APPENDIX C
EVALUATION OF HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

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C.1 Introduction

This appendix presents detailed information on the potential impacts on humans associated with incident-free (normal) releases of radioactivity from the U.S. Department of Energy (DOE) facilities proposed in this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* to be used for the disposition of surplus plutonium. This appendix also presents information on the calculation of worker doses that would be received as a result of performing facility modifications and processing plutonium materials for disposition. Chapter 2 of this *SPD Supplemental EIS* presents descriptions of the alternatives, the pit disassembly and conversion options, and the plutonium disposition options that contribute to the doses evaluated in this appendix. Appendix B provides descriptions of the facilities that support the plutonium disposition activities. The analysis in this appendix supports the human health risk assessments described in Chapter 4, Section 4.1.2, and Appendices F, G, and H of this *SPD Supplemental EIS*. Site-specific input data used in the evaluation of these human health impacts are provided or referenced, as appropriate. Resulting impacts can be compared to criteria invoked in DOE Order 458.1 for protection of the public (10 millirem per year from airborne pathways and 100 millirem per year total from all pathways); and Title 10 of the *Code of Federal Regulations* (CFR), Part 835, for protection of workers at Savannah River Site (SRS) and Los Alamos National Laboratory (LANL) (5,000 millirem per year). Worker doses would be monitored and controlled below the regulatory limit to ensure that individual doses are less than 2,000 millirem per year and as low as reasonably achievable (ALARA).

The rest of this section provides information to aid the reader in understanding the impacts from the radiological dose assessments. The text box on the following page presents basic information about the sources, types, and nature of radiation and units of measurement. Subsequent subsections address the sources of radiation protection guidelines, radiation exposure limits applicable to DOE operations, and the assessment of health effects from exposure to radiation.

C.1.1 Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection (ICRP). The ICRP is responsible for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations that address basic principles of radiation protection, leaving to the various national protection committees the responsibility to prepare detailed technical regulations, recommendations, or codes of practice that are best suited to the needs of their countries.

National Council on Radiation Protection and Measurements. In the United States, this council is the national organization that formulates and disseminates guidance and recommendations on radiation protection and measurements that represent the consensus of leading scientific thinking. The council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

Radiation Basics

What is radiation? Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

What is radioactivity? Radioactivity is produced by the process of radioactive atoms trying to become stable, a process termed "decay." Radiation is emitted in the process. In the United States, radioactivity is commonly measured in units called curies, where 1 curie is equal to 3.7×10^{10} disintegrations (decay transformations) per second. Internationally, radioactivity is generally measured in units called becquerels, where 1 becquerel is equal to 1 disintegration per second (1 curie = 3.7×10^{10} becquerels).

What is radioactive material? Radioactive material is any material containing unstable atoms that emit radiation.

What are the four basic types of ionizing radiation?

> ***Alpha particles*** — Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.
>
> ***Beta particles*** — Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.
>
> ***Gamma rays*** — Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in the air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.
>
> ***Neutrons*** — A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in the air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

What are the sources of radiation?

> ***Natural sources of radiation*** — Sources include cosmic radiation from the sun and outer space; natural radioactive elements in the Earth's crust; natural radioactive elements in the human body; and radon gas from the radioactive decay of uranium that is naturally present in the soil.
>
> ***Manmade sources of radiation*** — Sources include medical radiation (x-rays, medical isotopes); consumer products (TVs, luminous dial watches, smoke detectors); nuclear technology (nuclear power plants, industrial x-ray machines); and worldwide fallout from past nuclear weapons tests or accidents.

What is radiation dose? Radiation dose is the amount of energy in the form of ionizing radiation absorbed per unit mass of any material. For people, radiation dose is the amount of energy absorbed in human tissue. In the United States, radiation dose is commonly measured in units called rads or rem; a smaller fraction of the rem is the millirem (1/1,000 of 1 rem). Internationally, radiation dose is generally measured in units called grays or sieverts, where 1 rad = 0.01 grays and 1 rem = 0.01 sieverts.

Person-rem (or person-sievert) is a unit of collective radiation dose applied to populations or groups of individuals; it is the sum of the doses received by all the individuals of a specified population.

What is the average annual radiation dose from natural and manmade sources? Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This natural radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants. The average individual in the United States annually receives about 620 millirem of radiation dose from all background sources, of which about half is received from natural sources such as cosmic and terrestrial radiation and radon-220 and -222 in homes. Most of the remaining radiation dose is received from diagnostic x-rays and nuclear medicine (NCRP 2009).

What are the effects of radiation on humans? Radiation can cause a variety of adverse health effects in humans. Health impacts of radiation exposure, whether from external or internal sources, generally are identified as somatic (i.e., affecting the exposed individual) or genetic (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic than genetic effects. The somatic risks of most importance are induced cancers. Except for leukemia, which can have an induction period (time between exposure to the carcinogen and cancer diagnosis) of 2 to 7 years, most cancers have an induction period of more than 20 years.

For uniform irradiation of the body, cancer incidence varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities, rather than cancer incidence, are presented as a measure of impact in this document. These estimates are referred to as "latent cancer fatalities" (LCFs) because the cancer may take many years to develop.

National Research Council/National Academy of Sciences. The National Research Council, which functions under the auspices of the National Academy of Sciences, integrates the broad science and technology community with the Academy's mission to further knowledge and advise the Federal Government. The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR Committee) prepares reports to advise the Federal Government on the health consequences of radiation exposure.

U.S. Environmental Protection Agency (EPA). EPA has published a series of documents under the title *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a benchmark by a number of Federal agencies, including DOE and the National Nuclear Security Administration (DOE/NNSA), for the purpose of ensuring that regulation of public and occupational workforce exposures is protective, reflects the best available scientific information, and is carried out in a consistent manner.

U.S. Nuclear Regulatory Commission (NRC). NRC regulates nuclear power plants and the use of source materials, special nuclear materials, and byproduct materials by commercial and certain governmental entities. NRC has promulgated "Standards for Protection Against Radiation" in 10 CFR Part 20, which apply to NRC licensees.

U.S. Department of Energy (DOE). DOE establishes requirements for radiological protection at DOE sites in regulations and orders. Requirements for worker protection are included in "Occupational Radiation Protection" (10 CFR Part 835). Radiological protection of the public and environment is addressed in *Radiation Protection of the Public and the Environment* (DOE Order 458.1).

C.1.2 Radiation Exposure Limits

Radiation exposure limits for members of the public and radiation workers are derived from ICRP recommendations. EPA considers National Council on Radiation Protection and Measurements and ICRP recommendations in setting specific annual exposure limits (usually lower than those specified by the ICRP) in its radiation protection guidance to Federal agencies. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and EPA for radiation workers and members of the public are given in **Table C–1**.

Table C–1 Radiation Exposure Limits for Members of the Public and Radiation Workers

Regulation/DOE Order/Standard (Organization)	*Public Exposure Limits at the Site Boundary*	*Worker Exposure Limits*
10 CFR Part 835 (DOE)	–	5,000 millirem per year [a]
DOE-STD-1098-2008	–	2,000 millirem per year [b]
DOE Order 458.1 (DOE) [c]	100 millirem per year (all pathways)	–
40 CFR Part 61, Subpart H (EPA) [d]	10 millirem per year (all air pathways)	–
40 CFR Part 141 (EPA) [d]	4 millirem per year (drinking-water pathway)	–

CFR = Code of Federal Regulations; EPA = U.S. Environmental Protection Agency.

[a] Although this measurement is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with as low as reasonably achievable principles. Refer to footnote b.

[b] This is an administrative control level; exceeding this level generally requires approval of senior management. DOE established this level to assist in achieving its goal of maintaining radiation doses as low as reasonably achievable. DOE recommends that facilities adopt a more limiting Administrative Control Level (DOE 2009). Facility operators must make reasonable attempts to maintain individual worker doses below these levels.

[c] Consistent with 10 CFR Part 20.

[d] DOE Order 458.1 invokes the requirements of 40 CFR Part 61, Subpart H, and 40 CFR Part 141 for the air pathway and drinking water, respectively.

C.1.3 Human Health Effects Due to Exposure to Radiation

To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects. Radiation can cause a variety of damaging health effects in humans. The most significant effects are induced cancer fatalities, called latent cancer fatalities (LCFs) because the onset of cancer may take many years to develop after the radiation dose is received. In this *SPD Supplemental EIS*, LCFs are used to measure the estimated risk due to radiation exposure.

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. Cancer is caused by both external factors (tobacco, infectious organisms, chemicals, and radiation) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). For the U.S. population of about 310 million, the American Cancer Society estimated that, in 2010, about 1,529,560 new cancer cases would be diagnosed and about 569,490 cancer deaths would occur. Approximately one-third of U.S. cancer deaths are estimated to be caused by tobacco use and about one-third are related to excess weight or obesity, physical inactivity, and poor nutrition. The average U.S. resident has about 4 chances in 10 of developing an invasive cancer over his or her lifetime (44 percent probability for males, 38 percent for females). Nearly 25 percent of all deaths in the United States are due to cancer (American Cancer Society 2010).

The National Research Council's BEIR Committee has prepared a series of reports to advise the Federal Government on the health consequences of radiation exposure. Based on its 1990 report, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V* (National Research Council 1990), the former Committee on Interagency Radiation Research and Policy Coordination recommended cancer risk factors of 0.0005 per rem for the public and 0.0004 per rem for working-age populations (CIRRPC 1992). In 2002, the Interagency Steering Committee on Radiation Standards (ISCORS) recommended that Federal agencies use conversion factors of 0.0006 fatal cancers per rem for mortality and 0.0008 cancers per rem for morbidity when making qualitative or semi-quantitative estimates of risk from radiation exposure to members of the general public. No separate values were recommended for workers. The DOE Office of Environmental and Policy Guidance subsequently recommended that DOE personnel and contractors use the risk factors recommended by ISCORS, stating that, for most purposes, the value for the general population (0.0006 fatal cancers per rem) could be used for both workers and members of the public in National Environmental Policy Act (NEPA) analyses (DOE 2003a).

Recent publications by both the BEIR Committee and the ICRP support the continued use of the ISCORS-recommended risk values. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (National Research Council 2006) reported fatal cancer risk factors of 0.00048 per rem for males and 0.00066 per rem for females in a population with an age distribution similar to that of the entire U.S. population (average value of 0.00057 per rem for a population with equal numbers of males and females). ICRP Publication 103 (Valentin 2007) recommends nominal cancer risk coefficients of 0.00041 and 0.00055 per rem for adults and the general population, respectively, and estimates the risk from heritable effects to be about 3 to 4 percent of the nominal fatal cancer risk (see **Table C–2**).

Accordingly, a risk factor of 0.0006 LCFs per rem was used in this *SPD Supplemental EIS* to estimate risk due to radiation doses from normal operations and accidents. For high, acute individual doses (greater than or equal to 20 rem), the health risk factor was multiplied by 2 (NCRP 1993). The presentation of risks from radiation exposure associated with *SPD Supplemental EIS* activities are the increased risks of developing a cancer; that is, they are in addition to the risk of cancer from all other causes.

Using the risk factors discussed above, a calculated dose can be used to estimate the risk of an LCF. For example, if each member of a population of 100,000 people were exposed to a one-time dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem (100,000 persons times 0.1 rem). Using the risk factor of 0.0006 LCFs per person-rem, this collective dose is expected to cause 6 additional LCFs in this population (10,000 person-rem times 0.0006 LCFs per person-rem).

Table C–2 Nominal Health Risk Estimators Associated with Exposure to Ionizing Radiation [a]

Exposed Population	*Cancer* [b]	*Genetic Effects*	*Total*
Worker (adult) [c]	0.00041	0.00001	0.00042
Whole	0.00055	0.00002	0.00057

[a] Risk per rem (individual dose) or person-rem (population dose). For acute individual doses equal to or greater than 20 rem, the health risk estimators are multiplied by 2.
[b] Risk of all cancers, adjusted for lethality and quality-of-life impacts.
[c] Ages 18–64 years.
Source: Valentin 2007:Table A.4.4.

Calculations of the number of LCFs sometimes do not yield whole numbers and may yield a number less than 1. For example, if each individual of a population of 100,000 people were to receive an annual dose of 1 millirem (0.001 rem), the collective dose would be 100 person-rem, and the corresponding risk of an LCF would be 0.06 (100,000 persons times 0.001 rem times 0.0006 LCFs per person-rem). A fractional result should be interpreted as a statistical estimate. That is, 0.06 is the average number of LCFs expected if many groups of 100,000 people were to experience the same radiation exposure situation. For most groups, no LCFs would occur; in a few groups, 1 LCF would occur; in a very small number of groups, 2 or more LCFs would occur. The average number of LCFs over all of the groups would be 0.06 (just like the average of 0, 0, 0, and 1 is 1 divided by 4, or 0.25). In the preceding example, the most likely outcome for any single group would be 0 LCFs. In this *SPD Supplemental EIS*, LCFs calculated for a population are presented as both the rounded whole number, representing the most likely outcome for that population, and the calculated statistical estimate of risk, which is presented in parentheses.

The numerical estimates of LCFs presented in this *SPD Supplemental EIS* were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality resulting from a dose of 0.1 grays (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of LCFs. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation. However, a comprehensive review of available biological and biophysical data supports a "linear no-threshold" risk model in which the risk of cancer proceeds in a linear fashion at lower doses without a threshold and the smallest dose has the potential to cause a small increase in risk to humans (National Research Council 2006).

C.2 Assessment Approach

The dose assessments performed for this *SPD Supplemental EIS* were based on site-specific environmental data, facility-specific data, and assumptions related to various exposure parameters. Appendix F, Section F.10, of the S*urplus Plutonium Disposition Final Environmental Impact Statement (SPD EIS)* (DOE 1999) describes the methods that were used for the assessments for this *SPD Supplemental EIS*. The GENII Version 2 (GENII Environmental Dosimetry System, Version 2] computer code (Version 2.10) was used to calculate the projected doses from normal operations at SRS and LANL. The GENII computer code was developed under quality assurance plans based on the American National Standards Institute Standard NQA-1, is one of the toolbox models that meets DOE Order 414.1C, and is overseen by DOE's Office of Quality Assurance Policy and Assistance. All steps of code development were documented and tested, and hand calculations verified the code's implementation of major transport and exposure pathways for a subset of the radionuclide library. The code was reviewed by the EPA Science Advisory Board and a separate, EPA-sponsored, independent peer review panel. The quality assurance of GENII Version 2 has been reviewed by DOE (DOE 2003c) and continues to be rigorously reviewed with each updated version released by Pacific Northwest National Laboratory, the developer of the code.

