M.2.5 RADIOLOGICAL IMPACTS AT NEVADA TEST SITE

This section presents the radiological impacts of the various storage and disposition alternatives at NTS. Section M.2.5.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.5.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, NTS was divided into six separate areas which would release radioactivity in 2005. All release points in each area were aggregated into a single release point. Table M.2.5–1 presents the characteristics of each of the release points including location, release height, and minimum distance and annual average dispersion to the site boundary in each of the 16 directions. In order to calculate the maximum site boundary dose (that is, the dose ultimately incurred to the site MEI), the dose from each release point to the "maximum receptor" (that is, potential MEI) associated with each of the other release points has been calculated. For further clarification on the definition of "maximum receptor" refer to Section M.2.2.2. For example, the dose resulting from releases for Areas 5, 9, 12, 19, and Device Assembly Facility has been determined from the maximum receptor for Area 3. Figure M.2.5–1 illustrates the location of each maximum receptor in relation to each release point. The maximum site boundary dose (that is, the dose ultimately incurred to the site MEI) is then determined by the maximum dose to one of these maximum receptors. Table M.2.5–2 presents the direction, distance, and atmospheric dispersion from each release point to each of the maximum receptors. Annual radiological releases were assumed to remain constant during the full operational period.

The population and food stuffs distributions centered on each release area are provided in a Health Risk Data report, October 1996. The joint frequency distribution used for the dose assessment was based on the meteorological measurements for 1990 from the Desert Rock at the 10-m (33-ft) height and is contained in the Health Risk Data report.

Doses given in this section are associated with 1 year of operation because regulatory standards are given as annual limits. The health effects are presented on an annual basis in the tables, and for the projected operational period in the text. Tables M.2.5–3 and M.2.5–4 include the radiological impacts to the public from atmospheric release for No Action and the storage and disposition alternatives.

Table M.2.5–1. Release Point Characteristics, Direction, Distance, and Chi/Q at Nevada Test Site

