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)

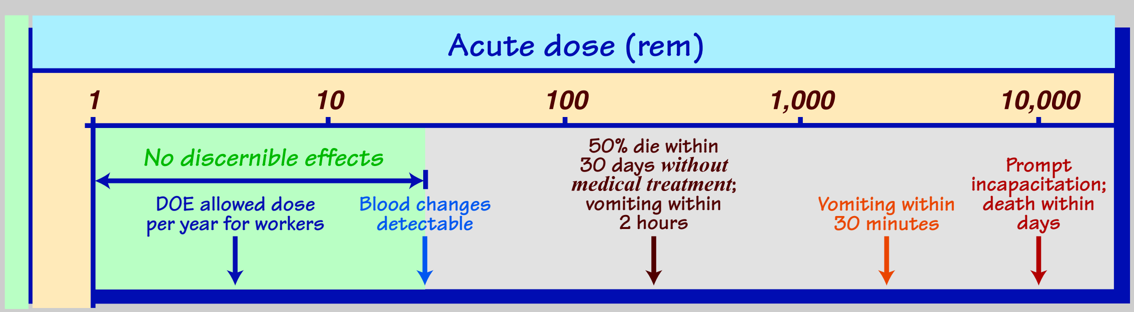
example, if 1,000 people each received a dose of 1 millirem (0.001 rem), the collective dose would be 1,000 persons × 0.001 rem = 1.0 person-rem. Alternatively, the same collective dose (1.0 person-rem) would result from 500 people each of whom received a dose of 2 millirem.

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 5.2-13. 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.

Waste form	Origin	Destination	Workers[a]		Public							
					Stops[b]		Sharing route		Along route		Total public effects	
			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]		Public: Sharing route		Public: Along route		Public: 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).

Waste form	Origin	Destination	Workers[a] Person-rem	Workers[a] LCF	Public: Stops[b] Person-rem	Stops[b] LCF	Sharing route Person-rem	Sharing route LCF	Along route Person-rem	Along route LCF	Total effects Person-rem	Total effects 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).

Waste form	Origin	Destination	Workers[a]		Public: Stops[b]		Public: Sharing route		Public: Along route		Public: 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	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.

Waste form	Origin	Destination	Population Risk[a]: Dose (person-rem)	Population Risk[a]: 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).

Waste form	Origin	Destination	Population Risk[a] Dose (person-rem)	Population Risk[a] 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.

Waste form	Origin	Destination	Population Risk[a]: Dose (person-rem)	Population Risk[a]: 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).

Waste form	Origin	Destination	Population Risk[a] Dose (person-rem)	Population Risk[a] 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.