5.11 Human Health and Safety Impacts

Health impacts to workers and the public are presented in this section. The methods used to estimate health impacts from radiological and chemical sources are described in Appendix F. The health impacts included in this section are those related to

- airborne release of radionuclides and chemicals from routine and accident conditions (excluding transportation)
- waterborne releases (via groundwater) over the long term
- construction activities
- operations
- fugitive releases of criteria pollutants
- inadvertent intrusion into disposal facilities.

Potential health effects included in this section are for the following populations of individuals:

1. construction workers – workers involved with construction activities
2. involved workers – workers directly involved in the activity being discussed
3. non-involved workers – workers physically near the activity being discussed, but not directly involved in the activity
4. maximally exposed individual (MEI) from atmospheric release – hypothetical member of the public who receives, through airborne emissions, the highest health impacts from onsite activities
5. maximally exposed individual from waterborne releases – hypothetical member of the public who receives, through waterborne emissions, the highest health impacts from onsite activities
6. local populations – the populations within 50 miles (80 km) of the center of the Hanford Site that are exposed to airborne releases
7. downstream populations – the entire populations of Pasco, Kennewick, and Richland (Tri-Cities), Washington, and downstream populations represented by Portland, Oregon
8. maximally exposed individual from inadvertent intrusion into disposal facilities – hypothetical individual receiving the highest impacts following inadvertent intrusion into the disposal facilities.

Impacts from construction activities include injuries to workers and impacts on air quality. Details of the air quality impact analysis for construction are presented in Section 5.2. The analysis of impacts on water quality (from waterborne releases to groundwater) is described in Section 5.3. Those sections compare air and water concentrations to appropriate limits. Results from those analyses have been extended to the estimates of human health impacts that are presented in this section. The analysis of impacts from potential releases and exposures to radionuclides and chemicals as a result of transportation of wastes is described in Section 5.8.

Health impacts are presented by alternative groups and are based on conservative assumptions used in this EIS. The methods, assumptions, and related information for routine release assessment and accident analysis are provided in Appendix F.

Construction worker injuries are estimated using standard construction worker accident rate information (described in Section 4.10) and the construction workforce projections for each facility that involve construction for a given alternative. The analysis includes all of the operations involving construction for each alternative. Consideration is also given to the type of construction activity (that is, heavy equipment operation versus building construction). Worker injuries during normal operations are evaluated using incident rates for industrial accidents.

Radiation doses as a total effective dose equivalent (TEDE) for workers involved in waste management activities were estimated using historical worker dose rates for Hanford facilities and the projection of the workforce involved (FH 2003).

Releases of radionuclides and chemicals to the atmosphere are evaluated for each solid waste facility based on the projected waste throughput volumes. Estimates are made of the annual release of pollutants to the atmosphere based on these processing volumes, the concentration of radionuclides and chemicals, and the release fractions for each facility. These release rates are used to estimate air concentrations at points of maximum exposure for the onsite worker and the offsite MEI. Individuals are assumed to be exposed to these transported pollutants through exposure pathways defined for each of two hypothetical exposure scenarios: industrial and resident gardener. The industrial scenario is used to evaluate the maximum health impacts for onsite, non-involved workers who are assumed to be located at 100 m (329 ft) from the release point. This distance represents a reasonably close point for a permanent work location (for example, a nearby building) for an individual not associated with the facility from which the releases occur. The 100-m (329-ft) distance also allows for elevated release plumes to reach near the ground providing the potential for exposure for the individual (at shorter distances from the source the plume might miss the individual entirely). The resident gardener scenario is used to evaluate potential public exposures. The resident gardener is located 20.6 km (13 mi) east-southeast of the 200 Areas, which is approximately across the Columbia River from the 300 Area and is approximately the location of the MEI for recent estimates from sitewide releases (see Figure 5.27). Consequences from accidental releases are based primarily on previously reported accident assessments for the facilities involved in the alternatives.

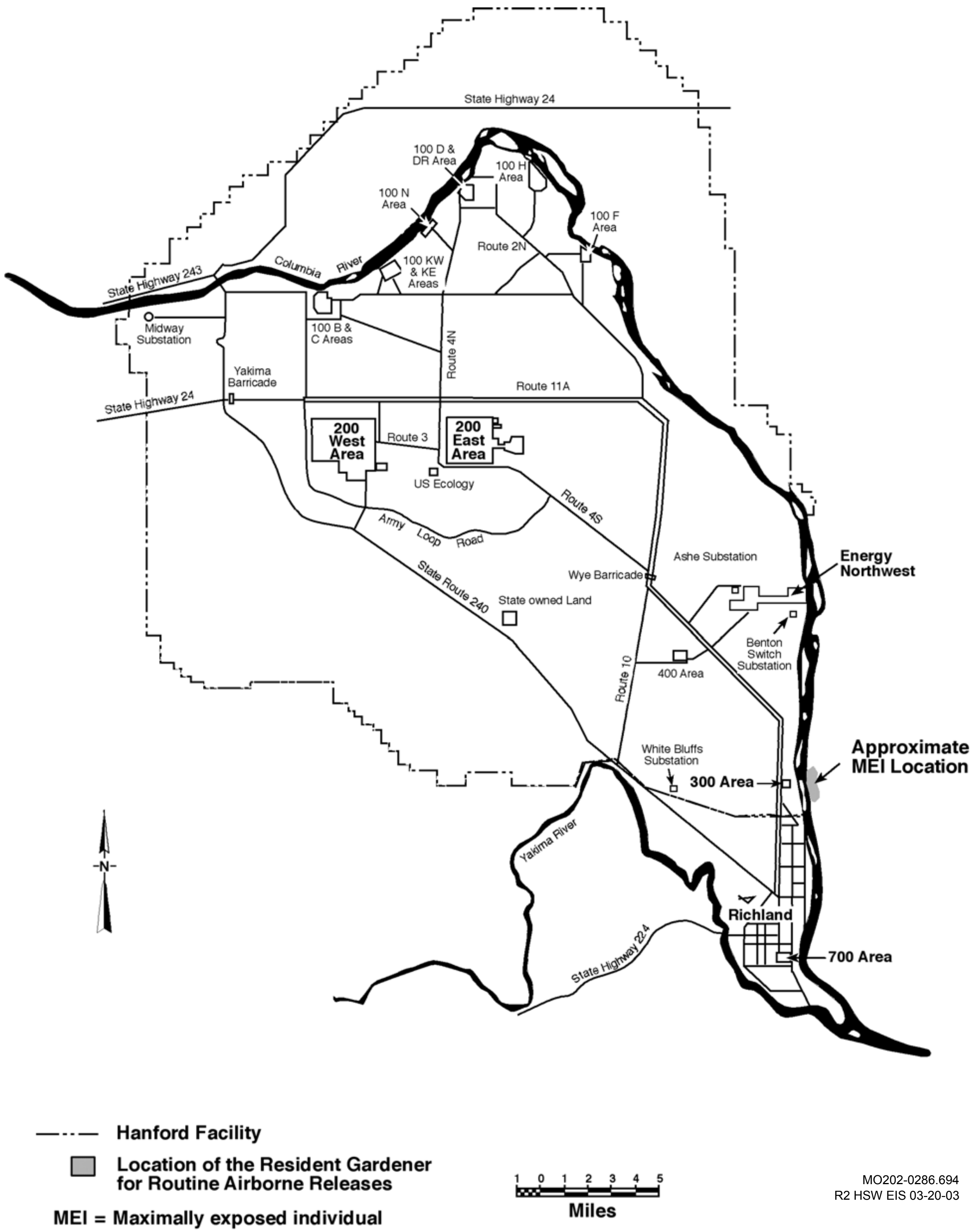

Figure 5.27. Location of the Resident Gardener for Routine Airborne Releases

Releases of radionuclides and chemicals to the unsaturated soil beneath the Hanford solid waste disposal facilities in the 200 Areas would occur as the waste packages degrade and water seeps through the waste. The movement of pollutants from these releases to the affected environment has been analyzed and described in Section 5.3. Users of the groundwater down-gradient from the waste disposal facilities may be exposed to contaminants in the water. Potential human health impacts from use of such groundwater were estimated for four locations. The first three are hypothetical wells (or points of analysis) located 1 km down-gradient from the HSW disposal facilities. The fourth location is a well (point of analysis) near the Columbia River[a], a representative point of access by a resident gardener, and the location where the peak water concentrations are predicted. These wells correspond to points of analysis used for groundwater analyses as addressed in Section 5.3 and detailed in Appendix G. A specific location is not defined because the location of the peak water concentration changes over time. For these locations, the resident gardener is assumed to live at the location and use the well as the source of all domestic and irrigation water. Details of these exposure scenarios are presented in Appendix F, Section F.1.4.

The impacts to populations downstream of Hanford have also been evaluated for Tri-Cities, Washington, and Portland, Oregon. The entire populations of the cities were assumed to use the Columbia River as the sole source of drinking water (presently not the case for Portland nor for the Tri-Cities). The concentration in the river is based on the total amount of radionuclides reaching the river over the next 10,000 years, as evaluated for the water quality analysis of Section 5.3. The release to the river is diluted in the average Columbia River flow rate at two exposure locations of about 3300 m^3/sec in the Tri-Cities and about 5300 m^3/sec in Portland.

Results of the consequence analyses are presented as annual radiation dose and lifetime radiation dose for individual exposures, as well as cumulative radiation dose for population exposures. The associated human health impacts are represented as the lifetime risk of a latent cancer fatality (LCF) [b] based on guidance from the DOE for evaluations related to NEPA (DOE 2002a). For workers, the LCF estimates are based on a conversion factor of 0.0006 LCFs per person-rem TEDE. For the public, the estimates are also based on 0.0006 LCFs per person-rem TEDE.

For radiological accidents discussed in the HSW EIS, the doses estimated for some hypothetical events may be greater than the doses to which the health effects coefficient was intended to apply. Depending on the radionuclides involved and the exposure pathways considered, the LCF risk may be up to twice that indicated by the LCF conversion factors for doses greater than 20 rem but less than a few hundred rem. For doses greater than a few hundred rem, there is a potential for short-term health effects other than cancer and hereditary effects, again, depending on the radionuclides and exposure pathways associated with a particular accident scenario. Additional information on the basis for radiological health consequences is given in Appendix F. For further discussion of related uncertainties see Section 3.5.