C.2.1 Meteorological Data

The meteorological data used in the SRS and LANL dose assessments were created from joint frequency distribution (JFD) files. A JFD file is a table listing the percentage of time the wind blows in a certain direction, within a certain range of speeds, and within a certain stability class. JFD data for SRS were based on measurements taken at the nearby Vogtle Nuclear Power Plant over a 5-year period (1998 through 2002) at a height of 33 feet (10 meters); JFD data for LANL were based on measurements taken at Technical Area 6 (TA-6) over a 9-year period (1991 through 1999) at a height of 36.7 feet (11.2 meters). Average annual rainfall, meteorological station parameters, and windspeed midpoints were used in the normal operational assessments. **Tables C–3** and **C–4** present the JFD data used in the SRS and LANL analyses.

Table C–3 Savannah River Site Joint Frequency Distribution Data

Average Wind-speed (m/s)	*Stability Class*	*Direction in Which the Wind Blows*															
		S	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***	***N***	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***
Vogtle Nuclear Power Plant: 10-Meter Height, Based on 1998 through 2002 Meteorological Data																	
0.94	A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01
	B	0.01	0	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0	0.01	0	0.01	0	0	0
	C	0.01	0.03	0	0.02	0.02	0.02	0.03	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02
	D	0.17	0.18	0.17	0.12	0.18	0.14	0.13	0.17	0.17	0.15	0.18	0.18	0.14	0.15	0.15	0.13
	E	0.28	0.29	0.29	0.3	0.34	0.36	0.37	0.44	0.64	0.41	0.48	0.46	0.41	0.31	0.31	0.19
	F	0.25	0.29	0.28	0.29	0.42	0.35	0.32	0.33	0.45	0.45	0.42	0.49	0.5	0.32	0.23	0.18
	G	0.4	0.27	0.41	0.37	0.44	0.46	0.3	0.32	0.28	0.42	0.55	0.64	0.61	0.39	0.33	0.37
1.66	A	0.02	0.05	0.02	0.03	0.04	0.04	0.02	0.02	0.06	0.04	0.05	0.06	0.04	0.02	0.03	0.01
	B	0.03	0.04	0.03	0.03	0.01	0.03	0.03	0.05	0.03	0.04	0.05	0.02	0.02	0.02	0.02	0.03
	C	0.07	0.03	0.03	0.04	0.06	0.04	0.05	0.03	0.08	0.06	0.06	0.06	0.08	0.06	0.05	0.04
	D	0.36	0.28	0.26	0.26	0.28	0.19	0.22	0.27	0.32	0.25	0.33	0.37	0.33	0.31	0.26	0.27
	E	0.26	0.26	0.32	0.39	0.41	0.48	0.49	0.71	0.68	0.55	0.68	0.66	0.41	0.33	0.3	0.22
	F	0.18	0.13	0.18	0.24	0.33	0.31	0.32	0.3	0.39	0.38	0.66	0.65	0.42	0.33	0.19	0.16
	G	0.13	0.04	0.07	0.18	0.24	0.15	0.14	0.11	0.14	0.3	0.54	0.49	0.41	0.17	0.07	0.1
2.35	A	0.07	0.09	0.08	0.15	0.15	0.12	0.1	0.07	0.09	0.13	0.13	0.14	0.16	0.06	0.04	0.05
	B	0.07	0.07	0.08	0.11	0.09	0.06	0.05	0.04	0.07	0.11	0.11	0.12	0.13	0.06	0.06	0.08
	C	0.15	0.15	0.12	0.15	0.11	0.11	0.09	0.07	0.15	0.13	0.15	0.19	0.22	0.12	0.14	0.15
	D	0.71	0.58	0.67	0.62	0.57	0.36	0.27	0.41	0.52	0.5	0.57	0.61	0.57	0.46	0.46	0.51
	E	0.34	0.46	0.71	0.68	0.73	0.58	0.63	0.72	0.62	0.62	0.74	0.6	0.59	0.45	0.31	0.3
	F	0.14	0.15	0.24	0.38	0.29	0.18	0.14	0.18	0.14	0.24	0.27	0.29	0.16	0.13	0.08	0.09
	G	0.04	0.03	0.03	0.08	0.07	0.04	0.04	0.04	0.06	0.11	0.17	0.13	0.12	0.04	0.01	0.05
3.30	A	0.11	0.07	0.08	0.17	0.24	0.13	0.09	0.05	0.1	0.17	0.2	0.25	0.21	0.13	0.1	0.11
	B	0.1	0.07	0.08	0.09	0.09	0.04	0.03	0.04	0.05	0.11	0.12	0.1	0.14	0.11	0.09	0.14
	C	0.16	0.13	0.14	0.16	0.18	0.1	0.07	0.08	0.1	0.17	0.21	0.17	0.22	0.09	0.12	0.16
	D	0.4	0.45	0.8	0.71	0.39	0.23	0.32	0.25	0.26	0.42	0.43	0.43	0.51	0.46	0.24	0.33
	E	0.25	0.29	0.53	0.44	0.27	0.18	0.34	0.24	0.18	0.29	0.39	0.2	0.37	0.35	0.17	0.16
	F	0.05	0.05	0.06	0.09	0.02	0.01	0.01	0.02	0.01	0.04	0.02	0	0.02	0.01	0.01	0.03
	G	0.01	0	0	0	0	0	0.01	0	0	0.02	0	0	0	0	0	0
4.35	A	0.06	0.04	0.13	0.15	0.1	0.03	0.03	0.04	0.04	0.08	0.11	0.18	0.19	0.1	0.06	0.03
	B	0.07	0.03	0.05	0.09	0.08	0.03	0.03	0.01	0.03	0.04	0.08	0.08	0.11	0.09	0.03	0.04
	C	0.07	0.07	0.06	0.13	0.1	0.03	0.04	0.03	0.04	0.07	0.13	0.1	0.15	0.09	0.06	0.03
	D	0.22	0.13	0.54	0.48	0.21	0.1	0.12	0.16	0.11	0.16	0.21	0.24	0.37	0.29	0.11	0.12
	E	0.05	0.06	0.23	0.17	0.09	0.06	0.11	0.06	0.05	0.11	0.11	0.06	0.12	0.16	0.08	0.04
	F	0	0.02	0.02	0.01	0	0	0	0	0	0	0	0	0.01	0.02	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Average Wind-speed (m/s)	***Stability Class***	***Direction in Which the Wind Blows***															
		S	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***	***N***	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***
5.87	A	0.01	0.03	0.03	0.07	0.02	0	0.01	0.01	0.01	0.03	0.05	0.06	0.05	0.04	0.04	0
	B	0.01	0.02	0.02	0.05	0.02	0.01	0	0	0.01	0.02	0.05	0.05	0.05	0.08	0.03	0.01
	C	0.01	0.01	0.03	0.04	0	0	0.01	0.03	0.01	0.02	0.05	0.05	0.1	0.11	0.04	0
	D	0.06	0.08	0.16	0.22	0.05	0.02	0.1	0.04	0.02	0.09	0.1	0.13	0.21	0.21	0.08	0.04
	E	0.03	0.03	0.06	0.1	0.05	0.03	0.02	0.02	0.02	0.04	0.03	0.02	0.03	0.07	0.02	0.02
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0.01	0	0
	G	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0

m/s = meters per second.
Note: To convert meters per second to miles per hour, multiply by 2.237; meters to feet, by 3.2808.

Table C–4 Los Alamos National Laboratory Joint Frequency Distribution Data

Average Wind-speed (m/s)	***Stability Class***	***Direction in Which the Wind Blows***															
		S	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***	***N***	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***
Technical Area 6: 11.2-Meter Height, Based on 1991 through 1999 Meteorological Data																	
0.78	A	0.11	0.2	0.42	0.73	0.83	0.69	0.75	0.59	0.33	0.17	0.11	0.06	0.06	0.06	0.07	0.07
	B	0.03	0.07	0.13	0.2	0.19	0.13	0.13	0.14	0.11	0.06	0.04	0.02	0.02	0.02	0.02	0.02
	C	0.07	0.14	0.16	0.21	0.23	0.14	0.11	0.16	0.19	0.13	0.07	0.04	0.03	0.03	0.03	0.04
	D	0.75	0.63	0.51	0.39	0.4	0.36	0.36	0.48	0.77	0.78	0.7	0.57	0.52	0.49	0.62	0.65
	E	0.4	0.24	0.15	0.08	0.07	0.08	0.09	0.13	0.24	0.39	0.47	0.41	0.33	0.33	0.41	0.45
	F	0.36	0.2	0.12	0.04	0.05	0.05	0.06	0.07	0.12	0.21	0.39	0.49	0.69	0.61	0.64	0.48
2.45	A	0.07	0.1	0.26	0.4	0.53	0.79	1.16	1.14	0.63	0.22	0.11	0.07	0.07	0.06	0.08	0.07
	B	0.06	0.13	0.32	0.38	0.4	0.43	0.53	0.96	0.82	0.36	0.16	0.1	0.07	0.07	0.09	0.07
	C	0.15	0.42	0.57	0.43	0.51	0.44	0.28	0.98	1.73	0.9	0.47	0.26	0.18	0.16	0.23	0.12
	D	0.92	0.89	0.47	0.17	0.22	0.23	0.13	0.45	1.49	2.51	2.39	1.58	1.32	1.31	1.67	0.93
	E	0.29	0.12	0.05	0.01	0.01	0.02	0.02	0.04	0.14	0.45	0.97	1.86	1.5	1.23	2.66	0.84
	F	0.11	0.04	0	0	0	0	0.01	0.01	0.03	0.04	0.14	0.76	3.12	3.3	1.15	0.3
4.47	A	0.01	0	0	0	0	0	0.01	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
	B	0.02	0.02	0.02	0	0	0	0.03	0.16	0.33	0.25	0.18	0.08	0.03	0.02	0.05	0.04
	C	0.06	0.2	0.16	0.02	0.01	0.02	0.03	0.56	1.55	1.01	0.62	0.63	0.38	0.27	0.36	0.08
	D	0.07	0.23	0.05	0.01	0.01	0.01	0	0.11	0.25	0.63	0.61	0.75	1.62	1.74	0.86	0.1
	E	0	0	0	0	0	0	0	0	0	0	0.01	0.03	0.2	0.45	0.05	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.18	0	0
6.93	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	C	0	0.01	0	0	0	0	0	0.01	0.04	0.06	0.05	0.06	0.02	0.02	0.03	0
	D	0.01	0.04	0	0	0	0	0	0.02	0.06	0.16	0.15	0.33	0.88	1.1	0.22	0.01
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.61	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0.12	0.29	0.03	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

m/s = meters per second.
Note: To convert meters per second to miles per hour, multiply by 2.237; meters to feet, by 3.2808.

C.2.2 Population Data

The SRS and LANL population distributions were based on data from the 2010 census (Census 2010) for areas within 50 miles (80 kilometers) of the locations for the proposed facilities. The 2010 populations derived from the census were projected to the year 2020, which was selected as the representative year for full-scale operations, by calculating a linear trend developed using data from the 1990, 2000, and 2010 decennial censuses (Census 1990, 2001, 2010). The populations were spatially distributed on a circular grid with 16 directions and 10 radial distances out to 50 miles (80 kilometers). The grids were centered in F-Area, K-Area, and H-Canyon/S-Area, the locations from which radionuclides were assumed to be released during incident-free operations at SRS, and in TA-55 (the location of the Plutonium Facility [PF-4]) at LANL. During the population distribution allocation process, those individuals who were geographically situated within a sector that was entirely on SRS or LANL property were moved (for the analysis) to an adjoining sector to ensure that no individuals were assessed as if they were living on DOE property. **Tables C–5**, **C–6**, **C–7,** and **C–8** present the population data used for the dose assessments.

Potential maximally exposed individual (MEI) locations at the SRS site boundary for all 16 compass directions were evaluated to determine the boundary location that yielded the highest aggregate total effective dose for all facilities associated with the alternatives evaluated in this *SPD Supplemental EIS*. It was determined that an SRS site boundary location west-southwest of F-Area yielded the highest annual MEI dose for all alternatives. The distances and compass directions to this MEI location used in the GENII Version 2 modeling were 9.6 kilometers (6.0 miles) to the west-southwest for F-Area emissions; 12.9 kilometers (8.0 miles) to the west for H-Area emissions; and 12.3 kilometers (7.6 miles) to the west-northwest for K-Area emissions. For LANL, the MEI was 1 kilometer (0.6 miles) north of PF-4. This is the location of an onsite trailer park just inside the site boundary and yields the highest dose to an individual of any site boundary location around LANL.

Table C–5 Estimated Population Surrounding the Savannah River Site F-Area in the Year 2020

	Distance (miles)									
Direction	***0–1***	***1–2***	***2–3***	***3–4***	***4–5***	***5–10***	***10–20***	***20–30***	***30–40***	***40–50***
NNE	0	0	0	0	0	656	4,800	3,518	7,694	42,519
NE	0	0	0	0	0	83	3,061	3,636	7,593	29,767
ENE	0	0	0	0	0	0	3,751	4,703	5,559	36,655
E	0	0	0	0	0	0	4,179	5,841	10,017	7,181
ESE	0	0	0	0	0	0	3,827	3,897	2,222	3,072
SE	0	0	0	0	0	0	847	2,813	5,720	11,984
SSE	0	0	0	0	0	0	540	696	1,641	4,168
S	0	0	0	0	0	0	561	1,520	6,420	5,071
SSW	0	0	0	0	0	0	849	2,389	4,894	3,053
SW	0	0	0	0	0	129	1,511	6,768	2,023	2,042
WSW	0	0	0	0	0	185	2,370	4,786	2,493	6,240
W	0	0	0	0	0	417	8,852	15,191	6,868	8,114
WNW	0	0	0	0	0	1,810	6,446	162,172	76,799	17,746
NW	0	0	0	0	0	1,432	18,907	99,702	28,091	4,320
NNW	0	0	0	0	0	1,701	30,484	17,430	12,366	3,588
N	0	0	0	0	0	2,599	35,691	11,508	8,609	11,894
Total Population										**868,681**

Note: Centered on 33.2865 degrees latitude, 81.6776 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2010.

