

5.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

5.1 FACILITY OPERATION AND WASTE TRANSPORT

In this section, the environmental impacts of air emissions, hazardous chemicals and wastes, solid wastes, and transportation were analyzed relative to the conditions described in Section 4.0, Affected Environment.

For the LLMW specified for treatment under this action, there are insufficient characterization data available to develop waste stream-specific chemical and radiological source terms. However, data are available for Hanford Site LLMW on a more global basis, which were assumed to provide a conservative basis for the LLMW evaluated under this action. Based on the discussion provided in Section 2.2, it was assumed that the chemical and radiological inventory of waste that would be treated under this action would be similar to the waste evaluated in the thermal treatment EA (DOE 1996a) with the exception of PCBs. Waste classified as containing PCBs would not be suitable for non-thermal treatment. Air emissions resulting from the non-thermal treatment of LLMW were taken from the ATG risk assessment work plan developed in support of the RCRA Part B permit application (Jacobs 1998). The air emissions estimate in the risk assessment work plan was derived using characterization data from Hanford Site LLMW.

5.1.1 Air Pollutant Emissions

Air pollutant emissions estimates from the non-thermal treatment facility were based on air dispersion modeling that was performed to analyze air quality impacts from thermal treatment of LLMW at the ATG MWF (Tetra Tech 1996a). The emission estimates were adjusted to reflect the contaminants emission rates projected in the ATG risk assessment work plan (Jacobs 1998) for the non-thermal treatment facility. The analyses were conducted to compare the calculated impacts of potential criteria pollutant releases against National Ambient Air Quality Standards and Washington State Air Quality Standards, the calculated impacts of emissions of toxic and hazardous air pollutants against applicable Washington State regulations, and the calculated impacts of emissions of radionuclides against applicable Federal and Washington State standards. Washington State standards are listed in the WAC and include the following:

- Acceptable source impact levels for toxic air pollutants (WAC 173-460)
- Ambient air quality standards for particulate matter (WAC 173-470)
- Ambient air quality standards for sulfur oxides (WAC 173-474)
- Ambient air quality standards for carbon monoxide, ozone, and nitrogen dioxide (WAC 173-475)
- Ambient air quality standards for radionuclides (WAC 173-480)
- Ambient air quality standards for fluorides (WAC 173-481)
- National emission standards for hazardous air pollutants (40 CFR 61)

- Radiation protection - air emissions (WAC 246-247).

The results of the analysis show no exceedance of Federal or State air quality standards for criteria pollutants, hazardous air pollutants, or radionuclides from the non-thermal treatment facility. The pollutants presented in Table 5.1 would result in the highest levels of emission compared to Federal or State standards.

Table 5.1. Major Air Pollutant Impacts

Pollutant	Averaging Period	Concentration g/m ³	State g/m ³	Federal g/m ³
Particulate matter (PM ₁₀)	24 hr	2.6E-03	1.5E+02	1.5E+02
Formaldehyde	Annual	2.9E-03	7.7E-02	NA
Diphenylene methane (fluorene)	24 hr	9.7E-06	5.3E+00	NA
Phenol	24 hr	1.1E-04	6.3E+01	NA
1,4-Dichlorobenzene (p-dichlorobenzene)	24 hr	1.1E-04	1.5E+00	NA
Combined methylphenol (cresol) isomers	24 hr	9.5E-03	7.3E+01	NA
Naphthalene	24 hr	2.0E-03	1.7E+02	NA
Dimethyl Phthalate	24 hr	1.1E-04	1.7E+01	NA
Di-n-Butyl Phthalate	24 hr	4.6E-04	1.7E+01	NA
Bis(2-ethylhexyl) phthalate	Annual	1.1E-04 ^a	2.5E+00	NA
Aluminum (combined particulate and vapor)	24 hr	1.2E-04	6.7E+00	NA
Barium (combined particulate and vapor)	4 hr	1.3E-06	1.7E+00	NA
Cadmium	Annual	8.8E-07 ^a	5.6E-04	NA
Iron	24 hr	1.6E-05	1.7E+01	NA
Lead	24 hr	1.5E-03	5.0E-01	NA
Nickel	Annual	1.2E-04 ^a	2.1E-03	NA
Radionuclide Emissions	Units	Dose (incremental)	State Standard	Federal Standard
Total radionuclides (maximum off-site receptor at point of maximum ground level concentration)	mrem/yr	1.1E-02	1.0E+01 ^b	1.0E+01 ^c

Notes:

^aThis is a 24-hour concentration value that is less than the annual State standards, therefore annual concentrations were not generated with Industrial Source Complex (ISC3) computer code (annual concentrations values are typically reduced from the 24-hour values by one to two orders of magnitude).

^b WAC 246-247.

^c 40 CFR 61.

Air concentrations taken from Tetra Tech (1996a) and adjusted to reflect non-thermal treatment emission rates projected in the Risk Assessment Work Plan (ATG 1998).

NA = Not applicable.

5.1.2 Transportation

The radiological and chemical transportation impacts associated with the non-thermal treatment of LLMW from the Hanford Site as well as nonradiological/nonchemical transportation accidents are evaluated in this section.

5.1.2.1 Radiological Risk

LLMW would be transported by truck from the 200 West Area to the ATG MWF for treatment at the non-thermal treatment building. Approximately 50 percent of the proposed route is subject to access controls. Only authorized personnel are allowed to travel on the access-controlled road. After treatment, the stabilized waste would be transported back to the 200 West Area for storage and eventual land disposal. The incident-free transportation health effects for this analysis were based on RADTRAN 4 computer modeling conducted by Tetra Tech (1996b). The worker population was assumed to consist of two people, the driver and a health and safety technician. Because the transport route is largely on the Hanford Site, the majority of non-workers potentially exposed during incident-free transport would be those sharing the roadway with the truck. Model default parameters designed to provide conservative analyses were used for a number of parameters including traffic counts, population density, and transport speed. Using a traffic count of 470 vehicles per hour (one way), the model estimated that, based on the calculated transport time, 317 people would be exposed during a single incident-free trip. The maximally exposed (MEI) individual non-worker is assumed to be located 10 m (33 ft) from the roadway.

The health effects from transportation accidents were based on RADTRAN 4 computer modeling conducted in Jacobs (1997) to support the Final EIS for Treatment of LLMW at the ATG Site (City of Richland 1998). The waste types evaluated in Jacobs (1998) were similar to the waste types evaluated in this EA.

Other important variables in calculating transportation risk are the number and size of shipments. The size of the shipments of untreated waste was 18,100 kilograms (kg) (40,000 pounds [lb]), which included 16 shipments per year (DOE 1996a). The same shipment size was assumed for the analysis in this EA, and the annual shipments of untreated waste would be approximately 16 shipments per year. Stabilizing the waste would include adding cement-like materials to the waste or encapsulating the waste in polymer materials. This would increase the volume of the treated waste by approximately 25 percent and therefore the number of trips of treated waste from the ATG MWF to the Hanford Site 200 West Area would increase proportionally to 20 shipments per year.

Latent Cancer Fatality Risk From Incident Free Transportation

The annual incident-free transportation latent cancer fatality (LCF) risk to the involved workers and noninvolved workers and general public are summarized in Table 5.2. There would be no anticipated LCFs to the workers ($3.0E-05 + 4.0E-05 = 7.0E-05$) or the noninvolved workers and general public ($1.2E-05 + 1.6E-05 = 2.8E-05$) based on three years of operation. The LCF risk to the MEI would be $3.5E-05$ ($1.5E-05 + 2.0E-05$) based on three years of operation.

Table 5.2. Incident-Free Transportation Latent Cancer Fatality Risk

Receptor	Annual Dose person-rem	3-year Dose person-rem	LCF Risk for Duration of Project
Untreated Waste Transported From Hanford 200 West Area to ATG MWF			
Involved worker population	2.5E-02	7.5E-02	3.0E-05
Involved worker MEI	1.3E-02 (rem)	3.8E-02 (rem)	1.5E-05
Noninvolved worker and general public population	9.8E-03	2.9E-02	1.2E-05
Noninvolved worker MEI	9.3E-06 (rem)	2.8E-05 (rem)	1.1E-08
Treated Waste Transported from ATG MWF to Hanford 200 West Area			
Involved worker population	3.3E-02	1.0E-01	4.0E-05
Involved worker MEI	1.7E-02 (rem)	5.0E-02 (rem)	2.0E-05
Noninvolved worker and general public population	1.3E-02	3.9E-02	1.6E-05
Noninvolved worker MEI	1.2E-05 (rem)	3.7E-05 (rem)	1.5E-08

Latent Cancer Fatality Risk From Transportation Accident

Each RADTRAN 4 model run assumes that accidents of six different severities could occur during the transportation of the waste. Accident-severity categories were defined as various combinations of thermal (i.e., fire) and mechanical (i.e., impact, puncture, crush) environments and differed in the degree to which package shielding was damaged and contents were released. More severe accidents were assumed to result in releases of greater amounts of radioactive materials over a larger area and to occur with a much lower frequency than less severe accidents.