(a) Although water might be drawn directly from the river for irrigation, it would be likely that well water would be used for domestic purposes.

(b) For an individual, the probability of an LCF cannot exceed one (certainty). Similarly, the number of LCFs among population groups occurs as whole numbers; the calculated value is given in parentheses. This calculated value represents an inferred incremental contribution to total cancer deaths in the exposed population.

The routine operations health impacts from carcinogenic chemicals are presented as the lifetime risk of cancer incidence from exposure in the given scenario. For non-carcinogenic chemicals, the impacts are expressed as a hazard quotient. Both types of impacts are presented as the sum over all chemicals in the release of the given type. A hazard quotient of one represents an exposure level that is considered safe for most members of the population (EPA 1991). A value greater than one may represent an exposure that is detrimental to public health.

The health impacts to workers from chemicals due to accidents are evaluated by comparing chemical air concentrations to the emergency response planning guideline (ERPG), or the temporary emergency exposure limit (TEEL). These are described in Appendix F. Although ERPGs are the official, preferred measure, ERPGs have not been established for many chemicals. Where ERPGs were not available, the TEELs were used.

The following sections present details of the human health impacts analyses for the six alternative groups considered in the HSW EIS. For a summary comparison of impacts among the alternatives, see Table 3.6 in Section 3.6. The impacts from the operational phase are presented for all alternative groups in Section 5.11.1, followed by the long-term health impacts resulting from contaminant transport through the groundwater (Section 5.11.2).

5.11.1 Operational Human Health and Safety Impacts

The impacts from the operational phase are presented by alternative group in the following sections.

5.11.1.1 Alternative Group A

The following sections present the potential human health impacts for Alternative Group A for the Hanford Only, Lower Bound, and Upper Bound waste volumes.

5.11.1.1.1 Construction

Primary impacts from construction activities would be air quality and injuries to construction workers. The construction activities would result in the emission of criteria pollutants (40 CFR 50) from the use of combustion engines and earthmoving activities. Impacts are measured by comparison of air concentrations with regulatory limits at the point of maximum potential public exposure. The air quality analysis (Section 5.2) indicates that maximum emissions of all criteria pollutants (including sulfur dioxide, carbon monoxide, nitrogen dioxide, and particulate material [PM_{10}]) from construction activities would result in air concentrations below the regulatory limits. As a consequence, no impacts on public health from emissions would be expected. Impacts from industrial accidents during construction are discussed in Section 5.11.1.1.3.

5.11.1.2 Normal Operations

Potential impacts to public health from normal operations include impacts from atmospheric releases of radionuclides and chemicals from solid waste management operations. Radiation doses for workers involved with waste management operations are also evaluated.

Alternative Group A involves operations that may result in routine releases of radionuclides and chemicals to the atmosphere. These operations include waste package verification, treatment, and packaging at the Waste Receiving and Processing Facility (WRAP), treatment and packaging of waste at the modified T Plant Complex; and treatment of leachate from mixed low-level waste (MLLW) trenches using pulse driers. The annual releases have been estimated for each year of operation for the facilities involved in this alternative. Details of the release calculations are presented in Appendix F, Section F.1.

5.11.1.2.1.1 Health Impacts from Routine Radionuclide Releases

Tables 5.27, 5.28, and 5.29 display the calculated doses and health impacts to non-involved workers and the public from routine atmospheric releases of radionuclides for the Hanford Only, Lower Bound, and Upper Bound waste volumes, respectively. The tables present the maximum annual dose to the non-involved workers and the public, the cumulative dose to the public, and the associated risk of LCF for these exposures occurring during the period covered by Alternative Group A. Given that the cancer risk estimates and doses are small in comparison to regulatory limits,[a] no adverse health impacts would be expected from radionuclide releases.

5.11.1.2.1.2 Health Impacts from Chemical Releases

Releases of chemicals to the atmosphere could occur from the same waste processes involving radionuclide release when wastes with hazardous chemicals are involved. The potential health impacts from chemical releases to the atmosphere are presented in Table 5.30 for all waste volumes. The results for the Hanford Only waste volume are the same as those for the Lower Bound waste volume because the processing volumes for mixed waste streams are nearly identical for both cases (only mixed wastes contain chemicals that may be released to the atmosphere). Because the peak hazard quotients are all less than 1, and because the cancer risk estimates are small, minimal adverse health impacts would be expected from chemical releases. Chemical releases from leachate treatment using a pulse drier are believed to be small compared to other processing (for example, WRAP) and are not included in the analysis of chemical health impacts.

5.11.1.2.1.3 Worker Occupational Radiation Exposure

The radiation dose received by workers involved with waste operations is estimated using historical exposure data for the facilities involved in the alternative (FH 2003). The exposure to involved workers is summarized in Table 5.31 for the Hanford Only waste volume, in Table 5.32 for the Lower Bound

(a) The maximum annual radiation dose presented in this section may be compared to the regulatory limit of 10 mrem/year (DOE 1993; WAC 246-247; 40 CFR 61).

waste volume, and in Table 5.33 for the Upper Bound waste volume. The worker category "Other" includes engineers, maintenance and construction personnel, and general support staff (for example, administrative and clerical workers). All estimated radiation doses to workers are well below regulatory limits.[(a)]

Table 5.27. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Hanford Only Waste Volume

Exposed Group	Exposure Scenario[(a)]	Facility	Lifetime Dose[(b)] (mrem)	Probability of an LCF[(c)]	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.2E-03	7E-10	2004	1.3E-05
		Modified T Plant Complex	4.8E-01	3E-07	2003	3.9E-02
		Leachate Treatment[(d, e)]	4.3E-07	3E-13	2026	3.2E-09
MEI Offsite	Resident Gardener	WRAP	9.9E-05	6E-11	2004	1.1E-05
		Modified T Plant Complex	1.5E-03	9E-10	2003	1.1E-04
		Leachate Treatment	3.0E-11	2E-17	2026	1.6E-12
		Total	1.6E-03	1E-09	2003	1.2E-04
			(person-rem)	**Number of LCFs[(g)]**	**Year**	**(person-rem)**
Population[(f)]	Population within 80 km (50 mi)	WRAP	9.1E-03	0 (5E-06)	2004	7.4E-04
		Modified T Plant Complex	1.4E-01	0 (8E-05)	2003	7.4E-03
		Leachate Treatment	2.1E-09	0 (1E-12)	2026	1.1E-10
		Total	1.5E-01	0 (9E-05)	2003	8.1E-03

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) Leachate treatment is a pulse drier operation.
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

(a) The annual limit for occupational exposures is 5000 mrem/year (10 CFR 835).

Table 5.28. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Lower Bound Waste Volume

Exposed Group	Exposure Scenario[a]	Facility	Lifetime Dose[b] (mrem)	Probability of an LCF[c]	Maximum Annual Dose Year	Maximum Annual Dose mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.4E-03	9E-10	2004	1.6E-04
		Modified T Plant Complex	5.8E-01	3E-07	2003	4.8E-02
		Leachate Treatment[d, e]	1.3E-07	8E-14	2026	7.4E-09
MEI Offsite	Resident Gardener	WRAP	1.2E-04	7E-11	2004	1.3E-05
		Modified T Plant Complex	1.7E-03	1E-09	2003	1.2E-04
		Leachate Treatment	6.8E-11	4E-17	2026	3.6E-12
		Total	1.8E-03	1E-09	2003	1.3E-04
			(person-rem)	**Number of LCFs[g]**	**Year**	**(person-rem)**
Population[f]	Population within 80 km (50 mi)	WRAP	1.1E-02	0 (6E-06)	2004	8.8E-04
		Modified T Plant Complex	1.6E-01	0 (9E-05)	2003	8.5E-03
		Leachate Treatment	6.2E-09	0 (4E-12)	2026	2.5E-10
		Total	1.7E-01	0 (1E-04)	2003	9.4E-03

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) Leachate treatment is a pulse drier operation.
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.29. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group A, Upper Bound Waste Volume

Exposed Group	Exposure Scenario[(a)]	Facility	Lifetime Dose[(b)] (mrem)	Probability of an LCF[(c)]	Maximum Annual Dose	
					Year	**mrem**
Worker Onsite (non-involved)	Industrial	WRAP	2.2E-03	1E-09	2004	1.9E-04
		Modified T Plant Complex	8.9E-01	5E-07	2006	7.2E-02
		Leachate Treatment[(d, e)]	1.9E-07	1E-13	2026	1.1E-08
MEI Offsite	Resident Gardener	WRAP	2.1E-04	1E-10	2004	1.6E-05
		Modified T Plant Complex	2.3E-03	1E-09	2006	1.7E-04
		Leachate Treatment	8.4E-11	5E-17	2026	4.5E-12
		Total	2.5E-03	1E-09	2006	1.9E-04
			(person-rem)	**Number of LCFs[(g)]**	**Year**	**(person-rem)**
Population[(f)]	Population within 80 km (50 mi)	WRAP	1.9E-02	0 (1E-05)	2004	1.1E-03
		Modified T Plant Complex	2.2E-01	0 (1E-04)	2006	1.5E-02
		Leachate Treatment	7.6E-09	0 (5E-12)	2026	3.1E-10
		Total	2.4E-01	0 (1E-04)	2006	1.6E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) Leachate treatment is a pulse drier operation.
(e) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(f) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(g) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.30. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Chemicals – Alternative Group A, All Waste Volumes

Volume	Exposed Group	Exposure Scenario[a]	Facility	Risk of Cancer Incidence[b]	Peak Annual Hazard Quotient[c]
Hanford Only and Lower Bound	Worker Onsite (non-involved)	Industrial	WRAP	1.2E-09	8.9E-05
			Modified T Plant Complex	3.2E-08	2.3E-03
	MEI Offsite	Gardener	WRAP	5.6E-11	3.4E-06
			Modified T Plant Complex	6.1E-11	7.2E-06
			Total	1.2E-10	1.1E-05
	Population	Population within 80 km (50 mi)	WRAP	0 (5E-06)[d]	NA[e, f]
			Modified T Plant Complex	0 (6E-06)[d]	NA
			Total	0 (1E-05)[d]	NA
Upper Bound	Worker Onsite (non-involved)	Industrial	WRAP	5.3E-09	6.9E-04
			Modified T Plant Complex	1.8E-07	2.4E-03
	MEI Offsite	Gardener	WRAP	2.3E-10	2.5E-05
			Modified T Plant Complex	2.0E-10	2.5E-05
			Total	4.2E-10	5.0E-05
	Population	Population within 80 km (50 mi)	WRAP	0 (2E-05)[d]	NA[e, f]
			Modified T Plant Complex	0 (2E-05)[d]	NA
			Total	0 (4E-05)[d]	NA

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The individual risk of cancer incidence is evaluated for the exposure duration defined for the given exposure scenario starting in the year that provides the highest total impact.
(c) Hazard quotients are reported for the year of highest exposure.
(d) Population risk from cancer is expressed as the inferred number of fatal and non-fatal cancers in the exposed population over the lifetime of the population from intakes during the remediation period. The actual value must be a whole number (cancers).
(e) Hazard quotients are designed as a measure of impacts on an individual and are not meaningful for population exposures.
(f) NA = not applicable.