Table C–6 Estimated Population Surrounding the Savannah River Site K-Area in the Year 2020

Direction	Distance (miles)									
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
NNE	0	0	0	0	0	0	2,902	4,316	6,368	21,981
NE	0	0	0	0	0	0	2,615	4,595	4,887	15,086
ENE	0	0	0	0	0	0	3,025	6,005	7,184	25,043
E	0	0	0	0	0	0	6,221	4,117	6,807	4,402
ESE	0	0	0	0	0	70	1,377	3,243	3,169	4,542
SE	0	0	0	0	0	101	573	3,255	6,388	9,070
SSE	0	0	0	0	0	137	437	789	2,642	2,842
S	0	0	0	0	0	105	735	2,577	6,685	7,785
SSW	0	0	0	0	0	130	1,458	2,140	3,934	5,861
SW	0	0	0	0	0	195	1,111	2,202	1,973	2,369
WSW	0	0	0	0	0	255	2,676	7,619	1,830	6,902
W	0	0	0	0	0	199	2,871	5,430	5,251	5,888
WNW	0	0	0	0	0	168	5,136	74,953	46,827	17,351
NW	0	0	0	0	0	102	5,820	126,058	128,104	7,723
NNW	0	0	0	0	0	0	9,829	44,403	16,769	7,836
N	0	0	0	0	0	0	12,539	40,535	7,792	15,063
Total Population										**809,378**

Note: Centered on 33.2113 degrees latitude, 81.6648 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2010.

Table C–7 Estimated Population Surrounding the Savannah River Site H-Canyon/S-Area in the Year 2020

Direction	Distance (miles)									
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
NNE	0	0	0	0	0	540	3,856	3,583	8,771	49,916
NE	0	0	0	0	0	106	3,071	3,576	7,862	29,112
ENE	0	0	0	0	0	0	4,461	4,026	6,763	46,879
E	0	0	0	0	0	90	5,025	5,504	9,170	6,300
ESE	0	0	0	0	0	95	5,214	2,923	2,358	3,069
SE	0	0	0	0	0	0	1,207	3,931	5,313	11,442
SSE	0	0	0	0	0	0	531	790	2,003	4,788
S	0	0	0	0	0	0	576	1,028	6,318	4,899
SSW	0	0	0	0	0	0	639	2,573	4,883	3,089
SW	0	0	0	0	0	29	1,152	4,688	2,343	1,963
WSW	0	0	0	0	0	24	1,623	7,431	2,512	6,110
W	0	0	0	0	0	211	5,205	20,875	7,684	8,718
WNW	0	0	0	0	0	1,542	4,871	154,496	116,020	15,646
NW	0	0	0	0	0	910	14,490	77,733	27,595	3,876
NNW	0	0	0	0	0	2,460	41,140	22,390	13,315	4,999
N	0	0	0	0	0	1,051	14,991	9,559	7,835	14,500
Total Population										**886,267**

Note: Centered on 33.2913 degrees latitude, 81.6403 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2010.

Table C–8 Estimated Population Surrounding the Los Alamos National Laboratory Plutonium Facility in the Year 2020

Direction	Distance (miles)									
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
NNE	21	1,114	762	130	0	120	997	1,658	364	249
NE	7	302	888	593	101	396	6,077	6,108	1,644	3,724
ENE	0	0	363	247	37	295	19,447	4,459	2,442	3,801
E	0	0	58	26	31	327	6,413	2,883	1,259	1,944
ESE	0	4	0	10	18	5,611	2,607	51,893	2,926	3,003
SE	0	0	0	0	0	444	2,155	65,473	8,134	552
SSE	0	0	0	0	3	73	927	1,657	1,403	878
S	0	0	0	0	3	31	755	3,230	2,016	9,380
SSW	0	0	0	1	4	32	488	2,704	14,870	142,556
SW	0	0	0	1	2	36	153	880	2,867	32,582
WSW	0	0	0	0	1	36	209	809	1,493	274
W	0	0	0	0	0	62	292	457	416	769
WNW	0	0	30	0	0	56	249	269	1,567	341
NW	0	898	1,610	21	0	32	125	153	155	181
NNW	11	1,158	1,960	229	0	49	157	198	140	159
N	84	782	857	52	0	73	421	485	385	187
Total Population										**447,541**

Note: Centered on 35.8817 degrees latitude, 106.2983 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2010.

C.2.3 Agricultural Data

Ingestion exposures from atmospheric transport include ingestion of farm products and inadvertent ingestion of soil. Farm products include leafy vegetables, other vegetables, cereal grains, fruit, cow's milk, beef, poultry, and eggs. The concentration in plants at the time of harvest was evaluated as the sum of contributions from deposition onto plant surfaces, as well as uptake through the roots. Pathways by which animal products may become contaminated include animal ingestion of contaminated plants, water, and soil. The human consumption rates used in the dose assessments for the MEI and average exposed individual in the surrounding population were those provided in NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR 50,* Appendix I (NRC 1977).

C.2.4 Source Term Data

Table C–9 presents the stack parameters for SRS and LANL facilities. Stack heights and release locations were provided in the responses to the facility data requests supporting this *SPD Supplemental EIS* (DOE/NNSA 2012; LANL 2013; SRNS 2012a; WSRC 2008), and the *SPD EIS* (DOE 1999).

Table C–9 Stack Parameters

Stack Parameter	KIS	PDC	Immobilization Capability	H-Canyon/ HB-Line	MFFF [a]	PDCF	WSB	LANL PF-4
Height (meters)	15.2	24.4	28.0	59.4	36.6	36.6	15.2	9.5
Area (square meters)	0.073	4.7	3.6	14.9	5.3	5.9	1.8	0.679

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; WSB = Waste Solidification Building.

[a] The same stack would be used for potential releases from fuel fabrication activities at MFFF as well as potential releases from metal oxidation furnaces if they are installed at MFFF.

Note: To convert meters to feet, multiply by 3.2808; square meters to square feet, by 10.764

Source: DOE 1999; DOE/NNSA 2012; LANL 2013; SRNS 2012a; WSRC 2008.

Tables C–10 through **C–15,** respectively, present the estimated incident-free radiological releases, based on plutonium-239 dose equivalents, associated with operations at the following SRS facilities: K-Area Interim Surveillance (KIS), the K-Area immobilization capability, H-Canyon/HB-Line processing to the Defense Waste Processing Facility (DWPF), the Mixed Oxide Fuel Fabrication Facility (MFFF) at F-Area, the Pit Disassembly and Conversion Facility (PDCF) at F-Area and the Pit Disassembly and Conversion Project (PDC) at K-Area, the Waste Solidification Building (WSB) at F-Area, and metal oxidation at MFFF. **Table C–16** presents estimated incident-free radiological releases from pit disassembly and conversion activities at LANL's PF-4. Plutonium-equivalent source term estimates were derived using Federal Guidance Report 13 (EPA 1999) dose factors. The source terms were either provided directly or derived from empirical source term data conveyed in responses to facility data requests supporting this *SPD Supplemental EIS* (DOE/NNSA 2012; LANL 2013; SRNS 2012a) and the *SPD EIS* (DOE 1999). Source terms were not provided in the data responses for the H-Canyon/HB-Line activities addressed in this *SPD Supplemental EIS* (i.e., processing plutonium metal to an oxide for transfer to MFFF, processing non-pit plutonium for fabrication into mixed oxide [MOX] fuel at MFFF, processing non-pit plutonium for transfer to DWPF, and processing pit and non-pit plutonium for disposal at the Waste Isolation Pilot Plant [WIPP]); rather, dose estimates were provided.

Table C–10 Annual Radiological Releases from K-Area Interim Surveillance Capability Activities

Isotope (curies per year)	*All Alternatives*
Plutonium-239 dose equivalent	1.6×10^{-7}

Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012a.

Table C–11 Annual Radiological Releases from the Immobilization Capability

Isotope (curies per year)	*Immobilization to DWPF Alternative*
Plutonium-239 dose equivalent	1.8×10^{-6}

DWPF = Defense Waste Processing Facility.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012a.

Table C–12 Annual Radiological Releases from the Mixed Oxide Fuel Fabrication Facility

Isotope (curies per year)	*Alternative*		
	No Action and Immobilization to DWPF Alternatives	*H-Canyon/HB-Line to DWPF and WIPP Alternatives*	*MOX Fuel Alternative*
Plutonium-239 dose equivalent	1.0×10^{-4}	1.1×10^{-4}	1.2×10^{-4}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012a; WSRC 2008.

Table C–13 Annual Radiological Releases from the Pit Disassembly and Conversion Facility and the Pit Disassembly and Conversion Project at K-Area

Isotope (curies per year)	*Alternative*	
	PDCF (All Alternatives)	*PDC at K-Area (MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives)*
Plutonium-239 dose equivalent	3.1×10^{-3}	4.0×10^{-3}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012a.

Table C–14 Annual Radiological Releases from the Waste Solidification Building

Isotope (curies per year)	*All Alternatives*
Plutonium-239 dose equivalent	9.3×10^{-5}

Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012a.

Table C–15 Annual Radiological Releases from Metal Oxidation at the Mixed Oxide Fuel Fabrication Facility

Isotope (curies per year)	*Alternative*
	Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives
Plutonium-239 dose equivalent	8.3×10^{-4}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2011a.

Table C–16 Annual Radiological Releases from Pit Disassembly and Conversion Activities at the Los Alamos National Laboratory Plutonium Facility

Isotope (curies per year)	*Alternative*	
	No Action, Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives (process 2 metric tons)	*Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives (process 35 metric tons)*
Plutonium-239 dose equivalent	2.4×10^{-4}	2.0×10^{-3}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999). To convert metric tons to tons, multiply by 1.1023.
Source: LANL 2013.

Because activities associated with the K-Area storage only involve receipt, storage, and shipping of materials within certified shipping containers, no airborne radiological emissions would result from these activities.

Under the H-Canyon/HB-Line to DWPF Alternative, DWPF would vitrify surplus plutonium dissolved at H-Canyon/HB-Line with liquid high-level radioactive waste (HLW). Filled canisters of vitrified HLW would be stored at the S-Area Glass Waste Storage Buildings pending their ultimate disposition. It was estimated that the additional production would require an increase in DWPF operations by a range of 2 weeks to 3 months. The plutonium mixed with the HLW would not add any significant contribution to the DWPF normal release source term. Similarly, no plutonium would be released from the can-in-canisters containing immobilized plutonium that would be vitrified at DWPF under the Immobilization to DWPF Alternative. Therefore, no incremental increases in normal releases or impacts on onsite or offsite receptors from DWPF or the Glass Waste Storage Buildings are expected (SRNS 2012a; WSRC 2008).

C.2.5 Other Calculation Assumptions

To estimate the radiological impacts of incident-free operation of the plutonium facilities at SRS and LANL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977):

- Receptors were assumed to be exposed to radioactive material deposited on the ground from facility emissions. Exposure pathways include direct exposure, inhalation, and translocation through the food chain.

- The annual external exposure time to the plume and soil contamination was assumed to be 0.7 years for the MEI.
- The annual external exposure time to the plume and soil contamination was assumed to be 0.5 years for the population.
- The annual inhalation exposure time to the plume was assumed to be 1 year for the MEI and general population.
- The exposed individual and population were assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of adult humans.
- A finite plume (i.e., Gaussian) model was assumed for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of animal products.
- The calculated doses were assumed to be 50-year committed effective doses from 1 year of intake.

In addition to the calculation assumptions listed above, a risk estimator of 0.0006 latent cancer deaths per rem or person-rem (600 cancer deaths per 1 million rem or person-rem) received by workers or members of the public was used in the impact assessments (DOE 2003a).

C.3 Savannah River Site

The following subsections present the potential incident-free radiological impacts that could occur from each of the separate facilities/processes at SRS. Human health risks from construction and normal operations were evaluated for several individual and population groups, including facility workers, a hypothetical MEI at the site boundary, and the regional population.

For the purposes of this *SPD Supplemental EIS*, a worker is a facility worker who is directly or indirectly involved with operations at a facility and might receive an occupational radiation exposure due to direct radiation (neutron, x-ray, beta, or gamma) or through radionuclides released as a part of normal operations. Direct radiation exposure from plutonium materials or contaminants in the material (e.g., americium-241) and residual amounts of similar material (contamination) within the facility would dominate the potential occupational exposure to onsite workers. Noninvolved workers outside of the facility would not be subject to direct radiation exposure due to building shielding and appreciable distances between operational facilities, but could be exposed to operational releases.

Workers at SRS may receive radiation doses slightly above those received by an individual at an offsite location. The 5-year average dose measured using thermoluminescent dosimeters near the burial grounds at the center of the site (E-Area) was 126 millirem; the 5-year average dose at an offsite control location (Highway 301) was 87 millirem. Because the onsite location is near active radioactive waste management operations, the dose may be conservatively high and not representative of other locations at the site. The 5-year average dose at another onsite monitoring location (D-Area) was 74 millirem, lower than the offsite location (SRNS 2009, 2010, 2011b; 2012b; WSRC 2008). This implies that there could be no significant difference between doses at onsite and offsite locations. Using the higher onsite location as a basis and adjusting the doses for a 2080-hour work-year, a worker could receive an annual dose of about 9 millirem from being employed at SRS. A 9 millirem dose is an increase of about 3 percent over the average annual dose one would receive from all sources of natural background radiation. The additional dose results in an increased annual risk of a latent fatal cancer of 5×10^{-6} or 1 chance in 200,000.

For this *SPD Supplemental EIS*, all of the materials released due to plutonium operations would be hydrogen-3 (tritium) and particulates (primarily plutonium isotopes and americium-241) that would be released through tall stacks. Particulates would be filtered through high-efficiency particulate air filters, sand filters, or both, before being released. These filter systems are designed to protect the onsite workforce and the public from normal and accidental releases. Normal releases are very small—in the microcurie to millicurie-per-year range in most cases. Monitoring results for SRS are reported in the annual site environmental reports, which indicate that the doses to the onsite populations are primarily from natural background radiation. During some past operations periods, airborne releases from reactor and used fuel operations have occurred, including releases of tritium, noble gases, iodine, and fission products. During recent operations, airborne releases of tritium from tritium operations and fission products from used fuel processing have occurred. As indicated in the annual site environmental reports, normal concentrations of plutonium in the air are very small and are at a level similar to those in other parts of the country.