Release Point[a]	Area 3		Area 5		Area 9		Area 12		Area 19		DAF	
Latitude	37°2'52.858"		36°51'17.933"		37°7'40.938"		37°13'9.788"		37°15'14.317"		6°53'37.824"	
Longitude	-116°0'23.131"		-115°57'12.384"		-116°2'5.827"		-116°9'20.893"		-116°18'59.322"		-116°2'54.794"	
Release Height	Ground Level		Ground Level		Ground Level		Ground Level		Ground Level		Ground Level	
Distance and Atmospheric Dispersion at Site Boundary												
Direction	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**	**Distance (m)**	**Chi/Q (s/m^3)**
N	22,334	9.6×10^{-9}	11,017	2.5×10^{-8}	13,494	1.9×10^{-8}	3,598	1.2×10^{-7}	14,593	1.7×10^{-8}	39,497	4.6×10^{-9}
NNE	12,393	2.3×10^{-8}	4,008	1.1×10^{-7}	13,751	2.0×10^{-8}	3,666	1.3×10^{-7}	13,493	2.0×10^{-8}	19,043	1.3×10^{-8}
NE	8,331	5.3×10^{-8}	2,719	2.7×10^{-7}	11,367	3.5×10^{-8}	4,317	1.3×10^{-7}	13,488	2.8×10^{-8}	12,827	2.9×10^{-8}
ENE	7,092	5.7×10^{-8}	2,290	3.0×10^{-7}	9,692	3.7×10^{-8}	6,382	6.6×10^{-8}	11,870	2.8×10^{-8}	10,926	3.2×10^{-8}
E	6,970	5.6×10^{-8}	2,249	2.9×10^{-7}	9,518	3.7×10^{-8}	17,654	1.6×10^{-8}	11,646	2.8×10^{-8}	10,734	3.1×10^{-8}
ESE	7,124	4.6×10^{-8}	2,307	2.4×10^{-7}	9,727	3.0×10^{-8}	20,667	1.1×10^{-8}	35,224	5.4×10^{-9}	10,975	2.5×10^{-8}
SE	8,470	3.3×10^{-8}	2,736	1.7×10^{-7}	11,519	2.2×10^{-8}	24,525	7.9×10^{-9}	41,754	3.9×10^{-9}	13,007	1.8×10^{-8}
SSE	12,801	2.1×10^{-8}	4,119	1.0×10^{-7}	17,407	1.4×10^{-8}	37,017	5.2×10^{-9}	63,001	2.6×10^{-9}	19,622	1.2×10^{-8}
S	37,774	6.3×10^{-9}	12,182	2.8×10^{-8}	50,960	4.3×10^{-9}	61,111	3.4×10^{-9}	58,791	3.6×10^{-9}	27,780	9.4×10^{-9}
SSW	43,741	5.7×10^{-9}	26,724	1.1×10^{-8}	52,085	4.6×10^{-9}	46,477	5.3×10^{-9}	20,820	1.5×10^{-8}	26,284	1.1×10^{-8}
SW	47,205	6.4×10^{-9}	26,537	4.0×10^{-9}	44,107	7.0×10^{-9}	31,082	1.1×10^{-8}	15,876	2.7×10^{-8}	30,390	1.1×10^{-8}
WSW	40,053	5.6×10^{-9}	38,554	5.9×10^{-9}	37,377	6.1×10^{-9}	27,130	9.3×10^{-9}	15,771	1.9×10^{-8}	36,372	6.3×10^{-9}
W	39,283	8.1×10^{-9}	44,204	6.9×10^{-9}	36,657	8.8×10^{-9}	27,851	1.3×10^{-8}	16,416	2.6×10^{-8}	35,698	9.1×10^{-9}
WNW	40,055	8.1×10^{-9}	45,100	7.0×10^{-9}	40,648	8.0×10^{-9}	28,395	1.3×10^{-8}	18,231	2.3×10^{-8}	36,413	9.2×10^{-9}
NW	27,062	7.7×10^{-9}	53,212	3.2×10^{-9}	16,370	1.5×10^{-8}	4,360	9.3×10^{-8}	15,211	1.6×10^{-8}	42,950	4.2×10^{-9}
NNW	22,808	4.2×10^{-9}	44,582	1.8×10^{-9}	13,801	8.2×10^{-9}	3,679	5.2×10^{-8}	14,912	7.4×10^{-9}	40,381	2.0×10^{-9}

[a] See Figure M.2.5–1 for location of release points.
Source: HNUS 1996a.

Table M.2.5–2. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Nevada Test Site Boundary

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Area 3			
Area 3	ENE	7,093	5.7×10^{-8}
Area 5	SSE	22,117	1.0×10^{-8}
Area 9	NNE	12,766	2.2×10^{-8}
Area 12	NNW	25,015	3.8×10^{-9}
Area 19	NNW	29,688	3.0×10^{-9}
DAF	SSE	16,601	1.5×10^{-8}
Release Point: Area 5			
Area 3	N	22,849	9.3×10^{-9}
Area 5	ENE	2,291	3.0×10^{-7}
Area 9	N	32,178	6.0×10^{-9}
Area 12	NNW	46,638	1.7×10^{-9}
Area 19	NNW	50,866	1.5×10^{-9}
DAF	NNE	6,740	5.3×10^{-8}
Release Point: Area 9			
Area 3	SE	12,141	2.0×10^{-8}
Area 5	SSE	31,344	6.4×10^{-9}
Area 9	ENE	9,692	3.7×10^{-8}
Area 12	NNW	15,986	6.8×10^{-9}
Area 19	NW	20,987	1.1×10^{-8}
DAF	SSE	25,762	8.3×10^{-9}
Release Point: Area 12			
Area 3	SE	26,875	7.0×10^{-9}
Area 5	SSE	44,834	4.0×10^{-9}
Area 9	ESE	21,893	1.0×10^{-8}
Area 12	NE	4,318	1.3×10^{-7}
Area 19	NNW	6,614	2.3×10^{-8}
DAF	SSE	39,639	4.7×10^{-9}
Release Point: Area 19			
Area 3	ESE	40,661	4.4×10^{-9}
Area 5	SE	55,804	2.7×10^{-9}
Area 9	ESE	36,584	5.1×10^{-9}
Area 12	E	16,711	1.7×10^{-8}
Area 19	ENE	11,871	2.8×10^{-8}
DAF	SE	51,278	3.0×10^{-9}
Release Point: DAF			
Area 3	NNE	21,318	1.1×10^{-8}
Area 5	SSE	11,411	2.4×10^{-8}
Area 9	NNE	29,792	7.4×10^{-9}
Area 12	N	40,290	4.5×10^{-9}
Area 19	NNW	43,910	1.8×10^{-9}
DAF	ENE	10,927	3.2×10^{-8}