The evaluation in Jacobs (1997) showed that the population health impacts from an accident while transporting LLMW would result in an annual health risk of 3.6E-04 LCF. The analysis evaluated transportation accidents in heavily populated areas such as Vancouver, Washington; Spokane, Washington; and Seattle, Washington that would bound the consequences of a transportation accident that could potentially occur en route from the Hanford Site to the ATG Site. The evaluation in Jacobs (1997) was based on 475 trips per year, which would bound the probability of a transportation accident based on 16 trips per year, as evaluated in this EA.

5.1.2.2 Chemical Risk From Transportation Accident

Potential acute hazards associated with exposure to concentrations of chemicals resulting from postulated LLMW transportation accidents were evaluated using a screening-level approach. The screening-level approach involved direct comparison of calculated exposure concentrations of chemicals to an MEI located within an assumed 10 m (33 ft) radius of the accident, to air concentration screening criteria known as Emergency Response Planning Guidelines (ERPGs). ERPGs are defined as follows.

- ERPG-1 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse effects or perceiving a clearly defined objectionable odor.

- ERPG-2 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action.
- ERPG-3 - The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

The health hazards were evaluated based on the corrosive/irritant effects and toxic effects. Chemicals were sorted into chemical classes, and representative chemicals having the highest potential health impacts from each chemical class were selected to provide a conservative prediction of the potential health impacts from the entire chemical class. Risks from chemicals within each group (corrosive/irritant or toxic) were assumed to be additive. This is a conservative assumption because many different chemicals affect different organs. Cumulative hazards for the corrosive/irritant and toxic chemicals were evaluated as follows:

$$\text{Cumulative Hazard} = C_1/E_1 + C_2/E_2 + \dots + C_i/E_i$$

Where:

- C = Calculated airborne exposure point concentration for an individual chemical (mg/m³).
- E = The ERPG for the chemical (mg/m³).

A cumulative Hazard Index (HI) greater than 1.0 indicates that the acute hazard guidelines for a chemical class has been exceeded and the chemical class may pose a potential acute health impact.

The chemical health hazards associated with a transportation accident are dependent on the severity of the accident, nature of the chemicals, local population density, and the weather conditions. The worst-case credible accident would be an accident resulting in a fire while transporting LLMW to the ATG MWF to be treated. Chemical consequences from untreated waste would be more severe than treated waste because the treatment process would immobilize hazardous organic chemicals, and the treated waste has a very low probability of igniting.

The following assumptions and parameters were used in calculating the chemical concentrations within a 10 m (33 ft) radius of the accident:

- Waste per truck shipment = 18,100 kg (40,000 lb) (Tetra Tech 1996b)
- Hazardous chemical/shipment = 152 kg (340 lb)
- Amount of waste spilled from the container and available to burn = 50 percent (assumed)
- Respirable release fraction for a fire = 5.0E-04 (DOE 1994). The release fraction was taken from DOE (1994) and is based on experimental data in which various types of packaged waste (e.g., paper, rags, tape, plastic, cardboard, oil) contaminated with uranium dioxide powder, uranyl nitrate liquid, and air-dried uranyl nitrate were burned. The

respirable release fraction is a combination of the airborne release fraction and the respirable fraction or the fraction of the material that is respirable.

- The material released is assumed to spread instantaneously and uniformly over a hemisphere 10 m (33 ft) in radius. The MEI is assumed to be located at the center of the hemisphere.

The chemical concentration within a 10 m (33 ft) hemisphere is calculated using the following equation:

$$C(\text{mg}/\text{m}^3) = [Q (\text{kg})] \left(\frac{3}{2\pi r^3} \right) (1.0\text{E}+06 \text{ mg}/\text{kg})$$

Where:

C = Concentration

Q = Respirable quantity released based on (truck inventory) (50 percent released in fire)
(respirable release fraction)

r = Assumed 10 m (33 ft) radius for distribution of source.

Therefore:

$$C = (152 \text{ kg}) (50 \text{ percent}) (5.0\text{E}-04) (4.77\text{E}-04/\text{m}^3) (1.0\text{E}+06 \text{ mg}/\text{kg}) = 1.75\text{E}+01 \text{ mg}/\text{m}^3$$

The chemical inventory involved in a potential truck accident was based on a breakdown of the Hanford Site LLMW by hazardous and toxic material constituents (Jacobs 1997). To facilitate the analysis the chemicals were sorted into chemical classes by chemical type and a representative chemical was selected from the class that would provide a conservative bound on the potential health effects from all chemicals within a given class. This approach provides a conservative prediction of the potential health effects by adding the chemical mass within each class and assuming that the entire mass is the selected representative chemical.

The air concentrations of the chemical classes are compared to the ERPGs in Table 5.3 (toxic concentration limits) and Table 5.4 (corrosive/irritant concentration limits). As shown in these tables, the accident would not result in any anticipated fatalities or the development of irreversible or serious health effects or the development of mild transient adverse effects.

5.1.2.3 Nonradiological/Nonchemical Transportation Impacts

The nonradiological/nonchemical impacts include injuries and fatalities resulting from truck accidents. The LLMW would be transported by truck from the 200 West Area to the ATG MWF. After treatment the stabilized waste would be transported back to the 200 West Area for land disposal. The 200 West Area is located approximately 33 km (20 mi) to the northeast of the ATG MWF. The rates of transportation accidents are assumed comparable to that of average truck transport in the United States. Unit-risk factors were developed based on statistics compiled by DOT (Rao 1982). The unit-risk factors for injuries and fatalities in a suburban zone

are 3.8E-07/km and 1.3E-08/km, respectively. Based on traffic counts and congestion levels that vary considerably throughout the work day along the transport route, injury and fatality rates from suburban zones were used. These rates are slightly higher than the rates for rural zones.

The number of injuries and fatalities during the 3 years of treatment were calculated using the following equation:

$$\text{Injuries} = D(\text{kg/m}^3) \cdot V(\text{m}^3) \times S(\text{kg/shipment})^{-1} \cdot T(\text{km/shipment}) \cdot I_i(\text{injuries/km}) \cdot F$$

$$\text{Fatalities} = D(\text{kg/m}^3) \cdot V(\text{m}^3) \cdot S(\text{kg/shipment})^{-1} \cdot T(\text{km/shipment}) \cdot I_f(\text{fatalities/km}) \cdot F$$

Where:

D = Waste density of 347 kg/m³ (21.7 lb/ft³) (Tetra Tech 1996b)

V = A volume of 2,600 m³ (92,000 ft³) of waste to be transported (Jacobs 1998)

S = 18,100 kg/shipment (40,000 lb/shipment) of waste to be treated (Tetra Tech 1996b)

T = 66 km/shipment (41 mi/shipment) round trip from the 200 West Area to ATG

I_i = Incidence rate of 3.8E-07/km for injuries resulting from truck transport accidents in a suburban zone (Rao 1982)

I_f = Incidence rate of 1.3E-08/km for fatalities resulting from truck transport accidents in a suburban zone (Rao 1982)

F = The waste volume after non-thermal stabilization would increase by 25 percent due to cement-like and polymer-like additives increasing the number of trips from ATG to the 200 West Area by the same proportion.

Therefore, the number of injuries would be less than 1 (1.6E-03) and the number of fatalities would be less than 1 (5.4E-05).

5.2 HUMAN HEALTH IMPACTS FROM PLANT OPERATIONS

Environmental health impacts analyzed in this section include potential LCF risks from radiological exposure and health hazards and incremental lifetime cancer risk (ILCR) from chemical exposures that would occur during routine non-thermal treatment operations or that could result from postulated accidents. The analysis also includes injuries and fatalities from nonradiological and nonchemical industrial type accidents that would be typical to the operations activities associated with the non-thermal treatment facility.

Table 5.3. Comparison of Chemical Concentrations to Toxic Concentration Limits for Transport Truck Fire ⁶

Analyte (Threshold values are presented in mg/m ³)	Exposure (mg/m ³)	ERPG-1 (mg/m ³)	ERPG-2 (mg/m ³)	ERPG-3 (mg/m ³)	
Solvent/Thinner Waste Stream					
Benzene ¹	MEI	1.8E+00	Threshold Value		
			7.80E+01	1.57E+03	3.13E+03
			Ratio of Exposure to ERPG ⁵		
			2.40E-02	1.2E-03	5.9 E-04

N-Butyl Alcohol ²	MEI	9.6E-01	Threshold Value		
			7.50E+01	7.50E+02	7.50E+03
			Ratio of Exposure to ERPG		
			1.3E-02	1.3E-03	1.3E-04
2-Hexanone ³	MEI	4.0E+00	Threshold Value		
			5.00E+01	5.00E+02	5.00E+03
			Ratio of Exposure to ERPG		
			8.4E-03	8.4E-04	8.4E-05
Petroleum/Coal Tar Derivatives					
Tridecane ⁴	MEI	5.8E+00	Threshold Value		
			3.70E+01	1.45E+03	7.33E+03
			Ratio of Exposure to ERPG		
			1.6E-01	4.0E-03	8.0E-04
Total MEI ratios			2.0 E-01	7.3 E-03	1.6E-03

Notes:

ERPG = Emergency Response Planning Guideline values. ERPG values were obtained from the Hanford Environmental Health Foundation (Dentler 1995)

MEI = Maximally exposed individual

¹ Benzene used as a representative chemical for aromatic compounds.