Table 5.31. Occupational Radiation Exposure – Alternative Group A, Hanford Only Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCF[c]
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002- 2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002- 2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033- 2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
Modified T Plant Complex	2002- 2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033- 2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	8	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026- 2077	Operator	0.4	54	1.1	0 (7E-04)
Total					765	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

Table 5.32. Occupational Radiation Exposure – Alternative Group A, Lower Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCF[c]
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002- 2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002- 2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033- 2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
Modified T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	8	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	0.8	54	2.2	0 (9E-04)
Total					766	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

1 **Table 5.33**. Occupational Radiation Exposure – Alternative Group A, Upper Bound Waste Volume
2

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (Person-rem)	Workforce LCF[c]
LLW and MLLW Trenches	2002- 2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	32	13	1.9	0 (1E-03)
Modified T Plant Complex	2002-2032	Operator	20	9	5.5	0 (3E-03)
		RCT	18	13	7.4	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
	2013 – 2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	20	34	12	0 (7E-03)
		RCT	13	35	8.2	0 (5E-03)
	2020-2026	Operator	7	34	1.7	0 (1E-03)
		RCT	5	35	1.2	0 (7E-04)
	2027-2044	Operator	3	34	1.8	0 (1E-03)
		RCT	2	35	1.3	0 (8E-04)
Pulse Driers	2026-2077	Operators	1.2	54	3.3	0 (2E-03)
Total					774	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

5.11.1.2.2 Accidents

The impacts of accidents involving radiological and chemical contaminants and industrial accidents are evaluated in this section. Waste management operations would involve a continuing potential for industrial accidents and accidental release of contaminants in four Hanford facilities: (1) the Central Waste Complex (CWC) for waste storage, (2) the WRAP for waste treatment, (3) the T Plant Complex (or similar new waste processing facility) for waste treatment, and 4) the HSW disposal facilities for waste disposal. Accident information for each of these facilities is presented in the sections that follow. Additional information on radiological and chemical accidents is provided in Appendix F, Section F.2 (including adjustments methods used to derive radiological consequence data).

Non-radiological consequences were evaluated by comparing estimated air concentrations to the TEEL or the ERPG for a given chemical. Additional information, including definitions of ERPG/TEEL levels, is presented in Appendix F.

Human health and safety impacts to workers actually involved in accidents (involved workers) are addressed in the general sense and not for each particular facility or potential accident for any of the alternative groups because the potential consequences would be highly variable, ranging from no effect to a fatality for one or more workers. The most likely consequence for any involved worker would be no or small impact. Workers involved in an accident could receive physical injuries or be killed during an accident, receive a range of radiation doses (none likely to be fatal), or be exposed to a range of hazardous chemical concentrations that could be high but of relatively short duration and, again, thought unlikely to be fatal. The reason for an optimistic outlook on radiation dose or chemical exposure for the involved worker under accident conditions is that in situations where there is a potential for radioactive or chemical risks, additional precautions are taken and workers are typically accompanied by a health physics technician.

The greatest likelihood of worker fatalities would be from physical trauma received during an accident. For example, the drum explosion and ion exchange module explosion accidents could result in involved worker fatalities if the workers were in the explosion blast zone. Most accidents would involve only one or two workers; the exception would be low probability, beyond-design-basis seismic events where a number of involved workers could be affected. Depending on the type of facility, worker location, and time of accident, zero to perhaps a dozen worker fatalities could result. Burial ground workers would probably be the least affected by extensive seismic structural damage for the types of facilities considered. Similarly, CWC workers would be more likely to avoid obstacles and debris and exit the facilities since there are no massive storage structures in this area. Workers in other waste management facilities could be more affected by falling debris as a result of extensive seismic damage.

Anticipated health impacts to all workers from industrial accidents during construction and operations would be 620 to 640 total recordable cases, 260 lost workday cases, and 8900 to 9200 lost workdays. A total of about 20,600 to 21,200 worker-years would be required to complete all activities over the operational period. Of that total, about 2800 to 3400 worker-years are for site support and waste generator services that do not appear in the direct facility worker and impact estimates in the following sections. About 97 to 99 percent of these health impacts are from operations.

5.11.1.2.3 Storage – CWC

No new storage would be needed at the CWC under Alternative Group A; therefore, no new construction would be required. Operations would continue at existing levels during the near-term, possibly increasing then declining as completion of waste processing is approached.

Radiological Consequences. Six accident scenarios involving radioactive material at the CWC were evaluated as part of the Interim Safety Basis (Vail 2001a). These accidents were a handling/forklift-caused drum failure, a drum-handling fire, a flammable gas explosion, a truck impact and fire, a design-basis earthquake, and a beyond-design-basis earthquake. They were selected for analysis using a hazard identification and assessment process and have estimated annual frequencies of occurrence ranging from 0.11 per year to 4E-06 per year, categorized as Anticipated and Extremely Unlikely, respectively. Accident consequences shown in terms of radiation dose and potential LCFs are presented in Table 5.34.

The largest consequences to the offsite MEI would be from a beyond-design-basis earthquake. This MEI would receive a dose of about 13 rem and have a 8E-03 probability of an LCF. This accident would also result in the largest consequences to the population. About 30 LCFs would be expected. LCFs in the population would be expected for all analyzed accidents except a handling/forklift drum failure.

The largest consequences to a non-involved worker would be from the truck impact and fire and the beyond-design-basis earthquake accidents. The non-involved worker would receive a dose of about 4900 rem and 5900 rem, respectively. Both of these doses would likely result in a fatality.

Table 5.34. Radiological Consequences of Accidents at the CWC

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number of LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Handling/Forklift Drum Failure	1.1E-01	0.0026	2E-06	11.5	0 (7E-03)	1.2	0.0007
Drum Handling Fire	1.1E-04	0.7	4E-04	3000	2	310	0.2
Flammable Gas Explosion	4.2E-04	1.0	6E-04	4300	3	460	0.3
Truck Impact and Fire	4.0E-06	11.0	6E-03	47,000	30	4900	(d)
Design-Basis Earthquake	3.3E-03	1.1	6E-04	4700	3	480	0.3
Beyond-Design-Basis Earthquake	(c)	13	8E-03	56,000	30	5900	(d)

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) Not quantified in reference but frequency less than design-basis earthquake.
(d) This accident would likely result in a fatality.

Non-Radiological (Chemical) Consequences. Given that MLLW is also stored in the CWC, non-radioactive hazardous materials may be involved in the same accident scenarios as radioactive materials. The radiological accident analysis determined that two accidents having the largest consequences are the flammable gas explosion and the truck impact and fire accidents. Potential non-radiological consequences of these two accident scenarios were assumed in the safety analysis (Vail 2001a) to provide a reasonable upper limit for all accidents. Accident consequences are presented in Table 5.35, which shows the ratio of estimated concentrations to TEEL values. A value less than 1 indicates an acceptable condition. A blank ratio in the table indicates a more restrictive TEEL level was previously met (for example, the ratio was less than 1) and evaluation of higher TEEL-level ratios is unnecessary.

The air concentration at the location of the offsite MEI would be well below the TEEL/ERPG-1 level for all chemicals except beryllium. The air concentration at the location of the MEI would exceed the TEEL/ERPG-1 level beryllium because of the truck impact and fire accident. A hypothetically exposed individual would not be expected to experience or develop irreversible or other serious health effects or symptoms that might impair his or her ability to take protective action. No impacts would be expected.

For the onsite non-involved worker, the TEEL/ERPG-3 level might be exceeded for beryllium for both of these accidents. This individual may experience or develop a life-threatening effect. TEEL/ERPG-2 levels might also be exceeded for mercury, lead, potassium hydroxide, phosphoric acid, and sodium hydroxide. An individual might experience or develop irreversible or other serious health effects or symptoms that might impair his or her ability to take protective action. The TEEL/ERPG-1 levels might also be exceeded for cadmium, nitric acid, and hydrofluoric acid.

Like the radiological consequences to involved workers, non-radiological consequences could be highly variable—ranging from no exposure to high concentrations of chemicals—depending upon whether or not a worker were directly in the plume of immediately released material, and for how long.

Industrial Accidents-Construction. No new construction would take place at the CWC under Alternative Group A, and no industrial accidents from construction would occur.

Industrial Accidents-Operations. Direct operations staffing in the CWC would total 3200 worker-years. Estimated health and safety impacts would be 85 total recordable cases, 36 lost workday cases, and 1200 lost workdays.