Source: HNUS 1996a.

Table M.2.5–3. Doses and Resulting Health Effects to the Maximally Exposed Individual at Nevada Test Site From Atmospheric Releases Associated With Annual Normal Operation

Alternative/Facility	Dose by Pathway (mrem)				Committed Effective Dose Equivalent (mrem)	Percent of Background[a]	Estimated 1-Year Fatal Cancer Risk
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	4.2×10^{-3}	1.2×10^{-5}	2.9×10^{-7}	2.2×10^{-9}	4.2×10^{-3}	1.3×10^{-3}	2.1×10^{-9}
Consolidated Storage Facility (P-Tunnel)	5.5×10^{-6}	9.6×10^{-9}	2.1×10^{-15}	4.4×10^{-12}	5.6×10^{-6}	1.8×10^{-6}	2.8×10^{-12}
Collocated Storage Facilities (P-Tunnel)	5.6×10^{-6}	9.6×10^{-9}	2.2×10^{-15}	6.6×10^{-12}	5.6×10^{-6}	1.8×10^{-6}	2.8×10^{-12}
Consolidated Storage Facility	1.3×10^{-6}	2.2×10^{-9}	4.9×10^{-16}	1.0×10^{-12}	1.3×10^{-6}	4.2×10^{-7}	6.5×10^{-13}
Collocated Storage Facilities	1.3×10^{-6}	2.3×10^{-9}	5.2×10^{-16}	1.6×10^{-12}	1.3×10^{-6}	4.2×10^{-7}	6.5×10^{-13}
Pit Disassembly/ Conversion Facility	1.4×10^{-4}	3.2×10^{-6}	8.6×10^{-13}	1.3×10^{-9}	1.5×10^{-4}	4.8×10^{-5}	7.5×10^{-11}
Pu Conversion Facility	9.5×10^{-5}	1.7×10^{-7}	3.9×10^{-14}	8.3×10^{-11}	9.5×10^{-5}	3.0×10^{-5}	4.8×10^{-11}
MOX Fuel Fabrication Facility	6.8×10^{-5}	1.2×10^{-7}	2.6×10^{-14}	1.3×10^{-10}	6.8×10^{-5}	2.2×10^{-5}	3.4×10^{-11}
Ceramic Immobilization Facility (Immobilized Disposition)	1.6×10^{-8}	2.8×10^{-11}	6.4×10^{-18}	1.3×10^{-14}	1.6×10^{-8}	5.1×10^{-9}	8.0×10^{-15}
Deep Borehole Complex (Direct Disposition)	2.7×10^{-9}	3.9×10^{-11}	1.0×10^{-17}	1.5×10^{-14}	2.7×10^{-9}	8.6×10^{-10}	1.4×10^{-15}
Deep Borehole Complex (Immobilized Disposition)	3.3×10^{-9}	5.8×10^{-11}	1.5×10^{-17}	2.3×10^{-14}	3.4×10^{-9}	1.1×10^{-9}	1.7×10^{-15}
Vitrification Facility	6.6×10^{-6}	4.3×10^{-7}	1.3×10^{-10}	7.1×10^{-8}	7.2×10^{-6}	2.3×10^{-6}	3.6×10^{-12}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.8×10^{-8}	8.5×10^{-8}	2.5×10^{-11}	1.4×10^{-8}	1.2×10^{-7}	3.8×10^{-8}	6.0×10^{-14}
Advanced Boiling Water Reactor	4.6×10^{-4}	2.3×10^{-2}	6.2×10^{-3}	5.7×10^{-4}	3.0×10^{-2}	9.6×10^{-3}	1.5×10^{-8}
CE System 80+ Reactor	1.4×10^{-3}	2.6×10^{-2}	5.7×10^{-4}	2.2×10^{-4}	2.9×10^{-2}	9.3×10^{-3}	1.5×10^{-8}
[Text deleted.]							
AP600 Reactor	7.4×10^{-4}	2.2×10^{-2}	1.7×10^{-3}	3.4×10^{-4}	2.5×10^{-2}	8.0×10^{-3}	1.3×10^{-8}
RESAR-90 Reactor	1.2×10^{-3}	3.2×10^{-2}	7.0×10^{-4}	2.8×10^{-4}	3.4×10^{-2}	1.1×10^{-2}	1.7×10^{-8}