As indicated by the results for the offsite MEI, the annual potential doses from normal releases (on the order of 0.01 millirem) are small fractions (approximately 0.003 percent) of the natural background radiation dose of 311 millirem per year (see Chapter 3, Section 3.1.6.1). A conservative estimate of the dose to a noninvolved onsite SRS worker was calculated using the GENII Version 2 computer code. Assuming no shielding, a location 1,000 meters (3,300 feet) from the SRS facility that would result in the highest offsite MEI dose, and 2,080 hours per year of exposure, the noninvolved worker would receive an incremental annual dose of about 0.010 millirem. This dose is small and comparable to the dose received by the MEI. The small doses to noninvolved workers from normal facility operations were not evaluated any further in this *SPD Supplemental EIS*. Doses to the offsite MEI, the offsite population, and the noninvolved worker under accident conditions were evaluated, as described in Appendix D of this *SPD Supplemental EIS*.

C.3.1 K-Area Storage, K-Area Interim Surveillance Capability, K-Area Pit Disassembly and Conversion Project, and Pit Disassembly in a K-Area Complex Glovebox

C.3.1.1 Construction

There would be no radiological risk to members of the public from potential construction or modification at K-Area facilities associated with storage, surveillance, or pit disassembly and conversion. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept ALARA. Construction workers would be monitored (badged), as appropriate. Limited demolition, removal, and decontamination actions at K-Area were completed in January 2008; however, it is possible that new construction to support PDC or a pit disassembly capability could take place within areas that nevertheless exhibit residual contamination levels. PDC construction activities would include 2 years of decontamination and equipment removal from K-Area. The 28 PDC workers involved in decontamination and equipment removal would receive an average annual dose of 18 millirem. This would result in a collective worker dose of 0.5 person-rem per year and a total dose of 1.0 person-rem over the anticipated 2-year construction period (SRNS 2012a).

To enable pit disassembly, the existing KIS glovebox, or a similar existing or new glovebox, would be modified or installed at the K-Area Complex. There would be an average annual dose of 100 millirem to 20 construction workers. This would result in a collective worker dose of 2.0 person-rem per year and 4.0 person-rem over the anticipated 2-year construction period (SRNL 2013).

C.3.1.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would continue at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999) and subsequent supplement analyses, as well as the *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina* (*MFFF EIS*) (NRC 2005). Where planned operations have changed substantially and might affect potential worker radiological exposures, they are noted.

Program activities under the No Action Alternative that would result in doses to workers include the following:

- *K-Area Storage*. Storage of non-pit plutonium in the K-Area Complex and gradual transfer to MFFF were previously evaluated in the first supplement analysis for the *SPD EIS* (*SPD EIS SA-1*) (DOE 2003b); the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996), including its first (SA-1) (DOE 1998), second (SA-2) (DOE 2002), and fourth (SA-4) (DOE 2007) supplement analyses; and the *Environmental Assessment for the Safeguards and Security Upgrades for Storage of Plutonium Materials at the Savannah River Site* (*Safeguards and Security EA*) (DOE 2005). Material storage in the K-Area Complex in support of the surplus plutonium disposition program would continue for about 40 years.[1]
- *KIS*. Operation of KIS would support the ongoing plutonium storage container surveillance mission (DOE 2005). KIS operations would continue for about 40 years.

Under the Immobilization to DWPF Alternative, the following possible program activities would result in worker doses:

- *K-Area Storage*. Activities at this area would be similar to those as discussed under the No Action Alternative, including removal of shipping containers from storage for transport to other onsite facilities. Worker impacts would be similar to those from current and recent container receipt and placement activities in storage locations. No net increase in worker impacts is expected. K-Area storage operations in support of the surplus plutonium disposition program would continue for 20 years.
- *KIS*. Operation of KIS would support plutonium storage container surveillance (DOE 2005). KIS operations would continue for 15 years.
- *Pit disassembly*. Under the PF-4 at LANL and H-Canyon/HB-Line and MFFF at SRS Option for pit disassembly and conversion, plutonium pits would be disassembled within a K-Area Complex glovebox with the plutonium being transferred to H-Canyon/HB-Line for oxidation. Pit disassembly operations would continue for 14 years.

Under the MOX Fuel Alternative, the following program activities would result in worker doses:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS.* Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 7 years.
- *PDC.* Under the option to construct PDC at K-Area to carry out the pit disassembly and conversion function, this facility would operate for a period of 12 years.
- *Pit disassembly.* Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

[1] *The K-Area Material Storage Area is the principal capability at the K-Area Complex for plutonium storage.*

Under the H-Canyon/HB-Line to DWPF Alternative, the following program activities would result in worker doses:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS*. Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 10 years.
- *PDC.* Operation of PDC at K-Area would be the same as under the MOX Fuel Alternative, operating for a period of 12 years.
- *Pit disassembly*. Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

Under the WIPP Alternative, program activities that would result in worker doses include the following:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS*. Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 7 years.
- *PDC.* Operation of PDC at K-Area would be the same as under the MOX Fuel Alternative, operating for a period of 12 years.
- *Pit disassembl*y. Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

Under all alternatives, because surplus plutonium activities for K-Area storage only involve receipt, storage, and shipping of materials within certified transportation packages that are not opened, no airborne radiological emissions would occur from these activities during normal operations. At KIS, the transportation packages would be opened and the DOE-STD-3013 containers (DOE 2012) would be opened within a glovebox. Small amounts of plutonium could become airborne within the glovebox and be transported through high-efficiency particulate air filters and a stack to the atmosphere. Workers performing these activities would be exposed to direct gamma and neutron radiation from plutonium in shipping packages, DOE-STD-3013 containers, and gloveboxes. At PDC, it is expected that workers would be exposed to direct gamma and neutron radiation from the handling of pit material. Small amounts of plutonium could become airborne from metal oxidation and be transported through high-efficiency particulate air filters and a stack to the atmosphere. For disassembly of pits within a K-Area Complex glovebox, workers would be exposed to direct gamma and neutron radiation from plutonium. For the option of disassembling pits in a K-Area Complex glovebox, oxidation of the pit metal would occur in H-Canyon/HB-Line. No emissions of offsite consequence are expected from K-Area glovebox pit disassembly activities.

Table C–17 presents the projected incident-free radiological impacts on workers from storage operations at the K-Area Complex. The total numbers of projected LCFs are also reported for the differing periods of operation per alternative. As indicated above, no impacts to the public are expected due to the absence of airborne emissions.

Tables C–18 through **C–22** present the projected incident-free radiological impacts on workers and the public from operations at KIS and PDC and from pit disassembly activities in K-Area Complex gloveboxes (SRNS 2012a; WSRC 2008). The total numbers of projected LCFs are also reported for the differing periods of operation per alternative.

Table C–17 Radiological Impacts on Workers from K-Area Storage Operations

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for K-Area Storage	**40**	**20**	**22**	**22**	**22**
Total Workforce					
Number of radiation workers	24	24	24	24	24
Collective dose (person-rem per year)	8.9	8.9	8.9	8.9	8.9
Annual LCFs [a]	0 (0.005)	0 (0.005)	0 (0.005)	0 (0.005)	0 (0.005)
Life-of-Project LCFs [a]	0 (0.2)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
Average Worker					
Dose (millirem per year) [b]	370	370	370	370	370
Annual LCF risk	0.0002	0.0002	0.0002	0.0002	0.0002
Life-of-Project LCF risk	0.009	0.004	0.005	0.005	0.005

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: DOE 1998; SRNS 2012a.

Table C–18 Radiological Impacts on the Public from Operation of the K-Area Interim Surveillance Capability

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for KIS	**40**	**15**	**7**	**10**	**7**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}
Percent of natural background radiation [a]	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}
Annual LCFs [b]	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})
Life-of-Project LCFs [b]	0 (1×10^{-6})	0 (4×10^{-7})	0 (2×10^{-7})	0 (3×10^{-7})	0 (2×10^{-7})
Maximally Exposed Individual					
Annual dose (millirem)	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}
Percent of natural background radiation [a]	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}
Annual LCF risk	5×10^{-13}	5×10^{-13}	5×10^{-13}	5×10^{-13}	5×10^{-13}
Life-of-Project LCF risk	2×10^{-11}	8×10^{-12}	4×10^{-12}	5×10^{-12}	4×10^{-12}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}
Annual LCF risk	3×10^{-14}	3×10^{-14}	3×10^{-14}	3×10^{-14}	3×10^{-14}
Life-of-Project LCF risk	1×10^{-12}	5×10^{-13}	2×10^{-13}	3×10^{-13}	2×10^{-13}

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area).

Table C–19 Radiological Impacts on Workers from Operation of the K-Area Interim Surveillance Capability

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for KIS	**40**	**15**	**7**	**10**	**7**
Total Workforce					
Number of radiation workers	40	40	40	40	40
Collective dose (person-rem per year)	25	25	25	25	25
Annual LCFs [a]	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	1 (0.6)	0 (0.2)	0 (0.1)	0 (0.2)	0 (0.1)
Average Worker					
Dose (millirem per year) [b]	630	630	630	630	630
Annual LCF risk	0.0004	0.0004	0.0004	0.0004	0.0004
Life-of-Project LCF risk	0.02	0.006	0.003	0.004	0.003

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a; WSRC 2008.

Table C–20 Radiological Impacts on the Public from Operation of the Pit Disassembly and Conversion Project in K-Area

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for PDC	**N/A**	**N/A**	**12**	**12**	**12**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	0.44	0.44	0.44
Percent of natural background radiation [a]	N/A	N/A	0.00017	0.00017	0.00017
Annual LCFs [b]	N/A	N/A	0 (0.0003)	0 (0.0003)	0 (0.0003)
Life-of-Project LCFs [b]	N/A	N/A	0 (0.003)	0 (0.003)	0 (0.003)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	0.0061	0.0061	0.0061
Percent of natural background radiation [a]	N/A	N/A	0.0020	0.0020	0.0020
Annual LCF risk	N/A	N/A	4×10^{-9}	4×10^{-9}	4×10^{-9}
Life-of-Project LCF risk	N/A	N/A	4×10^{-8}	4×10^{-8}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	N/A	0.00054	0.00054	0.00054
Annual LCF risk	N/A	N/A	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	N/A	N/A	4×10^{-9}	4×10^{-9}	4×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area).

Table C–21 Radiological Impacts on Workers from Operation of the Pit Disassembly and Conversion Project in K-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDC	**N/A**	**N/A**	**12**	**12**	**12**
Total Workforce					
Number of radiation workers	N/A	N/A	383	383	383
Collective dose (person-rem per year)	N/A	N/A	190	190	190
Annual LCFs [a]	N/A	N/A	0 (0.1)	0 (0.1)	0 (0.1)
Life-of-Project LCFs	N/A	N/A	1 (1.4)	1 (1.4)	1 (1.4)
Average Worker					
Dose (millirem per year) [b]	N/A	N/A	500	500	500
Annual LCF risk	N/A	N/A	0.0003	0.0003	0.0003
Life-of-Project LCF risk	N/A	N/A	0.004	0.004	0.004

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a; WSRC 2008.

Table C–22 Radiological Impacts on Workers from Pit Disassembly Activities in K-Area Complex Gloveboxes

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Pit Disassembly Activities in K-Area Complex Gloveboxes	**N/A**	**14**	**14**	**14**	**14**
Total Workforce					
Number of radiation workers	N/A	50	50	50	50
Collective dose (person-rem per year)	N/A	28	28	28	28
Annual LCFs [a]	N/A	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	N/A	0 (0.2)	0 (0.2)	0 (0.2)	0 (0.2)
Average Worker					
Dose (millirem per year) [b]	N/A	560	560	560	560
Annual LCF risk	N/A	0.0003	0.0003	0.0003	0.0003
Life-of-Project LCF risk	N/A	0.005	0.005	0.005	0.005

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNL 2013; WSRC 2008.

C.3.2 Immobilization Capability in K-Area

C.3.2.1 Construction

There would be no radiological risk to members of the public from the construction of a new immobilization capability at K-Area. The majority of the construction activities would occur in areas where dose rates would be close to background radiation levels, and there would be a limited amount of equipment in place that would require decontamination and removal. Due to the nature of contamination, the external dose rates from this equipment would be low. Total dose rates for the 2 years of decontamination and equipment removal during the construction phase would be about 3.3 person-rem per year; the average estimated dose rate would be about 46 millirem per worker per year for a member of the exposed construction workforce of 72 workers (SRNS 2012a). The total construction workforce dose would be 6.6 person-rem over the 2-year period. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept ALARA. Construction workers would be monitored (badged) as appropriate.

C.3.2.2 Operations

Under the Immobilization to DWPF Alternative, program activities that would result in worker and potentially offsite population doses are the processing of 13.1 metric tons (14.4 tons) of surplus plutonium in a new immobilization capability within K-Area. Processing this material is anticipated to require about 10 years of operation. This period of operation was used for projecting potential total numbers of latent cancers. **Tables C–23** and **C–24** present the projected incident-free radiological impacts of operation of the new immobilization capability.

Table C–23 Radiological Impacts on the Public from Operation of the K-Area Immobilization Capability

	Alternative				
Impact Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Immobilization	**N/A**	**10**	**N/A**	**N/A**	**N/A**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.00062	N/A	N/A	N/A
Percent of natural background radiation [a]	N/A	2.5×10^{-7}	N/A	N/A	N/A
Annual LCFs	N/A	0 (4×10^{-7})	N/A	N/A	N/A
Life-of-Project LCFs [b]	N/A	0 (4×10^{-6})	N/A	N/A	N/A
Maximally Exposed Individual					
Annual dose (millirem)	N/A	7.5×10^{-6}	N/A	N/A	N/A
Percent of natural background radiation [a]	N/A	2.4×10^{-6}	N/A	N/A	N/A
Annual LCF risk	N/A	5×10^{-12}	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	5×10^{-11}	N/A	N/A	N/A
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	7.7×10^{-7}	N/A	N/A	N/A
Annual LCF risk	N/A	5×10^{-13}	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	5×10^{-12}	N/A	N/A	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 809,000 for K-Area).