Table 5.35. Non-Radiological Air Concentrations for Accidents at the CWC

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Drum Explosion											
Ammonium fluoride	1.0E+00	2.3E-03	2.5	2.5	40	4.2E-01			9.3E-04		
Ammonium nitrate	1.0E+00	2.3E-03	10	10	500	1.0E-01			2.3E-04		
Ammonium sulfate	2.1E+00	4.5E-03	125	500	500	1.7E-02			3.6E-05		
Beryllium	7.7E-01	1.6E-03	0.005	0.025	0.1	1.5E+02	3.1E+01	7.7E+00	3.3E-01		
Carbon tetrachloride	4.9E+00	1.1E-02	125	600	4000	4.0E-02	8.2E-03		8.5E-05		
Hydrofluoric acid	7.0E+00	1.5E-02	1.5	15	40	4.7E+00	4.7E-01		1.0E-02		
Nitric acid	8.2E+00	1.7E-02	2.5	12.5	50	3.3E+00	6.5E-01		7.0E-03		
Phosphoric acid	7.0E+00	1.5E-02	3	5	500	2.3E+00	1.4E+00	1.4E-02	5.2E-03		
Potassium hydroxide	7.5E+00	1.6E-02	2	2	150	3.8E+00	3.8E+00	5.0E-02	8.2E-03		
Sodium hydroxide	1.0E+01	2.1E-01	0.5	5	50	2.1E+01	2.1E+00	2.1E-01	4.3E-01		
Sulfuric acid	4.4E-01	9.7E-04	2	10	30	2.2E-01			4.8E-04		
Truck Impact and Fire											
Ammonium fluoride	3.5E-01	7.4E-04	2.5	2.5	40	1.4E-01			3.0E-04		
Ammonium nitrate	3.5E-01	7.4E-04	10	10	500	3.5E-02			7.4E-05		
Ammonium sulfate	6.8E-01	1.4E-03	125	500	500	5.4E-03			1.2E-05		
Beryllium	6.0E+00	1.4E-02	0.005	0.025	0.1	1.2E+03	2.4E+02	6.0E+01	2.7E+00	5.4E-01	
Carbon tetrachloride	1.6E+00	3.5E-03	125	600	4000	1.2E-02			2.8E-05		
Hydrofluoric acid	2.3E+00	4.9E-03	1.5	15	40	1.5E+00	1.5E-01		2.5E-03		
Nitric acid	1.0E+01	2.1E-02	2.5	12.5	50	4.2E+00	8.3E-01		8.5E-03		
Phosphoric acid	2.3E+00	4.9E-03	3	5	500	7.5E-01			1.6E-03		
Potassium hydroxide	2.4E+00	5.3E-03	2	2	150	1.2E+00	1.2E+00	1.6E-02	2.7E-03		
Sodium hydroxide	1.4E+01	3.0E-02	0.5	5	50	2.8E+01	2.8E+00	2.8E-01	6.0E-02		
Sulfuric acid	1.4E-01	3.1E-04	2	10	30	6.9E-02			1.5E-04		
Mercury	1.7E+00	3.8E-03	0.025	0.1	10	6.9E+01	1.7E+01	1.7E-01	3.8E-02		
Cadmium	1.7E+00	3.8E-03	0.03	4	9	5.8E+01	4.3E-01		1.3E-01		
Polychlorinated biphenyls (PCBs)	3.5E-01	7.5E-04	3	5	5	1.2E-01	6.9E-02		2.5E-04		
Lead	1.7E+00	3.8E-03	0.15	0.25	100	1.2E+01	6.9E+00	1.7E-02	2.5E-02		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

5.11.1.2.3.1 Treatment – Waste Receiving and Processing Facility

Radiological Consequences. Seven accident scenarios involving radioactive material at the WRAP were evaluated in the WRAP Final Safety Analysis Report (Tomaszewski 2001). These accident scenarios were a handling/forklift drum failure, a drum handling fire, a container handling explosion, a fire in a process enclosure (glovebox), an explosion in process enclosure (glovebox), design-basis earthquake, and beyond-design-basis earthquake. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence are described qualitatively and quantitatively. The frequencies of occurrence range from anticipated (with an associated annual frequency range of 1 to 0.01) to a much lower frequency for the beyond-design-basis earthquake. Accident consequences, shown in terms of radiation dose and potential LCF, are presented in Table 5.36.

The largest consequences to the MEI would be from a beyond-design-basis earthquake. The MEI would receive a dose of about 1.1 rem and have a 7E-04 probability of an LCF. Six of the seven accidents examined would result in one to three LCFs in the population.

The largest consequences to a non-involved worker would be from a beyond-design-basis earthquake. The non-involved worker would receive a dose of about 500 rem and have a 0.3 probability of an LCF.

Table 5.36. Radiological Consequences of Accidents at WRAP

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[a]	Dose (person-rem)	Number LCFs[b]	Dose (rem)	Prob. LCF[a]
Handling/Forklift Drum Failure	Anticipated [c]	0.0014	8E-07	6.0	0 (0.003)	0.6	0.0003
Drum Handling Fire	2×10^{-3}	0.31	2E-04	1400	1 (0.8)	140	0.09
Container Handling Explosion	3×10^{-3}	0.74	5E-04	3300	2	340	0.2
Process Enclosure Fire	2×10^{-3}	0.20	1E-04	900	1 (0.5)	100	0.06
Process Enclosure Explosion	3×10^{-3}	0.67	4E-04	2900	2	300	0.2
Design-Basis Earthquake	1×10^{-3}	0.92	6E-04	4100	2	420	0.3
Beyond-Design-Basis Earthquake	[c]	1.1	7E-04	4800	3	500	0.3

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) Not quantified in reference.

Non-Radiological (Chemical) Consequences. Because MLLW would also be handled at the WRAP, non-radioactive hazardous materials may be involved in accidents. A process enclosure fire was evaluated for non-radiological consequences. The accident scenario for this analysis is the same as evaluated for radiological consequences of the process enclosure fire, where containers rupture and burn. A fire in the process enclosure is postulated due to the mixing of incompatible materials or damage to the packaging of pyrophoric material that allows ignition to take place. Because no mitigation credit is taken for the process enclosure, the consequence of this event is greater than any container fire at the WRAP. Accident consequences are presented in Table 5.37.

The air concentration at the location of the offsite MEI could exceed the TEEL/ERPG-1 level for beryllium, cadmium, and mercury. Hypothetically exposed individuals would not be expected to experience or develop irreversible or other serious health effects or symptoms that might impair their ability to take protective action.

For the onsite, non-involved worker, the TEEL/ERPG-3 level might be exceeded for beryllium, cadmium, mercury, and sodium oxide. This hypothetically exposed individual might experience or develop a life-threatening effect. The TEEL/ERPG-2 level could also be exceeded for uranyl nitrate hexahydrate, nitric acid, phosphoric acid, sodium, sodium hydroxide, and naphthylamine tritium. No other chemical would exceed the TEEL/ERPG-1 levels; therefore, no serious health effects or symptoms would be expected.

Like the radiological consequences to involved workers, non-radiological consequences could be highly variable—ranging from no exposure to high concentrations of chemicals—depending upon whether or not a worker were directly in the plume of immediately released material, and for how long.

Industrial Accidents. Direct operations staffing in the WRAP would total 1800 worker-years. Estimated health and safety impacts would be 48 total recordable cases, 20 lost workday cases, and 710 lost workdays.

Table 5.37. Non-Radiological Air Concentrations for a Process Enclosure Fire Accident at WRAP

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Ammonia	3.9E-01	8.5E-04	15	100	500	2.6E-02			5.7E-05		
Ammonium nitrate	6.9E+00	1.5E-02	10	10	500	6.9E-01			1.5E-03		
Beryllium	6.1E+00	1.3E-02	0.005	0.025	0.1	1.2E+03	2.4E+02	6.1E+01	2.7E+00	5.3E-01	
Butyl alcohol	7.0E-01	1.5E-03	150	150	4000	4.7E-03			1.0E-05		
Cadmium	7.8E+01	1.7E-01	0.03	4	9	2.6E+03	2.0E+01	8.7E+00	5.7E+00	4.3E-02	
Carbon tetrachloride	1.3E+01	2.9E-02	125	600	4000	1.1E-01			2.3E-04		
Cyclohexane	3.3E+00	7.1E-03	3000	4000	4000	1.1E-03			2.4E-06		
Dichloroethane	1.0E+00	2.2E-03	7.5	200	200	1.4E-01			2.9E-04		
Dioxane	2.2E+01	4.8E-02	75	350	1500	2.9E-01			6.3E-04		
Ethyl acetate (acetic ether)	7.8E-01	1.7E-03	1500	1500	7500	5.2E-04			1.1E-06		
Hydrogen peroxide	4.4E-01	9.5E-04	12.5	60	125	3.5E-02			7.6E-05		
Indole-2-C14 picrate	8.6E-05	1.9E-07	0.3	0.5	10	2.9E-04			6.2E-07		
Manganese	5.2E-02	1.1E-04	3	5	500	1.7E-02			3.8E-05		
Mercury	3.8E+01	8.3E-02	0.025	0.1	10	1.5E+03	3.8E+02	3.8E+00	3.3E+00		
Methanol	1.1E+00	2.4E-03	250	1250	6000	4.4E-03			9.5E-06		
Napthylamine tritium	8.6E+01	1.9E-01	7.5	50	300	1.1E+01	1.7E+00	2.9E-01	2.5E-02		
Nitric acid	3.0E+01	6.6E-02	2.5	12.5	50	1.2E+01	2.4E+00	6.1E-01	2.7E-02		
Phosphoric acid	4.4E+01	9.5E-02	3	5	500	1.5E+01	8.7E+00	8.7E-02	3.2E-02		
Propane	7.8E-01	1.7E-03	3500	3500	3500	2.2E-04			4.9E-07		
Sodium	2.3E+00	4.9E-03	2	2	10	1.1E+00			2.5E-03		
Sodium hydroxide	3.2E+01	7.0E-02	0.5	5	50	6.4E+01	6.4E+00	6.4E-01	1.4E-01		
Sodium hypochlorite	6.5E-03	1.4E-05	75	500	500	8.6E-05			1.9E-07		
Sodium oxide	4.1E+01	9.0E-02	10	10	10	4.1E+00	4.1E+00	4.1E+00	9.0E-03		
Styrene	2.4E+00	5.3E-03	200	1000	4000	1.2E-02			2.6E-05		
Tetrahydrofuran	1.2E+00	2.7E-03	750	3000	6000	1.7E-03			3.6E-06		
Tetralin	8.6E-05	1.9E-07	NA	NA	NA						
Toluene	7.6E-01	1.6E-03	150	1000	3500	5.0E-03			1.1E-05		
Uranyl nitrate hexahydrate	5.3E+00	1.2E-02	0.6	0.6	10	8.8E+00	8.8E+00	5.3E-01	1.9E-02		
Vinyl acetate	2.4E+00	5.3E-03	150	250	1500	1.6E-02			3.5E-05		
Vinyl chloride	3.6E+00	7.8E-03	12.5	12.5	200	2.9E-01			6.3E-04		
Zirconium	7.5E-01	1.6E-03	10	10	50	7.5E-02			1.6E-04		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

5.11.1.2.3.2 Treatment – Modified T Plant Complex

Radiological Consequences – Continuing T Plant Activities. Six accident scenarios involving current activities and radioactive material at T Plant were evaluated as part of the Interim Safety Basis (Bushore 1999, 2001). These accidents were a spray release in the 221-T canyon, railcar spill in the 221-T rail tunnel, filter fire in the 2706-T facility, LLW drum storage fire in the 214-T building, filter bank fire in the 219-T building, and seismic event.

