M.2.8 RADIOLOGICAL IMPACTS AT OAK RIDGE RESERVATION

This section presents the radiological impacts of the various storage and disposition alternatives at ORR. Section M.2.8.1 presents the radiological releases and resulting impacts from facilities associated with No Action. Section M.2.8.2 presents the radiological releases and resulting impacts from the various alternatives.

For purposes of radiological impact modeling, ORR was divided into seven separate areas which would release radioactivity in 2005. All potential release points in each area were aggregated into a single release point. Tables M.2.8–1 and M.2.8–2 present the characteristics of each of the release points including location, release height, minimum distance, and annual average dispersion to the site boundary in each of 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 the "maximum receptor," refer to Section M.2.2.2. For example, the dose resulting from releases from the Oak Ridge National Laboratory (ORNL), Y–12 Plant (Y–12), High Flux Isotope Reactor Areas, and the other storage and disposition alternatives, has been determined for the maximum receptor from the K–25 Site (K–25) incinerator. Figure M.2.8–1 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 those maximum receptors. Tables M.2.8–3 and M.2.8–4 present the distance, direction, 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.

Descriptions of population, foodstuffs distributions, and aquatic foods for each release area are provided in a Health Risk Data report, October 1996. The joint frequency distributions used for the dose assessment were based on 1990 meteorological measurements from five meteorological towers (Tower 1 for K–25, Tower 2 for ORNL, Tower 4 for the High Flux Isotope Reactor and Radiochemical Engineering Development Center, Tower 5 for Y–12, and Tower 6 for the proposed Tritium Supply Site location) at the 10-m (33-ft) height and are 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.2.8–5 through M.2.8–8 include the radiological impacts to the public from both atmospheric release and from using the surface water for No Action and the storage and disposition alternatives.

Table M.2.8–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (Without Presence of the Clinch River Breeder Reactor Site)

Release Point[a]	Immobilization Facility		K-25		X-10	
Latitude	35°55'59.139"		35°56'15.444"		35°55'39.169"	
Longitude	-84°20'55.855"		-84°22'54.796"		-84°18'55.580"	
Release Height	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)
N	3,200	2.2×10^{-7}	3,037	1.7×10^{-7}	4,218	2.1×10^{-7}
NNE	2,996	5.8×10^{-7}	3,919	3.2×10^{-7}	5,872	2.3×10^{-7}
NE	4,624	6.2×10^{7}	4,360	5.0×10^{-7}	8,512	2.0×10^{-7}
ENE	9,494	2.9×10^{-7}	4,633	4.8×10^{-7}	3,935	4.4×10^{-7}
E	6,806	1.5×10^{-7}	9,767	1.1×10^{-7}	4,337	2.3×10^{-7}
ESE	6,782	1.2×10^{-7}	9,643	6.1×10^{-8}	4,390	1.9×10^{-7}
SE	5,900	6.9×10^{-8}	4,931	1.1×10^{-7}	4,029	2.5×10^{-7}
SSE	3,558	6.1×10^{-8}	2,313	4.0×10^{-7}	4,367	2.0×10^{-7}
S	3,417	8.7×10^{-8}	2,414	6.1×10^{-7}	4,296	1.7×10^{-7}
SSW	3,851	3.2×10^{-7}	3,303	4.8×10^{-7}	3,752	2.4×10^{-7}
SW	2,903	1.1×10^{-6}	3,897	2.6×10^{-7}	3,750	4.5×10^{-7}
WSW	4,897	2.1×10^{-7}	2,892	5.9×10^{-7}	5,340	2.6×10^{-7}
W	5,700	5.6×10^{-8}	3,600	2.1×10^{-7}	8,677	4.5×10^{-8}
WNW	4,299	4.7×10^{-8}	2,775	1.2×10^{-7}	7,267	3.8×10^{-8}
NW	4,788	3.9×10^{-8}	2,374	1.3×10^{-7}	4,474	8.1×10^{-8}
NNW	4,767	4.7×10^{-8}	1,856	2.6×10^{-7}	3,900	9.4×10^{-8}

Table M.2.8–1. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (Without Presence of the Clinch River Breeder Reactor Site)—Continued