² N-butyl alcohol used as a representative chemical for glycols/alcohols.

³ 2-hexanone used as a representative chemical for aliphatics.

⁴ Tridecane (similar to kerosene) used as a representative chemical for petroleum and coal tar derivatives.

⁵ A ratio less than 1 indicates that the calculated exposure concentration is lower than the ERPG.

⁶ Because of uncertainties surrounding the release fractions for volatile or semi-volatile chemical compounds, exposure concentrations and ratios of exposure to ERPG threshold values were calculated using an airborne release fraction of 1.0 and a respirable release fraction of 1.0. The resulting ratio of exposure concentration to ERPG-3 would be an exceedence of 3.6. However, when the probability of the accident (6.6E-08) is taken into account the resulting risk would be 2.4E-04.

Table 5.4. Comparison of Chemical Concentrations to Corrosive/Irritant Concentration Limits for Transport Truck Accident ⁷

Analyte (Threshold values are presented in mg/m ³)	Exposure Concentration (mg/m ³)	ERPG-1 (mg/m ³)	ERPG-2 (mg/m ³)	ERPG-3 (mg/m ³)	
Solvent/Thinner/Freon Waste Stream					
Methylene Chloride ^{1,3}	MEI	8.4E-01	Threshold Value		
			7.00E+02	3.48E+03	1.74E+04
			Ratio of Exposure to ERPG ⁶		
			1.2E-03	2.4E-04	4.8E-05
Metals/Metal Salts Waste Stream					
Sodium Silicate ²	MEI	1.2E-01	Threshold Value		
			5.80E+00	1.16E+02	2.90E+02
			Ratio of Exposure to ERPG		
			2.1E-02	1.1E-03	4.2E-04
Amine Waste Stream					
Ammonia ⁴	MEI	2.5E-01	Threshold Value		
			1.70E+01	1.40E+02	6.80E+02
			Ratio of Exposure to ERPG		
			1.4E-02	1.8E-03	3.6E-04
Caustic (Acids/Bases) Waste Stream					
Sodium Hydroxide ⁵	MEI	4.6E-01	Threshold Value		
			2.00E+00	4.00E+01	1.00E+02
			Ratio of Exposure to ERPG		
			2.3E-01	1.2E-02	4.6E-03
Total MEI Ratios			2.7E-01	1.5E-02	5.5E-03

Notes:

ERPG = Emergency response planning guideline values. ERPG values were obtained from the Hanford Environmental Health Foundation (Dentler 1995)

MEI = Maximally exposed individual

¹ Methylene chloride used as a representative chemical for chlorinated solvents.

² Sodium silicate used as a representative chemical for metals and metal salts.

³ Methylene chloride used as a representative chemical for freon.

⁴ Ammonia used as a representative chemical for amines.

⁵ Sodium hydroxide used as a representative chemical for caustics.

⁶ A ratio less than 1 indicates that the calculated exposure concentration is lower than the ERPG.

⁷ Because of uncertainties surrounding the release fractions for volatile or semi-volatile chemical compounds, exposure concentrations and ratios of exposure to ERPG threshold values were calculated using an airborne release fraction of 1.0 and a respirable release fraction of 1.0. The resulting ratio of exposure concentration to ERPG-2 would be an exceedance of 4.6. However, when the probability of the accident (6.6E-05) is taken into account the resulting risk would be 3.0E-04.

5.2.1 Normal Operating Conditions

The health impacts from routine exposures are evaluated for three receptor groups or populations: the involved workers, noninvolved workers, and general public. Involved workers are those individuals directly involved in a non-thermal treatment activity. Noninvolved workers refer to the ATG Site employees who are not directly involved in the treatment activity.

The general public is the population distribution relative to the non-thermal treatment facility to a distance of 80 km (50 mi). Health impacts to the MEI from the involved workers, noninvolved workers, general public groups, and an individual located at the nearby child care center are also evaluated. An MEI is an individual who is assumed to receive the highest possible exposure.

This section examines potential risk from exposure to chemical and radiological contaminants and direct exposure to radiation during normal operations. Risk to the involved workers would be from direct exposure to radiation from non-thermal treatment operations during the work day. Chemical and radiological emissions are from a stack, and it is therefore assumed that the plume passes overhead. Risk to the noninvolved workers would be from potentially inhaling radioactive and chemical atmospheric stack emissions from non-thermal operations. Risk to the general public includes potentially inhaling radioactive and chemical atmospheric stack emissions and ingesting food and water contaminated by airborne deposition. Health impacts are based on 3 years of operation (the maximum duration for waste processing for the waste stream evaluated).

Involved Worker Radiological Consequences From Normal Operations

The LCF risk to the involved workers was calculated by multiplying the radiological exposure by a dose-to-risk conversion factor. The involved worker population dose was assumed to be 200 mrem/year per involved worker (historical average for the existing ATG low-level waste [LLW] treatment facility) and a population of 40 involved workers. The administrative control limit of 1 rem/year was assumed for the MEI. The dose-to-risk conversion factor used in the analysis to calculate the LCF risk to the involved workers was $4.0E-04$ LCFs per person-rem taken from the 1990 Recommendations of the International Commission on Radiological Protection (ICRP 1991). These factors are applicable where the dose to an individual would be less than 20 rem and the dose rate would be less than 10 rem per hour. The annual LCF risk to the involved worker population and the MEI involved worker during normal operations are presented in Table 5.5. No LCFs would be expected for the involved workers, and over the three year life of the project, the risk of the MEI receiving a fatal cancer from the LLMW operation is small [$1.2E-03$]. The results are conservative because the waste stream evaluated (300 metric tons/year) is much lower than the treatment capacity of the non-thermal treatment portion of the MWF (8,500 metric tons/year). Therefore, the waste stream evaluated in this EA would not require a full year of facility operation for treatment.

Table 5.5. Involved Worker Radiological Risk From Normal Operations

Receptor	Annual Dose EDE	Dose EDE for Project	Total Project Radiological Risk (LCF)
Involved worker population	8.0E+00 (person rem)	2.4E+01 (person-rem)	9.6E-03
MEI involved worker	1.0E+00 (rem)	3.0E+00 (rem)	1.2E-03

Notes:

Total project dose and radiological risk based on 3 years of operations

EDE = Effective dose equivalent

LCF = Latent cancer fatality

MEI = Maximally exposed individual

Involved workers dose is based on an annual 200 mrem per involved worker and 40 involved workers per year. The LCF risk is based on a dose-to-risk conversion factor of 4.0E-04 LCF per rem.

MEI-involved worker dose is based on 1,000 mrem per year (ATG administrative control limit). The LCF risk is based on a dose-to-risk conversion factor of 4.0E-04 LCF per rem.

Noninvolved Worker and General Public Radiological Consequences from Normal Operations

The radiological dose to the noninvolved workers and the general public was calculated using the EPA approved CAP88-PC program. The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from ingestion of food produced in the assessment area. It uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from either elevated stacks or uniform area sources. Dose is estimated by combining the inhalation and ingestion intake rates, air, and ground surface concentrations with dose conversion factors. The effective dose equivalent is calculated using the weighting factors in the International Commission on Radiological Protection Publication 26 (ICRP 1977). Site-specific meteorological data and population arrays were developed and used with CAP88-PC. The radionuclide source term used with CAP88-PC was taken from air emissions estimates for the ATG MWF that were adjusted to reflect a production rate of 870 m³/year. The annual emissions are shown in Table 5.6. The annual LCF risk to the noninvolved worker population, MEI noninvolved worker, general public population, and MEI general public during normal operations was calculated using ICRP Publication 60 (ICRP 1991) dose-to-risk conversion factors and are presented in Table 5.7.

The general public evaluation also included an analysis of a maximally exposed individual at a child care center located 2 km (1.25 mi.) to the east-southeast. No LCFs would be expected from the noninvolved worker and general public populations. The incremental risk or probability that the general public MEI would develop a fatal cancer from the non-thermal treatment operation is 1.7E-08. The general public MEI is the receptor within the Site-specific population array that receives the highest dose.