These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence are described qualitatively and quantitatively. The frequencies of occurrence range from less than 1.E-02 to 1.9E-05 for the 291-T filter bank fire, categorized as unlikely and extremely unlikely, respectively (see Appendix F, Section F.2.2). Accident consequences, shown in terms of radiation dose and potential LCF, are presented in Table 5.38.

Table 5.38. Radiological Consequences of Accidents at the Modified T Plant Complex for Continuing T Plant Activities

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Spray Release, 221-T Canyon	2E-05	0.31	2E-04	2100	1	220	1E-01
Railcar Spill, 221-T Rail Tunnel	< 0.01 [(c)]	0.10	6E-05	650	0 (0.4)	68	4E-02
2706-T Outdoor Drum Fire	1E-03 to 2.5E-04 [(c)]	0.70	4E-04	4800	3	500	3E-01
214-T LLW Drum Storage Fire	< 0.01 [(c)]	0.15	9E-05	1000	1 (0.6)	110	7E-02
291-T Filter Bank Fire	1.9E-05	0.02	1E-05	140	0 (0.08)	15	9E-03
Seismic Event	[(c, d)]	0.27	2E-04	1900	1	190	1E-01

(a) Prob. LCF = the probably of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.
(c) These less quantitative frequencies are also from (Bushore 2001).
(d) For a design-basis earthquake, an annual frequency would be about 1×10^{-3} or less.

The largest consequences to the MEI would be from an outdoor drum handling accident with fire at the 2706-T facility. The MEI would receive a dose of about 0.70 rem and have a 4E-04 probability of an LCF. Within the population, this accident would result in three LCFs, and three of the other accidents examined would result in one LCF.

The largest consequences to a non-involved worker would also be from an outdoor drum handling accident with fire at the 2706-T facility. The non-involved worker would receive a dose of about 500 rem and have a 3E-01 probability of an LCF.

Radiological Consequences – New Waste Processing Facility. Four accidents for the proposed new waste processing facility in the modified T Plant Complex were evaluated, based upon the analysis and results of the preliminary safety evaluation for the WRAP Module 2 (WHC 1991). These accidents were a filtered box drop, an unfiltered box drop, a design-basis earthquake with fire, and a tank farm pump spill. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence range from anticipated (with an annual frequency range of 1 to 0.01) to an extremely unlikely accident (with an annual frequency range of 1E-04 to 1E-06). Accident consequences, shown in terms of radiation dose and potential LCFs, are presented in Table 5.39.

The largest consequences to the MEI would be from a design-basis earthquake and fire. The MEI would receive a dose of about 0.31 rem and have a 2E-04 probability of an LCF. This accident also results in the largest consequences to the population, but no LCFs would be expected.

The largest consequences to a non-involved worker would also be from a design-basis earthquake and fire. The non-involved worker would receive a dose of about 77 rem and have a 5E-02 probability of an LCF.

Table 5.39. Radiological Consequences of Accidents for the Modified T Plant Complex with the New Waste Processing Facility

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Box Drop (filtered)	1E-02	8.9E-05	5E-08	0.21	0 (1E-04)	2.2E-02	1E-05
Box Drop (unfiltered)	1E-02	1.8E-01	1E-04	430	0 (0.3)	4.5E+01	3E-02
Design-Basis Earthquake and Fire (unfiltered)	1E-04	3.1E-01	2E-04	740	0 (0.4)	7.7E+01	5E-02
Tank Farm Pump Spill	7.7E-04	2.6E-09	2E-12	6.3E-06	0 (4E-09)	6.5E-07	4E-10

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.

Radiological consequences to involved workers from these accidents could be highly variable depending upon whether or not a worker were directly in the plume of immediately released material.

Non-Radiological (Chemical) Consequences – Continuing T Plant Activities. The Interim Safety Basis (Bushore 2001) does not contain an analysis of the potential consequences of accidents involving non-radiological constituents of waste streams. The non-radiological consequences of accidents at WRAP, presented previously (Section 5.11.1.1.3.2), are assumed to represent potential non-radiological consequences of continuing T Plant activities.

Non-Radiological (Chemical) Consequences – New Waste Processing Facility. Non-radiological consequences for the new waste processing facility have not been evaluated in detail. However, potential non-radiological impacts from accidents in the WRAP are assumed to be representative for potential impacts from new waste processing facility activities. Potential impacts from accidents in the CWC and Low Level Burial Grounds (LLBGs) would likely be bounding for accidents in the modified T Plant Complex.

Industrial Accidents-Construction. Employment for the T Plant Complex modification would total 120 worker-years. Estimated health and safety impacts would be 10 total recordable cases, 3 lost workday cases, and 66 lost workdays.

Industrial Accidents-Operations. Direct operations staffing in the modified T Plant Complex would total 3,900 worker-years. Estimated health and safety impacts would be 100 total recordable cases, 42 lost workday cases, and 1,500 lost workdays.

5.11.1.2.3.3 Disposal – LLBGs

Disposal and storage of solid radioactive waste generated at the Hanford Site would continue in the HSW disposal facilities of the 200 West and 200 East Areas. Accidents involving the LLW and MLLW trenches were evaluated in the Solid Waste Burial Grounds Interim Safety Basis by Vail (2001c) and the Solid Waste Burial Grounds Interim Safety Analysis by Vail (2001b).

Radiological Consequences – LLW Trenches. The radiological consequences associated with the disposal of LLW (Cat 1, Cat 3, and GTC3) are addressed in this section. Non-radiological (chemical) consequences were not evaluated due to the nature of the waste.

Five credible accidents at the trenches were evaluated as part of the Interim Safety Basis (Vail 2001c) and the Interim Safety Analysis (Vail 2001b). They were a heavy equipment accident with fire, a heavy equipment accident without fire, a drum explosion, an explosion involving an ion-exchange module, and a seismic event. Two other accidents involving high-integrity containers (HICs)—a heavy equipment accident with fire and a seismic event—were also addressed.

These accidents were selected for analysis through a hazard identification and assessment process and have estimated annual frequencies of occurrence ranging from 4E-02 per year to 5.3E-04 per year, categorized as anticipated and unlikely, respectively. Accident consequences, shown in terms of both radiation dose and LCFs, are presented in Table 5.40.

The largest consequences to the MEI would be from a heavy equipment accident with fire involving the HICs. The MEI would receive a dose of about 0.39 rem and have a 2E-04 probability of a LCF. This accident also results in the largest consequences to the population, with one LCF.

The largest consequences to a non-involved worker would be from a heavy equipment accident with fire involving the HICs. The non-involved worker would receive a dose of about 210 rem and have an 1E-01 probability of an LCF.

Table 5.40. Radiological Consequences of Accidents at the Low-Level Waste Trenches

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Heavy Equipment Accident with Fire	5.3E-04	0.027	2E-05	140	0 (0.08)	14	0.008
Heavy Equipment Accident without Fire	1.3E-02	0.0022	1E-06	11	0 (0.007)	1	0.0007
Drum Explosion	4.0E-02	0.049	3E-05	250	0 (0.2)	26	0.02
Explosion in Ion-Exchange Module	1.0E-02	0.019	1E-05	97	0 (0.06)	10	0.006
Seismic Event[(c)]	1.0E-03	0.016	1E-05	79	0 (0.05)	8.3	0.005
HIC Operations							
Heavy Equipment Accident with Fire	5.3E-04	0.39	2E-04	2000	1	210	0.1
Seismic Event	1.0E-03	0.045	3E-05	220	0 (0.1)	23	0.01

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) This estimate is based on a breach of 500 drums, which is a conservative estimate of the number of stacked, uncovered drums at the face of the waste trenches. (Vail 2001c) back-calculates the number of drums breached from the site radiological risk guideline for onsite worker dose and is not appropriate for this analysis.

Radiological Consequences – MLLW Trenches. The radiological consequences of five accidents at the MLLW trenches were evaluated as part of the Interim Safety Analysis (Vail 2001b). These accidents were a heavy equipment (for example, a bulldozer) accident with fire, a heavy equipment accident with no fire, a drum explosion, a seismic event, and a leachate collection system spray release. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence range from 4.0E-02 per year for anticipated accidents to 1E-02 to 1E-04 per year for unlikely accidents. Accident consequences, shown in terms of both radiation dose and LCFs, are presented in Table 5.41.

The largest consequences to the MEI would be from a drum explosion. The MEI would receive a dose of about 4.9E-02 rem and have a 3E-05 probability of a LCF. This accident also results in the largest consequences to the population but no LCFs would be expected.

The largest consequences to a non-involved worker would also be from a drum explosion. The non-involved worker would receive a dose of about 26 rem and have a 2E-02 probability of an LCF.

Table 5.41. Radiological Consequences of Accidents at the MLLW Trenches

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Heavy Equipment Accident with Fire	5.4E-04	0.029	2E-05	140	0 (0.09)	14	0.008
Heavy Equipment Accident without Fire	1.3E-02	0.0022	1E-06	11	0 (0.007)	1.1	0.0007
Drum Explosion	4.0E-02	0.049	3E-05	240	0 (0.2)	26	0.02
Seismic Event[(c)]	1.0E-03	0.017	1E-05	83	0 (0.05)	9	0.005
Leachate Collection System Spray Release	Unlikely[(d)]	0.00048	3E-07	2.4	0 (0.001)	0.25	0.002

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.
(c) This estimate is based on a breach of 500 drums, which is a conservative estimate of the number of stacked, uncovered drums at the face of the waste trenches. (Vail 2001c) back-calculates the number of drums breached from the site radiological risk guideline for onsite worker dose and is not appropriate for this analysis.
(d) No frequency provided. Estimated at "unlikely" (1E-02 to 1E-04).