Table C–24 Radiological Impacts on Workers from Operation of the K-Area Immobilization Capability

	Alternative				
Impact Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Immobilization	**N/A**	**10**	**N/A**	**N/A**	**N/A**
Total Workforce					
Number of radiation workers	N/A	314	N/A	N/A	N/A
Collective dose (person-rem per year)	N/A	310	N/A	N/A	N/A
Annual LCFs [a]	N/A	0 (0.2)	N/A	N/A	N/A
Life-of-Project LCFs [a]	N/A	2 (1.9)	N/A	N/A	N/A
Average Worker					
Dose (millirem per year) [b]	N/A	1,000	N/A	N/A	N/A
Annual LCF risk	N/A	0.0006	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	0.006	N/A	N/A	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a.

C.3.3 H-Canyon/HB-Line

C.3.3.1 Construction

Under any of the action alternatives, implementation of the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion would require modifications at the H-Canyon/HB-Line to support dissolution of metal and conversion to plutonium oxide feed for MFFF (pit disassembly would occur in a K-Area Complex glovebox; see Section C.3.1). Modification activities may result in construction workforce doses (an average dose of 100 millirem per worker per year) to 10 workers. Annual workforce doses are not expected to exceed 1.0 person-rem per year; over the 2 years required for these modifications, the workforce would receive a collective dose of 2.0 person-rem (SRNL 2013).

No significant modifications to H-Canyon/HB-Line would be needed to enable processing of surplus plutonium to prepare it for vitrification at DWPF under the H-Canyon/HB-Line to DWPF Alternative (SRNL 2013). Any equipment modifications or piping realignments would be conducted as part of normal operations.

Under the WIPP Alternative, construction workforce doses (an average dose of 58 millirem per worker per year) to 10 workers may result from modifications at the H-Canyon/HB-Line to support preparation of 13.1 metric tons (14.4 tons) of surplus plutonium for potential disposal at WIPP. A total potential construction workforce dose of 1.2 person-rem would occur over the estimated 2-year modification duration (SRNL 2013; WSRC 2008).

Under the MOX Fuel Alternative, H-Canyon/HB-Line may require modifications to dissolve and prepare 4 metric tons (4.4 tons) of non-pit plutonium as feed for MOX fuel fabrication and/or prepare 2 metric tons (2.2 tons) of surplus plutonium for potential WIPP disposal. The amount of modification work needed to accommodate these actions would depend on the planned processing rate. Modifications would range from minor modifications that would be made as part of normal operations to the level of modifications referred to above for preparation of 13.1 metric tons (14.4 tons) of plutonium for potential WIPP disposal.

There would be no radiological risks to members of the public from any of the potential modification scenarios of H-Canyon/HB-Line.

C.3.3.2 Operations

Processing 6 metric tons of non-pit plutonium for transfer to DWPF. Under the H-Canyon/HB-Line to DWPF Alternative, 6 metric tons (6.6 tons) of surplus non-pit plutonium could be dissolved, processed, and transferred to the liquid radioactive waste tank farm to become part of the feed to the HLW vitrification system at DWPF. No changes are expected in air or liquid emissions and discharges under this processing option. Dissolution, storage, and transfer of surplus plutonium are currently being performed under existing permits (WSRC 2008).

No changes in worker radiological exposure rates at H-Canyon are expected due to this processing option versus other materials normally handled at H-Canyon. H-Canyon missions currently include dissolution, storage, and transfer of surplus plutonium, and controls are in place for limiting personnel doses. Projected doses are estimated for each material type prior to the start of a campaign. Activities related to plutonium processing operations on HB-Line would result in an increase in worker exposure. It is estimated that 14 radiation workers would receive an average annual dose of 500 millirem as a result of these operations (SRNL 2013). Processing this material is expected to require about 13 years of operation under the H-Canyon/HB-Line to DWPF Alternative. This period of operation was used to project the total numbers of LCFs for all receptors. Processing this material is expected to require about 13 years of operation under the H-Canyon/HB-Line to DWPF Alternative. This period of operation was used to project the total numbers of LCFs for all receptors.

Processing 10 metric tons of pit and metallic plutonium for transfer to MFFF. Under all of the action alternatives, if the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion were implemented, 10 metric tons (11 tons) of surplus plutonium could be processed through the H-Canyon/HB-Line and sent to MFFF. Processing this material is expected to require about 14 years of operation under all action alternatives. This period of operation was used to project the total numbers of LCFs for all receptors.

Processing 4 metric tons of non-pit plutonium for transfer to MFFF. Under the MOX Fuel Alternative, 4 metric tons (4.4 tons) of non-pit plutonium would be processed through H-Canyon/HB-Line and sent to MFFF for MOX fuel. Processing this material is expected to require about 6 years.

Processing non-pit and pit plutonium for shipment to WIPP. Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of surplus plutonium could be processed through H-Canyon/HB-Line in preparation for ultimate transport to WIPP. Under the WIPP Alternative, 6 metric tons (6.6 tons) of non-pit plutonium would be processed through H-Canyon/HB-Line, and 7.1 metric tons (7.8 tons) of pit plutonium could be processed through H-Canyon/HB-Line. Processing this material is expected to require about 10 years of operation under the MOX Fuel Alternative and 25 total years under the WIPP Alternative. These periods of operation were used to project the estimated numbers of LCFs for all receptors. As an option to processing pit plutonium through H-Canyon/HB-Line at SRS for potential disposal at WIPP, these activities could be performed in TA-55 facilities at LANL, such as PF-4. Processing all or a portion of the 7.1 metric tons (7.8 tons) of pit plutonium at TA-55 facilities would reduce the operational period for this activity in H-Canyon/HB-Line by up to 12 years. Any reduction in the amount of material processed and operational period would result in a corresponding reduction to total public and worker impacts.

Tables C–25 through **C–30** present the projected incident-free radiological impacts at H-Canyon/ HB-Line for all three processing scenarios discussed above.

Table C–25 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Processing Surplus Non-Pit Plutonium for Transfer to the Defense Waste Processing Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to DWPF	**N/A**	**N/A**	**N/A**	**13**	**N/A**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	N/A	0.26	N/A
Percent of natural background radiation [a]	N/A	N/A	N/A	9.4×10^{-5}	N/A
Annual LCFs [b]	N/A	N/A	N/A	0 (0.0002)	N/A
Life-of-Project LCFs [b]	N/A	N/A	N/A	0 (0.002)	N/A
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	N/A	0.0024	N/A
Percent of natural background radiation [a]	N/A	N/A	N/A	0.00077	N/A
Annual LCF risk	N/A	N/A	N/A	1×10^{-9}	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	2×10^{-8}	N/A
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	N/A	N/A	0.00029	N/A
Annual LCF risk	N/A	N/A	N/A	2×10^{-10}	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	2×10^{-9}	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated value is provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Source: SRNL 2013.

Table C–26 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Processing Surplus Non-Pit Plutonium for Transfer to the Defense Waste Processing Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to DWPF	**N/A**	**N/A**	**N/A**	**13**	**N/A**
Total Workforce					
Number of radiation workers [a]	N/A	N/A	N/A	14	N/A
Collective dose (person-rem per year)	N/A	N/A	N/A	7.0	N/A
Annual LCFs [b]	N/A	N/A	N/A	0 (0.004)	N/A
Life-of-Project LCFs [b]	N/A	N/A	N/A	0 (0.05)	N/A
Average Worker					
Dose (millirem per year) [c]	N/A	N/A	N/A	500	N/A
Annual LCF risk	N/A	N/A	N/A	0.0003	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	0.004	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] It was estimated that no more than 30 percent of the 46 radiation workers at H-Canyon would be involved with plutonium processing activities under the H-Canyon/HB-Line to DWPF Alternative (i.e., 14 radiation workers).

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated value is provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNL 2013.

Table C–27 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Pit and Metal Conversion to Oxide for Mixed Oxide Fuel Fabrication

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to MFFF	**N/A**	**14**	**14**	**14**	**14**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.26	0.26	0.26	0.26
Percent of natural background radiation [a]	N/A	9.4×10^{-5}	9.4×10^{-5}	9.4×10^{-5}	9.4×10^{-5}
Annual LCFs [b]	N/A	0 (0.0002)	0 (0.0002)	0 (0.0002)	0 (0.0002)
Life-of-Project LCFs [b]	N/A	0 (0.002)	0 (0.002)	0 (0.002)	0 (0.002)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	0.0024	0.0024	0.0024	0.0024
Percent of natural background radiation [a]	N/A	0.00077	0.00077	0.00077	0.00077
Annual LCF risk	N/A	1×10^{-9}	1×10^{-9}	1×10^{-9}	1×10^{-9}
Life-of-Project LCF risk	N/A	2×10^{-8}	2×10^{-8}	2×10^{-8}	2×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	0.00029	0.00029	0.00029	0.00029
Annual LCF risk	N/A	2×10^{-10}	2×10^{-10}	2×10^{-10}	2×10^{-10}
Life-of-Project LCF risk	N/A	2×10^{-9}	2×10^{-9}	2×10^{-9}	2×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Note: Potential public impacts from the separate processing of 4 metric tons (4.4 tons) of non-pit plutonium for feed to MFFF (applicable under the MOX Fuel Alternative only) would be subsumed within the values provided in the MOX Fuel column.

Source: SRNL 2013.

Table C–28 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Pit and Metal Conversion to Oxide for Mixed Oxide Fuel Fabrication

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to MFFF	**N/A**	**14**	**14**	**14**	**14**
Total Workforce					
Number of radiation workers	N/A	100	100	100	100
Collective dose (person-rem per year)	N/A	29	29	29	29
Annual LCFs [a]	N/A	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	N/A	0 (0.2)	0 (0.2)	0 (0.2)	0 (0.2)
Average Worker					
Dose (millirem per year) [b]	N/A	290	290	290	290
Annual LCF risk	N/A	0.0002	0.0002	0.0002	0.0002
Life-of-Project LCF risk	N/A	0.002	0.002	0.002	0.002

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: Potential worker impacts from the separate processing of 4 metric tons (4.4 tons) of non-pit plutonium for feed to MFFF (applicable under the MOX Fuel Alternative only) would be subsumed within the values provided in the MOX Fuel column.

Source: SRNL 2013.

Table C–29 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Processing to the Waste Isolation Pilot Plant

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel* [a]	*H-Canyon/ HB-Line to DWPF*	*WIPP* [a]
Operational Years for H-Canyon/ HB-Line Processing to WIPP	**N/A**	**N/A**	**10**	**N/A**	**25**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	0.26	N/A	0.26
Percent of natural background radiation [b]	N/A	N/A	9.4×10^{-5}	N/A	9.4×10^{-5}
Annual LCFs [c]	N/A	N/A	0 (0.0002)	N/A	0 (0.0002)
Life-of-Project LCFs [c]	N/A	N/A	0 (0.002)	N/A	0 (0.004)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	0.0024	N/A	0.0024
Percent of natural background radiation [b]	N/A	N/A	0.00077	N/A	0.00077
Annual LCF risk	N/A	N/A	1×10^{-9}	N/A	1×10^{-9}
Life-of-Project LCF risk	N/A	N/A	1×10^{-8}	N/A	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [d]					
Annual dose (millirem)	N/A	N/A	0.00029	N/A	0.00029
Annual LCF risk	N/A	N/A	2×10^{-10}	N/A	2×10^{-10}
Life-of-Project LCF risk	N/A	N/A	2×10^{-9}	N/A	4×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of material would be processed; under the WIPP Alternative, 6 metric tons (6.6 tons) of non-pit material would be processed and 7.1 metric tons (7.8 tons) of pit material could be processed.

[b] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[c] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[d] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Source: SRNL 2013.

Table C–30 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Processing to the Waste Isolation Pilot Plant

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel* [a]	*H-Canyon/ HB-Line to DWPF*	*WIPP* [a]
Operational Years for H-Canyon/ HB-Line Processing to WIPP	**N/A**	**N/A**	**10**	**N/A**	**25**
Total Workforce					
Number of radiation workers	N/A	N/A	130	N/A	130
Collective dose (person-rem per year)	N/A	N/A	20	N/A	60
Annual LCFs [b]	N/A	N/A	0 (0.01)	N/A	0 (0.04)
Life-of-Project LCFs [b]	N/A	N/A	0 (0.1)	N/A	1 (0.9)
Average Worker					
Dose (millirem per year) [c]	N/A	N/A	150	N/A	460
Annual LCF risk	N/A	N/A	0.00009	N/A	0.0003
Life-of-Project LCF risk	N/A	N/A	0.0009	N/A	0.007

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of material would be processed; under the WIPP Alternative, 6 metric tons (6.6 tons) of non-pit material would be processed and 7.1 metric tons (7.8 tons) of pit material could be processed.

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNL 2013.

C.3.4 Mixed Oxide Fuel Fabrication Facility (including metal oxidation)

C.3.4.1 Construction

MFFF is already under construction and the only potential modifications to MFFF would be the installation of metal oxidation furnaces under any of the action alternatives. Approximately 140 construction workers would be involved in this activity over an estimated 3.5-year timeframe. Metal oxidation furnaces would be installed in an area set aside in MFFF (i.e., separate from the fuel fabrication operations), so construction workers would not be expected to receive any occupation radiation doses. There would be no radiological risk to members of the public from these construction activities at MFFF.

C.3.4.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would continue at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), the first supplement analysis to the *SPD EIS* (DOE 2003b), and the *MFFF EIS* (NRC 2005). Where planned operations have changed substantially and might affect potential worker radiological exposures, they are noted. Program activities under the No Action Alternative that would result in worker doses include fabrication of 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF. This is expected to require about 21 years of operation. The same MFFF throughput and operational time frame apply under the Immobilization to DWPF and WIPP Alternatives.

Under the H-Canyon/HB-Line to DWPF Alternative, operational activities that would result in worker doses at MFFF include processing 34 metric tons (37.5 tons) of surplus plutonium, as previously evaluated, as well as processing 7.1 metric tons (7.8 tons) of additional surplus pit plutonium (not previously analyzed). Processing operations associated with the additional 7.1 metric tons (7.8 tons) of pit plutonium would be similar to those for the other material previously evaluated and would extend the operating life of MFFF by 2 years, to a total of 23 years. Annual worker exposures would be similar to those previously analyzed, but the total exposures would increase in proportion to the extension of the facility's operating life.