Table 5.6. Annual Radiological Air Emissions

Isotope	Maximum Anticipated Emissions (Ci/year)
Tritium-3 (H-3)	1.22E+01
Carbon-14 (C-14)	2.27E-08
Sodium-22 (Na-22)	8.44E-12
Calcium-45 (Ca-45)	4.46E-12
Chromium-51 (Cr-51)	4.55E-10
Manganese-54 (Mn-54)	4.10E-11
Iron-55 (Fe-55)	6.84E-11
Cobalt-57 (Co-57)	1.04E-10
Cobalt-58 (Co-58)	1.86E-11
Cobalt-60 (Co-60)	5.32E-10
Nickel-63 (Ni-63)	5.21E-11
Zinc-65 (Zn-65)	2.21E-10
Strontium-90 (Sr-90)	2.01E-08
Yttrium-90 (Y-90)	2.01E-08
Zirconium-95 (Zr-95)	8.75E-12
Antimony-125 (Sb-125)	5.85E-11
Tellurium (Te-125m)	1.41E-11
Cesium-134 (Cs-134)	1.12E-11
Cesium-137 (Cs-137)	3.67E-08
Barium-140 (Ba-140)	3.18E-11
Lanthanum-140 (La-140)	3.18E-11
Europium-152 (Eu-152)	3.61E-12
Europium-154 (Eu-154)	1.60E-10
Lead-214 (Pb-214)	1.15E-13
Bismuth-214 (Bi-214)	1.05E-13
Radium-226 (Ra-226)	4.53E-11
Thorium-232 (Th-232)	1.87E-12
Uranium-235 (U-235)	1.34E-10
Uranium-238 (U-238)	9.28E-12
Plutonium-238 (Pu-238)	1.15E-08
Plutonium-239 (Pu-239)	5.19E-10
Plutonium-240 (Pu-240)	1.18E-10
Plutonium-241 (Pu-241)	9.13E-08

Notes:

Maximum anticipated emissions were taken from Attachment 4 of ATG (1998).

Ci = Curies

Table 5.7. Radiological Risk From Air Emissions During Normal Operations

Receptor	Annual Dose EDE	Project Total Dose EDE	Project Total Radiological Risk (LCF)
Noninvolved worker population	1.8E-03 (person-rem)	5.3E-03 (person-rem)	2.1E-06
MEI noninvolved worker	1.1E-05 (rem)	3.3E-05 (rem)	1.3E-08
General public population	1.4E-02 (person-rem)	4.2E-02 (person-rem)	2.1E-05
MEI general public	1.1E-05 (rem)	3.3E-05 (rem)	1.7E-08
MEI child care center	3.0E-06 (rem)	9.0E-06 (rem)	4.5E-09

Notes:

EDE = Effective dose equivalent

LCF = Latent cancer fatality

MEI = Maximally exposed individual

Dose EDE and radiological risk are based on 3 years of operation.

Noninvolved worker population dose was calculated by multiplying the MEI noninvolved worker dose by 160 noninvolved workers. 160 noninvolved workers = 60 workers at the MWF (50 at the thermal treatment facility and 10 support staff associated with non-thermal treatment) and 100 workers at ATG's existing LLW treatment facility.

The population dose represents a collective dose. If 100 people in an exposed population each received a dose of 0.01 rem, the population dose would be 1 person-rem.

Radiological risk calculated by using ICRP dose-to-risk conversion factors.

Involved Worker Nonradiological Chemical Consequences from Normal Operations

Routine chemical emissions from the non-thermal treatment facility would be released from a stack, and it is therefore assumed that the plume passes overhead and would not expose the involved workers working in the facility. Impacts associated with handling hazardous chemicals inside the facility would not be expected because standard hazardous waste storage and handling procedures would be followed. Exposure to hazardous chemicals inside the facility only would occur as a result of an accident.

Noninvolved Worker and General Public Nonradiological Chemical Consequences from Normal Operations

Exposure to chemicals in air emissions was evaluated by estimating inhalation intakes for identified chemical emissions and evaluating potential ILCR (i.e., the excess cancer risk from fatal and nonfatal cancers) and noncarcinogenic health hazards using chemical-specific cancer slope factors and reference doses, respectively. Cancer slope factors and chronic reference doses as published by EPA in the Integrated Risk Information System and Health Effects Assessment Summary Tables were applied in the chemical emissions evaluation.

Routine chemical emissions concentrations from the non-thermal treatment operations were based on emissions concentration data from the Industrial Source Complex (ISC3) air dispersion modeling results for the ATG MWF (Tetra Tech 1996a). The air concentrations were scaled to account for projected emission rates from the risk assessment work plan for the facility's RCRA permit (Jacobs 1998).

The inhalation intake of each chemical (milligram/kilogram [mg/kg]-day) was calculated using the following equation:

$$\text{Intake} = [(Ca) (IR) (EF) (ED)] / [(BW) (AT)]$$

Where: Ca = Estimated air concentration of the ith chemical, mg/m³
 IR = Inhalation rate, 20 m³/day (710 ft³)
 EF = Exposure frequency, 250 days/year
 ED = Exposure duration, 3 years
 BW = Body weight, 70 kg (150 lb)
 AT = Average time, days
 = (ED)(365 day/year) noncarcinogens
 = (70 year)(365 day/year) carcinogen (EPA 1989)

Potential health effects from exposure to multiple noncarcinogenic chemicals were estimated using the HI approach. The HI is defined as the summation of the hazard quotients (calculated dose divided by the reference dose [RfD]) for each chemical and is represented by the following equation:

$$\text{HI} = \frac{\text{Calculated Dose}_a}{\text{RfD}_a} + \frac{\text{Calculated Dose}_b}{\text{RfD}_b} + \dots + \frac{\text{Calculated Dose}_i}{\text{RfD}_i}$$

It was assumed that the noncarcinogenic health effects would be additive for all chemicals. This is conservative because to be truly additive in effect, chemicals must affect the same target organ system or result in the same critical toxic endpoint. An HI greater than or equal to 1.0 (unity) would be indicative of potential adverse health effects in the population of concern from exposure to multiple chemicals. Conversely, a HI less than 1.0 would suggest that no adverse health effects would be expected.

Quantitative estimates for ILCR risks were generated for each chemical according to the following equation:

$$R_i = q_i E_i$$

Where:

R_i = Estimated incremental risk of cancer associated with the chemical
 q_i = Cancer slope factor for the chemical, (mg/kg day)⁻¹
 E_i = Exposure dose for the chemical, mg/kg day

In evaluating potential carcinogenic risks from exposure to multiple carcinogenic chemicals, all carcinogenic risks were assumed to be additive. Consequently, the total ILCR represents the summation of individual chemical cancer risks. Federal (55 FR 8666 and 40 CFR 300) and State (WAC 173-340) regulatory agencies have suggested an acceptable level of risk to be between 1 in 10,000 (1.0E-04) and 1 in 1,000,000 (1.0E-06), with 1.0E-06 being the point below which there is no regulatory concern

Table 5.8 summarizes the noncarcinogenic health hazard and ILCR associated with routine air emissions from LLMW treatment operations. As shown by the results in Table 5.8, the HI ($7.8E-05$) is well below the benchmark value of 1.0, and the ILCR ($9.4E-09$) is considered low. Therefore, the proposed action would be expected to result in no adverse health effects from routine air emissions.

5.2.2 Accident Conditions

The health risks resulting from potential accidents associated with operation of the ATG non-thermal treatment facility are evaluated in this section. Accidents are unplanned events or a sequence of events that would cause undesirable consequences. This analysis addresses the following:

- Radiological and chemical risks associated with operations. The risk associated with a radiological release resulting from an accident was expressed as the product of the annual frequency of occurrence and the LCF risk. The risk associated with a chemical release resulting from an accident was expressed as the product of the annual frequency of the accident and the health hazard.
- Occupational risks, including the nonradiological/nonchemical injuries, illnesses, and fatalities from operation accidents common to the workplace such as falls, cuts, and operator-machine impacts. The risk associated with an accident was defined as the product of the fatality or injury/illness incidence rates and the number of workers at risk.
- Health impacts from radiological and chemical accidents are evaluated for the same receptors as for normal operations with the exception that the involved workers are not evaluated separately but are included in the on-site population located a minimum of 100 m (330 ft) from the point of release.

Radiological Consequences from Accident Conditions

Containerized LLMW from Hanford would be unloaded from trucks at the ATG Site, moved to the waste storage building, and would be transported to the non-thermal treatment building for processing. A forklift would be used to handle the containerized waste. A containerized waste handling accident was analyzed similar to a containerized waste handling accident evaluated in the Central Waste Complex Interim Safety Basis (HNF 1997). A fire is postulated to occur when forklift tines puncture two drums igniting the contents. It was assumed that the two drums burn in the resultant fire, which lasts less than one hour. The heat of the fire results in the lid seals failing on two additional drums from which 5.8 percent of the contents burn (HNF 1997). Although facility personnel in the vicinity of the accident would be aware of the accident as it occurred, no credit was taken for emergency response action to the fire. The respirable airborne release fraction for the combustible materials was $5.0E-04$ and for noncombustible material it was $6.0E-05$. These release fractions were taken from DOE (1994) and used in the Central Waste Complex Interim Safety Basis analysis. The release fraction for combustible materials was based on experimental data in which various types of packaged waste (e.g., paper, rags, tape,

Table 5.8. Human Health Risk to Maximum Exposed Receptor from Inhalation of Routine Chemical Air Emissions