Non-Radiological (Chemical) Consequences. The quantity and form of hazardous constituents in the MLLW trenches are subject to land disposal restrictions and other regulations that are prescriptive in how mixed waste must be treated prior to emplacement. No organic chemicals would be present. The Interim Safety Analysis by Vail (2001b) evaluated four of the previous accidents for non-radiological consequences at the MLLW trenches, including the heavy equipment accident with fire, a heavy equipment accident with no fire, a drum explosion, and a seismic event. Chemicals were assumed to be at the maximum allowable concentrations and the waste was in bulk form (rather than in containers). Accident consequences are presented in Tables 5.42 through 5.45.

For all accidents, the air concentration at the location of the offsite MEI would be well below the TEEL/ERPG-1 level for all chemicals. No impacts would be expected. For the onsite non-involved worker, the TEEL/ERPG-3 levels could be reached or exceeded for three chemicals—molybdenum, nickel, and selenium—for the heavy equipment accident with fire and only selenium for the seismic event. A hypothetically exposed individual may experience or develop a life-threatening effect as a result of a one-hour exposure to any one of these chemicals. The TEEL/ERPG-2 levels would be exceeded for 16 chemicals for the heavy equipment accident with fire, and 13 chemicals for the seismic event. An individual might experience or develop irreversible or other serious health effects or symptoms that might impair the ability to take protective action.

Table 5.42. Non-Radiological Air Concentrations for a Heavy Equipment Accident with Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[a] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[b] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	2.0E+02	3.9E-01	30	50	250	6.8	4.1	0.8	1.3E-02		
Antimony	1.0E+01	2.0E-02	1.5	2.5	50	6.8	4.1	0.2	1.3E-02		
Arsenic	2.0E-01	3.9E-04	0.03	1.4	5	6.8	0.15		1.3E-02		
Barium	1.0E+01	2.0E-02	1.5	2.5	12.5	6.8	4.1	0.8	1.3E-02		
Beryllium	1.0E-03	2.0E-06	0.005	0.025	0.1	0.2			4.0E-04		
Cadmium	4.1E-02	7.8E-05	0.03	4	9	1.4	0.01		2.6E-03		
Calcium hydroxide	1.0E+02	2.0E-01	15	25	500	6.8	4.1	0.2	1.3E-02		
Chromium	1.0E+01	2.0E-02	1.5	2.5	250	6.8	4.1	0.04	1.3E-02		
Cobalt	4.1E-01	7.8E-04	0.1	0.1	20	4.1	4.1	0.02	7.8E-03		
Copper	2.0E+01	3.9E-02	3	5	100	6.8	4.1	0.2	1.3E-02		
Iron oxide dust	1.0E+02	2.0E-01	15	25	500	6.8	4.1	0.2	1.3E-02		
Lead	1.0E+00	2.0E-03	0.15	0.25	100	6.8	4.1	0.01	1.3E-02		
Magnesium	1.0E+02	2.0E-01	30	50	250	3.4	2.0	0.4	6.5E-03		
Manganese	1.0E+02	2.0E-01	3	5	500	34	20	0.2	6.5E-02		
Mercury	2.1E-02	4.0E-05	0.025	0.1	10	0.8			1.6E-03		
Molybdenum	1.0E+02	2.0E-01	15	25	60	6.8	4.1	1.7	1.3E-02		
Nickel	2.0E+01	3.9E-02	4.5	10	10	4.5	2.0	2.0	8.7E-03		
Potassium hydroxide	4.1E-01	8.0E-04	2	2	150	0.2			4.0E-04		
Selenium	4.1E+00	7.8E-03	0.6	1	1	6.8	4.1	4.1	1.3E-02		
Silver	2.0E-01	3.9E-04	0.3	0.5	10	0.7			1.3E-03		
Sodium hydroxide	4.1E-01	8.0E-04	0.5	5	50	0.8			1.6E-03		
Thallium	2.0E+00	3.9E-03	0.3	2	15	6.8	1.0	0.1	1.3E-02		
Vanadium pentoxide	1.0E-01	2.0E-04	0.075	0.5	35	1.4	0.2		2.7E-03		
Zinc oxide	2.0E+02	3.9E-01	15	15	500	14	14	0.41	2.6E-02		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.43. Non-Radiological Air Concentrations for a Heavy Equipment Accident Without Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1, (mg/m^3)	TEEL-2, (mg/m^3)	TEEL-3, (mg/m^3)	Onsite[a] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[b] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	4.1E+00	7.8E-03	30	50	250	1.4E-01			2.6E-04		
Antimony	2.0E-01	3.9E-04	1.5	2.5	50	1.4E-01			2.6E-04		
Arsenic	4.1E-03	7.8E-06	0.03	1.4	5	1.4E-01			2.6E-04		
Barium	2.0E-01	3.9E-04	1.5	2.5	12.5	1.4E-01			2.6E-04		
Beryllium	2.1E-05	4.0E-08	0.005	0.025	0.1	4.2E-03			8.0E-06		
Cadmium	8.2E-04	1.6E-06	0.03	4	9	2.7E-02			5.2E-05		
Calcium hydroxide	2.0E+00	3.9E-03	15	25	500	1.4E-01			2.6E-04		
Chromium	2.0E-01	3.9E-04	1.5	2.5	250	1.4E-01			2.6E-04		
Cobalt	8.2E-03	1.6E-05	0.1	0.1	20	8.2E-02			1.6E-04		
Copper	4.1E-01	7.8E-04	3	5	100	1.4E-01			2.6E-04		
Iron oxide dust	2.0E+00	3.9E-03	15	25	500	1.4E-01			2.6E-04		
Lead	2.0E-02	3.9E-05	0.15	0.25	100	1.4E-01			2.6E-04		
Magnesium	2.0E+00	3.9E-03	30	50	250	6.8E-02			1.3E-04		
Manganese	2.0E+00	3.9E-03	3	5	500	6.8E-01			1.3E-03		
Mercury	4.2E-04	8.0E-07	0.025	0.1	10	1.7E-02			3.2E-05		
Molybdenum	2.0E+00	3.9E-03	15	25	60	1.4E-01			2.6E-04		
Nickel	4.1E-01	7.8E-04	4.5	10	10	9.1E-02			1.7E-04		
Potassium hydroxide	8.3E-03	1.6E-05	2	2	150	4.1E-03			8.0E-06		
Selenium	8.2E-02	1.6E-04	0.6	1	1	1.4E-01			2.6E-04		
Silver	4.1E-03	7.8E-06	0.3	0.5	10	1.4E-02			2.6E-05		
Sodium hydroxide	8.3E-03	1.6E-05	0.5	5	50	1.7E-02			3.2E-05		
Thallium	4.1E-02	7.8E-05	0.3	2	15	1.4E-01			2.6E-04		
Vanadium pentoxide	2.1E-03	4.0E-06	0.075	0.5	35	2.8E-02			5.3E-05		
Zinc oxide	4.1E+00	7.8E-03	15	15	500	2.7E-01			5.2E-04		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.44. Non-Radiological Air Concentrations for a Drum Explosion at the LLBGs