Under the MOX Fuel Alternative, operational activities that would result in worker doses at MFFF include processing 34 metric tons (37.5 tons) of surplus plutonium (previously analyzed); an additional 7.1 metric tons (7.8 tons) of surplus pit plutonium (not previously analyzed); and an additional 4 metric tons (4.4 tons) of surplus non-pit plutonium (not previously analyzed), or a total of 45.1 metric tons (49.7 tons) of surplus plutonium. Impacts from MOX fuel fabrication of the additional 7.1 metric tons (7.8 tons) of pit plutonium would be similar to the impacts of processing other material previously evaluated. The impacts of MOX fuel fabrication of 4 metric tons (4.4 tons) of non-pit plutonium after initial preparation of the material at H-Canyon/HB-Line would likewise be similar to the impacts of processing other material previously evaluated. The net effect of processing the additional plutonium under the MOX Fuel Alternative would be to increase the operating life of MFFF to a total of 24 years. Annual worker exposures would be similar to those previously analyzed, but the cumulative exposures would increase in proportion to the extension of the facility's operating life.

Under any of the action alternatives, two of the options for pit disassembly and conversion include the use of metal oxidations furnaces installed in MFFF for converting 35 metric tons (38.6 tons) of surplus plutonium to plutonium oxide over an estimated operational period of 20 years. This value is the upper-range for MFFF oxidation furnaces and could be correspondingly reduced (along with associated human health impacts) by any quantity of surplus plutonium which undergoes the oxidation process at another facility, such as PF-4 at LANL.

Tables C–31 and **C–32** present the projected incident-free radiological impacts of MFFF operations. **Tables C–33** and **C–34** present the projected incident-free radiological impacts from operation of metal oxidation furnaces at MFFF.

Table C–31 Radiological Impacts on the Public from Operation of the Mixed Oxide Fuel Fabrication Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for MFFF	**21**	**21**	**24**	**23**	**21**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.045	0.045	0.052	0.050	0.045
Percent of natural background radiation [a]	1.7×10^{-5}	1.7×10^{-5}	1.9×10^{-5}	1.9×10^{-5}	1.7×10^{-5}
Annual LCFs [b]	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})
Life-of-Project LCFs [b]	0 (0.0006)	0 (0.0006)	0 (0.0007)	0 (0.0007)	0 (0.0006)
Maximally Exposed Individual					
Annual dose (millirem)	0.00050	0.00050	0.00058	0.00055	0.00050
Percent of natural background radiation [a]	0.00016	0.00016	0.00019	0.00018	0.00016
Annual LCF risk	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	6×10^{-9}	6×10^{-9}	8×10^{-9}	8×10^{-9}	6×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.2×10^{-5}	5.2×10^{-5}	6.0×10^{-5}	5.8×10^{-5}	5.2×10^{-5}
Annual LCF risk	3×10^{-11}	3×10^{-11}	4×10^{-11}	3×10^{-11}	3×10^{-11}
Life-of-Project LCF risk	7×10^{-10}	7×10^{-10}	9×10^{-10}	8×10^{-10}	7×10^{-10}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Table C–32 Radiological Impacts on Workers from Operation of the Mixed Oxide Fuel Fabrication Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for MFFF	**21**	**21**	**24**	**23**	**21**
Total Workforce					
Number of radiation workers	450	450	450	450	450
Collective dose (person-rem per year)	51	51	51	51	51
Annual LCFs [a]	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)
Life-of-Project LCFs [a]	1 (0.6)	1 (0.6)	1 (0.7)	1 (0.7)	1 (0.6)
Average Worker					
Dose (millirem per year) [b]	110	110	110	110	110
Annual LCF risk	0.00007	0.00007	0.00007	0.00007	0.00007
Life-of-Project LCF risk	0.001	0.001	0.002	0.002	0.001

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a.

Table C–33 Radiological Impacts on the Public from Operation of Metal Oxidation Furnaces at the Mixed Oxide Fuel Fabrication Facility

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for Oxidation at MFFF	**N/A**	**20**	**20**	**20**	**20**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.37	0.37	0.37	0.37
Percent of natural background radiation [a]	N/A	0.00014	0.00014	0.00014	0.00014
Annual LCFs [b]	N/A	0 (0.0002)	0 (0.0002)	0 (0.0002)	0 (0.0002)
Life-of-Project LCFs [b]	N/A	0 (0.004)	0 (0.004)	0 (0.004)	0 (0.004)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	0.0041	0.0041	0.0041	0.0041
Percent of natural background radiation [a]	N/A	0.0013	0.0013	0.0013	0.0013
Annual LCF risk	N/A	2×10^{-9}	2×10^{-9}	2×10^{-9}	2×10^{-9}
Life-of-Project LCF risk	N/A	5×10^{-8}	5×10^{-8}	5×10^{-8}	5×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	0.00043	0.00043	0.00043	0.00043
Annual LCF risk	N/A	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	N/A	5×10^{-9}	5×10^{-9}	5×10^{-9}	5×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Table C–34 Radiological Impacts on Workers from Operation of Metal Oxidation Furnaces at the Mixed Oxide Fuel Fabrication Facility

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for Oxidation at MFFF	**N/A**	**20**	**20**	**20**	**20**
Total Workforce					
Number of radiation workers	N/A	35	35	35	35
Collective dose (person-rem per year)	N/A	2.3	2.3	2.3	2.3
Annual LCFs [a]	N/A	0 (0.001)	0 (0.001)	0 (0.001)	0 (0.001)
Life-of-Project LCFs [a]	N/A	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)
Average Worker					
Dose (millirem per year) [b]	N/A	65	65	65	65
Annual LCF risk	N/A	0.00004	0.00004	0.00004	0.00004
Life-of-Project LCF risk	N/A	0.0008	0.0008	0.0008	0.0008

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a.

C.3.5 Pit Disassembly and Conversion Facility in F-Area

C.3.5.1 Construction

There would be no radiological risk to the public from the construction of PDCF. Construction worker exposures to radiation derived from other activities at the site, past or present, would also be kept within ALARA levels. Construction workers would be monitored (badged) as appropriate.

C.3.5.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would proceed at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), *SPD EIS SA-1* (DOE 2003b), and *MFFF EIS* (NRC 2005). Program activities under the No Action Alternative that would result in worker doses and radiological emissions include processing surplus plutonium at PDCF over a period of 10 years, as evaluated in the *SPD EIS SA-1* (DOE 2003b) and the *MFFF EIS* (NRC 2005), with transfer of the liquid wastes to WSB.

Under the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, processing additional pit plutonium would extend the operating life to a total of 12 years (for example, see Chapter 2, Section 2.3). Annual worker and public exposures would be similar to those previously analyzed, but the cumulative exposures would increase in proportion to the extension of the facility's operating life. **Tables C–35** and **C–36** present the projected incident-free radiological impacts of PDCF operations.

Table C–35 Radiological Impacts on the Public from Operation of the Pit Disassembly and Conversion Facility in F-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDCF	**10**	**12**	**12**	**12**	**12**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.46	0.46	0.46	0.46	0.46
Percent of natural background radiation [a]	0.00017	0.00017	0.00017	0.00017	0.00017
Annual LCFs [b]	0 (0.0003)	0 (0.0003)	0 (0.0003)	0 (0.0003)	0 (0.0003)
Life-of-Project LCFs [b]	0 (0.003)	0 (0.003)	0 (0.003)	0 (0.003)	0 (0.003)
Maximally Exposed Individual					
Annual dose (millirem)	0.0055	0.0055	0.0055	0.0055	0.0055
Percent of natural background radiation [a]	0.0018	0.0018	0.0018	0.0018	0.0018
Annual LCF risk	3×10^{-9}	3×10^{-9}	3×10^{-9}	3×10^{-9}	3×10^{-9}
Life-of-Project LCF risk	3×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	0.00053	0.00053	0.00053	0.00053	0.00053
Annual LCF risk	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	3×10^{-9}	4×10^{-9}	4×10^{-9}	4×10^{-9}	4×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Source: SRNS 2012a.

Table C–36 Radiological Impacts on Workers from Operation of the Pit Disassembly and Conversion Facility in F-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDCF	**10**	**12**	**12**	**12**	**12**
Total Workforce					
Number of radiation workers	383	383	383	383	383
Collective dose (person-rem per year)	190	190	190	190	190
Annual LCFs [a]	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
Life-of-Project LCFs [a]	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.4)
Average Worker					
Dose (millirem per year) [b]	500	500	500	500	500
Annual LCF risk	0.0003	0.0003	0.0003	0.0003	0.0003
Life-of-Project LCF risk	0.003	0.004	0.004	0.004	0.004

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.
[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.
[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).
Source: SRNL 2013.

C.3.6 Waste Solidification Building

C.3.6.1 Construction

Potential impacts associated with the construction of WSB were previously analyzed (DOE 2008). No addition construction or modifications are evaluated in the *SPD Supplemental EIS*.

C.3.6.2 Operations

Under all alternatives, surplus plutonium disposition operations would proceed at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), *SPD EIS SA-1* (DOE 2003b), and the *MFFF EIS* (NRC 2005). Program activities under all alternatives, including processing liquid wastes from MFFF and PDCF, would result in worker doses and radiological air emissions. **Tables C–37** and **C–38** present the projected incident-free radiological impacts of WSB operations.

Table C–37 Radiological Impacts on the Public from Operation of the Waste Solidification Building

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for WSB	**21**	**21**	**24**	**23**	**21**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.031	0.031	0.031	0.031	0.031
Percent of natural background radiation [a]	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}
Annual LCFs [b]	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})
Life-of-Project LCFs [b]	0 (0.0004)	0 (0.0004)	0 (0.0004)	0 (0.0004)	0 (0.0004)
Maximally Exposed Individual					
Annual dose (millirem)	0.00063	0.00063	0.00063	0.00063	0.00063
Percent of natural background radiation [a]	0.00020	0.00020	0.00020	0.00020	0.00020
Annual LCF risk	4×10^{-10}	4×10^{-10}	4×10^{-10}	4×10^{-10}	4×10^{-10}
Life-of-Project LCF risk	8×10^{-9}	8×10^{-9}	9×10^{-9}	9×10^{-9}	8×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}
Annual LCF risk	2×10^{-11}	2×10^{-11}	2×10^{-11}	2×10^{-11}	2×10^{-11}
Life-of-Project LCF risk	5×10^{-10}	5×10^{-10}	5×10^{-10}	5×10^{-10}	5×10^{-10}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Table C–38 Radiological Impacts on Workers from Operation of the Waste Solidification Building

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for WSB	**21**	**21**	**24**	**23**	**21**
Total Workforce					
Number of radiation workers	50	50	50	50	50
Collective dose (person-rem per year)	25	25	25	25	25
Annual LCFs [a]	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	0 (0.3)	0 (0.3)	0 (0.4)	0 (0.3)	0 (0.3)
Average Worker					
Dose (millirem per year) [b]	500	500	500	500	500
Annual LCF risk	0.0003	0.0003	0.0003	0.0003	0.0003
Life-of-Project LCF risk	0.006	0.006	0.007	0.007	0.006

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: SRNS 2012a.

C.3.7 Defense Waste Processing Facility

C.3.7.1 Construction

There would be no radiological risk to the public from modifications to DWPF. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept ALARA. Construction workers would be monitored (badged) as appropriate. Doses associated with modifications would be minimal, resulting in less than 0.1 person-rem to the workforce. DWPF modifications are only expected under the Immobilization to DWPF Alternative (SRNS 2012a; WSRC 2008).

C.3.7.2 Operations

All action alternatives, with the exception of the WIPP Alternative, would rely on DWPF to handle the additional material processed through H-Canyon/HB-Line or the immobilization capability. Annual worker exposures would be similar to those previously analyzed in the *Final Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant* (DOE/EIS-0082) and the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE 1994). The cumulative exposures would increase in proportion to the extension of the facility's operating life.

Under the Immobilization to DWPF Alternative, 13.1 metric tons (14.4 tons) of surplus plutonium in cans would be transferred to DWPF to be encapsulated in canisters of HLW. Although additional HLW canisters would be generated (see Chapter 2, Section 2.2.1), no additional glass would be poured. Glass would simply be poured into additional canisters due to the 12 percent reduction in space for vitrified HLW within the 790 can-in-canister assemblies. No plutonium would be released from the canisters that would be processed at DWPF, so there would be no net increase in normal atmospheric radiological releases from DWPF (SRNS 2012a; WSRC 2008).

Under the MOX Fuel Alternative, 4 metric tons (4.4 tons) of non-pit plutonium would be processed at H-Canyon/HB-Line, creating waste that would generate approximately 2 additional canisters; under all action alternatives however, it is possible to process 10 metric tons (11 tons) of pit and metallic plutonium at H-Canyon/HB-Line, resulting in waste generating approximately 5 additional canisters.

Under the H-Canyon/HB-Line to DWPF Alternative, 6 metric tons (6.6 tons) of surplus plutonium from H-Canyon/HB-Line would be transferred for vitrification with HLW at DWPF. The plutonium mixed with the HLW would not contribute substantially to the DWPF normal release source term, so no incremental normal releases from DWPF are expected from these alternatives (SRNS 2012a; WSRC 2008). Therefore, no incremental normal releases from DWPF are expected under any of the alternatives (SRNS 2012a; WSRC 2008). **Table C–39** presents the projected incident-free radiological impacts on workers from DWPF operations.

Table C–39 Potential Incremental Radiological Impacts on Workers from Operation of the Defense Waste Processing Facility

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for DWPF	**N/A**	**10**	**6**	**13**	**N/A**
Total Workforce					
Number of radiation workers [a]	N/A	25	5	8	N/A
Collective dose (person-rem per year)	N/A	5.9	1.2	1.9	N/A
Annual LCFs [b]	N/A	0 (0.004)	0 (0.0007)	0 (0.001)	N/A
Life-of-Project LCFs [b]	N/A	0 (0.04)	0 (0.004)	0 (0.01)	N/A
Average Worker					
Dose (millirem per year) [c]	N/A	240	240	240	N/A
Annual LCF risk	N/A	0.0001	0.0001	0.0001	N/A
Life-of-Project LCF risk	N/A	0.001	0.0009	0.002	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers represent full-time-equivalent workers based on an estimate that no more than 1 to 5 percent of the dose to the 500 badged workers at DWPF would be due to plutonium processing activities (plutonium canister handling, vitrification of additional plutonium-canister material, and handling/staging of plutonium-vitrified material for transport to the Glass Waste Storage Building).