Emissions	Air Concentrations (mg/m ³)	Noncarcinogen Inhalation Intake (mg/kg-day)	Carcinogen Inhalation Intake (mg/kg-day)	Inhalation Reference dose (mg/kg-day)	Inhalation Slope Factor (kg-day/mg)	Noncarcinogen Hazard	Cancer Risk
2-Methylphenol	4.90E-08	9.61E-09	4.12E-10	1.0E-01	NC	9.6E-08	N/A
4-Methylphenol	1.27E-06	2.49E-07	1.07E-08	1.0E-01	NC	2.5E-06	N/A
Acetophenone	3.33E-09	6.53E-10	2.80E-11	1.0E-01	NC	6.5E-09	N/A
Benzoic Acid	1.33E-09	2.61E-10	1.12E-11	4.0E+00	NC	6.5E-11	N/A
bis(2-Ethylhexyl) Phthalate	3.29E-08	6.44E-09	2.76E-10	2.0E-02	1.4E-02	3.2E-07	3.9E-12
Butylbenzyl Phthalate	3.29E-08	6.44E-09	2.76E-10	2.0E+00	ND	3.2E-09	ND
Di-n-Butyl Phthalate	1.32E-07	2.59E-08	1.11E-09	ND	ND	ND	ND
1,4-Dichlorobenzene	3.30E-08	6.46E-09	2.77E-10	2.0E-01	2.4E-02	3.2E-08	6.6E-12
Dimethyl Phthalate	3.28E-08	6.43E-09	2.76E-10	1.0E+01	1.0E+00	6.4E-10	2.8E-10
Fluorene	2.11E-14	4.13E-15	1.77E-16	4.0E-02	NC	1.0E-13	N/A
Formaldehyde	8.79E-07	1.72E-07	7.38E-09	4.5E-02	4.6E-02	3.8E-06	3.4E-10
Naphthalene	5.93E-07	1.16E-07	4.98E-09	4.0E-02	NC	2.9E-06	N/A
Phenol	3.23E-08	6.34E-09	2.72E-10	6.0E-01	NC	1.1E-08	N/A
Barium	3.92E-10	7.68E-11	3.29E-12	1.0E-04	NC	7.7E-07	N/A
Cadmium	2.56E-10	5.02E-11	2.15E-12	5.0E-04	6.3E+00	1.0E-07	1.4E-11
Nickel	3.70E-08	7.25E-09	3.11E-10	2.0E-02	8.4E-01	3.6E-07	2.6E-10
Aluminum	3.65E-08	7.16E-09	3.07E-10	1.4E-02	NC	5.1E-07	N/A
Iron	4.84E-09	9.49E-10	4.07E-11	8.6E-03	NC	1.1E-07	N/A
Chrome	1.61E-08	3.15E-09	1.35E-10	ND	4.2E+01	ND	5.7E-09
Chromium VI	1.20E-09	2.34E-10	1.00E-11	5.0E-03	2.9E+02	4.7E-08	2.9E-09
Lead	1.45E-07	2.84E-08	1.22E-09	4.3E-04	NC	6.6E-05	N/A
					Total HI = 7.8E-05		
					Total Cancer Risk = 9.4E-09		

Table 5.8. Human Health Risk to Maximum Exposed Receptor from Inhalation of Routine Chemical Air Emissions (cont'd)

Notes:

HI = Hazard Index

NC = Noncarcinogen

ND = No data published

Air concentrations taken from Tetra Tech (1996a) and adjusted to reflect projected emission rates from the risk assessment work plan (ATG 1998). Air concentrations are the maximum predicted concentrations downwind of the stack. Modeling analysis results in Tetra Tech (1996a) were based on the ISC3 short-term dispersion model assuming 24 consecutive hours of low wind speeds, poor dispersion conditions (stability categories E and F), and persistent wind directions (randomized fluctuations within 10 degrees either side of the mean direction). Stack tip down wash and building wake effects were included in the model runs.

Noncarcinogen and carcinogen inhalation intake were calculated as follows:

$$\text{Intake}_i = [(C_{a_i}) (\text{IR}) (\text{EF}) (\text{ED})] / [(BW) (\text{AT})]$$

Where: Intake = Inhalation intake of the *i*th chemical, mg/kg-day

C_{a_i} = Estimated air concentration of the *i*th chemical, mg/m³

IR = Inhalation rate, 20 m³/day

EF = Exposure frequency, 250 days/year

ED = Exposure duration, 3 years

BW = Body weight, 70 kg

AT = Average time, days (noncarcinogens = 3 years, 365 days/year, carcinogens = 70 years 365 days/year)

Noncarcinogenic hazard = noncarcinogen inhalation intake divided by inhalation RfD.

Excess cancer risk = Carcinogen inhalation intake times inhalation slope factor (SF).

plastic, cardboard, oil) contaminated with uranium dioxide powder, uranyl nitrate liquid, and air dried uranyl nitrate were burned. The release fraction for noncombustible material was based on experimental data of suspended reactive powders under thermal stress. Drum contents were considered to be 65 percent combustible and 35 percent noncombustible. The annual frequency of this event was estimated to be 1.1E-04, for the Hanford Site Central Waste Complex using an event tree and was judged to be appropriate for the operations at the ATG Site (HNF 1997).

The waste inventory used to calculate the dose from the accident postulated to occur at the ATG Site is presented in Table 5.9. The inventory is based on the radiological inventory of the Hanford Site LLMW that was characterized for thermal treatment at the ATG thermal treatment facility (DOE 1996a). This inventory represents an averaged waste inventory and does not consider a worst-case inventory in calculating accident consequences. However, the average inventory is reasonable for calculating accident risk, which is the product of the probability of occurrence and the consequence. The probability of a waste package containing the worst-case inventory being involved in the postulated accident would be lower than that of the average container.

Radiation doses from the source term listed in Table 5.9 were computed with the GENII code (Napier et al. 1988) for the noninvolved worker and general public receptors. The doses from radioactivity absorbed into the body were computed using weighting factors for various body organs and the results summed to calculate a committed effective dose equivalent (CEDE). The computer code was used to calculate the inhalation dose for a 70-year dose commitment period. The Hanford Site 300 Area joint-frequency file and a population file that evaluated a population within a 80-km (50 mi) radius of the ATG Facility was used in the code. The code uses the Gaussian plume model for air dispersion.

The exposure pathways for the noninvolved worker receptor includes external exposure from immersion in the plume; external exposure from radioactive material deposited on the ground; internal exposure from inhalation of radionuclides in the airborne plume; and internal exposure from inhalation of previously-deposited radioactive material resuspended in air due to wind actions. The exposure pathways for the general public are the same as the noninvolved worker receptor exposure pathways but also includes internal exposure from the ingestion of food crops and animal products.

For the involved worker dose, the material released is assumed to spread instantaneously and uniformly over a hemisphere 10 m (33 ft) in radius. The 10 m (33 ft) is an assumed value used to calculate airborne concentrations of contaminants in close proximity to the point of release and has been used in similar accident analyses (WHC 1995). The MEI is assumed to be located at the center of the hemisphere. The equation used to estimate the dose is as follows:

$$D(\text{rem CEDE}) = [\text{ST}(\text{rem CEDE})] \left(\frac{3}{2p r^3} \right) \text{BR}(\text{m}^3/\text{s}) \text{T}(\text{s})$$

Table 5.9. Hanford Site LLMW Inventory Used In Drum Fire Accident Scenario

Isotope	Source Term (Ci)
Cs-137	4.6E-06
Sr-90	4.1E-06
H-3	7.2E-07
Fe-55	4.8E-07
Mn-54	2.4E-07
Ce-144	6.8E-08
Co-60	4.6E-08
Eu-154	3.4E-08
Pm-147	3.1E-08
Pu-241	2.3E-05
Pu-238	3.7E-07
Am-241	3.3E-07
Pu-239	1.2E-07
Pu-240	2.7E-08
Np-237	1.3E-09
C-14	1.4E-08
Tc-99	2.6E-09
I-129	3.9E-08

Notes:

Source term is the respirable fraction of the total inventory released in the fire. It represents the contents of two 55-gal. drums plus 5.8 percent of two additional drums that burn in the fire or a 1.69E-04 fraction of the total inventory. The source term is further reduced by multiplying the burned inventory by respirable airborne release fractions of 5.0E-04 for combustible material and 6.0E-05 for noncombustible material. Sixty five percent of the waste was considered to be combustible and 35 percent of the waste was considered to be noncombustible (HNF 1997).

Where:

CEDE = committed effective dose equivalent

D = Receptor dose in rem CEDE

ST = Respirable quantity of isotopes released in the fire, taken from Table 5.9, times the appropriate dose conversion factor from the GENII code (Napier et al. 1988).

The sum of the dose from each isotope was calculated to be 680 rem CEDE.

r = Assumed 10 m (33 ft) radius for distribution of source

BR = Breathing rate of 3.3E-04 m³/s

s = Second

T = Involved worker exposure time of 10 min.

Therefore:

$$D = (680 \text{ rem CEDE}) (4.77\text{E-}04/\text{m}^3) (3.3\text{E-}04 \text{ m}^3/\text{s}) (600 \text{ s}) = 6.43\text{E-}02 \text{ rem CEDE}$$

The LCF risk to the receptors was calculated by multiplying the dose (rem committed effective does equivalent [CEDE]) by dose-to-risk conversion factors. Conversion factors have been previously defined and are estimates of health effects from radiation exposure.