Release Point[a]	Y–12		MOX Fuel Fabrication		Pit Disassembly/Conversion	
Latitude	35°59'8.409"		35°59'.676"		35°58'50.204"	
Longitude	-84°15'38.488"		-84°15'43.725"		-84°16'13.244"	
Release Height	20.0 m		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)
N	675	$7.7x10^{-7}$	824	$1.9x10^{-6}$	839	$2.1x10^{-6}$
NNE	879	$1.0x10^{-6}$	1,070	$3.2x10^{-6}$	1,082	$3.1x10^{-6}$
NE	1,618	$9.8x10^{-7}$	1,982	$1.6x10^{-6}$	1,683	$3.0x10^{-6}$
ENE	2,360	$6.6x10^{-7}$	2,671	$8.3x10^{-7}$	3,396	$1.3x10^{-6}$
E	2,963	$3.4x10^{-7}$	2,765	$8.4x10^{-7}$	2,970	$5.2x10^{-7}$
ESE	2,283	$2.8x10^{-7}$	2,268	$2.0x10^{-7}$	2,837	$4.4x10^{-7}$
SE	2,329	$2.1x10^{-7}$	3,663	$5.3x10^{-8}$	3,719	$1.4x10^{-7}$
SSE	3,726	$1.3x10^{-7}$	3,570	$1.2x10^{-7}$	4,276	$4.6x10^{-8}$
S	4,682	$1.5x10^{-7}$	4,432	$8.9x10^{-8}$	4,100	$6.6x10^{-8}$
SSW	9,589	$7.2x10^{-8}$	9,563	$5.7x10^{-8}$	10,586	$7.5x10^{-8}$
SW	11,872	$3.8x10^{-8}$	11,602	$1.6x10^{-7}$	10,901	$1.7x10^{-7}$
WSW	3,454	$2.4x10^{-7}$	3,733	$7.3x10^{-7}$	3,306	$3.8x10^{-7}$
W	1,082	$5.3x10^{-7}$	1,370	$1.2x10^{-6}$	1,349	$5.7x10^{-7}$
WNW	810	$4.8x10^{-7}$	974	$6.4x10^{-7}$	921	$6.4x10^{-7}$
NW	688	$5.2x10^{-7}$	862	$6.6x10^{-7}$	801	$7.8x10^{-7}$
NNW	619	$7.1x10^{-7}$	798	$9.1x10^{-7}$	772	$1.1x10^{-6}$

[a] See Figure M.2.8–1 for location of release points.
Source: HNUS 1996a

Table M.2.8–2. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (With Presence of the Clinch River Breeder Reactor Site)

Release Point[a]	LWR Site		Immobilization Facility		K-25		X-10	
Latitude	35°54'9.137"		35°55'59.139"		35°56'15.444"		35°55'39.169"	
Longitude	-84°22'45.671"		-84°20'55.855"		-84°22'54.796"		-84°18'55.580"	
Release Height	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)
N	930	2.5×10^{-6}	3,199	2.2×10^{-7}	3,041	1.7×10^{-7}	4,206	2.1×10^{-7}
NNE	1,209	2.7×10^{-6}	2,995	5.8×10^{-7}	3,936	3.2×10^{-7}	5,852	2.3×10^{-7}
NE	8,444	2.0×10^{-7}	4,646	6.2×10^{7}	4,362	5.0×10^{-7}	8,512	2.0×10^{-7}
ENE	11,141	9.5×10^{-8}	9,893	2.7×10^{-7}	4,634	4.8×10^{-7}	5,162	2.9×10^{-7}
E	2,171	6.8×10^{-7}	7,827	1.2×10^{-7}	10,817	9.6×10^{-8}	4,863	2.0×10^{-7}
ESE	898	2.5×10^{-6}	7,133	1.1×10^{-7}	9,987	5.8×10^{-8}	4,707	1.7×10^{-7}
SE	830	3.4×10^{-6}	6,077	6.7×10^{-8}	5,089	1.0×10^{-7}	4,385	2.2×10^{-7}
SSE	979	2.3×10^{-6}	4,081	4.9×10^{-8}	2,306	4.0×10^{-7}	4,586	1.9×10^{-7}
S	2,154	5.0×10^{-7}	3,788	7.5×10^{-8}	2,418	6.1×10^{-7}	4,483	1.6×10^{-7}
SSW	1,863	7.2×10^{-7}	4,000	3.0×10^{-7}	3,436	4.5×10^{-7}	3,956	2.2×10^{-7}
SW	998	3.9×10^{-6}	2,903	1.1×10^{-6}	3,897	2.6×10^{-7}	4,134	3.9×10^{-7}
WSW	897	4.5×10^{-6}	5,279	1.9×10^{-7}	2,892	5.9×10^{-7}	5,340	2.6×10^{-7}
W	939	1.6×10^{-6}	5,700	5.6×10^{-8}	3,618	2.1×10^{-7}	8,677	4.5×10^{-8}
WNW	854	1.2×10^{-6}	4,294	4.7×10^{-8}	2,782	1.2×10^{-7}	7,259	3.8×10^{-8}
NW	755	1.5×10^{-6}	4,787	3.9×10^{-8}	2,355	1.3×10^{-7}	4,460	8.1×10^{-8}
NNW	764	1.4×10^{-6}	4,769	4.7×10^{-8}	1,855	2.6×10^{-7}	3,900	9.4×10^{-8}