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Source: DOE 1994: Section 4.1.11.2; SRNS 2012a; WSRC 2008.

C.4 Los Alamos National Laboratory

C.4.1 Los Alamos National Laboratory Plutonium Facility

C.4.1.1 Construction

There would be no radiological risk to the public from any potential modification activities (e.g., glovebox installations/modifications/decontamination and decommissioning (D&D) and installation of equipment) at PF-4. Construction worker doses are expected; however, they were estimated not to exceed an annual workforce dose of 18 person-rem per year to 60 workers (about 40 full-time equivalent workers) (LANL 2013), which is equal to an average construction worker dose of 300 millirem per year. This equates to a total potential construction workforce dose of 140 person-rem over the estimated 8 years of facility modifications. This workforce would be monitored (badged).

C.4.1.2 Operations

Under all alternatives analyzed in this *SPD Supplemental EIS*, some level of pit disassembly and conversion processing would occur at PF-4. For all alternatives, under the PDCF Option for pit disassembly and conversion, and for the MOX, H-Canyon/HB-Line, and WIPP Alternatives, under the PDC Option for pit disassembly and conversion, 2 metric tons (2.2 tons) of plutonium would be processed at PF-4. For all action alternatives under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion, 35 metric tons (38.6 tons) of plutonium could be processed at PF-4. The impacts presented in **Tables C–40** and **C–41** are for pit disassembly and conversion of 35 metric tons (38.6 tons) of plutonium at PF-4 and preparing it for shipment to SRS. However, there are processing variations that could result in reduced levels of activity or reduced quantities of plutonium processed at LANL. Under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion, a reduced level of activity may occur if plutonium from pit disassembly is packaged as a metal and shipped to SRS for conversion in metal oxidation furnaces in MFFF. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, some of the pit plutonium may be disassembled and oxidized using SRS facilities; for example, 10 metric tons (11 tons) of pit material could be processed at SRS through the K-Area Complex and H-Canyon/HB-Line. Under the WIPP Alternative, in lieu of sending material from PF-4 at LANL to SRS for oxidation and/or blending with inert material and packaging for potential WIPP disposal, preparation for WIPP disposal could be performed at TA-55 facilities at LANL, such as PF-4, in a manner similar to that described for H-Canyon/HB-Line (see Appendix B, Section B.1.3). It is assumed that incremental changes in worker impacts from blending and packaging at TA-55 facilities would be comparable to those for performing these activities at H-Canyon/HB-Line. Performing these activities at LANL would result in small increases in the public and worker impact estimates presented in Tables C–40 and C–41.

Table C–40 Potential Radiological Impacts on the Public from Pit Disassembly and Conversion Operations at the Los Alamos National Laboratory Plutonium Facility

	Alternative				
Impact Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Processing at LANL PF-4 (2 MT Case/35 MT Case)	**7**	**7/22**	**7/22**	**7/22**	**7/22**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.025	0.025/0.21	0.025/0.21	0.025/0.21	0.025/0.21
Percent of natural background radiation [a]	1.2×10^{-5}	1.2×10^{-5} / 1.0×10^{-4}	1.2×10^{-5} / 1.0×10^{-4}	1.2×10^{-5} / 1.0×10^{-4}	1.2×10^{-5} / 1.0×10^{-4}
Annual LCFs [b]	0 (2×10^{-5})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})
Life-of-Project LCFs [b]	0 (1×10^{-4})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})
Maximally Exposed Individual					
Annual dose (millirem)	0.0097	0.0097/0.081	0.0097/0.081	0.0097/0.081	0.0097/0.081
Percent of natural background radiation [a]	0.0021	0.0021/0.017	0.0021/0.017	0.0021/0.017	0.0021/0.017
Annual LCF risk	6×10^{-9}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}
Life-of-Project LCF risk	4×10^{-8}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.6×10^{-5}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}
Annual LCF risk	3×10^{-11}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}
Life-of-Project LCF risk	2×10^{-10}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MOX = mixed oxide; MT = metric tons; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose at LANL is 469 millirem for the average individual; the population within 50 miles (80 kilometers) in 2020 would receive a dose of about 210,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of LANL PF-4 in 2020 (approximately 448,000).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: LANL 2013.

Table C–41 Potential Radiological Impacts on Workers from Pit Disassembly and Conversion Operations at the Los Alamos National Laboratory Plutonium Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Processing at LANL PF-4 (2 MT Case/35 MT Case)	**7**	**7/22**	**7/22**	**7/22**	**7/22**
Total Workforce					
Number of radiation workers	85	85/345	85/345	85/345	85/345
Collective dose (person-rem per year)	29	29/190	29/190	29/190	29/190
Annual LCFs [a]	0 (0.02)	0 (0.02/0.1)	0 (0.02/0.1)	0 (0.02/0.1)	0 (0.02/0.1)
Life-of-Project LCFs [a]	0 (0.1)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)
Average Worker					
Dose (millirem per year) [b]	340	340/560	340/560	340/560	340/560
Annual LCF risk	0.0002	0.0002/0.0003	0.0002/0.0003	0.0002/0.0003	0.0002/0.0003
Life-of-Project LCF risk	0.001	0.001/0.007	0.001/0.007	0.001/0.007	0.001/0.007

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MOX = mixed oxide; MT = metric tons; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated value is provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: LANL 2013.

C.5 Combined Impacts Under Each Alternative

C.5.1 No Action Alternative

Construction. Construction workers would be monitored (badged), as appropriate. The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). None of these exposures are expected to result in any additional LCFs to construction workforces.

Because there is no ground surface contamination in F-Area where PDCF would be constructed, there would be no additional radiological releases to the environment or impacts on the general population from ground disturbing construction activities at this location (DOE 1999; NRC 2005:4-7).

Operations. **Tables C–42** and **C–43** summarize the potential radiological impacts on workers and the general public, respectively, under the No Action Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating time frame were determined by multiplying the annual impacts by each facility’s projected operating period.

Waste management activities would be conducted in support of surplus plutonium activities under this alternative at E-Area at SRS and principally at TA-54 at LANL. These activities are expected to result in negligible incremental impacts to both workers and the public from the staging of transuranic (TRU) waste awaiting shipment to WIPP, from potential storage of mixed low-level radioactive waste (MLLW) pending offsite shipment, or from storage or disposal of low-level radioactive waste (LLW).

Table C–42 Radiological Impacts on Workers from Operations Under the No Action Alternative

	SRS					*LANL*
	Support Facilities			*Pit Disassembly and Conversion*	*Disposition*	*Pit Disassembly and Conversion*
Impact Area	*K-Area Storage*	*KIS*	*WSB*	*PDCF*	*MFFF*	*PF-4*
Total Workforce						
Number of radiation workers	24	40	50	383	450	85
Collective dose (person-rem per year)	8.9	25	25	192	51	29
Annual LCFs [a]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1)	0 (0.03)	0 (0.02)
Life-of-Project LCFs [a]	0 (0.2)	1 (0.6)	0 (0.3)	1	0 (0.6)	0 (0.1)
Average Worker						
Dose (millirem per year) [b]	370	630	500	500	113	340
Annual LCF risk	0.0002	0.0004	0.0003	0.0003	0.00007	0.0002
Life-of-Project LCF risk	0.009	0.02	0.006	0.003	0.001	0.001

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Table C–43 Radiological Impacts on the Public from Operations Under the No Action Alternative

	SRS					*LANL*
	Principal Support Facilities			*Pit Disassembly and Conversion Option*	*Disposition*	*Pit Disassembly and Conversion Option*
Impact Area	*K-Area Storage* [a]	*KIS*	*WSB*	*PDCF*	*MFFF*	*PF-4*
Population within 50 Miles (80 kilometers)						
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46	0.045	0.025
Percent of natural background radiation [b]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017	1.7×10^{-5}	1.2×10^{-5}
Annual LCFs	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003)	0 (3×10^{-5})	0 (2×10^{-5})
Life-of-Project LCFs [c]	0	0 (1×10^{-6})	0 (0.0004)	0 (0.003)	0 (0.0006)	0 (1×10^{-4})
Maximally Exposed Individual						
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055	0.00050	0.0097
Percent of natural background radiation [b]	0	2.7×10^{-7}	0.00020	0.0018	0.00016	0.0021
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9}	3×10^{-10}	6×10^{-9}
Life-of-Project LCF risk	0	2×10^{-11}	8×10^{-9}	3×10^{-8}	6×10^{-9}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [d]						
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053	0.000052	5.6×10^{-5}
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}	3×10^{-11}	3×10^{-11}
Life-of-Project LCF risk	0	1×10^{-12}	5×10^{-10}	3×10^{-9}	7×10^{-10}	2×10^{-10}

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere resulting from storage of plutonium at the K-Area Complex and, therefore, no resulting public impacts.

[b] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 469 millirem per year at LANL for the average individual).

[c] Total number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[d] Obtained by dividing the SRS population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area), as well as by dividing the LANL population dose by the number of people projected to live within 50 miles (80 kilometers) of LANL PF-4 in 2020 (approximately 448,000).

C.5.2 Immobilization to DWPF Alternative

Construction. Construction workers would be monitored (badged) as appropriate. Under the Immobilization to DWPF Alternative, construction of the new immobilization capability at K-Area and minor modifications to DWPF to accommodate receipt of can-in-canisters from the immobilization capability would be required. The majority of the construction activities would occur in areas with dose rates close to background radiation levels, although there would be existing equipment that would require decontamination and removal. The total construction workforce dose would be 6.6 person-rem over the estimated 2 years during which decontamination and equipment removal would occur (see Section C.3.2.1).

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workforce doses would result from glovebox-related modifications at H-Canyon/HB-Line and glovebox installation or modification at the K-Area Complex. A total construction workforce dose of 2.0 person-rem could occur during the 2 years of modifications at H-Canyon/HB-Line (see Section C.3.3.1) A total construction workforce dose of 4.0 person-rem could occur during the 2 years of decontamination and equipment removal that would be required to support modifications in the K-Area Complex (see Section C.3.1.1).

The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). Under the PF-4 and MFFF Option or the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workers involved in the installation of metal oxidation furnaces at MFFF would likely receive doses only from background radiation levels at SRS.

At LANL PF-4, potential construction activities (e.g., glovebox installations, modifications, D&D, and installation of equipment) would be necessary to allow pit disassembly and conversion of 35 metric tons (38.6 tons) of plutonium. This could result in a total construction workforce dose of 140 person-rem over the estimated 8-year construction duration at the facility (see Section C.4.1.1).

None of these exposures is expected to result in any additional LCFs in construction workforces.

Construction of PDCF would not result in radiological impacts on the general population at the site boundary and beyond. Similarly, installation of metal oxidation furnaces in MFFF would not result in radiological impacts on the public. Construction of the immobilization capability at K-Area would involve decontamination, demolition, construction, and modification activities, including removal of contaminated equipment and piping. No radiological impacts on the public from these activities are expected, however, because all operations involving radioactive materials would occur within the K-Area reactor building and would be subject to strict controls (WSRC 2008). Releases of radioactive materials to the environment caused by modifications to DWPF to accommodate the can-in-canisters are not expected. In addition, no impacts on the public would result from modifications to H-Canyon/HB-Line or the K-Area Complex.

Operations. **Tables C–44** and **C–45** summarize the potential radiological impacts on workers and the general public, respectively, under the Immobilization to DWPF Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area in support of the Immobilization to DWPF Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP, from potential storage of MLLW pending offsite shipment, and from storage or disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management facilities.

Table C–44 Radiological Impacts on Workers from Operations Under the Immobilization to DWPF Alternative

	Support Facilities			***Pit Disassembly and Conversion Options***						***Disposition***		
					PF-4 at LANL and MFFF [a] at SRS		***PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS***					
							SRS					
Impact Area	***K-Area Storage***	***KIS***	***WSB***	***PDCF***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line/ K-Area Complex Glovebox [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***Immobilization Capability***	***DWPF***	***MFFF***
Total Workforce												
Number of radiation workers	24	40	50	383	35	85 / 345	100 / 50	35	85 / 345	314	25	450
Collective dose (person-rem per year)	8.9	25	25	192	2.3	29 / 190	29 / 28	2.3	29 / 190	314	5.9	51
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.2)	0 (0.004)	0 (0.03)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.2)	0 (0.3)	1	0 (0.03)	0 (0.1) / 3	0 (0.3) / 0 (0.2)	0 (0.03)	0 (0.1) / 3	2	0 (0.04)	1 (0.6)
Dose (millirem per year) [d]	370	630	500	500	65	340 / 560	290 / 560	65	340 / 560	1,000	236	113
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003	0.00004	0.0002 / 0.0003	0.0002 / 0.0003	0.00004	0.0002 / 0.0003	0.0006	0.0001	0.00007
Life-of-Project LCF Risk	0.004	0.006	0.006	0.004	0.0008	0.001 / 0.007	0.002 / 0.005	0.0008	0.001 / 0.007	0.006	0.001	0.001

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building;

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area Complex glovebox.

[c] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–45 Radiological Impacts on the Public from Operations Under the Immobilization to DWPF Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage [a]*	*KIS*	*WSB*	*PDCF*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*Immobilization Capability*	*DWPF [c]*	*MFFF*
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46	0.37	0.025/0.21	0.26	0.37	0.025/0.21	0.00062	0	0.045
Percent of natural background radiation [d]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017	0.00014	1.2×10^{-5} / 1.0×10^{-4}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 1.0×10^{-4}	2.5×10^{-7}	0	1.7×10^{-5}
Annual LCFs [c]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (4×10^{-7})	0	0 (3×10^{-5})
Life-of-Project LCFs [e]	0/0	0 (4×10^{-7})	0 (0.0004)	0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (4×10^{-6})	0	0 (0.0006)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	7.5×10^{-6}	0	0.00050
Percent of natural background radiation [d]	0	2.7×10^{-7}	0.00020	0.0018	0.0013	0.0021/0.017	0.00077	0.0013	0.0021/0.017	2.4×10^{-8}	0	0.00016
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	5×10^{-12}	0	3×10^{-10}
Life-of-Project LCF risk	0/0	8×10^{-12}	8×10^{-9}	4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	5×10^{-11}	0	6×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [f]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	7.7×10^{-7}	0	5.2×10^{-5}
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	5×10^{-13}	0	3×10^{-11}
Life-of-Project LCF risk	0/0	5×10^{-13}	5×10^{-10}	4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	5×10^{-12}	0	7×10^{-10}

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere from K-Area Complex storage activities and, therefore, no resulting public impacts.

