{-4}	7.5×10^{-8}	1.5×10^{-4}
Vitrified SBW	***INTEC***	***NGR***	3.5×10^{-5}	1.8×10^{-8}	1.1×10^{-5}
Vitrified SBW	***INTEC***	***WIPP***	4.7×10^{-5}	2.4×10^{-8}	1.1×10^{-5}
Total[c] (with SBW to NGR)			***0.023***	1.2×10^{-5}	2.1×10^{-4}
Total[c] (with SBW to WIPP)			***0.023***	1.2×10^{-5}	2.1×10^{-4}
NGLW Grout[d]	***INTEC***	***WIPP***	***0.062***	3.1×10^{-5}	7.7×10^{-6}

a. Each population risk value is the sum of the consequence (population dose or latent cancer fatalities) times the probability for a range of possible accidents.

b. The maximum individual dose total is the highest value in the group of results.

c. Maximum Individual Dose is not additive. The totals are presented only for comparison between options.

d. Stand-alone project.

CH-TRU = contact handled transuranic waste; Cs = cesium; ***HAW = high-activity waste;*** HIP = Hot Isostatic Pressed; LLW = low-level waste; ***NGLW = newly generated liquid waste; NGR = national geologic repository***; RH-TRU = remote handled transuranic waste; WIPP = Waste Isolation Pilot Plant.