The LCF risk is the product of the chance, or frequency, of an accident occurring and the consequences (measured in terms of the number of LCFs caused by the radiation exposure) of the accident if it were to occur. An event that was certain to occur would have a probability of 1 (a 100 percent certainty). If an accident was expected to happen once every 100 years, the annual frequency of occurrence would be 0.01 (1 occurrence divided by 100 years = 0.01 occurrences per year). The LCF risk therefore expresses the expected number of LCFs, taking account of both the chance that an accident might occur and the estimated consequences if it does occur.

The annual LCF risk to the receptors as a result of the accident scenario are presented in Table 5.10. The general public evaluation also included an analysis of a MEI at a child care center located 2 km (1.25 mi) to the east-southeast. No LCFs would be expected for any of the receptors. Because of uncertainties surrounding the release fractions for volatile or semivolatile isotopes, the change in risk resulting from higher release fractions for iodine-129 and H-3 (tritium) was evaluated. If an airborne release fraction of 1.0 and a respirable release fraction of 1.0 are assumed for iodine-129 and H-3, then the risk shown in Table 5.10 would increase by approximately 2.5 percent for each receptor.

Chemical Consequences from Accident Conditions

Chemical health hazards from the containerized waste fire were evaluated based on the corrosive/irritant effects and toxic effects. Chemicals within each group were assumed to be additive. This is a conservative assumption because many different chemicals affect different organs. Cumulative hazards for the corrosive/irritant and toxic chemicals were evaluated using the same methodology as previously presented in Section 5.1.2.2 for transportation accidents.

The following assumptions and parameters were used in calculating the chemical concentrations for the various receptors:

- Volume of waste that burns in two drums plus 5.8 percent of two additional drums = 0.44 m^3
- Density of the waste = 347 kg/m^3
- Weight of waste that burns = $152.6 \text{ kg} (0.44 \text{ m}^3 \cdot 347 \text{ kg/m}^3)$
- Hazardous chemicals in waste = 0.84 percent by weight or 1.28 kg

Table 5.10. Radiological Risk From Fire Scenario

Receptor	Dose (person-rem CEDE)	Dose-to-risk Conversion Factors (LCF/rem)	Annual Frequency	Total Project LCF Risk (LCF)
MEI-involved worker	6.4E-02 (rem)	4E-04	1.1E-04	2.8E-09
Noninvolved worker population	2.4E-02	4E-04	1.1E-04	1.1E-09
MEI-noninvolved worker	1.2E-04 (rem)	4E-04	1.1E-04	5.3E-12
General public	1.8E-02	5E-04	1.1E-04	9.9E-10
MEI-general public	3.4E-04 (rem)	5E-04	1.1E-04	1.9E-11
MEI child care center	1.3E-04 (rem)	5E-04	1.1E-04	7.2E-12

Notes:

CEDE = Committed effective dose equivalent

LCF = Latent cancer fatality

MEI = Maximally exposed individual

On-site population (200 persons = 100 persons at the LLW treatment facility and 100 persons at the MWF) is the sum of the involved workers and noninvolved workers at the ATG Facility. All 200 persons are assumed to receive the same dose as the MEI on-site receptor. This is conservative since it assumes all 200 persons are located 100 m (330 ft) down wind from the point of release.

LCF/rem are dose-to-risk conversion factors taken from Recommendations of the International Commissions on Radiological Protection (ICRP 1991). The difference in the on-site and off-site conversion factors is attributable to the presence of children off-site.

The annual frequency of the fire accident scenario is taken from Central Waste Complex Interim Safety Basis (HNF 1997).

The annual LCF risk is a point estimate risk and is the product of the dose (person-rem) dose-to-risk conversion factor (LCF/person-rem) annual frequency of occurrence of the accident.

- Respirable release fraction for combustible material = 5.0E-04 (DOE 1994). The release fraction is from DOE (1994), which is based on experimental data in which various types of packaged waste (e.g., paper, rags, tape, plastic, cardboard, and oil) contaminated with uranium dioxide powder, uranyl nitrate liquid, and air-dried uranyl nitrate were burned. Respirable release fraction is a combination of the airborne release fraction and the respirable fraction or the fraction of the material that is respirable.
- Respirable release fraction for noncombustible material = 6.0E-05 (DOE 1994)
- Combustible material in waste 65 percent
- Noncombustible material in waste = 35 percent

Therefore, the amount of respirable chemicals released in the fire is:

$$[(1.28 \text{ kg}) (5.0E-04) (0.65)] + [(1.28 \text{ kg}) (6.0E-05) (0.35)] = 4.4E-04 \text{ kg}$$

For the involved worker exposure, the material released is assumed to spread instantaneously and uniformly over a hemisphere 10 m (33 ft) in radius. The MEI is assumed to be located at the center of the hemisphere. The chemical concentration within a 10 m (33 ft) hemisphere is calculated using the following equation:

$$C(\text{mg}/\text{m}^3) = [Q (\text{kg})] \left(\frac{3}{2p r^3} \right) (1.0\text{E}+06 \text{ mg}/\text{kg})$$

Where:

- C = Concentration
- Q = Respirable quantity of hazardous chemicals released
- r = Assumed 10 m (33 ft) radius for distribution of source.

Therefore:

$$C = (4.4\text{E}-04 \text{ kg}) (4.77\text{E}-04/\text{m}^3) (1.0\text{E}+06 \text{ mg}/\text{kg}) = 2.1\text{E}-01 \text{ mg}/\text{m}^3$$

The chemical inventory involved in a potential fire was based on a breakdown of the Hanford Site LLMW by hazardous and toxic material constituents (Jacobs 1997). The chemicals were sorted into chemical classes and representative chemicals from each chemical class were selected that would best represent the class.

The air concentrations of the chemical classes are compared to the ERPGs in Table 5.11 (toxic concentration limits) and Table 5.12 (corrosive/irritant concentration limits). As shown in these tables, the accident would result in hazardous chemical concentrations that would be well below the ERPG-1 value, therefore, there would be no adverse effects to involved workers.

The atmospheric dispersion would dilute the concentration by the time it reached the general public; therefore, there would be no adverse effects to the general public.

Injuries, Illnesses, and Fatalities From Occupational Accidents

Occupational risks defined in the EA include nonradiological/nonchemical injuries, illnesses, and fatalities from operation accidents common to the workplace such as falls, cuts, electrical shocks, muscle strains, and operator-machine impacts.

The risk associated with an accident was defined as the product of the fatality or injury/illness incident rates and the number of workers at risk. The nonradiological/nonchemical occupational accidents would largely be a function of the number of person-years of labor required for operations of the non-thermal treatment facility. The more person-years of labor required, the more injuries, illnesses, and fatalities would occur.

The injury and illness incidence rates used in the analysis for construction and operations were based on the annual injury and illness reports for Washington State for the years 1985 through 1995 (BLS 1985, 1986, 1987, 1988, 1989, 1991, 1992a, 1993, 1994, 1995) and represent an 11-year average. The fatality rate used in the analysis is taken from the fatality report for Washington State (BLS 1992b). The incidence are summarized in Table 5.13 as well as the number of anticipated injuries, illnesses, and fatalities. There would potentially be 16 anticipated

Table 5.11. Comparison of Chemical Concentrations to Toxic Concentration Limits for Drum Fire Accident⁸

Analyte (Threshold values are presented in mg/m ³)	Exposure (mg/m ³)	ERPG-1 (mg/m ³)	ERPG-2 (mg/m ³)	ERPG-3 (mg/m ³)	
Solvent/Thinner Waste Stream¹					
Benzene ²	MEI	2.51E-02	Threshold Value		
			7.80E+01	1.57E+03	3.13E+03
			Ratio of Exposure to ERPG ⁷		
			3.2E-04	1.6E-05	8.0E-06
N-Butyl Alcohol ³	MEI	1.31E-02	Threshold Value		
			7.50E+01	7.50E+02	7.50E+03
			Ratio of Exposure to ERPG		
			1.8E-04	1.8E-05	1.8E-06
2-Hexanone ⁴	MEI	5.46E-03	Threshold Value		
			5.00E+01	5.00E+02	5.00E+03
			Ratio of Exposure to ERPG		
			1.1E-04	1.1E-05	1.1E-06
Petroleum/Coal Tar Derivatives⁵					
Tridecane ⁶	MEI	7.98E-02	Threshold Value		
			3.70E+01	1.45E+03	7.33E+03
			Ratio of Exposure to ERPG		
			2.2E-03	5.5E-05	1.1E-05
Total MEI ratios			2.8E-03	9.9E-05	2.2E-05

Notes:

ERPG = Emergency Response Planning Guideline values. ERPG values were obtained from the Hanford Environmental Health Foundation (Dentler 1995)

MEI = Maximally exposed individual

¹ Solvent/thinner waste stream represents 26 percent of the total hazardous chemicals. Aromatic solvents = 46 percent, glycols/glycol ethers/alcohols = 24 percent, and aliphatics = 10 of the solvent/thinner waste stream.