[a] Individual annual natural background radiation dose is equal to 313 mrem.

Source: HNUS 1996a.

Table M.2.5–4. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Nevada Test Site From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	3.7×10^{-3}	9.4×10^{-6}	3.6×10^{-6}	1.9×10^{-9}	3.7×10^{-3}	4.0×10^{-5}	1.9×10^{-6}
Consolidated Storage Facility (P-Tunnel)	1.7×10^{-6}	1.8×10^{-11}	6.6×10^{-16}	1.4×10^{-12}	1.7×10^{-6}	1.8×10^{-8}	8.5×10^{-10}
Collocated Storage Facility (P-Tunnel)	1.7×10^{-6}	1.9×10^{-11}	7.0×10^{-16}	2.1×10^{-12}	1.7×10^{-6}	1.8×10^{-8}	8.5×10^{-10}
Consolidated Storage Facility	2.6×10^{-6}	5.8×10^{-11}	1.0×10^{-15}	2.1×10^{-12}	2.6×10^{-6}	2.8×10^{-8}	1.3×10^{-9}
Collocated Storage Facilities	2.6×10^{-6}	6.2×10^{-11}	1.1×10^{-15}	3.2×10^{-12}	2.6×10^{-6}	2.8×10^{-8}	1.3×10^{-9}
Pit Disassembly/ Conversion Facility	2.9×10^{-4}	8.4×10^{-8}	1.7×10^{-12}	2.6×10^{-9}	2.9×10^{-4}	3.2×10^{-6}	1.5×10^{-7}
Pu Conversion Facility	1.9×10^{-4}	4.6×10^{-9}	8.0×10^{-14}	1.7×10^{-10}	1.9×10^{-4}	2.1×10^{-6}	9.5×10^{-8}
MOX Fuel Fabrication Facility	1.4×10^{-4}	3.4×10^{-9}	5.4×10^{-14}	2.6×10^{-10}	1.4×10^{-4}	1.5×10^{-6}	7.0×10^{-8}
Ceramic Immobilization Facility (Immobilized Disposition)	3.3×10^{-8}	7.2×10^{-13}	1.3×10^{-17}	2.7×10^{-14}	3.3×10^{-8}	3.6×10^{-10}	1.7×10^{-11}
Deep Borehole Complex (Direct Disposition)	5.3×10^{-9}	1.0×10^{-12}	2.1×10^{-17}	3.2×10^{-14}	5.3×10^{-9}	5.8×10^{-11}	2.7×10^{-12}
Deep Borehole Complex (Immobilized Disposition)	6.6×10^{-9}	1.5×10^{-12}	3.1×10^{-17}	4.8×10^{-14}	6.6×10^{-9}	7.2×10^{-11}	3.3×10^{-12}
Vitrification Facility	1.3×10^{-5}	5.2×10^{-7}	2.6×10^{-10}	1.4×10^{-7}	1.4×10^{-5}	1.5×10^{-7}	7.0×10^{-9}
Ceramic Immobilization Facility (Ceramic Immobilization)	3.7×10^{-8}	1.0×10^{-7}	5.1×10^{-11}	2.9×10^{-8}	1.7×10^{-7}	1.8×10^{-9}	8.5×10^{-11}
Advanced Boiling Water Reactor	7.3×10^{-4}	2.0×10^{-2}	5.8×10^{-3}	8.9×10^{-4}	2.7×10^{-2}	2.9×10^{-4}	1.4×10^{-5}
CE System 80+ Reactor	2.8×10^{-3}	2.0×10^{-2}	8.3×10^{-4}	4.5×10^{-4}	2.4×10^{-2}	2.6×10^{-4}	1.2×10^{-5}
[Text deleted.]							
AP600 Reactor	1.5×10^{-3}	1.7×10^{-2}	2.8×10^{-3}	6.9×10^{-4}	2.2×10^{-2}	2.4×10^{-4}	1.1×10^{-5}
RESAR-90 Reactor	2.4×10^{-3}	2.7×10^{-2}	1.2×10^{-3}	5.8×10^{-4}	3.2×10^{-2}	3.5×10^{-4}	1.6×10^{-5}