Table M.2.8–2. Release Point Characteristics, Direction, Distance, and Chi/Q at the Oak Ridge Reservation Boundary (With Presence of the Clinch River Breeder Reactor Site)—Continued

Release Point[a]	Y–12		MOX Fuel Fabrication		Pit Disassembly/Conversion	
Latitude	35°59'8.409"		35°59'.676"		35°58'50.204"	
Longitude	-84°15'38.488"		-84°15'43.725"		-84°16'13.244"	
Release Height	20 m		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)
N	657	7.9×10^{-7}	821	1.9×10^{-6}	826	2.1×10^{-6}
NNE	897	1.0×10^{-6}	1,087	3.1×10^{-6}	1,067	3.1×10^{-6}
NE	1,639	9.7×10^{-7}	2,000	1.5×10^{-6}	1,658	3.0×10^{-6}
ENE	2,344	6.6×10^{-7}	2,658	8.3×10^{-7}	3,380	1.3×10^{-6}
E	2,936	3.5×10^{-7}	2,772	8.4×10^{-7}	2,978	5.2×10^{-7}
ESE	2,286	2.8×10^{-7}	2,273	2.0×10^{-7}	2,844	4.4×10^{-7}
SE	2,320	2.1×10^{-7}	4,125	4.4×10^{-8}	4,241	1.1×10^{-7}
SSE	4,229	1.1×10^{-7}	4,085	9.5×10^{-8}	5,014	3.6×10^{-8}
S	5,423	1.3×10^{-7}	5,197	7.0×10^{-8}	5,193	4.6×10^{-8}
SSW	11,713	5.5×10^{-8}	11,444	4.4×10^{-8}	10,902	7.2×10^{-8}
SW	12,181	3.7×10^{-8}	11,898	1.5×10^{-7}	11,310	1.6×10^{-7}
WSW	3,433	2.4×10^{-7}	3,712	7.4×10^{-7}	3,330	3.8×10^{-7}
W	1,067	5.3×10^{-7}	1,353	1.2×10^{-6}	1,327	5.9×10^{-7}
WNW	803	4.9×10^{-7}	963	6.6×10^{-7}	911	6.5×10^{-7}
NW	687	5.2×10^{-7}	868	6.5×10^{-7}	795	8.0×10^{-7}
NNW	621	7.1×10^{-7}	805	9.0×10^{-7}	773	1.1×10^{-6}

[a] See Figure M.2.8–1 for location of release points.

Source: HNUS 1996a.

Table M.2.8–3. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (Without Presence of the Clinch River Breeder Reactor Site)

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Immobilization			
Immobilization Facility	SW	2,903	1.1×10^{-6}
K–25	SW	3,189	9.7×10^{-7}
X–10	SSE	3,582	6.0×10^{-8}
Y–12	NE	10,548	1.9×10^{-7}
MOX Fuel Fabrication	NE	10,449	1.9×10^{-7}
Pit Disassembly/Conversion	NE	9,699	2.1×10^{-7}
Release Point: K–25			
Immobilization Facility	SSE	2,315	4.0×10^{-7}
K–25	S	2,415	6.1×10^{-7}
X–10	SE	5,421	9.3×10^{-8}
Y–12	ENE	12,739	1.1×10^{-7}
MOX Fuel Fabrication	ENE	12,639	1.1×10^{-7}
Pit Disassembly/Conversion	ENE	11,863	1.2×10^{-7}
Release Point: X–10			
Immobilization Facility	WSW	5,468	2.5×10^{-7}
K–25	WSW	5,735	2.3×10^{-7}
X–10	SW	3,750	4.5×10^{-7}
Y–12	NNE	8,933	1.2×10^{-7}
MOX Fuel Fabrication	NNE	8,842	1.3×10^{-7}
Pit Disassembly/Conversion	NNE	8,184	1.4×10^{-7}
Release Point: Y–12			
Immobilization Facility	SW	12,769	3.4×10^{-8}
K–25	SW	13,055	3.3×10^{-8}
X–10	SW	11,875	3.8×10^{-8}
Y–12	NNE	879	1.0×10^{-6}
MOX Fuel Fabrication	N	812	6.4×10^{-7}
Pit Disassembly/Conversion	NW	772	4.5×10^{-7}