	Onsite Worker Conc. (mg/m³)	Offsite MEI Conc. (mg/m³)	TEEL-1 (mg/m³)	TEEL-2 (mg/m³)	TEEL-3 (mg/m³)	Onsite[a] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[b] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	9.3E+00	1.8E-02	30	50	250	3.1E-01			5.9E-04		
Antimony	4.6E-01	8.9E-04	1.5	2.5	50	3.1E-01			5.9E-04		
Arsenic	9.3E-03	1.8E-05	0.03	1.4	5	3.1E-01			5.9E-04		
Barium	4.6E-01	8.9E-04	1.5	2.5	12.5	3.1E-01			5.9E-04		
Beryllium	4.7E-05	9.1E-08	0.005	0.025	0.1	9.4E-03			1.8E-05		
Cadmium	1.9E-03	3.6E-06	0.03	4	9	6.2E-02			1.2E-04		
Calcium hydroxide	4.6E+00	8.9E-03	15	25	500	3.1E-01			5.9E-04		
Chromium	4.6E-01	8.9E-04	1.5	2.5	250	3.1E-01			5.9E-04		
Cobalt	1.9E-02	3.6E-05	0.1	0.1	20	1.9E-01			3.6E-04		
Copper	9.3E-01	1.8E-03	3	5	100	3.1E-01			5.9E-04		
Iron oxide dust	4.6E+00	8.9E-03	15	25	500	3.1E-01			5.9E-04		
Lead	4.6E-02	8.9E-05	0.15	0.25	100	3.1E-01			5.9E-04		
Magnesium	4.6E+00	8.9E-03	30	50	250	1.5E-01			3.0E-04		
Manganese	4.6E+00	8.9E-03	3	5	500	1.5E+00	0.9		3.0E-03		
Mercury	9.4E-04	1.8E-06	0.025	0.1	10	3.8E-02			7.3E-05		
Molybdenum	4.6E+00	8.9E-03	15	25	60	3.1E-01			5.9E-04		
Nickel	9.3E-01	1.8E-03	4.5	10	10	2.1E-01			4.0E-04		
Potassium hydroxide	1.9E-02	3.6E-05	2	2	150	9.4E-03			1.8E-05		
Selenium	1.9E-01	3.6E-04	0.6	1	1	3.1E-01			5.9E-04		
Silver	9.3E-03	1.8E-05	0.3	0.5	10	3.1E-02			5.9E-05		
Sodium hydroxide	1.9E-02	3.6E-05	0.5	5	50	3.8E-02			7.3E-05		
Thallium	9.3E-02	1.8E-04	0.3	2	15	3.1E-01			5.9E-04		
Vanadium pentoxide	4.7E-03	9.1E-06	0.075	0.5	35	6.3E-02			1.2E-04		
Zinc oxide	9.3E+00	1.8E-02	15	15	500	6.2E-01			1.2E-03		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.45. Non-Radiological Air Concentrations for a Seismic Event Without Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[a] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[b] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	7.4E+01	1.4E-01	30	50	250	2.5	1.5	0.3	4.8E-03		
Antimony	3.7E+00	7.1E-03	1.5	2.5	50	2.5	1.5	0.07	4.8E-03		
Arsenic	7.4E-02	1.4E-04	0.03	1.4	5	2.5	0.05		4.8E-03		
Barium	3.7E+00	7.1E-03	1.5	2.5	12.5	2.5	1.5	0.3	4.8E-03		
Beryllium	3.8E-04	7.3E-07	0.005	0.025	0.1	0.08			1.5E-04		
Cadmium	1.5E-02	2.9E-05	0.03	4	9	0.5			9.5E-04		
Calcium hydroxide	3.7E+01	7.1E-02	15	25	500	2.5	1.5	0.1	4.8E-03		
Chromium	3.7E+00	7.1E-03	1.5	2.5	250	2.5	1.5	0.01	4.8E-03		
Cobalt	1.5E-01	2.9E-04	0.1	0.1	20	1.5	1.5	7.4E-03	2.9E-03		
Copper	7.4E+00	1.4E-02	3	5	100	2.5	1.5	0.07	4.8E-03		
Iron oxide dust	3.7E+01	7.1E-02	15	25	500	2.5	1.5	0.1	4.8E-03		
Lead	3.7E-01	7.1E-04	0.15	0.25	100	2.5	1.5	0.004	4.8E-03		
Magnesium	3.7E+01	7.1E-02	30	50	250	1.2	0.7		2.4E-03		
Manganese	3.7E+01	7.1E-02	3	5	500	12	7.4	0.07	2.4E-02		
Mercury	7.6E-03	1.5E-05	0.025	0.1	10	0.3			5.8E-04		
Molybdenum	3.7E+01	7.1E-02	15	25	60	2.5	1.5	0.6	4.8E-03		
Nickel	7.4E+00	1.4E-02	4.5	10	10	1.6	0.7		3.2E-03		
Potassium hydroxide	1.5E-01	2.9E-04	2	2	150	0.08			1.5E-04		
Selenium	1.5E+00	2.9E-03	0.6	1	1	2.5	1.5	1.5	4.8E-03		
Silver	7.4E-02	1.4E-04	0.3	0.5	10	0.2			4.8E-04		
Sodium hydroxide	1.5E-01	2.9E-04	0.5	5	50	0.3			5.8E-04		
Thallium	7.4E-01	1.4E-03	0.3	2	15	2.5	0.4		4.8E-03		
Vanadium pentoxide	3.8E-02	7.3E-05	0.075	0.5	35	0.5			9.7E-04		
Zinc oxide	7.4E+01	1.4E-01	15	15	500	5	5	0.15	9.5E-03		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Radiological Consequences – ILAW Disposal. The radiological consequences associated with the disposal of ILAW (as MLLW) in a new disposal facility near the PUREX Plant are addressed in this section. There would be no non-radiological (chemical) consequences due to the processing and physical form of the waste, so non-radiological impacts were not evaluated.

A preliminary hazards assessment (Burbank 2001) identified 198 hazardous conditions grouped into 15 accident categories; quantitative results were reported for two accidents. A bulldozer accident was assumed to occur and shear off the tops of six ILAW containers. A crane accident had the crane falling into a trench with the boom striking an exposed container array 10 packages wide by 5 packages wide. Accident consequences, shown in terms of both radiation dose and LCF, are presented in Table 5.46.

Table 5.46. Radiological Consequences of Accidents Involving ILAW Disposal

Accident	Estimated Annual Frequency	Offsite MEI		Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person -rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Bulldozer Accident	N/A	1.9E-05	1E-08	5.0E-02	3E-05	2.3E-02	1E-05
Crane Accident	N/A	3.4E-05	2E-08	9.0E-02	5E-05	4.3E-02	3E-05

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.

The largest consequences to the MEI would be from the crane accident. The MEI would receive a dose of about 3E-05 rem and have a 2E-08 probability of an LCF. This accident also results in the largest consequences to the population, with about a 5E-05 probability of an LCF.

The largest consequences to workers would also be from the crane accident. The non-involved worker would receive a dose of about 0.04 rem and have a 3E-05 probability of an LCF.

LLBGs Industrial Accidents. This section addresses potential health and safety impacts from construction and operation of LLW and MLLW trenches and supporting facilities (pulse driers) in the LLBGs. Estimated health and safety impacts from construction and operation of MLLW trenches are included in totals for the LLBGs presented below.

LLBGs Industrial Accidents-Construction. Construction of new trenches and pulse driers for MLLW trenches would require a total of 7 to 10 worker-years. The estimated health and safety impacts would be less than one total recordable case, less than one lost workday cases.

LLBGs Industrial Accidents-Operations. Direct operations staffing in the LLBGs would total 3800 worker-years. Estimated health and safety impacts would be 100 total recordable cases, 42 lost workday cases, and 1500 lost workdays.

ILAW Industrial Accidents. Industrial impacts are not separated by construction and operations. A total of about 5,000 worker-years would be required for construction, operations, and closure. The estimated health and safety impacts would be about 200 total recordable cases, 84 lost workday cases, and about 2900 lost work days.

5.11.1.3 Alternative Group B

Alternative Group B is similar to Alternative Group A except that use of commercial treatment facilities would be minimized with construction of a new waste processing facility, instead of modifying the T Plant Complex. New LLW and MLLW trenches would be constructed using the current design instead of the wider, deeper trench designs. Alternative Group B would involve the same waste processing and the same waste management approaches. The alternative includes the establishment of necessary facilities for storage, inspection, treatment, and final disposal or shipment offsite for all included waste streams. In addition, Alternative Group B includes the same sources, waste streams, and volumes of waste as Alternative Group A.

As in Alternative Group A, all of the wastes would be removed from storage and treated as necessary for disposal in the HSW disposal facilities or sent to the WIPP. After about 10 years, wastes would only be held in storage for short periods of time to allow for characterization and evaluation prior to treatment or disposal. Under Alternative Group B, the analyses use the Hanford Only, Upper, and Lower Bound of forecasted disposal waste volumes for LLW and MLLW.

5.11.1.3.1 Construction

New construction activities are anticipated for HSW disposal facilities and the new waste processing facility. The primary impacts from construction activities would be to air quality and injuries to construction workers. No impacts to construction workers are expected from radiation and chemicals because new construction activities would be performed away from areas of known contamination. Impacts to non-involved workers (from other onsite activities) are expected to bound potential air quality impacts to construction workers. Impacts from industrial accidents during construction are discussed in Section 5.11.1.2.3.

The construction activities may involve emission of criteria pollutants from the use of combustion engines and earthmoving activities. The potential impacts from these activities are described in Section 5.2 and are summarized here. Impacts are measured by comparison of air concentrations at the point of maximum potential public exposure. The analysis indicated that emissions of criteria pollutants (including sulfur dioxide, carbon monoxide, nitrogen dioxide, and PM_{10}) from construction activities would result in air concentrations below the regulatory limits. As a consequence, no health impacts would be expected from these emissions.

5.11.1.3.2 Normal Operations

Potential impacts to public health from normal operations include air quality impacts from atmospheric releases of radionuclides and chemicals from waste operations. Long-term impacts from releases to groundwater from LLBGs are discussed in Sections 5.11.2 and 5.3.

Alternative Group B involves operations that may result in routine releases of radionuclides and chemicals to the atmosphere. These operations include waste package verification, treatment, and packaging at WRAP; processing of materials and equipment at modified T Plant Complex; treatment and processing of waste in the new waste processing facility; and treatment of leachate from MLLW trenches using pulse driers. Annual releases have been estimated for each year of operation for the facilities involved in this alternative. Details of the release calculations are described in Appendix F.

5.11.1.3.2.1 Health Impacts from Routine Radionuclide Releases

The expected doses and health impacts to non-involved workers and the public from routine atmospheric releases of radionuclides are presented in Table 5.47 for the Hanford Only waste volume, Table 5.15 for the Lower Bound waste volume, and in Table 5.49 for the Upper Bound waste volume. The tables present the maximum annual dose to the non-involved workers and the MEI, and the collective dose to the public along with the probability of developing an LCF for the individual and the number of LCFs expected for the public. Given that the cancer risk estimates and doses are small in comparison to regulatory limits,[a] no adverse health impacts would be expected from radionuclide releases.

5.11.1.3.2.2 Health Impacts from Chemical Releases

Releases of chemicals to the atmosphere could occur for the same processes involving release of radionuclides when wastes with hazardous chemicals are involved. The potential health impacts from chemical releases to the atmosphere are presented in Table 5.50 for all waste volumes. The results for the Hanford Only waste volume are the same as those for the Lower Bound waste volume because the processing volumes for mixed waste streams are nearly identical for both (only mixed wastes contain chemicals that may be released to the atmosphere). Because all the peak hazard quotients are less than 1, and because the cancer risk estimates are small, no adverse health impacts would be expected from chemical releases.

5.11.1.3.2.3 Worker Occupational Radiation Exposure

The radiation dose received by workers involved with waste operations is estimated using historical exposure data for the facilities involved in the alternative as provided the Technical Information Document (FH 2003). The potential radiation exposure to workers for Alternative Group B are summarized in Table 5.51 for the Hanford Only waste volume, in Table 5.52 for the Lower Bound waste volume, and in Table 5.53 for the Upper Bound waste volume. All estimated radiation doses to workers are well below regulatory limits.[b]

(a) The maximum annual radiation dose presented in this section may be compared to the regulatory limit of 10 mrem/year (WAC 246-247; 40 CFR 61; DOE 1993).

(b) The annual limit for occupational exposures is 5000 mrem/year (10 CFR 835).