[a] Dose to the population within 80 km from natural background radiation in year 2030 is equal to 9,190 person-rem.
Source: HNUS 1996a.

M.2.5.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, five of the six areas have radioactive releases to the atmosphere from normal operation. Table M.2.5.1–1 presents the estimated annual atmospheric radioactive releases.

Table M.2.5.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Nevada Test Site (curies)

Isotope	Area 3	Area 5	Area 9	Area 12	Area 19
H-3	0	0.29	0	3.7	0
Kr-85	0	0	0	0	160
Pu-239	1.0×10^{-3}	0	7.5×10^{-4}	0	0

Source: NT DOE 1994b.

Tables M.2.5–3 and M.2.5–4, respectively, include the radiological impacts to the maximally exposed member of the public and offsite population within 80 km (50 mi). The MEI would receive an annual dose of 4.2×10^{-3} mrem. An estimated fatal cancer risk of 1.0×10^{-7} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 3.7×10^{-3} person-rem in 2030 (mid-life of operation). An estimated 9.3×10^{-5} fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. There are no radioactive liquid releases to the offsite environment associated with No Action. Therefore, there are no resulting impacts.

Worker Doses and Health Effects. Based on measured values during the time period of 1989 to 1992 (*Twenty-Second Annual Report Radiation Exposures for DOE and DOE Contract Employees–1989* [DOE/EH-0286P]) and subsequent yearly dose reports), the annual average dose to a badged worker at NTS was calculated to be 5 mrem. It is projected that in 2005 and beyond, there would be 619 badged workers involved in No Action activities at NTS. The annual average dose to these workers was assumed to remain at 5 mrem; the annual total dose among all these workers would then equal 3 person-rem. From 50 years of operation, an estimated fatal cancer risk of 1.0×10^{-4} would result to the average worker and 0.060 fatal cancer could result among all workers.

M.2.5.2 Storage and Disposition

Radioactive Releases and Resulting Impacts to the Public. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the incremental impacts from the storage or disposition facilities to determine the impacts from total site operation. For example, to determine the radiological impact for the addition of an AP600 reactor at NTS, the doses from No Action facilities have to be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases from the facilities associated with the various alternative actions are given in Section M.2.3. Tables M.2.5–3 and M.2.5–4 include the radiological impacts by alternative facility. There are no radioactive liquid releases to the offsite environment associated with any alternative action.

The annual incremental doses associated with the different alternative facilities range from 2.7×10^{-9} to 0.034 mrem to the MEI and from 5.3×10^{-9} to 0.032 person-rem to the 80-km (50-mi) population in the year 2030. The associated health effects from annual operations are included in both tables.

Worker Doses and Health Effects. For the storage and disposition alternatives, the impacts from the No Action facilities need to be added to the incremental impacts from the storage or disposition facilities to determine the impacts from total site operation (refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).