Table M.2.8–3. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (Without Presence of the Clinch River Breeder Reactor Site)—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: MOX Fuel Fabrication Facility			
Immobilization Facility	SW	12,523	1.4×10^{-7}
K–25	SW	12,809	1.4×10^{-7}
X–10	SW	11,606	1.6×10^{-7}
Y–12	NN	1,143	2.8×10^{-6}
MOX Fuel Fabrication	NNE	1,071	3.1×10^{-6}
Pit Disassembly/Conversion	NW	863	6.6×10^{-7}
Release Point: Pit Disassembly/ Conversion			
Immobilization Facility	SW	11,735	1.5×10^{-7}
K–25	SW	12,021	1.5×10^{-7}
X–10	SW	10,902	1.7×10^{-7}
Y–12	NE	1,776	2.7×10^{-6}
MOX Fuel Fabrication	NE	1,683	3.0×10^{-6}
Pit Disassembly/Conversion	NNE	1,083	3.1×10^{-6}

Source: HNUS 1996a.

Table M.2.8–4. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (With Presence of the Clinch River Breeder Reactor Site)

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: LWR Site			
LWR Site	WSW	897	4.5×10^{-6}
Immobilization Facility	NNE	1,728	1.5×10^{-6}
K–25	N	1,518	1.1×10^{-6}
X–10	E	3,420	3.4×10^{-7}
Y–12	NE	14,878	9.2×10^{-8}
MOX Fuel Fabrication	NE	14,780	9.2×10^{-8}
Pit Disassembly/Conversion	NE	13,996	1.0×10^{-7}
Release Point: Immobilization			
LWR Site	SSW	4,244	2.8×10^{-7}
Immobilization Facility	SW	2,903	1.1×10^{-6}
K–25	SW	3,198	9.7×10^{-7}
X–10	S	4,027	6.8×10^{-8}
Y–12	NE	10,571	1.9×10^{-7}
MOX Fuel Fabrication	NE	10,472	1.9×10^{-7}
Pit Disassembly/Conversion	NE	9,674	2.2×10^{-7}
Release Point: K–25 TSCA Incinerator			
LWR Site	S	4,244	2.6×10^{-7}
Immobilization Facility	SSE	2,306	4.0×10^{-7}
K–25	S	2,419	6.1×10^{-7}
X–10	SE	5,747	8.5×10^{-8}
Y–12	ENE	12,761	1.1×10^{-7}
MOX Fuel Fabrication	ENE	12,663	1.1×10^{-7}
Pit Disassembly/Conversion	ENE	11,836	1.3×10^{-7}
Release Point: X–10 (ORNL)			
LWR Site	WSW	7,297	1.6×10^{-7}
Immobilization Facility	WSW	5,471	2.5×10^{-7}
K–25	WSW	5,743	2.3×10^{-7}
X–10	SW	4,135	3.9×10^{-7}
Y–12	NNE	8,956	1.2×10^{-7}
MOX Fuel Fabrication	NNE	8,863	1.3×10^{-7}
Pit Disassembly/Conversion	NNE	8,163	1.4×10^{-7}

Table M.2.8–4. Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Oak Ridge Reservation Site Boundary (With Presence of the Clinch River Breeder Reactor Site)—Continued

Maximum Receptor For	Direction	Distance (m)	Atmospheric Dispersion Chi/Q (s/m^3)
Release Point: Y–12			
LWR Site	SW	14,978	2.8×10^{-8}
Immobilization Facility	SW	12,769	3.4×10^{-8}
K–25	SW	13,064	3.3×10^{-8}
X–10	SW	12,259	3.6×10^{-8}
Y–12	NNE	898	1.0×10^{-6}
MOX Fuel Fabrication	N	827	6.2×10^{-7}
Pit Disassembly/Conversion	NW	785	4.4×10^{-7}
Release Point: MOX Fuel Fabrication Facility			
LWR Site	SW	14,726	1.1×10^{-7}
Immobilization Facility	SW	12,523	1.4×10^{-7}
K–25	SW	12,818	1.4×10^{-7}
X–10	SW	11,989	1.5×10^{-7}
Y–12	NNE	1,163	2.7×10^{-6}
MOX Fuel Fabrication	NNE	1,087	3.1×10^{-6}
Pit Disassembly/Conversion	NW	868	6.5×10^{-7}
Release Point: Pit Disassembly/ Conversion			
LWR Site	SW	13,950	1.2×10^{-7}
Immobilization Facility	SW	11,735	1.5×10^{-7}
K–25	SW	12,030	1.5×10^{-7}
X–10	SSW	11,293	6.9×10^{-7}
Y–12	NE	1,798	2.7×10^{-6}
MOX Fuel Fabrication	NE	1,705	2.9×10^{-6}
Pit Disassembly/Conversion	NNE	1,067	3.1×10^{-6}

Source: HNUS 1996a.