Table 5.47. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Hanford Only Waste Volume

Exposed Group	Exposure Scenario[a]	Facility	Lifetime Dose[b] (mrem)	Prob. of LCFs[c]	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.2E-03	7E-10	2004	1.3E-04
		T Plant Complex	4.8E-01	3E-07	2003	3.9E-02
		NWPF[d]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[e, f]	6.9E-08	4E-14	2026	4.9E-09
MEI Offsite	Resident Gardener	WRAP	9.9E-05	6E-11	2004	1.1E-05
		T Plant Complex	1.0E-03	6E-10	2003	7.9E-05
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	2.2E-10	1E-16	2027	1.2E-11
		Total	2.1E-03	1E-09	2003	1.6E-04
			(person-rem)	Number of LCFs[h]	Year	(person-rem)
Population[g]	Population within 80 km (50 mi)	WRAP	9.1E-03	0 (5E-06)	2004	7.4E-04
		T Plant Complex	9.2E-02	0 (6E-05)	2003	5.5E-03
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	2.0E-08	0 (1E-11)	2026	8.2E-10
		Total	1.9E-01	0 (1E-04)	2003	1.1E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.48. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Lower Bound Waste Volume

Exposed Group	Exposure Scenario[(a)]	Facility	Lifetime Dose[(b)] (mrem)	Prob. of LCFs[(c)]	Maximum Annual Dose Year	Maximum Annual Dose mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.4E-03	9E-10	2004	1.6E-04
		T Plant Complex	5.8E-01	3E-07	2003	4.8E-02
		NWPF[(d)]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[(e, f)]	5.0E-07	3E-13	2026	2.8E-08
MEI Offsite	Resident Gardener	WRAP	1.2E-04	7E-11	2004	1.3E-05
		T Plant Complex	1.2E-03	7E-10	2003	9.5E-05
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	2.6E-10	2E-16	2027	1.4E-11
		Total	2.3E-03	1E-09	2003	1.8E-04
			(person-rem)	**Number of LCFs[(h)]**	**Year**	**(person-rem)**
Population[(g)]	Population within 80 km (50 mi)	WRAP	1.1E-02	0 (6E-06)	2004	8.8E-04
		T Plant Complex	1.1E-01	0 (7E-05)	2003	6.7E-03
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	2.3E-08	0 (1E-11)	2026	9.6E-10
		Total	2.1E-01	0 (1E-04)	2003	1.3E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.49. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Upper Bound Waste Volume

Exposed Group	Exposure Scenario[a]	Facility	Lifetime Dose[b] (mrem)	Prob. of LCFs[c]	Maximum Annual Dose Year	Maximum Annual Dose mrem
Worker Onsite (non-involved)	Industrial	WRAP	2.2E-03	1E-09	2004	1.9E-04
		T Plant Complex	8.9E-01	5E-07	2006	7.2E-02
		NWPF[d]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[e, f]	8.4E-07	5E-13	2026	4.7E-08
MEI Offsite	Resident Gardener	WRAP	2.1E-04	1E-10	2004	1.6E-05
		T Plant Complex	2.0E-03	1E-09	2006	1.5E-04
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	4.3E-10	3E-16	2026	2.3E-11
		Total	3.2E-03	2E-09	2006	2.3E-04
			Dose (person-rem)	**Number of LCFs[h]**	**Year**	**Dose (person-rem)**
Population[g]	Population within 80 km (50 mi)	WRAP	2.0E-02	0 (1E-05)	2004	1.1E-03
		T Plant Complex	1.8E-01	0 (1E-04)	2006	1.0E-02
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	3.9E-08	0 (2E-11)	2026	1.9E-09
		Total	2.9E-01	0 (2E-04)	2006	1.6E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.50. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Chemicals – Alternative Group B, All Waste Volumes

Volume	Exposed Group	Exposure Scenario[a]	Facility	Risk of Cancer Incidence[b]	Peak Annual Hazard Quotient[c]
Hanford Only and Lower Bound	Worker Onsite (non-involved)	Industrial	WRAP	1.2E-09	8.9E-05
			T Plant Complex	3.2E-08	2.3E-03
			NWPF[d]	1.7E-07	9.1E-03
	MEI Offsite	Gardener	WRAP	5.6E-11	3.4E-06
			T Plant Complex	3.3E-11	2.0E-06
			NWPF	6.9E-09	3.7E-04
			Total	7.0E-09	3.8E-04
	Population	Population within 80 km (50 mi)	WRAP	0 (5E-06)[e]	NA[f, g]
			T Plant Complex	0 (3E-06)[e]	NA
			NWPD	0 (6E-04)[e]	NA
			Total	0 (6E-04)[e]	NA
Upper Bound	Worker Onsite (non-involved)	Industrial	WRAP	5.3E-09	6.9E-04
			T Plant Complex	1.8E-07	2.4E-02
			NWPF	1.7E-07	9.1E-03
	MEI Offsite	Gardener	WRAP	2.3E-10	2.5E-05
			T Plant Complex	1.7E-10	2.0E-05
			NWPF	6.9E-09	3.7E-04
			Total	7.3E-09	4.2E-04
	Population	Population within 80 km (50 mi)	WRAP	0 (2E-05)[e]	NA[f, g]
			T Plant Complex	0 (2E-05)[e]	NA
			NWPF	0 (6E-04)[e]	NA
			Total	0 (7E-04)[e]	NA

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The individual risk of cancer incidence is evaluated for the exposure duration defined for the given exposure scenario starting in the year that provides the highest total impact.
(c) Hazard quotients are reported for the year of highest exposure.
(d) NWPF = new waste processing facility.
(e) Population risk from cancer is expressed as the inferred number of fatal and non-fatal cancers in the exposed population over the lifetime of the population from intakes during the remediation period. The actual value must be a whole number (cancers).
(f) Hazard quotients are designed as a measure of impacts on an individual and are not meaningful for population exposures.
(g) NA = not applicable.

5.11.1.3.3 Accidents

Continuing waste management operations under Alternative Group B would involve a continuing potential for accidental release that would be very similar to those discussed for Alternative Group A in four Hanford facilities: the CWC for waste storage, the WRAP for waste treatment, the modified T Plant Complex for waste treatment, and the HSW disposal facilities for waste disposal. Alternative Group B also adds a new treatment facility, the new waste processing facility, for which potential health impacts from accidents were evaluated. Health and safety impacts from industrial accidents would differ only slightly from Alternative Group A from construction activities for the new waste processing facility and LLBGs under Alternative Group B.

Anticipated health impacts to all workers from industrial accidents during construction and operations would be 640 to 660 total recordable cases, 260 to 270 lost workday cases, and 9000 to 9300 lost workdays. A total of about 20,800 to 21,400 worker-years would be required to complete all activities. Of these worker-years about 2800 to 3400 are site support and waste generator-paid workers that do not appear in the direct facility worker and impact estimates in the following sections. About 94 to 97 percent of these health impacts are from operations.

5.11.1.3.3.1 Storage – CWC

Potential radiological, non-radiological, and industrial accidents and impacts for the CWC would be the same as for Alternative Group A (see Section 5.11.1.1.3.1).

5.11.1.3.3.2 Treatment – WRAP

Potential radiological, non-radiological, and industrial accidents and impacts for the WRAP would be the same as for Alternative Group A (see Section 5.11.1.1.3.2).

5.11.1.3.3.3 Treatment – T Plant Complex

Potential radiological, non-radiological, and industrial accidents and impacts for continuing the existing T Plant activities are described under Alternative Group A (see Section 5.11.1.1.3.3).

Table 5.51. Occupational Radiation Exposure – Alternative Group B, Hanford Only Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[c]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.1	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	20	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (4E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	7.6	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	2.8	54	8.0	0 (5E-03)
Total					772	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

1 **Table 5.52**. Occupational Radiation Exposure – Alternative Group B, Lower Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[c]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.1	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	20	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (4E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	7.6	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	3.3	54	9.4	0 (6E-03)
Total					773	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

Table 5.53. Occupational Radiation Exposure – Alternative Group B, Upper Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[c]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	20	34	12	0 (7E-03)
		RCT	13	35	8.2	0 (5E-03)
	2020-2026	Operator	7	34	1.7	0 (1E-03)
		RCT	5	35	1.2	0 (7E-04)
	2027-2044	Operator	3	34	1.8	0 (1E-03)
		RCT	2	35	1.3	0 (8E-04)
Pulse Driers	2026 – 2077	Operator	5.6	54	16	0 (9E-03)
Total					786	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

5.11.1.3.3.4 Treatment – New Waste Processing Facility

The DOE would construct a new waste processing treatment facility in the 200 West Area to augment existing capabilities for treatment of contact-handled (CH) MLLW. DOE would provide onsite treatment for CH MLLW at this facility in addition to non-standard, remote-handled (RH) MLLW and TRU waste.

Radiological Consequences. Radiological consequences of accidents would be the same as those described for the modified T Plant Complex described under Alternative Group A (see Section 5.11.1.1.3.3).

Non-Radiological (Chemical) Consequences. Non-radiological consequences for the new waste processing facility have not been evaluated in detail. However, potential non-radiological impacts from accidents in the WRAP and the modified T Plant Complex are expected to be representative for potential impacts from the new waste processing facility. Potential impacts from accidents in the CWC and LLBGs would likely be bounding for accidents in the new waste processing facility.

Industrial Accidents-Construction. Direct employment for the new waste processing facility construction would total 278 worker-years. The estimated health and safety impacts would be 23 total recordable cases, 8 lost workday cases, and 150 lost workdays.

Industrial Accidents-Operations. Alternative Group B direct operations staffing in the new waste processing facility would be the same as described for the modified T Plant Complex under Alternative Group A (see Section 5.11.1.1.3.3).

5.11.1.3.3.5 Disposal – HSW Disposal Facilities

Potential radiological and non-radiological (chemical) accidents and impacts for the HSW disposal facilities under Alternative Group B would be the same as for Alternative Group A. Industrial accidents are discussed below.

Industrial Accidents-Construction. Slightly more impacts would be expected for LLBG construction under Alternative Group B than Alternative Group A and would require 54 to 83 worker-years. The estimated health and safety impacts would be 4 to 6 total recordable cases, 1 to 2 lost workday cases, and 24 to 41 lost workdays.

Industrial Accidents-Operations. Industrial accidents from LLBG operations would be the same as Alternative Group A (see Section 5.11.1.1.3.4).

ILAW Industrial Accidents. Industrial accidents form ILAW trench construction, operations, and closure would be the same as Alternative Group A (see Section 5.11.1.1.3.4).

5.11.1.4 Alternative Group C

Alternative Group C is similar to Alternative Group A except for the disposal location of some of the