[b] Potential doses to members of the public from pit disassembly activities in K-Area Complex gloveboxes would be extremely small due to *de minimis* releases from such activities and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012a).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and therefore no resulting public impacts.

[d] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 469 millirem per year at LANL for the average individual).

[e] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[f] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

C.5.3 MOX Fuel Alternative

Construction. Under the PDC Option, construction of PDC at K-Area would entail decontamination and removal of existing equipment. The total workforce dose over the 2 years required for decontamination and equipment removal in support of PDC construction would be 1.0 person-rem (see Section C.3.1.1).

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, construction worker doses would be the same as discussed for the Immobilization to DWPF Alternative. A total construction workforce dose of 2.0 person-rem could occur during the 2 years of modifications at H-Canyon/HB-Line (see Section C.3.3.1). A total construction workforce dose of 4.0 person-rem could occur during the 2 years of decontamination and equipment removal that would be required to support modifications in the K-Area Complex (see Section C.3.1.1).

H-Canyon/HB-Line may require modifications to dissolve and prepare 4 metric tons (4.4 tons) of non-pit plutonium as feed for MOX fuel fabrication and/or prepare 2 metric tons (2.2 tons) of surplus plutonium for potential WIPP disposal. Depending on the throughput rate selected, modifications would range from minor modifications that would be made as part of normal operations to modifications resulting in a workforce dose of 1.2 person-rem over a 2-year period (see Section C.3.3.1).

The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). Under the PF-4 and MFFF Option or the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workers involved in the installation of metal oxidation furnaces at MFFF would likely receive doses only from background radiation levels at SRS.

At LANL PF-4, construction activities would be the same as discussed under the Immobilization to DWPF Alternative for pit disassembly and conversion of 35 metric tons (38.6 tons) of plutonium. This could result in a total construction workforce dose of 140 person-rem over the estimated 8-year construction duration at the facility (see Section C.4.1.1).

None of these exposures is expected to result in any additional LCFs in construction workforces.

Construction of PDCF would not result in radiological impacts on the general population at the site boundary and beyond. Similarly, potential PDC construction activities would not be expected to result in any radiological impacts on the public. In addition, no impacts on the public would result from modification to H-Canyon/HB-Line or the K-Area Complex. Any other potential construction activities, such as at MFFF (e.g., installation of metal oxidation furnaces), would not result in radiological impacts on the public. Similarly, PF-4 construction activities at LANL would not result in any radiological impacts on the public.

Operations. **Tables C–46** and **C–47** summarize the potential radiological impacts on workers and the general public, respectively, under the MOX Fuel Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility’s projected operating period.

Activities at E-Area, in support of the MOX Fuel Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management support facilities.

Table C–46 Radiological Impacts on Workers from Operations Under the MOX Fuel Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage*	*KIS*	*WSB*	*PDCF / PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line/K-Area Complex Glovebox [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF*	*MFFF*	*H-Canyon/ HB-Line Preparation for WIPP*
Total Workforce												
Number of radiation workers	24	40	50	383 / 383	35	85 / 345	100 / 50	35	85 / 345	5	450	130
Collective dose (person-rem per year)	8.9	25	25	192 / 192	2.3	29 / 190	29 / 28	2.3	29 / 190	1.2	51	20
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.0010)	0 (0.02 / 0.1)	0 (0.0007)	0 (0.03)	0 (0.01)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.1)	0 (0.4)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.2)	0 (0.03)	0 (0.1) / 3	0 (0.004)	1 (0.7)	0 (0.1)
Average Worker												
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 560	290 / 560	65	340 / 560	236	113	150
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0003	0.0002 / 0.0003	0.00004	0.0002 / 0.0003	0.0001	0.00007	0.00009
Life-of-Project LCF Risk	0.005	0.003	0.007	0.004 / 0.004	0.0008	0.001 / 0.007	0.002 / 0.005	0.0008	0.001 / 0.007	0.0008	0.002	0.0009

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area Complex glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–47 Radiological Impacts on the Public from Operations Under the MOX Fuel Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and M`FFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage [a]*	*KIS*	*WSB*	*PDCF / PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF [d]*	*H-Canyon/ HB-Line Preparation for WIPP*
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025 / 0.21	0.26	0.37	0.025 / 0.21	0	0.052	0.26
Percent of natural background radiation [e]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 1.0×10^{-4}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 1.0×10^{-4}	0	1.9×10^{-5}	9.6×10^{-5}
Annual LCFs [f]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (0.0002)
Life-of-Project LCFs [f]	0	0 (2×10^{-7})	0 (0.0005)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0007)	0 (0.002)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097 / 0.081	0.0024	0.0041	0.0097/0.081	0	0.00058	0.0024
Percent of natural background radiation [e]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0021 / 0.017	0.00077	0.0013	0.0021/0.017	0	0.00019	0.00077
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	4×10^{-10}	1×10^{-9}
Life-of-Project LCF risk	0	4×10^{-12}	9×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	8×10^{-9}	1×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [g]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	6.0×10^{-5}	0.00029
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	0	4×10^{-11}	2×10^{-10}
Life-of-Project LCF risk	0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	9×10^{-10}	2×10^{-9}

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and M`FFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage [a]*	*KIS*	*WSB*	*PDCF / PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF [d]*	*H-Canyon/ HB-Line Preparation for WIPP*

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere from storage of plutonium at the K-Area Complex and, therefore, no public impacts.

[b] Potential doses to members of the public from pit disassembly activities in K-Area Complex gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012a).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] At MFFF, 45.1 metric tons of plutonium would be processed over a 24-year period; this would result in an estimated annual throughput rate difference of about 15 percent over the duration of the No Action Alternative (34 metric tons over 21 years).

[e] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year at SRS and 469 millirem per year at LANL for the average individual).

[f] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[g] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

C.5.4 H-Canyon/HB-Line to DWPF Alternative

Construction. The impacts of construction activities under the H-Canyon/HB-Line to DWPF Alternative would be the same as those under the MOX Fuel Alternative for all potential facilities and functions at F-, K-, or H-Area at SRS, as well as at PF-4 at LANL.

As an additional note under this alternative, however, there could likely be minor modifications at H-Canyon/HB-Line to prepare non-pit plutonium for DWPF vitrification. Operators may change out or reconfigure some tanks and/or piping to increase plutonium storage capacity. Furthermore, HB-Line may reactivate its scrap recovery south line and change out some unused equipment and add additional equipment to implement vacuum salt distillation and sodium peroxide fusion in the effort to minimize equipment corrosion and increase dissolving-throughput-rates. However, no incremental doses to such construction/modification workers carrying out such functions would be expected.

In all cases, no construction worker exposures are expected to result in additional LCFs to construction workforces.

As is the case in the alternatives discussed above, none of the construction would result in any radiological impacts to the public.

Operations. **Tables C–48** and **C–49** summarize the potential radiological impacts on workers and the general public, respectively, under the H-Canyon/HB-Line to DWPF Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating time frame were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area in support of the H-Canyon/HB-Line to DWPF Alternative are expected to result in negligible incremental impacts to both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management facilities.

C.5.5 WIPP Alternative

Construction. The impacts of construction discussed under the MOX Fuel Alternative would also apply to the WIPP Alternative. In addition, to prepare 13.1 metric tons (14.4 tons) of surplus plutonium for potential disposal at WIPP, modifications would be required at H-Canyon/HB-Line. The total construction workforce dose of 1.2 person-rem would occur over the estimated 2 years required for modifications (see C.3.3.1).

In all cases, no construction worker exposures are expected to result in additional LCFs in construction workforces.

As is the case in the alternatives discussed above, none of the construction would result in any radiological impacts on the public.

Operations. **Tables C–50** and **C–51** summarize the potential radiological impacts on workers and the general public, respectively, under the WIPP Alternative; impacts are presented for preparing 6 metric tons (6.6 tons) of non-pit and 7.1 metric tons (7.8 tons) of pit plutonium in H-Canyon/HB-Line at SRS. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area in support of the WIPP Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, only negligible incremental impacts on either workers or the public are expected from operations at the waste management facilities.

Table C–48 Radiological Impacts on Workers from Operations Under the H-Canyon/HB-Line to DWPF Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage*	*KIS*	*WSB*	*PDCF/PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line/ K-Area Complex Glovebox [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF*	*MFFF*	*H-Canyon/ HB-Line (Dissolution to DWPF)*
Total Workforce												
Number of radiation workers	24	40	50	383 / 383	35	85 / 345	100 / 50	35	85 / 345	8	450	14
Collective dose (person-rem per year)	8.9	25	25	192 / 192	2.3	29 / 190	29 / 28	2.3	29 / 190	1.9	51	7.0
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.001)	0 (0.03)	0 (0.004)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.2)	0 (0.3)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.2)	0 (0.03)	0 (0.1) / 3	0 (0.02)	1 (0.7)	0 (0.06)
Average Worker												
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 560	290 / 560	65	340 / 560	236	113	500
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0003	0.0002 / 0.0003	0.00004	0.0002 / 0.0003	0.0001	0.00007	0.0003
Life-of-Project LCF Risk	0.005	0.004	0.007	0.004 / 0.004	0.0008	0.001 / 0.007	0.002 / 0.005	0.0008	0.001 / 0.007	0.002	0.002	0.004

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area Complex glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–49 Radiological Impacts on the Public from Operations Under the H-Canyon/HB-Line to DWPF Alternative

Impact Area	*Support Facilities*			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage [a]*	*KIS*	*WSB*	*PDCF/PDC*	*Metal Oxidation Furnaces at MFFF)*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF)*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF [d]*	*H-Canyon/ HB-Line Dissolution to DWPF*
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025/0.21	0.26	0.37	0.025/0.21	0	0.050	0.26
Percent of natural background radiation [e]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 1.0×10^{-4}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 1.0×10^{-4}	0	1.9×10^{-5}	9.6×10^{-5}
Annual LCFs [f]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (0.0002)
Life-of-Project LCFs [f]	0 / 0	0 (2×10^{-7})	0 (0.0005)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0007)	0 (0.002)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	0	0.00055	0.0024
Percent of natural background radiation [e]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0021/0.017	0.00077	0.0013	0.0021/0.017	0	0.00018	0.00077
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	3×10^{-10}	1×10^{-9}
Life-of-Project LCF risk	0 / 0	4×10^{-12}	9×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	8×10^{-9}	2×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [g]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	5.7×10^{-5}	0.00029
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	0	3×10^{-11}	2×10^{-10}
Life-of-Project LCF risk	0 / 0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	8×10^{-10}	2×10^{-9}

Impact Area	*Support Facilities*			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
	K-Area Storage [a]	*KIS*	*WSB*	*PDCF/PDC*	*Metal Oxidation Furnaces at MFFF)*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF)*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF [d]*	*H-Canyon/ HB-Line Dissolution to DWPF*

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere from storage of plutonium at the K-Area Complex and, therefore, no resulting public impacts for either of the cases presented.

[b] Potential doses to members of the public from pit disassembly activities in K-Area Complex gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012a).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] At MFFF, 41.1 metric tons of plutonium would be processed over a 23-year period; this would result in an estimated annual throughput rate difference of about 10 percent over the duration of the No Action Alternative (34 metric tons over 21 years).

[e] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 469 millirem per year at LANL for the average individual).

[f] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[g] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–50 Potential Radiological Impacts on Workers from Operations Under the WIPP Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*	
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*				
							SRS				
Impact Area	***K-Area Storage***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line / K-Area Complex Glovebox [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***MFFF***	***H-Canyon/ HB-Line Preparation for WIPP***
Total Workforce											
Number of radiation workers	24	40	50	383 / 383	35	85 / 345	100 / 50	35	85 / 345	450	130
Collective dose (person-rem per year)	8.9	25	25	190 / 190	2.3	29 / 190	29 / 28	2.3	29 / 190	51	60
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.03)	0 (0.04)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.1)	0 (0.3)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.2)	0 (0.03)	0 (0.1) / 3	1 (0.6)	1 (0.9)
Average Worker											
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 560	290 / 560	65	340 / 560	110	460
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0003	0.0002 / 0.0003	0.00004	0.0002 / 0.0003	0.00007	0.0003
Life-of-Project LCF Risk	0.005	0.003	0.006	0.004 / 0.004	0.0008	0.001 / 0.007	0.002 / 0.005	0.0008	0.001 / 0.007	0.001	0.007

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area Complex glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–51 Radiological Impacts on the Public from Operations Under the WIPP Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	*K-Area Storage [a]*	*KIS*	*WSB*	*PDCF / PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF*	*H-Canyon/ HB-Line Preparation for WIPP*
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025 / 0.21	0.26	0.37	0.025 / 0.21	0	0.045	0.26
Percent of natural background radiation [d]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 1.0×10^{-4}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 1.0×10^{-4}	0	1.7×10^{-5}	9.6×10^{-5}
Annual LCFs [e]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (0.0002)
Life-of-Project LCFs [e]	0/0	0 (2×10^{-7})	0 (0.0004)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0006)	0 (0.004)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	0	0.00050	0.0024
Percent of natural background radiation [d]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0021/0.017	0.00077	0.0013	0.0021/0.017	0	0.00016	0.00077
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	3×10^{-10}	1×10^{-9}
Life-of-Project LCF risk	0/0	4×10^{-12}	8×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	6×10^{-9}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [f]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	5.2×10^{-5}	0.00029
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11}/ 3×10^{-10}	0	3×10^{-11}	2×10^{-10}
Life-of-Project LCF risk	0/0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	7×10^{-10}	4×10^{-9}

	Support Facilities			Pit Disassembly and Conversion Options						Disposition		
					PF-4 at LANL and MFFF [a] at SRS		PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS					
							SRS					
Impact Area	K-Area Storage [a]	KIS	WSB	PDCF / PDC	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	H-Canyon/ HB-Line [b]	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	DWPF [c]	MFFF	H-Canyon/ HB-Line Preparation for WIPP

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere from K-Area Complex storage and, therefore, no resulting public impacts for either of the cases presented.

[b] Potential doses to members of the public from pit disassembly activities in K-Area Complex gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012a).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 469 millirem per year at LANL for the average individual).

[e] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[f] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

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