Table M.2.8–5. Doses and Resulting Health Effects to the Maximally Exposed Individual at Oak Ridge Reservation 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)	1.4	1.7×10^{-2}	3.2×10^{-2}	5.3×10^{-4}	1.5	5.0×10^{-1}	7.4×10^{-7}
Upgrade HEU Storage	2.2×10^{-7}	5.3×10^{-10}	8.8×10^{-16}	1.7×10^{-11}	2.2×10^{-7}	7.5×10^{-8}	1.1×10^{-13}
[Text deleted.]							
Collocated Storage Facility	4.4×10^{-5}	8.0×10^{-8}	1.8×10^{-14}	5.5×10^{-11}	4.5×10^{-5}	1.5×10^{-5}	2.3×10^{-11}
Pit Disassembly/Conversion Facility	1.3×10^{-2}	3.0×10^{-4}	7.9×10^{-11}	1.2×10^{-7}	1.4×10^{-2}	4.7×10^{-3}	7.0×10^{-9}
Pu Conversion Facility	9.1×10^{-3}	1.7×10^{-5}	3.9×10^{-12}	8.2×10^{-8}	9.2×10^{-3}	3.1×10^{-3}	4.6×10^{-9}
MOX Fuel Fabrication Facility	6.8×10^{-3}	1.2×10^{-5}	2.6×10^{-12}	1.2×10^{-8}	6.8×10^{-3}	2.3×10^{-3}	3.4×10^{-9}
Ceramic Immobilization Facility (Immobilized Disposition)	5.9×10^{-7}	1.0×10^{-9}	2.2×10^{-16}	4.6×10^{-13}	5.9×10^{-7}	2.0×10^{-7}	3.0×10^{-13}
Deep Borehole Complex (Direct Disposition)	9.3×10^{-8}	1.4×10^{-9}	3.7×10^{-16}	5.6×10^{-13}	9.4×10^{-8}	3.2×10^{-8}	4.7×10^{-14}
Deep Borehole Complex (Immobilized Disposition)	1.2×10^{-7}	2.0×10^{-9}	5.4×10^{-16}	7.9×10^{-13}	1.2×10^{-7}	4.1×10^{-8}	6.0×10^{-14}
Vitrification Facility	2.3×10^{-4}	1.5×10^{-5}	4.4×10^{-9}	2.5×10^{-6}	2.5×10^{-4}	8.5×10^{-5}	1.3×10^{-10}
Ceramic Immobilization Facility (Ceramic Immobilization)	6.5×10^{-7}	3.0×10^{-6}	9.1×10^{-10}	4.9×10^{-7}	4.2×10^{-6}	1.4×10^{-6}	2.1×10^{-12}
Advanced Boiling Water Reactor	4.9×10^{-2}	3.2	1.5	6.7×10^{-2}	4.8	1.6	2.4×10^{-6}
CE System 80+ Reactor	1.1×10^{-1}	3.1	8.9×10^{-2}	1.4×10^{-3}	3.3	1.1	1.7×10^{-6}
[Text deleted.]							
AP600 Reactor	2.5×10^{-2}	2.1	2.5×10^{-1}	1.5×10^{-2}	2.3	7.8×10^{-1}	1.2×10^{-6}
RESAR-90 Reactor	9.0×10^{-2}	3.2	1.0×10^{-1}	1.7×10^{-2}	3.5	1.2	1.8×10^{-6}

[a] Individual annual natural background radiation dose is equal to 295 mrem.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.8–6. Doses and Resulting Health Effects to the Population Within 80 Kilometers of Oak Ridge Reservation From Atmospheric Releases Associated With Normal Operation in 2030