² Benzene used as a representative chemical for aromatic compounds.

³ N-butyl alcohol used as a representative chemical for glycols/alcohols.

⁴ 2-hexanone used as a representative chemical for aliphatics.

⁵ Petroleum/coal tar derivatives represents 38 percent of the total hazardous chemicals.

⁶ Tridecane (similar to kerosene) used as a representative chemical for petroleum and coal tar derivatives.

⁷ A ratio less than 1 indicates that the calculated exposure concentration is lower than the ERPG.

⁸ Because of uncertainties surrounding the release fractions for volatile or semi-volatile chemical compounds, exposure concentrations and ratios of exposure to ERPG threshold values were calculated using an airborne release fraction of 1.0 and a respirable release fraction of 1.0. The resulting ratio of exposure concentration to ERPG-1 would be an exceedence of 7.6. However, when the probability of the accident (1.1E-04) is taken into account the resulting risk would be 8.4E-04.

Table 5.12. Comparison of Chemical Concentrations to Corrosive/Irritant Concentration Limits for Transport Truck Accident ¹

Analyte (Threshold values are presented in mg/m ³)		Exposure Concentration (mg/m ³)	ERPG-1 (mg/m ³)	ERPG-2 (mg/m ³)	ERPG-3 (mg/m ³)
Solvent/Thinner Freon Waste Stream ^{1,5}					
Methylene Chloride 3,7	MEI	5.51E-02	Threshold Value		
			7.00E+02	3.48E+03	1.74E+04
			Ratio of Exposure to ERPG ¹²		
			7.9E-05	1.6E-05	3.2E-06
Metals/Metal Salts Waste Stream ³					
Sodium Silicate ⁵	MEI	2.31E-02	Threshold Value		
			5.80E+00	1.16E+02	2.90E+02
			Ratio of Exposure to ERPG		
			4.0E-03	2.0E-04	8.0E-05
Amine Waste Stream ⁷					
Ammonia ⁹	MEI	3.36E-03	Threshold Value		
			1.70E+01	1.40E+02	6.80E+02
			Ratio of Exposure to ERPG		
			2.0E-04	2.4E-05	4.9E-06
Caustic (Acids/Bases) Waste Stream ^{10,9}					
Sodium Hydroxide ¹¹	MEI	6.30E-03	Threshold Value		
			2.00E+00	4.00E+01	1.00E+02
			Ratio of Exposure to ERPG		
			3.2E-03	1.6E-04	6.3E-05
Total MEI Ratios			7.4E-03	4.0E-04	1.5E-04

Notes:

ERPG = Emergency response planning guideline values. ERPG values were obtained from the Hanford Environmental Health Foundation (Dentler 1995)

MEI = Maximally exposed individual

¹ Because of uncertainties surrounding the release fractions for volatile or semi-volatile chemical compounds exposure concentrations and ratios of exposure to ERPG threshold values were calculated using an airborne release fraction of 1.0 and a respirable release fraction of 1.0. The resulting ratio of exposure concentration to ERPG-1 would be less than 1 (6.3E-01). However, when the probability of the accident (1.1E-04) is taken into account the resulting risk would be 6.9E-05.

² Solvent/thinner waste stream represents 26 percent of the hazardous waste.

³ Methylene chloride used as a representative chemical for chlorinated solvents and represents 20 percent of the solvent/thinner waste stream.

⁴ Metals/metal salts waste stream represents 11 percent of the hazardous waste.

⁵ Sodium silicate used as a representative chemical for metals and metal salts.

⁶ Freon waste stream represents 0.25 percent of the hazardous waste.

⁷ Methylene chloride used as a representative chemical for freon.

⁸ Amine waste stream represents 1.6 percent of the hazardous waste.

⁹ Ammonia used as a representative chemical for amines.

¹⁰ Caustic (acids/bases) waste stream represents 3 percent of the hazardous waste.

¹¹ Sodium hydroxide used as a representative chemical for caustics.

¹² A ratio less than 1 indicates that the calculated exposure concentration is lower than the ERPG.

Table 5.13. Nonradiological/Nonchemical Occupational Accidents

Activity	Person-Years	Incidence Rate (incidence/100 person-year)	Incidences
Operations			
Total recordable injury/illness	150 person-year	10.8 injuries/illnesses	16 injuries/illnesses
Lost work day injury/illness	150 person-year	4.8 injuries/illnesses	7.2 injuries/illnesses
Fatalities	150 person-year	1.14E-02 fatalities	1.7E-02 fatalities

Notes:

The total recordable injury/illness incidence rate includes lost work day injuries/illnesses.
 Person-years represents 50 workers/year for 3 years of operation.

recordable injuries and illnesses from continuous facility operations over three years and no anticipated fatalities. These results are conservative because the waste stream evaluated in this EA would not require the full capacity of the stabilization facility.

County and State Emergency Response to Accidents

Washington State and Benton county are structured to respond to emergency conditions from operation accidents or transportation accidents that could potentially result in radiological or chemical releases to the environment. County and State emergency response plans have been developed and documented in a contingency plan that is a part of the RCRA Part B permit application. The purpose of this plan is to guide the emergency response actions of facility officials (in this case it would be the ATG emergency response organization) and agencies of the City of Richland, Benton and Franklin Counties, and Washington State. These plans reflect the assignment of responsibilities for off-site protective actions and the methods of communicating among the involved local and State agencies. An effective emergency response can reduce the severity of a postulated accident.

5.3 MIXED WASTE STORAGE

Commercial waste and DOE waste would be kept separate by treating in separate campaigns. Waste streams that are required to be kept separate for regulatory, technical, or administrative reasons would be stored, handled, and treated separately. Commercial and DOE generated wastes would be treated in separate campaigns to maintain waste stream segregation.

Waste storage capacities are summarized in Table 5.14. The waste containers proposed for the scope of work would include 55-gallon (gal.) and 85-gal. drums, 4 by 4 by 8 ft metal boxes, and B-25 boxes. The waste volumes per container are: 0.208 m³ for 55-gal. drums, 0.322 m³ for 85-gal. drums, 3.40 m³ for 4 by 4 by 8 ft metal boxes, and 2.55 m³ for B-25 boxes.

Waste storage is limited to the physical capacity of containers and facilities as well as by regulatory permit capacities and time limits. RCRA Part B permitted (or RCRA Interim Status) storage facilities are limited by the land disposal restrictions (LDRs) of 40 CFR 268. Untreated mixed waste is not allowed to undergo land disposal. For mixed waste, storage is limited to 1 year (40 CFR 268.50[c]). RCRA allows for temporary extensions due to unforeseen problems, with proper approval.

Table 5.14. Total Storage Capacities of Mixed Waste Storage Building

Building Location	Building Location	Storage Type	Container Type	Container Volume (ft ³)	Total Storage Volume (ft ³)
Pre-engineered building	Bulk raw waste storage area	Sea van storage	Sea van	2,560	5,120
		18-yd ³ roll-off box storage	Roll-off Box	486	1,944
		B-25 box storage	B-25 box	100	400
	Stabilized waste storage	Stabilized waste storage	B-25 box	100	800
		Stabilized waste storage	55-gal drum	7.3	1,051
		Stabilized waste storage	55-gal drum	7.3	1,051
		Stabilized waste storage	55-gal drum	7.3	6,307
		Stabilized waste storage	64 ft ³ box	64	4,608
		Stabilized waste storage	64 ft ³ box	64	576
Modular Waste Storage	Containerized raw wastes storage	Raw waste storage	55-gal drum	7.3	701
		Raw waste storage	85-gal drum	11.2	538
		Raw waste storage	55-gal drum	7.3	2,102
		Raw waste storage	85-gal drum	11.2	134
	Containerized reactive, Corrosive, ignitable waste storage	Reactive waste storage	55-gal drum	7.3	234
		Corrosive waste storage	55-gal drum	7.3	234
		Flammable/ignitable waste storage	55-gal drum	7.3	234

Source: ATG (1996).

The ATG mixed waste storage building would be managed in compliance with an approved spill prevention, control, and countermeasures (SPCC) plan, employing secondary containment, physical barriers between incompatible wastes, and routine inspections.

5.3.1 Hazardous Process Chemical Storage

Storage of hazardous process chemicals will be in accordance with Occupational Safety and Health Administration (OSHA) requirements and the SPCC plan. Hazardous process chemical storage within the ATG MWF would be limited to the amounts required to support daily operations, which in the case of hazardous wastes is equivalent to one to three days of processing. The reagent storage area and chemical handling procedures are designed to allow safe and effective operational access to the hazardous chemicals and to reduce impacts resulting from any spills. Safety measures for acids and bases prevent vapor or liquid contact with skin, eyes, and mucous membranes. Physical barriers will separate oxidizers and flammables/ combustibles. Other controls will include secondary containment, temperature controls, and ventilation.