Alternative/Facility	Dose by Pathway (person-rem)				Committed Effective Dose Equivalent in 2030 (person-rem)	Percent of Background[a]	Estimated 1-Year Fatal Cancers
	Inhalation	Ingestion	Plume Immersion	Ground Shine			
No Action (Total Site)	26	0.41	2.3	5.7×10^{-2}	29	7.7×10^{-3}	1.5×10^{-2}
Upgrade HEU Storage	3.4×10^{-6}	8.0×10^{-10}	1.4×10^{-14}	2.7×10^{-10}	3.4×10^{-6}	9.0×10^{-10}	1.7×10^{-9}
[Text deleted.]							
Collocated Storage Facilities	8.7×10^{-4}	1.4×10^{-7}	3.5×10^{-13}	1.0×10^{-9}	8.7×10^{-4}	2.3×10^{-7}	4.4×10^{-7}
Pit Disassembly/Conversion Facility	0.12	1.7×10^{-4}	6.9×10^{-10}	1.0×10^{-6}	0.12	3.2×10^{-5}	6.0×10^{-5}
Pu Conversion Facility	7.4×10^{-2}	9.3×10^{-6}	3.2×10^{-11}	6.6×10^{-8}	7.4×10^{-2}	2.0×10^{-5}	3.7×10^{-5}
MOX Fuel Fabrication Facility	4.8×10^{-2}	6.3×10^{-6}	1.9×10^{-11}	9.1×10^{-8}	4.8×10^{-2}	1.3×10^{-5}	2.4×10^{-5}
Ceramic Immobilization Facility (Immobilized Disposition)	1.1×10^{-5}	1.7×10^{-9}	4.2×10^{-15}	8.5×10^{-12}	1.1×10^{-5}	2.9×10^{-9}	5.5×10^{-9}
Deep Borehole Complex (Direct Disposition)	1.8×10^{-6}	2.3×10^{-9}	6.9×10^{-15}	1.1×10^{-11}	1.8×10^{-6}	4.7×10^{-10}	9.0×10^{-10}
Deep Borehole Complex (Immobilized Disposition)	2.2×10^{-6}	3.4×10^{-9}	1.0×10^{-14}	1.5×10^{-11}	2.2×10^{-6}	5.8×10^{-10}	1.1×10^{-9}
Vitrification Facility	4.3×10^{-3}	5.0×10^{-5}	8.7×10^{-8}	4.7×10^{-5}	4.4×10^{-3}	1.2×10^{-6}	2.2×10^{-6}
Ceramic Immobilization Facility (Ceramic Immobilization)	1.2×10^{-5}	9.8×10^{-6}	1.7×10^{-8}	9.6×10^{-6}	3.2×10^{-5}	8.4×10^{-9}	1.6×10^{-8}
Advanced Boiling Water Reactor	0.16	3.1	1.7	0.19	5.1	1.3×10^{-3}	2.6×10^{-3}
CE System 80+ Reactor	0.39	2.8	0.21	4.9×10^{-3}	3.4	9.0×10^{-4}	1.7×10^{-3}
[Text deleted.]							
AP600 Reactor	8.7×10^{-2}	1.9	0.69	5.2×10^{-2}	2.8	7.4×10^{-4}	1.4×10^{-3}
RESAR-90 Reactor	0.31	3.0	0.29	5.8×10^{-2}	3.6	9.5×10^{-4}	1.8×10^{-3}

[a] Dose to the population within 80 km from natural background radiation in year 2030 is equal to 379,000 person-rem.

[Text deleted.]

Source: HNUS 1996a.

Table M.2.8–7. Doses and Resulting Health Effects to the Maximally Exposed Individual at Oak Ridge Reservation From Liquid Releases Associated With Annual Normal Operation

	Dose by Pathway (mrem)								
Alternative/ Facility	**Fish Ingestion**	**Other Food Ingestion**	**Drinking Water**	**Boating**	**Swimming**	**Shoreline**	**Committed Effective Dose Equivalent (mrem)**	**Percent of Background[a]**	**Estimated Risk of 1-Year Fatal Cancers**
No Action (Total Site)	1.6	1.0×10^{-1}	1.2×10^{-2}	1.5×10^{-5}	3.0×10^{-5}	6.1×10^{-3}	1.7	5.8×10^{-1}	8.6×10^{-7}
Advanced Boiling Water Reactor	2.7×10^{-2}	1.0×10^{-3}	3.2×10^{-2}	2.6×10^{-6}	5.3×10^{-6}	2.9×10^{-4}	6.0×10^{-2}	2.0×10^{-2}	3.0×10^{-8}
CE System 80+ Reactor	9.0×10^{-2}	6.7×10^{-3}	2.0×10^{-1}	5.1×10^{-6}	1.0×10^{-5}	8.0×10^{-4}	3.0×10^{-1}	1.0×10^{-1}	1.5×10^{-7}
[Text deleted.]									
AP600 Reactor	1.0×10^{-1}	1.1×10^{-2}	3.6×10^{-1}	5.7×10^{-6}	1.1×10^{-5}	8.5×10^{-4}	4.7×10^{-1}	1.6×10^{-1}	2.4×10^{-7}
RESAR-90 Reactor	8.0×10^{-2}	1.4×10^{-2}	4.5×10^{-1}	5.7×10^{-6}	1.1×10^{-5}	4.9×10^{-4}	5.4×10^{-1}	1.8×10^{-1}	2.7×10^{-7}

[a] Individual annual natural background radiation dose is equal to 295 mrem.

Source: HNUS 1996a.

Table M.2.8–8. Doses and Resulting Health Effects to the Population Downstream of Oak Ridge Reservation From Liquid 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
	Fish Ingestion	Other Food Ingestion	Drinking Water	Boating	Swimming	Shoreline			
No Action (Total Site)	2.3	2.3	0	6.8×10^{-4}	5.8×10^{-4}	4.8×10^{-2}	4.7	1.2×10^{-3}	2.3×10^{-3}
Advanced Boiling Water Reactor	5.2×10^{-2}	2.3×10^{-2}	0	1.2×10^{-4}	1.1×10^{-4}	2.3×10^{-3}	7.8×10^{-2}	2.1×10^{-5}	3.9×10^{-5}
CE System 80+ Reactor	1.4×10^{-1}	1.5×10^{-1}	0	2.4×10^{-4}	2.1×10^{-4}	6.4×10^{-3}	3.0×10^{-1}	7.9×10^{-5}	1.5×10^{-4}
[Text deleted.]			0						
AP600 Reactor	2.3×10^{-1}	2.6×10^{-1}	0	2.7×10^{-4}	2.3×10^{-4}	6.8×10^{-3}	5.0×10^{-1}	1.3×10^{-4}	2.5×10^{-4}
RESAR-90 Reactor	1.5×10^{-1}	3.2×10^{-1}	0	2.6×10^{-4}	2.3×10^{-4}	3.9×10^{-3}	4.8×10^{-1}	1.3×10^{-4}	2.4×10^{-4}

[a] Total dose to the population within 80 km from natural background radiation in year 2030 is equal to 379,000 person-rem.

Source: HNUS 1996a.

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 test.

M.2.8.1 No Action

Atmospheric Releases and Resulting Impacts to the Public. For No Action, three of the five areas have radioactive releases into the atmosphere from normal operation. Table M.2.8.1–1 presents the estimated annual atmospheric radioactive releases.

Tables M.2.8–5 and M.2.8–6 include the atmospheric radiological impacts to the maximally exposed member of the public and the offsite population within 80 km (50 mi), respectively. The maximally exposed individual would receive an annual dose of 1.5 mrem. An estimated fatal cancer risk of 3.7×10^{-5} would result from 50 years of operation. The population within 80 km (50 mi) would receive a dose of 29 person-rem in 2030 (midlife of operation). An estimated 0.73 fatal cancers could result from 50 years of operation.

Liquid Releases and Resulting Impacts to the Public. For No Action, two of the five areas have radioactive releases to the offsite surface water from normal operation. Table M.2.8.1–2 presents the estimated annual liquid radioactive releases.

Tables M.2.8–7 and M.2.8–8 include the radiological impacts to the maximally exposed individual and the offsite populations using surface water within 80 km (50 mi) downstream of ORR, respectively. The maximally exposed member of the public would receive an annual dose of 1.7 mrem. An estimated fatal cancer risk of 4.3×10^{-5} would result from 50 years of operation. The population would receive a dose of 4.7 person-rem in 2030. An estimated 0.12 fatal cancers could result from 50 years of operation.

Worker Doses and Health Effects. Based on measured values during 1991 and 1992 (Dose Reports for 1991 and 1992), it is estimated that the average dose to a badged worker involved in No Action activities at ORR in 2005 and beyond would equal 2.6 mrem. It is projected that in 2005 and beyond, there would be 17,215 badged workers involved in No Action activities. The annual dose among all these workers would equal 44 person-rem. From 50 years of operation, an estimated fatal cancer risk of 5.2×10^{-5} would result to the average worker and 0.88 fatal cancers could result among all workers.

Table M.2.8.1–1. Annual Atmospheric Radioactive Releases From Normal Operation of No Action at Oak Ridge Reservation (curies)