5.4 NATURAL HAZARDS

The non-thermal treatment facility has been designed to meet or exceed uniform building code design standards. The facility design meets standards for Seismic Zone 3 and wind forces. Design standards for wind forces are generally more stringent than Seismic Zone 3 requirements for the facility, since they require the structure to withstand up to 113 km per hour (70 mi per hour) winds. The release of radiological and chemical constituents resulting from a seismic or high-wind event would require a beyond-design-basis accident. Beyond-design-basis accidents were not evaluated in this analysis.

Tanks and containers of liquids will be secured, to the extent feasible, to prevent overturning in a seismic event. Spill control measures are described in Section 5.3.

5.5 WATER RESOURCES

No effluent discharges to surface water bodies or groundwater would take place. All waste handling, storage, and treatment activities at the ATG MWF would take place within covered areas with a base having a secondary spill containment system, which would prevent releases to the environment that could potentially impact groundwater.

The 200 West Area, the ATG MWF site, and the transport route are not located within the 100- or 500-year flood plain.

In the unlikely event that a transportation accident occurred, appropriate Hazardous Waste Operation and Emergency Response procedures and protocols would be followed to prevent and significantly reduce infiltration into the soils to prevent migration to the groundwater system.

The ATG MWF would be equipped with a secondary spill containment system which collects the waste until it is detected and removed, preventing releases to the environment that could impact groundwater. This spill containment system would prevent spills from impacting surface water and/or groundwater.

The secondary containment system would have to fail in order for liquid waste to be released to the environment. In the unlikely event that such a failure occurred in conjunction with a hazardous materials spill, then a portion of the spill could be released to the ground surface. Normal hazardous material spill recovery procedures would be implemented to control and remediate the spilled material in that event. Based on this secondary containment system and the distance from the surface to the water table, impacts to groundwater are not analyzed in this EA.

5.6 BIOLOGICAL RESOURCES

No threatened or endangered species are known to exist or suspected to be present at the ATG property, and no ground-disturbing activities are planned at the 200 West Area as part of this action. Therefore, no impacts on such species are anticipated. Activities related to the proposed action at the 200 West Area primarily involve loading and unloading of wastes at existing waste storage facilities, which would not adversely affect the relatively few threatened or endangered species found at Hanford Site. Neither wetlands or sensitive habitats would be affected by the proposed action.

5.7 CULTURAL AND ARCHEOLOGICAL RESOURCES

Cultural and archeological resources are most likely to be found in areas that have not previously been disturbed or along shorelines and at elevated locations. Soil at the ATG Facility has been extensively disturbed by previous Site activities associated with construction and operation of the LLW treatment facility and agricultural production. The facility is not near shoreline areas (Columbia and Yakima Rivers) or elevated locations. A cultural resources review was part of the siting process for the ATG MWF conducted by the Washington State Department of Ecology (Ecology). This review found that the proposed MWF is not located within an archeological or historic site. Additionally, the Site is not located within proposed or existing historic districts (Ecology 1995). Therefore, the potential impacts to cultural and archeological resources are minimal.

5.8 SOCIOECONOMIC IMPACTS

No additional employees would be required at the Hanford Site 200 West Area. Approximately 50 employees would be added by ATG to operate the non-thermal treatment portion of the MWF. With an estimated population of approximately 200,000 in the two-county area, the addition of this number of jobs would be expected to have a minor effect on the economy of the area.

5.9 ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations," requires Federal agencies to identify disproportionately high and adverse effects on low-income and/or minority populations in terms of environmental effects and health effects. The analysis in this EA indicates that implementation of the proposed action would result in minimal impacts to the socioeconomic environment or to human health. It follows that there would not be disproportionately high or adverse impacts to minority or low-income populations.

5.10 CUMULATIVE IMPACTS

5.10.1 Radiation

The cumulative impacts from routine radiological air emissions from the ATG Facility, the Hanford Site, and the Washington Public Power Supply System Plant No. 2 are presented in Table 5.15. Radiological consequences from routine air emissions were previously evaluated for the MWF operating at design capacity while treating DOE and commercial waste streams in the SEPA EIS for treatment of LLMW (City of Richland 1998). The radiological doses from routine air emissions during the thermal treatment of DOE LLMW from the Hanford Site were evaluated (AES Environmental 1996). The highest cumulative population dose from the MWF (3.9E-02 person-rem/year) added to the population dose from the existing LLW facility would represent the total contribution from the ATG Facility from continuous operation of both the LLW and MWF facilities at maximum-design capacity. Because the LLW air emissions were assumed for the commercial LLMW analysis (City of Richland 1998), the annual population dose from the LLW stream would be 3.9E-02 person-rem. Therefore, the total population dose from the ATG Facility would be 7.8E-02 person-rem. The radiological doses from the non-thermal treatment of the waste stream evaluated in this EA would not be additive to the radiological doses from the ATG EIS because that analysis evaluated impacts from continuous facility operation at maximum design capacity. The population dose from Hanford Site operations during 1996 was 0.2 person-rem (PNNL 1997). The annual population dose from the nearby Washington Public Power Supply System Plant No. 2 is 0.7 person-rem/year (DOE 1996b). Therefore, the total population dose from the ATG Facility would result in a small incremental increase of approximately 9 percent of the population dose from the combined current operations at the nearby Hanford Site and commercial power generation. The incremental increase from the ATG Facility would result in an increase of approximately 40 percent of the population dose from Hanford Site operations in 1996. These population doses represent LCF risks of 3.9E-05 for the entire ATG Facility operating at maximum design capacity and 3.5E-04 from the Washington Public Power Supply System Plant No. 2.

Table 5.15. Cumulative Impacts from Routine Radiological Air Emissions

Contributor	Dose (person-rem/yr)	LCF/yr
ATG	7.8E-02	3.9E-05
Hanford Site	2.0E-01 ¹	1.0E-04
Supply System	7.0E-01	3.5E-04
Total Contribution	9.8E-01	4.9E-04

Notes:

¹Population dose from Hanford Site operations during 1996.

Supply System = Washington Public Power Supply System Plant No. 2

Because the LLMW treatment facility would process two different waste streams, DOE waste and commercial waste, the highest cumulative air impacts from the ATG Site would be a combination of the highest emissions from the proposed MWF and the emissions from the existing LLW treatment facility. Air permits will require both facilities to meet the 10 mrem/year at the nearest residence under the National Emission Standards for Hazardous Air Pollutants

(NESHAP). Last year the low-level treatment facility NESHAP estimate was 0.0012 mrem/year at the nearest residence.

The routine radiological dose from the MWF and LLW treatment facilities combined would not be expected to exceed 200 mrem/year per involved worker as used in the impact analyses. Based on this, there would be no cumulative radiological impacts to facility workers from routine radiological exposure.

5.10.2 Other Impact Areas

In addition to ATG waste treatment activities, there are other nuclear and industrial facilities with air emissions or direct radiation exposure near the ATG Site that could potentially contribute to the impacts described for the proposed action. These facilities include a commercial nuclear power plant (Washington Public Power Supply System Plant No. 2), a nuclear fuel production plant (Siemens Power Corporation), and a food processing facility (Lamb-Weston). A commercial radioactive waste burial site (US Ecology) and a commercial decontamination facility (Interstate Nuclear Services) would also have cumulative impacts from transportation and, to a lesser degree, air emissions with the ATG operations. All other impact areas to the natural and built environment not specifically identified were considered to be minor based on the impact discussions in previous sections; therefore, no cumulative impacts were calculated.

Air Quality

Because the LLMW treatment facility would process two different waste streams, DOE waste and commercial waste, the highest cumulative air impacts from the ATG Site would be a combination of the highest emissions from the proposed MWF and the emissions from the existing LLW treatment facility. Other industrial facilities in the local area also would be releasing air pollutants, and the emissions from the ATG Facility would add to the cumulative total in the region. There are no indications that the incremental air emissions from the proposed ATG Facility would result in violations of Federal or State air quality standards because air quality monitoring from the surrounding area indicates that pollutant levels are well below levels of regulatory concern.

Transportation

Transporting untreated waste from the Hanford Site to the ATG Site would require approximately 16 shipments per year, and transporting treated waste from the ATG Site to the Hanford Site would require approximately 20 shipments per year. These shipments in combination with the approximately 50 ATG non-thermal treatment workers commuting to and from the ATG Site would be approximately 1 percent of the 3,000 vehicles per hour projected for peak morning traffic volumes on Stevens Drive near the 1100 Area in 1999 (DOE 1996b).

5.11 IMPACTS OF ALTERNATIVES TO THE PROPOSED ACTION

5.11.1 No Action

Under the No Action alternative, there would be no impacts from transporting or treating the waste. The No Action alternative would however result in potentially larger radiological doses associated with long-term monitoring and storage of the waste.

5.11.2 Other Action Alternatives

Although not analyzed in detail, impacts of treating this waste under the other alternatives would be expected to be higher due to increased transportation impacts for both routine and accident conditions associated with transporting the untreated and treated waste over longer distances. There would be an increased accident probability due to a lack of access controls over much of the transportation route and longer travel times. It is assumed that waste treatment actions under the other action alternatives would be similar and would result in similar operational impacts to those identified for the ATG MWF.