Isotope	K–25	X-10	Y–12	No Action HEU Storage[a]
H-3	0	2.4×10^{2}	0	0
Be-7	0	3.8×10^{-4}	0	0
K-40	4.0×10^{-2}	0	0	0
Ar-41	0	1.8×10^{3}	0	0
Co-57	1.2×10^{-4}	0	0	0
Co-60	4.4×10^{-3}	2.6×10^{-6}	0	0
Sr-90	0	3.8×10^{-4}	0	0
Tc-99	0.12	0	0	0
Ru-106	4.5×10^{-3}	0	0	0
Cd-109	7.6×10^{-3}	0	0	0
I-129	0	2.5×10^{-4}	0	0
I-130	0	5.5×10^{-5}	0	0
I-131	0	5.3×10^{-2}	0	0
I-132	0	0.93	0	0
I-133	0	0.20	0	0
I-135	0	0.47	0	0
Xe-135	0	5.0×10^{1}	0	0
Xe-138	0	7.1×10^{1}	0	0
Cs-134	0	5.2×10^{-7}	0	0
Cs-137	5.0×10^{-3}	5.1×10^{-4}	0	0
Cs-138	0	7.1×10^{1}	0	0
Ba-140	0	4.9×10^{-4}	0	0
Ce-141	2.0×10^{-4}	0	0	0
Eu-152	0	1.7×10^{-6}	0	0
Eu-154	0	2.5×10^{-6}	0	0
Eu-155	0	5.2×10^{-6}	0	0
Os-191	0	0.17	0	0
Pb-212	0	0.37	0	0
Th-228	3.8×10^{-4}	1.5×10^{-6}	0	0
Th-230	5.9×10^{-5}	5.7×10^{-8}	0	0
Th-232	1.1×10^{-4}	3.3×10^{-8}	0	0
Th-234	1.8×10^{-2}	0	0	0
U-234	4.0×10^{-3}	8.7×10^{-6}	4.7×10^{-2}	4.7×10^{-5}
U-235	1.8×10^{-4}	4.7×10^{-7}	1.5×10^{-3}	1.5×10^{-6}
U-236	0	0	1.9×10^{-4}	1.9×10^{-7}
U-238	4.2×10^{-3}	2.8×10^{-5}	6.5×10^{-3}	6.5×10^{-6}
Np-237	5.7×10^{-4}	0	0	0
Pu-238	2.5×10^{-4}	2.8×10^{-6}	0	0
Pu-239	5.7×10^{-5}	8.0×10^{-6}	0	0
Am-241	0	4.6×10^{-6}	0	0
Cm-244	0	7.3×10^{-5}	0	0

[a] No Action HEU storage release is assumed equal to 0.001 of Y–12 releases.
Source: OR DOE 1994c.

Table M.2.8.1–2. Annual Liquid Releases From Normal Operation of No Action at Oak Ridge Reservation (curies)

Isotope	K-25	X-10
H-3	0	1.8×10^{-3}
K-40	0.019	0
Co-60	0	0.55
Sr-90	0	6.7
Tc-99	0.030	0
Ru-106	0.038	0
Cs-137	1.2×10^{-3}	0.018
Ce-143	0.20	0.040
Th-228	0.20	0
Th-230	2.4×10^{-5}	0
Th-234	0.036	0
U-234	7.7×10^{-3}	9.5×10^{-4}
U-235	0.014	0.056
U-236	5.8×10^{-4}	0
U-238	6.0×10^{-3}	4.5
Np-237	1.2×10^{-3}	0
Pu-238	1.6×10^{-4}	0

Source: OR DOE 1994c.

M.2.8.2 Storage and Disposition

Atmospheric Releases and Resulting Impacts to the Public. Total site radiological impacts during operation of storage or disposition facilities can be found by adding the impacts resulting from No Action facilities to the incremental impacts resulting from storage or disposition facilities. For example, to determine the radiological impact for the addition of the AP600 reactor at ORR, the No Action facilities doses would be summed with the AP600 reactor doses. Estimated annual atmospheric radioactive releases for the storage and disposition facilities are given in Section M.2.3. Tables M.2.8–5 and M.2.8–6 present the atmospheric radiological impacts by alternative facility.

The annual dose associated with the different alternative facilities range from 9.4×10^{-8} to 4.8 mrem to the maximally exposed member of the public and from 1.8×10^{-6} to 5.1 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.

Liquid Releases and Resulting Impacts to the Public. There are two disposition technologies that would release liquid discharges to the surface water surrounding ORR. These are the large and small evolutionary Advanced LWRs. The liquid releases for these technologies are given in Section M.2.3. As an example of determining the total site liquid radiological impact associated with the addition of an AP600 reactor at ORR, the No Action liquid doses must be summed with the AP600 reactor liquid doses. Tables M.2.8–7 and M.2.8–8 present the liquid radiological impacts for the applicable alternative facilities.

No change was reported in liquid radioactive releases due to the upgraded or new HEU storage facilities for continued HEU storage at ORR above those radioactive releases already included in No Action. Therefore, there are no changes in dose to the public from the upgraded or new HEU storage facilities at ORR.

The annual incremental doses associated with the different LWR's that have liquid releases range from 0.060 to 0.54 mrem to the maximally exposed member of the public, and range from 0.078 to 0.50 person-rem to the downstream population in 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 changes in impacts from the storage or disposition facilities to determine the impacts from total site operations, refer to the worker discussion under No Action, above, and to Table M.2.3.2–1).